



OPEN ACCESS GOVERNMENT

JULY 2023 • ISSN 2516-3817

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NIJ PUTS SCIENCE TO WORK FOR JUSTICE SYSTEM STAKEHOLDERS

Nancy La Vigne PhD, Director of the National Institute of Justice, shares perspectives on how scientific tools and discoveries can support justice system stakeholders



Sandra Gallina, Director General at Directorate-General Sante (DG SANTE), tells us the purpose of the European Health Union, which sets out to provide a healthier tomorrow thanks to the actions of today



The Honourable Pascale St-Onge, Canada's Minister responsible for Sport, shares her vision for a safe and accountable sport system in which Canadian athletes from all walks of life can thrive



Preethi Kesavan, Head at the School of Advanced Technology and Digital Media, LSBF Singapore, highlights the transformative role of science, research and innovation in Asia

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OVER-THE-COUNTER: AN UNDER-APPRECIATED TOXIC DANGER

The term 'overdose' refers to the administration, intentional or unintentional, of a drug or other biologically active substance in an amount that exceeds a safe dose, and therefore can cause toxicity. Most of us associate this term with use of illicit drugs, such as methamphetamine, or the abuse of regulated, controlled medications, like the opioid fentanyl, likely because adverse effects associated with these drugs are common topics in the news, social media, and movies or books. But any biologically active substance that can be ingested, inhaled, injected, or absorbed through the skin, including compounds essential to life, such as oxygen and water, can cause toxicity when in excess...

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OVER-THE-COUNTER: AN UNDER-APPRECIATED TOXIC DANGER

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FOREWORD

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Investing in health will lead to a better & wealthier future

Dr Josep Figueras, Dr Matthias Wismar from European Observatory on Health Systems and Policies, with Dr Natasha Azzopardi Muscat from WHO/Europe, argue that investing in health will lead to a better and wealthier future

The COVID-19 pandemic has left an indelible mark on our lives, from homeschooling and restaurant closures to travel bans and backlogs in healthcare. But amidst the chaos and disruption, a silver lining emerged: the realisation that there can be no healthy economy without a healthy population. As governments implemented severe measures to contain the virus, we saw firsthand the power of decision-making and collaboration across all sectors.

Now, as the pandemic wanes and the world's economy remains vulnerable, we must not let investment in health fall by the wayside. While other sectors may be vying for attention and investment, policy-makers must not underestimate the impact that health investments can have on their economies and societies.

According to a [recent policy brief](#) from the European Observatory on Health Systems and Policies and WHO/Europe, investing in better health and health policies can not only improve our health and the resilience of health systems but also contribute to policy objectives in other sectors.

Achieving the Sustainable Development Goals (SDGs) by investing in health

This is where the concept of health co-benefits comes in. By investing in better health, we can achieve both direct and indirect benefits, from improved health and health equity to the impact that health systems and policies have on other areas of life.

However, identifying and quantifying these co-benefits is not easy, requiring sector-specific knowledge and understanding of context.

To help policy-makers think about the various links across health and other sectors, our report proposes a framework oriented by the Sustainable Development Goals (SDGs). The health sector, for example, can be an employer and purchaser, invest in research and education, and have a broader influence on infrastructure, urban development, and climate change.

One practical example of health co-benefits is the role of the health sector – which is a major emitter of greenhouse gases – in addressing the urgent climate crisis. Investing in green hospitals and making their

design and construction carbon-neutral can help policy-makers pursue SDG 13 – climate action. Similarly, hospitals introducing smart mobility concepts can support SDG 11 – making cities and human settlements inclusive, safe, resilient, and sustainable.

The [health and care workforce](#) is another area that requires urgent attention, particularly given its gender dimension. Nearly 80% of the workforce is made up of women, which means this is also a [gender equality crisis](#). By investing in and supporting those who care for us, governments can contribute to both decent work and economic growth (SDG 8) and gender equality and empowerment of women (SDG 5).

Lastly, the development and production of pharmaceuticals in lower- and middle-income countries is an area where we can see how the links between health and industrial policies can lead to better health outcomes. For example, technology transfer and local production of pharmaceuticals can promote SDG 9 – innovation and industry – while meeting health needs.

A new narrative for investing in health & health systems

There is no doubt that better health leads to a better economy, better work, and more equality. But while the benefits of investing in health are clear, achieving health co-benefits requires overcoming political challenges such as siloed thinking and opposition.

Achieving our objectives will depend on good governance and the political context, so everyone [understands that health is everybody's problem](#).

By emphasising the mutual benefits of health and other sectors working together, we can make action across sectors more appealing and bring other sectors on board.

Because of COVID-19, we have done a decent job placing health in all policies. As evidence continues to mount that health is wealth, it's time to invest in health for all policies. This will help us get Europe and the world back on track for the much-needed Sustainable Development Goals.

You can download the policy brief 'Making Health for All Policies: Harnessing the co-benefits of health' [here](#)



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Registered in England & Wales.
Company Reg No. 8667479.
VAT Registration No. 169 9152 64.



Editor's Introduction

Welcome to our jam-packed July 2023 digital edition, which hosts coverage of numerous policy issues from various angles worldwide.

We warmly welcome Lorna Rothery as Editor of the Open Access Government online publication, who will primarily focus on our extensive health sections going forward.

Staying with health, Sandra Gallina, Director General at DG SANTE, explains the goal of the European Health Union, established in 2020, to provide a healthier tomorrow due to the actions taken today. The recent proposal to update pharmaceutical regulations, the role of medications in a successful healthcare system, and the European Health Data Space are all covered in this article.

The Honourable Pascale St-Onge, Canada's Minister of Sport, outlines her goals for a safe and accountable sport system where all Canadian athletes can succeed. The Minister cites significant achievements as "good governance and better accountability from sport organizations, enhancing the athlete voice and promoting better education."

This time, our regular writer, Dr Zisis Kozlakidis, examines the value of diet in diagnosing and treating acute childhood leukaemia. He underlines the challenge to broaden our understanding of childhood leukaemia causes and, therefore, what he describes as "the underlying opportunities for future preventative and therapeutic opportunities" that may arise.

We are delighted that Nancy La Vigne, PhD, Director of the National Institute of Justice (NIJ), offers insights on how the Institute promotes justice within the United States and beyond by

strengthening the scientific tools and discoveries supporting justice system stakeholders. According to La Vigne, the NIJ's mission is to "generate the science that advances justice, mostly through research grants it awards to colleges, universities, and research institutes."

Preethi Kesavan, Head of the School of Advanced Technology and Digital Media, LSBF Singapore, highlights how science, research, and innovation have transformed Asia. Learn about the contributions that researchers in Asia have made to education, physics, medicine, and environmental sciences.

Additionally, with the upcoming implementation of Lacey Act Phase VII, the USDA's Animal and Plant Health Inspection Service from North America offers insightful policy commentary on how the USDA combats the trafficking of illegally taken plants. When importing plant products or items containing plant products, you must ensure that those are legally harvested, Erin Otto, Lacey Act National Policy Manager, urges.

We also provide commentary on various topics, including the changing attitudes towards animal welfare, Australia's clean energy ambitions, U.S. quantum information science research initiatives and the need for greater global action to support those suffering from poor mental health.

I sincerely hope you enjoy reading the wide-ranging and insightful material in this packed edition and that you will join us for many more in the years to come.

Jonathan Miles
Managing Editor



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240 | EMERGENT DIMENSIONALITY: EXPLORING ALL POSSIBLE (AND UNOBSERVABLE) EXTRA DIMENSIONS. Dr Szymon Łukaszyk, Łukaszyk Patent Attorneys, explains emergent dimensionality, exotic R4, 'life as the explanation of the measurement problem', and personal motivations.

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244 | VESTAS AIRCOIL: KEY INSIGHTS FROM SUCCESSFULLY BRIDGING THE GAP BETWEEN ACADEMIA AND INDUSTRY. Open Access Government engages in a conversation with Kevin Jose, a recently graduated PhD student who concluded his research and successfully defended his thesis at the University of Southampton. In this interview, Kevin shares his insights on transitioning from academia to industry.

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258 | Research and innovation investments in Norway. Open Access Government explores the importance of funding research and innovation investments in Norway for the future of sustainability and technology.

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270 | UNDERSTANDING THERMOLABILE PROTECTING GROUPS FOR NUCLEIC ACID-BASED DRUGS. Serge L. Beaucage investigates thermolabile protecting groups for the amine functions of purine and pyrimidine deoxyribonucleosides for the development and implementation of synthetic DNA sequences as nucleic acid-based drugs.

272 | AARS URZYMES: EXPERIMENTAL BIOCHEMISTRY TO MAP GENETIC CODING. Dr Charlie Carter from the University of North Carolina at Chapel Hill explores how advances in enzymology and phylogenetics enable biochemical measurements that could map the ancestral development of genetic coding.

274 | U.S. quantum information science research initiatives. Open Access Government lifts the lid on the work of one of America's oldest physical science laboratories, focussing on their quantum information science research work.

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278 | THE DEVELOPMENT OF RESEARCH SOFTWARE ENGINEERING AS A PROFESSION. Dr Joanna Leng at the School of Computing explores Research Software Engineering (RSE) as an emerging profession, and how computing technology is core to many professions.

280 | THE CHALLENGES OF PRACTISING INTELLECTUAL HUMILITY WITH DEEPLY HELD RELIGIOUS BELIEFS. In this fourth of a five-article series in Open Access Government on the topic of intellectual humility (IH), Peter C. Hill explores the challenges associated with practising IH with deeply held religious beliefs.

284 | PIONEERING BIOMASS TRANSFORMATION TO UNIQUE MULTIFUNCTIONAL/ BIOCOMPATIBLE ULTRANANOCRYSTALLINE DIAMOND (UNCD™). O. Auciello's group at The University of Texas-Dallas is developing a new revolutionary low-cost microwave plasma pyrolysis process, implemented in a kitchen microwave oven, for biomass transformation.

ASIA FOCUS

286 | Unleashing the power of science, research and innovation in Asia. Preethi Kesavan, Head at the School of Advanced Technology and Digital Media, LSBF Singapore, highlights the transformative role of science, research and innovation in Asia.

288 | BUSINESS AND HUMAN RIGHTS IN JAPAN: AN OVERVIEW. Professor Emi Sugawara from Osaka University of Economics and Law, Faculty of International Studies, walks us through the critical development of Japan's policies concerning business and human rights.

292 | FOSTERING SELF-REGULATED LEARNERS THROUGH CHILD-CENTRED EVALUATION ACTIVITIES. Emiko Izumi, PhD from Kwansei Gakuin University, discusses child-centred evaluation activities, including enhancing thinking, judgment and expression skills.

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294 | An introduction to spina bifida and its available treatments. Dr Nauf AlBendar, Doctor of Clinical Medicine & Founder of The Womb Effect, introduces spina bifida, the primary cause of foetal loss and substantial disabilities in newborns.

296 | FIRST INTERNATIONAL MEETING TOWARDS ELIMINATING PARALYSIS AFTER AORTIC ANEURYSM SURGERY.

Professor Hamdy Awad, MD, FASA, from the Ohio State University Wexner Medical Center, examines the dangers of aortic aneurysm surgery and the importance of continued research towards eliminating paralysis.

298 | Microbial electrosynthesis: Transitioning towards a bioeconomy. Aarthi JanakiRaman, Research Director of Chemicals and Advanced Materials TechVision at Frost & Sullivan, discusses the broad potential of microbial electrosynthesis in supporting the green-energy transition and circular economy.

300 | HOW TO CONVERT CO₂ TO BIOPLASTICS IN THE AGE OF GLOBAL WARMING. Arpita Bose, PhD, Associate Professor, describes how to convert CO₂ to bioplastics through new bugs and novel tools with a focus on fighting global warming.

304 | Exploring the science behind gene therapy in treating genetic diseases. Professor Alan Boyd explains the science behind gene therapy, the challenges in treating genetic diseases, and current trends in the sector.

306 | THE CHALLENGE OF TREATING GENETIC DISEASES: THE EXAMPLE OF CREATINE TRANSPORTER DEFICIENCY. The vast majority of genetic diseases remains beyond possibilities of treatment with research continuing to be able to offer therapies to the affected patients.

HISTORY

308 | The importance of inclusion when studying history. Dr Leanna Brinkley, Study Group's Head of Quality Assurance and Enhancement at Cardiff University International Study Centre, shares her stance on respectful dialogue in the classroom when studying history.

310 | THE QUESTION OF BEING 'ROMAN': EXAMINING ANCIENT HISTORY MORE CLOSELY. Prof Dr Felix K Maier, Professor for Ancient History at University of Zurich, provides an intriguing and instructive analysis of the question of being 'Roman' in his most recent ancient history focus.

314 | BRINGING HISTORY TO THE SURFACE: HOW DO HISTORICAL INVESTIGATIONS AFFECT THE WAYS WE VIEW OUR HISTORY? Associate Professor of Anthropology, Dr Liza Gijanto, outlines how archaeological and historical investigations are vital in revealing important insights into society's past.

EDUCATION

318 | Essentiality of diversity in STEM education. Nadeem Ahmad, Founder and Managing Director of Templeton and Partners, discusses his thoughts on the essentiality of diversity in STEM education.

320 | USING LIVE THEATER TO FOSTER FACULTY INCLUSION. Florida International University's Bystander Leadership™ programme has collaborated with professional live theatre artists to increase awareness of gender and race bias among faculty through evidence-based practices.

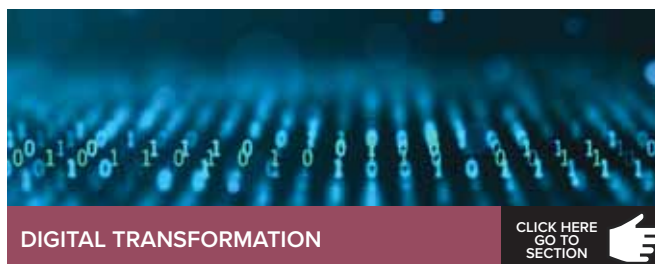
322 | INSPIRING STEM EDUCATION FOCUSED ON SOLUTIONS. Nancy Butler Songer, from the University of Utah, makes a call for collective action to create a new curriculum focused on the design of solutions.

324 | DOES ENGLAND HAVE A BIAS AGAINST ETHNIC MINORITY TEACHERS? 85% of teachers in England are White British, and 46% of schools have no racially diverse teachers at all. Does this mean England has a bias against ethnic minority teachers? Beng Huat See from Durham Evidence Centre for Education explores.

GENDER & ENTREPRENEURSHIP

326 | Why must we increase representation for female entrepreneurship? Although we live in a diverse world working towards equal opportunities, the statistics show that females are less likely than males to start businesses. Shalini Khemka, CBE, explores why female entrepreneurship is essential to foster sustainable economic growth.

328 | SEX-BASED LABOUR MARKET SEGREGATION AND WOMEN'S PERCEPTIONS OF ENTREPRENEURSHIP. Professors Tonoyan, Strohmeyer, and Jennings investigate.



332 | Digital transformation: Legacy ICT challenges. Crown Commercial Service (CCS) technology experts discuss how public sector customers can overcome some of the challenges associated with legacy ICT and outline a better way forward towards digital transformation.

334 | RISK MANAGEMENT: TO QUANTIFY OR NOT TO QUANTIFY? Patrick Parker, Director of CGR Ltd, explores whether a qualitative or quantitative risk assessment is optimal for risk management in your organisation.

336 | THE CUTTING-EDGE PROPERTY INSPECTION AND OPERATIONS SOFTWARE EMPOWERING THE PUBLIC SECTOR. Property Inspect has been awarded 'Crown Commercial Service Supplier' to provide award-winning property inspection software to the public sector.

340 | CLOUD SECURITY NEEDS A NEW PLAYBOOK, AND IT STARTS WITH WIZ. A practical guide to transforming security teams, processes, and tools to support cloud security development.

342 | CCS Mobile Voice and Data Services agreement update. CCS provide an update on the Mobile Voice and Data Services agreement, illustrating the broader aim to enable the best pricing on core services for the public sector.

344 | TOP 5 CHALLENGES FACED WHEN MIGRATING TO THE CLOUD. Firstserv's Sebastian Tyc outlines the risks of migrating to the cloud and how to best approach them.

346 | WHAT IS NEEDED FOR ENTERPRISE COMMUNICATIONS. In this opinion piece, Charles Stephenson, Divisional Director from YUDU Sentinel, explores the way ahead when it comes to enterprise communications.

348 | WHY COMPETENCY MATTERS AND REQUIRES MORE THAN JUST AN L&D APPROACH. Roberta King, Chief Executive Officer at SQEPtech, outlines the concept of competency and the importance of collaboration between teams.

350 | ACCURATE PAYROLL BEGINS WITH A RELIABLE DUTY MANAGEMENT SYSTEM. Crown Workforce Management emphasises the need for digitised duty management systems to optimise police force operations, reduce costs, and improve efficiency.

352 | BUILDING A PRACTICAL CYBER SECURITY RISK AWARENESS STRATEGY.

Nick Denning, CEO of IT consultancy Diegesis and veteran of multiple public sector IT transformation projects shares his thoughts on what makes a successful risk cyber security risk awareness strategy.

354 | AI: CHALLENGES TO DEPLOY RESPONSIBLE & ETHICAL SYSTEMS.

Dayna Arnold, Project Manager at Zest Consult, a leading digital technology consultancy, discusses the challenges businesses face with AI and the struggle for ethical systems.

356 | HOW CAN WORKFLOW MANAGEMENT PLATFORMS DRIVE DIGITAL TRANSFORMATION?

Marc Hoogstad, Head of Product Management at Finworks, explains how workflow management platforms can boost workforce digital dexterity, optimise organisational agility, and support businesses in implementing new ways of working to achieve desired outcomes.

358 | DRIVING INNOVATION AND EFFICIENCY IN UK PUBLIC SECTOR PROCUREMENT.

With digital transformation emerging as a catalyst for driving public sector procurement practices, we examine how technology and software continues to change the world around us.

360 | WHY GOVERNMENT AGENCIES SHOULD INVEST IN ETHICAL AI FOR HIRING DECISIONS.

Barb Hyman, CEO and Founder of Sapia.ai, explains the benefits of employing AI to assist in decision-making and mitigate human biases.

362 | Ensuring the digital futures of the UK's local authorities.

Joanne Green, Head of Public Sector at Neos Networks, outlines how local authorities can harness smart technologies and digital tools to drive infrastructural, social and economic improvements across their local areas.

364 | HOW SMALL CELLS ARE EMPOWERING LOCAL GOVERNMENTS TO BUILD SMARTER CITIES.

Ian Newbury, Business Development Director at BT Wholesale, describes how small cells can support greener and more sustainable technology infrastructure and facilitate a better digital future for everyone.



368 | NIJ puts science to work for justice system stakeholders.

Nancy La Vigne PhD, Director of the National Institute of Justice, shares perspectives on how the Institute advances justice across the nation and beyond, strengthening the scientific tools and discoveries that support justice system stakeholders.

370 | HONOURING THE SOCIAL CONTRACT: TOWARD ENDING THE "AWFUL BUT LAWFUL" ERA.

Charles E. "Chuck" MacLean, J.D., PhD1, walks us through his research about honouring the social contract toward, in his opinion, ending the "awful but lawful" era when it comes to criminal justice in the United States.

372 | THE PRISON SEMINARY MOVEMENT AND THE IMPACT OF FAITH-BASED PROGRAMMES.

Byron R. Johnson and Sung Joon Jang share key challenges affecting America's prison system, the prison seminary movement and the positive impact that faith-based programmes can have.

374 | Post-Brexit economy: Where are we now, and where are we going?

Nigel Wilcock, Executive Director at the Institute of Economic Development (IED), discusses the post-Brexit economy, examining the critical economic challenges that have emerged following the UK's departure from the EU.

376 | WHAT HAS BEEN THE IMPACT OF BREXIT ON THE UK ECONOMY?

Sarah Hall, University of Nottingham, discusses and assesses the impact of Brexit on the UK economy, in combination with COVID-19 and the Ukraine war.

378 | FINDING COMMON GROUND: THE DELICATE BALANCE OF POLITICAL COMPROMISE IN DEMOCRACY.

Associate Professor of Political Communication, Mariken A.C.G. van der Velden, explores the complexities of political compromise, including its impact on political representation and citizen support.

380 | Improving rural digital connectivity and broadband.

As digital infrastructure, tech, and connectivity evolve, investment in rural digital connectivity must be prioritised for economic growth, social inclusion and improving quality of life.

384 | BROADBAND DELIVERY SOLUTIONS: SOLVING THE PROBLEM OF RURAL CONNECTIVITY TODAY.

David Hennell from National Broadband explores alternative broadband delivery solutions that local, regional and central government authorities need to be aware of.

WELFARE & PUBLIC POLICY

386 | Can social dialogue identify answers to the challenges of our time?

Pekka Ristolä, EESC Member and Rapporteur for the opinion on Strengthening social dialogue, argues that social dialogue is vital to identifying answers to the challenges of our time.

388 | Is welfare spending distinct from health spending?

Paul Christie, Co-Founder and CEO of Tachmed, examines the benefits of a more joined-up approach in health and welfare spending to combat threats to global health.

390 | WELFARE ECONOMICS: PROMOTING EQUALITY THROUGH GENERAL POLICIES.

Yew-Kwang Ng, Emeritus Professor at the Department of Economics, Monash University, continues a discussion about welfare economics, focusing on efficiency supremacy in specific areas, arguing that equality should be promoted through general policies.



396 | European integration and the single market perspectives.

Prof Dr Kyriakos Kouveliotis, Provost and Chief Academic Officer at Berlin School of Business and Innovation, outlines the challenges and perspectives around European integration and the single market.

400 | INDUSTRIAL ORGANIZATION: UNDERSTANDING THE MECHANISMS OF MARKET STRUCTURES.

Patrick Legros, Professor of Economics at Université libre de Bruxelles, explores how Industrial Organization can help understand the positive and normative consequences of different market structures.

402 | NATIONAL FRAUD INITIATIVE (NFI) CREDITORS – “CLAIM, VET AND MATCH”.

Ray Dorney talks us through Rockford Associates Limited's Accounts Payable Recovery Audits used to detect and prevent overpayments in the public sector and beyond.

404 | Boosting economic progress through digital transformation in Egypt.

Usama Elsayed, COO and Managing Director for MEA region, BPC, charts how digital transformation in Egypt is boosting economic progress and financial inclusion.

406 | SUPPORTING ICT EMPLOYMENT OPPORTUNITIES FOR WOMEN IN EGYPT.

Ragui Assaad and Irene Selwaness examine the increase of women in ICT jobs in Egypt, as well as gender disparities and the efforts to promote ICT employment growth.



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410 | Transitioning to a long-term sustainable transport system in Europe.

Thord Stefan Back, Member of the EESC, charts the transition to a long-term sustainable transport system to achieve climate neutrality in Europe by 2050.

412 | POWERING UP LIVERPOOL'S PUBLIC CHARGING NETWORK TO BECOME THE NORTH OF ENGLAND'S MOST EV FRIENDLY CITY.

Here Shell Fleet Solutions discuss how ubitricity is working with Liverpool City Council to help Liverpool expand its public charging network to become the north of England's most EV friendly city.

414 | DECARBONISING PUBLIC SECTOR COMMERCIAL VEHICLES AND ENSURING THE AVAILABILITY OF EV CHARGING STATIONS. From harnessing data to support EV uptake to ensuring the availability of EV charging stations, Beverley Wise, Webfleet Regional Director UKI at Bridgestone Mobility Solutions, shares key criteria to help make the switch to greener transportation more straightforward and cost-effective.

416 | Energy storage in the electric vehicle & renewables revolution.

Alan Greenshields, Director of Europe at ESS Inc, charts the road to net zero, highlighting the crucial role of energy storage in the electric vehicle and renewables revolution.

418 | LEVI FUNDING – WHAT DOES THIS MEAN FOR YOUR LOCAL AUTHORITY?

£380.8m has been promised for the Local Electric Vehicle Infrastructure Fund or LEVI fund in an effort to push transport towards net zero through the expansion of EV charging infrastructure.

420 | WORKING TOWARDS A FUTURE OF ZERO-EMISSION FLEETS.

Robert Austin, Sector Lead for UK Power Networks Services, discusses the challenges of zero-emission fleets, including balancing a resilient energy supply, meeting capacity requirements and sustainability pressures.

422 | MAKING EV CHARGING INFRASTRUCTURE AND EV UPTAKE EASIER FOR LOCAL AUTHORITIES.

With over 30 years of experience in developing smart electronic solutions, EZ-Charge explains how it is supporting a seamless uptake of electric vehicles by working with local authorities to offer user-friendly and reliable EV charging infrastructure.

424 | ACCELERATING EV CHARGING FACILITIES AND INFRASTRUCTURE ROLL-OUT.

Perran Moon, CEO of electric vehicle charging network provider Believ, tells us how local authorities can overcome common hurdles when implementing EV charging facilities in their local areas.

426 | DEBUNKING ELECTRIC VEHICLE MYTHS: WHY EVS ARE THE FUTURE OF TRANSPORT.

Olivia Serrage, Group Marketing Manager at evcc, looks to the future of transport, explaining why sustainability will be better achieved with the adoption of electric vehicles.

427 | Promoting green travel with sustainable aviation fuel.

Sarah Wilkin, Founder & CEO of Fly Green Alliance (FGA), looks at how the airline industry is working to reduce its carbon footprint through the use of sustainable aviation fuel.

430 | Applying data in real-time to global shipping operations.

Dom Couldwell, Head of Field Engineering EMA at DataStax, charts the role of data in global shipping operations, which we discover improves the real world in real-time.



ENVIRONMENT

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434 | Feeding the world: A productive and sustainable fishing industry.

Phil Haslam, Managing Director of North Atlantic Fishing Company (NAFCO), walks us through feeding the world through a productive and sustainable fishing industry.

438 | THE Fish-X PROJECT: SUPPORTING EU SMALL-SCALE FISHERIES GOING DIGITAL.

The implementation of innovative data management and data collection tools will help support the sustainable development of EU fisheries; learn how the Fish-X project will support this digital transition of small-scale fisheries.

440 | FOOD WEBS AND FISH: OCEAN CLIMATE CHANGE IN ALASKA.

Open Access Government talks to ocean climate expert Dr. Robert Suryan, who is the lead of an ecosystem studies program at the Alaska Fisheries Science Center's Auke Bay Laboratories.

444 | Sustainable & equitable futures through placemaking.

Maria Adebowale-Schwarte, CEO of Foundation for Future London, analyses and promotes sustainable and equitable futures through placemaking.

448 | THE TOXICOLOGICAL IMPLICATIONS OF E-WASTE.

Here, Donald A. Bruun and Pamela J. Lein discuss the toxicological implications of e-waste and how to address this global problem.

450 | A sustainable government for a sustainable economic policy.

Claire Benson, Founder and Director at SDG Changemakers, argues that implementing a sustainable economic policy intervention requires a sustainable government.

454 | GAMIFIED ECO-DRIVING TO MOTIVATE SAFE AND SUSTAINABLE DRIVING.

With young drivers at the greatest risk of accidents on the road, eco-driving could offer a solution that promotes safer driving techniques while reducing the environmental impact.

456 | UNDERSTANDING THE CLIMATE CHANGE IMPACT ON HEALTH. Scientists at the Climate Service Center Germany (GERICS) help society to prepare for climate change impacts on health in a multi-faceted approach.

458 | BAMBOO CIRCULATION IN SATOYAMA AND SATOUMI: JAPAN'S HILLY AND COASTAL AREAS.

Professor Saijo Kiyoshi at the Miyagi University of Education explains the work behind the bamboo circulation project of 2020, focusing on bamboo growth and utilization in Satoyama and Satoumi.

460 | Monitoring ecosystems from space to calculate biodiversity net gain. Shashin Mishra, Vice-President of EMEA at AiDash, examines how monitoring ecosystems from space can revolutionise biodiversity net gain progress and aid the eco-crisis.

462 | Transition to the biobased economy: Integrated approach needed. Aarthi JanakiRaman, Research Director, Chemicals and Advanced Materials TechVision, Frost & Sullivan, charts the transition to a biobased economy, stressing the need for an integrated approach.

466 | MICROALGAE AS A SUSTAINABLE SOURCE OF PROTEIN AND FOOD INGREDIENTS. Microalgae can be an alternative sustainable source of protein and functional food ingredients that have the potential to improve gut and liver health.

468 | RENEWFOOD MANUFACTURING: FOOD PRODUCTION FOR A NOURISHED, RESILIENT NATION. Dr Kang Lan Tee, Matthew Hutchinson, Joe Price and Professor Tuck Seng Wong from the University of Sheffield explain the importance of re-imagining food production to support people and the planet.

470 | WASTE MANAGEMENT: WASTE-FREE CONCERTS & EVENTS. Bengt Fellbe, Program Leader, SSEC, Swedish Surplus Energy Collaboration, directs our thoughts to waste-free concerts and events and reckons that for the first time, this remarkable waste management notion may work.

472 | Ecology conservation and truly valuing our environment. Dr David Smith, Director of Ecological Planning & Research (EPR), gets us up to speed with ecology conservation research and what we can do to help our environment thrive.

474 | STORED FUEL'S IMPORTANCE FOR MIGRATING MONARCH BUTTERFLIES: IMPLICATIONS FOR CONSERVING ALL MIGRANT ANIMALS. In his latest research, Keith A. Hobson, Research Scientist and Professor at Western University, explores why stored fuel is critical to migrating animals, such as monarch butterflies.

476 | A FOCUS ON GLOBAL BIODIVERSITY FRAMEWORK TARGET 7: APPROACHES TO POLLUTION. Dr Christoph Neumann analyses the Global Biodiversity Framework Target 7, and explains the need for a qualified risk-based approach to pollution from the COP15 convention.



AGRICULTURE

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480 | USDA combats trafficking of illegally taken plants. From the USDA's Animal and Plant Health Inspection Service: Plant Protection Today – Lacey Act Phase VII Is Coming – USDA combats trafficking of illegally taken plants.

482 | ORGANIC SOIL AMENDMENTS: ENHANCING VEGETABLE PRODUCTION & SOIL HEALTH IN PUERTO RICO. Ermita Hernandez Heredia, Associate Professor from the University of Puerto Rico, details enhancing vegetable production and soil health in Puerto Rico in this organic soil amendments particular focus.

484 | GENETIC MECHANISMS OF PIGMENT ACCUMULATION IN CARROT COLORS. We hear from Philipp Simon, from the USDA, Agricultural Research Service & University of Wisconsin, Madison, about how a kaleidoscope of colors reveals new genetic mechanisms of pigment accumulation in carrot colors.

486 | OPTIMISING SUBSURFACE DRIP IRRIGATION FOR EFFECTIVE DROUGHT DEFENCE. Professor Pete W. Jacoby from Washington State University describes how the innovative use of drip irrigation can enhance vineyard resilience to drought.

488 | A U.S. perspective on the EU's Farm to Fork strategy. David Green, Executive Director of the U.S. Sustainability Alliance, discusses sustainable food systems, mirror clauses and their meaning.

492 | SUPPORTING EUROPE'S TRANSITION TO CLIMATE-NEUTRAL FARMING. We hear from CliNFarms, an Innovation Action project funded by the European Commission to support the European Green Deal and achieve climate-neutral farming across Europe's agricultural industry by 2050.

494 | Adopting agriculturally sustainable practices in rice cultivation. Aarthi JanakiRaman from Frost & Sullivan explores sustainability in agriculture, focusing on the extent to which rice cultivation shows the way ahead.

496 | Combatting NCDs using Plant-based Proteins and Animal-Waste Products. Professor Apichart Vanavichit, PhD, a Rice Genomic Breeding Expert at the Rice Science Center, walks us through high-quality crop-based and ovo-based protein hydrolysates to combat non-communicable diseases in Thailand, specifically among its ageing population.

498 | THE EFFECT OF SOIL DEGRADATION ON HUMAN, ANIMAL AND PLANT HEALTH. Dr. Christine Sprunger, soil scientist and ecologist at W.K. Kellogg Biological Station (KBS) and the Department of Plant, Soil, and Microbial Sciences at Michigan State University, discusses the danger of soil degradation on human and animal life, and what we can do to mitigate it.

500 | Public procurement: An opportunity to transform the EU's food system. Dorina Meyer and Giorgia Dalla Libera Marchiori from ICLEI Europe discuss opportunities for improving food security across the EU, public procurement, and cultivating a more equitable and environmentally conscious food system.

502 | The devastating water footprint of animal agriculture. Jasmine Clark, Senior Environment Campaigner at Viva! walks us through the devastating water footprint of animal agriculture, including scarcity, pollution and unsustainable demand.

504 | URBAN LIVING LABORATORIES: OPPORTUNITIES FOR MODELLING SUSTAINABILITY TRANSITIONS. Here, a group of academics present Urban Living Laboratories to study sustainable food production systems, using systems dynamic modelling to analyse policy alternatives.

ANIMAL HEALTH

506 | Phasing out the use of animals in science. Barney Reed, Senior Scientific Manager, Animals in Science Department at the RSPCA, stresses the need for ambitious strategies for phasing out the use of animals in science.

509 | ANIMAL ETHICS IN RELATION TO DESENSITISATION AND EXTREME COMPARTMENTALISATION.

Dr Rebekah Humphreys, a Senior Lecturer in Philosophy at the University of Wales Trinity St David, Lampeter, discusses animal ethics and the morality of our treatment of animals in testing and intensive farming.

512 | NUTRITIONAL MANAGEMENT OF CHRONIC KIDNEY DISEASE IN PETS. Renea Creech and Kim Wilson outline the challenges of Chronic Kidney Disease in pets, the irreversible loss of kidney function, and how nutrition can help.

514 | Advancing animal rights. With a particular focus on South Korea, Open Access Government explores the changing perceptions around animal welfare and some of the policies introduced to support this.

518 | WHY DO WE ALWAYS CARE ABOUT THE WELFARE OF LABORATORY ANIMALS? Seasoned experts from the Daegu-Gyeongbuk Medical Innovation Foundation (K-MEDI hub) in South Korea share their research perspectives on the welfare of laboratory animals, including the issue of veterinary care.



522 | Fighting energy poverty in the EU. Baiba Miltoviča, President of the Section for Transport, Energy, Infrastructure and the Information Society (TEN), European Economic and Social Committee (EESC), argues that the EU must take tangible steps to fight energy poverty in the EU and safeguard vulnerable people's right to access energy.

526 | NET ZERO INDUSTRIES AND CITIES ARE WITHIN REACH. Technological expertise and solutions for climate target response is already here, but to unlock the hidden potential in industries and cities, we need clear priority setting by politics, orchestrated deployment, and significant public funding (CAPEX and OPEX) backed by an eased regulatory framework.

528 | BRIDGING THE GAP BETWEEN RESEARCHERS AND ENTREPRENEURS. Dr Venizelos Efthymiou from the FOSS Research Centre at the University of Cyprus discusses the vision of partnership for researchers and entrepreneurs in the EIRIE platform.

530 | ENGINEERING A GREENER FUTURE WITH RENEWABLE HEATING TECHNOLOGIES.

Here, Andy Farquhar, Senior Product Manager (New Energy) for Groupe Atlantic UK, Republic of Ireland and North America, the parent company of Ideal Heating, discusses the vital role of manufacturers in the shift to renewable heating technologies.

532 | DIVERSIFYING THE TRANSITION TO RENEWABLE ENERGY IN TAIWAN. MMA Global Aqua discuss the transition from the traditional uses of oil and gas to renewable energy in Taiwan, describing the challenges, benefits and skills needed in the transition.

535 | What to consider when getting a heat pump installed. Aoife Foley, Chair in Net Zero at The University of Manchester, assesses the pros and cons of getting a heat pump installed in this special energy focus.

538 | HEAT PUMPS IN HEALTHCARE ARE THE CATALYST FOR A NET-ZERO NHS. Paul Burnett, MD and Co-Founder at Asset+, a Johnson Controls Company, explores how UK healthcare can benefit from the Public Sector Decarbonisation Scheme and the efficiency, sustainability, and financial gains of moving to heat pumps in healthcare.

540 | THE ROLE OF BATTERY ENERGY STORAGE SYSTEMS IN RENEWABLE POWER. Founded in 2010, Harmony Energy is one of the UK's leading developers of utility-scale battery energy storage systems. Here is how they are shaping the future of renewable energy.

542 | DECARBONISING SCHOOL HEATING SYSTEMS. Mounting pressure on already tight budgets has prompted many educational establishments to look for additional savings. One way to cut costs is to upgrade school heating systems, which has added environmental benefits.

544 | REVOLUTIONISING RENEWABLE TECHNOLOGY IN THE UK FOR A GREENER FUTURE. Hannah Jepp from Ares Power, part of Kingdom Energy, explores how we can use renewable technology in the UK to accelerate our clean energy revolution.

546 | CAPITALISING ON RENEWABLE HEATING AND THE POWER OF HEAT PUMPS. Martin Fahey, Head of Sustainability for Mitsubishi Electric UK & Ireland, explains how we can efficiently enter the renewable heating market with heat pumps to reduce emissions.

548 | How hydrogen cars can drive us towards the UK government's net zero targets. Steve McEvoy, Vice President of Automotive at Expleo, outlines how hydrogen cars can drive us towards the UK government's net zero targets.

550 | HYDROGEN PRODUCTION IN THE ENERGY TRANSITION: EXPLORING PROTIUM PROJECT PIONEER 1. Protiem explores green hydrogen production in a case study of the Protiem Project Pioneer 1, exploring carbon storage and net zero possibilities in energy.

552 | Australia's energy policy priorities. Open Access Government investigates some of the energy policy priorities of Australia's Minister for Climate Change and Energy, The Hon Chris Bowen MP, especially clean energy, energy efficiency and electric vehicles.

554 | MAXIMISING ENERGY EFFICIENCY WITH ELECTRIC MOTORS. With an increasing number of technologies and applications employing electric motors, Rukmi Dutta from the University of New South Wales discusses the mechanisms and efficiency potential of electric motor systems.

BATTERY INNOVATION

556 | To meet energy demand, creating new battery chemistries is key. Johan Söderbom, Thematic Leader Smart Grid and Energy Storage, EIT InnoEnergy argues that creating new battery chemistries is key to addressing the rising demand in the battery industry.

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SECTION

HEALTH & SOCIAL



AL CARE



Who is the European Health Union?

Sandra Gallina, Director General at Directorate-General Sante (DG SANTE), tells us the purpose of the European Health Union, formed in 2020, which sets out to provide a healthier tomorrow thanks to the actions of today



Image: © MJ_Prototype | iStock

These recent and challenging years have led the eyes of the world to shift their gaze firmly onto the public policy of healthcare.

Indeed, the devastation brought by the COVID-19 pandemic has shed light on the importance of working together to protect and improve the health and lives of our Union's citizens.

It is this spirit of collaboration that sparked the European Health Union into life in 2020. In the darkest days of the pandemic, work was already underway to build such a Union.

The challenges we face are clear: the shortages of medicines, the cracks in supply chains, and the inequality of access to medicines between Member States.

To uphold our principles of equality, we must ensure that such gaps are reduced and that citizens can avail of the same treatments and medicines no matter where they live.

To achieve this goal, we must rethink the structures of the past and look to the future and embrace innovation. This will be done through a more efficient and future-looking framework.

The recent proposal to revise the pharmaceutical rules does this by rewarding those who bring innovative medicines to the market, with further incentives for launching in all Member States.

This creates an environment that values a new forward-looking approach to create a single market for medicines, equally available to every citizen, regardless of whether they live in a large or small Member State.

Medicines supplies in the EU

Medicines are the lifeblood of an efficient healthcare system, and that is why it is crucial that we ensure a clear, uninterrupted path from research laboratories to manufacturers, all the way to patients via pharmacies and hospitals across the EU.

Our proposal, tabled in April, includes practical measures to strengthen the security and continuity of supply of medicines in the EU.

These include new requirements for the monitoring and management of shortages of medicines by national authorities and the European Medicines Agency (EMA), which will also be afforded a stronger coordination role to be up to the task.

In addition, companies will be bound by new obligations to report shortages and withdrawals of medicines at an earlier stage as well as maintaining Shortage Prevention Plans for all medicines.

The sooner the signal can be raised, the greater the possibility for mitigation or prevention of the shortage.

Other targeted measures include the establishment of an EU list of critical medicines, for which the Commission can adopt legally binding measures to strengthen the security of their supply.

These multiple and diverse tools in our toolbox will be used to reduce the risk of shortages. But as with the pandemic, we must also continue to innovate to keep up with new and ever-changing challenges that may lie ahead of us all.

The days of a 'one-size-fits-all' model is for yesterday, not tomorrow. We want to empower each citizen to be the master of their own health, not only through better access to the medicines they need but also through the way health data is used.

European Health Data Space (EHDS)

The European Health Data Space (EHDS), unveiled just over a year ago, will empower individuals across the EU to exercise their rights over their health data fully – enabling citizens to digitally access and share their data with health professionals when they want and how they want – at home and abroad.

At the same time, the EHDS will also improve the re-use of health data for research, innovation, regulatory and policy-making purposes in full compliance with data protection requirements whilst protecting individuals' privacy.



Sandra Gallina

Using just one example of how EHDS benefits us all; it will make data on various types of cancers more widely available and in a timelier way.

It will also strengthen cancer registry systems which play an important role in Europe's Beating Cancer Plan in informing cancer prevention strategies, diagnostics, and treatments.

Health legislation fit for the 21st century

Though recent years have brought about unprecedented challenges, the EU is firmly looking ahead and not back, updating health legislation to make it fit for purpose in the 21st century while firmly travelling down the digital path to ensure our Union best serves its citizens wherever they may be and ensure a stronger Health Union for years to come.

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IC2PERMED: FOSTERING COLLABORATION BETWEEN EUROPE AND CHINA TO ENHANCE PERSONALISED MEDICINE

Tailoring care to meet patients' needs can dramatically improve clinical outcomes; we hear how the IC2PerMed project is bolstering efforts in personalised medicine

Image: © Adene Sanchez | iStock

“To ensure that patients receive the most appropriate treatment and care, it is essential that healthcare professionals have sufficient knowledge of personalised medicine”

Over the past twenty years, personalised medicine (PM) has shown the potential to transform healthcare by tailoring prevention, diagnosis, and therapies to meet individuals' needs. PM uses genotypic, phenotypic, and environmental data to adapt healthcare interventions, resulting in improved health outcomes.⁽¹⁾ It also aims to improve the efficacy of medications and therapeutic strategies by moving away from the 'one-size-fits-all' approach.

'Integrating China in the International Consortium for Personalised Medicine' (IC2PerMed) is a coordination and support action of the International

Consortium for Personalised Medicine (ICPerMed) funded by EU Horizon 2020. The initiative aims to foster common approaches between the People's Republic of China and the EU on PM research, development, innovation, and policies, therefore promoting long-term EU-China research collaboration.⁽²⁾

Methodology of the IC2PerMed project

Initially, researchers conducted a mapping-based analysis of policies and initiatives within the European Union (EU) and China to determine the project's priorities in PM.⁽³⁾ Workshops addressed vital topics, including

awareness and empowerment, shaping sustainable healthcare, big data, and ICT solutions, bringing innovation to market, and translating basic to clinical research. These workshops identified key priorities validated by Delphi surveys. The questionnaire was developed in English and then translated into Chinese; bilingual moderators were also present to facilitate participant communication. The study results were published in both English and Chinese, and validated priorities were subsequently collected to compose the IC2PerMed roadmap for future collaboration between the EU and China.

Results of the IC2PerMed project

Even if the importance of PM is widely recognised, several barriers hinder its implementation, such as a need for more literacy on the topic.⁽⁴⁾ To ensure that patients receive the most appropriate treatment and care, it is essential that healthcare professionals have sufficient knowledge of personalised medicine, as this will aid their decision-making. Efforts should therefore be made to provide healthcare professionals with education and training to enhance their knowledge and skills.

Additionally, efforts should be directed towards promoting the deliberate use of novel 'omics' technologies and providing accurate information to users to increase citizens' understanding of the topic.^(5,6,7,8) Investment in R&D to support market innovations heavily depends on research and innovation actors adopting them; this is more common when corporate stakeholders are involved. Stakeholders in PM should connect to support new technologies, particularly in implementing Health Technology Assessment (HTA). Advancing research projects and focusing on Machine Learning algorithms and their applications in the domains of rare illnesses and cancer might help build worldwide investigative standards and procedures.

This close interdependence between diagnostics and therapeutics is also reflected in the most recent updates by the World Health Organization regarding the coding of healthcare reimbursement,⁽⁹⁾ creating a favourable environment for implementing PM tools and practices. It is essential to establish a regulatory framework that ensures PM safety and efficacy while promoting their accessibility and

affordability. This can be achieved through intersectoral multi-stakeholder collaborations with regulatory authorities, industry stakeholders, and patient representatives to develop transparent and consistent data collection, analysis, and share standards across borders, paying attention to ethical and legal issues.⁽¹⁰⁾ Finally, it is essential to establish clear guidelines and regulations facilitating data sharing for research purposes.

Promoting Sino-EU cooperation for further research

The IC2PerMed project has thoroughly analysed existing policies and opportunities for alignment while involving experts and creating a roadmap for integrating China into ICPerMed. However, this integration should not be regarded as finalised; the produced work only laid the foundations for future initiatives. Furthermore, the EU and China have expressed interest in PM and an understanding of the value of collaboration. With the findings obtained and collected in the roadmap, the initiative aims to promote Sino-EU cooperation for further research in the area.

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CLASSIFICATION OF RARE DISEASES: THE CASE OF THE ULTRA- AND HYPER-RARE

Dr C. I. Edvard Smith, Dr Daniel W. Hagey and Dr Rula Zain, from the Karolinska Institutet in Sweden, note that there is an almost infinite number of unique diseases, contributing to the challenges with the classification of rare diseases

It was recently estimated that there are many more unique diseases than people living on this planet (Smith et al., 2022). Therefore, how do we conduct the identification and classification of ultra and hyper-rare diseases?

Diseases are either common or rare. Even if most people are affected by the common ones, it is among the rare ones that the most significant number of disease entities are found. This is because there are many mechanisms underlying disease. To provide two examples:

- Human beings have more than 20,000 genes; alterations in a single gene can cause several diseases. On top of that, defects in different genes can be combined in many ways that generate phenotypes and unique disease symptoms.
- There is an estimated up to one thousand billion (1,000,000,000,000) microorganism species on this planet (Locey & Lennon, 2016). Therefore, if only one microorganism in a million can cause disease in any potential context, this would still equal one million different infections.

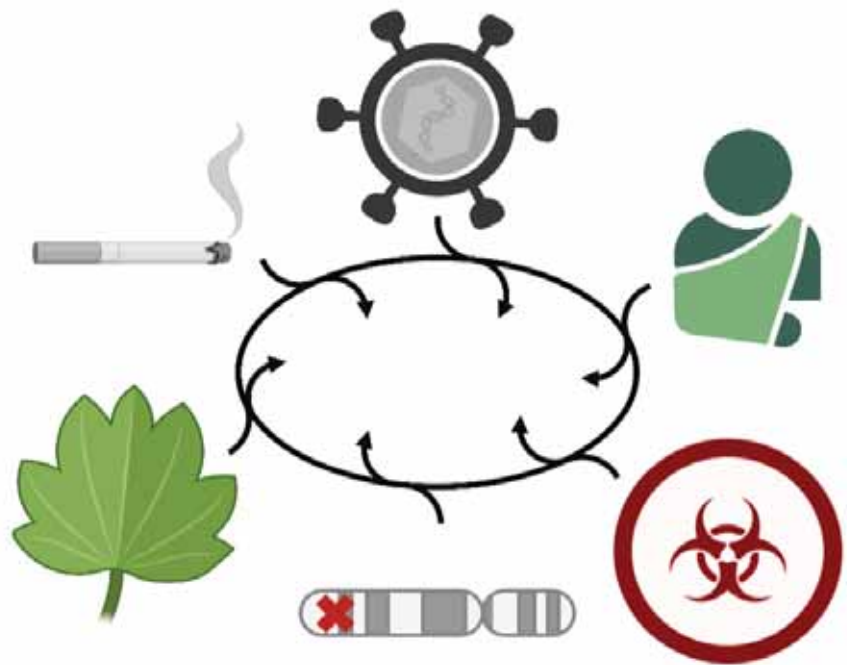


Figure 1: The interaction between external elements such as the environment, lifestyle risk factors, infections, injuries, hazardous agents, and genetic factors causes disease

The Online Mendelian Inheritance of Man

A subclass of rare diseases belongs to the hyper-rare group, which affects fewer than one in a hundred million people (Smith et al., 2022). This demonstrates the considerable challenge of the classification of rare diseases.

Many different tools have been developed for creating disease nomenclatures. Such initiatives are essential for cataloguing the growing number of diagnoses discovered by novel diagnostic techniques. For example, Victor A. McKusick pioneered what is today known as Online Mendelian Inheritance of Man (OMIM),

a freely available, daily updated, comprehensive collection of human genes and genetic phenotypes. It contains information on all known Mendelian disorders and over 16,000 genes.

A special initiative for rare diseases (affecting fewer than 1/2000 individuals) is the ORPHAcode system, based on the Orphanet classification of rare diseases. This is a unique and multilingual standardised system aimed at providing specific terminology for rare diseases. As defined by [Orphanet](#), each clinical entity is assigned a unique and time-stable ORPHAcode, around which the rest of the data present in the Orphanet database is structured. This coding system provides a common language across healthcare systems, registries, and research.

Biesecker et al., 2021 have formalised a versatile approach to assert that only by a combinatorial, or dyadic, approach taking both genotype and phenotype into account can a unitary, distinct genetic disorder be designated.

Furthermore, they argue that this approach to delineating and naming disorders reconciles the complexity of gene-to-phenotype relationships simply and clearly. They also make a case for [GeneReviews](#)[®], which is defined as an international point-of-care resource for busy clinicians and provides clinically relevant and medically actionable information for inherited conditions in a standardised journal-style format. We have previously contributed such a review for a monogenic disease, the primary immunodeficiency, named X-linked agammaglobulinemia (Smith & Berglöf, 2016).

The International Classification of Diseases (ICD) has been the basis for comparable statistics on causes of mortality and morbidity between places for more than a century. The latest version of the ICD, ICD-11, was adopted in 2019 and came into effect on 1 January 2022. While useful, this taxonomy is much more limited regarding the classification of rare diseases and certainly not applicable when discussing ultra- and hyper-rare diseases.

“Diseases are either common or rare. Even if most people are affected by the common ones, it is among the rare ones that the most significant number of disease entities are found. This is because there are many mechanisms underlying disease”

Patients affected by concurrent diseases causing a distinct phenotype

While the existing nomenclatures are useful, it is still essential to develop classifications to include a simple system for the inclusion of patients affected by concurrent diseases causing a distinct phenotype, what we have named ‘phenotype conversion’ (Smith et al., 2022).

Here, it is essential to clearly distinguish between concurrent diseases causing a distinct illness, i.e., when their pathological mechanisms interact (phenotype conversion) or not (phenotype maintenance). For example, phenotype maintenance is when two diseases do not interact, such as when someone breaks a leg and has a mouth ulcer.

In contrast, patients inheriting two disease genes, each of which will cause a heart abnormality, may acquire a novel disease entity distinct from each of the individual illnesses. As such, when these layers of potential disease diversity are considered on top of one another, the number of definable, unique diseases becomes functionally infinite.

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SECARNA: NEXT GENERATION ANTISENSE THERAPEUTICS

Leading independent European antisense drug discovery company, Secarna, aims to bring novel and effective antisense therapeutic options to an increasing number of patients. CEO Alexander Gebauer tells us how

Secarna Pharmaceuticals is a next-generation antisense oligonucleotide (ASO) company that addresses disease areas of high unmet medical need, focusing on immuno-oncology and inflammation/fibrosis-related indications.

Founded in 2015, Secarna is proud to have established its discovery and development unit in over 2,000 square feet of lab and office space at the IZB Martinsried, Munich – one of Europe's most vibrant biotechnology clusters. Alexander Gebauer, CEO of Secarna, explains why the company's best-in-class ASO platform, LNAPlus™, combined with its strategic business model, offers Secarna an advantageous position to establish ASOs as the third pillar, together with small molecules

and antibodies, of drug development, expanding the universe of targetable genes.

Exploring Secarna's business model

Secarna's strategy builds on two pillars: our partnering approach based on our unique technology platform, where we jointly work on the discovery and development of antisense oligonucleotides in disease focus areas for our respective partners, and our growing proprietary pipeline, which is focused on areas of high unmet medical need such as immuno-oncology and inflammation/fibrosis.

We plan to partner our proprietary projects after reaching certain value inflection points.

How does Secarna's technology stand out from other antisense therapeutics? What are the company's core expertise?

Over time, and with our extensive experience, we have built a highly versatile, effective, and valuable platform encompassing all aspects of drug discovery and preclinical development, delivering high-quality candidates quickly.

From the inception of each project, we focus on simultaneously assessing both efficacy and safety. Our proprietary Oligofyer bioinformatics system allows us to thoroughly screen all relevant databases and select the most promising antisense oligonucleotides in-silico, minimising off-target effects and potentially toxic sequences at a very early stage.

We set the bar very high for each project; therefore, we exclusively work on so-called third-generation chemistry ASOs, with improved stability, target affinity, pharmacokinetic properties and productive cellular uptake. Moreover, our molecules show no or reduced unwanted immune system stimulation and other possible side effects.

What do you believe are the advantages/disadvantages that ASOs have over other therapies? Which indications might profit from them the most?

Like other compound classes, such as small molecules or antibody therapies, antisense oligonucleotides are not a miracle solution for every therapeutic problem. However, we see clear advantages over other modalities for many targets.

Therapeutic antibodies cannot address intracellular targets, small molecules cannot be designed for every target, and siRNAs require transport technologies, altogether highlighting the need for tailored approaches, depending on the indication. We believe that ASOs offer a particular advantage over other drug modalities; for example, in contrast to siRNAs, they can be applied 'naked' and still enable potent target knockdown in various organs and tissues.

Also, they achieve specific blockage of all functions of a selected target due to pre-messenger RNA (mRNA) targeting, whereas an antibody might block only one epitope.

Furthermore, they can target all types of proteins (e.g., intracellular, secreted, surface), making them relevant to treat a wide range of diseases, where the liver, kidney, central nervous system

(CNS), lung or other organs are affected. ASOs are also acquiring a relevant role in oncology, bringing the immuno-oncology space to the focus of our proprietary pipeline.

How is Secarna's pipeline structured?

While we can share only limited information about our partnered programmes, it is public that Denali and SciNeuro are both CNS companies. Lipigon is currently in phase 1 clinical trials with its cardiometabolic antisense oligonucleotide project. Immuno-oncology and inflammation/fibrosis are key areas of interest in our internal pipeline.

Is there an indication that Secarna has a stronger position?

Our main areas of scientific expertise are oncology, inflammation, and CNS, backed by a strong network of key opinion leaders that support us and advise us in the development of our current programmes and partnerships.

Nonetheless, we have the capability to quickly expand our therapeutic range if required.

What are the key factors that make a successful partnership? What type of partnerships is Secarna looking for?

Besides scientific and operational excellence, a successful partnership requires efficiently working with the partner's scientific team and building a trustful collaboration model.

At Secarna, we pride ourselves on our versatile business model to match our partner's needs, demonstrated by a track record of fruitful and robust partnerships.

What is your vision for the company for the next 5-10 years, and Secarna's plans for the development of its internal programmes?

We plan to become the global partner of choice for all antisense oligonucleotide projects. Therefore, we continue to refine and update our discovery and development engine and invest in our knowledge to be at the forefront of understanding the underlying science behind ASOs.

Our vision is that in a few years, we will contribute significantly to expanding the therapeutic options against currently undertreated diseases. Our partnered programmes and in-house projects will hopefully offer more patients new and excellent therapeutic options. Either via external capital or partnering, several of our internal projects are expected to reach the IND-ready and clinical development stages by 2024/25.



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OVER-THE-COUNTER: AN UNDER-APPRECIATED TOXIC DA

The term 'overdose' refers to the administration, intentional or unintentional, of a drug or other biologically active substance in an amount that exceeds a safe dose, and therefore can cause toxicity. Most of us associate this term with use of illicit drugs, such as methamphetamine, or the abuse of regulated, controlled medications, like the opioid fentanyl, likely because adverse effects associated with these drugs are common topics in the news, social media, and movies or books. But any biologically active substance that can be ingested, inhaled, injected, or absorbed through the skin, including compounds essential to life, such as oxygen and water, can cause toxicity when in excess...

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OVER-THE-COUNTER: AN UNDER-APPRECIATED TOXIC DANGER

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ANGER

DRUG REPOSITIONING WITHOUT THE GENE EXPRESSION OF DISEASE CELLS TREATED WITH DRUGS

Y-h. Taguchi, Professor at the Department of Physics, Chuo University in Japan, provides comment on drug repositioning without the gene expression of disease cells treated with various drugs

Finding new drugs to treat diseases is always tricky. For example, although we have an effective mRNA vaccine for COVID-19, no effective drugs to treat COVID-19 have yet been identified. Since the difficulty is due to experiential evaluation, it is better to have a computer-oriented method. But how? We have one proposal for this at the Department of Physics, Chuo University in Japan.

In our previous Open Access Government article, we introduce how to use gene expression ⁽¹⁾ with which several drugs were treated for drug repositioning. The problem with the studies described in the last piece is that the strategy could be used only for diseases whose gene expression is retrieved. In the study described in the previous article, we analyzed gene expression profiles of cancer cell lines. Thus, the drug repositioning we could

identify was only those toward cancers. This is a little bit problematic. If we would like to perform drug repositioning for other diseases, we need to prepare cell lines made from cells of target diseases. Since cancer cells are abnormal in some sense, it is not difficult to add immortality to cancer cell lines. Thus, we can easily maintain cancer cell lines in a Petri dish, but it is not the case for other cells. In addition to this, it is often challenging to collect cells from target diseases. It is time-consuming to treat cells of target diseases with various drugs.

Drug repositioning without the gene expression of disease cells

Here in this article, we would like to introduce another method ⁽²⁾ by which we can perform drug repositioning without the gene expression of disease cells treated with various drugs. To

achieve this method, we need two kinds of gene expression profiles: gene expression of disease cells and gene expression of cells treated with multiple drugs. The point is that cells treated with various drugs do not have to be those of target diseases but can be any kind of cells. Then these two kinds of gene expression can be integrated with tensor decomposition ^(3,4).

In an actual study, gene expression of cells treated with various drugs was taken from a model animal, a rat. This database, DrugMatrix, stores a vast number of gene expression profiles of multiple tissues treated with various drugs. Measurement was performed not only after the treatment but also at different timed points after the treatment. On the other hand, gene expression of disease was typically taken from human cells. The only issue we must consider is that these two

expression profiles must be taken from the same tissues. If we would like to perform drug repositioning for heart disease, tissues from which gene expression is taken should be the heart, too. Then we multiply these two expressions to have tensors like:

(healthy control vs patients) x (various drugs) x (time points) x (genes)

Since a tensor can have more than two indexes than a matrix can have, by applying tensor decomposition to the above tensor, we can have vectors that express “healthy control vs patients”, “various drugs”, “time points”, and “genes”. At first, we try to find which vectors coincide with a distinction between healthy controls and patients and which vectors represent time dependence. Then, after the identification of these pairs of vectors, we can find which drug vectors and gene vectors are associated with these “healthy control vs patients” vectors and “time points” vectors. Finally, the investigation identified the combination of drug genes that contribute most to these drug and gene vectors, respectively.

Using mathematical procedures for these processes

Although this process sounds very complicated, it can be easily performed with purely mathematical procedures. Moreover, we do not need any special or complex computer software since tensor decomposition is a standard method invented long ago.

We applied this procedure to six diseases: heart failure, post-traumatic stress disorder (PTSD), acute

lymphocytic leukaemia (ALL), diabetes, renal carcinoma, and cirrhosis. Identified genes are compared with genes whose expression is known to be altered when drug-target genes are knocked out. Using statistical tests, we found that identified genes are significantly overlapped with genes whose expression is known to be altered when drug target genes are knocked out for five diseases tested other than ALL. Thus, our method is advantageous for performing drug repositioning.

A focus on cirrhosis

One might wonder if our method is only helpful for performing statistical analyses and not valuable for identifying a single drug to be tested for the actual disease. To deny this possibility, we focused on one specific disease, cirrhosis, since no effective drugs were known for this disease and due to our analyses, identified two genes, CYPOR and HNF4A, and one drug, bezafibrate, as the topmost promising genes and drugs toward cirrhosis. The binding energy between these two proteins is bezafibrate, and we found large enough binding energy between these two proteins and drugs. Actually, bezafibrate was once tested for cirrhosis, and its efficiency toward cirrhosis was reported, although it has never been released as an effective drug. Thus we could identify effective drugs validated experimentally, simply in silico evaluation.

We could not experimentally test the drugs identified for five diseases, but they should be very promising since the one specified for cirrhosis was validated experimentally.

Drug repositioning approach

In addition, we recently released a computational package to perform this analysis, TDbasedUFEadv⁽⁵⁾, in Bioconductor that is known to store various applications used in Bioinformatics. Thus now anyone interested in our method can test it. This should be a starting point for the drug repositioning task by our methods, and we expect that many new drugs will turn out to be effective towards diseases by the drug repositioning of our approach.

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The benefits of exercise for mental health

Lorna Rothery spoke to the European Psychiatric Association's President, Professor Peter Falkai, about the benefits of exercise for mental health



While exercise has often been seen as an activity for improving physical health, an increasing number of studies have shown the positive effects of exercise on mental health. As well as reducing stress levels, regular exercise has proved to be a valuable intervention for those suffering from mental health conditions, including depression, anxiety, and ADHD. One organisation delving further into the mental health benefits of exercise is the European Psychiatric Association (EPA). Founded in 1983, the EPA is the leading association representing and promoting psychiatry-related research, treatment, and teaching in Europe. It acts as a key mediator at policy level between practitioners, official councils and public authorities on matters relating to mental health. Lorna Rothery spoke to the organisation's President, Professor Peter Falkai, about the biological processes that occur when we exercise and the interventions that he feels could benefit those suffering from mental health problems, as well as the wider population.

Why is physical activity linked to better mental health? What happens in our brains when we exercise?

When we discuss the impact of exercise on mental health, we refer to the plasticity processes or synaptic plasticity, which influence how we learn, communicate, process, and store information. Improved plasticity has been shown to aid concentration as well as short-term memory. Our research shows that this plasticity is myelin based; it is not only small cells communicating within a network but long-ranging connectivity from one area to another, which is improved through exercise.

Are there certain types of exercise that are associated with improved mental health? How much exercise is necessary to derive the benefits?

Exercising large muscle groups will have the greatest impact; sitting down and playing chess, for example,

would not be enough. We have just finished a series of studies called Exercise 3, and we found that small-scale movements are not enough to affect outcome parameters and symptoms related to cognition or mood. As part of this large-scale study, we compared indoor cycling with balance and toning exercises like yoga. If you do bigger moves and use bigger muscle groups, that is more beneficial.

In terms of duration, the WHO recommends a minimum of 75 minutes and a maximum of 150 minutes of exercise per week. I always tell my patients that adopting simple, 15-minute daily habits is a good starting point, like taking the stairs and walking to work, which can amount to a lot of time and become a sustainable part of their routine. At the same time, these short, gentle movements will not greatly affect cognition; 30 to 45 minutes of exercise three times a week is recommended to see acute improvement in symptoms.

What are some of the key barriers to performing physical activity for people with poor mental health?

Firstly, it is important to note that barriers are often very similar to those of healthy people. Even though we know that there are benefits of exercise for mental health and metabolism, many people do not do it. Literature on this topic often references the impact of upbringing on one's attitude to exercise; if you are part of a family that has always been active, you likely make exercise or sports part of your weekly routine. Learning from the model early on is important.

Another influencing factor relates to where you exercise and how it is presented. For example, if you exercise as part of a group or have a personal trainer who can help you reach an optimal level and give positive feedback, that can be beneficial. I support the idea of variables and individuals being able to measure their progress, for instance, setting themselves a goal to reach 10,000 steps per day.

Framing exercise as something that needs to be done regularly can put people off as they think it takes up too much time, especially if they have other responsibilities. It is better to frame it as part of your routine that you do two to three times per week instead of a daily chore. Start small and make those small changes like walking to work or taking the stairs; it is about transitioning to being a more active person and generally moving more. People

with severe mental illness can often default to sedentary behaviour, which can make leading an active life more difficult, so starting with small changes can help.

How can exercise be incorporated alongside other interventions to improve mental wellbeing, and what is the interplay between exercise, nutrition, and sleep?

I call this a health package. Leading a healthy lifestyle includes eating varied and nutritious food, getting enough sleep (ideally between six and eight hours) and generally trying to be less sedentary, so standing instead of sitting during your commute in the morning would enable you to keep some tension in your muscles, for example.

Social contact is also hugely influential for our long-term health. Positive social connections are defined in studies as having people in your life who would be willing to help you if asked. So if you have a network of 25 to 30 people, including friends online, and you are in contact regularly, this can be hugely beneficial for your mental health.

We are seeing increases in levels of sedentary behaviour and poor mental health, and often people avoid exercising at times when it could have the greatest benefit. How can policymakers and stakeholders across healthcare help change the narrative around exercise?

I would say there are two things that we are lacking; firstly, we need to have programmes which are evaluated. From a research point of view, this is one of my next focus areas – we need to understand how such programmes could be made more accessible. For example, how can we effectively encourage people to incorporate small, 15-minute daily habits that are easy to monitor and provide feedback so they can track their progress? I think this level of supervision could especially benefit those suffering from mental ill health.

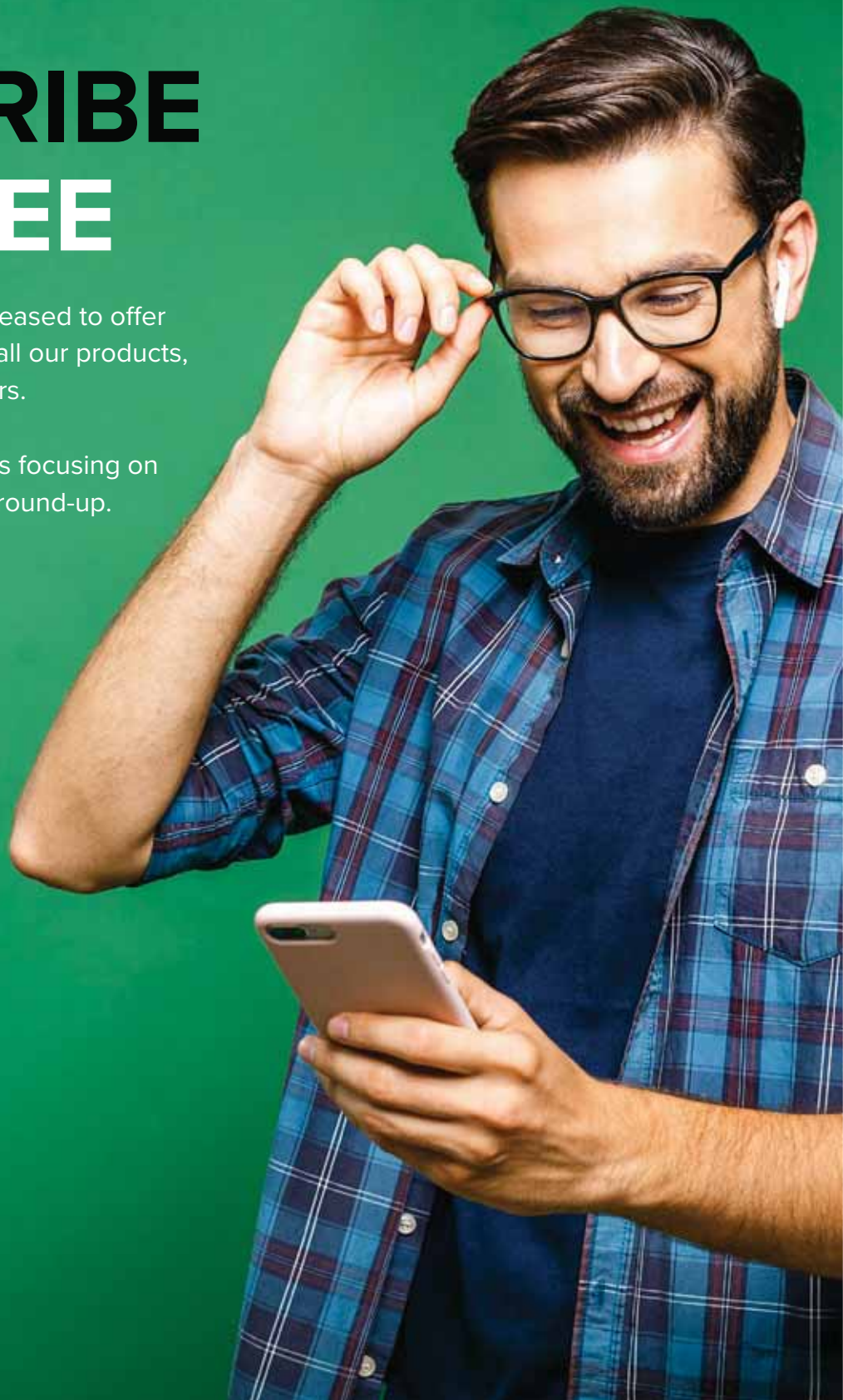
As patients start to recover, very simple changes to their daily routine can make a big difference, so they might have goals or prompts like getting out of bed before 9am, remembering to drink enough fluids, taking their medication or meeting with friends. Social contact is important for people who cannot work because of their mental health and equally for retired people who could benefit from more structure in their day. Lack of routine can be detrimental for people, and I think we need

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HOW THE NATIONAL INSTITUTE ON AGING SUPPORTS PUBLIC HEALTH

As part of its aim to 'extend the healthy, active years of life,' the [NIA](#) leads and supports research efforts to better understand the varying influences and processes that impact mental and physical health as people age. Research covers a broad area of age-related health issues, particularly Alzheimer's disease and dementia, with information disseminated among the public, as well as healthcare professionals and the scientific community.

To reduce the risk of age-related health problems, the NIA shares relevant research and advice on how people can implement healthy lifestyle habits. This could relate to diet, social interaction, cognitive training, and exercise. Exercise is particularly important for older adults, and the NIA recommends four types of exercise comprising endurance, strength, balance, and flexibility.

Earlier this year, an NIH-funded team of researchers shed light on the [connection between the gut microbiome and motivation to exercise](#). The team identified a class of compounds produced by gut microbes called fatty acid amides (FAAs), which results suggested could stimulate sensory neurons and, in turn, lead to increased dopamine levels in the brain during exercise and, therefore, greater motivation. Such findings could help inform public health programmes around exercise.

Understanding health disparities is an essential area of research for the NIA; earlier this year, the National Advisory Council on Aging of the NIA approved a proposed concept for a research and development contract. The contract aims to develop technology to help characterise the exposome in under-resourced populations. This technology is particularly important for studies related to Alzheimer's disease and other forms of dementia. Find out more about it [here](#).

programmes that support people at different phases of their lives – from childhood through to retirement age. For example, we should look at the minimum level of sports in schools that could help prevent depression in later life because we know from large studies that exercise can prevent the condition. When people leave education and have other responsibilities like owning a house, going to work, looking after children etc., exercise becomes secondary; we need health programmes that support people to exercise throughout their lives.

Are there any notable developments or current issues in this area of research that you would like to highlight?

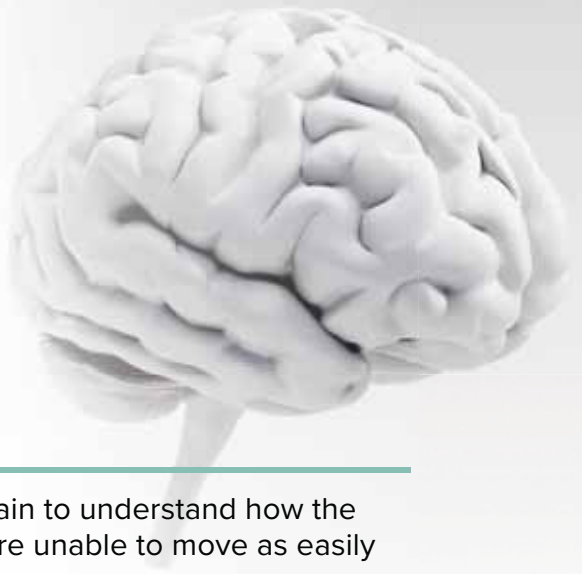
Besides the aforementioned variables, something like a stress ring that can measure your cortisol levels would be beneficial because many people are stressed but have no way of measuring or monitoring their feelings. For me, the next step besides the programmes is about honing in on things like emotional wellbeing or blood pressure and enabling people to monitor those daily. Such interventions must be easy for people to use and not feel overwhelming.

I am interested in understanding why exercise for mental health is beneficial on a molecular level, and this is something my team and I are currently focused on. Once we understand the biology underlining exercise, it is easier to explain the benefits of exercise for mental health to patients. Only 50% of people benefit from exercise, so we need to target and identify that other 50% early on and help them implement changes and decipher what type of exercise and dosage would benefit them.

Prof Dr Med Peter Falkai
President
European Psychiatric Association



HOW BRAIN RESEARCH IS MAKING THE BENEFITS OF REGULAR EXERCISE ACCESSIBLE TO ALL



Robert Wessells from Wayne State University looks to the brain to understand how the benefits of regular exercise can be delivered to those who are unable to move as easily

Exercise is an indispensable part of our daily life to maintain a healthy body and brain across ages. Regular exercise has been shown to reduce the incidence of many age-related diseases, including type-2 diabetes, several types of cancer, heart disease, Alzheimer's and other neurodegenerative diseases.

Regular exercise also preserves healthy function during normal aging, improving quality of life and independence.

However, regular exercise remains inaccessible to portions of the population due to injury, illness, advanced age, or job-enforced sedentary periods.

Therefore, identifying potential exercise mediators or mimetics which can deliver the benefits of exercise to sedentary people would be potentially transformative in reducing disease burden worldwide.

At Wayne State University in Detroit, Michigan, USA, Dr Robert J. (RJ) Wessells and his lab team have used the many genetic tools available for use in fruit flies to identify several single molecules that act as powerful exercise mimetics in the brain and muscle of sedentary flies.

The benefits of regular exercise modelled by a fruit fly

The fruit fly *Drosophila melanogaster* is an excellent model organism to study mechanisms of exercise due to its short lifespan, large sample sizes, and low cost of maintenance. Moreover, about 60% of *Drosophila*'s genes have known human homologs, making genetic discoveries highly likely to be relevant to humans.

To understand how flies respond to exercise, the Wessells group first established an automated exercise device known as the Power Tower that utilizes flies' inherent response to negative geotaxis, an instinctive behaviour to climb upwards after being dropped to the bottom of their vials.

The Power Tower raises a platform full of fly vials up and drops them every 15 seconds. Each drop induces flies to climb up the sides of the vials.

Concurrently, unexercised control flies are placed on the Power Tower, but their climbing is restricted by pushing the foam plug down near the bottom of the vials. After a three-week program of ramped daily training, the endurance and speed of the exercised group is dramatically higher than unexercised controls.

Coordinating a systemic response to regular exercise training

Using this system, the Wessells group identified a specific subset of neurons in the brain that were necessary and sufficient to coordinate a systemic response to regular exercise training.

These neurons are responsible for the synthesis and synaptic release of the invertebrate functional equivalent of norepinephrine, known as octopamine.

In humans, norepinephrine is a well-known player in acute bouts of exercise, where it acts to increase heart rate and blood pressure to ensure sufficient delivery of oxygen to exercising muscles, so the involvement of octopamine in fly exercise was not completely surprising.

However, the idea that this conserved acute response could also be acting to coordinate the long-term systemic response to regular exercise training was unexpected and exciting.

Controlling octopamine production at will

To confirm the central role of octopamine, they next expressed an inducible depolarizing construct specifically in octopaminergic neurons,

making it possible to turn octopamine production on and off at will.

Using this, they performed an experiment in which octopaminergic neurons were activated with the exact time and duration of the flies' normal training program, but without any actual exercise.

Amazingly, this pulsatile release of octopamine in sedentary flies caused the exact same increases in speed, endurance and cardiac performance as that delivered by actual exercise.

Conceptually, this means that, at least in flies, the coordinated response to regular endurance exercise training is completely mediated by a subset of neurons in the brain, and does not absolutely require actual movement to occur, provided the brain can be induced to initiate its normal response to exercise.

What molecules are responding to octopamine in muscle to mediate the benefits of training?

So far, the Wessells group has identified two proteins that are induced by circulating octopamine and can mimic the effects of exercise training when overexpressed in muscle. Each has conserved orthologs or analogs in humans, suggesting that these molecules may serve as promising therapeutics to humans that are unable to exercise because of injury or illness.

These molecules may be promising therapeutics for those unable to exercise:

Sestrin: Sestrins are small stress-activated proteins found from invertebrates to humans. Muscle-specific overexpression of sestrin can boost exercise benefits in unexercised flies, including increased

“Regular exercise has been shown to reduce the incidence of many age-related diseases, including type-2 diabetes, several types of cancer, heart disease, Alzheimer’s and other neurodegenerative diseases.”

speed, endurance, metabolism, autophagy, and mitochondrial respiration. In collaboration with the Lee lab at University of Michigan, requirements for Sestrins during exercise have also been demonstrated in mice. In collaboration with the Todi lab at Wayne State University, they have also shown that Sestrin can preserve mobility in a fly model of the neurodegenerative disease SCA2.

Spargel: spargel is the fly homolog of the well-known mammalian exercise response gene PGC-1 α . Muscle-specific overexpression of spargel can mimic the effects of exercise training on speed, endurance and cardiac performance, and they have recently shown that spargel is sufficient to restore exercise tolerance in a fly model of the mitochondrial disease Barth syndrome.

Having established that the benefits of exercise can be mediated by communication between brain and muscle, the Wessells group is working to identify a safe way of ‘tricking’ the brain into an exercise response in humans. One promising avenue for executing this is with sensory stimulation by virtual reality (VR).

The power of sensory stimulation by virtual reality

VR integrates auditory and visual simulations to deliver an immersive experience to its users while allowing users to retain a sense of identification and control over the virtual environment.

Using a customized virtual environment created by collaborators

at the company 4Experience, the Wessells group has begun pilot experiments to examine whether “virtual” exercise could cause the release of norepinephrine that, if applied safely in a pulsatile fashion, might mimic some of the benefits of exercise. They and others have so far demonstrated that “virtual” exercise can increase heart rate and alter heart rate variability in a way consistent with the activation of norepinephrine.

It remains to be seen whether chronic application of VR stimulation could have the same benefits in humans, and this will be an active area of investigation in the next few years.

If so, they imagine a future in which patients confined to bed rest could use “virtual” exercise to maintain metabolic health and avoid the complications induced by enforced sedentary behavior, a potentially transformative, low-cost change to health care.



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RECORDING AND DECODING NEURAL SIGNALS FROM THE VAGUS NERVE

Dominique M Durand, distinguished Professor of Biomedical Engineering, Case Western Reserve University, Cleveland Ohio, USA, discusses the study of neural signals from the vagus nerve

The vagus nerve is a critical component of the autonomic nervous system, providing sensory input to the brain and controlling the internal organs through its parasympathetic outputs. Autonomic dysfunction has been associated with various chronic diseases such as epilepsy, diabetes, hypertension, and cancer. Vagus-nerve stimulation has been successful in treating many diseases, particularly epilepsy, even though the mechanisms underlying its effectiveness are not well understood. In particular interest is the fact that vagal afferent fibers innervate all the body's organs and carry information about the health and status of these organs. The majority of vagal afferent fibers come from the gut, and abnormal vagal activity has been implicated in eating and metabolic disorders. Therefore, the ability to record and interpret the vagal signals could provide critical insights into the pathophysiology of various diseases and offer potential therapeutic targets.

What have been the issues with the chronic recording of vagal signals?

Chronic recording of vagal signals has been challenging due to the difficulty in recording high-quality signals in small autonomic nerves. Extraneural cuff electrodes have been effective, but they require desheathing of the nerve or have a low signal-to-noise ratio (SNR). Intraneural electrodes have

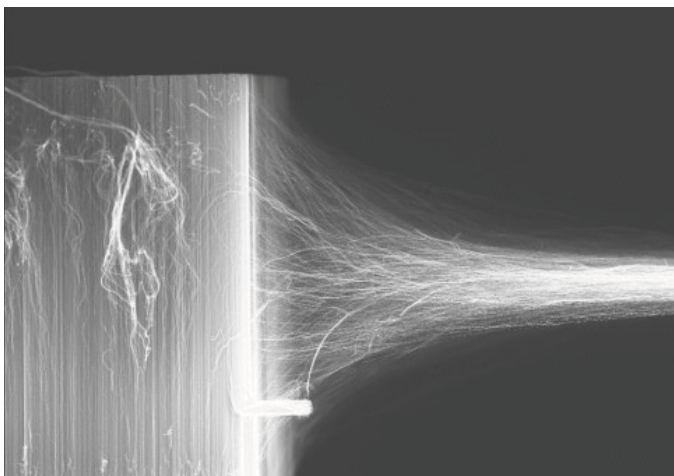


higher SNR but are more invasive and have stability issues, particularly for small autonomic nerves. Carbon nanotube yarn (CNTY) electrodes have been shown to provide a stable, high-SNR interface for chronic recording in small autonomic nerves in rats, with high-quality signals continuing up to four months after implantation^[1,2]. CNTY electrodes are a promising neural interface for interfacing with small peripheral nerves. These electrodes are small, low-impedance, and highly flexible biosensors, which makes them ideal for interfacing with small peripheral nerves. They are more than ten times more flexible than PtIr electrodes of the same diameter, making them highly attractive for use in various applications.

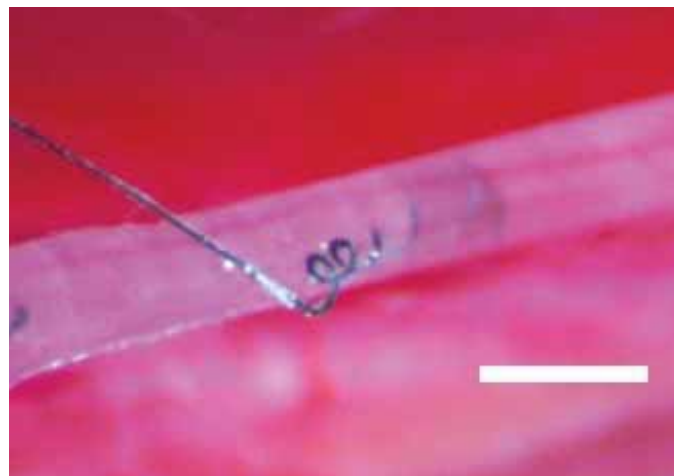
“Vagal tone” indicates overall levels of vagal activity

This technology has allowed for the first direct measurements of vagal tone in freely moving animals.^[3] The vagus nerve is the largest autonomic nerve, innervating every organ in the body. “Vagal tone” is a clinical measure believed to indicate overall levels of vagal activity. Vagal tone is estimated indirectly through the heart rate variability (HRV), and abnormal vagal tone has been associated with many severe conditions such as diabetes, heart failure, and hypertension. However, vagal tone has never been recorded directly, leading to disagreements in its interpretation and influencing the effectiveness of vagal therapies. Using carbon nanotube yard electrodes, we were able to chronically record neural activity from the left cervical vagus in both anesthetized and unanesthetized rats. Here we show that tonic neural activity does not correlate with common HRV metrics with or without anesthesia. Additionally, we found that average vagal activity increases during inspiration compared to expiration; however, this vagal respiratory signal was also not correlated with HRV. This work is a significant step forward in recording technology and advancing our understanding of vagus nerve physiology and behavior.

The ability to continuously record spontaneous vagal-spiking activity



Carbon nano-tubes are twisted to form a yard (bar: 10um)



Carbon nanotube yarns implanted in a rodent vagus nerve.

from awake, freely moving rats for extended periods up to two weeks after implantation is a significant breakthrough in this field. Neural recording was synchronized with a continuous video recording of the subjects, and spike sorting was used to separate semi-distinct spike clusters correlated to animal behavior identified from the video recordings. Interspike interval distributions were found to change in response to food intake, presenting another neural feature that can be used to decode spontaneous vagal activity^[4]. Several spike clusters show tuning to animal eating, and the firing dynamics of multiple decoded spike clusters can be used to classify eating compared to drinking, grooming, and resting behaviors.

Research focuses on using CNTY electrodes for chronic recording in small autonomic nerves

This line of research focuses on using CNTY electrodes for chronic recording in small autonomic nerves, such as the vagus and glossopharyngeal nerves, and for stimulation in larger somatic nerves and fascicles, such as the rat sciatic nerve. The study results demonstrate that CNTY electrodes can be used for the chronic recording small nerves, such as the vagus nerve,

providing the first demonstration that spontaneous, physiologically relevant autonomic signals can be recorded chronically.

In what ways is the vagus nerve important?

The vagus nerve plays a vital role in homeostasis, reflex pathways, and responses to physiological changes. While individual vagal-spiking activity has been recorded from isolated fibers and acute intraneural recordings, this is the first-time neural spikes have been recorded within the vagus nerve in a chronic model. The study demonstrates that various spontaneous and physiologically relevant signals can be recorded from the rat vagus nerve from freely moving animals using CNTY electrodes.

Neural interfaces that allow for stable, high-SNR recordings are necessary for high-fidelity closed-loop control and chronic recording in animal models. The neurotechnology with Carbon Nanotubes Yarns has significant potential for vagus-nerve-stimulation therapy, which is a rapidly growing field with a wide variety of companies and studies investigating its use for the treatment of a wide variety of diseases, including epilepsy, obesity, and heart failure.

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Building a better, safer and more accountable sport system in Canada

The Honourable Pascale St-Onge, Canada's Minister responsible for Sport, shares her vision for a safe and accountable sport system in which Canadian athletes from all walks of life can thrive

Sport has the power to build people and communities up. It improves our physical, mental and emotional health and teaches us invaluable skills, like resilience, teamwork and determination.

But despite its many virtues, sport is not exempt from the ills that afflict other sectors of our society. Cultures of silence, toxic power relations, physical and psychological abuse are, unfortunately also part of the experience for many athletes.

Collectively, we need to tackle these challenges and have the courage to name the issues and put forward the solutions that will help us offer healthy, safe, inclusive and enriching experiences to all our athletes.

While there is no one-stop solution, we must lay the foundations to tackle these problems head-on. This means challenging how things are done and establishing clear standards that we must all abide with to achieve culture change in sport.

Where do we start? Good governance and better accountability from sport organizations, enhancing the athlete voice and promoting better education are key milestones. That work has started.

Greater compliance and accountability

Good governance and corporate transparency are fundamentals for a safer sport system. That's why we are creating a completely new unit at Sport Canada to focus on the compliance and accountability of National Sport Organizations (NSOs). The unit will work with sport organizations and external experts on the development of concrete action plans with clear indicators on governance, safe sport, and athlete representation. Failing to achieve improvements will have escalating repercussions, including financial consequences for sport organizations.

Good governance, the basis of systemic change

Governance issues in sport have made headlines this past year. We have all witnessed the devastating fallout for our athletes when sport organizations have weak or flawed governance structures. Boards of directors are responsible for the proper functioning and integrity of their organizations, and they must be held to account. That's why, going forward, all NSOs will have to comply with new governance standards to be eligible for federal funding. This will mean target requirements for diversity on boards of directors, athlete representation on boards, strict rules around board independence and term limits, and other concrete requirements to improve transparency.

Many of these and other standards are included in the Canadian Sport Governance Code. While some organizations have already adopted some or all of this code, we need greater consistency and compliance at the national level. That's why all NSOs that receive federal funding will be required to fully implement the Code by April 2025.

Better amplification of athletes' voices

We must ensure that our athletes have safe spaces in which to express themselves and we must listen carefully to what they have to say. Amplifying athletes' voices is vital to building a better sport system.

To this end, we are making athlete representation on NSO boards mandatory. Athletes have been asking this for years and we are making it happen. But our athletes need to be well prepared to fully contribute to board decision-making, which is why we will invest in governance training by providing funding to AthletesCAN to enhance athletes' voices within the sport system. We also have created the Sport Canada Athlete Advisory

Committee to give athletes a say in the development of our sport policies.

We must also be sure that athletes and other sport participants are never prevented from disclosing any mistreatment they have experienced or witnessed. That's why, from now on, Sport Canada will prohibit any non-disclosure agreements, NSO contracts, policies, procedures, or actions that could restrict an athlete or a participant's rights, as defined by the Universal Code of Conduct to Prevent and Address Maltreatment in Sport (UCCMS). To enforce fair contractual agreements, NSOs will be mandated to align with the language of the athlete agreement template developed by AthletesCAN.

Better coach certification

Athletes and their parents must be able to count on the fact that NSO coaches are consistently and thoroughly screened. We need to set higher standards for coach certification and selection. To achieve this, we will work with the Coaching Association of Canada to ensure that all coaches hired by our NSOs undergo a rigorous background check and have the appropriate certifications and training, including training to prevent abuse and mistreatment.

Better reporting mechanisms

All athletes and participants in the sport system also need to know their rights and responsibilities so they can identify problematic situations and act. That's why we are investing in the promotion of tools such as the UCCMS.

This is also the *raison d'être* of the Office of the Sport Integrity Commissioner (OSIC), which ensures that national athletes have trusted and independent complaint mechanisms. As of April 1, 2023, all NSOs must be a Program Signatory to the Abuse-Free Sport program, including the services of the OSIC, to receive funding from the Government of Canada. National Multisport Service Organizations and Canadian Olympic and Paralympic Sport Institute Network had until July 1, 2023, to become a Program Signatory.

Public registry of sanctions

The SDRCC is also creating a public registry of individuals who have been sanctioned under the UCCMS. The registry, which will be available within the next year, will apply to all NSOs and all our organizations under OSIC's jurisdiction.



The Honourable Pascale St-Onge

Better access for all

Recognizing the benefits of safe sport, we are also working hard to remove the barriers that Indigenous, Black and racialized communities, 2SLGBTQI+groups, low-income people, newcomers and people living with disabilities face in the world of sport. That's why the Government of Canada supports organized community sport projects that are affordable, accessible, green, and focused on increasing participation in underserved communities.

Sport is integral to building stronger, healthier communities. It should be accessible to and safe for everyone, everywhere in Canada – no matter what.

We are making progress, but we must set our sights high. Our athletes deserve that. These measures are only the foundation on which we can – and will – build a stronger, better sport system for all. So now, we keep working.

The Honourable Pascale St-Onge
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 for the Regions of Quebec
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INJURY PREVENTION RESEARCH: REDUCING YOUTH SPORT-RELATED INJURIES

Dr Carolyn Emery, Chair Sport Injury Prevention Research Centre, Faculty of Kinesiology and Cumming School of Medicine, University of Calgary, highlights injury prevention research in informing best practices and policies to reduce the burden of sport-related injuries and concussions in youth sports

Sports are a natural and beneficial part of childhood and adolescence and create some of the most lasting memories of childhood, including friends, successes, and experiences. Yet every day, youth are at risk of sport-related injury, often without being aware of the risk or the strategies that could protect them. Unintentional injuries are the leading cause of disability in youth (ages 10-19), with >50% sport-related.⁽¹⁾ One in 3 youth will seek medical attention for a sport-related injury and 1 in 10 for a concussion each year.⁽²⁾ Injury leads to reduced physical activity and increased risk of chronic disease and obesity, which has risen ~20% in the past decade.⁽³⁾ Consequences of injury may include post-traumatic osteoarthritis, persistent post-concussive symptoms, functional deficits, mental health impact, and economic costs.⁽⁴⁾ A significant paradigm shift from the current focus of managing health away from treatment and towards prevention is critical to improving the health and quality of life of all youth.

Prevention is the best medicine, and evidence-informed primary injury prevention solutions can ensure lifelong sport participation and all the associated health benefits. Promoting a healthy and active future for youth through sports injury prevention research and knowledge translation will reduce the public health burden of sport-related injuries and their consequences. The [Sport Injury Prevention Research Centre \(SIPRC\)](#)



at the University of Calgary is one of 11 [International Olympic Committee Research Centres for Injury Prevention and Protection of Athlete Health](#). The vision of SIPRC is the elimination of injuries and their consequences that prevent youth from lifelong participation in sport. Strong epidemiological approaches, validated injury surveillance methods (i.e., [SHRed Concussions – Surveillance in High Schools and Community Sport to Reduce Concussions/Injuries](#)), and transdisciplinary collaboration (e.g., biomechanics, physiology, psychology, sport-medicine, physiotherapy) are core to the evaluation of novel, effective, and sustainable primary injury prevention strategies. Strategies may include sport policy/rules changes, training interventions, personal protective equipment, and wearable technologies. In Canada and many other countries, some of the most vulnerable youth live in rural and Indigenous communities and/or with



Carolyn Emery

disabilities. Injury prevention research and evidence-informed programs should also reach these communities as done using the [SHRed Mobile](#) to engage all vulnerable youth communities.

Sports rules/policy changes to reduce injuries

While ice hockey is one of the most popular winter sports in many countries, the burden of injuries and concussions is high in young players. Evidence-informed policy change disallowing body checking in games in 11-12-year-old leagues in Canada and the USA was based on 4-fold higher

rates of concussion in leagues allowing body checking. Prospective evaluation of this national policy change confirmed a >50% reduction in injury and concussion rates (translating to >8000 injuries saved annually in Canada).⁽⁵⁾ Further, body-checking policy changes in adolescent (13-17 years) non-elite leagues have had a similar impact.⁽⁶⁾ This research informs evaluation of policy/rule changes aimed to reduce injuries in other youth collision sports (e.g., tackle football, rugby union, lacrosse), including reduced contact practices, level of the tackle, and age of implementation of collision techniques (e.g. tackle) in competition.

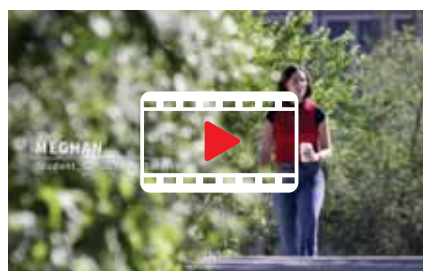
Training strategies to prevent sports injuries

SIPRC research has focused on the evaluation of neuromuscular training (NMT) warm-up programs (including balance, strength, and agility components) for >20 years. NMT warm-ups effectively reduce injury rates by >35% in youth team sports with significant healthcare cost savings.^(7,8) A 46% lower injury rate was also found for girls when NMT was introduced in physical education classes.⁽⁹⁾ The effectiveness of such programs in reducing concussion rates, specifically in youth sports, is promising, and evaluation is ongoing. Other training-related strategies include modification of training load during rapid growth periods for youth, reconsideration of early sport specialization, and grouping youth athletes based on growth and development rather than chronological age. Training approaches to reduce head impacts and weekly training loads for youth are also being evaluated. Tackle training strategies to optimize tackle proficiency and reduce injury rates are also a key focus in tackle-related youth sports.

Personal protective equipment and wearable technologies

Personal protective equipment (e.g., mouthguards, helmet fit) and wearable technologies (e.g., jump load monitoring and instrumented mouthguards with video analysis) can play a significant role in injury prevention in youth sports. For example, we have demonstrated the effectiveness of mouthguards in reducing the odds of concussion by 58% in youth ice hockey players.⁽¹⁰⁾ Combining wearables technologies, video analysis, and injury surveillance is key for evaluating load modification (e.g., jump, head impacts) and rules (e.g., rugby tackle height, zero-tolerance for head contact) in youth sports.

The best injury is the one that never happens. The [Sport Injury Prevention Research Centre](#), [Calgary Adapted Hub](#), and [Canadian Concussion Network](#) bring together researchers, clinicians, industry, and community stakeholders to address this epidemic of youth sport-related injury. Such networks are critical in optimizing evidence-informed best practices and policies to reduce the burden of sport-related injuries in youth. Let's all work together to promote safe and lifelong sports for generations of youth to come.




Acknowledgements: SIPRC is an [International Olympic Committee \(IOC\) Centre for Prevention of Injury and Protection of Athlete Health](#). I acknowledge the shared vision for injury prevention in youth sport from funding sources including the [IOC](#), [Canadian Institutes of Health Research](#), [Canada Research Chairs Program](#), [Canada Foundation for Innovation](#), [Alberta Innovates](#), [National Football League Play Smart Play Safe Program](#), [National Basketball Association/General Electric Partnership](#), [World Rugby](#), and [Joan Snyder](#). Thank you to the youth sport participants, parents, coaches, teachers, referees, administrators, and clinicians that support a shared vision for reducing the burden of injuries in youth sport.

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How Japan prioritises preventative care

We discuss healthcare in Japan, from its early adoption of universal healthcare to its vision for a health system that is fit for the future

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Japan's high life expectancy has long been a subject of curiosity and inspiration for other countries around the world. According to Japan's Ministry of Health, Labour and Welfare, the average life expectancy in Japan in 2021 was 87.57 years for women and 81.47 years for men, one of the highest in the world. This is predominantly due to the country's early adoption of universal healthcare and emphasis on preventative care. In contrast to many other developed nations, Japan boasts remarkably low mortality rates from ischemic heart disease and cancer, which is thought to be attributable to the country's low

levels of obesity (4.8% for men and 3.7% for women) and higher consumption of plant-based foods, fish - specifically n-3 polyunsaturated fatty acids - and non-sweetened beverages like green tea. ⁽¹⁾

Universal healthcare in Japan

According to Tatsuya Kondo, Japan's healthcare system "focuses on providing treatment and care based on "patient-centeredness", prioritizing the provision of rational medicine to patients as a team under the initiative of medical doctors. ⁽²⁾

In 1961, Japan implemented the National Health Insurance (NHI) system to enable universal health coverage for medical care funded by taxes and individual contributions. While copayment rates were initially variable and meant some had to pay up to 50% of the scheduled fee for all services and medications, over the years, rates have gradually declined, and patients generally accept responsibility for up to 30% of medical and pharmaceutical costs while the government pays the remaining 70%. Some Japanese residents have additional private health insurance to supplement their universal health insurance, such as for extensive medical or long-term care. Children and low-income older adults have lower coinsurance rates.

Japan's universal healthcare insurance system has been applauded for helping to reduce healthcare inequities and enable people to access the most appropriate care at costs they can afford. A government committee sets fees, and all residents in the country for more than three months are required by law to register for health insurance. Individuals who do not have insurance provided by their employer may enrol in a health insurance programme that is run by local governments. In Japan, the National Health Insurance and Employee Insurance plans cover medical appointments and procedures related to illness, injury, and dental care. What's more, patients have the freedom to choose their preferred physicians or facilities and hospitals must also operate as non-profit organisations and are overseen by medical professionals.

The Japanese government has taken steps to improve healthcare services throughout the country by increasing the number of medical schools, particularly in rural areas. This initiative aims to address the shortage of physicians and improve the quality of healthcare services. The universal healthcare reimbursement system evaluates the services provided by each facility to further promote equal access to high-quality care across the country. ⁽²⁾ Small regional differences in the mortality rate for ischemic cerebral infarction and the high five-year survival rate of all carcinomas reflect government efforts to balance standards of care. ⁽²⁾

Supporting global health

Promoting universal health coverage globally has been an important objective for Japan's government. In 2015, it announced the 'Basic Design for Peace and Health', which functions as a guideline for Global Health policy under the Development Cooperation Charter. It comprises three basic policies that reflect Japan's commitment to strengthening global health, including establishing resilient health systems and governance that can respond to public health emergencies and disasters, promoting seamless utilisation of essential health services and universal healthcare and leveraging Japanese expertise, experience, and medical products and technology. The Basic Design for Peace and Health further supports the 2030 Agenda for Sustainable Development of ensuring that good health and wellbeing are achievable for all. Japan released a revised [Development Cooperation Charter](#) earlier this year.

Prioritising the promotion of universal health coverage has been a significant theme at summit-level meetings. The government has endeavoured to push this agenda forward, supporting the establishment of universal healthcare in Africa, Asia, and other regions alongside the international community and organisations. Following a high-level forum on universal healthcare co-hosted by Japan in 2017, government leaders from over 30 countries and representatives and experts from international organisations adopted the [Tokyo Declaration on UHC](#), outlining their commitment to accelerate efforts to achieve universal health coverage by 2030.

Japan's focus on achieving more resilient, equitable, and sustainable health systems was reiterated last May when the Kishida administration announced its new Global Health Strategy based on the experience of responding to the spread of COVID-19. The guidelines aim to assist in developing global health infrastructure and strengthening healthcare systems so they are better prepared for public health emergencies.

At this year's G7 summit hosted by Japan, ministers announced an [eight-point action plan to realise universal](#)

DEVELOPMENT OF A NEW GENE THERAPY DRUG AS A TREATMENT FOR HYPOPHOSPHATASIA

The current primary treatment for hypophosphatasia is enzyme replacement therapy however the development of a new gene therapy drug, ARU-2801, may change the landscape forever

Understanding hypophosphatasia

Hypophosphatasia (HPP) is a rare bone disease caused by mutations in the *ALPL* gene, which encodes tissue-nonspecific alkaline phosphatase (TNALP).

Patients can present with the following:

- Decreased serum ALP activity
- Hypocalcification of systemic bone
- Deformity of long bones
- Irregularity of the ends of the diaphysis
- Poor weight gain
- Seizures

Symptoms range from mild to severe depending on the patient and are classified into six types according to the age of onset: perinatal lethal form, perinatal benign form, infantile form, childhood form, adult form, and odontohypophosphatasia.

If untreated, almost all patients with the perinatal lethal form and about half of those with the infantile form will die.

The prognosis for other forms of the disease is good, but a variety of symptoms that can affect daily life can occur in all forms.

The current primary treatment for hypophosphatasia is enzyme replacement therapy. This method requires subcutaneous injections of enzymes 3-6 times a week, and the associated inflammatory reactions at the injection site can be problematic.

Gene therapy research for HPP

We have been studying gene therapy for HPP for many years and have tried a number of methods for treatment, such as:

- Intravenous administration of lentiviral vectors or adeno-associated virus (AAV) vectors expressing TNALP
- Intrauterine fetal administration of AAV vectors
- Transplantation of hematopoietic stem cells transduced with lentiviral vectors
- Intramuscular administration of AAV vectors
- Treating HPP infantile model mice lacking the *Alpl* gene (*Alpl*^{-/-} mice), therapeutic effects such as prolongation of survival and improvement of bone formation have been observed.

Table 1 summarizes the gene therapy studies to date. Our results indicate that gene therapy is feasible for all types

of hypophosphatasia, from perinatal to adult and odontohypophosphatasia.

Among these therapies, we are developing an intramuscularly administered TNALP-D10-expressing AAV type 8 vector (ARU-2801), which we believe to be the simplest and safest therapy for HPP.

Development of gene therapy drug (ARU-2801)

The ARU-2801 is a gene therapy drug that incorporates TNALP with bone affinity by binding D10 to the catalytic domain of human TNALP in an AAV vector.

The TTP (Target Product Profile) of ARU-2801 is shown in Table 2, and we believe that the development of ARU-2801 will provide long-term sustained efficacy with a single safe treatment and will be of great benefit to patients with HPP in terms of both ADL and quality of life.

Efficacy of ARU-2801

To evaluate the efficacy of ARU-2801 against HPP, we administered a single intramuscular dose of ARU-2801 to neonatal *Alpl*^{+/-} mice and followed their plasma ALP activity, survival, and bone formation over an 18-month period. Plasma ALP activity was around 10 U/ml over a long period (18 months).

Untreated HPP mice died within 3 weeks, whereas ARU-2801-treated mice

Table 1. Gene Therapy Research for Hypophosphatasia

Animal	Vector	Route	Dose (/body)	Target type
<i>Alpl</i> ^{-/-} mouse	lentiviral	IV	5x10 ⁷ TU	Infantile form
<i>Alpl</i> ^{-/-} mouse	AAV8	IV	5x10 ⁹ ~5x10 ¹¹ vg	Infantile form
<i>Alpl</i> ^{-/-} mouse	AAV9	IU	2x10 ¹¹ vg	Perinatal form
<i>Alpl</i> ^{-/-} mouse	lentiviral	BMT	1x10 ⁶ cells	Infantile form
<i>Alpl</i> ^{-/-} mouse	AAV8	IM	1x10 ¹¹ ~1x10 ¹² vg	Infantile form
<i>Alpl</i> ^{-/-} mouse	AAV8	IM	3x10 ¹¹ vg	Infantile form /odontohypophosphatasia
<i>Alpl</i> ^{P^{rx1}/P^{rx1}} mouse	AAV8	IM	3x10 ¹¹ vg	Adult form /odontohypophosphatasia

TU: Transduction Unit, vg: vector genome, IV: Intravenous, IU: Intrauterine, BMT: Bone marrow transplantation, IM: Intramuscular

Table 2. TPP (Target Product Profile) of ARU-2801

Name of investigational candidate	AAV type 8 vector expressing TNALP-D10 (ARU-2801)
Pharmaceutical classification	Investigational regenerative medical product (Gene therapy drug)
Administration	One time treatment, via intramuscular injection
Potential efficacy	Life-prolonging effect and improvement of various symptoms in HPP Improving ADL, and QOL in patients with HPP
Current therapies	Bone marrow transplantation, Enzyme replacement therapy, Cell therapy (MSC transplantation, under investigation)
Potential benefits over existing treatments	Deliver potentially curative and durable efficacy without the limitations of chronic administration

survived longer and showed weight gain, bone formation, and bone mineral density comparable to wild type control mice.

In addition, intramuscular administration of ARU-2801 also improved alveolar bone, indicating that ARU-2801 is useful for the odontohypophosphatasia. Furthermore, in *Alpl*^{P^{rx1}/P^{rx1}} mice, a late-onset (adult-type) HPP model, intramuscular administration of ARU-2801 also improved alveolar bone.

These results suggest that a single intramuscular administration of ARU-2801 provides a therapeutic effect in all forms of hypophosphatasia.

Examining the safety of ARU-2801

The safety of ARU-2801 was examined in *Alpl*^{-/-} mice and non-human primates (NHPs) by administering a single intramuscular dose of ARU-2801.

Biodistribution of ARU-2801

Quantitative PCR analysis of the distribution of ARU-2801 in each organ showed that ARU-2801 was detected in the muscle of the administration side and in the skin of the administration site, but not in other organs.

Examination of tumor formation and carcinogenesis

No evidence of tumor formation or

carcinogenesis was observed at necropsy, CT scan, or histopathology in both *Alpl*^{-/-} mice and NHPs that were administered intramuscularly.

Immunotoxicity

No increase in ALT or AST, thrombocytopenia, anemia, or renal dysfunction was observed in *Alpl*^{-/-} mice or NHPs treated with ARU-2801 intramuscularly during the observation period, and antibodies to TNALP-D10, a therapeutic protein, were produced after treatment with ARU-2801, and a temporary decrease in TNALP was observed, but no serious side effects were observed.

General toxicity

No abnormal calcification was observed in primates in gross findings, radiological examination, CT scan, and Von Kossa staining. No abnormal findings were observed in biochemical tests, including liver function, renal function, and Ca levels.

What does the future hold concerning the treatment for hypophosphatasia

As described above, ARU-2801 treatment for hypophosphatasia has been shown to be effective and safe in HPP mice and primates, and the single intramuscular administration of ARU-2801 avoids the adverse events reported in recent years with intravenous administration of AAV vectors.

ARU-2801 has been shown to be effective not only in prolonging the life of patients with hypophosphatasia, but also in improving ADL, and quality of life. We are now preparing for the clinical trial of ARU-2801. We hope that ARU-2801 will be available to patients with hypophosphatasia as soon as possible.

FOUNDING: This work was supported by JSPS KAKENHI Grant Numbers 15K09605 and 20K08268, and is supported by AMED under Grant Number JP23ek0109670.

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ACHIEVING INCLUSIVE GLOBAL COOPERATION

The COVID-19 pandemic forced the international community to acknowledge that global public health issues can only be tackled effectively when governments work together. As the world moves towards a state of post-pandemic recovery, global health governance is now focused on how countries can share knowledge and expertise to achieve health and wellbeing for all citizens, in line with the Sustainable Development Goals. However, as countries gathered for the 76th World Health Assembly (WHA) earlier this year, efforts to promote international inclusivity were undermined as Taiwan's request to join the annual meeting was denied.

As WHO members, twelve of Taiwan's diplomatic allies put forth a proposal to invite Taiwan as an observer to participate in the WHA. However, increased pressure from China that Taiwan can only participate in the international meeting if it accepts China's sovereignty led to Taiwan being unable to attend the meeting as an observer.

The decision of the WHA was welcomed by China's Ministry of Foreign Affairs, who stated that nearly 100 countries supported its "one China principle" and opposed the involvement of Taiwan. The Ministry of Foreign Affairs, Republic of China (Taiwan) (MOFA) said its participation was meaningful given Taiwan's "active contributions to the world's health security over the past several decades, including its sharing of medical expertise and provision of anti-pandemic supplies during the COVID-19 pandemic" and that its participation in the WHA is a "global public health issue" for which "politics should not be allowed to take precedence over professionalism."

Reflecting on Taiwan's efforts to mitigate the spread of the coronavirus, Dr Hsueh Jui-yuan, Minister of Health and Welfare of the Republic of China (Taiwan), said the country had ranked sixth lowest in COVID-19 mortality and case-fatality rates when compared with 38 Organisation for Economic Co-operation and Development Member States and Singapore. Taiwan also achieved impressive rankings in terms of COVID-19 vaccination rates. It ranked fourth in coverage rates for at least one vaccine dose and third in administering vaccine boosters. The minister also reflected on Taiwan's achievements in "maintaining an inclusive and equitable universal health coverage system" and its efforts to support the international agenda for realising the Sustainable Development Goals through sharing "its experience in creating a cross-sectoral, innovative, and people-centred health approach to help the international community."

Taiwan had observer status at the WHO from 2009 until 2016. China's ongoing attempt to isolate Taiwan from the global community includes preventing Taiwan's participation in global organisations. According to the Chinese government, Taiwan is considered a province of China, and they are opposed to any agreements that enhance Taiwan's independence. MOFA said "[r]epresentatives on the Chinese side inappropriately linked the resolutions to Beijing's so-called "one China principle". It added that China's obstruction "runs counter to the estimable goal of "Health for All" enshrined in the WHO Constitution" and it pleaded with the WHO to accept its participation in WHO meetings and events.

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[health coverage](#) for all people by 2030. Strengthening global cooperation and learning from the COVID-19 pandemic was central to this year's summit; health ministers from the group of seven major countries said they would work collaboratively to ensure rapid and equitable access to vital medical supplies, including vaccines. There was a call for an international framework and more sustainable funding to support the response to future public health crises, including narrowing gaps between LMICs and high-income countries.

“Japan boasts remarkably low mortality rates from ischemic heart disease and cancer, which is thought to be attributable to the country’s low levels of obesity (4.8% for men and 3.7% for women)...”

Japanese Health Minister Katsunobu Kato, who chaired the Nagasaki meeting, told a news conference, “We agreed that each country will work promptly to build a system to improve access to pharmaceutical products.”⁽³⁾

Adapting health systems for today’s society

The government has adopted several reforms in the past two decades to help manage increasing healthcare expenditures and changing demands, including the Long-term Care Insurance System (2000), the Integrated Community Care System (2006), The Comprehensive Reform of Society Security and Tax (2010); and the Regional Healthcare Vision (2014).

Recently, the Ministry of Health, Labour and Welfare launched [Japan Vision: Health Care 2035](#) – Japan’s vision for a ‘sustainable health care system that delivers unmatched health outcomes through care that is responsive and equitable to each member of society and that contributes to prosperity in Japan and around the world.’⁽⁴⁾ This paradigm shift in Japan’s healthcare provision is centred on three main pillars of reform: lean healthcare (implement value-based healthcare), life design (empower society and support personal choice) and global health leader (lead and contribute to global

health). It also emphasises principles of fairness, solidarity built on autonomy and shared prosperity of Japan and the world.⁽⁵⁾

Japan’s commitment to preventative, high-quality care has afforded Japanese citizens a better quality of life and has been recognised as a positive approach internationally. However, as in many countries, demographic changes and slow economic growth mean Japan’s health system must adapt to changing demands and healthcare needs. Reforms across healthcare and other sectors are necessary for the government to realise its vision of low-cost, equitable health systems that can suitably support society today and in the future.

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KNEE PAIN AND OSTEOARTHRITIS (KNEE OA) TREATMENT RESEARCH

Professor Shaw-Ruey Lyu from the School of Medicine, Tzu-Chi University, discusses Knee Pain and Osteoarthritis (Knee OA) Treatment Research, in particular Knee Health Promotion Option (KHPO)

Starting from 2002, I conducted a series of studies^(1-3,5,6,8,9) to investigate medial abrasion phenomenon (MAP) as a cause of knee OA. I found a high correlation between medial plica-related MAP and knee OA. MAP would elicit lifelong interplay between a pathologic medial plica and the facing medial femoral condyle, and therefore plays a role in the pathogenesis of knee OA both physically and chemically.^(10,11,13) Consequently, I have developed the procedures of arthroscopic medial release (AMR)⁽⁴⁾ and the concept of arthroscopic cartilage regeneration facilitating procedure (ACRFP)^(7,15) for the treatment of knee OA. Moreover, the concurrent execution of the removal of MAP and conventional surgical procedures such as osteotomy or arthroplasty could lead to better outcomes.⁽¹⁴⁾ The clinical applications of this concept at our practice have won positive patient feedback which led me to develop in 2009 a multidisciplinary treatment option, which I called the “knee health promotion option (KHPO)⁽¹²⁾”, for the comprehensive management of knee OA from prevention to treatment based on my discovery that MAS is a cause of knee OA. While not entirely in agreement with the traditionally and commonly accepted treatment guidelines and protocols issued by major governing bodies, our treatment has been wildly

successful clinically as evidenced by the long line of patients on the waiting list to be seen at our clinic. My protocol and my arthroscopic surgery have so far successfully treated thousands of knee OA patients, saving them from knee replacements that otherwise ensue under the traditional treatment protocol.

The ‘Knee Health Promotion Option’ conceptualization

In the early 2000, I accidentally found the ‘hidden lesions’ related to the medial abrasion phenomenon (MAP) caused by the medial plica in the knee of a knee OA patient. After some investigations of the hidden lesions^(1-3,5,6,8,9) I designed a novel arthroscopic medial release technique to remove the MAP and cured some knee OA patients.⁽⁴⁾ These surprising events persuaded me to design more studies to investigate the relationship of MAP with knee OA. And, in 2012, I published the technique and its outcome of a novel concept of the arthroscopic cartilage regeneration facilitating procedure (ACRFP).⁽⁷⁾ This concept emphasizes that the three sequelae of MAP: inflammation, focal abrasion, and increased static pressure between cartilage will cause damage to the cartilage. A timely ACRFP to remove these three detrimental factors from the knee cavity could make it hospitable for cartilage to

regenerate.⁽¹⁵⁾ Based on this theory, KHPO was conceptualized to provide comprehensive management of knee OA by smart knee care for prevention in early-stage OA, preservation arthroplasty for cure in moderate-stage OA, and precision total knee replacement for salvage in late-stage OA.⁽¹²⁾

Five keyways you can look after your knees and avoid Knee Pain and Osteoarthritic change

- To renew your knowledge that knee OA is not an irreversible degenerative process, rather, it is preventable and curable.
- To realize that the three sequelae of MAP: focal abrasion, inflammation, and therefore increased static pressure between cartilage are the main causes of cartilage damage.
- After understanding the mechanism of how MAP damages cartilage and causes pain, you can employ smart knee care to avoid knee pain and modify the natural course of knee OA.
- The first part of smart knee care is to modify daily activities to avoid MAP by decreasing the frequency, speed, and time of bending the knee.
- The second part of smart knee care is to do 3 easy home exercises to

New Hope for Knee OA



increase muscle strength around the knee and increase flexibility of the knee to decrease static pressure between cartilage: leg raise, knee hug, and knee press

Motivations for research on Knee Pain and Osteoarthritis

Although knee OA is a common progressive musculoskeletal condition and remains an immense public health concern worldwide, its pathophysiology is not well understood. A lot of work has been put into searching for the etiologic factors of knee OA and multiple hypotheses have been proposed, but still there is not a clear understanding of its natural course. Based on those hypotheses, a wide variety of treatments have been developed, such as pharmacological therapy, biologic intra-articular injection therapies (e.g., platelet-rich plasma, cell-based treatment options including bone marrow mesenchymal stem cells and autologous adipose stem cells), weight-shifting modalities (e.g., knee brace, wedge insole), or surgical procedures (e.g., arthroscopic debridement, microfracture, corrective osteotomy, autologous or allogeneic cartilage transplantation, and chondrocyte transplantation). But all such proposed treatments provide only symptomatic relief rather than preventative or regenerative outcomes, and they may eventually lead the sufferers to total knee arthroplasty. The inconsistency and inconclusiveness

of these treatments in demonstrating disease modification in the process of chondral degradation are due to a lack of understanding of the initiating events that result in cartilage degradation.

Having some experience in treating complications of knee replacement that make old patients lead miserable daily living for the rest of their lives, I decided to search for the cause of knee OA and create an alternative, novel treatment for knee OA so that patients may be more likely to keep their natural knees while their knee pains are relieved and their quality of life improved.

Upcoming Knee Pain and Osteoarthritis projects in 2024

My upcoming Knee Pain and Osteoarthritis projects in 2024 include a prospective study to compare the outcome of ACRFP and ACRFP + cell therapy. Another is the development of a wearable device system to assist the implementation of smart knee care for the prevention of knee OA. A third will be the promotion of KHPO to the global society.

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Acknowledgment: Publication of the present article was supported by the [BIONET Corp.](#)



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Emerging remote patient monitoring solutions – ‘virtually’ re-wiring the hospital ward of the future

As virtual wards become more prevalent, technology-enabled care solutions will become increasingly important. Kelly Bevington, Principal Category Manager for IT and Digital Procurement Frameworks at NHS Shared Business Services (NHS SBS), explains remote patient monitoring solutions



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Amongst the many legacies left by the coronavirus pandemic is a backlog of patient appointments, likely to continue for some time – but, remote patient monitoring solutions could help!

With 19 out of 20 hospital beds taken and 14,000 being occupied by someone clinically ready to leave but unable to be discharged to the appropriate care setting, NHS England (NHSE) has, in its [delivery plan for recovering urgent and emergency care services](#), stated its ambition to “improve to 76% of patients being admitted, transferred or discharged within four hours by March 2024”.

The plan sees virtual wards as important in expanding capacity by joining-up health and care outside the hospital.

Virtual wards combine technology and remote monitoring with advice, diagnostics, and treatment to allow hospital-level care at the patient’s place of residence.

Designed to replace admissions and facilitate discharges, they are considered a safe and efficient alternative to hospital care, particularly for frail and elderly patients.

Some of the core technology-enabled care (TEC) solutions facilitating virtual wards and care include:

Remote clinical monitoring solutions

Remote clinical monitoring platforms and services connect to vital sign devices that aid in the monitoring, reporting, and analysing of a patient's acute or chronic condition from outside the hospital, for instance, blood pressure or blood glucose levels. As a result, they facilitate real-time understanding of a patient's disease state, enabling clinical decisions to be made.

Alarm receiving centre platforms

These software platforms allow the remote connection of telecare and telehealth devices - for example, movement sensors which aid in the detection of falls, raising an alarm if unusual activity is detected, or pill dispensers which release medication at the appropriate time, triggering an alarm if it is not removed from the dispenser.

Digital alarm services and peripherals (social alarms)

These support independence by facilitating automatic and remote non-clinical monitoring of individuals using a combination of behavioural and environmental sensors, alarms or other means linked to a communications device.

Social alarms include pendants that users can activate to call for assistance in urgent situations through wireless systems that detect possible problems with smoke or gas. Sensors automatically raise an alarm alerting a monitoring centre which contacts a carer.

Intelligent activity monitoring

A non-intrusive system of sensors, machine learning and automatic data communication which monitor activities of daily living and detect deviations from previous patterns is crucial to assessing the ability of an individual to live independently in their community and the early detection of upcoming critical situations. Moreover, the data generated can capture insights that pre-empt longer-term subtle behavioural changes.

WHAT SCOPE DO VIRTUAL WARDS AND REMOTE CARE OFFER IN MITIGATING CARE BACKLOGS AND ED PRESSURES?

In recent years, the NHS has faced mounting demands and hospital admissions coupled with an unprecedented workforce shortage and an increasingly fragile social care system. All this has been compounded by the COVID-19 pandemic.

A rapidly ageing population in need of care, and patients with increasingly complex needs led to the government launching an urgent and emergency care plan in January this year. Following positive results from virtual wards already rolled out, the NHS announced plans to tackle wait times for emergency care by offering tailored support to older adults and vulnerable patients at home. Part of the new plan would see the scaling up of community services (with up to 50,000 people per month treated at home) and urgent community response teams supporting patients at home within two hours.

Reflecting on the benefits of the plan, Health and Social Care Secretary [Steve Barclay said](#): "Up to 20% of hospital admissions are avoidable with the right care in place. By expanding the care provided in the community, the most vulnerable, frail, and elderly patients can be better supported to continue living independently or recover at home."

Though at home care is nothing new, policymakers want to scale up digital infrastructure to improve and diversify care delivery, enabling patients to be monitored and treated safely at home. The NHS has since been working with industry partners to implement new technologies that support patients with conditions including diabetes and respiratory disease.

References

1. <https://www.gov.uk/government/news/nhs-to-expand-services-to-keep-vulnerable-out-of-hospital>

TAILOR-MADE PROMOTION

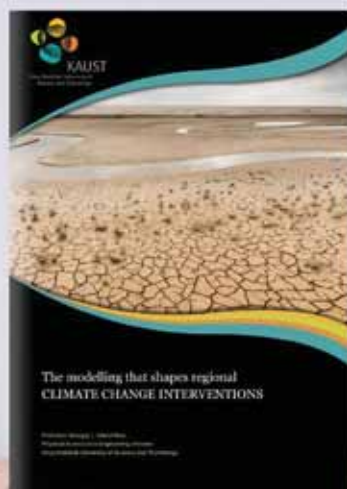
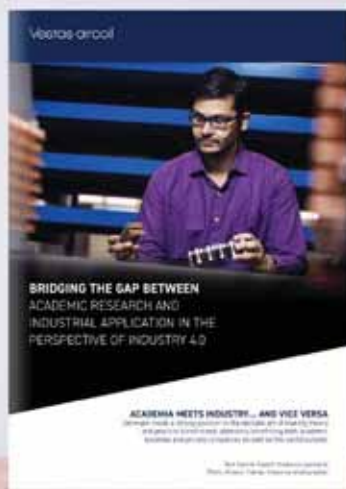
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Patient controlled personalised healthcare records

These allow individuals to access their healthcare records and related data in one place. The supplier solutions complement the NHS app and can empower users to add, access and share their health information with healthcare professionals in various settings.

NHSE recognises the potential of technology-enabled care services to transform how people engage in and control their healthcare. It believes that by embracing this technology, the NHS can empower millions of patients to own their care and transform how it plans and delivers services to create a sustainable NHS for the future.

As part of this, Integrated Care Systems (ICSs) are expected to deliver [virtual ward capacity equivalent to 40-50 virtual ward beds](#) per 100,000 people by December 2023, with virtual ward services developed across ICSs and provider collaboratives, rather than individual institutions to improve health and integrated care across the health and care system.

ICSs bring together providers and commissioners of NHS services like hospitals and GP practices, local authorities and other partners (including charities, voluntary, community and social enterprise organisations) to collectively plan and deliver health and care services to meet the needs of their respective populations.

Enabling ICSs to acquire remote patient monitoring solutions

To enable ICSs to acquire remote patient monitoring solutions that can reduce the burden on the health and care system at pace, compliantly and cost-effectively, NHS SBS has, in collaboration with NHSE's Transformation Directorate, local authorities, national technology-enabled care (TEC) policymakers like TEC Cymru, as well as industry bodies including the TSA (TEC Services Association), designed the [Technology Enabled Care Services 2](#) procurement framework agreement.

Comprising services endorsed as recommended routes to market by NHSE and free to access, it focuses on three key themes: remote clinical monitoring, patient empowerment and social care monitoring.

As virtual wards continue to expand and become more prevalent, technology-enabled care solutions are likely to become increasingly important in delivering effective and efficient care for patients.

“NHSE recognises the potential of technology-enabled care services to transform how people engage in and control their healthcare.”

In the longer term, as advances are made in point of care diagnostics and remote monitoring, [NHSE](#) expects virtual wards to be a standard alternative to acute care in hospitals across a range of conditions.

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Virtual care is the new standard in healthcare innovation in

Professor Sultan Mahmud, Director of Healthcare at BT explores the latest virtual care NHS strategy, which BT is helping to deliver safely with the adoption of virtual wards

In the face of budget challenges and staffing shortages, the National Health Service (NHS) is confronted with a distinctive set of hurdles. With an [ageing population](#), mounting [waiting](#) and [discharge](#) lists due to the impact of the COVID-19 pandemic, and an increasing number of individuals living with long-term health conditions, the pressure on the NHS has reached unprecedented levels. However, recent research from BT reveals [74% of NHS staff believe](#) technology and virtual care can play a pivotal role in delivering superior quality care. But harnessing technology's potential extends far beyond cables and infrastructure.

Technology has the power to connect for good and the NHS is ushering in a new era of innovative, patient-centred care. BT, as a trusted long-term partner, is working alongside the NHS to help build smarter, safer, and more efficient services. With a heritage of innovation, BT is harnessing its experience and capabilities to co-create and safely scale new ideas and approaches that deliver enhanced patient outcomes and address frontline challenges.

A new model of care: Virtual Wards

While aspects of the virtual ward concept, often referred to as "hospital at home," have existed for some time, the pandemic and technology advancements have accelerated their implementation. NHS England considers virtual wards to be an approach that allows [patients to get the care they need at home safely and conveniently, rather than being in hospital](#). They provide patients with acute virtual care, monitoring, and treatment in the comfort of their homes, either by preventing unnecessary hospital admissions or facilitating early discharge. Virtual wards have the potential to significantly transform patient care, enhancing the NHS's agility, scalability, and freeing up desperately required hospital beds for those who really need them.

To advance the adoption of virtual wards, BT has launched a [new innovative programme](#), dedicated to simplifying the deployment of the technology as well as virtual care and remote patient monitoring tools. It consists of a revolutionary, wrap-around approach using state of the art technology, empowering patients

to take control of their own health by managing it at home safely and conveniently.

This envisages a unified service that seamlessly blends in-person and virtual care. Support includes remote monitoring using apps, technology platforms, wearables, and medical devices such as pulse oximeters.

Bolstered by BT's partnership with digital health provider Feebris, virtual wards can leverage intelligent automation to generate real capacity for clinical teams. Feebris' AI-supported virtual care platform enables anyone in the community to capture real-time, clinically reliable health information and assess the risk of rapid deterioration in conditions.

This is deployed by integrated care systems across the continuum of care, from care homes, community nursing, to virtual care wards, evidencing improved patient outcomes and reducing the pressure on clinical services.

Drawing on this, the Government's [plan for supporting urgent and emergency care](#) recovery outlines how expanding virtual wards will be a key solution to prepare the NHS ahead of winter, providing additional capacity and improving patient flow. By December 2023, integrated care systems have been asked to deliver [virtual ward capacity equivalent to 40 to 50 beds per 100,000 population](#) to help deliver care closer to home.

Better ways of working: staff and patient well-being

Patient journeys are crucial to the NHS, encompassing everything from patients' admission to discharge. Optimised workflows are essential to provide timely and high-quality care, minimising delays, shortening hospital stays, and improving patient satisfaction and outcomes.

While technology holds the potential to revolutionise care, its current state is a [source of stress for 49% of NHS staff](#), highlighting a need for improvement in terms of usability and performance of digital solutions.

Strategy for the NHS

care
wards

The introduction of virtual wards addresses this challenge directly. It frees up bed capacity, providing front-line staff with more time to focus on those who more urgently need it, while also empowering patients to manage their own recovery. Both of these aspects of virtual care will help to reduce the patient backlog currently being experienced.

To ensure the successful implementation of virtual wards, effective management is vital. This involves a clear decision-making process, supported by accurate data integration across primary care, community care, hospital emergency departments, and 111 services. Robust systems are needed to provide comprehensive oversight of patient capacity throughout the healthcare system, with real-time data availability enabling informed resource allocation and minimising risks associated with home-based, virtual care.

Helping those on the frontline in the NHS

At its heart, the NHS is a person-focused organisation, which means streamlining digital workflows is vital for staff empowerment. Tech must alleviate workloads and empower staff to allocate valuable time and resources more efficiently, enabling them to deliver the best possible care.

The challenge lies in effectively digitising patient care and bridging the translational gap between innovation and frontline implementation. [BT's Clinical Advisory Board](#) is committed to supporting the NHS through co-developed, cutting-edge solutions. As Dr Mateen Jiwani, a member of the Clinical Advisory Board, says, "Innovation exists, but it isn't always reaching the frontline."

To address this gap, [BT's Vanguard Programme](#) and [BT's research campus at Adastral park](#) provide a collaborative space to engage in co-innovation between digital and clinical teams. Similarly, regular roundtables with healthcare leaders such as [Nuffield Trust](#) ensure that the issues impacting the front line are consistently discussed.



Professor Sultan Mahmud

The future of healthcare is virtual

Beyond virtual wards, BT continues to forge partnerships with leading technology companies, such as my mHealth. Through this collaboration, personalised, digital interventions are made available for patients with long-term conditions. The my mhealth range of platforms empowers patients with tools for self-management, including rehabilitation programmes, accredited education courses, care plans, and medication management, giving patients more control over their own care.

Technology has immense potential to transform healthcare delivery, improve workforce well-being, and enhance patient outcomes. It can offer a path towards creating a more fulfilling working environment, positively impacting organisational cultures and reducing burnout and helping to retain staff.

To embark on this virtual care transformation successfully, the NHS requires effective technology integration to benefit staff and patients.

BT plays a pivotal role as a trusted partner that has proudly stood by its side for decades.

By harnessing technology and cultivating strategic partnerships, BT is committed to driving healthcare innovation which empowers patients and healthcare professionals alike. Together, we can create a future where technology connects for good, revolutionises healthcare delivery, enhances patient outcomes and bolsters our NHS to meet the challenges of tomorrow.

FROM VIRTUAL WARD TECHNOLOGY TO STRONGER COMMUNITIES

Professor Rhys Thomas & Professor Kevin Doughty from Virtual Ward Technologies, detail their plan for community health support via cutting edge virtual ward technology

The evidence for supporting discharged patients at home, or closer to home, using virtual ward technology is well-established. The benefits are apparent to all stakeholders, as described in Table 1.

However, the focus has previously been on the columns towards the left of this table, i.e. on improving the performance and efficiency of NHS services.

The opportunities for supporting community and social care, and ultimately, self-care and communities, are also apparent and may be addressed by pivoting the use and type of technology from purely medical applications towards 'virtual social care'.

Beyond these direct benefits relevant to patients who have been hospitalised for exacerbations of lung conditions, such as COPD, and cardiac or circulation issues, Virtual Ward Technologies offer interventions across the health and social care landscape.

Pre-habilitation before major surgery

The success of many surgical interventions can be improved by ensuring that patients are fit to undergo an invasive procedure.

Ideally, they could be offered personalised exercise and diet plans before being admitted to the hospital. Their health and fitness might then be tracked during their hospital stay, enabling a quicker and safer discharge using a conventional Virtual Ward technology arrangement.

Appropriate response to an emergency

The resources of ambulance trusts are being stretched to the point where they routinely fail to meet national emergency targets. Call handlers need to decide how to prioritise paramedic visits who, in turn, need to determine in a patient's home whether they can be treated and left or taken to a hospital where they might end up on a trolley for several hours.

If vulnerable people had the technology available to them before an incident that could measure, record, and share vital signs data when appropriate, call handlers could use such information to accelerate response or to use community resources.

Similarly, if the patient must be left at home, changes in their functional status can be followed in real-time, allowing escalation procedures to be implemented.

Health & well-being improvement with technology

Strategies to improve general health often focus on the six Pillars of Prevention shown in Figure 1. However, success often depends on measuring key performance indicators such as body weight, resting heart rate (and variability) and sleep quality, but on recognising the issues and doing something about it.

Acute hospitals	Community hospitals	General Practice	Social care	Patients or service users	Friends & families
Allows beds to be cleared	Reduces length of stay	Enables safe handovers	Supports safe discharge	Avoids extended hospital stays	Reduces travel needed to DGH
Avoids delayed transfers	Allows consultant overview	Allows sharing of clinical data	Can become a component of reablement	Allows people to recover in comfort	Improves confidence
Allows rapid detection of decline	Enables confident discharge	Provides escalation pathway	Addresses the prevention agenda	Reduces risk of hospital-acquired infection	Allows for informal support

Table 1: Benefits of Virtual Wards

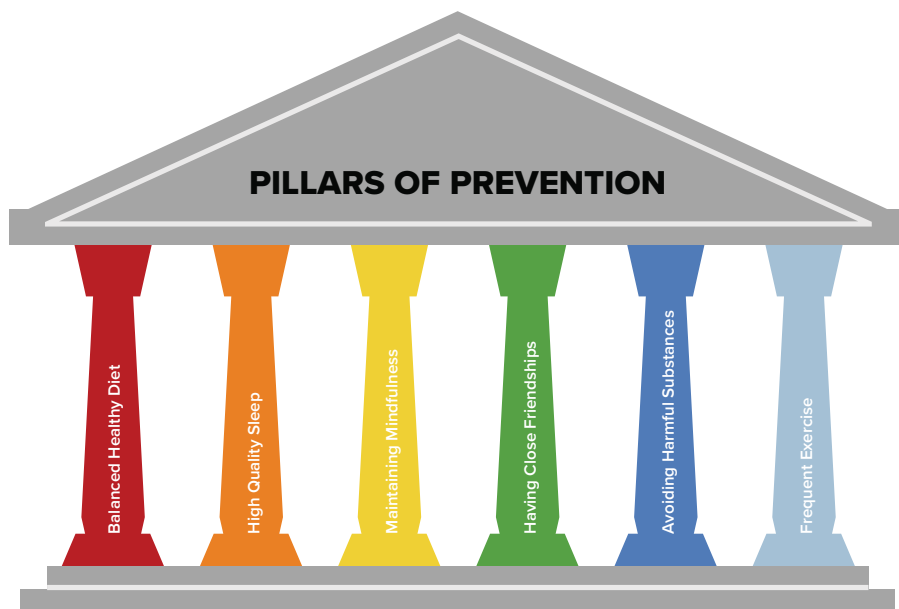


Figure 1: The Traditional Pillars of Prevention

third-sector organisations, enabling low-level interventions, such as the introduction of assistive technologies, to be made early.

Combined with the power of data, this drives a prevention agenda that benefits society and makes health a personal responsibility, as it drives activity from acute healthcare setting back to the community and the individual and their friends and family.

Virtual Ward Technology provides accurate measurements to clinical staff, but when used appropriately, it can provide feedback to the patient and their family. This enables the nudges and naggings necessary to change behaviour that can be far more effective than the advice of doctors, nurses and therapists in achieving the required compliance.

Introducing Virtual Ward Technologies at a population level

Introducing Virtual Ward Technologies at a population level is the key to all three examples described above.

This does not need the expensive and, therefore, limited medical devices that formed the original technologies provided in early work. Instead, it can benefit from the more recent developments in smart watches worn by the masses. With batteries that can last a week without the need to be recharged, they provide 24/7 provision of an increasing number of relevant parameters.

The Community	
Tier 1	Support from family/friend with nudges for support from community connectors
Tier 2	Team coaches applying the pillars of lifestyle medicine and use of social prescribing
Tier 3	Lifestyle coach and prevention team offering advice and guidance
Tier 4	Patients own GP supporting cohorts with long term conditions
Tier 5	Intermediate care team supporting discharged patients in their own homes
Tier 6	Hospital medical team supporting discharged patients in the community
Tier 7	Hospital team supporting patients in acute setting prior to discharge; onboarding & establishing baseline



Figure 2: The VWT Seven-Tier Operational Model

Virtual Ward Technologies have introduced a system of technologies whereby the whole family and community can support each other in health and wellness. The focus is then on the community and the social capital of individuals. This arrangement is at the heart of a new operational model shown in Figure 2.

This leverages the support of community connectors, first responders and, where appropriate,



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BAYWATER HEALTHCARE VIRTUAL WARD SOLUTION

Baywater Healthcare walk us through their Virtual Ward solution which has helped revolutionise healthcare for over 7,500 patients since 2020

Baywater Healthcare developed and began delivering its Virtual Ward solution in November 2020. Since then, over 7,500 patients have been supported through this innovative approach to in-home care. Virtual Wards have gained significant traction in recent years, particularly during the COVID-19 pandemic, as healthcare providers sought innovative solutions to manage patient care remotely. They offer an opportunity to ease the burden on hospitals and deliver efficient, high-quality care to patients in the comfort of their homes.

A Virtual Ward is a digital solution for clinicians to support patients in their homes. It is a 'wrap-around' service that ensures patients can quickly receive the care they need while reducing the need for avoidable hospital admission.

Patients are monitored using pulse oximeters and other vital sign measurement monitors, including blood pressure and weight, which they use to submit daily readings. These readings are used to monitor any changes in patients and provide them with vital reassurance and clinical support in their treatment.

What is the Baywater Healthcare's Virtual Ward solution?

Baywater Healthcare is a CQC-regulated specialist provider of patient monitoring services and offers solutions to NHS patients to be monitored under a Virtual Ward. Baywater Healthcare's Virtual Ward is a web-based platform that allows patients and providers to access the same patient data from anywhere.

They have built-in alerts and reminders to help ensure that patients receive timely care and follow-up. In addition, its cloud-based architecture makes it easier to integrate with NHS systems, and its advanced analytics capabilities make it easier to identify trends.

Baywater's system's intelligent workflow automation helps streamline the care process and reduce administrative burdens on clinicians. They work closely with their NHS customers to create bespoke, adaptable services to meet changing requirements.

Their solution is easy to use, cost-effective, and has positive patient and clinician outcomes. The Virtual Ward can monitor well-being and a wide range of conditions, including but not

limited to frailty, respiratory, cardiac, learning disabilities, mental health, oncology, care homes, diabetes and wound care.

Baywater CEO Adam Sullivan comments: "Digital health technologies have rapidly evolved in recent years, this includes telemedicine, mobile health apps, wearables, and remote patient monitoring devices.

These technologies have the potential to improve patient outcomes, reduce healthcare costs, and increase access to care. With an aging population and the recent evidence of how stretched the healthcare system becomes during periods of winter pressure and pandemic, the need for in-home-based digitally enabled clinical supervision is an obvious path that can ease the workload in primary care.

The development of our Virtual Ward services has evolved over a 15-year period, during which we have demonstrated a sustainable model for remote healthcare services that complement specialist clinical services.

This ensures that all patients have a level of support that is applicable to their condition and that creates peace of mind for them and their families while allowing healthcare specialists to maximise their skills and resources across a wider group of people.

At Baywater Healthcare, our experienced team engages in over one million patient interactions annually. We do so with respect and with empathy. This experience has been invaluable in designing our digital applications to ensure they are user-friendly yet suitably advanced to

provide meaningful interaction and feedback to their healthcare provider."

The Virtual Ward provides significant cost savings for the NHS

The Virtual Ward assists the NHS in significant cost savings by reducing hospital admissions. This was a case when Baywater collaborated with Gloucestershire CCG to develop and deliver a COVID Virtual Ward. The innovative solution allowed Baywater Healthcare to monitor patients in their own homes.

"Baywater's system's intelligent workflow automation helps streamline the care process and reduce administrative burdens on clinicians. They work closely with their NHS customers to create bespoke, adaptable services to meet changing requirements. "

Key monitoring needs were identified, including daily monitoring of SP02 via oximeter and general well-being questions to monitor symptoms. The solution had several positive outcomes, including reducing pressures on NHS hospitals, patients feeling more reassured, and faster intervention, reducing the risk to the patient's health.

Users of Baywater Healthcare's Virtual Ward shared some great feedback. One patient of the Virtual Ward stated, "It was very easy to submit readings, and knowing that someone was there keeping an eye on my state of health in case I took a turn for the worse was very reassuring".

While another shared, "I am not sure I could have got through without the Virtual Ward team. They were amazing. Thank you for all your help and kind support from the bottom of my heart."

Revolutionising the future of healthcare

Baywater Healthcare's Virtual Ward solution revolutionises healthcare by offering a cost-effective, efficient, and patient-centred approach to in-home care. Through collaboration with healthcare providers like the NHS, Baywater's Virtual Ward has demonstrated its potential to improve patient outcomes, reduce healthcare costs and increase access to care.

If you have any enquiries about Baywater Healthcare's Virtual Ward solution, please complete the contact form available on their website or message sales@baywater.co.uk



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NEW HIGH-TECH GREENER SURGERY WILL ENSURE HEALTHCARE'S ENERGY-EFFICIENCY FUTURE

Greener surgery practices must be integrated into healthcare systems now. Reducing costs and increasing efficiencies will become possible with new energy-efficient operating theatre technology from Jones AV

Healthcare accounts for 4% of UK greenhouse emissions and similar levels globally.

Hospitals occupy a large share of this output. With operating theatres being a hefty contributor to hospital CO₂ emissions, greener surgery technologies need to be implemented now.

Several factors contribute to the high emissions we see from the healthcare sector, such as the heavy use of high-energy devices, anaesthetic gases, the high churn of intraoperative single-use

equipment, instrument decontamination, and many others.

With minimally invasive surgeries constantly increasing, whether formal or robotic, the requirement for more remote and online teaching and training capabilities and integrated operating theatre systems are seeing a real upturn.

While improving theatre capabilities and efficiencies, and helping to reduce the UK backlog, one of the downsides of deploying more technology into the

operating theatres is increasing the carbon footprint.

What is Jones AV's aim regarding healthcare's energy-efficiency future?

With the climate crisis being high on everyone's agenda and continued NetZero Healthcare pledges announced around the globe, there is a need for new technology to facilitate this desired change.

Jones AV set out to deliver the benefits of different technology in helping to

Image: © Gumpanat | iStock



reduce carbon footprints and refurbish existing installations.

An integrated operating theatre system

JAV Medical Systems is proud to launch the first Near Net Zero integrated operating theatre system.

After 18 months of research and development, the new system will help optimise designs to increase their technical performances and decrease energy consumption to below 75% of comparable systems.

Additionally, huge efforts were made to optimise many different components such as:

- Improving supply chains
- Evaluating better energy performance components
- Finding suppliers with easier recyclable or less packaging

- Assessing use of recycled materials as part of new devices
- Reviewing shipping and transport
- Developing more intelligent software
- Reducing the total numbers of components used
- Using less cabling and natural resources in the building process
- Ensuring a circular approach to electronics component lifecycle management
- Offsetting any residual CO₂ impact.

Increasing these operational efficiencies allows more surgeries to occur in the same timeframe, driving down waiting lists and decreasing the pre-surgery energy usage and CO₂ footprint.

Using greener surgery in the push towards an energy-efficiency future

The new systems measure ongoing energy performance, noticing if residual energy consumption deviates from original targets.

In addition, we aim to invest in offset measures for each installed system whilst continually striving to better the system's overall energy performance.

One of the most significant and welcome side effects of the new technology is the overall reduction in operating costs. Electricity consumption can be seen to drop below a quarter of its original price.

As a result, savings of up to £5000 in running costs per annum, making a case for green investment into a new NetZero Integrated system even more compelling.

The new “integrated theatre of things” and the future of surgery

The new “integrated theatre of things” comes with all the advantages of superior teaching capabilities and remote surgical assistance, recording procedures and storing intraoperative video and images to the digital patient file for improved post-operative care and surgical analytics.

By using JAV Medical Systems you can achieve NetZero Targets and get the latest and best technology available while saving thousands.

Contact JAV Medical Systems and find out how we can help you to make surgery greener together and save the planet. Email us on info@jonesav.info or call 0151-6750675.



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AI AND ML: EXPLORING THE PROGRAMMES AND SEARCH ENGINES OF THE FUTURE



The way we use computers and technology is rapidly changing, here Paul Grosvenor Director at Optima Systems Ltd explores the search engines of the future and how AI and ML will change the way we access information

Artificial Intelligence (AI) and Machine Learning (ML) articles appear all over the press at the moment and they hint at genuinely impressive developments. However, very often, the reality is that we are still a long way from true AI and ML remains limited in its usefulness. But, there is some technology around that should make us sit up and watch.

Some of this tech has been around for a while but now all of the various strands are being collected together to form newer even more powerful tools. Don't be fooled though. Intelligence is not just a function of complexity (although sometimes it can look like it).

Much work has been done building search engines and improving how they collect their source data to respond to questions. In its more familiar forms, it isn't intelligence as such, but it is certainly clever how so much information can be distilled and delivered and used and it's all free. And anyone can do it.

Using AI and ML to create graphical images

Take a look at a product such as [midjourney.com](https://www.midjourney.com). By entering a simple text string describing the image you are trying to create the system will go away, analyse the string, and then once it has



worked out what you are directing (the clever bit), it creates an image for you. The system was trained on a vast number of images to enable it to learn what it should or could draw.

For example, you might type "a Prismatic Butterfly". If you did you might then receive an image not dissimilar to the one shown here. You could add further modifiers such as "photorealistic" or "in the style of Monet". All of these attributes go together to define and refine the image.

Then again you might get something slightly different. The image is determined by the data available at the time and so can change. It like many similar products are fascinating to use. The result is never known until the final stages of production and simple textural changes can make a big difference to the result.

Google Lens, future of language translation and so much more

Another clever piece of tech which has been around for some time in one form or another is Google Lens. What makes it stand out from many language translation Apps is that it works with images or your phone camera in real time. Stop and think about that for a moment.

To work, the App has to interrogate the image (or video stream), identify which elements are text, determine the language, convert to my language, and then write back the converted text into the video stream. All in real time and all for free.

This is certainly not Machine Learning and not really AI either but it is a good example of how different pieces of code can be brought together to create new applications. It is certainly complex but is constrained by the rules of the application it cannot step outside of that domain.

One might argue that there was 'learning' going on during its development and possibly the code alters parts of itself to reflect changes in use. In my past we would have called this refactoring (or simply bug fixing for the obvious errors).

ChatGPT and intuitive AI

Now this is interesting and generating a lot of interest in the computing industry and beyond. ChatGPT from openai.com allows us to enter a text prompt from which we receive a human readable and understandable response.

ChatGPT differs from say a Google search in that it is designed to return a single 'best' answer to the prompt rather than the many pages of hits we are currently used to seeing. Many of the search engine vendors are sitting up and looking carefully at the potential of this technology. Not just because it is rather good but because they can see it taking a chunk of their market away.

So how would ChatGPT describe itself ?

When asked, the response is as follows:

- ChatGPT is a large-scale language model developed by OpenAI that has been trained on vast amounts of text data from the internet. It uses a deep learning algorithm called a transformer, which allows it to generate human-like responses to text-based prompts.
- ChatGPT is particularly useful for conversational AI applications, as it has been fine-tuned to generate responses to a user's text-based prompts or questions. It can understand and generate responses to a wide range of topics, and its responses can be remarkably human-like.
- ChatGPT has been used in a variety of applications, including customer

service, chatbots, and language translation. It has also been used in research applications to develop tools for natural language understanding and dialogue systems.

- Overall, ChatGPT represents a major breakthrough in the field of natural language processing and has the potential to revolutionize the way we interact with computers and machines.

All things considered the response is not bad at all. It is certainly readable and makes sense but like using GPS, having a little local knowledge is often a very good thing.

How will AI and ML change how we interact with computers?

AI and ML are rapidly transforming the way we use computers and technology in many different ways. Here are a few examples of how they are expected to change the way we interact with computers in the next few years:

- 1. Enhanced personalization:** AI and ML can enable computers to learn more about our preferences, behaviours, and interests, which will allow for more personalized experiences in everything from social media to e-commerce.
- 2. Improved natural language processing:** With the development of advanced NLP (Natural Language Processing) systems, users will be able to interact with computers in more natural and intuitive ways, without having to use a keyboard or mouse.

3. Increased automation: AI and ML can automate tasks that are repetitive and time-consuming, which will enable us to focus on more complex and creative tasks.

4. Improved decision-making: With the help of AI and ML, we can make more informed decisions by analysing large amounts of data and identifying patterns and trends that would be difficult for humans to recognize.

5. Advanced robotics: As AI and ML technologies continue to advance, we can expect to see more advanced robots that can perform tasks in a variety of industries, from manufacturing to healthcare.

Overall, AI and ML will continue to transform our use of computers and technology in many different ways, making our lives more convenient, efficient, and personalized.

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Innovation Pop Up: Inspiring data-driven digital hospitals

As Chief Scientific Officer at Leeds Teaching Hospitals NHS Trust, Professor David Brettle, is responsible for delivering transformational healthcare technologies to ensure staff can work effectively in data-driven, digital hospitals ⁽¹⁾



How do you deliver two new digital hospitals with a smaller footprint than the estate they replace and with an expected growth in patient numbers? For good measure, they also need to be sustainable and promote economic growth!

The Innovation Pop Up is the first step to help answer this challenge.

Historically, [Leeds Teaching Hospitals has a fantastic track record in innovation](#) with a series of national and international breakthroughs, including the clinical thermometer, the first hospital use of AI, the world's first double hand transplant and the birth of modern emergency medicine, to name a few.

In fact, the Leeds General Infirmary was the world's first civic hospital. We know that the right innovation and technology can save lives and make life better for staff.

Still, it can be difficult to adopt in large hospitals due to work pressures, established work practices and the cost of implementation.

Staff engagement for new healthcare technologies

"People make a place", and it is never truer than in a hospital, so our key priority was staff engagement and

helping them understand and embrace the challenges and opportunities of introducing new technologies.

Staff need to have the chance to try new technologies they wouldn't ordinarily come across and evaluate them in a safe space to identify what will work and what won't.

Working with our partners and industry, we can maximise the opportunities and benefits for new technology development in Leeds whilst building our credibility as a health-technology enabler and stimulating the growth of the health-technology sector in the Leeds region.

Innovation Pop Up at Leeds General Infirmary

The Innovation Pop Up based in Leeds General Infirmary was, therefore, conceived as an agile initiative to stimulate interest in innovation.

It provides a physical space in the hospital where we can readily engage with colleagues, partners, and industry in a non-clinical setting.

It enables us to operate on the 'NHS side of innovation' with the same real-world challenges and limitations as the wider hospital but in a clinically safe space.



Launched almost two years ago, the Pop Up is home to a growing collective of companies that benefit from access to clinical teams, tailored business support and open-plan workspace.

In the last year, we have worked with 150 companies, clinicians, and entrepreneurs from the UK and worldwide, including Israel, Norway, Spain, Canada, Japan, Switzerland, the U.S., and Taiwan, resulting in 30 collaborations and ten funding opportunities.

“Real-Time Location Systems, an established and mature technology outside of health, allow staff to track and locate equipment quickly. This may not sound transformational until you consider that it has been reported that a third of nurses spend at least an hour or more per shift looking for equipment.”

We are helping streamline regulatory processes to make it easier for companies to conduct evaluations and commercialise their innovations in the UK - because we recognise that many good ideas never make it past the

pilot stage, and those lost innovations are lost opportunities for potentially better patient care.

New transformational technologies for the future of healthcare

Through the Innovation Pop Up, we can introduce our workforce to new transformational technologies now, ahead of the opening of our new data-driven digital hospitals, which we believe will be vital for the future of healthcare.

These core transformational healthcare technologies are:

Real-Time Location Systems, an established and mature technology outside of health, allow staff to track and locate equipment quickly.

This may not sound transformational until you consider that it has been reported that a third of nurses spend at least an hour or more per shift looking for equipment.

Removing this problem is equivalent to creating an additional 2.7% extra nursing capacity in the NHS without additional recruitment. ⁽²⁾

Remote monitoring and virtual wards will harness data's power to enable seamless patient management across the broader healthcare system.

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At the same time, they remain in the best place for them, whether that be on a ward or at home.

Providing a better patient experience

Breaking the limitations of traditional hospital-centric transactional health will free up valuable hospital beds by reducing the length of stay and providing a better patient experience and outcomes whilst easing the work pressures on staff.

Smart devices will empower the population to take greater control over their own health and encourage more preventative care by anticipating health problems before they happen.

In addition, they can provide a single portal to health providers, for example, remote consultations, diagnostic results and even automatic check-in and navigation when visiting the hospital.

On top of these transformations are the limitless clinical innovations, such as using Virtual Reality to help distract young patients when having injections or blood samples taken or ultrasonic surgery to treat cancer patients without invasive operations.

An award-winning concept

We believe the Innovation Pop Up approach is working, and last year, the Pop Up won the research and innovation category in the NHS England Chief Scientific Officer's Excellence in Healthcare Science Awards.

The Chief Scientific Officer for NHS England, Professor Dame Susan Hill, praised the Pop Up initiative for fostering "impressive new technologies" and "the cross fertilisation of ideas that happen by bringing entrepreneurs and clinicians together".⁽³⁾

As it stands, the physical Innovation Pop Up is only a temporary solution. One day, it will 'pop-down' again. Its job will be done when we open the doors to our new data-driven, digital hospitals and our fully trained staff are using the latest technologies to deliver outstanding healthcare to the people of Leeds, Yorkshire and beyond, all the while flourishing in a culture of innovation at the heart of the Leeds City Innovation Arc.⁽⁴⁾



Professor David Brettle

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DETECT & PREVENT FALLS IN CARE HOMES WITH ROOMMATE

Sven Seljom, UK Country Manager at Sensio, walks us through a revolutionary safety sensor, RoomMate, that detects and prevents falls in care homes

Falls in care homes are one of the biggest challenges in elderly care. Hartford Court was the first care home in the UK to trial a pioneering technology to reduce falls, and Herron Hill followed shortly after. So, what are their experiences a couple of months after implementing the technology?

One of the biggest challenges for Hartford and Herron Hill is falls

“The impact of a fall on a resident is enormous, and if you fall once, chances are high that you will fall again. So, we have tried various things to reduce falls, like sensor mats taped to the floor and other alarms fitted into the beds. But they were of poor quality and uncomfortable, and the residents avoided them”, explains Michelle Presdee, Home Manager at Hartford Court.

What is RoomMate?

A revolutionary safety sensor which prevents and detects falls and notifies on a variety of potentially harmful situations. This means that the resident does not need to alert actively, which is especially important for people with dementia. RoomMate alerts the staff, based on individually preset criteria. Anonymized, digital supervision allows the staff to see and talk to the resident to quickly assess whether there is a need for physical intervention to prevent falls or other unwanted events. 24-hour activity overview provides unique decision support to give the residents individual follow-up and treatment. Staff use their handhelds and other existing screens to receive the alerts and do the digital supervision. Seven years of success in the Nordics, with 10,000 sensors sold to more than 200 care homes and launched in the UK.

Proven technology to detect & prevent falls in care homes

Both Hartford and Herron Hill discovered RoomMate by [Sensio](#), and Hartford got the chance to be the first care home in the UK to pilot the revolutionary falls sensor early in 2023. Though new in the UK market, RoomMate is installed in several hundred care homes in the Nordics, creating safety for thousands of residents – and healthcare staff – daily.

“We are very confident that RoomMate has prevented falls here at Hartford Court, and we can now also react very quickly if a resident falls, so that they get help as soon as possible”, Michelle explains.

Assurance for care home residents, relatives & staff

The Care Home Manager at Herron Hill, Nicola Spedding, has been working in the care sector since 1992.



Hartford Care

Hartford Care is a top 20 mid-size care home group in the UK, and an innovator in using modern technology to take the best possible care of its residents. Hartford Court is a 60-bed care home in the Hartford Care group in Portsmouth.

“Using RoomMate can be assuring for both relatives and staff, as we now have a better view of what is happening with the residents – but also can observe their behaviour and ensure their safety”, Nicola says.

The clinical Lead at Herron Hill, Sandra Lawrence, is also excited about the opportunities that lies within the safety sensor.

“The residents can now have more privacy and safety, which gives them an overall better level of care”, Sandra remarks.



Improved nights for care home residents & staff

In both Hartford Care and Herron Hill, residents initially had concerns about feeling monitored. But they feel at ease when shown how RoomMate anonymises the picture and tests it out at work.

“The night staff finds it especially useful and likes that they can now check in on several residents in a shorter period. In addition, they have reduced the need for hourly checks and now do digital supervision on a screen from the nurse’s station. This ensures that the

Herron Hill

For over 20 years, the family-owned Abby Healthcare has provided care in their group of 16 care homes across England and Scotland. In Kendal, Herron Hill is working tirelessly to provide its residents with both physical and emotional well-being.

residents are not interrupted as much and get a much better quality of sleep”, Nicola comments.

Helpful support at Sensio

Sensio has assisted in setting up the system, and both Michelle and Nicola speak highly of the supportive and friendly team.

“Sensio is very helpful and always answers any questions. It has also helped that they now have a permanent presence in the UK.” Michelle explains that the last training they gave locally “has really boosted our staff’s confidence in using RoomMate.”

Full nurse call system

RoomMate also provides other features and can be implemented with a complete nurse call system. When asked whether Nicola and Sandra would ever recommend trying out RoomMate, they have no doubt.

“Try it! It gives both the resident, their family and the health staff the reassurance that the residents are taken good care of.” They conclude that this is not about watching people, but about caring about them.

Interested in trying RoomMate? [Contact us](#) for an obligation-free trial!

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UNDERSTANDING DIGITAL TRANSFORMATION IN THE NHS AND WHERE IT'S GOING?

Digital transformation in the NHS can mean different things to different people, here Ben Riley explores the digital future of the NHS and what online data can do for healthcare



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In this piece, I'm looking into digital transformation in the NHS, where it is currently, where it was (and could have been now) and where it looks to be going in the future.

I'll also dive into some personal opinions or suggestions on how I think we might solve some of the problems in later parts of this series. This will mostly be from a high level, but we'll also go into some detail when relevant.

The relative nature of digital transformation in the NHS

First, digital transformation in the NHS can mean different things to different people and on several different levels. From a high level you could say it's

about how the public will be able to use digital media to interact with the NHS and their own personal data.

For others, especially those working in or with clinicians, it might be about transferring a paper-based system in a hospital or clinic onto a database. Searching the web you'll find many different descriptions such as [this](#) article from the government or digging through NHS England into their long-term plan [here](#) and [here](#).

From my own personal perspective, I've got two different viewpoints as I used to be an NHS employee. As I mentioned above, as a member of the public, I personally think it's about

communication between us and NHS, how this is evolving and how I interact with my personal data.

From my other perspective, as someone who worked in the NHS for almost two decades in several different IT, data engineering and analytical roles, I see it as something to improve how the existing computer systems communicate. I'm also married to a nurse, and she's got her own viewpoints on all this as a clinician.

Full disclosure though, I'm no longer an NHS employee as I left to start my own company a few years ago. However, I still deal with several NHS organisations regularly in a

professional capacity to support them with their data, information, and analytics platforms. This career path through the NHS has given me a good view of how the NHS deals with data and digital transformation.

NHS digital transformation from a public perspective

As a member of the public, how do we see digital transformation in the NHS? How does it benefit us? If you're like me, then you've probably seen several apps that let you do things such as book appointments with your local GP and view your personal health information. I'd imagine that unless you're an NHS employee, though, this is probably the only direct exposure to digital transformation in the NHS that you're aware of.

You could argue that this is probably all we need or want from the NHS in terms of digital transformation (from a publicly visible standpoint that it). For me, I'd agree with you, I mean if you've got an app or website you can open to view your appointments or medical history or book stuff, what more do you want?

In terms of these apps and websites, I think at this it's also probably pertinent to mention that there are of course, many less tech-savvy people who don't use (or in some cases, aren't even aware of) any of these facilities. Do older members of your family know about or use these apps? Most of mine don't; they just use the phone.

This all seems well and good, it really is how the NHS should have been several years ago, at least in a public-facing capacity. There is good progress being made in many areas. So, what's the

issue? Everything seems ok, doesn't it? Well, not exactly.

The devil is in the details when it comes to the NHS and data

There is a subtle issue hiding here, something that's not entirely obvious to anyone outside the NHS and who knows about its complicated relationship with data.

This is something that isn't necessarily an issue for the public user who is opening their NHS app and booking appointments or ordering prescriptions. This is more an issue of how this data is getting to these apps. This brings us to another part of the plan for digital transformation. Trying to get all the different computer systems to talk to each other.

But surely the NHS just has its own computer system everyone feeds into by now, I hear you say? I remember reading years ago that you'd be able to book an appointment with your GP, and the hospital could access the data.

Well, not exactly. We need to talk about the way the NHS is structured, as it is a little bit like lots of small businesses acting as a single entity. We have GP surgeries, hospitals, clinics and so on.

Quick side note, we'll leave aside from a moment the high-level strategic structure of the NHS, such as how it's split into commissioning and service provider organisations, although we may return to that at a later time.

Where's my data?

For now, we'll just focus on looking at each the GP surgeries, hospitals, and clinics etc. They each store data separately on their own computer

systems. This is why the NHS and government are looking trying to improve how these computer systems talk to each other, this is also why your GP (at least at the moment) may have its own app, and the NHS has a separate one.

The NHS doesn't have your data (yes, we'll talk about the Spine later); it's the individual GP surgeries, hospitals, and clinics you've visited that do. Note that only the surgeries, hospitals, and clinics you've visited have your data.

Other hospitals, clinics, or surgeries don't. It's all separate, too, on different computer systems held by each of these organisations. To coin a term used in business intelligence, they're like data silos that are hard to join together.

In the next part, we'll look at how digital transformation in the NHS has been attempted in the past and if there are any lessons we can learn from what happened.



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How can connected drug delivery devices help patients adhere to their therapies?

Poor adherence to drug therapies can lead to medication waste and poor patient outcomes. Tim Wooller shares some of the reasons behind poor adherence to medication and how connected drug delivery devices can help

Drug therapies are only effective if people take them as intended. The [WHO](#) published a report back in 2003 stating rates of adherence in developed countries averaged only about 50%, with adherence for some drug therapies being significantly lower. Poor adherence leads to poor patient outcomes, straining healthcare systems and impacting pharmaceutical company profits and further investment in drug R&D.

In the 20 years since the WHO report, medical technology has moved significantly, especially around smart devices and connectivity. Embedded electronics and wireless technologies have found their way into many drug delivery devices which patients use at home, such as injectors, inhalers, patch pumps, and nebulisers. These technologies help automate processes, capture data, and communicate that data to the patient or doctor directly or via companion devices such as smartphones or tablets.

Yet, while there has been a rush to implement connectivity in these devices, technology alone does not result in better patient outcomes. To have a positive impact, designers and healthcare companies must find better ways to engage patients and help them adhere to their therapies. But how?

Understanding why your users do not adhere to their therapies

As a starting point, it is important to understand why patients do not adhere in the first place. Many academics have published theories on [medication adherence](#), concluding that the issue is complex and driven by a range of factors, including:

- How the patient's condition affects their ability to adhere to their therapy;
- The drug and its actual or perceived side effects on the patient;



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- Whether the healthcare system and quality of care the patient receives are adequate; and
- Other patient-related, demographic and behavioural factors such as social life and general attitude to health.

To discern the barriers at play and design more compelling and engaging experiences to help people adhere, healthcare companies must gain understanding and empathy for patients. This can be achieved through a range of Human-Centred Design (HCD) methods which help map the context of use: How do patients, their therapies, and their environments differ? What tasks do patients perform to administer the therapy? How do they feel when they perform these tasks, and where are they struggling? From this output, a better picture can be formed to understand where the opportunities lie for improvement.

Simplify the process of taking drug therapies

One such opportunity to improve connected drug delivery devices is to simplify the process of taking a therapy. Patients lead busy lives, so if steps in the process can be automated, such as requesting refills or repeat prescriptions when supplies are running low or reminding

patients when medications need taking, it reduces the burden on patients to remember, especially if they suffer cognitive impairments due to their condition.

Connected drug delivery devices also collect a lot of data in real time, and one of the most meaningful uses of this data is to monitor patients remotely and to track trends over time. Rather than relying on infrequent doctor's appointments to identify issues with the patient's medication or adherence, the device and service can monitor the patient's progress and flag issues as they occur, feeding the information back to the doctor to make more informed choices about corrective actions. Remote patient monitoring has become an effective way of improving patient care in recent years, with [Deloitte](#) finding that it is especially effective in allowing people with COPD to control their condition themselves from home, increasing the likelihood of adherence.

Gamification can improve patient self-management

An engaged patient is more likely to persevere with their therapy, and there are many behavioural strategies which can help influence this. Gamification, used successfully in consumer fitness and learning apps, employs features such as points, rewards and goals, usually broken down into achievable chunks, to help keep attention sharp and encourage progression. A study by [Health Informatics Journal](#) corroborates this, finding that gamification has the potential to improve patient self-management for chronic diseases. Critically, gamification is an important way to engage children, especially those with notoriously hard-to-manage conditions like type 1 diabetes.

Personalise and standardise the user experience of medical devices

The more relevant the device user experience is to an individual, the better. A personalised medical device and app ecosystem can provide a better way for patients to manage their condition by working around their lifestyle rather than against it, capturing their medication history, and cataloguing any side effects that can be fed back to their doctor.

At the wider end of the spectrum, connected drug delivery devices can also help even out the quality of healthcare patients receive. Big data can capture key learnings and aggregate them across large patient populations, enabling a degree of standardisation to their care.

REVOLUTIONISING ENGLAND'S NHS WITH ARTIFICIAL INTELLIGENCE

In 2021, the UK Government announced a £36 million investment towards AI technology use in the NHS to transform healthcare delivery. While the COVID-19 pandemic accelerated the uptake of digital solutions, focus has now turned to understanding how solutions such as AI can be implemented at scale in an ethical, equitable and strategic way. As well as tackling care backlogs and alleviating administrative burdens so clinicians can spend more time with patients, AI-guided tools could improve disease detection and diagnostics and bolster targeted interventions at the population level.

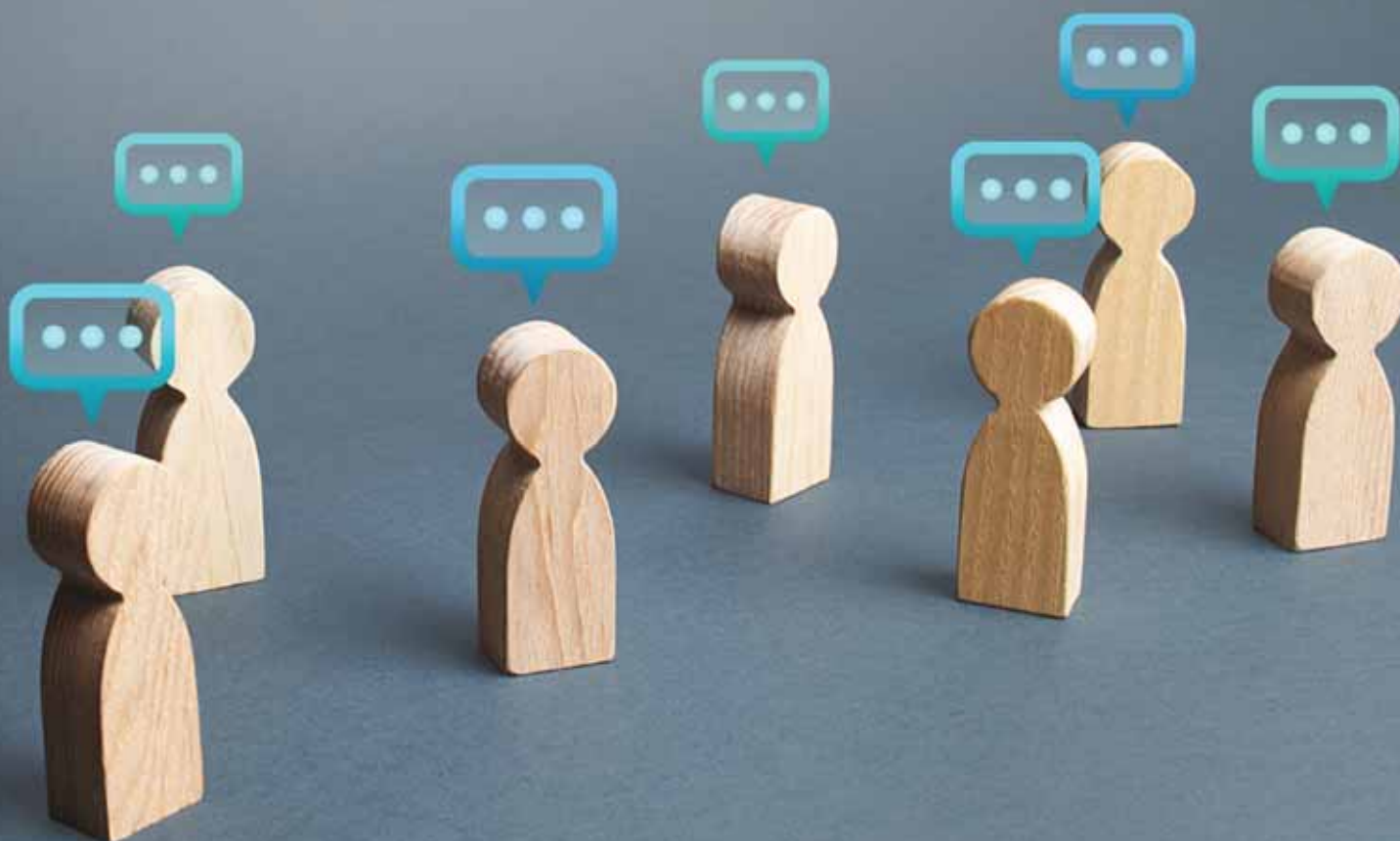
Bringing together government, health and care providers, academics and technology companies, the NHS Artificial Intelligence Laboratory (NHS AI Lab) will fund programmes to help tackle challenges that may arise with implementing AI technologies and support the development and deployment of new solutions. Projects will form part of the NHS AI Lab's £140 million AI in Health and Care Award set up to accelerate the testing and evaluation of AI technologies in the NHS and, therefore, bring solutions to patients more quickly. So far, the NHS AI Lab has awarded 86 innovations with £123 million worth of AI Award funding and delivered five proof-of-concept AI tools alongside NHS trusts.

Gathering evidence of AI's efficacy in healthcare settings is key to its adoption. [Speaking to digitalhealth.net](#), Dominic Cushman, Director of AI, Imaging, and Deployment at the NHS Transformation Directorate, explains: "By starting with addressing one use case for deployment, such as radiology AI solutions, we hope to create blueprints and case studies which can be used to solve AI adoption problems from IG compliance to infrastructure to standards to scalability in other areas. That plays nicely into the work we've all been doing since the NHS Long Term Plan on building up imaging networks and community diagnostic hubs. We're looking at how we can provide the appropriate level of algorithm support in those areas quickly, rather than piecemeal."

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The future of connected drug delivery devices

Connectivity has come so far, with the promise of going a lot further. In future, we expect to see more pervasive patient monitoring and deeper integration of connected drug delivery devices into healthcare systems. We will also see big data and algorithms take a more prominent role in reacting to trends in individual patient therapies as well as broader patient groups and society.

The challenges of patient data and security remain a hot potato in the healthcare industry as it goes through a digital transformation. However, with the right safeguards, smarter and better-connected drug delivery devices will benefit all stakeholders. With this, patients will get an engaging and personalised experience, healthcare systems will be able to automate certain aspects of care and reduce cost, and pharmaceutical companies will benefit from greater adherence rates and proving the efficacy of drugs more easily.

The key is to approach and design these connected systems around the patient and therapy journey rather than from a purely technical perspective. By putting people – patients, medics, and carers – at the heart of the treatment journey, and to simplify, gamify and personalise their experience, we will be able to change behaviours towards greater adherence.

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TRANSFORMING CLINICAL CAPACITY TO BE A FORCE FOR GOOD

Elina Naydenova, CEO of Feebris, shares her thoughts on how to improve the NHS clinical capacity, to serve more patients with enhanced healthcare technologies

Today, healthcare is evolving rapidly, mostly in response to pressing challenges such as workforce shortages, patient backlogs and an ageing population. In meeting the challenges of today, we can build clinical capacity and resilience for a better tomorrow.

The decentralisation of healthcare is now inevitable; the system cannot be sustained without it, and patients demand it as the new standard of care. Performing specialised and emergency treatment will become the core of what hospitals are responsible for, and less specialised tasks will be increasingly shifted to community and home settings. Virtual wards and virtual care are essential pieces of this transformation.

Over the last four years at Feebris, we have served NHS and social care partners to deliver virtual care and virtual ward programmes across over 100 sites to improve clinical capacity. Together, we have evidenced that these new work models can accelerate access to treatment, reduce hospitalisations and ultimately save £500,000 for every 1,000 patients impacted. ⁽¹⁾

When embedding such virtual programmes, we always aim to address the short and long-term challenges facing patient access, workforce development and system sustainability.

From reactive to proactive patient care

For many ICSs across the country, a minority of patients occupy the majority of the clinical capacity in the region. These are typically patients like Gloria – an 83-year-old woman living with three chronic conditions. Last year, she saw the GP six times, was in A&E five times and was hospitalised three times. With every hospitalisation, she worries that she might become too frail and have to move to a nursing home. Virtual wards can help the NHS care for patients like Gloria in several ways.

First, rather than spending multiple weeks in the hospital, Gloria can be discharged home early onto a step-down virtual ward, with wearable technology continuously monitoring her recovery and alerting the clinical team if she deviates from her expected baseline.

Second, even before hospital admission, a community nurse may visit Gloria and admit her directly onto the step-up virtual ward, equipping her with technology for regular observations, which alerts the clinical team if any signs of deterioration are detected. For Gloria, such virtual wards minimise the risk of hospital-acquired infections and reduce the stress of being in the hospital. For the system, better clinical capacity means freeing up the hospital bed for another patient.

However, there is an opportunity to do even better. By embedding routine monitoring into Gloria's routine, done by her or her carer, we could proactively identify any signs of deterioration early and minimise exacerbations, now completely reducing the number of highly acute episodes.

Augmenting the workforce with technology

Technologies such as AI have a considerable role to play in predicting deterioration ahead of time and augmenting clinical decision-making to mitigate it. For patients like Gloria suffering from complex co-morbidities, this could provide a regular personalised review, engaging clinical teams when an intervention is needed.

At Feebris, we are growing clinically validated technology to deliver personalised predictions of risk escalation in close to real-time. Introduced to a virtual ward, this will equip clinical teams with the ability to plan clinical capacity ahead and significantly reduce the volume of avoidable admissions and readmissions.

The greatest asset of the NHS is its people. With endemic workforce shortages across the system, virtual ward technologies mustn't add a burden but improve efficiency, enable skill mixing and ultimately improve job satisfaction.

To achieve this, we must invest in transformation, not only technology

Simply providing people with technology does not ensure adoption. Transforming clinical workflows to enable the effective management of risk virtually requires embedding new operating procedures, building up digital capabilities, improving clinical capacity, and ultimately earning trust among clinical stakeholders.

At Feebris, we act as a transformation partner, providing a change management service, alongside our technology, to ensure the contextualisation of our platform to the needs of each region and the sustainable adoption at scale.

Integrating the community workforce is key to health equity

Community and district nursing teams nationwide reach some of the most vulnerable patients at home. As Dr Crystal Oldman, CEO of the Queen's Nursing Institute (QNI), recently stated at the House of Lords: "What fantastically skilled allied health professionals, nurses and carers do in people's homes is not well understood, or the potential of that to be built upon to be part of an integrated service."⁽²⁾

Whilst there is immense value in empowering patients to self-monitor and manage their condition whilst on a virtual ward, for some of the most vulnerable patient groups, community nursing is an essential requirement for ensuring equitable access.

Community nursing teams in some of the most rural areas of the UK have used Feebris to ensure efficiencies (reducing the time required to conduct a health assessment) and improve skill mixing (standardising the quality of assessment between junior and senior nurses).

Ensuring sustainability at scale

Patient-generated data can be very powerful in helping clinical teams manage patients' health in the community. However, large volumes of often very noisy data can overwhelm clinicians, taking up valuable time. As the Topol Review pointed out, data need to be filtered before being passed onto clinicians for this to be sustainable.

At Feebris, we leverage the power of machine learning to translate data captured in the community into actionable insights. Unlike conventional remote patient monitoring, our AI-supported technology ensures clinical time is not wasted attending to unreliable data.

In regions like Norfolk, we are implementing virtual care across the care continuum, including step-up and step-down virtual wards in care homes. We can generate greater clinical capacity beyond freeing up hospital beds when virtual technology supports integrating services and pathways.

Moreover, this can also equip the health system with the data required to underpin the types of outcome-based

payment models that the recent Hewitt Review spotlights as essential for the long-term success of ICSs.

This transformation requires a population health approach beyond individual pilots. Working in partnership with BT, a trusted long-term partner to the NHS, we are fusing innovation with large-scale infrastructure to serve the NHS at scale.

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VIRTUAL ANTICIPATORY CARE SOLUTIONS THAT FOCUS ON PERSONALISED CARE

Dan Moody, Director, Public Sector Solutions at IQVIA, unpacks virtual anticipatory care solutions that focus on personalised care and their value

IQVIA is proud to offer a complete virtual care solution to allow NHS organisations to achieve key delivery targets. By expanding new services across primary and secondary care, our team of experts provides quality clinical care underpinned by world-class technology and data.

Key issues faced by the NHS and healthcare providers

As reflected in the NHS 2023/24 priorities and operational planning guidance, the NHS has been significantly impacted during the pandemic and must prioritise workforce investment, COVID-19 recovery and the elective care backlog. This has put pressure on the quality of patient care and outcomes, which will only be exacerbated by a more complex patient base and a growing ageing population.

It is widely recognised that anticipatory care enables better and longer quality of care for those at high risk of unwarranted health outcomes. Typically, this involves structured proactive care and support from a clinical multi-disciplinary team.

Many suppliers and providers to the healthcare system focus on a 'step-down' virtual ward approach focusing on early discharge.

IQVIA has developed a Virtual Care support service that focuses on

identifying and proactively managing patients, an anticipatory care solution that can be supplemented with remote monitoring to keep patients away from hospital. This solution can be developed for providers at pace and scale.

Our team of experts can project manage the service, from identifying suitable patient cohorts, through to providing technology, ongoing support and clinical care to patients via remote monitoring at home.

IQVIA works collaboratively with NHS organisations to co-produce virtual care models. By joining up the right capabilities and using our data insights to target care where needed, we can achieve extraordinary results in improving population health.

Our comprehensive solution:

- Enables the rapid, efficient deployment of pathways on a local and national scale.
- Empowers patients nationwide to manage their health more effectively and share their key health metrics with IQVIA and NHS healthcare professionals.
- Provides clinicians and GPs the ability to focus on delivering care to those that urgently need it.

IQVIA anticipatory virtual care solutions focus on the personalised care agenda and support self-management

IQVIA's anticipatory care solution focuses on identifying patients being managed in primary care. Using validated tools, we identify cohorts to create a dynamic list of patients who will be offered proactive care interventions to improve or sustain their health.

Approaches can be tailored to your locality to deliver digitally enhanced, anticipatory care using a population health management approach.

A blended population health management approach:

- **Understanding the problems and opportunities:** Work with system partners on areas of opportunities of QoF and IIF based on variations, e.g., QoF achievement prevalence, risk, admission, data, and length of stay.
- **Identify, segment and risk-stratify patient cohorts:** Tailored and specialised searches of primary care systems and NHS datasets, e.g., health/QoF indicators, absence of review in 12 months, and utilisation of primary care services.
- **Clinical support and management:** Manage and optimise agreed cohorts, e.g., virtual and in-person patient

review, activate digital support applications, deploy remote monitoring technology, and provide continuous monitoring.

Fully enhanced pathways

Based on your priorities, IQVIA will safely and securely undertake population analysis to identify, segment and stratify populations for anticipatory care. These activities may be conducted using primary care and secondary care datasets.

Thereon, we can support the anticipatory care approach across multiple pathways based on risk profiles. IQVIA can dovetail with your local existing teams, technologies and processes to help key gaps with clinical or administrative workforce solutions and technology and software applications.

Capability and proof points

IQVIA connects healthcare data intelligence, clinical expertise and industry-leading patient technologies to enable self-supported care delivery and improve population health.

Healthcare data intelligence

IQVIA's Interface Clinical Services division has:

- Provided 300k virtual consultations over the last 12 months identified through segmentation and stratification.
- Worked with over 3,600 GP practices in the last five years.
- 200+ clinical pharmacists across the UK.
- 100+ therapy area AI algorithms for medical event prediction.

Clinical workforce expertise

Access to a large, skilled, flexibly managed project management office and clinical workforce.

- IQVIA has provided clinical nursing support to the NHS for over 30 years.
- Able to mobilise clinical workforce at scale across multiple sites and geographies.
- >200k NHS patient interactions annually in patient support programmes and homecare (nursing).
- Strong footprint across all 42 Integrated Care Systems

Industry-leading technology

Accelerate the move toward connected care. Give people the means to lead healthier and better lives.

- Limitless, no code pathways.
- >200 clients, >60,000 patients supported, 66% hospital admission reduction.
- ISO 13485 and 27001 certified, DTAC, DSPT.
- 100% Friends and Family Test. 100% Clinical recommendation. 98% Patient recommendation.

IQVIA Virtual Care will ensure integration with NHS systems so clinicians can access patient data throughout the patient journey. We have supported various government initiatives in times of crisis at pace to achieve meaningful outcomes to work through the complexity and accelerate healthcare innovation for the benefit of patients.

About IQVIA

As a global human data science company and a major investor in UK life sciences – consistently attracting commercial clinical trials in cancer, neurology, paediatrics and rare disease to the UK, IQVIA is now the third most prominent life sciences employer, making over £2.2 billion in contributions to the British economy.

To support and drive key advancements towards improving patient outcomes, IQVIA is at the forefront of unlocking the potential of NHS health data to realise future health improvements for the UK and deliver transformative benefits for the patients of today and tomorrow.

IQVIA believes that the value of NHS health data is not in the data per se. Still, in clinical decision-making, it can inform. As a trusted partner to health systems and providers, we use our extensive data and analytics capabilities to transform health outcomes and deliver pioneering biomedical research within 95% of NHS Trusts who use one or more of our services.



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MRI RENTAL VS OWNERSHIP: WHAT ARE THE BENEFITS?

Matthew Bradfield, Managing Director at Fairford Medical Ltd considers the potential benefits of MRI rental as opposed to ownership

Looking to upgrade your medical imaging equipment? You've come to the right place. Before diving into any financial decisions, it's essential to determine whether MRI rental or ownership best suits your needs.

Whether your current equipment is outdated or you're in the market for a more cost-effective solution, purchasing new MRI technology is not a decision that should be taken lightly. Considering the significant upfront capital investment required, practice

managers must carefully weigh up the advantages and disadvantages to ensure that the acquisition of new equipment aligns with the needs of the patients seen at the facility and long-term financial projections.

Purchasing MRI equipment isn't the only option

For those eager to preserve capital, renting medical imaging technology can often prove the more efficient solution. Depending on your circumstances, the rental of a mobile

MRI unit can act as the perfect budgetary bridge between limited imaging capabilities and a permanent scan room. Beyond affordability, renting equipment can allow practices ongoing access to the latest technology without long-term commitment.

So, to buy or not to buy? That is the question. While there is no one-size-fits-all-solution, practices considering purchasing new technology should bear in mind the following drawbacks to MRI ownership:



What costs should be considered when purchasing an MRI scanner?

For most practices, the budget will play a pivotal role in determining whether to buy or rent equipment: after all, purchasing an MRI scanner usually involves a large down payment that not all facilities can afford. While it's often assumed that larger, more established practices benefit from MRI ownership as opposed to scanner rental, the truth is that upfront purchases are rarely a cost-effective solution, regardless of your practice's size or financial status.

On the other hand, renting equipment allows practices to acquire technological assets with minimal initial expenditures. You can obtain equipment with minimal impact on your cash flow without the need for upfront investment. For low-to-mid-budget practices seeking to enhance their service and improve patient care, renting MRI technology is the obvious choice.

Maintenance of MRI machines

The benefits of MRI ownership are clear: having made an upfront purchase, the practice won't be burdened by ongoing equipment costs. That is until the machine needs maintenance. As the asset ages, practices will spend an increasing amount on sustaining the technology over the course of its lifespan. Having already invested a significant amount, to begin with, most practices cannot simply replace their MRI equipment with the latest cutting-edge technology every few years.

Moreover, advancing technology could make an asset obsolete before it's fully depreciated. With outdated equipment and insufficient capital to fund another purchase, practices find themselves between a rock and a hard place. Ownership may have seemed like the most logical solution when plans were initially drawn, but in the face of growing competition, purchasing MRI

equipment can often prove problematic.

MRI rental offers flexibility

Rather than funding a single purchase and praying the return is worth the investment, large and small practices are turning to MRI rental to cut costs and allow for flexibility in payment structure.

Since it requires little capital outlay, taking advantage of a service that offers MRI rental can benefit practices seeking immediate access to the latest technology. In doing so, they can offer their patients exceptional, diagnostic-quality imaging services without breaking the bank.

Founded in 2016, Fairford Medical understood that renting [mobile](#) and [relocatable](#) MRI and CT scanners would answer the UK's chronic shortage of imaging equipment. Today, the company focuses on renting and leasing individualised, mobile, and relocatable scanners as suitable solutions to the sector's multi-faceted problem.



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HOW CAN AI ONCOLOGY DIAGNOSTICS HELP THE NHS?

DeepMed has developed an AI oncology diagnostics system, DeepPath™ - LYDIA, to assist histopathologists in performing lymph node metastasis detection quickly and accurately

[DeepMed](#) is an ISO-13485 certified start-up MedTech company based in Manchester, UK. Through the support of [SBR](#) we developed an AI-powered product, DeepPath™ - LYDIA, to assist histopathologists in performing lymph node metastasis detection quickly and accurately.

DeepPath™ - LYDIA is expected to improve and accelerate the oncology diagnosis and treatment pipeline, which is currently under pressure. The system was CE-Marked in May 2022 as a Class I decision support product as per IVDD.

AI oncology diagnostics can support overstretched pathologists

The oncology-histopathology combination was selected as our initial focus for two reasons. Cancer incidence is growing globally as the population ages, and histopathology is at the centre of all diagnostics.

In addition, histopathology itself drives patient management and affects the outcome of patient treatment. Secondly, the field of histopathology needs more experts.

According to the Royal College of Pathologists workforce survey (2018), pathology requests grow at 4.5% p.a., while staff numbers grow by only 1.2%. In 2018, 97% of pathology departments in the UK reported inadequate staffing.

The USA reports state a 20% decrease in active pathologists in the past decade. That shortage of pathologists causes pathology departments to be under intense pressure, resulting in a 15% drop in diagnostic accuracy, long waiting times to receive results, and up to two months of treatment delays.

All these issues directly affect patient outcomes, overall survival, and quality of life.

How does the AI oncology diagnostics system, DeepPath™ – LYDIA, work?

Histopathological diagnosis in cancer consists of two main pillars: grading and staging.

In grading a tumour, a tumorous tissue section is examined under a microscope, and based on the morphological characteristics of the whole tumour and the tumour cells, the cancer type and subtype are deduced. This indicates the tumour's aggressiveness and guides the oncologists towards specific therapeutic strategies.

On the other hand, in staging, tissue sections from lymph nodes surrounding the tumour site are examined under a microscope to determine whether the tumour has spread beyond the primary site, an event known as metastasis.

The oncologists completely alter the consequent diagnostic procedures and therapeutic protocols if a tumour has metastasised. DeepPath™ - LYDIA focuses on the former diagnostic aspect, namely staging, to offer decision support to histopathologists.

DeepPath™ - LYDIA is a groundbreaking AI oncology diagnostics system that detects metastatic tumours on digitised microscope slides of Hematoxylin & Eosin (H&E) stained lymph nodes.

It is the first CE-Marked metastasis detection system to identify tumours from four different cancer types: breast, lung, colon and melanoma, accounting for ~43% of total cancer incidence.

The AI oncology diagnostics system outlines the detected tumour regions (also measuring maximum diameter for each region) and presents them to the histopathologist for making the diagnosis; it also re-ranks multiple lymph node slides that belong to a single case from high to low or no tumour content for a further efficiency boost.

The system is compatible with the most popular Whole Slide Image scanners (used to digitise microscope slides).

Furthermore, it makes sure that the histopathologist does not miss any tumour sites with a sensitivity of >97%, while at the same time, it does not clutter the screen with false positives (specificity >90%).

The system is flexible since it can be deployed on the cloud or locally. Furthermore, it can be offered as a standalone system. However, the preferred way to maximise workflow

efficiency is as a plug-in to the Picture Archiving and Communication System (PACS) already used by each lab.

We have already integrated DeepPath™ - LYDIA into the [SECTRA PACS](#) for digital pathology, which is one of the leading PACS solutions and we continue integrating into other PACS systems as driven by market demand.

The system currently undergoes pilot testing in hospitals across the UK and EU. Furthermore, we are actively working towards expanding DeepPath™ - LYDIA coverage to more tumour types to deliver the clinic's first pan-cancer metastasis detection system for cancer staging worldwide.

Beyond Diagnostic Decision Support

DeepMed participated in the public VisioMel-Challenge along with 540 other participants and, through just three submissions, made it to the top 10 with a performance that is marginally close to the [leader](#).

This competition concentrated on predicting relapse in melanoma patients from digitised slides of H&E-stained biopsies using AI. The competition was based on the extensive RIC-Mel dataset, which included data from over 40,000 patients across 49 sites in France.

VisioMel was a collaborative effort initiated in 2021 by the French Society of Pathology, the French Society of Dermatology, the French Cutaneous Cancers Group, and the National Professional Council of Pathologists.

The primary sponsor was the French Ministerial Delegation for Digital Health as part of the French government's 'Digital Health Acceleration Strategy'.

DeepMed intends to use its technology, methodology and know-how to develop AI-powered modalities capable of augmenting or even replacing expensive and time-consuming molecular tests for relapse prediction in oncology, such as DecisionDx-Melanoma, Oncotype DX for breast cancer, Oncotype DX Genomic Prostate Score and others.

Those modalities, being much cheaper and having far-less turn-around time, will enable the democratisation at a global scale of predictive and personalised medicine.

As such, apart from the UK, Europe and the US, healthcare systems in developing countries unable to sustain the current technology would now have access to much cheaper and faster alternatives.

This would enable them to offer higher quality services, which would translate to prolonged survival and higher quality of life for patients, constituting our sole mission.



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Understanding NHS emissions to reach net zero

Dr Atanu Chaudhuri, Associate Professor in Technology & Operations Management at Durham University Business School, discusses the need for digitalisation and a supply chain strategy to reduce NHS emissions

In 2019, research conducted by environmental NGO Care Without Harm in partnership with consultancy firm Arup, and [covered by the Guardian](#), stated that global healthcare accounted for as much as 4.4% of the world's net Co2 emissions. Though a small number, it's no doubt a significant amount - the Guardian pointed out this would be akin to being the fifth largest emitter on the planet if "healthcare" was a country.

On a local scale, in the UK, the NHS has a significant challenge on its hands. The same report found NHS emissions were responsible for 5.4% of the UK's output. And it's not hard to see why.

NHS emissions from hospitals to transport

The NHS has a massive footprint across the country. Not only is there the running of physical buildings to consider; hospitals, clinics, GP surgeries and dentists, but also the NHS' extensive transport infrastructure, the energy required to run a 24/7 service of response in person, online and over the phone, and a global supply chain for medicines, machinery and consumables. Therefore, like any large organisation, it has a vital role in reaching net zero targets for the UK.

In helping to make such ambitions a reality, the NHS has not been shy in making a commitment, becoming [the first health system to embed net zero into legislation](#), through the [Health and Care Act 2022](#).

The UK has developed a comprehensive strategy for reducing NHS emissions to net zero through planned interventions at every level of its operations, from the day-to-day care provision, medicines and supply chain, transport and travel to the implementation of digital transformation-led innovations, upgrading hospital infrastructure, including heating, lighting and long-term climate sensitive efforts. Baselineing concerning 1990 has already been conducted – several scenarios were modelled, and an extended set of interventions and carbon reductions were identified.

Net zero within regional NHS trusts

Furthermore, efforts are being made by Academic Health Science Networks in England to initiate work to reduce NHS emissions with regional trusts. I believe there should be synergies between existing NHS Transformation Programmes such as NHS Lean, which emphasises waste minimisation and NHS Digital Transformation, which should support net zero goals.

A broader societal challenge must be overcome if the NHS has any hope of reaching its targets. Reducing patient admissions and patient visits are considered as overarching goals, not only in avoiding capacity bottlenecks and reducing waiting lists but also emissions, as every patient admission is associated with transportation and consumption of medicines and medical consumables, energy, etc.

There are multiple ways to avoid admissions and re-admissions – the fundamental one being building awareness of healthy lifestyles and healthy food habits in children, teenagers and young adults so they do not need as much healthcare. Obviously, it is easier said than done, but a more concerted effort must be made.

Advances in the NHS, including digitalisation

Advances such as the digitalisation of patient services, using AI to predict conditions before they advance, robotic surgeries and the use of 3D printing for both planning surgeries and producing custom-designed surgical tools and implants have all been shown to not only have better clinical outcomes and reduced re-admissions, but also reduce treatment time, thereby improving cost efficiency and indirectly reducing NHS emissions and its carbon footprint.

On the transportation and logistics front, as electric vehicles become more reliable and battery production becomes more environmentally friendly, the NHS might also consider moving beyond petrol and diesel vehicles and consider more novel mobility solutions.

Change is needed to achieve NHS net zero goals

However, despite a willing attitude to create such change, achieving any – if all – of the above will require a significant commitment of time and focus over the next 20-30 years, something which may be in short supply, given that the NHS remains overburdened and underfunded. A vast reduction of NHS emissions is not possible without investment – which poses a significant hurdle at a time when the service is in crisis and making cuts across the board.



Dr Atanu Chaudhuri

Any funding cuts on net zero initiatives will undoubtedly harm progress made so far, halting a more significant challenge emerging. Climate change brings with it health implications, which put further strain on already limited resources. The NHS cannot afford to let up or deviate from its net zero goals, and we cannot afford to sit by whilst it fights fire on both sides.

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REDUCING WASTED MEDICINES: BEYOND NET ZERO TO SUSTAINABLE HEALTHCARE

Dr Nazneen Rahman, Founder and CEO of YewMaker and Sustainable Medicines Partnership (SMP) Director describes how tackling wasted medicines is crucial to achieving sustainable healthcare

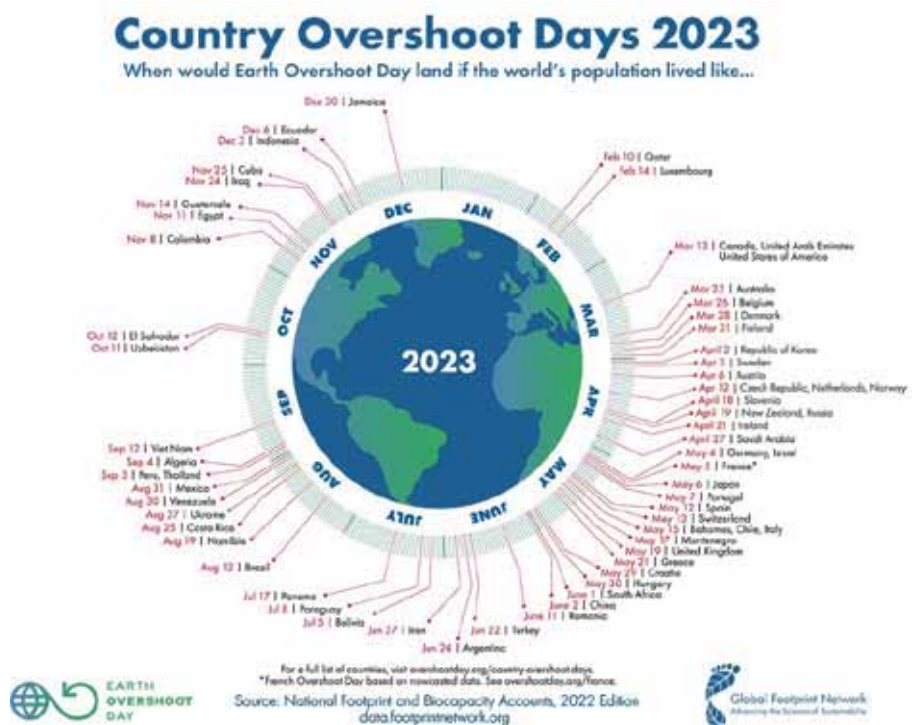
The NHS is responsible for an estimated [4-5%](#) of England's carbon footprint and has committed to become [net zero by 2045](#). "Net zero" refers to achieving a balance between the amount of greenhouse gases emitted into the atmosphere and the amount removed from it. It is an important, challenging, ambitious goal, but it is a milestone not the end of our journey to a sustainable, low-carbon future.

This is because achieving a balance of emissions does not address the underlying problem that humans are over-consuming and depleting Earth's resources at an alarming and ever-increasing rate. Achieving net zero focuses activity on commendable solutions such as clean energy sources and carbon capture technologies. But these are not enough to address the climate crisis.

We need to consume less. We need to waste less. We need to do more with less. We must change our mindsets and our systems to be more careful and purposeful with Earth's resources.

How bad is our current consumption?

[Earth Overshoot Day](#) starkly measures our excessive consumption. It marks the date when humanity's demand for ecological resources in a given year exceeds what Earth can regenerate in that year. In [2023](#), the global Overshoot



Day is August 2nd. In [1973](#), just fifty years ago, it was December 3rd.

Unsurprisingly, there is wide variation in country-level Overshoot Days. We have already passed the [2023 UK Overshoot Day](#), which was May 19th. We would need 2.7 Earths to support humanity if everyone on the planet lived as we do in the UK.

Clearly we need to change, and a priority focus should be to stop wasting resources.

Wasted resources in healthcare

It is well recognised that wasted healthcare resources present a major challenge for national and global health systems. According to a [2017 study](#), up to 20% of health spending in [OECD](#) countries could be better utilised. A [2019 study](#) revealed wasteful spending in the US health system amounts to over \$760 billion annually, representing nearly 25% of total healthcare expenditure.



Image by YewMaker CC-BY 4.0

The medicine supply chain is a significant contributor to wasted healthcare resources and is our focus at [YewMaker](#) and the [Sustainable Medicines Partnership](#) (SMP).

Medicines are wasted for many reasons as I described in a [previous blog](#). Two strategies SMP are prioritising to tackle wasted medicines are 1) reducing medicines that are made but not used, and 2) reducing medicines that are prescribed but not needed:

Reducing medicines made but not used

Any medicine that is manufactured but not used should be considered wasted medicine. It is not possible to eliminate this waste entirely as some excess is required to ensure stable supply. However, there are substantial opportunities to reduce wasted medicines, throughout the supply chain, through improved visibility and inventory management.

One example is the [inventory held by pharmaceutical manufacturers](#), which has been increasing in recent years and varies greatly between manufacturers.

This rise in inventory has occurred at the same time as increasing medicine shortages, suggesting insufficient inventory is not the primary reason for scarcity, rather we need the right inventory in the right locations.

The impact of this one cause of wasted medicines is substantial, resulting in approximately [\\$12.5 billion of medicines being written off](#) last year across 28 pharmaceutical companies whose DIO (days of inventory outstanding) was evaluated by SMP collaborator, [nVentis](#).

Reducing medicines prescribed but not needed

When a person takes a medicine they do not need, it is potentially harmful for them and a waste of that medicine. This becomes an increasing issue as more medicines are prescribed. The percentage of [people receiving prescriptions increased by 65%](#) between 1999 and 2012, and increasing proportions are receiving multiple medicines.

Unnecessary prescriptions are a substantial problem in many countries,

particularly for medicines like antibiotics and painkillers. Overprescription contributes to clinical harms, spiralling costs, and wasted resources. It is estimated [10% of NHS primary care](#) prescriptions are not needed and unnecessary medicines contribute to the 6.5% of hospital admissions caused by adverse drug reactions.

Taking action – Sustainable Medicines Partnership

The root causes of wasted medicines are complex and holistic solutions are needed to tackle them. The [Sustainable Medicines Partnership](#) is an action collaborative of 48 diverse partners working together to reduce wasted medicines, to make healthcare more sustainable and equitable.

SMP is executing a four-year programme aligned to our See-Measure-Reduce-Share action framework. We are bringing awareness and visibility to the problems (See), developing practical metrics to measure current practices and to drive and monitor change (Measure), developing and piloting reduction strategies, with particular focus on overproduction and overprescription (Reduce), and sharing innovations through events, showcases, and publications (Share).

If you are interested in this work please contact us on info@yewmaker.com.



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FINAL MILE CHALLENGES: TRACKING ITEMS TO THEIR ENDPOINT LOCATION

Kevin Sample, Product Consultant at Elcom, examines the final mile challenges in a delivery's journey from R&D to their endpoint location

In healthcare, efficiency not only reduces costs but can also improve patient safety and experience. Solving the logistical issues in a supply chain is a fundamental part of this, with final mile challenges being the cause of significant problems.

Learn more about healthcare's final mile challenges, how they affect healthcare, and some steps towards a solution.

A neglected link in the supply chain

As the name suggests, the supply chain comprises many links to provide an end-to-end solution for ordering and receiving goods.

Some of these links are stronger than others, and have been developed and improved through procurement expertise and the use of technology.

NHS Trusts have P2P or ERP solutions to improve the visibility of ordered products. Once an item is ordered, it can be tracked through Purchase Order Acknowledgements, Advanced Shipping Notices, and delivery tracking apps. However, when the item is received into Goods In, a weakness in the links of the chain is often evident.

Most hospitals do not have a solution that follows an item's internal path to

ensure it reaches its point of use or storage. This can result in items being delivered to the wrong place, delayed, or even lost altogether.

What are some of the final mile challenges associated with delivery?

The delivery of the last mile is one of many final mile challenges in hospital logistics operations.

Some of the issues associated with this inability to monitor the last mile delivery accurately include:

- Loss of items, such as goods being delivered to the wrong location and not being returned;
- Conflict between requestors and the R&D team around timeliness of delivery and whether items were actually delivered;
- Delays or cancellations of procedures because the necessary items cannot be located; and
- Overstocking and carriage charges associated with reordering, where requestors are unaware that their goods have arrived.

A lot of time and effort is put into ensuring suppliers meet contracted lead times and Purchase Orders are

efficiently created and authorised. However, once goods arrive at the Trust, this diligence is rarely as thorough.

Hospitals usually include a mental picture of doctors and nurses, ambulances, and beds. But the smooth running of an NHS Trust is so much more. Property maintenance, parking, catering, and communications are all part of a Trust.

Ensuring that clinical staff have the appropriate support, data, supplies, products, and services is critical to healthcare delivery.

Consider items that are required for an urgent procedure – if these items are not in the right place at the right time, there is no other option but to re-order. Consequently, the number of emergencies or overnight deliveries for the replacement of lost items can increase immensely.

Adding inefficiencies into the process increases costs and the carbon impact of NHS Trusts. This impacts their hard work to meet NHS sustainability plans and targets.

Procurement partnerships and consolidated storage in offsite facilities have grown and will continue to grow, since the inception of the Integrated Care System (ICS) model.

This added layer presents opportunities for cost savings through smarter procurement but also magnifies the final mile challenges. Distribution across several organisations and sites increases the complexity of final mile distribution and the risks mentioned earlier.

How can final mile delivery concerns be solved?

There are four key stages in solving final mile challenges. They are:

- Logging receipt of the goods;
- Adding goods to the delivery round;
- Delivering goods and capturing Proof of Delivery (POD); and
- Analysing and reviewing performance to find additional efficiencies.

The first step is to record the goods' receipt into the Trust; a simplified receipting process is critical in supporting the R&D team. To achieve this, all of the means of ordering goods, like requisitioning systems, NHS Supply Chain ordering, and Inventory Management Solutions, need to be integrated into a single receipting application.

Once goods are booked in, they can be added to a delivery round or route. Depending on need and resource, a round can be a single department or several drop-off points to ensure effective use of the available resources.

Once delivered, POD information can be captured, which is available in real-time to requestors and the wider R&D team. By using technology like handheld scanners, the drop off

location can be scanned, or photographic and signatory details can be captured where possible. The scanning devices also allow communication through messaging apps and team locations monitored through GPS tracking.

Finally, the data captured through the technology used in distribution should be analysed to evaluate final mile challenges in the process.

Several questions should be addressed when analysing this:

- Do some delivery routes take more time than others?
- Do some departments need more, or fewer drop offs?
- If so, are these drop offs is seasonally affected?

The ability to analyse this information means that efficient solutions can help address issues and play a key role in improving the service provided.

Easy-to-use tools with real-time notifications are needed to understand the internal delivery process. Elcom's DistributIN solution offers organisations the opportunity to solve final mile challenges and created an effective, streamlined internal distribution service.

Benefits to organisations include a reduction of overstocking, fewer re-orders due to errors, and a decrease in emergency deliveries.

Moreover, the solution provides real-time stock delivery notifications, using the organisation's network to ensure

timely updates. Trusts can increase delivery efficiencies by planning routes and delivery rounds to help R&D staff complete their deliveries as efficiently as possible.

The first step in solving final mile challenges is to understand the process and how efficient processes, coupled with technological solutions, can address issues and support ongoing improvement.

Follow the link below to see a video explaining the journey to an efficient final mile solution.

****[\(watch here: Challenges, Solutions and The Future: Final Mile Delivery in Healthcare\)](#)****



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TRANSFORMING PLASTIC WASTE INTO SUSTAINABLE CLOTHING

Upcycled Medical Ltd describe the process of transforming plastic waste into sustainable clothing

The plastic pollution filling our oceans poses an urgent and critical problem – not only does it harm wildlife and the environment, but it also poses a direct threat to humans. Ignoring plastic pollution risks macroplastic spreading through every level of the food chain, which would have drastic consequences.

At Upcycled Medical, we realise things need to change and are committed to protecting the environment. Millions of tonnes of plastic enter the oceans annually – our mission is to take that waste and upcycle it into eco-friendly fibres, which we use to make sustainable clothing and fabric.

Our work is defined by what we've called the three Ps:

Protect Our Planet – by collecting plastic waste from seas, oceans, and lakes, we're helping to clean up our environment and save marine wildlife and plants.

Protect Our People – we take the plastic waste and upcycle it into clothing, which uses up fewer natural resources and creates less waste at the same time.

Purposefully Produce Ethical Clothing – we offer a sustainable alternative to other clothing brands and have the lowest verifiable carbon footprint in the world.



Ending plastic pollution on our sustainable clothing process

We're committed to ending plastic pollution and addressing the damage that's already been caused by waste plastic. The first step in our process is collecting plastic waste and harvesting it from the oceans; we also collect it from our partners, including Bupa.

All of this plastic waste is then sorted and turned into pellets and flakes. These are then sent to a factory in Spain, where they're upcycled into polyester yarn.

Instead of ending up in landfills or harming wildlife, this plastic is woven into textiles which we turn into eco-friendly products. NHS workers are already wearing our clothing in Milton

Keynes. Each piece of medical clothing comprises around seven or nine plastic bottles, ensuring we breathe new life into what would otherwise be rubbish.

Our partners also collect plastic waste

We don't work alone. We've teamed up with ocean clean-up programmes and plastic waste collectors to collect plastic waste. We partnered with the SeaQual Initiative and their network of similarly minded organisations - thanks to an agreement that's been endorsed by the Spanish government, they've incentivised fishermen to fight back against marine pollution and trawl the oceans at the end of their working day, bringing back as much marine litter as they can.



As well as plastic, they collect plastic, metal, rubber, glass, and wood – for every kilogramme of yarn that we’ve produced so far, we estimate that we’ve collected between 600 grammes and 1 kilogramme of marine litter.

The collected plastic is upcycled into Seaqual Yarn using innovative recycling techniques. Other companies that make medical scrubs use plastic made in Saudi Arabia, which is then shipped to China to create the scrubs that are shipped here to the UK. This wastes fossil fuels, water, and energy – unlike those companies, we make our products here in the UK from yarn produced in Spain.

Our products: Turn plastic waste into sustainable clothing

While many materials can be upcycled, from wood to textiles, we focus solely on plastic because of how harmful it can be to the environment and how long it takes to protect them.

Since we make our products this way, they’re longer-lasting – and once they reach the end of their working life, they can be recycled all over again and upcycled into new medical clothing.

Our mission is to turn plastic waste – whether bottles, yarn, or old clothing into sustainable clothing. The products we sell at Upcycled Medical are ethically sourced and environmentally friendly and are made from 65% polyester and 35% cotton fabric.

Our clothing products include scrubs, coats, tabards, fleece jackets, and gowns. We also make face masks, bedsheets, and curtains; many medical staff and healthcare professionals currently use our products.

Tackling plastic waste – our future

By taking plastic waste and upcycling it, we aim to eliminate the need to create anything from new plastic and end plastic pollution. We hope to create

more than just clothes – a vast range of products, from shopping bags to designer clothing – could be made from PET plastic pellets.

By working with organisations like the Seaqual Initiative and Bupa, we’re transforming waste management and creating a safer, greener future. Working together, we can revolutionise the manufacturing industry and preserve our oceans for future generations.



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TRANSFORMING TRANSPORT FOR THE NHS: CONNECTED KERB LEADS THE CHARGE

Transforming transport for staff and visitors in the NHS is a prime opportunity for the Government to lead the public sector charge towards a more sustainable future



Time is ticking ahead of 2030 when a UK ban on the sale of new petrol and diesel vehicles comes into force in the UK. Back in March, the Government published its electric vehicle (EV) infrastructure strategy and committed £1.6 billion funding towards its target of 300,000 charging points by this deadline. Policy Exchange states that 400,000 public charging points are needed to fulfil a full EV transition, although some estimates put the figure even higher. But switching to EV is more than just a numbers game – it requires an unprecedented shift in public attitudes, and enforcing that change requires leadership: someone to really show the way.

Transforming transport with EV charging infrastructure

Last year Connected Kerb, one of the UK's leading providers of EV charging

infrastructure, published a report, "[How to meet the UK's charging needs ahead of 2030](#)," a flagship piece of research that included a survey of 2000 people and interviews with industry experts. It was clear that EV users craved convenience the most, offering a series of recommendations to local authorities, charging operators, developers, and central government on what still needed to be done. The report also included a big idea – installing long-lasting, sustainable, affordable electric vehicle charging infrastructure across thousands of NHS sites for staff.

The NHS is a golden opportunity for an ambitious EV infrastructure project. It has over one million employees, and a large fleet of vehicles and operates nearly half a million parking spaces where chargers could be installed. It has a well-established company

car/salary sacrifice scheme that could evolve to encourage EV uptake, while guaranteed workplace charging would de-risk transitioning to an EV. It would also offer a serious subsidy to staff in reduced fuel bills. NHS employees come from various backgrounds across the country, so it could also help spread EV ownership around the UK. It would also show government commitment to the transition at home and abroad. Having a reputable brand such as Connected Kerb pioneering the shift would only boost the reputation of electric vehicles. Such a project offers a chance to position the UK as an EV leader. A deployment of this scale would be the largest in the world and provide a blueprint for other projects. If it was awarded to UK businesses, it could help them scale to become dominant global players that could export around the globe.

There are forces that could pressure the government into pursuing such a project, particularly as it faces significant pressure to meet strict sustainability targets. The current parking estate is already using its maximum capacity. The power for chargers must not interrupt the main supply, and many NHS Trusts simply do not have the funding. Many worry about how revenue from car parks could be affected while the lack of knowledge and conflicting stakeholder objectives is also a threat.

Relying solely on rapid charging is not the answer

The national debate on EVs has long focused on the cost of ownership and range anxiety, but the outlook on both fronts is improving. Another misconception revolves around the speed of charging, where rapids might be preferred to the uninitiated. But Connected Kerb is exploding this belief with a focus on long-dwell charging, deploying in locations where cars may be stationary for long periods of time. NHS staff regularly park for several hours in car parks, providing an ideal opportunity to charge during that time. It is worth remembering that the faster the charge, the more energy capacity required and the higher the up-front cost. Although rapid chargers have their place, an over-reliance on them can impact battery life and durability.

The NHS operates around 436,900 parking spaces at NHS England hospital sites. Current data is not split, but historical data suggests around 200,000 are for staff and the rest for patients/visitors. Similar workplace charging schemes suggest drivers without home charging will charge their

vehicles 2-3 times per week, and those with charging at home less often. A reasonable guide would be to aim to deploy EV chargers in 25% of staff bays, though a full analysis of transport patterns and power availability would be needed at each site. One could assume a deployment of charging infrastructure in 50,000 bays over five years. Once delivered, NHS fleet services and company car schemes could be used to incentivise vehicle transition.

How could such a project of this scale be funded?

A privately funded option would see deployment funded by infrastructure investors who recover the costs by charging drivers. A long-term (15+ years) contract would allow tariffs to be lower than most alternatives. Costs could be increased (e.g. for visitors to generate NHS revenue) or reduced through subsidies (e.g. to incentivise staff) as required. Secondly, through leasing, the NHS could pay an annualised cost for the charging infrastructure and operating costs to the lease provider. They then choose the tariff to be applied for charging and/or whether to subsidise. A third option could see government funding cover capital investment with an option for full or partial cost recovery from user charging.

Connected Kerb's turnkey service

Connected Kerb, backed by a £110 million investment from Aviva Investors is in a prime position to deliver such a project. Having worked with local authorities across the country, it is already building relationships with NHS Trusts that will form the bedrock of their sustainability aspirations.

The London-based firm provides a turnkey service that delivers on all aspects of site selection, installation, operation and maintenance. For example, they provide a desktop feasibility study by our in-house infrastructure planner as well as a 30-minute virtual site tour with an expert site assessor. They provide an on-site feasibility assessment with a recommendation paper delivered by a project manager. An introduction to the firm's installation partners to discuss bespoke requirements on site is complemented by a free of charge Automated Site Assessment programme for fleet initiatives. NHS Trusts will be supported every step of the way with staff able to access EV Masterclasses and join staff awareness sessions on the benefits of charging. You can even join an education and engagement group to share your experiences and ask questions.

For more information and to arrange a call today, please click [here](#).



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HOW TO PRESERVE ENERGY & MAKE A POSITIVE ENVIRONMENTAL IMPACT WITH YOUR MEDICAL FRIDGE

Harrison Thomas, Content Marketing Executive at CoolMed, walks us through what we need to know about energy efficiency and running a medical fridge

Acknowledging the significance of energy efficiency and eco-friendly business practices is essential. Let's delve into the importance of maintaining your medical fridge correctly to conserve energy and contribute to the well-being of our planet. Following these practices is vital for the environment and can be more cost-effective.

This article explores how businesses like [CoolMed](#) strive to implement sustainable measures.

Maintaining a medical fridge to ensure it works efficiently

When purchasing a medical fridge, you should consider your storage requirements to ensure you find the right size. If the refrigerator is too large, you could be wasting energy needlessly, whereas if the fridge is too small, the airflow will be compromised, and the products could be spoiled.

It is also important to follow the "four Rs" daily to ensure your medical fridge is working efficiently:

Read: Daily recordings of the thermometer's maximum, minimum and current temperatures daily.

Record: Record the temperatures accurately.

Reset: Reset the controller after all recordings.

React: Act if the temperature falls outside +2°C to +8°C.

To promote eco-friendly practices and maximise the lifespan of your fridge

while conserving energy, it is crucial to prioritise regular maintenance and servicing. Adhering to the guidelines set by the [MHRA \(Medicines and Healthcare products Regulatory Agency\)](#), it is recommended to have your fridge serviced annually by a qualified engineer and also to calibrate your medical fridge on an annual basis.

By prioritising regular maintenance and servicing, you actively protect your fridge, reduce the risk of malfunctions, and ensure a sustainable and eco-friendly approach to refrigeration management.

Waste electrical & electronic equipment regulations

If your medical fridge was to become faulty or broken, all electric devices must be disposed of correctly. Healthcare facilities must embrace eco-friendly practices to reduce their environmental impact. By aligning with guidelines such as [WEEE \(Waste Electrical and Electronic Equipment\)](#) regulations, businesses can effectively manage electronic waste and contribute to a more sustainable future.

Sustainability with Cool Earth & Earthly

Businesses can continue prioritising environmental sustainability by partnering with environmental initiatives such as [Earthly](#) and [Cool Earth](#). By utilising the tools and systems provided by Earthly and Cool Earth, businesses can actively work towards a greener future and strive to

achieve the highest levels of environmental sustainability.

CoolMed has significantly reduced its carbon footprint through collaboration with Earthly. Together, they have planted 691 trees, removing 591.83 tonnes of carbon from the atmosphere. Additionally, their efforts have supported an area spanning 297,426 square meters, contributing to preserving vital ecosystems.

Embracing eco-friendly practices in business

Businesses like CoolMed are committed to continuous improvement in their eco-friendly endeavours. Every small step counts, and companies can make significant improvements by being dedicated to making a difference one action at a time. By adopting the tips provided, you can also contribute to a more sustainable future while saving unnecessary future investment and maintaining the proper functions of your medical fridge.



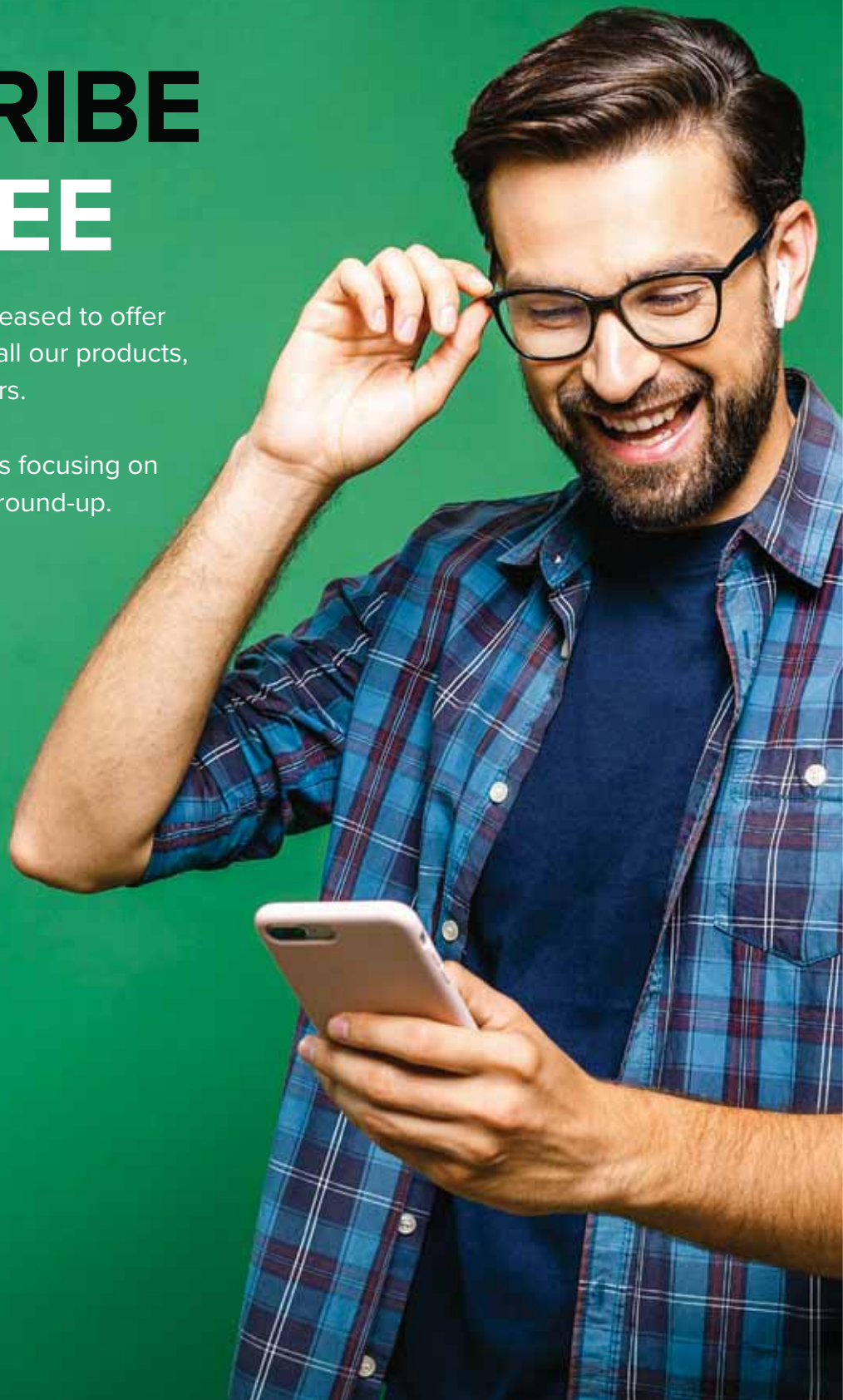
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NCI study outlines opportunities to achieve President Biden's Cancer Moonshot goal of reducing cancer death rates in the United States

From the U.S. National Cancer Institute at the National Institutes of Health (NIH): NCI study outlines opportunities to achieve President Biden's Cancer Moonshot goal of reducing cancer death rates in the United States

Researchers from the National Institutes of Health (NIH) have outlined opportunities for achieving President Biden and First Lady Biden's [Cancer MoonshotSM](#) national goal of reducing the cancer death rate by at least 50% over the next 25 years. A study published April 17 in *Cancer Discovery*, led by researchers at the National Cancer Institute (NCI), part of NIH, has concluded that [achieving this goal will require increased access to and use of interventions known to prevent common causes of cancer death](#).

"Achieving a 50% reduction in cancer mortality in 25 years will be impossible without addressing cancer health equity," said Monica M. Bertagnolli, M.D., director of NCI, who co-authored an [accompanying commentary](#). "For several of the strategies highlighted in this study, improving access is critical."

The opportunities outlined in the study include further reducing the prevalence of cigarette smoking and use of other tobacco products, increasing the use of colonoscopy for prevention and early detection of colorectal cancer, increasing the use of hormone therapy to prevent and treat breast cancer, and increasing detection and treatment of hepatitis B and hepatitis C viral infections to reduce the risk of liver cancer. Additionally, new strategies are needed to reduce deaths from prostate, liver, pancreatic, and other cancers, as well as to address inequities in access to all these interventions.

"There are a lot of tools that we know have reduced cancer death rates substantially for specific cancers, and if those are used more broadly, with greater access,

we feel that this ambitious goal might be achievable," said Meredith Shiels, Ph.D., of NCI's [Division of Cancer Epidemiology and Genetics](#), who led the study.

"Continued innovation is also really important," noted co-investigator Neal D. Freedman, Ph.D., also of the Division of Cancer Epidemiology and Genetics. "If there are new blockbuster drugs for common cancers, for example, or really great new screening tests, or a combination of those things, that would do a lot toward reducing cancer mortality."

The study focused on opportunities for lung, colorectal, pancreatic, breast, prostate, and liver cancers because these together contribute the largest number of cancer deaths in the United States. However, the researchers pointed out that it's also important to prevent deaths from other cancers, including rare tumors and pediatric cancers.

In their projections, the researchers showed that, if the most recent trend in deaths from all cancers combined continues, the overall age-adjusted cancer death rate is estimated to decrease 44% by 2047, falling short of the 50% improvement in cancer mortality rate goal. Cancer death rates would need to decline more rapidly – by an average of 2.7% per year versus the current rate of 2.3% per year – to achieve a 50% reduction by 2047.

The study was conducted by researchers in NCI's Division of Cancer Epidemiology and Genetics, the [NCI Center for Cancer Research](#), and their collaborators, using data from NCI's Surveillance, Epidemiology, and End Results (SEER) Program and the Centers for Disease Control and

Prevention's National Center for Health Statistics. The researchers examined trends in age-standardized cancer incidence, survival, and mortality rates from 2000 to 2019 for all cancers combined, as well as for the six cancers that together account for 57% of cancer deaths: lung, colorectal, pancreatic, breast, prostate, and liver. They then projected the overall cancer death rate in 2047 based on the assumption that current trends would continue.

According to their analysis, because of decreasing cancer incidence and improvements in survival, age-adjusted death rates from all cancers combined declined by 1.4% per year from 2000 to 2015 and by 2.3% per year from 2016 to 2019. These declines reflect substantial reductions in deaths from lung cancer (-4.7% per year during 2014-2019), as well as colorectal cancer (-2.0% per year during 2010-2019) and breast cancer (-1.2% per year during 2013-2019).

Trends in prostate, pancreatic, and liver cancer death rates have been less promising. Death rates from prostate cancer had declined strongly (-3.4% per year during 2000-2013), but the decline has slowed (to -0.6% per year during 2013-2019). Death rates from pancreatic cancer have been increasing (0.2% per year during 2006-2019). Death rates from liver cancer, which had been increasing for decades, recently began to decline (-0.5% per year during 2016-2019). Death rates from all other cancer types combined have declined (-1.7% per year during 2016-2019).

The publication of this study coincides with the release of the [National Cancer Plan](#), a long-term, ambitious framework developed to support a national response to achieving the goals of the Cancer Moonshot, which was first launched in 2016 by then-Vice President Joe Biden to accelerate progress against cancer. Last year, President Biden and First Lady Jill Biden reignited the Cancer Moonshot, with bold new goals to reduce the age-adjusted cancer death rate by at least 50% over the next 25 years and improve the experience of people and their families living with and surviving cancer.

About the National Cancer Institute (NCI): NCI leads the National Cancer Program and NIH's efforts to dramatically reduce the prevalence of cancer and improve the lives of people with cancer. NCI supports a wide range of cancer research and training extramurally through grants and contracts. NCI's intramural research

program conducts innovative, transdisciplinary basic, translational, clinical, and epidemiological research on the causes of cancer, avenues for prevention, risk prediction, early detection, and treatment, including research at the NIH Clinical Center – the world's largest research hospital. Learn more about NCI's intramural research from the [Center for Cancer Research](#) and the [Division of Cancer Epidemiology and Genetics](#). For more information about cancer, please visit the NCI website at [cancer.gov](https://www.cancer.gov) or call NCI's contact center at 1-800-4-CANCER (1-800-422-6237).

About the National Institutes of Health (NIH):

NIH, the nation's medical research agency, includes 27 Institutes and Centers and is a component of the U.S. Department of Health and Human Services. NIH is the primary federal agency conducting and supporting basic, clinical, and translational medical research, and is investigating the causes, treatments, and cures for both common and rare diseases. For more information about NIH and its programs, visit [nih.gov](https://www.nih.gov).

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Source: National Cancer Institute at the National Institutes of Health (NIH). Accessed 24th May 2023.

National Cancer Institute (NCI)
Part of the National Institutes of Health (NIH)
<https://www.cancer.gov/>
<https://www.cancer.gov/espanol>



THE EMERGENCE OF PRECISION MEDICINE FOR ONCOLOGY

Dr Priya Hays, PhD, considers how the rapid development of precision medicine for oncology has impacted diagnosis, treatment, and clinical outcomes in cancer care

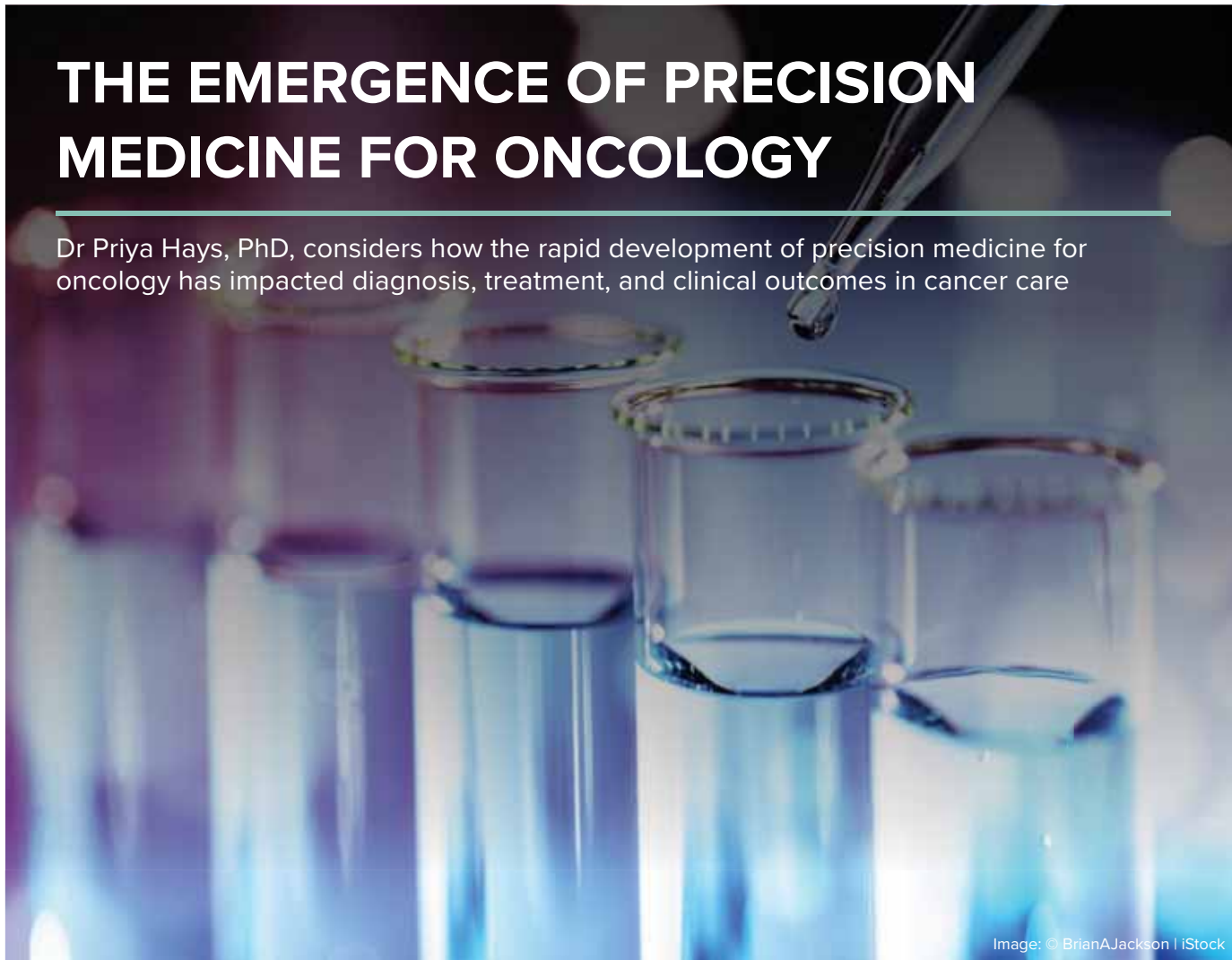


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Personalised medicine, also referred to as precision medicine, had its early conceptual foundations in the Human Genome Project, the multi-institutional effort to sequence the entire base pair sequences of the human genome, or DNA sequences in the cell.

The sequencing revealed variations between individuals in their DNA sequences. This variation, or what came to be known as genomic variation, could be mobilised to differentiate diagnosis and treatment between individual genomes.

Targeted therapies - small molecule inhibitors designed to attack cancer cells exclusively by affecting signalling pathways - were developed as viable

treatment options defined by the personalised medicine pathway.

Precision oncology emerged as a new field encompassing small molecular inhibitors and biologics.

One such small molecular inhibitor that first appeared was imatinib for the targeted treatment of chronic myeloid leukaemia, a blood cell disorder involving myeloid cell precursors.

This design of destroying cancer cells while leaving normal cells intact rapidly expanded to other tumour types such as melanoma, breast cancer, lung cancer, colorectal cancer and prostate cancer, along with other carcinomas

such as renal cell carcinoma and hepatocellular carcinoma, in addition to a whole host of other cancers in blood cell categories such as chronic lymphocytic leukaemia and acute lymphocytic leukaemia.

Precision medicine for oncology in lung cancer

Initial successes of precision medicine for oncology came in lung cancer, which targeted a specific histologic sub-type of lung cancer called non-small cell lung cancer.

Drugs such as lorlatinib for ALK-positive mutations, osimertinib for EGFR mutants, and adagrasib for resistant KRAS mutants were developed for non-small cell lung cancer.

Targets for BRAF mutations emerged for melanoma, and this solid tumour became particularly amenable for immunotherapy approaches such as the immune checkpoint inhibitors nivolumab and ipilimumab, also known as PD-1 inhibitors since they remove the inhibition of cytotoxic T cells to destroy the foreign antigens on cancer cells.

Gene therapy, wherein a patient's T cells could be genetically re-engineered ex-vivo and re-administered back into the patient to kill abnormally expanding cells, also known as chimeric antigen T cells, was developed for paediatric lymphomas, a hematologic malignancy with poor prognosis.

While many of these small molecular inhibitors, biologics and cellular therapies were accompanied by adverse events, including hematologic disorders, cytokine release syndrome and neurotoxicities, ranging from mild to moderate to severe, many responders exhibited robust long-term positive clinical outcomes.

Improving prognostic and predictive indicators in cancer care

It was not only in the realm of treatment that personalised medicine had its impact.

Novel technologies such as liquid biopsy and companion diagnostics accompanied evolving trends in personalised medicine and prognostic and predictive markers such as minimal residual disease; PD-L1 status became relevant in helping cancer patients and their providers manage the disease's genotypic and phenotypic complexity. For breast cancer, the companion diagnostic for HER-2 antibodies was FDA (Food and Drug Administration) approved, along with

Herceptin, to detect the presence of the mutation and improve outcomes.

In addition, diagnostic tools became widely adopted for the predictability of treatments for breast cancer, such as OncotypeDx and MammaPrint.

Traditionally, diagnosis and prognosis of cancers are usually done through tumour biopsy, an invasive way of determining tumour characteristics.

Liquid biopsy, derived from the blood and contains samples of the tumour DNA, is now being developed as a viable approach to characterise a tumour's spatial and temporal heterogeneity and thereby give measured prognostic and predictive indicators.

Liquid biopsy has the additional benefit of being non-invasive.

A whole new world of clinical data

With the advent of personalised medicine, new approaches to clinical trials that complemented randomised controlled trials and took advantage of molecular variation in patient populations entered the medical realm.

Precision medicine trials, such as adaptive trials, have the potential to accelerate the clinical trial and drug development process while reducing overall costs.

These trials involve dividing patient populations by biomarkers and administering targeted therapies accordingly.

Basket trials involve molecular profiling of tumours, while umbrella trials offer distinct treatments based on biomarker results.

Clinical trials in oncology are measured by what are known as endpoints, and these statistical measures give a good indication of the treatment potential of these drugs.

With the advent of personalised medicine, enormous streams of clinical data emerged for analysis and interpretation. KEYNOTE, IMpower, and CheckMate evaluated key targets, particularly immunotherapies, for determining the clinical meaningfulness of precision medicine therapies which for many tumour types has become the standard of care.

Precision medicine for oncology is the 'best thing' to happen in patient care

In this medicine paradigm, personalised medicine has become a mainstay. It is perhaps one of the 'best things' to happen to medicine in recent years in terms of innovation and patient care, with the potential for even greater developments in the future.

However, healthcare equity remains a factor to be considered in ensuring that the benefits of personalised medicine reach all populations.



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PHOTODYNAMIC THERAPY: KILLING CANCER GENTLY WITH VISIBLE LIGHT

Photodynamic therapy, using visible light with lower energy, causes fewer side effects when treating cancer, find Drs. Mary Potasek, Evgueni Parilov, and Karl Beeson, Co-founders of Simphotek, Inc

You are probably familiar with x-ray radiation therapy for treating cancer. But do you know that x-rays are ionizing radiation that can cause damage to many tissues besides killing cancer cells? Simphotek and others are using near-infrared or “gentle” visible light whose wavelength is longer than x-rays and with much lower energy so that it causes fewer side effects.

The novel therapeutic modality known as Photodynamic Therapy (PDT) can do just this. PDT does not cause nausea as chemotherapy does, does not damage ordinary tissue as x-ray radiation does, nor does it require removing or damaging parts of the body as surgery does.

A new approach for killing cancer with light: photodynamic therapy

PDT uses light (usually provided by a laser), a light-sensitive drug and molecular oxygen to trigger multiple cascading events that generate a cytotoxic agent, singlet oxygen, that kills cancer cells. There are various forms of PDT treatment including External Beam or surface (EB-PDT), Intracavity or intraoperative (icavPDT), and interstitial (I-PDT). The first method is used mainly for skin conditions and cancers where the drug is applied superficially, and the treated area is exposed to light. The icav-PDT is usually performed after a surgical procedure, such as lung surgery, where a cavity is either present or formed by the surgery.

A photosensitive drug is administered into the body and is “activated” by the treatment laser light. I-PDT is used to treat solid cancers that are deeper in the body, such as the brain, esophagus, bladder, head and neck, cholangiocarcinoma, lung, and prostate. Light travels only a few millimeters in tissue so another mechanism must be added for successful treatment. These treatments use cylindrical diffusing optical fibers that tunnel the light from external lasers directly into the tumors and uniformly distribute it in the cancerous areas.

The amount of the delivered visible light matters

The amount of the delivered visible light matters, as it should be above a therapeutic threshold established by previous and current clinical trials. Because it is practically impossible to perform measurements everywhere inside the tumor to make sure that the light dose is delivered correctly, computer simulations based on advanced mathematical models of light propagation in human tissue are performed before the treatment starts. The EB-PDT can be done without extensive mathematical simulations, but the last two types of photodynamic therapy require advanced mathematical simulations to determine if the prescribed amount of light is delivered to various sections of the tumor, such that it is sufficient to kill cancer cells.

Simphotek has been supported by United States National Institute of Health (NIH) to create such a simulation research tool for solid cancers and it’s called Dosie™.

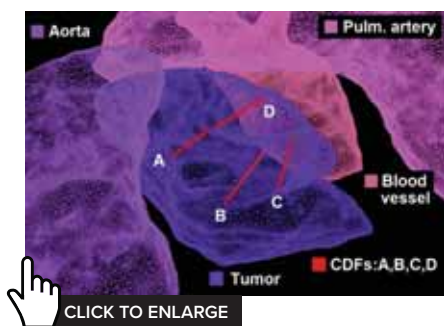
Simulating Cancer Treatment with Dosie

There are several simulation methods that can model certain aspects of the photodynamic therapy process, but they do not cover everything that is needed for complete cancer treatment simulation. To the best of our knowledge, Dosie is the first comprehensive tool to simulate the PDT process including the light transport, drug, and molecular oxygen interactions to create the cytotoxic agent, singlet oxygen, which kills cancer. Treating cancer is complex and just as for radiation therapy, it requires advanced computer simulations.

Treating cancer with light requires advanced computer simulations

Starting with a CT scan or MRI of the tumor, a detailed 3D model of the tumor and its surroundings is created. Using state-of-the-art 3D graphics, Dosie can guide the physician in near real-time during the icav-PDT or I-PDT treatment to visualize the portion of the tumor that receives a therapeutic visible light dose to ensure a uniform light delivery. One of the benefits of using Dosie is its ability to estimate not only the conventional light dose but

Dosie Screen Shot of MCAO-Red lines are fibers



also the state-of-the-art PDT dose (that includes the variation of the drug concentration in the tumor) and singlet-oxygen dose (that estimates the amount of the cancer-killing agent and its distribution). The most common type of PDT is EB-PDT, which is responsible for most of the global PDT market. The total market is anticipated to reach more than USD 15.1 Billion by the end of 2031 and is projected to advance at a CAGR of 13.5% from 2022 to 2031 ⁽¹⁾.

North America is expected to dominate the photodynamic therapy market, due to a high rate of adoption and new product launches by market players ⁽²⁾. Simphotek and its academic collaborators have treated a number of different cancers but the most recent one is non-small cell lung cancer that manifests itself as an endobronchial tumor growth near or inside the airway. Unfortunately, the tumor can become large enough to block the bronchus and in doing so it also becomes intertwined with several other tissues including blood vessels. The mixture of different tissues makes treatment planning difficult.

Image Guided I-PDT Treatment for MCAO

Malignant central airway obstruction (MCAO) is becoming a serious problem for patients with lung cancer. Lung cancer is the most common cancer and the leading cause of death in both men and women ⁽³⁾. The American Cancer Society estimates that for 2023 there will be about 238,340 cases of lung

cancer (67,160 in men and 59,910 in women) in the United States ⁽³⁾.

Global lung cancer market revenue was worth USD 21.1 billion in 2021, growing to USD 67.9 billion by 2030 with a 14.1% CAGR from 2022 to 2030. North America has dominated with more than 35.5% of lung cancer market share in 2021 ⁽⁴⁾. Lung cancer is often treated by radiation and chemotherapy both of which can lead to damaging effects on non-cancerous tissue. Applying PDT does not result in these tissue-damaging problems. In addition, PDT is one therapeutic option for inoperable lung cancer where other options have been exhausted ⁽⁵⁾. A growing problem for lung cancer patients is airway obstructions that can manifest as intrinsic (endobronchial tumor growth), extrinsic (extrabronchial tumor compression), or mixed obstructions.

A potential to improve tumor response and survival

At present, additional treatment options and numerous hospital visits are needed to treat these patients and to improve the tumor response and survival. In contrast, endobronchial obstructions have several treatment options including surgery or heat treatments followed by airway stenting. Therapeutic options for endo/extrabronchial (mixed) tumors are currently limited and treated with stents following balloon dilation. Along with the development of interventional pulmonology, photodynamic therapy is being used in the treatment of respiratory malignant tumors because of its low level of trauma, high specificity, and compatibility with traditional or common therapies ⁽⁵⁾. Simphotek and its academic collaborators are engaged in a Phase I/IIa (NCT03735095) clinical trial to treat MCAO.

This therapy is becoming more common due to advanced primary lung

cancer ⁽⁶⁾. In this trial, to treat MCAO an ultrasound system (Endobronchial Ultrasound, EBUS) is used that images the tumor and guides fiber insertions into the tumor to treat it with I-PDT. Prior to treatment a CT scan of the chest is obtained to identify the airway, the tumor, and the amount of blockage that may be present.

This is imported into Dosie by the study team to simulate treatment. The results of simulations help to determine specific parameters for the treatment: the laser and diffusing fiber configurations. The goal is to treat the tumor's greatest volume with the least exposure to the major blood vessels or other sensitive areas. We hope that this clinical trial will bring us one step closer to our aim of treating patients as safely and effectively as possible.

Summary

We have described a novel light-based method to treat solid cancers with fewer side effects than traditional methods.

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THE NEXT FRONTIER IN ANTI-CANCER DRUGS

Dr Anthony J. Berdis, Case Comprehensive Cancer Center discusses the future of cancer treatments and anti-cancer drugs

Being diagnosed with cancer is a horrifying experience for patients and their loved ones. What comes next – discussing treatment strategies – can also strike terror due to the numerous uncertainties associated with the process, procedures that will be used, and possible outcomes. Most cancers are treated using combination therapy in which surgery and/or radiation is first used to remove and eliminate as much cancerous material as possible. This is then followed by several rounds of chemotherapy, an anti-cancer drug designed to eradicate any remaining cancer cells. The goal of this strategy is to achieve remission or at least delay the cancer from returning for as long as possible.

Mechlorethamine was the first FDA-approved anti-cancer drug

Chemotherapy became standard of care in the 1950s, and the approach was to use a single drug. This monotherapy approach was based, in part, on the accepted clinical concept of

using “one drug to treat one disease”. Initial support for this approach was based on early success of Mechlorethamine in treating diffuse large cell B cell lymphoma.

Remarkably, this drug was born on the battlefields of Europe during World War I, and in 1949 was the first FDA-approved anti-cancer drug. At the cellular level, Mechlorethamine is a DNA damaging agent remarkably similar in chemical composition to sulfur-mustard gases used in trench warfare. Based on the efficacy of Mechlorethamine against lymphoma, other DNA damaging agents such as cyclophosphamide, BCNU, and cisplatin were subsequently developed and used to treat a wide variety of solid tumors including colon, lung, breast, and pancreatic cancers.

How successful is monotherapy?

Unfortunately, monotherapy is only modestly successful in producing

disease free survival over a 5-year period. This lack of efficacy is caused by several interrelated problems. First, the axiom of “one drug to treat one disease” does not apply to cancer since most tumors are heterogenous as they consist of different sub-populations of cells that can be sensitive or resistant to a singular anti-cancer agent. Oncologists quickly began to combat this problem by treating patients with mixtures of different chemotherapeutic agents. The goal is to attack different cellular targets responsible for cancer progression and those responsible for drug resistance.

These combinations can also improve the efficacy of each other, generating a synergistic cell-killing effect to eliminate more cancer cells. This synergy means that patients can be treated with lower drug doses to still kill cancer cells without causing significant side effects by damaging normal cells. This strategy has two beneficial effects – first, by extending the life of the

patient and secondly, by improving their quality of life.

How do we decide on anti-cancer drug combinations?

The types of drug combinations used clinically depend upon the type and stage of cancer being treated. Since DNA damaging agents were historically developed first, most combination strategies evolved initially to improve their efficacies and/or combat drug resistance. For example, unresectable pancreatic cancer was originally treated using a combination of the DNA damaging agent, cisplatin, and gemcitabine, a nucleoside analog.

This combination provides a classic “one, two punch” in which the DNA damaging agent kills cancer cells by inhibiting DNA synthesis while the nucleoside analog reinforces these cell killing effects by also inhibiting DNA synthesis and by blocking the repair of damaged DNA produced by cisplatin. This combination is being replaced by the “FOLFIRINOX regimen” that simultaneously uses three drugs, 5-fluorouracil, a nucleoside analog combined with two DNA damaging agents, irinotecan and oxaliplatin.

Despite improving disease free survival, combination therapies using DNA damaging agents still suffer from producing adverse side effects that compromise effective treatments. As a result, there is now a growing shift in combining different classes of agents during treatment. Perhaps the fastest growing compounds in this area are termed “checkpoint inhibitors”. These are monoclonal antibodies that do not directly kill cancer cells like DNA damaging agents do but rather improve normal immune function to find and eliminate cancer cells within the body.

Distinguishing foreign cells protects our bodies

One key function of the immune system is to distinguish normal cells from foreign cells such as bacteria, viruses, and cancer cells. This identification process is mediated in part by “checkpoint” proteins present on cells that can activate (or deactivate) a full immune response against foreign cells. For example, PD-1 is a checkpoint protein present on specific immune cells called T cells that functions as an “off switch” to prevent T cells from attacking normal cells. This communication is mediated by the binding of PD-1 to another protein, PD-L1, present on normal cells. The interaction between these complementary partners prevents T cell activation to generate an abnormal autoimmune response.

However, some cancer cells have adapted to express large amounts of PD-L1 on their cell surface. In this case, binding of PD-1 to the excess amount of PD-L1 stops the T cell from attacking the cancer. To block this process, monoclonal antibodies such as Pembrolizumab (Keytruda) and Nivolumab (Opdivo) that by targeting PD-1 to block binding to PD-L1 boosts the immune response against cancer cells. Keytruda was initially approved in 2014 to treatment numerous malignancies including certain types of skin cancers, breast cancers, and colon cancers. Today, it is often combined with the DNA damaging agent, carboplatin, and paclitaxel (microtubule inhibitor) to treat various types of lung cancer.

The next frontier in combination chemotherapy

It is clear that tumors do not exist in isolation from other cell types in the body. Indeed, the tumor microenvironment, a diverse

ecosystem surrounding the cancer, can directly affect cancer progression and treatment outcomes. Thus, intricacies associated with typical tumor heterogeneity become exponentially more complex due to the co-existence of cancer cells with microorganisms including bacteria, viruses, and even fungus that can influence the activity of chemotherapeutic agents.

A recent study showed that bacteria can metabolize the drug gemcitabine to render it ineffective against pancreatic cancer. Thus, the next frontier in combination chemotherapy will likely combine anti-cancer agents with anti-microbial agents to eliminate bacteria that may adversely affect treatment outcomes. However, this is not likely to be a simple task as it will be necessary to generate selective anti-microbial agents that only kill “bad” bacteria while leaving “good” microbes unaffected.



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OVARIAN CANCER RESEARCH: EXAMINING OVARIAN FUNCTION AND DYSFUNCTION

JoAnne S Richards, PhD, Professor at Baylor College of Medicine, explores ovarian cancer research with a focus on ovarian function and dysfunction

The ovary is the female gonad responsible for supporting 1) follicular development, 2) ovulation of fertilizable oocytes/eggs and 3) luteinization to maintain viable offspring during pregnancy. Ovarian follicles produce estradiol that induces the surge of pituitary luteinizing hormone (LH); this initiates ovulation and the release of a fertilizable egg/oocyte. After ovulation, follicular cells (granulosa/theca) form progesterone producing corpora lutea that maintain pregnancy if a viable embryo implants (Figure 1).

Ovarian Preovulatory Follicle

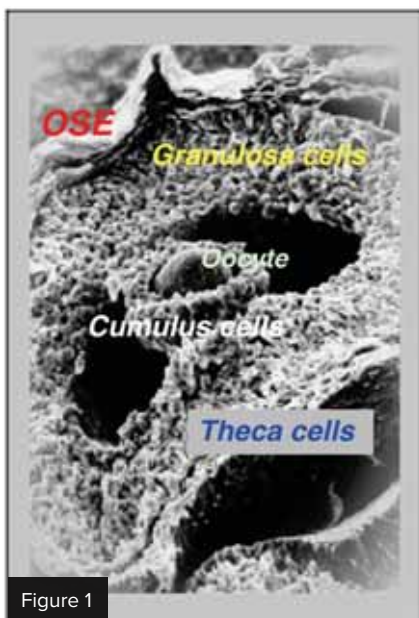
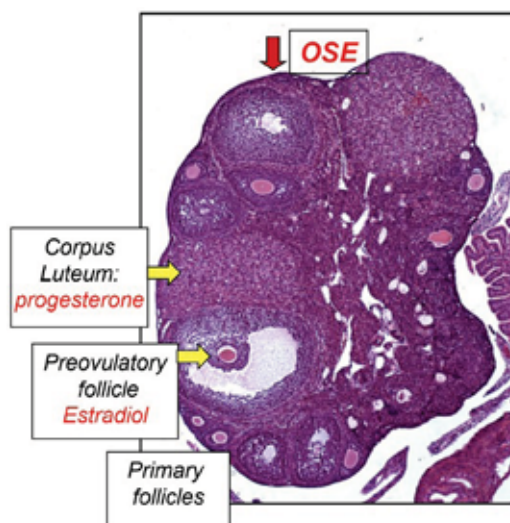


Figure 1

Ovarian cancer is largely a misnomer because the cells giving rise to malignant tissue are not derived from either follicular or luteal cells.

Mouse Ovarian Morphology;
Single Layer of OSE cells



Mouse Ovarian Surface
Epithelial (OSE) Tumor Cells

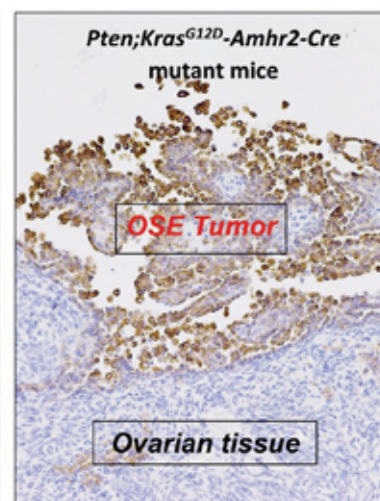


Figure 2

Instead, ovarian cancer cells evolve from ovarian surface epithelial cells (OSEs) that cover the surface of the ovary and fallopian tube and separate these tissues from the abdominal peritoneal cavity. Unlike other cancers that metastasize through the vascular system, ovarian cancer cells detach from the ovarian surface, disseminate and grow in the peritoneal cavity (Figure 2).

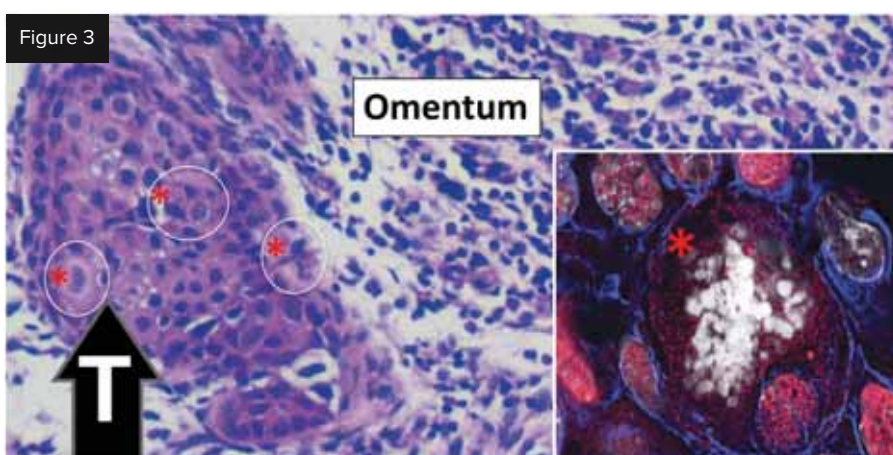
What are the causes of ovarian cancer?

The answers to this question are complex. There is not just one, but many underlying factors. However, the most common cause that initiates cancer involves mutations in specific

genes, such as tumor protein 53 (*TP53*), *BRAC1/2*, *KRAS*, *PTEN*, that lead to abnormal cell proliferation and evasion of cell death. Many of these genes are involved in DNA repair, essential for maintaining normal gene expression; others are involved in metabolic/growth regulatory pathways.

Our studies in mice documented that mutations in *p53*, *Kras* and *Pten* in ovarian surface epithelial cells led to epithelial ovarian cancer and provided us with the first model of ovarian cancer that occurred early and was 100% penetrant (Figure 2). By depleting the tumor repressor protein 53 (*Trp53*; *p53*) gene in the *Kras/Pten* mutant mice, we discovered that wild type *p53*

T, tumor cells on the omentum in the peritoneal cavity, *PGCCs (multinucleated) in a metastatic tumor of human HGSOE cells on the omentum. Insert: Polyploid giant cancer cell (*center). The cell membrane is blue, the large abnormal chromosomes of DNA are white and the protein p53 is stained red. Normal, much smaller cells surround the PGCC.



was essential for tumor growth, whereas cells lacking p53 developed only small tumor lesions. By contrast, p53 null epithelial cells were exquisitely sensitive to steroid hormones, becoming highly metastatic when exposed to estradiol. Human high-grade serous ovarian cancer cell lines provide models to study the role of mutant p53 in tumor formation. One hallmark of these HGSOE cells is the presence of polyploidy giant cancer cells (PGCCs) (Figure 3).

Why is ovarian cancer so deadly?

Ovarian cancer is lethal because **1)** it is usually detected at a late stage, **2)** surgical removal of malignant tissue from the peritoneal cavity is rarely, if ever complete and **3)** the cytotoxic drugs used to block ovarian cancer progression routinely lead to drug resistance and persistent tumor growth. The latter is particularly

devastating because drug resistance is associated with, and likely mediated by the generation of PGCCs that evade senescence/cell death by a special replication process that gives rise to daughter cells with altered genetic features that confer drug resistance.

“...ovarian cancer cells evolve from ovarian surface epithelial cells (OSEs) that cover the surface of the ovary and fallopian tube and separate these tissues from the abdominal peritoneal cavity.”

1&2) Detection and surgical removal of ovarian cancer

Because ovarian cancers metastasize to the peritoneal cavity, they develop into large structures before they are detected. Although many studies have identified specific markers of ovarian cancer cells in patient serum samples, such as CA125, tumors are large before this method is sensitive enough to be reliable and effective. Therefore, newer

technologies are needed to improve the method and sensitivity of detection. Regrettably, surgical removal is risky and never complete.

3) Cytotoxic drugs and PGCCs

The common strategy for reducing ovarian cancer is the administration of cytotoxic drugs, paclitaxel and cisplatin, that target microtubule integrity and thereby impede cell division/proliferation. Although these drugs are initially effective in causing cancer cell death, the drugs, at the doses that can be safely administered to women, can also cause stress responses in cells that lead to the generation of PGCCs. PGCCs evade senescence/death by entering a specific type of cell replication, known as endoreplication.

Endoreplication normally occurs in early embryonic fetal development and

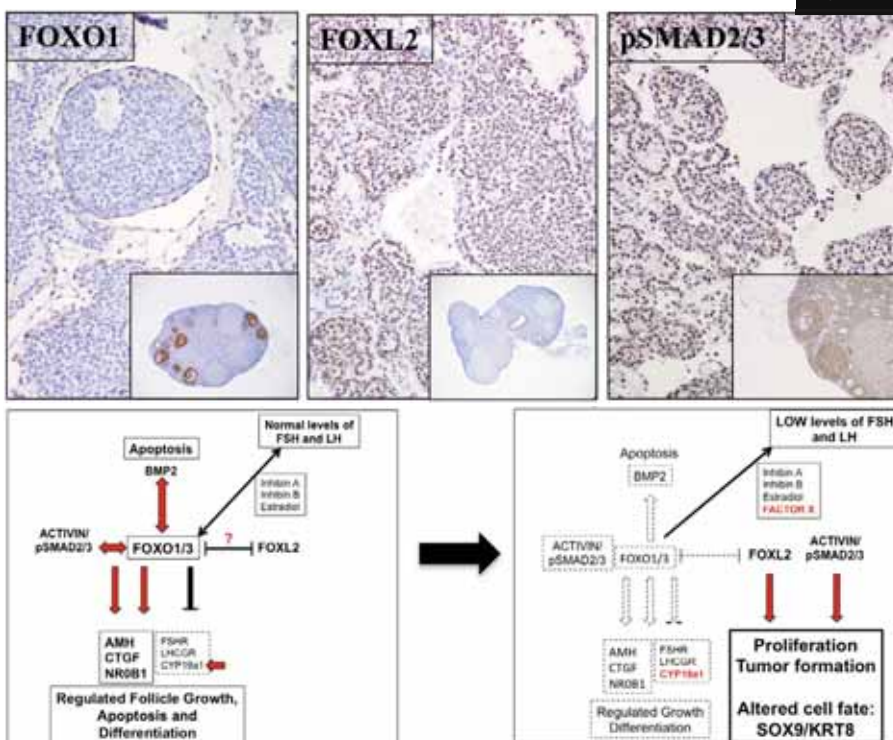
provides cells with the ability to generate daughter cells in which DNA rearrangements occur, leading to genetic diversity. In ovarian cancer cells, endoreplication generates daughter cells that are resistant to the cytotoxic drugs; hence tumor progression continues with cisplatin or paclitaxel treatments. Thus, ovarian cancer research investigators are searching for new therapeutic drugs that will disrupt the endoreplication cycle.



“Ovarian cancer is largely a misnomer because the cells giving rise to malignant tissue are not derived from either follicular or luteal cells.”

Foxo1/3 depleted GCTs express high levels of FOXL2 and pSMAD2/3

Figure 4



Foxo1/3 sit at the hub of granulosa cell fate decisions in growing follicles

Foxo1/3 depletion alters granulosa cell fate decisions leading to proliferation and tumor formation

Ovarian granulosa cell tumors

Granulosa cells are rare. Our studies have shown that targeted disruption of *Foxo1*, *Foxo3* and *Pten* in granulosa cells leads to the formation of granulosa cell tumors that exhibit many characteristics of adult granulosa cell tumors in women and express specific granulosa cell markers (FOXL2/SMAD4); hence they are highly proliferative but retain granulosa cell identity (Figure 4).

What does the future hold for ovarian cancer research?

Ovarian cancer is unique concerning cell type and the site of metastasis. However, the underlying events that lead to uncontrolled proliferation are shared with other cancers, such as triple negative breast cancer. As with other cancers, cytotoxic drugs are only partially effective in preventing tumor growth; new therapeutic approaches

are needed. Perhaps someday, there will be a novel immune approach or a way to eliminate PGCCs.

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TAILOR-MADE PROMOTION

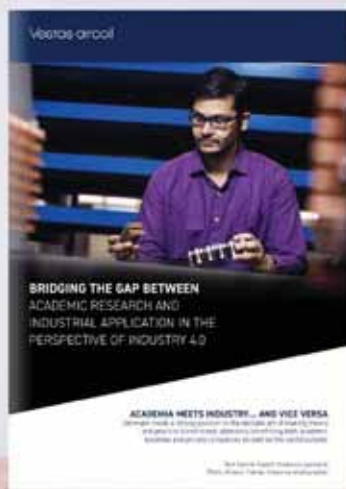
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CLINICAL TRIAL CHALLENGES FOR NEW TECHNOLOGY IN RADIATION ONCOLOGY

Stephen Kry, Professor from the [University of Texas MD Anderson Cancer Center](#), explores clinical trial challenges for new technology in radiation oncology, including the radiotherapy treatment technique, proton therapy

While novel drugs must show efficacy before they are approved for clinical use, there is no such requirement for the new technologies that drive development in radiation oncology. As long as the technology is shown to be safe, it can be implemented. One advantage of this is that it allows new treatments to be implemented very quickly into clinical practice as there are relatively few scientific and regulatory requirements.

On the other hand, there is little data to demonstrate which patients stand to benefit or the degree of benefit received by the patient. Expensive new therapies are, therefore, often implemented with little more than a theoretical justification. Despite not being required, clinical trials comparing novel treatments to traditional ones are the most clear and robust method for establishing the value and efficacy of these advancements.

However, clinical trials evaluating novel technologies have unique challenges compared to traditional trials of novel drugs. While the technical administration of drugs is not generally in question, the lack of clinical experience and familiarity with novel technologies create real and substantial challenges to optimal care delivery. Additionally, any significant change in technique or technology is invariably associated with iterative refinement, as the initial release will invariably leave room for advancement.

Because of these two issues, it takes years, or often decades, for the community to optimally understand how to use novel technologies and for novel technologies to evolve enough to start meeting their potential. This is a substantial problem for trial design; conducting a trial with a novel technology that isn't being used to its potential sets it up for failure, even when it may have excellent long-term capabilities.

Radiotherapy treatment technique – proton therapy

A contemporary example of this issue is found with the relatively new radiotherapy treatment technique of proton therapy. Since the 1930s, radiation therapy has been conducted using large doses of x-rays to treat solid tumors. Naturally, there has been a dramatic evolution of x-ray treatments during this time. A major change in technology over the past decade is the increasingly mainstream use of highly accelerated protons, instead of x-rays, to kill tumor cells.

Proton therapy has substantial theoretical advantages compared to x-rays, but is also a much more expensive modality. It is ultimately unknown when proton therapy is worthwhile and for which types of patients. What is clear is that with ten years of experience delivering proton therapy, we are much less skilled at using this tool than we are at using x-rays, with which we have 90 years of

experience. X-rays are undoubtedly an inferior tool, but we are exceptionally good at using them.

Clinical trials comparing proton therapy to x-ray therapy are being undertaken to evaluate the advantage of protons in treating lung, esophageal, prostate, and other tumors. Despite the clear theoretical benefit of protons, trial results show, at most, a modest benefit. However, the outcomes from proton therapy are based on a relatively crude use of this novel technology. Even in the past ten years, there has been substantial clinical practice growth and familiarization with delivering proton therapy, along with simultaneous evolution in the technical aspects. For example, the three-dimensional shaping of the dose distribution has already become far superior (leading to more sparing of healthy tissue and less toxicity), and treatments are more robust to patient movement or changes in the patient's internal anatomy. The proton clinical trial results that are just being reported are already bordering on being obsolete, are often not representative of current practice, and are far from capturing the full potential of this novel technology.

This is a systemic challenge when running clinical trials for novel technologies. As the technologies are constantly evolving and refining to enhance patient outcomes, and as practitioners gain increasing familiarity

with these refinements, it is impossible to compare two different approaches cleanly. We can only compare two different approaches with different histories. Any evaluation is not simply x-ray versus proton therapy, but rather highly honed x-rays therapy versus nascent efforts with proton therapy. Importantly, it is critical that the nascent nature of novel technology does not undermine its performance in clinical trials. Several guiding principles should be met to minimize this risk.

Clinical trials for new radiation oncology technology

First, novel technology should be evaluated to ensure it is being optimally used (at least as well as current standards allow). This is often done by clinical trial quality assurance bodies, such as the Imaging and Radiation Oncology Core, which supports several-hundred clinical trials from the National Cancer Institute in the United States. Several active trials are comparing (or allowing as a radiotherapy modality) proton therapy.

Before any proton therapy facility can enroll patients in trials, they must undergo extensive evaluation by the Imaging and Radiation Oncology Core (as described under the proton approval process at <https://irochouston.mdanderson.org>). This evaluation includes verifying that accurate radiotherapy doses are correctly delivered under various clinically relevant scenarios (e.g., through surrogate patient irradiation test) and verifying that the facility employs up-to-date and best clinical practices. Importantly, this process is iterative so that institutions have a chance to improve their practice, and it is done in a scientific context (not a regulatory one) to promote a collaborative move to treatment optimization.

Second, as technological evolution and clinical practice standards often develop and change most rapidly immediately following their clinical introduction, trials comparing new technologies should not be immediately compared to clinical standards. There must be some time for the basic evolution of technology and basic familiarization of techniques before efficacy can be meaningfully examined. How long a wait is required depends on how complicated the novel practice elements are, but an appropriate interval should be implemented while never losing sight of the critical need for a high-quality evaluation based on a clinical trial.

The Imaging and Radiation Oncology Core has historically not allowed institutions to even be evaluated for potential participation in proton clinical trials until they have six months of clinical practice to become familiar with this technology. But this is after more than a decade of broader technical refinement of this technology by the community and manufacturers as a whole.

In working with proton institutions, the Imaging and Radiation Oncology Core has identified numerous qualitative and quantitative areas for improvement at individual proton centers (Taylor 2016; Taylor 2022). These issues have included incorrect calibration of imaging and treatment equipment, and deficiencies in clinical practice. The Imaging and Radiation Oncology Core has also identified systematic problems with early features of proton therapy technology, including major inadequacies in the way the intended dose was calculated (Taylor 2017). These sorts of findings have made critical progress in raising the technological bar of this novel technology, raising and standardizing

the clinical practice of this novel technology, and setting the stage for the best currently possible clinical trials to evaluate this novel technology.

Positively impacting patient care & clinical trials

While there are clearly challenges in conducting trials with novel technology, a rigorous, robust, and appropriately timed evaluation of institutions using novel technology, such as that implemented by the Imaging and Radiation Oncology Core, is a well-proven approach that positively impacts patient care and clinical trials.

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Nutrition research for acute childhood leukaemia

Dr Zisis Kozlakidis explores the value of nutrition in acute childhood leukaemia diagnosis and treatment

The global burden of cancer in children is expected to rise, with recent projections estimating that 6.7 million incident cases will be diagnosed between 2015 and 2030. ⁽¹⁾ The great majority of these patient cases are anticipated to occur in low- and middle-income countries (LMICs) where population growth, changes in lifestyle plus exposure to environmental pollutants all play a part as major contributing factors.

Acute leukaemia is one of the most frequently diagnosed types of cancer among children and adolescents, with an estimated worldwide incidence of approximately 46 cases per million per year in children aged 0-14 years. ⁽²⁾ Despite the relatively high frequency within childhood cancers, the causes are not well understood. For example, acute childhood leukaemia is well-linked to X-ray radiation exposure, specific forms of chemotherapy and some genetic syndromes – yet all of these causes taken together may only explain as low as 10% of all diagnosed cases. ⁽³⁾ Therefore, there is a need to widen our understanding of the causes, and in doing so, the underlying opportunities for future preventative and therapeutic opportunities might also emerge.

The impact of lifestyle on acute leukaemia

The very different incidence observed for acute leukaemia by geographic regions worldwide has led many scientists to propose that lifestyle and environmental factors, which are also highly regionally specific, may be inherently involved in its aetiology. This is not the first case where such distinct regional variations have been observed regarding specific cancer incidence. For example, kidney cancer in adults also displays a high geographically dependent incidence, with the highest rates in Europe registered in Czechia and the lowest in Cyprus and Bulgaria. Ongoing studies are currently attempting to elucidate the underlying environmental factors contributing to these highly specific regional patterns.

For childhood leukaemia, a peak incidence occurs at approximately two to five years of age. Therefore, it is reasonable to assume that factors during pregnancy or the very first years of the child's life might play a role. For example, studies have shown that maternal smoking and alcohol consumption during pregnancy contributes to the emergence of acute leukaemia.

These two behaviours, i.e., smoking and alcohol consumption, are strongly linked with the development of many other cancers, and as such, it was an unsurprising outcome. However, they constitute only part of the picture and still little is known about the impact of other lifestyle factors, such as, for example, the mother's overall diet.

The importance of nutrition in cancer diagnosis and treatment

The overall diet or nutritional status is a measurable and modifiable factor often not considered during cancer diagnosis and treatment; therefore, its clinical impact remains understudied and undervalued.

Addressing poor nutrition, for example, in LMICs, is a complex challenge because of its multifactorial nature. It is often caused by a combination of lack of available fresh food, lack of education, and low socio-economic status, and this complexity also impacts the competing demands on clinicians in LMICs, where the treatment of more acute clinical symptoms would be prioritised.

In many regions, e.g., many locations in sub-Saharan Africa, endemic rates of undernutrition remain at high levels. At the same time, the rapid increase of obesity in LMICs leaves clinicians faced with managing the double burden of malnutrition and initiating treatment for cancer.

Improving the nutritional status of children is a worldwide aim to ensure their health and flourishing in later life;

even more so in children with cancer in LMICs, where an improved nutritional status is expected to enhance their prospects for survival during and post-therapy, as has been demonstrated in high-income settings. Therefore, understanding and monitoring the nutritional status of children undergoing cancer treatment can be a critical component for delivering optimal care, particularly in LMIC settings where the availability of medications may be otherwise limited.

A broader definition of malnutrition was established jointly by the World Health Organization (WHO) and the Food and Agriculture Organization (FAO) to address the coexistence of under-nutrition (inclusive of wasting, stunting, and micronutrient deficiencies) and overweight and obesity (imbalance of energy, proteins, and micronutrients) and their implications with the growing global challenge of noncommunicable diseases, such as cancer. Thus, understanding the nutritional status of children in LMICs and its clinical impact is becoming an essential component of cancer prevention and care, especially as more paediatric cancer units will be established in LMICs in years to come.⁽⁴⁾

The International Agency for Research on Cancer (IARC), an executive research agency of the WHO, in collaboration with the International Initiative for Pediatrics and Nutrition (IIPAN) at Columbia University, U.S., are launching in 2023 an ambitious set of research activities in many locations worldwide, aimed to monitor the nutritional status of children with cancer, and how the lifestyle and nutritional factors may influence the outcomes of cancer treatment, with particular emphasis at first instance on acute childhood leukaemia.⁽⁵⁾

Understanding nutritional factors for developing paediatric oncology research

Conclusively, understanding lifestyle and nutritional factors can be used as a basis for developing interventional research in paediatric oncology aimed at disentangling the complex relationships between nutritional status, therapeutic efficacy, prognosis, and survival. Furthermore, nutrition also has the potential to be used as a proactive, preventative tool towards lowering cancer incidence.

As improvements in access to care, training of healthcare professionals, and elements of supportive care have led to clinically significant gains in survival for children with cancer in several regions across the globe; the understanding of lifestyle and nutrition can complement and strengthen further this progress.

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DEVELOPING NOVEL THERAPIES FOR CHILDHOOD SOLID CANCERS

With a particular focus on glioma, Dr Peter J Houghton from Greehey Children's Cancer Research Institute outlines the barriers that have hindered the development of effective therapies for childhood solid cancers

Childhood cancer represents less than 1% of human cancers, thus, is not a priority for drug development in the pharmaceutical industry. However, the consequences of having a child diagnosed with a malignant disease can be devastating for families. Developing new therapies for childhood solid cancers presents certain constraints that are seldom encountered with neoplastic diseases diagnosed in adults.

Childhood tumours are rare, which has therefore restricted large-scale drug evaluations or randomised clinical trials. For example, of the new Phase I agents evaluated in adult malignancies, less than 30% receive an adequate assessment in children.

Furthermore, drug-screening strategies focus on selecting new anti-cancer agents with specific activity against adult neoplastic diseases (e.g. colon, lung, breast, etc.) so that agents with specific activity against childhood malignancies might not be identified.

A further restriction on drug development is that many 'common' solid cancers and tumours seen in children respond to drugs of established efficacy, resulting in many patients being cured. This ethically precludes the use of 'experimental' agents in many untreated cases.

Poor prognosis of advanced or metastatic solid cancers

Advanced or metastatic solid cancers in

children have a poor prognosis. For most patients with metastatic disease at diagnosis, the long-term event-free survival (EFS) is less than 30%.

Current therapies include all the known active agents plus radiation, but neither the intensification of chemotherapy by increasing the dose of drugs or adding active agents to standard agents nor the use of high-dose chemotherapy with stem-cell rescue have improved outcomes over the last 30 years.

Certainly, these data question the value of continuing to develop classical cytotoxic therapies. However, genomic studies have revealed few mutations that can be exploited therapeutically.

Challenges in developing effective therapies for solid cancers

One of the major problems in developing effective therapies that do not lead to resistance is that we have very little knowledge of changes in tumour characteristics during the evolution of resistance under therapeutic stress.

Rarely are tumours biopsied at relapse; hence mutations conferring resistance are not documented, and the characteristics of the relapse tumour are largely unknown. Genetic changes have been shown to confer drug resistance to cytotoxic agents through gene amplification or point mutations in genes encoding the drug target.

However, much less is understood about resistance mechanism(s) selected for very complex multi-drug regimens. There are a multitude of reasons why drug therapy fails in advanced diseases. Drugs can be excluded from brain tissue by the blood-brain barrier (BBB) for brain tumours, exacerbating drug failure.

Brain tumours constitute about 21% of paediatric cancers; low-grade tumours occur most frequently. While the survival rate for these patients is relatively good, even at five years, these indolent tumours progress.

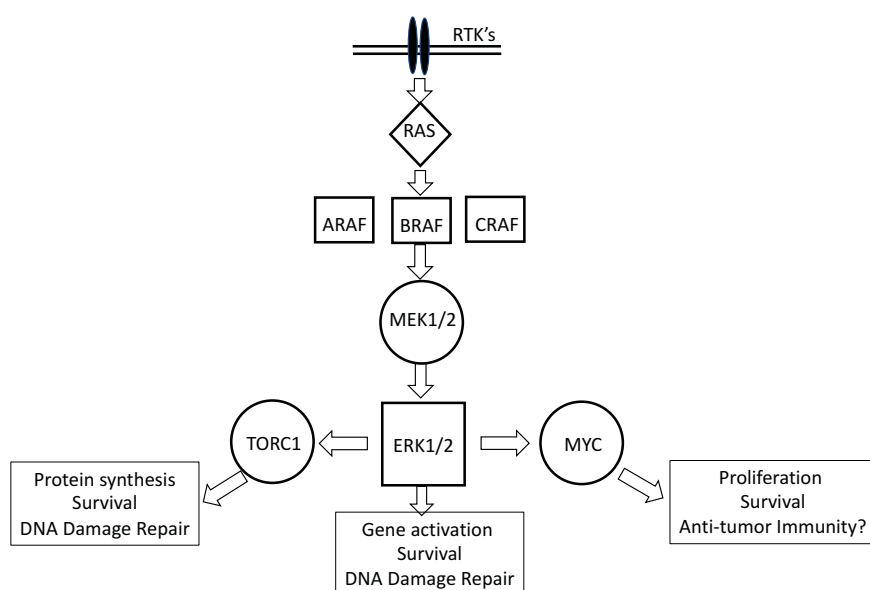
Current treatments and treatment-resistant progressive disease

Current treatment of glioma includes intensive chemo-radiation therapy that leads to cognitive decline, malignant transformation, and other life-debilitating or threatening sequelae.

The 15-year incidence of adverse outcomes such as blindness, hearing loss, obesity, and hormonal imbalance was 18%, 22%, 53% and approximately 25%, respectively. Among survivors assessed for intellectual function, 34% had an intelligence quotient (IQ) below average.

Treatment-resistant progressive disease is the most common cause of death.

Genomic studies have shown that in low-grade tumours (juvenile pilocytic astrocytoma), ~90% have a tandem



In normal cells, MAPK activation occurs after growth factor binding to membrane-bound RTKs. In glioma cells, activating mutations of BRAF abrogate the requirement for growth factor binding and constitutively activate downstream components of the pathway leading to proliferation and survival

duplication involving the KIAA1549 and BRAF genes that generate constitutively active KIAA1549-BRAF fusion. Higher-grade tumours tend to have activating point mutations of BRAF, most frequently the V600E variant (where glutamic acid is substituted for the naturally occurring valine).

Such activating mutations are identified in diffuse astrocytomas (23%), gangliogliomas (33%), and pleomorphic xanthoastrocytoma (70%). Some 10-15% of paediatric glioblastomas and many epithelioid glioblastomas also carry this mutation. It is estimated that around 1400 new paediatric BRAF mutant brain tumours are diagnosed annually in the US.

The MAPK pathway

A common characteristic of these solid cancers and tumours is receptor tyrosine kinase (RTK) activation of the MAPK pathway, highly simplified in the Figure. Low-grade glioma activation of BRAF abrogates the requirement for growth factor-induced signalling activation.

First-generation BRAF inhibitors (BRAFi) are not active against tumour cells with the KIAA1549-BRAF fusion, and preclinical data from childhood astrocytoma xenografts in immune-deficient mice were important in demonstrating selective anti-tumour activity of selumetinib (a MEK inhibitor that blocks signalling downstream of mutant BRAF) only in BRAF(V600E) mutant astrocytoma.

Such data was used to develop Phase I (PBTC029) and subsequent selumetinib Phase II trials of selumetinib that demonstrated high-level activity, with around 40% of patients having tumour control over two years.

Could selumetinib be an alternative?

These clinical results show that selumetinib could be an alternative to standard chemotherapy and led to two COG Phase 3 studies comparing standard chemotherapy to selumetinib in patients with newly diagnosed LGGs. In the Phase 2 trial, treatment was limited to two years as the long-term

consequences of MEK inhibitors in children were unknown.

In those patients with tumours driven by KIAA1549-BRAF fusions, a proportion did not progress when treatment was terminated, or the drug dose decreased after two years, suggesting possible cures. However, most BRAF(V600E) mutant tumours either progress on treatment (i.e., become resistant during therapy) or rapidly when selumetinib is terminated.

These tumours remain a clinical challenge, as do higher-grade gliomas that are a significant focus for research and drug development. The focus on developing more effective therapies for these high-risk BRAF-mutant gliomas will depend on understanding why tumours become resistant to MAPK inhibitors and developing strategies that reverse or, perhaps, more importantly, prevent the development of resistance.



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Understanding primary biliary cholangitis

Chronic liver diseases can have a detrimental impact on physical and mental health; we explore the underlying causes, symptoms, and treatment for primary biliary cholangitis

Primary biliary cholangitis, also known as primary biliary cirrhosis or PBC is a type of chronic liver disease whereby the small bile ducts which help to transport waste products from the liver become inflamed and are slowly destroyed. As the bile ducts become more inflamed, their functionality is inhibited, causing bile to build up inside the liver and damage healthy tissues. This degradation of tissues can lead to scarring (cirrhosis) and prevents the liver from functioning correctly.

Women are nine times more likely than men to develop PBC, with those aged between 45 to 65 being most at risk. According to recent estimates, approximately 65 out of every 100,000 women in the U.S. have PBC.

While no cure exists, medications are available to support associated symptoms and slow disease progression. Equally, the severity of the disease can vary significantly between individuals; for some, PBC can develop slowly over several decades.

What are the main symptoms of primary biliary cholangitis?

According to the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), about 60% of people with PBC are diagnosed before symptoms occur; some are asymptomatic for years following diagnosis. However, common signs for those who experience symptoms include:

- Bone and joint aches
- Fatigue
- Itchy skin
- Dry eyes and mouth and/or pain or discomfort in the upper right side of their tummy.

The NIDDK also notes that people with primary biliary cholangitis may have other underlying health conditions, including autoimmune thyroid diseases, Raynaud's disease, Sjögren's syndrome, scleroderma, and autoimmune hepatitis.

How is primary biliary cholangitis diagnosed?

People are often diagnosed with PBC after having a routine blood test for something else. If PBC is suspected, a patient will have a blood test to check for antimitochondrial antibodies (AMA). Once diagnosed, a patient may be invited for an ultrasound to rule out other diseases and evaluate the bile ducts and liver condition. A liver biopsy may also be required, whereby a small sample of liver tissue is taken to confirm the diagnosis and to help doctors decide on the best course of treatment.

How much is known about the causes of PBC?

While the causes of PBC are not entirely clear, it is considered an autoimmune disease because the body's natural defence system mistakenly attacks the bile ducts. While it is unclear why this happens, a combination of subtle changes is thought to impact the immune system's functionality. According to studies, genetics could affect a person's likelihood of developing PBC and thus make them susceptible to environmental factors that trigger an autoimmune response. These environmental factors include smoking, infections, and exposure to certain chemicals.

According to the NIDDK, primary biliary cholangitis is more common in people who are white compared with other racial or ethnic groups and people who have a parent or sibling – particularly an identical twin – with primary biliary cholangitis.

How is PBC treated?

Treatments are available to help people manage symptoms and slow down disease progression. Among these is Ursodiol, a naturally occurring bile acid (ursodeoxycholic acid or UDCA) that can help the body transport bile from the liver to the small intestine. If used early enough, Ursodiol can improve liver function and may delay or keep patients from needing a liver

transplant. For those who do not respond to this daily medication (40% of patients do not achieve a suitable reduction in alkaline phosphatase (ALP) or bilirubin with UDCA, and 5-10% are unable to tolerate UDCA), they may be prescribed obeticholic acid. The drug, also known under its brand name Ocaliva, was approved in May 2016 to be used in combination with Ursodiol or as a single therapy. Obeticholic acid reduces the liver's exposure to toxic levels of bile acids by increasing bile flow and reducing bile acid production. However, it can cause side effects and has not been shown to reverse deterioration or prevent cirrhosis. Hence it is not recommended for people with long-term liver damage.

Immune system suppression medicines, including prednisone or azathioprine, may be prescribed, and treatments are available to help patients with associated symptoms. A liver transplant may be offered if patients do not respond to treatment.

Lifestyle changes for PBC

To help prevent further liver damage, doctors may recommend a series of lifestyle modifications such as dietary changes, avoiding alcohol, smoking and stress and exercising. Since the disease can progress slowly over several years, and many people experience delayed symptoms, adopting healthy habits may help prevent complications further down the line.

Clinical trials for chronic liver diseases

An increasing number of research and development projects are underway to develop novel therapies for treating PBC. [According to DelveInsight](#), there are 22+ active players working to develop 24+ pipeline therapies to improve treatment options for PBC. [An upcoming drug, CNP-104, is currently in development](#). It utilises Cour's nanoparticle platform (CNP), a unique and exclusive system that merges disease-specific pathogenic antigens with advanced pharmaceutical nanoparticles. These nanoparticles imitate the natural elimination process of dead or dying cells from the body.

Part of the NIDDK's remit includes conducting and supporting clinical trials for liver diseases, and they have information on their website about how people can find out about clinical trials and participate. The ClinicalTrials.gov database is a comprehensive resource consisting of clinical studies that are privately and publicly funded and conducted across the globe.

In 2017, an international group of researchers conducted the most [extensive study of its kind](#) into the genetic associations underlying a similar chronic liver condition called primary sclerosing cholangitis (PSC) and how it is impacted by inflammatory bowel disease (IBD). They studied the DNA of approximately 4,800 people with PSC, a condition causing bile ducts inside and outside the liver to become inflamed. They compared it to the DNA of almost 20,000 healthy individuals. They uncovered four areas of the genome with more common variants in people with the disease. One of the variants causes higher levels of a protein called UBASH3A, suggesting that this protein may have a role in PSC and could therefore be a therapeutic target.

As part of their research, the scientists collaborated with the International IBD Genetics Consortium, of which the NIDDK's IBD Genetics Consortium is a member. They analysed the genomes of individuals with PSC and compared them to those with irritable bowel disease (IBD). The study revealed that genetic factors associated with PSC are more strongly associated with ulcerative colitis than Crohn's disease, another form of IBD. This could be the reason why a more significant number of people with PSC have ulcerative colitis rather than Crohn's disease. Additional research could help identify the specific genes responsible for PSC. It may also lead to the development of effective therapeutic options and improved screening techniques and ultimately shed light on the drivers of chronic liver disease.

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UNDERSTANDING IMMUNE MECHANISMS TO CREATE NOVEL TREATMENTS FOR PRIMARY BILIARY CHOLANGITIS

Professor Channakeshava S Umeshappa from Dalhousie University discusses the burden of primary biliary cholangitis and how understanding immune mechanisms may help to treat it

Primary biliary cholangitis: The most common autoimmune-mediated liver disease

Primary biliary cholangitis (PBC) is characterised by chronic inflammation of the interlobular bile ducts, leading to fibrosis, cirrhosis, and liver failure if left untreated.

Symptoms of PBC include fatigue, jaundice, itchy skin, abdominal pain, nausea or vomiting, dry eyes and mouth, and bone and joint aches.

The incidence of PBC is increasing worldwide,⁽¹⁾ but is most common in Europe and North America.⁽²⁾ PBC has a female predominance, affecting primarily middle-aged women (over 90% of the PBC cases). Clinically, it is often diagnosed by detecting anti-mitochondrial autoantibodies and elevated alkaline phosphatase enzymes in blood tests.

Immunological mechanisms of primary biliary cholangitis

The exact cause of PBC is less understood. However, a combination of genetic risk and environmental factors, such as exposure to an environmental mimic of a modified E2 component of the pyruvate dehydrogenase complex (PDC-E2), is believed to predispose individuals to PBC development.⁽³⁾

These risk factors appear to cause loss of tolerance to PDC-E2 in biliary epithelial cells, leading to the

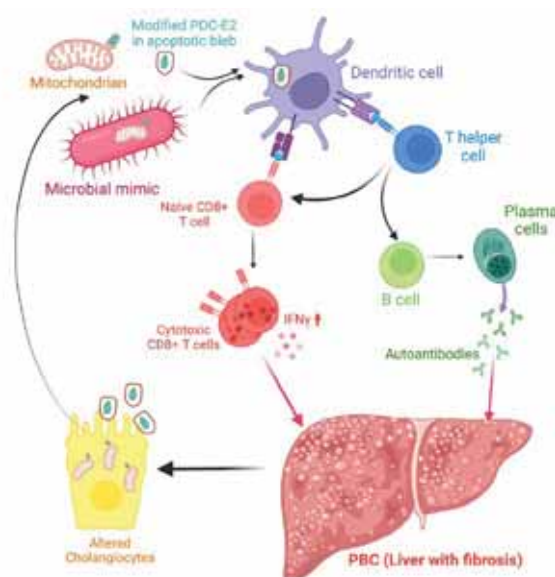


Figure 1. Immune dysregulation in PBC. Exposure to an environmental mimic of a modified PDC-E2 autoantigen leads to a multilineage immune response targeted at biliary epithelial cells. Created with BioRender.com

destruction of these cells by autoreactive T and B cells, cirrhosis, and liver failure (Fig. 1).

Unfortunately, immunologists have not studied PBC until recently due to its 'rare' designation. We do not know what precisely causes tolerance breakdown to PDC-E2, leading to T and B immune cell-mediated liver destruction.

My previous postdoctoral work identified pathogenic and regulatory immune cells in the body that can promote or prevent PBC development, respectively.

Using PDC-E2-epitope-specific major histocompatibility complex-II-based nanomedicines (pMHC-NMs), we have

expanded cognate (PDC-E2-epitope-specific) CD4⁺ T cells in two PBC mouse models having different genetic backgrounds.⁽⁴⁾ The NMs likely targeted the pathogenic cells. This is because they displayed the epitope that overlaps with a repetitive element in PDC-E2 with homology to the E. coli bacterial antigen – playing a role in PBC development.⁽⁵⁾

As these pathogenic CD4⁺ T cells are known to promote autoreactive responses of both CD8⁺ cytotoxic T lymphocyte and B cell responses, they likely play crucial roles in autoimmunity development. In the subsequent studies, we also found increased levels of proinflammatory type 1 invariant Natural Killer T cells (iNKT1) in the liver of mice with established PBC.

Additionally, we discovered the presence of a liver-specific regulatory iNKT subset in both mice and humans that may have a role in the control of PBC development.⁽⁶⁾ However, these inflammatory and regulatory T cells' contributions to PBC development, their nature, and the mechanisms by which they cause or regulate PBC are unknown. Hence, my lab is currently investigating the potential mechanisms used by these immune cells in the regulation of PBC development.

This sheds light on identifying novel therapeutic target to block the destructive autoinflammatory responses and the development of next-generation therapies.

Primary biliary cholangitis and the future of treatments

There is no curative treatment for PBC. Hence, current treatment centres on preventing complications and alleviating symptoms.

Non-specific ursodeoxycholic acid and obeticholic acid are indicated, but they are poorly effective in 30-40% of the patients, who will continue to have disease progression.⁽⁷⁾ Therefore, there is an urgent need to develop disease-specific treatments for PBC.

Since PBC results from autoimmune-mediated damage, targeting the key immune cells and pathways involved in the disease represents an ideal therapeutic approach.

In my previous studies, using PDC-E2-relevant pMHCII-NMs, we programmed and expanded PDC-E2-epitope-specific CD4⁺ T cells into regulatory cells^(4,8) (Fig. 2). These cells established local regulatory network by favouring regulatory B cells and suppressor

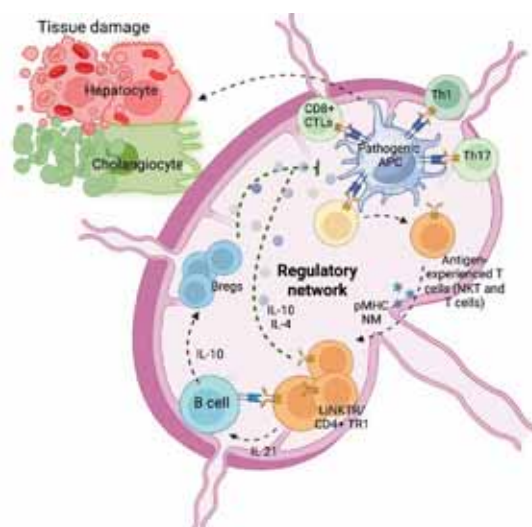


Figure 2. Mechanisms of actions of autoreactive CD4⁺ T cell- and liver iNKT cell-targeting pMHC-based nanomedicines in the liver-draining lymph node. Upon injection, pMHC-based NMs expand their cognate regulatory T cell populations, which, in turn, establish local regulatory network and blunt PBC. Created with BioRender.com

neutrophil formation and suppressing pathogenic antigen-presenting cells and controlled PBC in mouse models.

Furthermore, results showed autoimmune-hepatitis (AIH)-relevant pMHCII-NMs can also expand AIH-epitope-specific CD4⁺ T cells and control primary biliary cholangitis in a liver-centric manner, irrespective of autoantigen specificity.

In a more recent study, we expanded liver-specific regulatory iNKT cells and controlled PBC.⁽⁶⁾ Undoubtedly, these NMs are promising candidates for human PBC therapy. However, due to the chronic nature of PBC and the relatively short-term effects of these drugs, the patients need to be treated for life, which may result in unwanted side effects.

Encouraged by the success of these drugs, my laboratory is currently focusing on developing newer and better mechanism-based immunotherapies that provide long-term protection against PBC in a radical manner.

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Opportunities and challenges in blood collection and transfusion medicine

Kate Fry, CEO of America's Blood Centers, discusses the essential role of blood products and transfusion medicine in the U.S. and the efforts to ensure blood's safety and availability

Blood is recognised around the world as an essential medicine. In the United States, blood transfusions remain one of the most common hospital procedures, with a patient requiring a blood transfusion every two seconds.

The collection of blood and recruitment of blood donors relies on a network of not-for-profit blood center located throughout the country.

This model contrasts the U.S. with many other developed nations that rely on a nationalised blood system or a single primary blood supplier.

Individuals can locate their nearest community blood center at www.americasblood.org.

The need for more blood

The US blood supply remains dependent on a voluntary, non-renumerated base of blood donors. These donors are essential to surgeries, and organ and bone marrow transplants.

Despite the importance and constant need for blood, [only 3% of Americans donate blood yearly](#). This percentage continues to decline, with the most acute declines occurring in younger generations.

The rate of younger donors who donated blood – those between the ages of 16 and 24 – decreased by double digits from 2017 to 2019 alone.

The diversity of the U.S. donor base also remains a

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Within the FDA, the Center for Biologics Evaluation and Research (CBER) regulates the collection of blood and blood components used for transfusion or manufacturing pharmaceuticals derived from blood and blood components.

CBER regularly publishes guidelines and regulations promoting the nation's blood supply's safety, purity, and potency.

These may include testing requirements for infectious diseases, safety requirements for the donation process, and/or donor eligibility requirements.

As a result of the multi-layered system of safety standards, the U.S. blood supply is the safest it has ever been.

During the recent COVID-19 pandemic, the FDA and CBER worked with the blood community to ensure the blood supply's safety while recognising the pandemic's impact on blood collection efforts.

The FDA's efforts included amending blood donor eligibility requirements that safely increased the number of eligible donors and changing regulations without impacting safety.

The FDA was also extensively involved in regulating the use of COVID-19 Convalescent Plasma (CCP), with more than 500,000 units of CCP collected by U.S. blood establishments.

Public policy priorities

As the blood community looks forward to its work with the FDA, Congress, and other government partners, two areas remain at the forefront: expanding the pool of blood donors and available blood through awareness and education efforts and ensuring blood transfusions are available to patients when and where they need blood.

Over the past year, the FDA has relied on extensive data and science to make fundamental changes to blood donor eligibility, including the re-entry of previously deferred donors from the potential [risk of vCJD](#) based on time spent in specific European nations and [a move to individual donor assessment](#), which allows for some previously deferred gay or bisexual men, and women who have sex with bisexual men, to donate now.

The blood community supported these changes to safely allow more individuals to contribute and treat all donors with the fairness, equality, and respect they deserve.

concern, with [less than](#) 20% of all blood donations coming from communities of colour.

A wide variety of conditions that disproportionately impact minority populations require ongoing blood transfusions as part of a patient's care management, and these patients need blood that is closely matched beyond just blood type.

This type of closely matched blood is most likely from someone of a similar racial and ethnic background.

Regulation of the blood supply

The U.S. Food and Drug Administration (FDA) licenses and regulates blood centers.

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THE FDA'S OFFICE OF BLOOD RESEARCH AND REVIEW (OBRR)

The Office of Blood Research and Review (OBRR) falls under the FDA's Center for Biologics Evaluation and Research (CBER). Its primary function is to regulate blood and blood products commonly used in transfusion medicine.

The OBRR oversees retroviral diagnostic tests, blood donor screening assays, and software utilised in collecting, testing, processing, or storing donated blood to guarantee their safety, effectiveness, and availability.

The OBRR also conducts regulatory reviews and creates policies related to the products it regulates.

The OBRR collaborates extensively with other relevant offices under the FDA, such as the Office of Tissues and Advanced Therapies, the Office of Biostatistics and Epidemiology, and the Office of Compliance and Biologics Quality.

In addition, it performs various regulatory functions, including setting policies and standards and reviewing regulatory applications.

The FDA's regulation of blood stems from the Public Health Service Act and Food, Drug, and Cosmetics Act.

Blood components are regulated as licensed biologics and as blood. Manufacturers of blood products rely on guidance documents provided by the FDA to comply with regulations.

OBRR ensures blood safety by establishing product standards, enforcing current good manufacturing practices, and monitoring the lot release testing of blood screening tests to ensure products meet the same standards as the original approved products.

Due to this multi-layered approach to blood safety, with overlapping safeguards, if one layer fails, protections remain in place to keep the blood supply safe.

For more information about the OBRR, click [here](#).

To learn more about blood and blood product regulation, click [here](#).

The U.S. blood community is also actively [promoting access to blood products in emergency settings](#) outside of the traditional hospital environment.

Studies have demonstrated that blood transfusions following trauma save lives.

One study found up to 5% increased odds of mortality for every minute of delay in access to blood.

According to the U.S. Centers for Disease Control and Prevention (CDC), unintentional injury is the leading cause of death among individuals ages 1-44.

Bleeding is the leading cause of preventable death following a severe injury, and sadly, up to 56% of those victims die before ever reaching the hospital.

Yet, due to local, state, and federal policies, most Americans cannot access blood before reaching the hospital.

Blood centers' expanding mission

While challenges remain, blood collection and transfusion medicine opportunities are also expanding

their mission to positively impact even more lives through advancements in biotherapies. Community blood centers have existing infrastructure and clinical expertise to make an immediate impact in this quickly evolving area of healthcare with the appropriate recognition and resources.

Overall, the blood community remains an essential part of the nation's healthcare system, dedicated to saving and improving lives no matter where and when it is required. America's Blood Centers urges policymakers, regulators, community partners, businesses, civic organisations, and individuals to commit to supporting the blood supply to ensure blood remains safe and available to every patient in need.

Kate Fry
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RECENT ADVANCEMENTS IN ARTIFICIAL BLOOD TECHNOLOGY

Professor Allan Doctor from the University of Maryland School of Medicine shares promising developments regarding the creation of safe and effective artificial blood products

Haemorrhage accounts for approximately 35% of civilian and approximately 90% of military potentially survivable in-field deaths.

However, logistic challenges (blood typing, donor availability and cold chain) limit blood deployment in resource-limited and austere environments. As such, a 'universal donor', shelf-stable, portable whole blood analogue (WBA) could transform care in both civilian and military settings.

Multiple research programmes have been striving to enable field resuscitation with a fluid that would perform similarly to 'natural' whole blood (restore blood pressure, O₂ delivery, and haemostasis – the ability to form blood clots). Viable prototypes have been developed separately for each blood component and are ripe for integration to create artificial blood.

First-generation blood substitutes and artificial blood

Oxygen (O₂) carriers 'first gen' designs comprised two approaches: perfluorocarbon emulsions and simple

polymerised haemoglobin (Hb, PolyHb). Both failed to emulate normal red blood cell (RBC) physiology because of design flaws which did not preserve physiologic interactions with O₂ - to capture O₂ in the lungs and release O₂ effectively to tissue - and with nitric oxide (NO) to support (rather than interfere with) NO based regulation of blood vessel caliber, which caused vasoconstriction.

We now appreciate that a major problem with the 'first gen' designs is the significant abundance of low molecular weight (LMW) PolyHb species which elicit vasoconstriction, hypertension, and oxidative injury and were associated with death, heart attack, and stroke, prompting premature FDA closure of their phase 3 trials. In a novel approach, a US team (Palmer Lab, Ohio State University, in preclinical development) optimised the PolyHb MW profile, limiting adverse effects and modulating O₂ affinity to emulate RBCs more closely.

Other promising 'next-gen' approaches encapsulate Hb in nano-assembled membranes to create bio-synthetic

artificial cells: haemoglobin vesicles (HbV, Sakai Group in Japan, now in phase 1 human trials) and (ErythroMer, EM, developed in the US by KaloCyte and University of Maryland, in final pre-clinical development) are first-in-class, bio-synthetic, nano-cytes that closely imitate RBC physiology.

EM modulates O₂ affinity to context during circulation, slows NO trapping while permitting O₂ diffusion, recycles oxidised Hb via simple reduction and (EM, but not HbV) allows lyophilisation with facile reconstitution, permitting extended shelf life under temperature extremes and enabling field deployment.

Producing safe and effective dried plasma

First developed in the 1930s, freeze-dried plasma was widely used by British and American forces in WWII and the Korean War but was abandoned because of disease transmission risk. Modern methods to improve blood safety have made it possible to produce safe and effective dried plasma, now available in France, Germany, South Africa, and a limited

number of other countries. Octapharma commercialised a solvent/detergent (S/D) treated pooled plasma, producing a frozen product that has since been administered safely to millions of patients.

Other available dried plasmas include French Lyophilised Plasma (FLYP), produced by the French Military Blood Institute (Centre de Transfusion Sanguine des Armees [CTSA]), LyoPlas N-w, produced by the German Red Cross and Bioplasma FDP, produced by National Bioproducts Institute, Pinetown, South Africa.

Additional promising products are in advanced development employing different drying methods, pathogen reduction, pooling, packaging, and other approaches. Two promising products are EZPLAZ, in development by Teleflex (FDA approval in process) and FrontlineODP (Velico Medical), a spray drying unit that can generate dry plasma. Velico's device is in phase 2 human clinical trials; a 510k device approval for commercial availability is anticipated for Q1 2025, enabling blood banks to produce SDP locally.

The University of Maryland is exploring the formulation of a modular, adaptive plasma analogue (MAPA) based on a novel polymerised Albumin construct (polyAlb, Palmer Lab, Ohio State University) and select freeze-dried human clotting factor concentrates. MAPA composition would be customisable to context/need (e.g., for simple volume expansion or to promote hemostasis), and polyAlb may be used for simple haemorrhage alone. In the setting of trauma induced coagulopathy (TIC), (currently approved) coagulation factor concentrates (fibrinogen and prothrombin complex concentrates) and haemostatic pharmaceuticals

(tranexamic acid) would be co-administered.

Platelet technologies

Currently, two promising approaches are underway to enable field deployment of platelets in resource-limited settings. The first is Thrombosomes developed by CellPhire which is in human phase 2 trials. Thrombosomes are a natural platelet-derived haemostatic technology comprising freeze-dried platelet-derived membrane vesicles that limit bleeding in models of trauma and thrombocytopenia.

Alternatively, SynthoPlate (SP, in advanced preclinical development by Haima Therapeutics and Case Western Reserve University) is a biocompatible liposomal nanoparticle-templated 'platelet surrogate' technology with surface presentation of synthetic peptides to mimic 'natural' platelet injury site-selective adhesion and aggregation. Freeze-dried SP has demonstrated haemostatic efficacy and survival benefit in traumatic haemorrhage models and is storage-stable at a wide range of ambient storage conditions. Notably, the identity and density of SP surface ligands are customisable, enabling precise performance adaptation to context.

Integrating components into a field-deployable whole blood analogue

The US Department of Defense Advanced Research Projects Agency delivery (DARPA) recently established a four-year programme to develop, evaluate, and rapidly translate a first-in-class formulation and delivery system for a field-deployable whole blood analogue (WBA). The University of Maryland, Baltimore (UMB) Center for Blood Oxygen Transport & Hemostasis

(CBOTH) and Center for Translational Medicine (CTM) were selected to lead this effort to optimise and integrate a comprehensive set of WBA prototypes into an artificial blood solution that matches performance to 'natural' whole blood.

The prototype portfolio for this effort includes multiple lead haemoglobin-based O2 carrier component candidates (PolyHb and ErythroMer), both pathogen-inactivated freeze-dried plasma (EZPLAZ FDP) and, potentially, a condition-specific, modular adaptive plasma analogue (MAPA), as well as nanoparticle platelet mimetics (SP). This effort includes an artificial intelligence (AI) based system to guide blending combination, improvement, and down-selection of WBA components. DARPA programme objectives also address the need for production efficiency and scaling, effective technology transfer, regulatory approvals, clinical trials, licensing, and commercialisation.

Overall, artificial blood research programmes are advancing rapidly, with individual/combined prototypes ready or approaching readiness for technology translation and commercialisation in the near future.

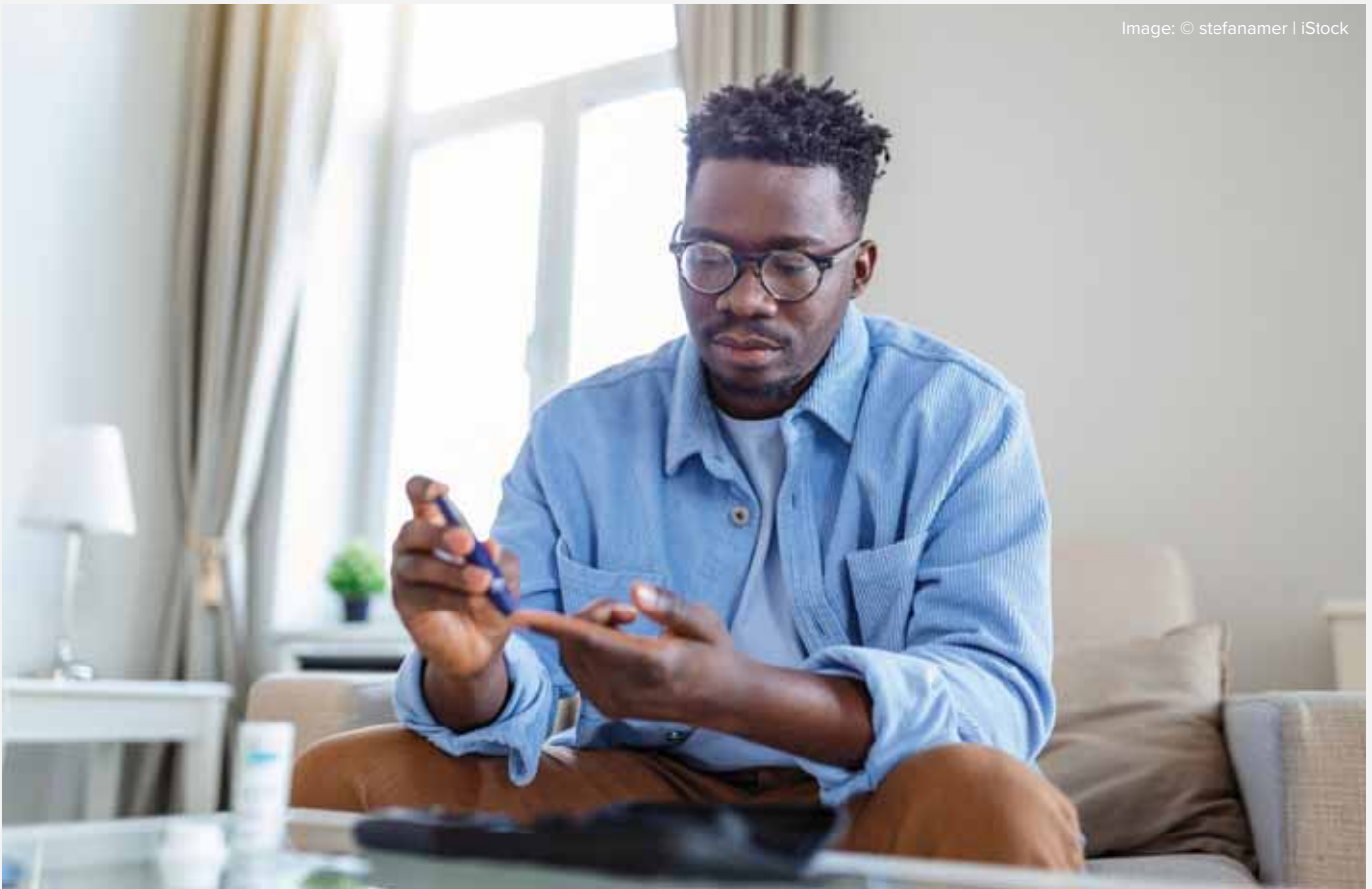


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Improving diabetes management and prevention

Diabetes can pose significant implications for individuals' mental and physical wellbeing. While new research shows promise in supporting diabetes management and care, many challenges still remain. We discussed these with Beyond Type 1's content strategist Dr Liz Kopco



According to the Centers for Disease Control and Prevention (CDC), 37 million people in the U.S. have diabetes, roughly equating to one in every ten people. What's more, one in five people do not know they have the condition.

The disease itself is categorised as type 1 (where the body does not make enough insulin) and type 2 (where the body is unable to use insulin correctly).

In recent years, the number of people diagnosed with type 2 diabetes has been increasing, and it now accounts for 90-95% of all diagnosed diabetes cases.

Young people, in particular, have shown a worrying susceptibility to diabetes, with the latest figures from the CDC revealing that between 2001 and 2017, those aged 20 or under living with type 1 diabetes increased by 45%, and the number living with type 2 diabetes grew by 95%.

This upwards trend could mean as many as 220,000 young people will or may have type 2 diabetes in 2060 — a nearly 700% increase. ⁽¹⁾

Not only is diabetes becoming increasingly costly for health systems, it can heavily impact a person's physical and mental wellbeing and increase their susceptibility to

serious health complications, including kidney failure, heart disease and loss of limbs.

Hoping to raise awareness and improve care for those living with diabetes through peer support programs, global campaigns and digital platforms is a nonprofit organisation called Beyond Type 1, which serves both type 1 and type 2 diabetes communities.

Lorna Rothery spoke to Beyond Type 1's content strategist Dr Liz Kopco about the challenges facing patients and the measures needed to improve diabetes management and care.

Type 2 diabetes in young people **Why has type 2 diabetes increased among young people during the last 20 years?**

Several factors increase a [young person's risk of developing type 2 diabetes](#) (T2D). These include genetics and family history, the mother having [gestational diabetes](#) during pregnancy, having other conditions that impact insulin resistance, hormones during puberty and being from a background that is predisposed to having fewer resources available like African American, Hispanic/Latino, Native American/Alaska Native, Asian American, or Pacific Islander.

Studies like the [Treatment Options for Type 2 Diabetes in Adolescents and Youth \(TODAY\)](#) and [SEARCH for Diabetes in Youth](#) have found that young people who develop T2D at an early age are also more likely to experience complications from it—even in their early 20s.

Unfortunately, these studies also showed that [socioeconomic status](#) is a significant factor putting young people from underserved communities at risk for T2D. [Disparities](#) like food insecurity, lack of safe environments for daily movement, income levels and lack of access to affordable healthcare are common risk factors.

The COVID-19 pandemic added to the vast disparities. Younger people from low-income communities, who tend to make up more of the workforce and not deemed essential workers, were laid off and left without income or health insurance.

In addition, the overwhelming stress from the pandemic may have contributed to increased prevalence since [stress can impact blood sugar regulation](#).

Newer studies are also finding that individuals with prior infections of COVID-19 have a higher risk of developing diabetes.

With research showing that T2D is developing in younger people, providers may be screening for it at younger ages, leading to an increase in diagnoses. Getting an early diagnosis is critical to helping establish diabetes management early and prevent or delay the onset of complications.

However, we cannot stop at diagnosis. As someone diagnosed with type 2 diabetes at 23, I know there is a considerable lack of support for younger people with diabetes because of the assumption that younger people are supposed to be healthier and therefore do not need preventative care.

When most of the resources on T2D depict and target people in their 50s or older, it is a disservice to these younger people. Trying to navigate life at 23 was difficult enough; managing a chronic disease was not a top priority, given that I barely had any health insurance in college.

Thankfully, Beyond Type 2 had resources all in one place for those [newly diagnosed](#) and even for [navigating insurance](#).

We need to ensure diabetes education for newly diagnosed younger people is tailored to their lifestyle and is geared toward their interests—partying with diabetes, managing diabetes during puberty, etc.

COVID-19 and diabetes **How did the COVID-19 pandemic highlight the importance of addressing chronic diseases like diabetes?**

The COVID-19 pandemic opened everyone's eyes to how vital our health is, especially with regards to prevention. For people with chronic illnesses like diabetes, the pandemic highlighted how complicated these interactions between viral infections and diseases are.

Having diabetes is a vital risk factor for developing adverse effects from COVID-19, and with approximately 37 million people in the U.S. having diabetes and an estimated eight million living with undiagnosed diabetes, this pandemic addressed how important it is to get everyone screened and diagnosed.

Even three years later, the [International Diabetes Federation](#) (IDF) reported on studies showing that adults with diabetes with elevated HbA1C levels have a 35–40% higher odds of COVID-19 hospitalisation and severe illness.

The key to preventing adverse outcomes with COVID-19 is better diabetes management, but during the pandemic, many people with diabetes were left to manage it on their own—some for the first time.

Imagine being newly diagnosed with diabetes right before everything shut down. People were left waiting months to be seen by providers to establish their diabetes management plan.

Thankfully telehealth became an option, but the pandemic showed how important teaching self-management of chronic diseases is. Providing people with the tools and knowledge they need for self-management is more important than ever.

Managing and preventing chronic diseases

Why is it essential to continue managing and preventing chronic diseases, now and in the future?

There are several reasons why preventing and managing chronic disease is important now and in the future. We all want a good quality of life. Preventing or managing chronic disease is critical for reducing complications which can negatively impact the quality of life.

Living with a chronic disease can also heavily [impact mental health](#), and there is insufficient support for the intersect of mental health and chronic disease management.

Beyond Type 1 is a great resource that medical professionals can share with their patients. We have created various [mental health resources](#) to help address the gap in that education and support.

Given that healthcare affordability and accessibility challenges persist for some people, preventing chronic disease is important for people's livelihood. No one should have to pick between managing their chronic condition or putting food on the table. Preventing chronic disease is also preventing further health disparities.

Even looking at the bigger impact, a [recent study](#) funded by the National Institute on Minority Health and Health Disparities estimated that the cost of racial and ethnic health disparities on the U.S. economy increased over a span of four years by 41% to \$451 billion in 2018.

I would imagine that has only increased with the COVID-19 pandemic. The cost of chronic disease management is hurting the people directly impacted by it and the economy for several reasons, including the unregulated costs associated with healthcare.

Ignoring the cost of it, managing chronic disease is a human right—everyone's right to live a healthy and fulfilling life is essential.

Type 2 diabetes prevention programmes **How effective are programmes and campaigns, such as those implemented by the CDC, in helping to prevent type 2 diabetes and increase understanding of the condition?**

The CDC and National [diabetes prevention programmes \(DPP\)](#) are part of the solution needed to raise awareness, get people screened and diagnosed, provide the resources for self-management and the support people need. These are evidence-based programmes using data about diabetes management plans to help prevent, delay onset, or better manage life with type 2 diabetes.

The great thing is that DPPs are offered in various places—including local YMCAs and even online. Programmes and campaigns are only effective if they are

accessible to those needing them. Programmes in different languages, at local community centers and online improves prevention and management.

As far as understanding the condition, I think we still have a way to go for two reasons. First, it is difficult to make people look past established [misconceptions and stigmas](#) to educate them on the condition. When society and media perpetuate these misconceptions and stigmas, it is working against all the work these programmes and campaigns are trying to do.

Secondly, science must truly understand the condition because it is extremely complicated. There is no one cause for diabetes, which makes it hard to provide one treatment or cure.

What we do understand is that living with diabetes is very challenging physically and mentally. We all still need to raise awareness and provide support to prevent and manage type 2 diabetes.

What are researchers doing to find ways to prevent type 1 and type 2 diabetes?

A lot of amazing research is being done for both type 1 and type 2 diabetes. Every year researchers present their work and findings at conferences like the American Diabetes Association's Scientific sessions and the International Conference on Advanced Technologies and Treatments of Diabetes (ATTD), to name a few. Beyond Type 1 will be highlighting and sharing some of the research at this year's ADA conference.

As for type 1 diabetes, the current research is looking into several things like beta cell and gene therapy to help prevent further beta cell deterioration and even protect against type 1 diabetes development.

A recent [beta cell summit](#) hosted by three organisations, including JDRF, highlighted some pretty spectacular research being done that showed promising results on regenerating beta cell mass and more.

A big recent advancement was the [FDA approval](#) of Prevention Bio's drug, Tzield (teplizumab-mzwv), to delay the onset of type 1 diabetes. This is the first drug of its kind, and I am excited to see how this paves the way for more treatments to come.

Type 2 diabetes research has also come a long way. Most studies in adults have focused on and concluded that lifestyle changes have a big impact on lowering risks, but recent studies have shifted and focused on the [genetics](#) behind type 2 instead.

A recent [promising study](#) utilised gene therapy to treat and even prevent the progress of type 2 diabetes.

The research is really breaking through barriers to go even beyond what past studies have done for preventing and treating all forms of diabetes. It is an exciting time for diabetes research and tech development.

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MANAGING PATIENTS WITH DIABETES IN RURAL UNDERSERVED AREAS

[Professor Richard J. Santen](#), MD from the University of Virginia, explains the need for retired endocrinologists returning to work to manage patients with diabetes in America's rural underserved areas, including comment on telemedicine

Rural, financially challenged areas in the United States lack endocrinologists to help manage patients with diabetes mellitus. One solution is to encourage retired endocrinologists to return to practice part-time and use telemedicine to evaluate and treat these patients. In addition, retired endocrinologists have acquired much wisdom about diabetes management over their years of practice.

Every year, endocrinologists decide to retire when they reach a certain age, arguably, when they are still in their prime and benefit from significant clinical experience. Many would like to continue to serve, heal, care and share what they know, and they have the bonus of perspective. Retirement indeed encourages perspective, and many physicians stepping outside the arena of a busy hospital or medical practice often feel a sense of unfinished business or, even worse, that they are no longer needed. They are so wrong – they can continue to contribute. Wisdom is a terrible thing to waste, doubly so when it can save lives.

How can retired doctors help patients with diabetes living in rural areas?

Patients with diabetes living in rural, underserved areas frequently experience less than adequate health outcomes, often exacerbated by higher rates of poverty, lack of health insurance and insufficient primary care and specialist providers. While this is a

shocking situation, it is also an opportunity. Many retired doctors are eager to offer their services and are looking for ways to reach out and help. At the same time, spread around the country are 1,400 Federally Qualified Community Health Centers (figure 1) that provide sorely needed medical services to patients, independently of their ability to pay. These centers, supported by \$5.78 billion in U.S.-Federal funding, generally have skilled primary healthcare personnel, but many of them lack the ability to offer patients specialty care. Herein lies an opportunity to connect retired endocrinologists via telemedicine with patients attending these rural community health centers.

Can telemedicine help patients with diabetes?

How can this be done easily? The solution is telemedicine – for example, a doctor in Alabama would not have to leave home to help a person in an underserved rural community hundreds of miles away. Imagine that a primary care provider at a rural community health center refers a patient to an endocrinologist and provides detailed medical records and test results. The endocrinologist then conducts an initial consultation with the patient via videoconference with the primary health care provider present; community health centers have the necessary technological infrastructure for such consultations. The endocrinologist then provides

detailed recommendations regarding further laboratory assessment and patient management guidelines. Follow-up sessions with the patient are arranged via telephone or, if necessary, videoconference to ensure they are on track with the ongoing care; in each case, they provide feedback to the primary healthcare provider. This helps build robust relationships with both the patient and provider – something most retirees miss the most about their medical careers.

How can this work without undue hassle? Providing detailed reports of the findings and recommendations can take time! However, various digital dictation software programs (such as Dragon Medical One) are available, which are highly accurate and secure. The endocrinologist can do the entire consultative process sitting at a home desk with a cup of coffee close at hand.

Perspective of a partially retired endocrinologist

Can this process work? Absolutely – Dr Richard Santen has been doing it for over six years. As a partially retired endocrinologist, he has managed to help treat people with diabetes in underserved rural areas in Southwest Virginia. He encourages other endocrinologists to follow in his footsteps with these comments: “I've done much telemedicine-based diabetes management from the comfort of my study. In a way, technology has ‘rebooted’ my medical career. I am now

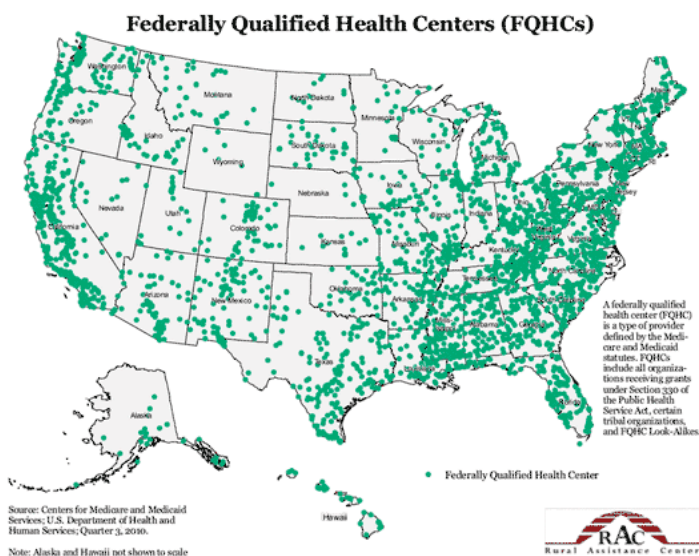


Figure 1. Map of the locations of the 1,400 Federally Qualified Community Health Centers in the United States.

encouraging other endocrinologists who have retired and are feeling the pangs of regret or are itching to 'get back to work' but still enjoy some of the benefits of retirement to take advantage of the remarkable advances in telemedicine to 'reboot' themselves and make a difference."

Full disclosure – rebooting requires teamwork. You can't just fire up your laptop and plug it into a medical 'matrix.' The staff at the rural community health centers play a pivotal role. They are, in essence, the management machine behind the whole process – they're involved in scheduling, ordering medications and laboratory tests, non-urgent communications with patients, and coordinating consultations – rebooting can't be done without their input and organizational muscle.

The "rebooting process" is also not entirely cost-free. It helps to have someone called a 'navigator' who can do the managerial component of the process: renewing the retired endocrinologist's medical license, obtaining malpractice insurance, communicating with rural community health center administrators and building a relationship with them. Proprietary, secure dictation software is

not free, but any cost incurred is an investment, and the return is worth it.

Dr Santen has found the whole process completely rewarding: all the benefits of providing specialized healthcare without the more burdensome aspects of running a medical practice. He comments: "I get to interact with patients, see a marked clinical improvement in them and be part of a team dedicated to caring. It has its challenges, but it's medicine without the misery – no traveling, filling out endless forms, following someone else's rigid regulations, chasing payments, and continually trying to squeeze more patients into shrinking appointment times."

Retired endocrinologists re-entering practice

The last point is essential because time takes on a whole new meaning when one retires – one reflects on the extended period that was your career to date and knows that the time ahead of you is probably shorter. This usually means that one wants to make the most of it. For some people, that may mean fishing or traveling, but for those who dedicate their lives to healing, it's hard to close the door and walk away knowing there is still a significant need

for your care. Nevertheless, limited time has a high value, so retired endocrinologists re-entering practice can decide how much they would like to spend. That could be as little as five hours a week or as many as twenty; that's up to them. They cannot let demand determine their supply of time, or they will burn out.

Dr Santen comments that he knows of many specialists who have built highly successful careers and can now retire and enjoy the financial benefits of their hard work. They probably won't miss the hassles of running a busy practice or the high-pressure demands of a big hospital. However, they will miss the patients and the immense satisfaction of caring and healing. It's what made them want to be doctors. For them, telemedicine from their home provides a solution."

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Living with HIV: The prevalent pandemic which is no longer considered a pandemic

Dr Avinash Hari Narayanan (MBChB), Clinical Lead at London Medical Laboratory, explains that we need stronger efforts worldwide to end HIV transmission and improve the lives of those living with the disease



Can the HIV pandemic ever be ended, and can the UK's healthcare providers and planners ever be confident they are winning the battle until HIV is defeated globally? I explain why Britain's HIV eradication measures cannot succeed until the virus is controlled worldwide and why the global health agenda is key to shaping narratives locally.

On March 11, 2020, the World Health Organization (WHO) officially declared COVID-19 a 'pandemic' – i.e., a widespread epidemic crossing national boundaries. A little over three years later, on May 5, 2023, it announced that the COVID-19 pandemic was no longer a global health emergency. This de-escalation signified the success of global health measures for vaccination, use of personal protective equipment (PPE) and movement restrictions.

In contrast to this seemingly cut-and-dried beginning and end, the HIV/AIDS pandemic has lasted over 40 years, killing millions worldwide. Yet HIV is seldom even called, yet alone treated comparably to, a 'pandemic' today. Why is that? Could it be down to geography, economics or even prejudice?

A global history of HIV

The first reported deaths from illnesses related to Acquired Immune Deficiency Syndrome (AIDS) were reported in New York in June 1981. It was later discovered that a virus now termed human immunodeficiency virus type 1 (HIV-1) was the cause. It would become one of the most devastating infectious diseases in modern times.

Today, 42 years later, over 40.1 million people have died worldwide, while 38.4 million currently have HIV. Living

with HIV, as individuals and as a society, remains challenging within the UK. Still, ease of access to testing, robust treatments and a forward-thinking social and public health strategy have significantly improved outcomes for people with HIV.

Unfortunately, the same cannot be said for many worldwide who are subject to poverty, deprivation, exploitation, prejudice, and discrimination. 650,000 people still died from HIV/AIDS-related illnesses in 2021; recognising this startling figure is essential.

Even though annual HIV/AIDS-related deaths are likely to far outstrip COVID-related deaths this year, the WHO refers to HIV as an [epidemic](#) rather than a pandemic. Could Western nations no longer consider HIV a pandemic, despite its global death toll across many nations, because it no longer kills many people in wealthy countries?

Of those 650,000 annual deaths, the vast majority happen outside the West. Africa remains severely affected, with nearly one in every 25 adults (3.4%) living with HIV and accounting for more than two-thirds of those with HIV worldwide.

In 2014, the United Nations committed to a [target](#) of eradicating what it pointedly called 'The AIDS epidemic' by 2030. Looking at treatments and new infection levels from the standpoint of the UK, that goal is possible. Globally, however, nearly three-quarters of a million people die every year from the virus, either because they do not know they have contracted it and are not on treatment or start treatment late.

The economic burden of HIV and the lack of disease control measures

Most of these people live in countries either too poor to support such programmes fully or where there is so much prejudice and fear surrounding the virus that they are reluctant to have themselves checked, let alone engage with disease control measures.

It may be that health-related issues are eclipsed by more immediate priorities, such as food, clean water, and safety. This problem is highlighted by considering pre-exposure prophylaxis (PrEP), an intervention positively adopted in the West. PrEP is a powerful tool to prevent

new cases of HIV successfully. Still, the socioeconomic costs to the individual and country may not be feasible at scale in the African continent.

An estimated 1.5 million people were newly infected with HIV in 2021. While the world has committed to ending AIDS by 2030, new infections and death rates are not falling rapidly enough to meet this target.

A 2018 [paper](#) published in the journal *'Emerging Infection Diseases'*, specifies the targets needed to be achieved to eradicate HIV as a pandemic. The paper, entitled 'Ending the HIV/AIDS Pandemic' (and a key point here is the use of the term 'pandemic'), was coincidentally co-authored by Dr Anthony Fauci – an expert in the study of HIV and a key international health leader during the COVID-19 pandemic. Dr Fauci has become well known for not shying away from controversy and notably does not 'downgrade' HIV/AIDS to the status of an epidemic.

Fauci notes: 'The phrase "HIV/AIDS pandemic" indicates a global HIV epidemic, which may be generalised in some countries, such as South Africa, and localised in other countries, such as the United States.'

He believes ending the pandemic can be achieved when the following targets have been met. For example, the number of new HIV infections would be fewer than the number of AIDS-related deaths; HIV infection and AIDS incidence would decrease to fewer than one AIDS case per thousand population; 73% of persons living with HIV and AIDS would be receiving treatment; 86% would experience virus suppression; and mother-to-child transmission would be eliminated to less than 5%.

How near are we to these global targets?

Some have been met, but only 68% of people living with HIV are virally suppressed. In addition, just 81% of pregnant women living with HIV have access to antiretroviral medicines to prevent transmission of HIV to their children, which is still significantly short of the numbers needed to reduce mother-to-child transmission to less than 5%.

The UK has played a vital role in shaping the agenda and working towards eliminating HIV as a global health problem. However, for the pandemic to be over by 2030, the UK needs to look beyond HIV as a local public health

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concern and continue its role in global health stewardship and leadership mirroring contributions during the COVID-19 pandemic.

THE NIH OFFICE OF AIDS RESEARCH

The [Office of AIDS Research \(OAR\)](#) is part of the National Institutes of Health and is tasked with advancing HIV/AIDS research to end the HIV pandemic and support those living with the condition. The OAR's remit includes coordinating research programmes across NIH organisations and facilitating collaboration between key stakeholders, including federal agencies, clinicians, researchers, and community partners.

This year's critical research milestones have included the discovery that a daily statin medication could reduce the risk of cardiovascular disease among people living with HIV. NIH is keen to maintain momentum in the field of immunology and vaccinology and is supporting scientists to create an HIV vaccine by applying innovative tools. Since the NIAID Vaccine Research Center (VRC) was founded in 1997, it has bolstered efforts in long-acting antibody-based HIV prevention strategies and, more recently, managed to harness broadly neutralising antibodies (bNAbs) that can stop most strains of the virus from entering immune cells. Novel HIV vaccine designs are expected to enter early-stage clinical trials this year and include a novel T-cell vaccine which can generate an HIV-specific immune response in healthy volunteers.

To improve HIV vaccine research and ensure the needs of all communities affected by HIV/AIDS are considered, the NIH is making efforts to ensure vaccine research studies engage underserved and marginalised groups, particularly those who have thus far been under-represented in clinical trials. Research will provide better and faster access to treatment and preventative programmes and can also inform responses to future emerging public health threats.

This may be an unpopular view in current socially insular times. Still, the UK must continue investing in research, prevention, and treatment programmes at home and abroad and lead the agenda through strong commitment, innovative strategies, and influential partnerships.

Locally we have supported marginalised populations and promoted inclusivity in HIV prevention, treatment, and support. However, this must translate globally by addressing the social, structural, and economic determinants of HIV. The key to defeating HIV is to create an equitable global response to this pandemic.



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UNDERSTANDING HIV RISK IN OLDER ADULTS

Laneshia Conner, Assistant Professor at the University of Kentucky, discusses gaps in HIV and AIDS prevention and why greater awareness and support for HIV risk in older adults is needed

When AIDS (acquired immunodeficiency syndrome) appeared in the 1980s, blood transfusions were the route of transmission and heavily impacted older adults (those aged 50 and above). Individuals deemed 'at-risk' were those who received transfusions before 1985. The social stigma surrounding HIV (human immunodeficiency virus) and AIDS as a disease primarily affecting White, homosexual males or individuals living in Sub-Saharan Africa has resulted in a lack of awareness among people outside of these groups, making it difficult for them to connect with and internalise the reality that anyone can be affected by the virus. Clinical trials have focused on men who have sex with men (MSM), persons who inject drugs, and other sub-groups, such as ethnic minority women of reproductive age. There is a need to broaden the category of 'high-risk' groups to include ageing and older adults.

Ageism has increased HIV risk in older adults

While condoms provide a protective barrier from most STIs/STDs, as a form of contraception, they are not as commonly used, especially among older adults. As individuals grow older, they often encounter ageism and cultural discrimination. Unfortunately, this has put them at a greater risk of HIV transmission due to two main factors. Firstly, they were not initially



Figure 25.4 New HIV diagnoses among people aged 50 and older in the USA and dependent areas by transmission category and sex, 2018.[2]
Source: CDC. Diagnoses of HIV infection in the United States and dependent areas, 2018 (updated). *HIV Surveillance Report* 2020; 31.

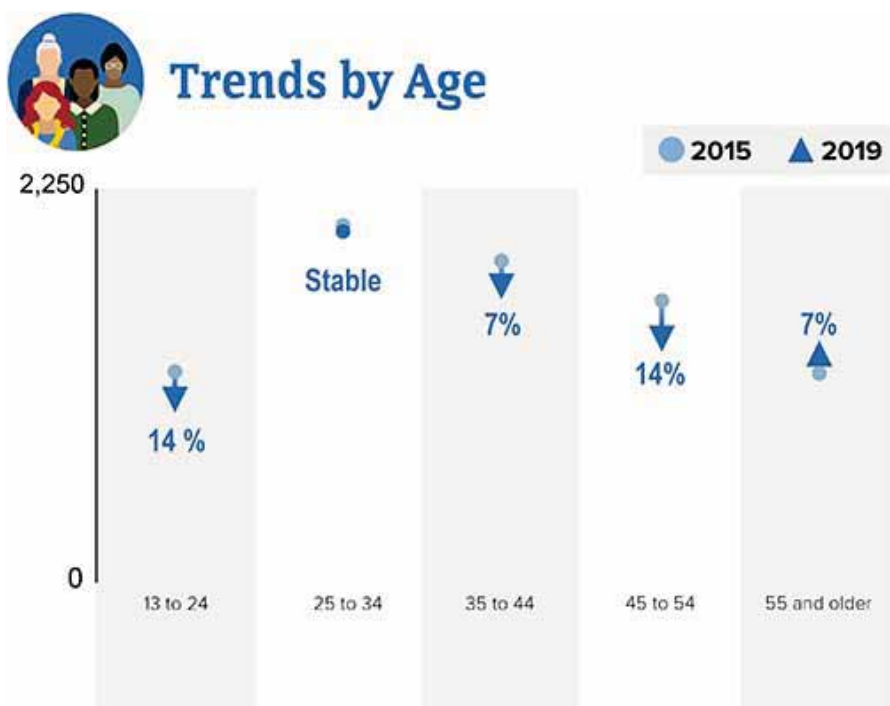
considered a population that could be affected by HIV/AIDS. Secondly, they may engage in behaviours linked to the transmission and contraction of HIV/AIDS. One of the most common HIV statistics related to age is that over half (51%) of people in the United States diagnosed with HIV were aged 50 and older and comprise nearly half (46%) of clients served by the Ryan White HIV/AIDS Program (RWHAP). Close to half of those aged 55 and older diagnosed with HIV also had AIDS (40%), which means that they were diagnosed in the later stages of the infection. Sexual contact is the primary mode of HIV risk in older adults. According to the Centers for Disease Control and Prevention (CDC), in 2022, most of the new HIV diagnoses were among older men (N=4,548) compared to older women (N=1,815).

While HIV acquisition predominantly affects the population of men who have sex with men (MSM), increasingly, heterosexual sex has increased HIV risk among older women, especially those who belong to ethnic minority groups.

African American's have been disproportionately affected by HIV

African American communities have been disproportionately affected by HIV, despite their smaller representation in the general population. Compared to other groups of older adults, older African Americans are at increased risk of HIV acquisition and higher rates of HIV mortality, demonstrating a racial/ethnic disparity in HIV diagnoses among adults. Older African American males (OAAM) who have sex with males constitute 66% of new HIV diagnoses. Among older African American women (OAAW), 86% of new HIV diagnoses were transmitted via heterosexual contact.

Although older adults are receiving more attention in federally funded HIV initiatives and research, most initiatives have focused on biomedical research, neglecting important cultural and behavioural issues that influence high-risk behaviours among older adults. Accounting for relevant physiological changes can potentially address a health promotion gap for HIV risk



Source: CDC. Diagnoses of HIV infection in the United States and dependent areas, 2019. HIV Surveillance Report 2021;32

reduction among older adults. For example, in sexual health education, training models such as synthetic penises and vaginas are used for condom skills behavioural training and education. Most models reflect reproductive processes (i.e., a vagina for a gynaecological exam) or birth control (i.e., condom training). These popular focuses leave out the physiological changes related to age and comorbidities because their target population continues to be younger adults, particularly younger women.

Heterosexual transmission of HIV occurs through the female genital tract

Nearly 40% of heterosexual transmission of HIV occurs through the female genital tract, and there is substantial clinical evidence that supports the increased HIV risk in older adults through mucosal barriers.

In other words, a clear physiological difference exists in female and male HIV risk acquisition.

“The social stigma surrounding HIV and AIDS as a disease primarily affecting White, homosexual males or individuals living in Sub-Saharan Africa has resulted in a lack of awareness among people outside of these groups, making it difficult for them to connect with and internalise the reality that anyone can be affected by the virus.”

Physiological changes include increased risk of contracting or transmitting HIV through vaginal sex without a condom with someone of unknown HIV status, age-related thinning and dryness of vaginal tissue,

and the discontinuation of using protective barriers such as condoms due to no concern for pregnancy prevention. After menopause, there is a possibility of the vulva and vagina atrophying. Older women also have a higher risk of developing incontinence, which can lead to vulvar and perineal dermatitis. Related to penises, the scrotum will sag, there is a loss of size, development of curvature, and erectile dysfunction, to name a few. There are additional performance-related changes due to decreased testosterone levels, nerve function, and sensitivity. When considering comorbidities, healthcare providers should consider the physical aspect of sexual acts. Sexual health education can provide the knowledge and skills necessary to help people make safe choices and reduce misinformation; currently, it does not cater to ageing populations. The societal norms surrounding sex have been primarily focused on non-disabled individuals and younger generations, creating a challenge for older adults. Unfortunately, sex in the later stages of life is often stigmatised as non-conventional. Increasing awareness about these important factors can greatly minimise exposure to new infections.



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TOWARDS ONE HEALTH INTELLIGENCE SURVEILLANCE SYSTEMS

The increase in global diseases and other health threats in recent decades has necessitated the importance of strengthening our surveillance systems towards early detection and monitoring of drivers

The recent COVID-19 pandemic has exposed the vulnerability of countries to such global health threats, which requires collective actions beyond individual organisations and countries (Agenda 2024, 2020). There was a global call to strengthen health surveillance systems (WHO, 2007; FAO, OIE and WHO, 2010), and countries deliberated to depart from traditional reactive surveillance to novel proactive approaches, including integration of the systems (Shuai et al., 2006; Wahl et al., 2012; Lwin et al., 2014).

The need for a One Health intelligence system

One Health intelligence surveillance systems are tools and resources that collect, analyse, and share information about human, animal, and environmental health.

Through the integration of surveillance and other relevant activities across one health domain, the capability and capacity to detect and respond to emerging and ongoing threats will improve (FAO, 2022).

Efficient systems require reliable data management platforms, Artificial Intelligence methods that will enable analysis of massive infectious diseases, and surveillance data to support response to diseases in the future (Wong et al., 2019).

Big data analytics helps to understand health risks and minimise the impact of adverse health issues by identifying

high-risk populations, and combining data or processes acting at multiple scales. These futuristic innovations can also benefit One Health's intelligence surveillance systems if there are appropriate systems and collaborations among stakeholders.

How does SACIDS enhance intelligent systems?

Over the years, SACIDS has built a strong domain in health surveillance systems, technologies, and data sciences in order to enhance prevention, early disease detection, and respond to infectious diseases including Antimicrobial resistance.

One Health intelligence systems is anchored on leveraging digital technologies to improve existing surveillance systems and use data sciences for analysis, visualisation, and prediction (Fig. 1).

We always aim to improve disease detection through syndromic surveillance, monitoring status for endemic diseases, and monitoring drivers that may signal health threats.

That has been done through the development of digital surveillance tools such as AfyaData and AfyaWatch for real-time data collection at the least cost.

The data science arm makes use of massive data generated to analyse, visualise, and train models for the prediction of health threats including infectious diseases and antimicrobial resistance.

The ultimate goal is to contribute to country-level and international One Health intelligence systems for early warning through the interoperability of surveillance and other systems, data sharing across sectors, enhanced decision-making processes, and cross-sectoral and multi-sectoral collaborations.

To ensure the acceptability, ownership and sustainability of the work that we do, our overall approaches are as follows:

- EpiHacking which involves a gathering of professionals from the fields of public health, animal health and environmental health (epidemiologists), together with software developers to come up with solutions through a systematic hacking process that involves defining challenges, brainstorming and creating prototypes;
- Community-centred where prototypes are tested to ensure they are at the epicentre of surveillance for enhancing timely reporting;
- Multi-actor participation whereby we ensure all important stakeholders in surveillance are taken aboard and understand and own the development process; and
- Flexibility and adaptability are our core principles where we aim at developing systems that are flexible enough to incorporate new variables and changes but can also be adapted to suit the context and purpose.

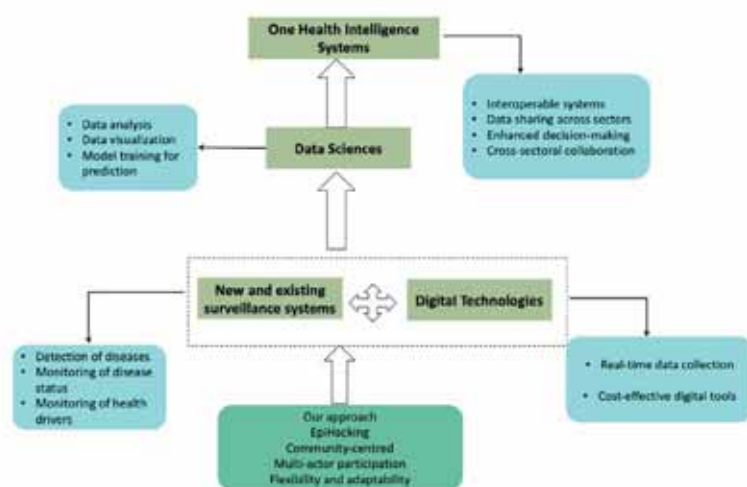


Fig. 1

Our experience in developing early warning systems

Development and Deployment of AfyaData

In December 2014, with funding from Skoll global threats (now Ending Pandemics) SACIDS teamed up with InSTEDD, EAIDSNet to host an EpiHack event that gathered human health, animal health, ICT specialists, and community members from over 14 countries to brainstorm and collaboratively prototype fit for purpose digital solution to detect infectious disease outbreaks through strengthened inter-sectorial and cross-border disease surveillance.

During [Epihack event](#) four prototypes were designed and presented, Community Surveillance, Official reporting, Feedback and Contact tracing.

In 2016, with funding from SKOLL global threats (now ending pandemics), SACIDS developed the AfyaData tool and initiated a community-based surveillance platform. We built a methodology of recruiting, training, and integrating community based surveillance with official surveillance systems.

We trained 144 community health workers 108 health (human and animal) officials.

The AfyaData app was deployed to support community-based surveillance in Tanzania.

The collected data is accessed in near to real-time by all relevant authorities through specific access code. Since the deployment of the AfyaData in August 2016, a total of 7,340 human and animal disease events have been detected and reported from communities and received prompt responses from the district authorities.

Development of the One Health digital surveillance platform in Tanzania

The initial step in the creation of the One Health Digital platform took place in December 2019, during a consultative meeting organised by the One Health Desk, now section (OHS) within the Prime Minister's Office (PMO).

Key stakeholders from various sectors, including the Ministry of Health (MoH), Ministry of Livestock and Fisheries (MoLF), Ministry of Natural Resources (MNRT), and SACIDS Foundation for One Health (SACIDS), discussed the establishment of a National One Health Information Sharing Platform. It was collectively agreed that the platform was timely and should be hosted and coordinated by the PMO OHS.

SACIDS, with funding support from Ending Pandemics, took on the project of developing the surveillance system platform. Their strategy focused on a collaborative approach of co-creation and co-deployment.

They initiated the development process

by hosting an EpiHack event, which brought together multidisciplinary experts and the community to identify health challenges and conceptualize solutions. IT experts then built prototypes based on these discussions, which were later showcased at the event. This approach proved effective in identifying challenges and generating solutions.

Conclusion

Our experience has shown us that it is possible to achieve efficient and intelligent surveillance systems for health threats detection, such as infectious diseases and antimicrobial resistance.

Technologies may help us achieve the development of the systems, but the operationalisation requires intensive stakeholders engagement and institutional commitments to make that happen.



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Why is the global threat of the tuberculosis pandemic continually neglected?

Tuberculosis is the second most infectious deadly disease after COVID-19, so why has it been met with political inertia? Vinny Wooding, Senior Parliamentary Advocacy Officer at RESULTS UK, discusses the burden of TB and the rapid action needed to address this global threat



Image: © koto_feja | iStock

Tuberculosis (TB) is both preventable and curable, yet each year over a million and a half people die needlessly from the tuberculosis pandemic, including 350,000 children. ⁽¹⁾ The infecting bacterium, *Mycobacterium tuberculosis*, is one of humanity's oldest bacteria, with a history spanning five thousand years.

TB can be either active or passive: 90% of people with TB have inactive, or latent, TB. These people are asymptomatic and are unable to transmit TB. On the other hand, active TB is spread from one person to another through airborne droplets and can affect all parts of the body, most commonly the lungs. Immunocompromised individuals are at a greater risk of contracting active TB, and social factors play a large role in transmitting and treating the disease.

A failure to properly invest in TB means that even after five millennia, global health actors have yet to effectively find, diagnose, treat, and ultimately prevent deaths from the tuberculosis pandemic.

The fight to eradicate the tuberculosis pandemic is replete with roadblocks

In 2022, the number of recorded deaths from tuberculosis rose, ending a decade-long streak of decline. ⁽¹⁾

The funding required to finance TB diagnosis, prevention and treatment is short by \$7.5 billion, whilst research and development (R&D) funding for TB falls short by \$1.1 billion. 48% of people who contract TB will face catastrophic financial costs associated with loss of income, treatment costs and other hardships. ⁽¹⁾

Compounding this, research into new tools and treatments is slow due to the complex nature of the TB bacterium and lack of financing. We cannot solve the tuberculosis pandemic overnight, yet there are concrete actions we can take now to accelerate progress towards eradicating TB by the end of 2030, in line with SDG 3.3.2.

Lessons from the COVID-19 pandemic in response to TB

COVID-19 has shown the world how an airborne respiratory virus can threaten human health and security on a global level in a very short space of time. TB can potentially cause another global epidemic as the bacteria is quickly evolving resistance to modern drugs and medicines.

Drug-resistant TB cannot be cured with regular TB medication and requires a strong cocktail of drugs taken for a prolonged period of time, with extremely toxic side effects to the individual. Drug-resistant TB accounts for a third of all global deaths related to antimicrobial resistance (AMR).⁽²⁾ Drug-resistant TB is not only a threat to the global spread of AMR but also to the ability of global health systems to respond to future pandemics.

Perhaps the best thing to help drive down tuberculosis levels would be a novel, effective and resilient vaccine that prevents an individual from ever contracting TB.

One TB vaccine already exists - the Bacillus Calmette-Guérin vaccine (BCG), but this is over 100 years old. Clinical trials for vaccines were developed long after the discovery of the BCG vaccine, yet it is still the most widely used TB vaccine in the world.

Vaccine candidates and their shortfalls

Unfortunately, it is also not very effective: the BCG has only 37% efficacy amongst children under five.⁽³⁾ There is little evidence to suggest that the BCG has any efficacy in adults.⁽⁴⁾ The lack of an effective TB vaccine costs millions of lives yearly. The international community needs to do

TB: A PANDEMIC THAT MUST NOT BE IGNORED

According to the WHO, 1.6 million people died from TB in 2021; the disease is also the second leading infectious killer after COVID-19. The burden of TB is particularly felt in low-and-middle-income countries, where over 80% of cases and deaths occur. Despite the likelihood of TB killing more people than COVID-19 in LMICs this year alone, political action and funding to assuage this threat has been historically poor. Countries fighting tuberculosis receive approximately \$800 million annually from the Global Fund, which accounts for 77% of their financial support. In contrast, the Access to Covid-19 Tools Accelerator (ACT-A) provides over \$30 billion to these same countries in their fight against COVID-19.⁽¹⁾

As the threat of drug resistance increases globally, new medicines must be developed, especially because it is estimated that by 2050, if new cures are not developed, drug-resistant TB will kill 75 million people and cost the global economy a cumulative \$16.7 trillion.⁽²⁾

Drug-resistant TB can develop when drug regimens are not administered correctly or patients with TB stop taking their medicines before their body entirely eradicates the disease. The resistant strain can be transmitted to others, requiring prolonged and intensive treatment. TB Alliance, an organisation spearheading R&D for new TB regimens, has so far brought three new products to the market, including Pretomanid, which can be used to treat adults with pulmonary extensively drug-resistant tuberculosis (XDR-TB) and multidrug-resistant TB (MDR-TB), in combination with bedaquiline and linezolid, as part of the BPaL regimen. It was FDA approved in 2019 and is the first anti-TB drug to be developed and registered by a not-for-profit organisation.⁽³⁾

The COVID-19 pandemic brought a renewed focus to health inequities, and it is hoped that world leaders will maintain momentum to help fight TB globally. As well as the UN high-level meeting on TB, the G7 and G20, hosted respectively by Japan and India are significant platforms for countries to mobilise efforts and strengthen preventative measures, including funding for new TB interventions. Given that only three new TB medicines have been approved in the last 40 years, countries must strengthen their response to serious infectious diseases that already exist while they endeavour to prepare for future pandemics.

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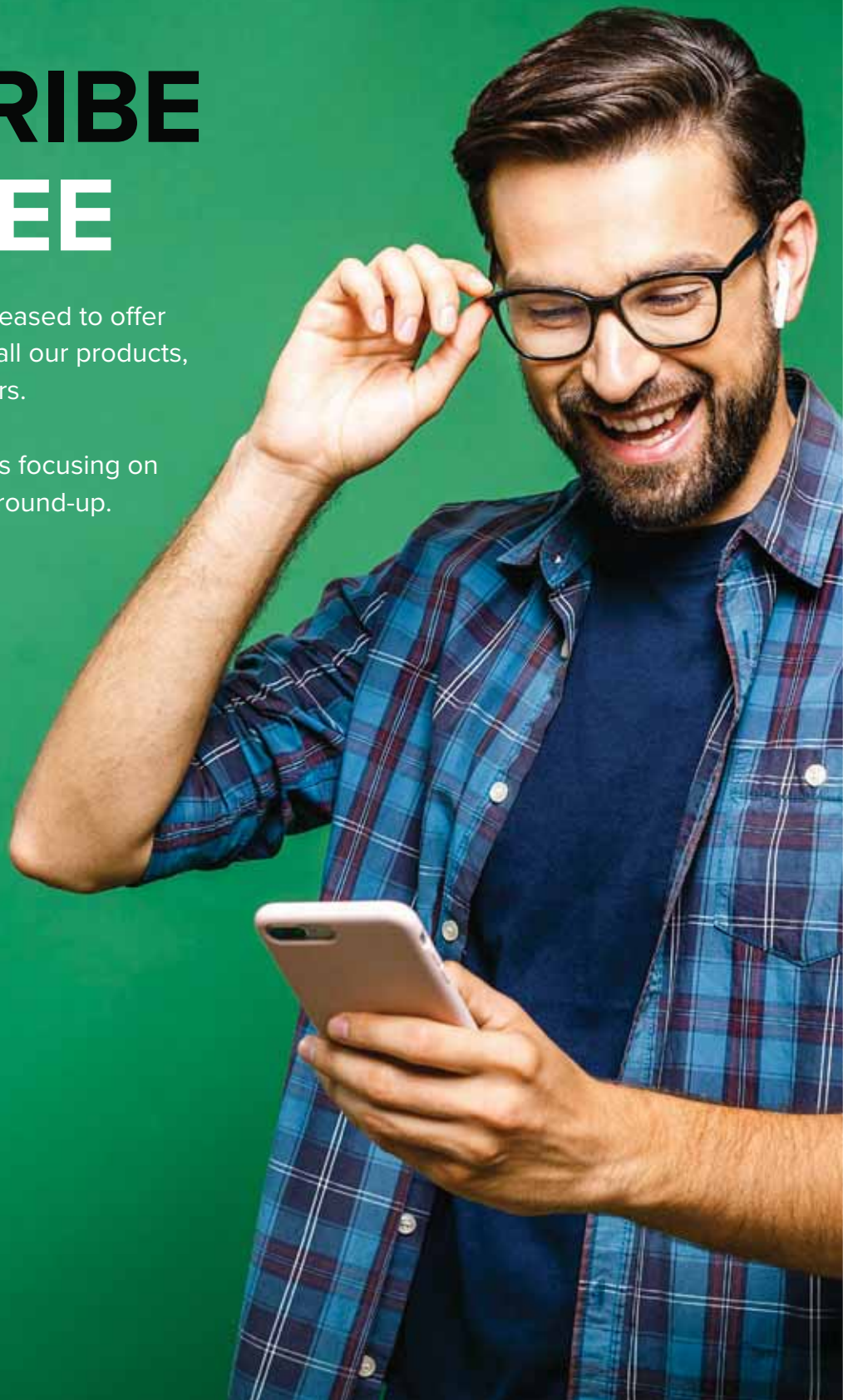
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more to drive R&D to discover new tools to fight against the TB bacterium.

There are several promising vaccine candidates in the pipeline at the moment against tuberculosis. [Six potential vaccine candidates](#) are in Phase 3 of the clinical development process - the final phase before the vaccine can be regulated for public use. Yet promising vaccine candidates have emerged before and have ultimately fallen short.

Stakeholders within the global TB community wait with bated breath for updates on the progress of these six vaccine candidates. However, we need to be prepared if all six candidates fail - and this requires significantly more finance for further R&D from Nation States and other international actors.

The 2018 UN High-Level Meeting (HLM) on TB set a target of \$2 billion per year for R&D into new vaccines, surveillance tools, treatments, and preventative measures. Yet, in 2022, only \$900 million was forthcoming from donors. ⁽¹⁾

We need to find innovative and novel ways of raising finance to support TB R&D, and the 2023 HLM provides just that opportunity. Additionally, we need to accelerate political leadership and engagement with the tuberculosis pandemic.

The tuberculosis pandemic is just as much political as it is infectious

A transformational leadership approach is needed now more than ever in an increasingly unpredictable and volatile world. All countries have a responsibility to invest in health systems to protect people, societies, the economy, and the planet from the tuberculosis pandemic.

As the old adage goes: 'no one is safe, until everyone is safe.'

COVID-19 exposed and magnified the weaknesses and inequality within global health systems. To end the tuberculosis pandemic, we must strengthen health systems to be resilient, gender-responsive, and community-led, with an empowered workforce that can meet the needs of the most marginalised in society.

Proactive policy frameworks are required to target the most vulnerable and marginalised groups by addressing the social, economic, and cultural determinants driving TB. These policies require a multi-sectoral approach with collaboration across stakeholders and sectors to end TB and ensure no one is left behind.

The 2023 UN High-Level Meeting on TB will take place in September. It presents a perfect opportunity for Heads of State and governments to step up to the challenge and show what global health solidarity means.

The cost of investing proactively to end TB far outweighs the cost of treating TB and its related consequences; we can reduce this further with countries working together to share resources, knowledge, and best practice. Evidence suggests that for every \$1 spent investing in TB, \$34 of economic benefit is gained ⁽⁵⁾, highlighting again the benefits and imperatives of proactively tackling TB before it becomes active. The urgent need to end the tuberculosis pandemic is more than a health issue; it is imperative to protect our societies, health systems and the global economy for the future.

How can any political leader or country not afford to invest in this?

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EXPLORING THE POSSIBILITIES OF BACTERIOPHAGES FOR TUBERCULOSIS

Bacteriophages have long offered prospects for treating bacterial infections. Is it time to use phages to control tuberculosis? Professor Graham F. Hatfull explores this

Bacteriophages – phages for short – are viruses that infect bacteria. They were discovered about 100 years ago and are prevalent throughout the biosphere and indeed throughout our bodies. Phages infect and kill bacteria as they replicate, and because of this antibacterial action, they have long been recognized as having therapeutic potential. This potential was largely side-lined once broad-acting antibiotics were discovered, but the troubling emergence of antimicrobial drug resistance has prompted the revisitation of bacteriophage therapeutics.

Phages are different to antibiotics

Bacteriophages differ from antibiotics in several important ways. Firstly, where antibiotics are small, highly active chemicals often with associated toxicities, phages are biological entities with the capacity to replicate and evolve and are not toxic. Phages are larger than typical antibiotics, and this influences how and where they can travel in the body. Unlike antibiotics, phages are potential targets of the immune system, which might limit their applications. And perhaps most importantly, phages can be very specific for individual bacterial strains, unlike broadly acting antibiotics. But this specificity is a double-edged sword. On the one hand, phages are like guided missiles targeting bad bacteria, leaving good bacteria in our

microbiomes unharmed. On the other hand, their specificity confounds the development of generalized treatments, often requiring personalization for individual patients.

Are there phages that infect *Mycobacterium tuberculosis*?

Yes indeed. *M. tuberculosis* (Mtb) is one of many important species within the genus *Mycobacterium*, and phages of mycobacteria (i.e. mycobacteriophages) have been described. Mtb is a slow-growing pathogen, so the process of isolating new bacteriophages from the environment using Mtb can be technically challenging. However, the fast-growing non-pathogenic *Mycobacterium smegmatis* is a superb host for phage isolation, and over 12,000 individual phages have been discovered; 2,200 have completely sequenced genomes⁽¹⁾. This genomic information provides an important framework for understanding their relationships and their diversity. Moreover, their genomic patterns can be correlated with which ones also infect a laboratory strain of Mtb. Although not all bacteriophages isolated on *M. smegmatis* also infect Mtb, a few key ones do. And an important and interesting finding is that these phages often infect various clinical isolates of Mtb, reflecting the overall genetic coherence of Mtb⁽²⁾. Thus, personalization of phage therapies for TB may not be necessary.

What have we learned from using phages to treat nontuberculous mycobacterium infections?

Unfortunately, the clinical use of phages to treat TB has not been explored, and its potential remains unknown⁽³⁾. However, recently phages have been used on a compassionate use basis to treat several patients with highly antibiotic-refractory nontuberculous mycobacterium (NTM) infections. These cases shed considerable light on the prospects for phage therapy for TB. First, it must be appreciated that patients eligible for such experimental treatments are very sick, often with multiple challenging conditions, that have run out of options for treating their NTM infections. Second, the good news is that several of these well-documented cases suggest phage interventions can indeed be therapeutically beneficial with favorable clinical or microbiological outcomes. A consecutive series of 20 cases included five for which no outcome could be determined, but of the remaining 15, 11 showed favorable outcomes, with four having no evident improvement⁽¹⁾. Each of these cases required personalized treatments based on strain screening to identify suitable phages, and phage engineering was required to optimize infection and bacterial killing. Overall, these are encouraging outcomes, notwithstanding the evident challenges.

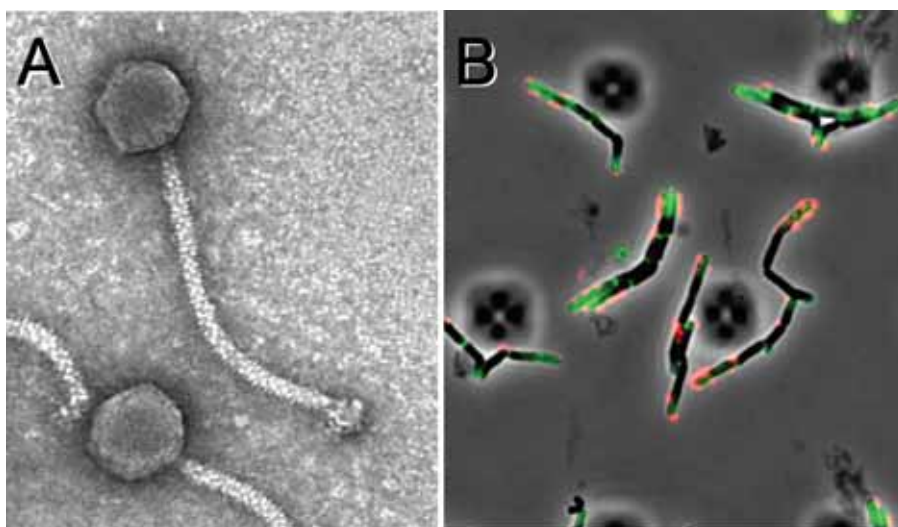


Figure 1. Mycobacteriophages. A. Electron micrograph of a mycobacteriophage. B. Micrograph of a mycobacteriophage (red) infecting a Mycobacterium cell (green).

What are the impediments to using phages to treat tuberculosis?

Unlike antibiotics, bacteriophages have very strong safety profiles and reports of any adverse reactions are extremely rare, although only very small numbers of patients have been treated with any phage for any infection. Optimal phage dosages are unknown, but the safety profiles suggest that dose escalation studies to determine toxicity may not be essential. The optimal route of administration – intravenous or inhaled – also requires evaluation. Any clinical trial is likely to require regulated manufacturing processes which can be costly, and patient care and follow up is also expensive. However, clinical trial design can vary enormously, and could be anything from a small targeted early bactericidal assay to a full blown multicenter, randomized, and blinded trial. Carefully defining the goals and how phages might play a therapeutic role is a critical first step.

How might phages fit into an anti-tuberculosis therapeutic strategy?

Expectations of the clinical benefits of bacteriophage therapy for TB should be moderate, and there are many potential challenges. Phages may access extracellular bacteria in an advanced infection, but intracellular bacteria or bacteria within granulomas may be hidden to the phage. A stand-alone phage therapy would seem a tall-order. However, it is simpler to envisage benefits from combination phage-antibiotic regimens, where phages may help to shorten treatments, and perhaps minimize the emergence of antibiotic resistance. Similarly, phages might be useful in combination with new (and expensive) antibiotics to help reduce loss of efficacy of the newly developed drugs due to resistance. Because phages have the capacity to replicate on their target bacteria within the human host, one could imagine that a single

relatively large phage dose may be administered, simplifying logistics in the developing world. Finally, there is the possibility of using phages prophylactically to minimize transmission among family and workplace colleagues.

In conclusion, many of the pieces needed to evaluate bacteriophages for TB therapy are now falling into place. The time is now to finally put the question to the test: Is there a role for phage therapy in TB control?

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Why research on immune system disorders is critical to improving patient outcomes

The immune system is the body's natural defence against antigens such as bacteria and viruses, but in some cases, it can malfunction. We explore the prevalence of immune system disorders, the associated unmet medical needs, and therapeutic research

The immune system is vital to our overall health. Made up of a complex network of cells, tissues, and organs, it can process and store information on harmful pathogens to help protect us from illness. However, when the immune system is weak or does not function correctly, it can trigger reactions and cause symptoms of disease. Equally, when the immune system cannot distinguish a 'foreign' invader from one's own cells and tissues, it can initiate an autoimmune response whereby our immune system turns on itself and mistakenly attacks healthy tissues.

The vast and somewhat enigmatic immune landscape has intrigued researchers for many years as they try to unearth its impact on disease development, and reaction to therapeutics. Despite there being over 100 known autoimmune diseases, most still have no known cure and patients with rarer conditions can go years without proper diagnosis. ⁽¹⁾

Why does the immune system malfunction?

There are many reasons why the immune system fails to function correctly; some people are born with a weak immune system (primary immune deficiency), and others may have a more vulnerable immune system due to disease (acquired immune deficiency). The immune system can also fail to work correctly if it is overactive or reacts negatively to harmless substances, triggering an autoimmune response.

While the root causes of many immune-system-related conditions have evaded scientific understanding, it is thought that genetics and the interplay between genetics and the environment affect the immune response and the development of autoimmune diseases. For instance, conditions such as asthma, eczema and allergic rhinitis may be caused by genetic susceptibility to harmless environmental allergens, such as dust, mould, pollen, and certain foods.

In autoimmune diseases, the immune system attacks healthy cells, tissues, and organs. In type 1 diabetes, for instance, T lymphocytes immune cells destroy cells in the pancreas that make insulin, a hormone that controls blood sugar levels. Similarly, the immune system attacks body tissues and organs in lupus, including the lungs and kidneys. These chronic conditions can lead to the weakening of bodily functions and even become life-threatening.

The likelihood of developing an autoimmune disease is not fully understood, but is thought to be influenced by genetics, environmental factors, gender, sex hormones and infection. Women are more susceptible to these diseases than men, and they remain a significant cause of mortality in youth and middle age. ⁽¹⁾

Autoimmune conditions and their unmet medical needs

The immune system's multi-faceted network and systems have made it difficult for scientists to understand the subtle changes that can trigger an autoimmune response. This is partly why there remain significant unmet medical needs for autoimmune conditions.

Patients with autoimmune conditions often have limited treatment options that address symptoms and act by suppressing the immune response. Medications can have broad effects and are not specific to the patient's disease, which can lead to unpredictable and severe side effects such as infections and malignant disease.

Research and development for autoimmune diseases

The global recognition that an increasing number of people have autoimmune diseases and require effective treatments has led to the emergence of innovative solutions and targeted research. For example, anti-CD20 mAbs for B cell depletion therapy has demonstrated encouraging outcomes for patients with neuroinflammatory diseases. ⁽²⁾ Additionally, CAR T-cell therapy involving the

modification of immune cells was shown to send lupus into remission in five severely ill patients.⁽³⁾

Individuals who have autoimmune conditions face a higher likelihood of developing cancer. Disruptive technologies such as artificial intelligence and computational immunology are also broadening our understanding of how the immune system responds to certain stimuli and treatments, which can help inform the development of effective therapies in the future.⁽⁴⁾ Novel solutions (such as novel checkpoint inhibitors and neoantigen vaccines) are being developed in immunotherapy – a treatment that helps the immune system recognise and destroy cancer cells. For instance, clinical cancer immunologists and biological engineers at the Wyss Institute formed an NIH-funded Immuno-Engineering to Improve Immunotherapy (i3) Center and are working on solutions to provoke anti-cancer T-cell immunity for treatment-resistant cancers.⁽⁵⁾

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HOW THE NIH SUPPORTS AUTOIMMUNE CONDITIONS RESEARCH

The National Institute of Environmental Health Sciences (NIEHS) is part of the National Institute of Health. It supports cutting-edge science and technology to understand the interplay between environmental exposures, human biology, genetics, and diseases. A considerable part of the NIEHS's research is how the environment affects the development of autoimmune conditions; together with the National Toxicology Program (NTP), it is investigating the genetic and environmental drivers of autoimmune diseases, including how exposure to ultraviolet radiation from sunlight may be connected to the development of juvenile dermatomyositis and the link between socioeconomic status in childhood and rheumatoid arthritis in adulthood.

In 2010, the institute gathered an interdisciplinary panel of 40 experts to assess this field's current state of science. Among its conclusions, the panel stated:

- Solvent exposure from working with products such as paint thinners and cleaners is linked to systemic sclerosis;
- Crystalline silica exposure, from working with quartz or granite, for example, can contribute to the development of several autoimmune diseases; and
- Smoking can contribute to the development of seropositive rheumatoid arthritis.

The NIEHS is also conducting a range of clinical studies, including the link between inflammation and immune cells in the bloodstream, myositis development in adults, juveniles and military personnel, and environmental factors that may result in dermatomyositis or polymyositis. Earlier this year, NIH researchers discovered an autoinflammatory disease that arises from mutations in the LYN gene. This gene is crucial in regulating immune responses. The condition is called Lyn kinase-associated vasculopathy and liver fibrosis (LAVLI), and the discovery could open up the possibility of repurposing existing drugs to target genes linked to certain illnesses.

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POTENTIAL IMPLICATIONS OF COSMETIC BoNT-A USE ON FUTURE TREATMENT OPTIONS FOR NEUROMUSCULAR DISORDERS AND PAIN

Given the rise in cosmetic procedures involving BoNT-A, cosmetic physician Dr Mary Dingley discusses the therapeutic implications of antibody-induced resistance on future treatment of various conditions including post-stroke spasticity and pain disorders

Botulinum neurotoxin type A (BoNT-A) is produced by the *Clostridium botulinum* bacterium and is the most powerful neurotoxin known. But it is also a very useful medication. It is used to treat the symptoms of neuromuscular disorders such as cervical dystonia, cerebral palsy, post-stroke spasticity, and migraine and pain disorders. It is also a key part of the frequently used, minimally invasive cosmetic procedure called 'BOTOX'. However, the increasing aesthetic use of BoNT-A raises concerns that this may render the substance therapeutically useless or ineffective.

Botulinum neurotoxin-A

In nature, BoNT-A enters the body via the gut (by eating contaminated food). It has a coating of accessory proteins to protect the core toxin from digestion and facilitate its passage through the gut wall. These neurotoxin-associated proteins (NAPs) take no part in the action of the core neurotoxin, the main one being the blockage of neurotransmitter release from nerves so that muscles do not contract.

Therapeutically and aesthetically, BoNT-A is injected, so there is no requirement for NAPs to be present. However, treatment results are temporary, so injections are usually

repeated every three to four months to maintain the beneficial effect.

How does the immune system produce antibodies to BoNT-A?

The immune system employs a two-step assessment process to make antibodies. Initially, dendritic cells decide whether substances are dangerous. For example, the NAPs and other bacterial-derived components, such as flagellin, denatured neurotoxin and clostridial DNA, are considered dangerous; however, the core neurotoxin is not deemed so (in nature, the NAPs and core neurotoxin arrive together). Secondly, at lymph nodes, dendritic cells would present the dangerous antigen to the T Helper cells, which decide whether the substance is foreign or non-self. Both NAPs and core neurotoxin are foreign, so antibodies will then be formed by the activated T cells and B cells.

If NAPs are absent, dendritic cells do not tend to 'see' core neurotoxin, so it does not enter the immune pathway, and antibodies are not produced. However, in the presence of NAPs and other 'danger' signals, BoNT-A may accidentally be gobbled up by activated dendritic cells, thereby entering the immune pathway, and antibodies may be formed.

As treatment with BoNT-A is usually ongoing, repeated injections act like booster vaccinations and further stimulate the immune system to increase the production of antibodies against BoNT-A, impairing BoNT-A's ability to block targeted neuromuscular junctions.

What is the result of this immune stimulation?

Over time, the increase in antibodies against BoNT-A may mean treatment efficacy declines. This is usually seen as increasing dose requirements to achieve the same, or a lesser, effect and a decrease in time between treatments (dose and interval creep). This may lead to a cessation of benefit known as secondary non-response (SNR).

While immunoresistance resulting in SNR has long been recognised in therapeutic treatments, it was thought that this was not of concern in cosmetic treatments due to the lower dosages employed. However, cosmetic use has dramatically expanded, with more people having more indications treated and higher dosages being used for some of these indications. Treatment may also occur over entire adult lifespans, so it is hardly surprising that reports of immunoresistance from cosmetic exposure to BoNT-A are increasing.

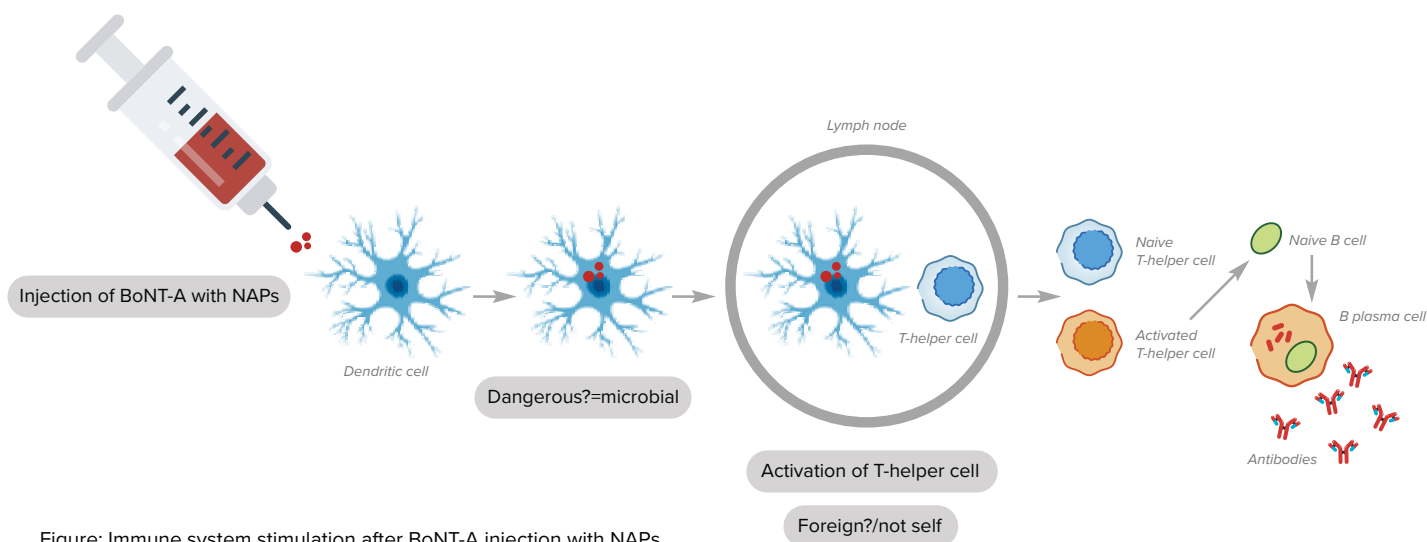


Figure: Immune system stimulation after BoNT-A injection with NAPs

While immunoresistance has been reported to occur immediately following a second BoNT-A treatment, it usually develops progressively over several years, with signs of dose and interval creep being apparent. This may be readily documented in the therapeutic world, where patients are usually treated in the same facility which records all their treatment history, but cosmetic patients may frequent different clinics and change practitioners, especially if they feel their treatments are not giving them the same results as previously obtained. This makes it much harder to follow patients' progress accurately.

Should SNR develop through cosmetic exposure, it may mean that in later life, should BoNT-A be required for a neuromuscular concern, such as post-stroke spasticity, it will not work. BoNT-A is the only available medication choice for some of these neuromuscular disorders, leaving patients with no other treatment options.

Do all BoNT-A formulations have NAPs?

In the 1990s, the commercially

available forms of BoNT-A reduced the overall bacterial protein load in their formulations. This significantly reduced the degree of immunoresistance which occurred; however, it did not eliminate it. Currently, there are more forms of BoNT-A available, but only one (incobotulinumtoxin-A) has completely removed the NAPs from its formulation. There has been no documented case of immunoresistance when this form of BoNT-A is used exclusively.

What can be done to reduce immunoresistance to botulinum neurotoxin-A?

Using the lowest effective dose and ensuring treatment doses are not administered too frequently may reduce the stimulation to the immune system. Avoiding top-up doses wherever possible may also help. It would seem prudent to use the least immunogenic form where treatment efficacy is equivalent among various forms of BoNT-A. Agencies that approve medicines worldwide may wish to look at biological medications over a longer time frame, as immunoresistance usually develops over several years.

Patients, whether having therapeutic or cosmetic treatments, should be educated and informed about which toxins are being administered to them, along with the risk of immunoresistance and its possible future implications.

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A new era of pathogen surveillance using genomic sequencing

We spoke to Dr Joanne Hackett, Former Chief Commercial Officer of Genomics England and Regional Board Member of Movement Health 2030, about how genomic sequencing supports preparedness and response to public health threats

Genomic sequencing is a method scientists use to decipher the genetic material found in organisms or viruses. The significance of genomic sequencing tools was truly brought to the fore during the COVID-19 pandemic as researchers were able to observe any sudden changes (or mutations) in a virus's genetic code which may give it an advantage over other variants of itself, for example, spreading faster or causing more harm to those it infects.

Mutations do not always result in a major change in a virus's ability to spread or cause disease. Still, if variants are left unchecked, they can become more prevalent in a population over a shorter period. Similarly, if a specific

variant starts to have a widespread impact on a population, it may be classified as a variant of concern.

Scientists are gaining a better understanding of how organisms and diseases function and adapt to changing environments due to advancements in technologies that support genomic data analysis, like machine learning and big data tools. In the wake of the COVID-19 pandemic, more countries are using novel technologies and data to monitor potentially harmful viruses on a larger scale. The U.S. Centers for Disease Control and Prevention (CDC) established a new [Center for Forecasting and Outbreak Analytics](#) hub in 2021 to expand data sharing and integration capabilities and improve forecasting and

Image: © JuSun | iStock



By comparing their genomes with those who experienced mild symptoms or were asymptomatic, they aim to gain deeper insights into the factors contributing to COVID-19's impact on people.

To discuss the role of surveillance and genomic sequencing in aiding the response to public health threats, we spoke to Dr Joanne Hackett, Head of Genomic and Precision Medicine at IQVIA and Former Chief Commercial Officer of Genomics England.

Can you describe the virus genome sequencing process and how it supports the detection and control of infectious diseases?

Virus genome sequencing proved to be a key tool in the detection of SARS-CoV-2 variants in the pandemic. Technically speaking, a virus is easy to sequence as it is so small compared to a human genome. The bigger challenges are the speed of sequencing and the importance of timely sharing.

The early sharing of genomic sequencing data from the novel pneumonia in China in early 2020 allowed the rapid development of diagnostic tests and, most crucially, the record-breaking development of vaccines.

The big global achievement was to scale up genomic sequencing to be able to deal with massive numbers of positive specimens and report them in national and global databases. There are currently over nine million SARS-CoV-2 genomes on the global GISAID database. The rapid uploading of sequences led to the identification of the major variants of concern – often initially given the names of the countries that first identified them due to effective surveillance. These are now more sensibly referred to via Greek letters.

What was the significance of ongoing viral monitoring during the COVID-19 pandemic? How have genomic sequencing surveillance strategies and sequencing technologies changed since the pandemic began?

The initial population-scale viral genomic sequencing of genomes relied on academic consortia working with hospitals and public health agencies. In time, once the

outbreak analytics in public health decision-making to better respond to public health threats. The CDC subsequently launched a new [Notice of Funding Opportunity](#) (NOFO) to support decision-making in emergencies and establish a national outbreak response network. This programme aims to assist state and local officials in creating and utilising the most appropriate analytical tools based on reliable data for their respective areas. Dylan George, Director of CDC's Center for Forecasting and Outbreak Analytics, said: "This network will increase our national capacity to use disease models, analytics, and forecasts to support public health action, prevent infections, protect people, and safeguard economies. The network will also provide desperately needed tools to fight outbreaks quickly and effectively in our communities, where critical response decisions are made."

In the UK, Genomics England collaborates with NHS England and the NHS Genomic Medicine Service to collect genomic data and create customised and predictive healthcare solutions. One of its noteworthy initiatives is the COVID-19 Study, which involves partnering with the GenOMICC consortium to examine the genome sequences of roughly 20,000 individuals who suffered severe illness from contracting the coronavirus.

TAILOR-MADE PROMOTION

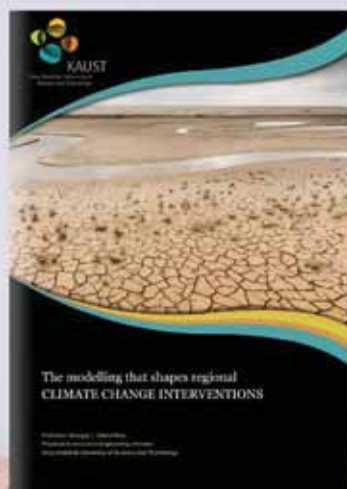
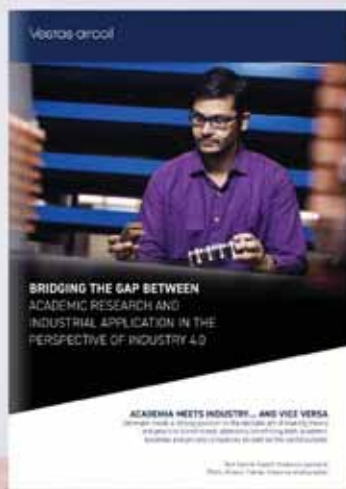
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value of viral genomes was established, these academic efforts have been aligned with national testing strategies. The other major challenge has been robust sampling strategies and the ability to link viral genomes to patient data – including the date of infection and severity of the illness. Some countries have struggled to achieve this due to the separation of testing and sequencing facilities and concerns about data governance.

How did the UK's surveillance system for new variants compare to other countries?

The UK established a very rapid viral sequencing capability through the work of the COG-UK Consortium led by Sharon Peacock and colleagues and relying on existing research capacity at the Sanger Centre, the Quadram Institute, and many others. Research agencies funded this, but it was quickly connected to the main PCR testing laboratory network, the Lighthouse Laboratories. The data then flowed via existing academic databases into the four main public health agencies in the UK. At one time, the UK had deposited over 50% of the sequences in the global databases and remains second only to the USA for total SARS-CoV-2 sequences.

The UK has also funded an initiative called the New Variant Assessment Platform that supports low- and middle-income countries to develop their own genomic sequencing and analysis capabilities and to support the biological characterisation of new variants using facilities in the UK.

How important is international collaboration to the work of genomic pathogen surveillance, and can you outline any associated challenges?

The pandemic has highlighted the importance of international cooperation and data sharing. COVID-19 relied on infrastructure developed to respond to pandemic influenza, including the GISAID database.

Several global initiatives during the pandemic highlighted the importance of pathogen genomics that shaped the response to that and potentially any future pandemic threats. The WHO and G7 have recommended that all countries aimed to sequence 5-10% of COVID-19 cases and that data be shared widely to track new variants of

concern, drive enhanced responses, and inform plans for vaccination or modified vaccine composition.

Several countries have taken specific action to improve global cooperation. Under the UK's G7 presidency, Sir Jeremy Farrar recommended a global network of expertise to provide a new 'global pandemic radar'. This is being developed at the International Pathogen Surveillance Network led by the WHO. Germany has committed funding to a WHO Hub for Pandemic and Epidemic Intelligence in Berlin to develop tools to detect and tackle new pandemic threats. Many countries are funding enhanced surveillance facilities and support from global initiatives like the Coalition for Epidemic Preparedness Innovation (CEPI) and the One Health initiatives on animal and agricultural threats.

How do you see the UK and Europe's genomic industries developing in the future to support response efforts to public health threats such as antimicrobial resistance?

The industry has played a key role in developing diagnostics, vaccines, and countermeasures and has relied on genomics and advanced data analytics. Genomics and other industries are key partners in initiatives like the 100 Days Mission to accelerate the response to a new pandemic threat. Antimicrobial resistance is also a key public health priority requiring global action. Many of the capabilities used in the COVID pandemic are capable of being applied in AMR surveillance and response.

Dr Joanne Hackett
 Head of Genomic and Precision Medicine
 IQVIA
 Former Chief Commercial Officer
 Genomics England



APPLYING DATA SCIENCE ADVANCES IN DISEASE SURVEILLANCE AND CONTROL

Dr. David S. Ebert from the University of Oklahoma's Data Institute for Societal Challenges and Dr. Aaron Wendelboe from the University of Oklahoma Health Sciences Center outline how a cohesive, multidisciplinary, and multi-tiered approach can support a more predictive model in disease surveillance and control

Early detection of disease transmission has been a public health goal for decades. Syndromic and sentinel disease surveillance systems are two approaches designed to enhance early detection surpassing traditional, passive approaches.⁽¹⁾ Public health disease surveillance is being conducted in countless settings, including healthcare, vertebrate and invertebrate animals, wastewater, air quality, transportation, and commercial activities. Threats from pandemic influenza, bioterrorism, SARS1/MERS, antibiotic-resistant bacteria, and increased distribution of pathogens and insects, which threaten the environment, have been priority concerns for public health agencies. Unfortunately, attaining the goal of early disease detection has been somewhat elusive. The current challenges include identifying optimal data sources, maintaining the ability to efficiently conduct ongoing disease surveillance that relies on a large and complex data network, and effectively analysing and summarising the data in a way that cuts through the 'noise' and identifies true events of public health concern.

Many other approaches to mitigate the impacts of current and potential health threats have been ongoing, such as the World Health Organization's Health Emergencies Programme,⁽²⁾ the UK's Influenza Pandemic Preparedness

Strategy,⁽³⁾ and the USA's National Pandemic Strategy.⁽⁴⁾ In addition, there is a history of including academic partners, such as the Centers for Disease Control and Prevention's (CDC) Centers for Public Health Preparedness,⁽⁵⁾ as an innovative way to protect against severe pandemics.

Adopting a One Health approach to disease surveillance and control

Emphasis on taking a One Health approach to disease surveillance and control has been growing. The One Health approach capitalises on the interconnected human, animal, and environmental systems and emphasises coordinating, communicating, and collaborating among stakeholders who protect human, animal, and environmental health.⁽⁶⁾ While progress has been made since the First International One Health Congress was held in 2011,⁽⁷⁾ calls for improved application of One Health principles continued to be made early in the COVID-19 pandemic.⁽⁸⁾

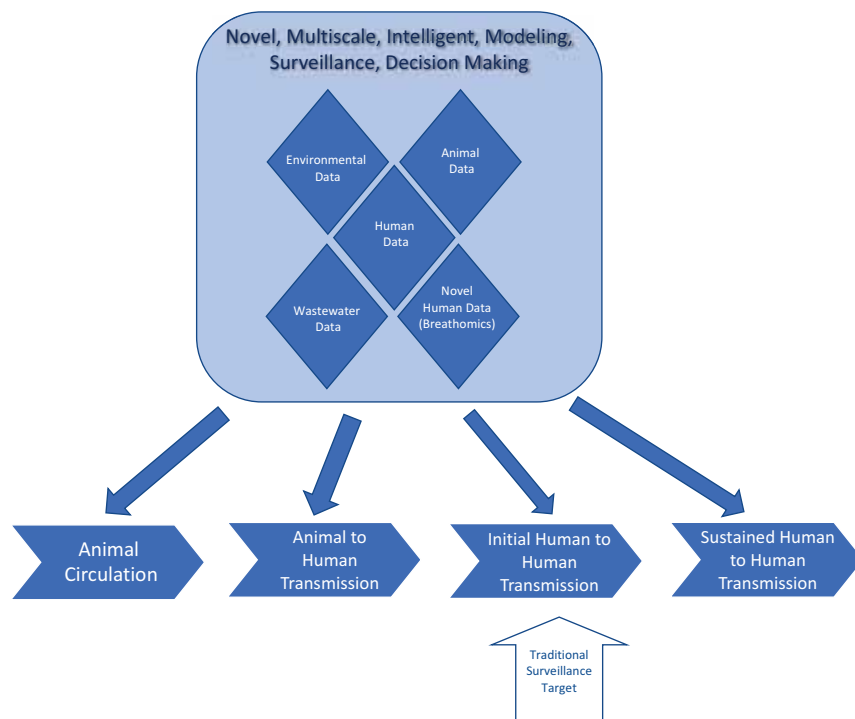
Another key shortcoming of public health preparedness efforts is the insufficient collaboration between multidisciplinary experts, such as data scientists, computer engineers, anthropologists, social scientists, and systems engineers. Even collaborations within health-related fields, such as

veterinary and environmental health, have been relatively weak.

Despite efforts, the SARS-CoV-2 virus still managed to cause a major pandemic unseen for a century. Furthermore, given that SARS-CoV-2 was first detected in a symptomatic patient⁽⁹⁾ (as opposed to earlier in the chain of disease emergence, such as in an animal host), it is evident improvements in disease surveillance methodology are required for earlier detection of pathogens of pandemic potential.

Multi-tiered approach to disease surveillance and control

To address these gaps in knowledge and preparedness, we are responding in a multi-tiered approach with a One Health perspective that will be economically feasible and sustainable, as summarised in Figure 1. To achieve this goal, we have identified and engaged a broad set of stakeholders, created broad multidisciplinary teams, are combining relevant data sources in innovative ways that will serve as early indicators, are using advanced technologies for early diagnosis, and advancing analytic methods to maintain high specificity for true event identification, while reducing the number of false positive alerts. Developing and implementing these



approaches will shift disease surveillance and control for emerging infectious diseases from a solely reactive model to a more predictive model functioning in real time. The following section elaborates on our strategies and progress for each goal.

We met with government agencies and academic teams to engage stakeholders and described our project's goals. In this process, we have identified organisations and teams in Oklahoma and neighbouring states with complementary goals. We are working towards building and strengthening new collaborations to combine resources. In addition, we are holding regular webinars on topics covered by each team. Again, this has led to identifying new stakeholders who want to contribute to the success of our project.

We brought together experts in public health, medicine, veterinary science, data science, computer science, anthropology, informatics, and systems engineering to bring the needed skills to address the problem.

The data sources we are accessing include governmental disease surveillance, syndromic surveillance data from environmental data, ESSENCE/Biosense,⁽¹⁰⁾ wastewater surveillance data,⁽¹¹⁾ veterinary data,⁽¹²⁾ and medical record data from the health information exchange.⁽¹³⁾ We will access environmental monitoring data from Earth-observing satellites and ground-based sensor networks. The wastewater and river shed surveillance data are a key data source that intersects environmental, animal, and human data. In the past, these data sources have essentially acted as silos; we are combining them to help verify signals.

One exciting new technology we are using is in the field of breathomics research. We have developed a tool in which an individual's breath can be analysed, and a diagnosis of COVID-19 can be made within one minute. The technology works by identifying specific volatile organic compound signatures from pathogens. We are in the process of extending this technology to be used to identify influenza and RSV.

The advanced analytic methods implement a data-driven syndromic and epidemiological model that harnesses novel AI-enabled methods to monitor, integrate, and correlate sources across various scales for pandemic detection and prediction. We leverage human-guided, predictive, information and interpretable AI/ML within methods for disease surveillance deployment, sampling, and analysis to manage these large data streams. Not only are we detecting alerts, but developing models to project the impact of an event if it goes undetected. These models are expected to help prioritise which signals must be investigated first.

By successfully achieving these five activities, we will be positioned to have an intelligent, interactive response planning and monitoring system that scales these new data sources and analytical methods across the community, state, and national levels and accounts for diverse population dynamics and disease spread, enabling earlier detection and response.

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How AI will revolutionise stroke care

From supporting diagnosis and optimal treatment to predicting patient outcomes, artificial intelligence (AI) is set to revolutionise the delivery and quality of care; we take a look at its potential impact on stroke care



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Stroke, so named because of the way it can strike people down, is a serious life-threatening condition that often leaves the sufferer with long-term after-effects. There are different types of strokes with varying severity, but all are characterised by the blood supply to part of the brain being cut off. Transient ischaemic attacks (TIA), or 'mini stroke', cause similar symptoms to a stroke, but effects usually ease within 24 hours, whereas strokes caused by carotid stenosis (a narrowing of the artery in the neck that supplies blood to the brain) or blockage of an artery are more dangerous.

According to the WHO, stroke is a leading cause of mortality and morbidity worldwide, affecting 15 million people annually. Certain conditions can increase the risk

of stroke, including hypertension, high cholesterol, atrial fibrillation, and diabetes. Recognising the symptoms of a stroke quickly is vital to give patients the best possible outcome; at present, around five million people are left permanently disabled, placing a burden on health systems, families, and communities.⁽¹⁾ Survivors can experience loss of vision and/or speech, paralysis, and confusion. Unfortunately, the risk of further episodes significantly increases for people who have experienced a stroke before.

As a major public health concern, governments and health systems are endeavouring to find new solutions to support stroke prevention, detection, treatment and associated clinical decision-making. Technological

advances facilitate the collection of vital data, which can be stored and analysed by large-scale computer algorithms. Large datasets can provide valuable insights and support stroke detection and rehabilitation research. According to the UK's Department of Health and Social Care, cutting-edge AI technology is associated with a tripling of the number of stroke patients recovering or able to perform daily activities. ⁽²⁾

The rise of AI use in healthcare

The field of AI is a distinct area of computer science that involves the design of intelligent computer systems employing various algorithms and techniques that can imitate and go beyond the capabilities of human intelligence. This revolutionary technology is increasingly used in healthcare to support physicians in decision-making, streamline administrative tasks and improve overall patient care. Examples of AI use in healthcare include virtual wards to support care delivery outside the hospital, analysis of X-ray images, and analysis of brain scans; more [innovative solutions are also in the pipeline](#).

Neuroimaging plays a crucial role in stroke research and clinical care. Those suspected to have experienced a stroke usually undergo computed tomography (CT scan) and/or magnetic resonance imaging assessments (MRI). AI can support different aspects of this evaluation. For example, image recognition improvements from deep learning could support the rapid detection and interpretation of images relating to infarction in ischaemic stroke, leading to faster patient triaging and better treatment efficacy.

In the UK, AI has been incorporated in some areas of clinical software since the 1970s. Recent advancements in machine learning (a subset of AI) and deep learning (a machine learning technique) have led to significant breakthroughs in the healthcare industry, enabling systems to learn from so-called 'training data' and showing the potential to streamline and automate many administrative and operational tasks. Commercial AI systems are already in use in some NHS settings, and other products to support healthcare are in development. ⁽³⁾

Challenges in AI adoption

Machine learning algorithms learn and perform tasks using data-driven rules derived directly from large data sets. For AI to learn and make sense of data, it must process large amounts of data collected from patients, but this can cause concerns over privacy as well as the range of data-sharing agreements between health systems and industry. The UK Government established the NHSX Centre for Improving Data Collaboration in 2020 to ensure data-sharing partnerships benefit the NHS, patients and the public.

Privacy and data protection are essential for building public confidence in AI; in an [article by Ian Mundell for Imperial Enterprise](#), he states, "when you are dealing with people's health, the explainability of AI – our ability to understand why systems have made certain decisions – becomes much more important. This means dealing with human-machine interaction, trust and the security of AI systems, and questions about autonomy. It also means operating in settings where there is tight regulation." ⁽⁴⁾

Ding *et al.* also note that processing large volumes of unstructured data is challenging for conventional machine learning techniques, such as data from medical imaging or electronic medical records. ⁽⁵⁾ To produce accurate results and advance the use of machine learning models, it is crucial to have access to standardised and high-quality data.

As well as potential technical, ethical, and regulatory concerns, implementing AI solutions will require healthcare staff to be up to speed on how such systems work and process different data types. Making clinical decisions alongside machines could lead to potential legal repercussions. ⁽³⁾ Clinicians will need to be clear on how they balance recommendations from AI tools with their own knowledge and clinical expertise.

Reducing stroke risk and improving patient outcomes

In recent years, the use of AI to support diagnosis, risk stratification, and clinical decision-making has become more widespread. This is partly due to the rapid

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development of deep learning and machine learning algorithms. Research has shown that AI algorithms could be used for early diagnosis of atrial fibrillation (a risk factor for stroke) using normal sinus rhythm electrocardiographs.⁽⁶⁾ AI algorithms have also been used to screen high-risk populations for stroke risk.

Studies have shown that machine learning models can accurately predict the long-term outcomes of stroke patients. In their paper on AI in acute ischemic stroke subtypes, Miceli *et al.* state that the application of AI in predicting patient outcomes with acute ischemic stroke concerns both early detection of clots into large vessels, which represent the stroke subtype more related to disability and also the identification of patients in this population at increased risk of developing complications.

⁽⁷⁾ Ding *et al.* reference the creation of a deep neural network model trained with six variables from the Acute Stroke Registry and Analysis of Lausanne score which were able to predict a three-month modified Rankin Scale score better than the traditional Acute Stroke Registry and Analysis of Lausanne score.⁽⁵⁾

Procuring AI technologies to support stroke care

In the near future, AI technology could offer the capability to improve stroke-related care across the entire care pathway, from identifying patients who would benefit from revascularisation to alerting physicians of side effects to medication.

In the UK, [NHS Shared Business Services](#) (NHS SBS) wants to streamline and de-risk the procurement process for AI technology through a procurement framework called 'Provision of AI Software in Neuroscience for Stroke Decision Making Support'. This unique framework would be used specifically to aid AI analysis of stroke imagery. The new framework agreement, which will run initially from February 18, 2022, through to February 17, 2026, has been developed alongside expert contributions from NHS England and NHS Improvement (NHSE/I), the Care Quality Commission (CQC), the Academic Health Science Network and with further input from NHSX and clinical leaders from the 20 Integrated Stroke Delivery Networks across England. Darrien Bold, National Digital and AI Lead for Stroke at NHS England and NHS Improvement

(NHSE/I), said: "We are already seeing the impact AI decision-support software is having on stroke pathways across the country, and the introduction of this framework will drive forward further progress in delivering best-practice care where rapid assessment and treatment are of the essence."⁽⁸⁾

Image analysis software incorporating AI can support clinical decisions and therefore speed up diagnosis and treatment for stroke patients. It would also support the NHS's Long Term Plan of increasing the number of patients receiving a thrombectomy (surgical removal of a blood clot in the artery following a stroke) and, by 2025, ensuring all suitable patients have this option.

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INNOVATIVE TECHNOLOGIES IMPROVING STROKE CARE AND PHYSICIAN BURNOUT

Zoë Sebastian from RapidAI shares how novel solutions are making a meaningful impact on the delivery of care, reducing physician burnout, and ultimately improving patient outcomes in stroke care and beyond

Over the past three years, we have become increasingly attune to the extreme levels of physician burnout around the world. For example, a July 2022 [survey by the UK's General Medical Council](#) found that 66% of UK physicians often or always felt worn out at the end of the day, and in September of that same year, a similar [survey by the American Medical Association](#) showed that 63% of physicians were experiencing at least one manifestation of burnout – an all-time high, according to the organisation.

While at the time, people, even those within healthcare, largely attributed these extreme levels of burnout to the enormous strain caused by COVID-19, many physicians felt that the pandemic was only one of many (albeit the most extreme) factors contributing to a problem that had been growing for years. Another of the largest contributors to physician burnout and frustration being workflow.

80% of physician burnout is due to workflow issues

According to [research](#) by The New England Journal of Medicine, about 80% of physician burnout is due to workflow issues – including the administrative, operational, and clinical workstreams that go into delivering patient care.

Some studies suggest that as much as 40% of a clinician's time is wasted each day through redundant or manual

processes, unnecessary repetition, and inefficiencies like poor utilisation of resources. The impact of these workflow challenges can manifest in many different ways, including poor care-team communication, slower decision-making and time to treatment, and errors and mistakes that indirectly or directly impact patient outcomes.

While each hospital and department faces unique workflow challenges, some technologies are showing great promise in measuring how care teams align to deliver better care.

We spoke to Dr Adrian Blight, a Stroke Physician at St. George's University Hospital, about some of the challenges he and his team face, the top areas where new and advanced technology is enabling more efficient care in vascular/neurovascular medicine, and what that means for reducing burnout and ultimately improving patient care more broadly.

Interoperability for image transfer

One pain point physicians across the healthcare ecosystem, particularly in stroke care, contend with is the inability to quickly and easily share patient information between hospitals, even within their network.

“Being able to view images for patients referred from other sites sounds quite easy, but it can be very difficult – particularly for hugely time-sensitive

clinical scenarios like hyper acute stroke management where time is brain,” said Dr Blight.

One of the reasons, he says, is that despite hospital systems around the world – including the NHS – implementing image exchange portals, the reality is that they are often clunky and, despite their good intentions, rarely operate fast enough to meet physicians' needs for urgent decision making – often slowing down the process and adding unnecessary stress to physicians as they try to treat patients.

Since implementing RapidAI's specialty-specific stroke technology that eliminates the need to go through complex NHS network structures and allows him and his team to share patient scans between network hospitals and care teams more quickly, Dr Blight said it has significantly reduced delays in decision-making:

“This technology has made a big impact thus far and helped us greatly improve a process that was once incredibly frustrating. We're actually able to make clinical decisions within the sort of rapid timeline that we wanted to,” he said.

Mobile apps for connecting teams outside hospital walls

Another tool that is playing an increasingly critical role in improving workflow and reducing physician burnout is mobile technology.

In stroke care, where the demand for emergency care has increased dramatically, research shows that over 50% of neuro-interventionalists are on-call every other night. Additionally, many physicians have to cover more than one hospital while on-call, further contributing to higher physician burnout.

With HIPAA and GDPR-compliant communication technology like RapidAI, physicians can view, organise, and track cases from multiple sites and communicate with stroke teams in a single application, whether they are at home, in the hospital, or on the go, ensuring no time is lost accessing critical patient information.

“The convenience of the mobile app has been beneficial, particularly if we’re in transit or other clinicians, particularly the interventionists, are in transit,” said Dr Blight. “Going straight from the CT scan workstation to a RapidAI server and then to the mobile device or mobile or web viewer means that key stroke decision makers within the comprehensive stroke centres, like myself, can view images straightaway. It cuts out a lot of unnecessary delays in the process. That’s been incredibly helpful.”

This increased convenience and flexibility that comes with enabling physicians to view images sooner and communicate with the care team easier is not only helping care teams stay more connected than ever – even when physically apart – but is playing a significant role in reducing physician burnout and the lack of work-life balance.

AI for clinical decision support when CDS

One of the most compelling ways technology is helping to alleviate the symptoms of burnout is by supporting physicians in their clinical decision making.

“Some of the automated advances, particularly Rapid CTP, have supported clinical decision making in a way that is much more time efficient and removes some unnecessary delays which were exceptionally frustrating,” said Dr Blight.

In stroke and other specialty interventional care, for example, physicians are already contending with high-stress clinical situations, often on little sleep while on-call; clinical decision support AI can be a welcome addition to their clinical workflow.

“Some of the AI tools are incredibly helpful in supporting clinicians with decision making, particularly those decisions on your own without much clinical support, often in the middle of the night,” said Dr Blight. “By supporting clinicians with complex decisions, we’re also helping to reduce clinician variability, and that is a really good example of where AI technology can support the clinician workforce.”

Additionally, even for the most experienced and confident clinicians, AI-enabled clinical decision support tools are helping many to ‘see’ and analyse information not previously capturable by the human eye – which can have a remarkable impact on care decisions.

“More diagnostic information is really helpful to any clinician because it

makes them feel a bit more confident – more confident in their referrals, and more confident that they’re delivering the best possible care for their patients,” said Dr Blight. “Rapid CTP, for example, gives us even more confidence around the stroke diagnosis and the amount of potentially salvageable brain for our interventions to be effective.”

While stopping – or furthermore reversing – physician burnout is an enormous challenge requiring time and individualised approaches, some solutions can make a specific but meaningful impact today.

Advanced clinically-validated tools like RapidAI and others can not only help streamline clinical workflow and improve work-life balance immediately but, over time, enable more efficiency to manage growing case volumes, deliver better care, and improve outcomes.

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Breaking new ground in stroke research and care

Simone Schoenwaelder from Australia's Heart Research Institute tells us about exciting advancements in stroke research and care that could dramatically improve clinical outcomes for patients

Stroke is a leading cause of death and disability globally, with 16 million people suffering strokes annually. Approximately 85% of strokes are ischaemic, caused by a blockage of an artery within the brain which reduces cerebral blood flow. If not resolved within a few hours, irreversible brain damage can occur.

Many stroke victims are never able to return to their normal life. Some cannot work, while others end up in nursing homes, regardless of age.

Unmet clinical needs in stroke research and care

Despite decades of research, there is currently only a single treatment which dissolves blood clots in the acute phase of stroke, Tissue plasminogen activator (tPA). The

problem is that only 10% of stroke victims can receive it, leaving those that cannot have the clot surgically removed to suffer the devastating impacts of stroke.

To make matters worse, tPA has many limitations and does not work effectively in many stroke patients. There is a significant unmet clinical need to identify new anti-clotting approaches that can improve tPA function and reduce stroke injury.

Breaking new ground in the treatment of stroke

It has never been a more exciting time to be in medical research as we break new ground in treating cardiovascular disease thanks to the advancement of technology. At the Heart Research Institute in Australia,



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research led by Professor Shaun Jackson's Thrombosis Group strives to improve clinical outcomes for patients suffering from cardiovascular diseases, including stroke.

Having identified and developed a new anti-clotting compound with the potential to improve blood flow to the brain and reduce and/or prevent brain injury, the team has demonstrated in preclinical models that when combining this revolutionary new class of anti-clotting drug with existing stroke therapies, blood flow to the brain can improve and thus reduce/prevent brain injury.

This discovery is the holy grail of stroke research. It could be a game changer in advancing the traditional methods of treating ischaemic stroke and improving the quality of life for thousands of stroke sufferers.

The team is preparing to take the novel anti-clotting drug to the next level, commencing Phase 2 clinical trials in humans. If successful, this discovery will be the first pharmacological scientific breakthrough for stroke in two decades. It could have an optimal impact on minimising cognitive and physical disabilities caused by stroke.

This new drug, developed over the last 15-20 years, has been a long time coming. Its potential for improving stroke therapy has been aided by advancements in technology, including cutting-edge fluorescence microscopy, which allows us to monitor the development of a blood clot in real time.

Fluorescence microscopy

Technology is already revealing critical new insights into how these clots form within the body, providing us with the necessary information which will assist in the design of safe and effective therapies for acute stroke care.

Previously, scientists could detect deadly clots blocking blood flow to vital organs such as the brain or heart by monitoring blood flow markers. We knew a clot was forming as we could observe changes in blood flow, but we could not visualise the dynamics of clot formation in larger arteries.

With the development of a fluorescence microscope imaging system, it is now possible to introduce fluorescent markers into models to identify and track the different cell types involved in clot formation in real time, providing never-before-seen dynamic information on how these clots form. Current standard-of-care clot-busting therapies can be administered to learn more about their limitations and complications.

This has allowed researchers to learn more about the complications of current therapies and ultimately inform the development of new treatments to save more lives.

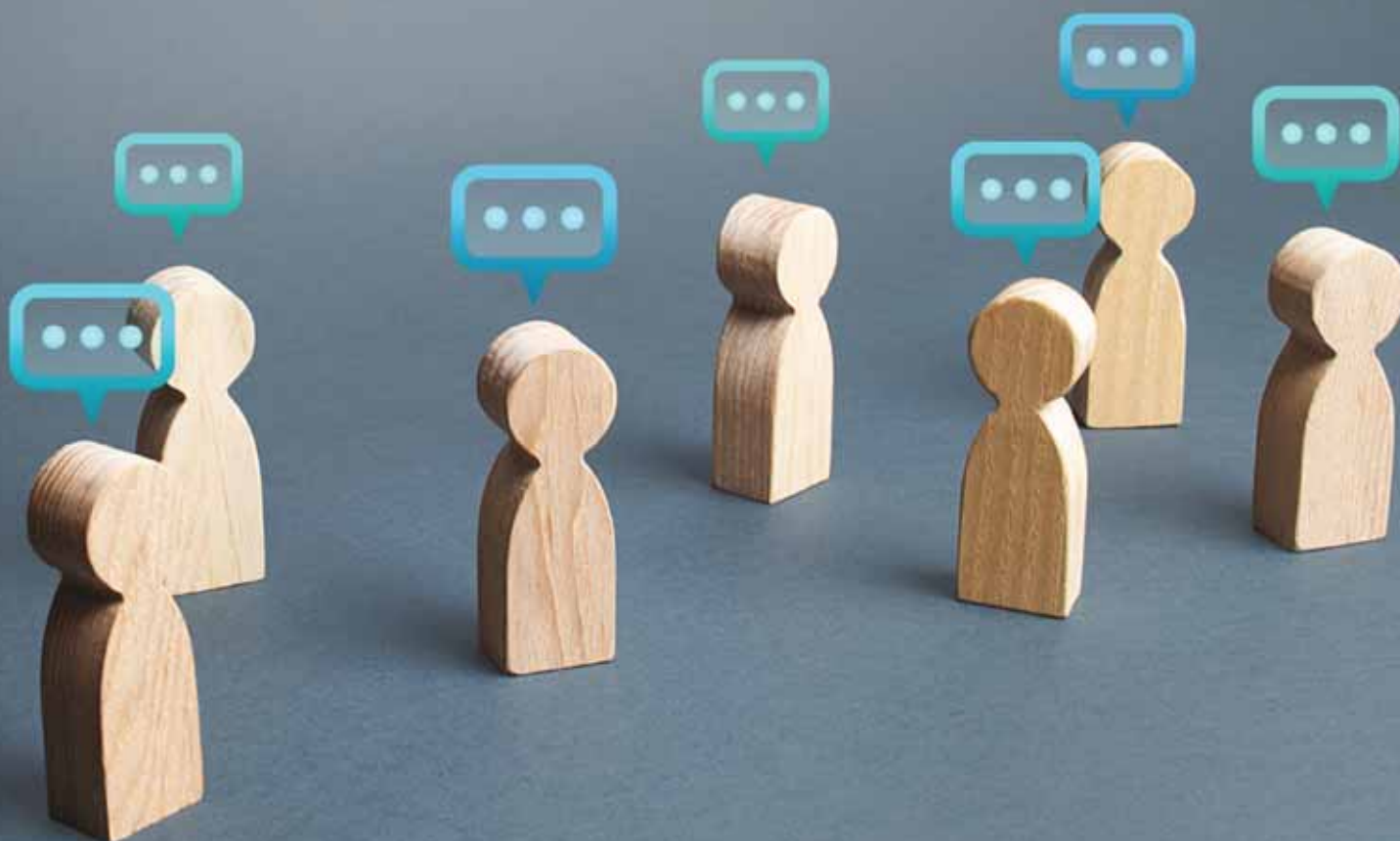
Could a novel anti-clotting drug revolutionise stroke care?

The new drug developed at the Heart Research Institute belongs to a similar group of blood thinners known as antiplatelets, including drugs such as aspirin, often used to treat heart attacks. The benefit of this novel anti-clotting drug is its unprecedented safety profile. Unlike aspirin and other antiplatelets on the market, its anti-clotting activity comes without the potentially devastating risk of bleeding, which can lead to further brain damage and death.

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CHALLENGES IN STROKE AFTERCARE AND REHABILITATION

Stroke is a leading cause of adult disability; worldwide, five million people are left permanently disabled every year after a stroke, ⁽¹⁾ leaving hospital with complex needs that require daily care.

The trajectory of demographic development could mean more adults suffer from strokes in the future, thus creating a higher socioeconomic cost and demand for rehabilitation and long-term care.

At the same time, improvements to primary prevention strategies and acute and long-term stroke care could decrease stroke mortality rates while the burden of stroke morbidity rises.

Prompt rehabilitation can significantly enhance the recovery of patients who have suffered a stroke.

This is particularly important given that research has also indicated an increasing trend in the reduced length of time stroke patients spend in hospital before being discharged. ⁽²⁾

According to a report by [SAFE](#), Europe's non-profit organisation representing a range of stroke support organisations from across the region, there are significant disparities in access to rehabilitation therapies, standards used to measure adherence to care guidelines and relevant research and data across Europe.

Often, a lack of capacity in rehabilitation centres and community-based interventions means stroke survivors struggle to access vital services or wait a long time before receiving support.

Equally, health insurers and national health authorities seldom provide assistance in helping stroke survivors adapt, such as supporting individuals who aspire to return to work.

In its [report](#), SAFE advises that countries set targets for secondary prevention, screening for depression, and psychological and social support in order to improve the quality of life for stroke survivors. It recommends multi-disciplinary assessments in the stroke unit and for rehabilitation to start as soon as someone is medically stable.

Further research into evidenced-based rehabilitation interventions and collaborative efforts must be implemented to reduce the burden on survivors and their families. This will, of course, be paramount with the roll-out of new therapies and technologies and reducing inequities in access to stroke care between and within countries.

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When the anti-clotting drug is combined with the existing tPA, it not only helps dissolve the stroke-causing blood clot more effectively but can also stop the clot from reforming altogether. It achieves this by targeting different and complementary components of the blood clot than tPA alone and does so without an added risk of bleeding, which we know leads to more strokes, so this drug may help reduce the risk of another stroke.

If successful, it will mean 90% of stroke sufferers could now have increased options when it comes to treatment in those crucial first 48 hours.

This exciting and cutting-edge research will mean that over the next decade, healthcare professionals

worldwide could potentially have a better treatment for stroke, translating to less death and disability for stroke sufferers.

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CORTEC'S BRAIN INTERCHANGE™ SYSTEM: REVOLUTIONIZING BRAIN THERAPY WITH CLOSED-LOOP NEUROMODULATION

CorTec's Brain Interchange™ system offers closed-loop neuromodulation, revolutionizing brain therapy by precisely adapting treatment based on individual needs



The central nervous system is a complex organ that receives, computes and forwards information using bioelectrochemical processes.

Particular networks of brain cells are associated with various functions, e.g. cognitive or motoric capabilities. Disruption of network functionality, caused by injury or disease, leads to impaired brain function, which then causes multiple conditions such as motor disorders, e.g., Parkinson's disease (PD), or mood/mental disorders, e.g., anxiety, schizophrenia, and depression.

An alternative approach to brain therapy: closed-loop neuromodulation

The definitive treatment of these conditions uses pharmaceuticals, but the therapeutic outcome in these conditions is not always satisfactory.

An alternative approach to drugs is modulating the network activity using electrical neuromodulation techniques. Electrical neuromodulation implants have successfully been clinically applied to some conditions (e.g., PD, dystonia, chronic pain) and are an established clinical treatment option today.

However, most of the available devices operate in open-loop mode: the clinician sets the parameters that define how stimulation is repetitively applied to the selected biological target location at the beginning of the brain therapy. Then, parameters are refined on demand when the therapeutic effects or potential side effects require to do so.

Although CorTec acknowledges the success of these therapies and their considerable impact on the patient's quality of life, we are convinced that

neuromodulation can be used to treat many more brain conditions, given the brain therapy is auto-adaptively operating in closed-loop mode.

This will allow for precisely regulating the therapeutic doses according to the patient's individual need, which constantly changes, sometimes within seconds, due to the condition itself but also due to the environment and the mental and motoric activity of the patient. Such a closed-loop system operates continuously by analyzing the therapeutic need, refined brain therapy delivery, and therapeutic outcome measurement.

Closed-loop therapy relies on identifying the therapeutic need

A critical element of such a closed-loop brain therapy is identifying the therapeutic need for which at least one reliable biomarker is required.

For example, a biomarker clinically used for triggering brain stimulation to prevent epileptic seizures is a measurable electrical voltage known as local field potential that is locally generated by networks of millions of nerve cells of the affected brain.

The FDA approved Responsive Nerve Stimulator of NeuroPace, Inc. uses this biomarker clinically to treat drug refractory epilepsy. The clinical research community has already provided evidence for biomarkers that allow closed-loop neuromodulation of Parkinson's Disease with a clinical outcome superior to that of today's open-loop neuromodulation implants. Many more closed-loop applications are on the horizon for which the biomarkers today are still unclear and require clinical research to be identified and evaluated. CorTec has developed a tool for biomarker identification and discovery of new therapies.

The CorTec Brain Interchange™ system consists of an implanted electronic device that provides coupling to the brain using 32 electrical contacts that can be located on and in the brain. Each contact can be used for sensing of network activity as well as for electrically modulating this biological circuitry.

Sensed activity data is amplified and digitized by the implanted electronics and wirelessly sent through the skin to a portable computing unit which runs researcher-defined analytical algorithms. Based on this data processing, a therapeutic need is calculated, and an electrical stimulation command is wirelessly sent to the implant where it is executed. A cycle of brain signal recording, processing and stimulation can take as little as 0.02 seconds.

Body-external signal computing gives the researcher freedom. Algorithms can quickly be adapted, and additional information, e.g. supplied by smartwatches, can be used to define brain therapy.

Also, the algorithms could involve heavy "data crunching" since the computing power is not limited by battery size, which was the case if the algorithms ran directly on the implant.

Currently, we provide the CorTec Brain Interchange™ system as a therapy discovery platform to researchers worldwide, addressing mental, mood and motor disorders. It is also planned to use it as a brain-computer interface to permit heavily impaired patients to communicate again and to control assistive devices like a wheelchair. Many more applications can be thought of, and CorTec is constantly searching for experts in their field for future cooperation.

CorTec and the development of a novel stroke therapy

A major focus of CorTec is the development of a novel stroke therapy utilizing the CorTec Brain Interchange™ system: Patients will receive the implant with electrodes located subdurally on the cortex in the stroke-affected area.

The system will record local field potentials and will electrically stimulate the brain in synchrony with the patient's beta band activity, which are electrical oscillations generated by the brain with a characteristic frequency of 15 to 25 Hz. This stimulation paradigm, carried out for a few months after stroke, approximately two hours per day, will induce increased network plasticity.

Plasticity describes the ability of the brain to (re-) learn the processing of particular tasks. Based on recent literature and clinical data acquired using stationary and heavy body-external laboratory equipment, CorTec and partners developed a therapeutic approach using our implant, that allows the restoration of body functions lost by stroke, helping the brain reorganizing itself.

The National Institutes of Health and continued research opportunities

The National Institutes of Health (US) scientifically supports our stroke project. Clinical studies are planned to start in 2024, while the translation of our brain therapy discovery platform to an implantable medical device is supported by a European Innovation Council (EIC) Accelerator grant.



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Exploring neurological & mental brain disorders in Europe

European Brain Council provides a very helpful update on Brain disorders in Europe – neurological and mental alike

Brain disorders – neurological and mental alike – are widespread in Europe, highly disabling and often difficult to treat. Approximately 60% of the European population lives with a neurological condition ⁽¹⁾, and one in six citizens in Europe is affected by mental ill-health. ⁽²⁾

These numbers are alarming without considering that they date back to before the COVID-19 pandemic, which we now know spurred higher rates of mental health conditions ⁽³⁾ as well as COVID-19-triggered neurological complications. ⁽⁴⁾ These conditions represent a high individual, social and economic burden and contribute to the global disease burden and disability.

We should not forget, however, that understanding the brain is not just to tackle a “burden”. It is also to allow people to thrive: to live healthily, to power our economies and to build for future generations. Investing in the brain and brain research is critical.

Instead of divesting in a cost, policymakers and society at large should view the prioritisation and support of research into brain disorders as an investment into a healthier future.

The brain: Defining areas for prioritisation

The brain is complex. Understanding how the brain works, how brain diseases progress – basic research – and finding treatments and cures for these diseases – applied research – is a long-term endeavour.

Brain research is highly interdisciplinary, requiring the use of a wide range of research techniques based on different models – human, artificial, digital and, predominantly, animal – which remains essential for progress in this domain.

Calling for prioritisation of research of brain disorders at the political level has been a major effort from the brain research community for decades, but, despite a steady

growth of investment by the European Union, it has been nowhere near enough, lacks efficiency, remains fragmented, lacks recognition as a priority area ⁽⁵⁾ and is persistently misunderstood and underestimated.

Tackling the complexity of the brain together

Enhancing global collaboration in the domain of research and innovation is key to effectively addressing today’s societal challenges and improving the health and well-being of citizens.

This is particularly true for brain disorders, as understanding the brain has proven to be incredibly complex, and the effort needed is immense. The quest to understand the brain for the benefit of all affected by brain conditions and the improvement of overall brain health is global and should not be tackled in silos but at a global level, particularly as our world grows increasingly borderless.

Competition in this space would be futile. Fostering of concrete global partnerships and alliances for brain research is urgently needed to share knowledge, learn from peers, conduct similar research in collaboration rather than duplicating efforts, and strengthen alignment across diverse public and private entities to structure and track investments for the benefit of international research and the health of all populations.

Plenty of high-calibre brain research is underway across continents, and the fostering of concrete global partnerships and alliances could only work to further strengthen the work and avoid duplication.

Strengthen rather than hinder R&I in Europe for accurate brain disorder research

Despite advances in neuroscience research in the past decades, disease-modifying drugs for brain disorders are still lacking. Research using animal models has been

essential for the advancement of scientific knowledge and understanding of how the brain works.

Equally, considerable progress has been made using alternatives; however, most of what can be learned about the brain and behaviour still depends, directly or indirectly, on research in animal models. One of the main bottlenecks sustaining this limitation is the lack of scientifically valid methods and in vitro models to conduct brain research beyond the use of animal models.

Despite continued political pressure for a roadmap to phase out all animal testing in the EU as soon as possible, reiterated again in a recent European Citizens' Initiative, ⁽⁶⁾ a complete ban on the use of animals in biomedical research is premature and incredibly detrimental to the quest to improve the quality of life of the many citizens affected by brain conditions and towards a future with better understanding and interventions for these conditions.

The scientific community in Europe urgently needs a shift of focus back to the most important issue – supporting European science for the sake of society at large and tackling unmet healthcare needs.

We cannot allow for the EU's ability to lead and further boost scientific innovation, discovery and leadership to be hindered and fall on others abroad for biomedical innovation. It remains vital that scientific advancement is encouraged while offering scientists the time and means to develop viable alternatives.

Addressing unmet needs in brain research

As the burden continues to grow and the EU turns its focus on addressing unmet needs, brain research and innovation must be recognised, more than ever, as a health and research priority in the EU (and beyond) and cannot be left behind.

A European Brain Research and Innovation Plan ⁽⁷⁾ is urgently needed, combining research and public health initiatives to address brain disorders and brain function in a comprehensive, collaborative and innovative way at the EU and international levels, supporting scientists to conduct their work for the benefit of those who need it most and our future generations.



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PROGRESS IN DEVELOPMENT OF DISEASE-MODIFYING TREATMENTS IN PARKINSON'S DISEASE

Henri Huttunen, Chief Scientific Officer, Herantis Pharma Plc, charts progress in the development of disease-modifying treatments for Parkinson's disease

Recent FDA approvals of two potentially disease-modifying Alzheimer's disease drugs give hope that similar successes in Parkinson's disease may be around the corner. However, despite the recent advances in understanding complex disease biology and the development of novel drug targets and biomarkers, progress in the clinical development of new treatments remains slow.

The need for disease-modifying treatments to improve quality of life

James Parkinson published his essay 'Shaking Palsy' in 1817, describing the clinical features of Parkinson's disease ([McDonald, 2018](#)). In the late 1950s, the discovery of dopamine as the key neurotransmitter regulating movement laid the foundation on how the symptoms of Parkinson's are treated still today. Nevertheless, the biggest challenge – how to stop or delay the progression of the disease – remains unaddressed. As a result, nearly 10 million people with Parkinson's disease need disease-modifying treatments to improve their quality of life and, importantly, give them hope and a chance for healthier aging.

During the past decades, we have seen a surge in research interest, public funding and clinical trials to expedite the development of treatments that address the underlying pathological mechanisms of neurodegeneration and would stop the disease progression (disease modification). As the most

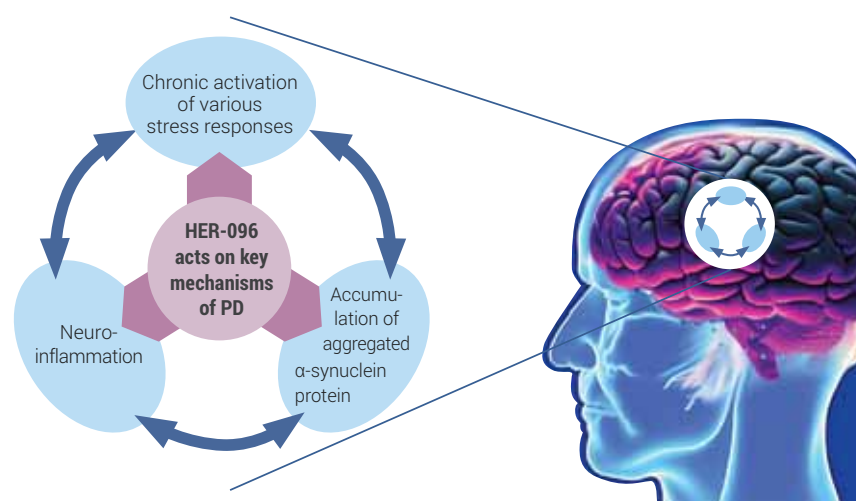


Figure 1 - HER-096 aims to slow down disease progression by reducing stress caused by toxic protein aggregates and reducing inflammation in the brain.

common form of dementia, Alzheimer's disease has led the way, but Parkinson's, the second most common neurodegenerative disease, is not far behind.

2022 was an important landmark in Alzheimer's disease with FDA approvals for two amyloid immunotherapies, aducanumab and lecanemab by Biogen/Eisai ([Lancet, 2022](#)). These passive immunotherapies are the first approved treatments for Alzheimer's that are considered disease-modifying and are based on the idea that antibodies binding to specific pathological forms of aggregated beta-amyloid protein in the brain can slow down disease progression. Pathological protein aggregation in the brain is a shared feature with several neurodegenerative diseases ([Wilson,](#)

[2023](#)). In Parkinson's, Lewy bodies, clumps of aggregated alpha-synuclein protein are a typical neuropathological feature. Like the recent FDA-approved Alzheimer's drugs, several alpha-synuclein immunotherapies are in clinical development for Parkinson's ([Knecht, 2022](#)).

Why is progress in the development of new disease-modifying treatments for neurodegenerative diseases so slow?

It took about 20 years to bring amyloid immunotherapies to market approval in Alzheimer's, and the standard of care for Parkinson's disease is based on a 60-year-old treatment concept. So why is progress in developing new treatments for aging-related brain diseases so slow?

First of all, the underlying pathology at the genetic, molecular, cellular, and tissue levels has turned out to be very complex and heterogenous ([Jankovic, 2020](#), [Panicker, 2021](#), [Gaertner, 2022](#)). This results in clinical heterogeneity and the disease progresses at different rates in different patients. Instead of a one-size-fits-all strategy, it seems that Parkinson's disease, should be considered an etiologically heterogeneous syndrome rather than a single disease. This has several fundamental implications for all aspects of drug development, from animal disease models to biomarker development and clinical trial designs.

Nevertheless, despite the diversity of the potential underlying genetic or environmental triggers of the disease, it appears that there are some [common features](#) shared by most subtypes of disease, such as accumulation of protein aggregates, altered energy metabolism and waste clearance, and chronic inflammation in the brain ([Calabresi, 2023](#), [Tansey, 2022](#)). Finally, clinical trials progress in stages, and due to the slow progression of the disease, an individual clinical trial may require years to demonstrate meaningful changes in the progression of the disease.

Biomarkers help to understand complex disease biology & to stratify patients

Genetic studies of Parkinson's have identified many causative and risk genes that together have indicated a group of cellular processes to be centrally involved in the pathobiology of the disease. Novel drug targets have also emerged. While there is still plenty of work to do even with the basic research questions, we can now tailor specific treatments for some disease subtypes, such as the LRRK2 inhibitors by Denali/Biogen ([Jennings, 2023](#)).

The learnings from the fields of Alzheimer's and oncology have shown that biomarkers are a paramount part of clinical trial success. Biomarkers based on brain imaging, fluid biopsies, or genetics can be used to stratify patients based on the subtype of disease they have and monitor how the body is responding to the treatment.

Moreover, as a movement disorder, Parkinson's offers fascinating novel technological approaches for continuous objective measurement of patients' symptoms with smartwatches, offering new ways to improve the collection, analysis and granularity of data in clinical trials ([Lipsmeier, 2022](#), [Sieberts, 2021](#), [Stephenson, 2021](#)).

Compared to traditional clinical metric-based designs, biomarkers can make a difference between failure and success in demonstrating treatment efficacy in a clinical trial.

Is disease heterogeneity a friend or foe?

The personalized medicine ethos is attractive for clinical development and applies well to some of the known genetically defined subtypes of Parkinson's disease. However, the challenge is that for the vast majority of Parkinson's patients, the disease appears to be idiopathic, i.e., without a known cause.

Immunotherapies that boost the clearance of protein clutter from the brain have shown that targeting a common disease feature could be one successful strategy. However, will 'improved waste management' be sufficient to bring the patients a clinically meaningful, long-lasting improvement of the cardinal symptoms of the disease? Are there better ways, or are there ways that could be combined with immunotherapies to achieve stronger treatment effects?

[Herantis Pharma](#), a Finnish clinical-stage biotech company, is developing a novel disease-modifying treatment for Parkinson's disease. Herantis' lead product HER-096 mimics our body's built-in mechanism for maintaining the health and functionality of dopamine neurons by counteracting the adverse effects of the alpha-synuclein aggregation and modulating the inflammatory responses in the brain tissue.

Preclinical studies with HER-096 and its parent protein CDNF ([Lindholm, 2022](#)) have shown improved proteostasis and reduced inflammation in association with restored neuronal functionality. After promising preclinical data, HER-096 is being tested in a first-in-human clinical study. Topline data from this healthy volunteer Phase 1a trial is expected at the end of 2023.

There is an enormous public health need for effective disease-modifying treatments to stop the progression of Parkinson's disease. Learnings from past clinical trials that help to improve trial designs with targeted patient selection and more sensitive biomarkers will hopefully pave the way to success for companies like Herantis Pharma in their mission to improve the lives of millions of patients.

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E-LEARNING PLATFORM FOR DEMENTIA CAREGIVERS

Jockey Club Centre for Positive Ageing is developing a multimedia e-learning platform for dementia caregivers; here, they share the vast benefits

Taking care of a loved one who has dementia is a challenging task for family members. According to an opinion survey conducted by Jockey Club Centre for Positive Ageing (JCCPA), almost 90% of caregivers reported experiencing stress while caring for a family member with dementia, with about half of them experiencing frequent episodes of stress.⁽¹⁾

Data indicates that family members who assume the primary role of caring for individuals with dementia experience a significant burden of caregiving. On average, caregivers devote between five and 20 hours per day to caring for these individuals.⁽²⁾ Extended caregiving hours can reduce the time available for rest and social engagement, leading to feelings of loneliness and social isolation.⁽³⁾ It is common for caregivers to experience high levels of depression.⁽⁴⁾

As dementia progresses, the functional decline of care recipients necessitates an increased caregiving workload for family members. Common behavioural changes, such as agitation and repetition, can present significant challenges for caregivers, particularly those who lack relevant knowledge and skills.⁽⁵⁾

How can an e-learning platform for dementia caregivers alleviate stress?

Education programmes are promising non-pharmacological interventions for alleviating the stress of caring for individuals with dementia. By providing

caregivers with the necessary knowledge and skills for dementia care, they can become more confident in their ability to care for their family members.

Studies have shown that education programmes for dementia caregivers can decrease anxiety and caregiving burden and improve caregivers' quality of life.^(6,7) Education programmes have increased caregiving self-efficacy and delayed the institutionalisation of individuals with dementia.

In the aforementioned survey, over 80% of respondents expressed their willingness to participate in a dementia e-learning platform. The top reasons cited were the convenience of being able to learn anywhere and anytime, the flexibility to choose topics suitable to their needs, and the ability to save time by avoiding the need to travel to a physical location.⁽⁸⁾

Traditional face-to-face education programmes for dementia caregivers can be challenging due to barriers, including long travel times, difficulty finding support for caregiving responsibilities, and work-related conflicts.⁽⁹⁾ Some caregivers express concerns about privacy during in-person education programmes, citing past experiences of misunderstanding about dementia from others and discrimination in their caregiving roles.⁽¹⁰⁾ These challenges can hinder caregivers, particularly those with family members who have greater caregiving needs.

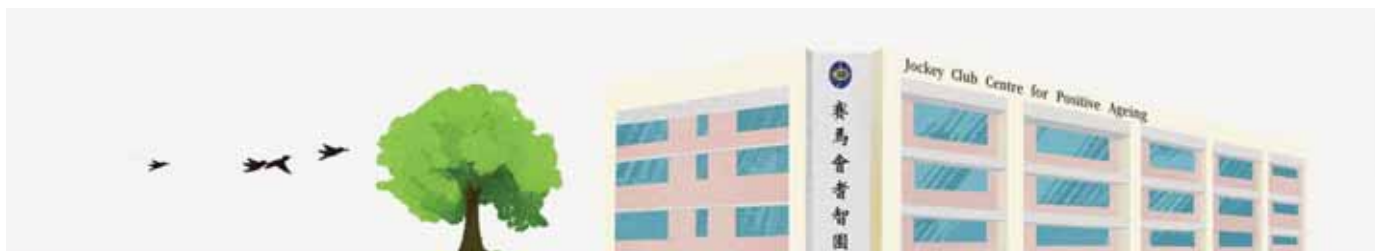
Accessible e-learning platform for dementia caregivers

An e-learning platform for dementia caregivers provides them with access to dementia knowledge and skills at all times, regardless of their location or device, thus eliminating the need for travel. This is particularly beneficial for caregivers living in remote areas, who may otherwise face significant time and financial constraints associated with attending traditional in-person education programmes.⁽¹¹⁾

Convenient access to the e-learning platform allows caregivers to learn at their own pace without the constraints of a fixed schedule. Additionally, the relative anonymity of the internet provides a safeguard for the privacy of caregivers.⁽⁹⁾ The anonymity provided by the e-learning platform ensures that others are not aware of the caregiving responsibilities and challenges faced by caregivers in their care for individuals with dementia, thereby minimising the potential for stigmatisation.⁽¹¹⁾

E-learning platform for dementia caregivers developed by healthcare experts

An e-learning platform for dementia caregivers is typically developed by experienced healthcare experts who consider a range of scenarios related to caring for individuals with dementia. By covering various domains, family members can select topics relevant to their needs and the demands of their care recipients.⁽¹⁾ Caregivers of people



with dementia often have dynamic educational needs due to changes in the functional abilities of individuals with dementia.

The comprehensive nature of an e-learning platform for dementia caregivers enables them to revisit relevant topics when they face new challenges. The involvement of health experts ensures the quality and effectiveness of dementia knowledge and caregiving skills, ultimately saving caregivers time that might otherwise be spent searching for adequate and evidence-based resources online.⁽¹²⁾

Interactive e-learning platforms improve comprehension

Research has shown that e-learning platforms designed with videos, graphics, audio, and text are more effective in maintaining caregiver engagement than static text alone.⁽¹³⁾ Videos can significantly improve comprehension for family members, particularly for complex caregiving skills, such as managing agitation behaviours.

Interactive exercises, such as quizzes and games, are also incorporated into e-learning platforms as a means of engaging and drawing attention from caregivers. These exercises improve learning effectiveness by enabling caregivers to assess their understanding of the knowledge and skills covered in the programme by reviewing their test results.⁽¹⁴⁾

The effectiveness of an e-learning platform for dementia caregivers has been demonstrated in research studies. Caregivers who use e-learning platforms have shown reduced emotional distress related to perceived stress, anxiety, and depression.⁽¹⁵⁾ They also perceive themselves as receiving more knowledge and social support and are more competent in providing care for their family members with dementia.

E-learning platforms with multi-component interventions, which combine information and caregiving strategies, have been found to be more effective in improving the wellbeing of caregivers compared to those with single-component interventions.⁽¹⁶⁾

In conclusion, caring for individuals with dementia can overwhelm family caregivers, leading to significant emotional and physical burdens. E-learning platforms have emerged as a promising solution for providing caregivers with the necessary knowledge and skills for dementia care.

The convenience and accessibility of e-learning platforms, combined with the comprehensive and interactive nature of the programmes, have been shown to alleviate caregiving stress and improve the wellbeing of caregivers.

Jockey Club Centre for Positive Ageing is developing a multimedia e-learning platform with comprehensive dementia knowledge and skills, ranging from effective communication with

individuals with dementia to managing behavioural changes. This platform is anticipated to make a significant difference in the lives of dementia caregivers and their care recipients, guided by experienced experts.

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Multiple sclerosis: A debilitating disease, but new treatments offer hope

Rhett Reichard, PhD and Keri C. Smith, PhD from [Saba University School of Medicine](#), says that while multiple sclerosis is a debilitating disease, new treatments offer hope



Multiple sclerosis (MS) is a neuroinflammatory disease affecting the central nervous system (CNS), resulting in progressive loss of sensory, motor and cognitive functions. Consisting of billions of interconnected neurons, the brain and spinal cord comprises the CNS. Each neuron functions as an independent processing center that integrates input from thousands of other neurons into a single signal propagated to downstream neurons. The brain must rapidly adapt to internal and external stimuli; it must identify the stimuli, select the appropriate response, and carry out the intended response within a matter of milliseconds! This rapid response time demands very efficient communication within and between intricate neural circuits.

Multiple sclerosis explained (MS)

Neurons receive input from thousands of other neurons at tree-like arborizations, dendrites, that contain

receptors for chemical messengers, neurotransmitters, released by other neurons. Binding of neurotransmitters to cognate receptors opens distinct ion channels allowing ions to either enter or exit the neuron. If the summated ion movement results in significant depolarization, the neuron becomes electrically excited. This results in the generation of an electrical signal called an action potential. This electrical signal is transmitted down the length of specialized neuronal processes called axons which comprise nerves/nerve fibers. For efficient processing of sensory input and fluid movement to occur, these electrical signals must propagate without interference. This is accomplished by the wrapping of nerves with myelin, specialized tissue comprised of proteins and fat. Analogous to the insulation surrounding electrical wires, the myelin sheath functions as an insulator and maintains the integrity and transmission efficacy of the electrical signals carried by nerve fibers to and from the brain.

Multiple sclerosis results in the destruction of the myelin sheath which can eventually lead to neuronal cell death. This destruction can be visualized by the formation of “lesions” – areas of inflammation and damage in different parts of the nervous system. This dramatically reduces the brain’s capacity to interpret sensory information and to carry out movement. Demyelination of the optic nerve disrupts the electrical signals conveyed from the eyes to the brain and underlies the visual disturbances associated with MS.

Similarly, demyelination of motor nerve fibers conveying signals controlling muscles results in extreme muscle weakness and reduced coordination of movement. This progressive motor loss can make normal day-to-day tasks such as walking extremely difficult. People living with MS can struggle with the symptoms of their disease for many years. The recurrence and remission of symptoms, in particular, are frustrating, and people living with MS often describe their experience as “everything is hard”.

The presentation of the disease can vary between patients

The presentation of the disease can vary between patients. The rarest form of MS is the primary-progressive form, where patients experience steadily worsening symptoms from the start of disease onset, without remission. Most people diagnosed with MS have the relapsing-remitting form of the disease, where symptoms persist for a few days to a few months, then resolve for some period of time until the symptoms occur again. Unfortunately, without effective treatment to stall the progression of the disease, most MS patients will go on to develop secondary-progressive MS, where symptoms become steadily worse without periods of remission. The goal of treatment for most forms of MS is to halt the progression from the relapsing-remitting form to the secondary progressive form.

What causes multiple sclerosis?

The cause of multiple sclerosis, unfortunately, remains elusive though most researchers believe the disease is a type of autoimmune response. One theory is that a combination of genetic susceptibility together with exposure to infectious agents leads to the development of myelin-reactive white blood cells that attack and damage the CNS. In support of this theory, a recent study identified a strong correlation between infection with a

blood-borne human herpesvirus (Epstein-Barr virus; commonly associated with mononucleosis) and subsequent development of MS. In-depth investigations of CNS lesions in MS patients have found the presence of both T cells and B cells, confirming the role of a targeted immune attack in neuronal cell damage.

Long-term disease-modifying therapies

Cutting-edge treatments for MS are classified as long-term disease-modifying therapies (DMTs). Some MS therapies are broadly anti-inflammatory, including steroid treatment and diroximel fumarate. Other biologic therapies directly target B cells, including ocrelizumab, rituximab, ofatumumab, and atacicept. Yet more DMT’s such as cladribine, alemtuzumab, and siponimod target both B and T lymphocytes. The specific therapy that works for each MS patient is unique, and increasingly, MS specialists prescribe these medications based on individual patient profiles. Consistent use of these therapies has proven to slow the progression from relapsing-remitting to secondary progressive MS. More importantly, the anti-B cell therapy ocrelizumab has shown promise in treating refractory primary-progressive and pediatric forms of MS.

As early intervention leads to a better quality of life for people with this disease, further research is needed to target therapies more effectively for individual patients. In addition, increasing awareness of the role of viral infections, especially EBV, may also lead to the development of vaccines that may prevent triggering of the autoimmune response to myelin.

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Protecting people's mental health at work

With mental health issues on the rise, Ryan Exley from the Institution of Occupational Safety and Health explains why organisations must understand risk factors for poor mental health at work and implement measures to protect the wellbeing of their staff



Image: © Georgiy Datsenko | iStock

During the COVID-19 pandemic, a lot of focus was placed on frontline staff and key workers to keep essential services running. But the truth is, they were integral to society before, have been since, and will continue to be so. But do we ever stop to consider how the roles they play impact their mental health at work?

Negative impact of COVID-19 on mental health at work

We know that the strain they face can have a significant negative impact. In health workers, for example, a study by Abdul Rahim and others highlighted the burden of the

pandemic on mental health, showing that up to 46% of them suffered from anxiety and up to 37% from depressive symptoms. Burnout, meanwhile, was estimated to affect up to 52%, with physicians and nurses being the hardest hit.

This does not bode well for the future of these workers or the quality of healthcare delivery.

While the worst of the pandemic is behind us, the world we live and work in continues to change, driven by technological advances, the global economic situation and many other factors.

These changes, particularly digitalisation, naturally impact workers' mental health, both positively and negatively.

Digital technology and platforms can indeed provide opportunities for social connection and support. They also offer increased accessibility to digital mental health care services, which can be advantageous, including greater flexibility, particularly when such services are available, and improve monitoring to detect mental health issues early.

“the perceived constant need to be connected and ‘digitally available’ can increase stress and contribute to burnout.”

However, they can also lead to social isolation, anxiety, and depression. Furthermore, the perceived constant need to be connected and ‘digitally available’ can increase stress and contribute to burnout. So, while technological advances such as digitalisation offer significant opportunities for frontline staff and key workers, the risks are apparent and must be addressed.

The need for better understanding of mental health at work

The need for employers to ensure they manage the mental health risks of frontline staff and key workers is not new. But as we continue to change the way we work, consideration must be given to how this impacts mental health and how the risks can be managed to prevent problems from occurring.

Although interventions to reduce stress and burnout at work have been developed and evaluated, most studies have lacked the effectiveness to improve the situation. Thus, more knowledge of interventions and analysis of their mechanisms are needed to reduce the risk of further adverse mental health problems. Similarly, high-quality randomised controlled trials of interventions to promote mental health, with coherently formed outcomes, are needed, especially at organisational level.

As has been recognised by Jennifer Robertson and others in Safety Science, improved guidance material and support from regulators is required, along with training for managers about how to identify and manage psychosocial hazards to reduce the significant burden of

mental health disorders and musculoskeletal problems.

The Institution of Occupational Safety and Health (IOSH) believes the inclusion of health and safety (including mental health) in the design and implementation phase of new technologies must also be formally integrated into policies at both policy and company levels.

A prevention-first approach for mental health issues at work

Mental health issues are on the rise due to occupational and non-occupational causes, and both will impact people's wellbeing at work.

In response to a European Commission consultation on approaches to mental health at work, IOSH advocated for a prevention-first approach, ensuring risks are appropriately managed and, when issues occur, the right level of support is offered.

We also highlighted that occupational safety and health professionals can be fundamental to modern businesses and play a key role in identifying health hazards, including psychosocial hazards, supporting good risk management and the prevention and mitigation of occupational risks that impact health, including mental health.

What is clear is that we cannot just sit by and let mental health issues continue to affect people. Instead, we must all come together to ensure that staff wellbeing is a key priority in the changing world of work.

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CAN “RESILIENCE” PROTECT KEY WORKERS FROM POOR MENTAL HEALTH?

First responders, other public safety personnel, and healthcare workers appear to be those most at risk of poor mental health following their occupations – but what does increasing resilience do, and how can governments protect their key workers?

The contemporary Canadian healthcare model and associated research efforts typically focus on diagnoses and treatments of experienced illnesses and injuries; in contrast, proactive mitigation efforts have received much less attention.

Investments in proactive healthcare

Investments in proactive healthcare make intuitive sense, with numerous campaigns focused on public education and behaviour changes (e.g., dental hygiene, exercise, healthy eating). Measuring the outcomes of such efforts often requires generational timelines for comparisons; nevertheless, recent advances have suggested similar efforts are necessary for improving mental health, particularly among persons necessarily and frequently exposed to stressors as a function of their employment.

What jobs are most at risk for adverse mental health?

First responders and other public safety personnel (PSP; e.g., border services, correctional workers, firefighters, paramedics, police, public safety communicators), as well as health care workers (HCW; e.g., nurses, physicians), appear to be among the professions most frequently exposed to potentially psychologically traumatic events (e.g., direct or indirect exposures to actual or threatened

death, serious injury, or sexual violence). Workers in these sectors appear to experience many more mental health challenges than the general population; accordingly, PSP and HCW have increasingly been inundated with a myriad of programs claiming to increase “resilience”.

“Resilience” and protecting one’s mental health

Resilience is an evolving concept, and the word is used in many contexts. Historically, resilience has been defined as resistance to experiences involving psychosocial risk or the ability to bounce back or return to the previous state following exposure to a stressor. Contemporary thinking suggests that resistance and resilience should be conceptualized as distinct constructs. We suggest also considering and delineating the conceptual relationships with posttraumatic growth, wherein new skills and strengths are developed in response to adversity, offering novel protections against subsequent stressors.

Modern conceptualizations of resilience extend beyond individual difference factors (e.g., personality traits) to include acquirable coping tools and strategies; however, the same conceptualizations continue to place the onus for managing the psychological impacts of stressors on the individuals experiencing the

stressor, abdicating responsibilities by organizations and communities. Focusing on the individual has been rightfully and broadly criticized for more than 100 years, and has been reflected in recent presumptive injury legislative changes related to posttraumatic stress injuries experienced by PSP.

Emerging approaches to resiliency are developing more holistic ecological views of resilience that consider the individual, as well as their families, workplaces, communities, and environments. Doing so more appropriately distributes responsibilities for mental health, and offers a myriad of opportunities to better protect the entire ecosystem by leveraging diverse multi-system tools for reducing risk and building resilience.

We proffer an initial ecological approach to resilience that recognizes interactions between individual, families, and workplaces.

Individual Resilience

Examples of individual resilience skills include regularized exercise, diaphragmatic breathing, mindfulness, and cognitive reframing, any of which may help with stress management. Like all skills, effectiveness improves with deliberate practice, which can provide broad protection for mental health

during exposures to stressors. There is evidence for potential benefits of resilience training for mental health and well-being; however, very few psychoeducation programs exist specifically for PSP and HCW, despite pervasive calls for research. There has also been a proliferation of programs claiming capacity to support mental health for PSP and HCW, although very few of which programs are evidence-informed and even fewer are evidence-based. Our randomized control trials evaluated an online resilience training resource in both nurses and primary care paramedic student populations demonstrated moderate effects, but with fairly rapid skill decay.

Familial Resilience

Family members can influence worker wellbeing as the first to notice signs and symptoms of a posttraumatic stress injury and as the first to provide support and encourage help-seeking; however, PSP and HCW family members also experience more challenges than other families, and are themselves at increased risk for diverse problems with health and wellbeing. Intra-familial processes such as maintaining shared beliefs and effective communication are integral to supporting resilient families. PSP and HCW families often develop specific coping strategies through trial and error, but there are brief, systems-focused psychoeducational programs that could be more proactive options for developing communication skills, decision-making skills, positive self-esteem, healthy personal relationships within the family, and external peer supports.

Workplace Resilience

Most people spend almost a third of their adult lives working, which means the workplace can powerfully influence mental health. Workplace factors influencing mental health include the actual work, workload, and workload management, as well as perceptions of psychological and social support, wellbeing resources, organizational culture, shared goals, leadership, policies, and opportunities for personal and professional growth. There is evidence that occupational stressors can be at least as psychologically injurious as potentially psychologically traumatic events, exacerbating the risks for PSP and HCW, but that compounding also offers meaningful opportunities for leaders to protect the mental health of workers by increasing workplace resilience. Psychologically safe workplaces can be difficult to build and maintain, particularly for PSP and HCW; fortunately, there are already initial guidelines available through the National Standard on Psychological Health and Safety in the Workplace that can help motivated leaders to start making positive changes.

Promoting PSP and HCW mental health: Challenges and opportunities

Public safety personnel and health care workers are frequently exposed to potentially psychologically traumatic events and other potentially harmful occupational stressors, substantially increasing their risk for diverse posttraumatic stress injuries. Proactive contemporary leaders who maintain holistic ecological views of resilience – considering individual, familial, workplace, community, and

environmental elements – have meaningful opportunities to create competitive advantages for their organizations. Promoting PSP and HCW mental health by facilitating holistic resilience can increase worker recruitment, retention, and effectiveness, all which having the inherent benefit of being morally justified. There are growing options for evidence-informed and evidence-based interventions that support elements of holistic resilience, all of which start with learning more and stepping ahead of the curve by leaders and organizations prioritizing whole people.

Learn more about the options available through the research, webinars, and training showcased by the [Canadian Institute for Public Safety Research and Treatment \(CIPSRT\)](#), and by reviewing programs and services through the dedicated CIPSRT website www.pspmentalhealth.ca.



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COVID-19 EXPERIENCE FOR CHILDREN IN CUSTODIAL SETTINGS

Dr Charlotte Lennox from the University of Manchester reports on the main findings of her research and argues that children in custodial settings were an invisible group during the COVID-19 pandemic, in this second of a two-part series

Image: © Motortion | iStock

Children in custodial settings have much higher rates of mental health and neurodevelopmental disorders than children in the general population. ⁽¹⁾

Prior to the COVID-19 pandemic, HM Inspectorate of Prisons (HMIP) repeatedly expressed concerns about the safety of children in custodial settings. ⁽²⁾

There is now evidence to suggest that the COVID-19 restrictions and limited social interactions had a significant impact on the general population ⁽³⁾ and a disproportionate impact on children's mental health. ⁽⁴⁾

As children in custodial settings were an already vulnerable group, there were concerns about the effect of the COVID-19 restrictions. ⁽⁵⁾

Understanding the impact of the pandemic on children in custodial settings

We undertook a study aimed at understanding this impact. The study consisted of three parts. We accessed all HMIP and Ofsted inspection reports for custodial settings.

We undertook an analysis to understand the policies implemented in response to COVID-19 and the impact that these policies had on children, staff and the settings.

We interviewed 41 participants, predominantly NHS staff, but we also



interviewed non-NHS staff, commissioners/policy makers, professional stakeholders and children with custody experience during COVID-19.

We accessed NHS England Health and Justice Children and Young People Indicators of Performance (CYPIPs) to assess health service performance changes.

What were the impacts of COVID-19, and what was done to help?

There were direct and indirect impacts of the COVID-19 pandemic and the policies implemented.

Direct impacts

Children were not considered when COVID-19 guidance was being developed

for custodial settings. There was no consistency of approach across the three site types [Secure Children's Homes (SCH), Secure Training Centres (STC) and Young Offender Institutions (YOI)], and no one government department had oversight.

This resulted in most sites adopting, to differing degrees, the COVID-19 guidelines for the adult prison estate.

However, this meant that children were locked in their rooms, in the worst cases, for 23.5 hours a day for weeks at a time. Generally, the smaller SCHs could offer more time out of their room, but this was not the case during lockdowns, on admission, or when children needed to self-isolate, they did this time on their own and locked in their rooms.

This isolation resulted in a deterioration of children's mental health. The NHS England CYPIP data revealed an increase in referrals once restrictions were lifted compared to pre-COVID-19 rates.

'Bubbles' were one of the main ways sites managed children.

Initially, these were successful as the smaller groups were easier for staff to manage behaviour; keep good communication; and helped develop staff and child relationships.

However, over time these bubbles led to rising tensions and inter-bubble conflict. These issues were more apparent in the larger sites than within the SCHs.

Data from our interviews showed that the rollout of the COVID-19 vaccination programme and conflicting messaging and behaviours from residential staff around vaccine take-up appeared to have an impact on childhood vaccinations more generally, with an increase in refusals for all vaccinations.

Indirect impacts

COVID-19 and policies implemented to minimise transmission affected staffing levels.

Low staffing levels impacted many aspects of life, including how the children's behaviour was managed and their ability to access facilities, services and professionals, ultimately resulting in further restrictions and isolation.

Staffing issues were more acute in the larger sites.

Before COVID-19, NHS England commissioned the *Framework for Integrated Care (SECURE STAIRS)* to improve children's care quality. It aimed

to do this through culture change, promoting trauma-informed, formulation-driven, whole-systems approach.

Sites were at varying stages of implementation in March 2020 ⁽⁶⁾. Our data showed that while the number of children with a formulation had increased during COVID-19, efforts to deliver the Framework for Integrated Care (SECURE STAIRS) were being restricted by staffing issues within the custodial settings.

Future infection/emergency/pandemic planning

There is a need for consistent infection control policies that are suitable for children in all custodial settings. In the future, if isolation periods are needed, this should be for the shortest amount of time, the needs of the child should be paramount, and there should be effective senior leadership in monitoring isolation.

There is a need to support settings to encourage childhood vaccination uptake, given the increase in refusals.

Lessons learned from the COVID-19 pandemic

The use of bubbles over time within the larger sites has been problematic. While the direction of travel is for smaller Secure Schools ⁽⁷⁾, our study highlights some important considerations, particularly around group dynamics. There is also a need to address staffing issues across the sector.

Areas of practice to be refreshed

The introduction of the Framework for Integrated Care (SECURE STAIRS) is likely to deliver improvements in children's care. However, it requires

sustained buy-in from all sectors, we would urge a drive to refresh uptake by the custodial settings.

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Note: This project is not supported by HM Prison & Probation Service or Youth Custody Services.

This research is funded by the National Institute for Health Research (NIHR) Policy Research Programme (NIHR202660). The views expressed are those of the author(s) and not necessarily those of the NIHR or the Department of Health and Social Care.



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Making mental health matter

Open Access Government explores the increasing prevalence of mental health problems and the policy-level measures aiming to improve mental health services and mitigate stigma and discrimination



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Poor mental health is a global public health problem. Amid the COVID-19 pandemic, the UK's Office for National Statistics questioned whether the UK was, in fact, facing a mental health pandemic following data collated on self-reported depression in adults during early 2021 and experimental analysis of the amount of depression diagnoses by GPs during the early stages of the pandemic. ⁽¹⁾ In 2023, it is a similar picture across the globe. The World Health Organization (WHO) indicates that in 2019, one in eight (or 970 million) people were living with a mental health problem, with anxiety and depressive disorders being the most common. ⁽²⁾ These conditions are also estimated to cost the global economy \$1 trillion yearly due to reduced productivity or a loss of 12 billion working days. ⁽³⁾ According to the Organisation for Economic Co-operation and Development, mental ill health in European countries can result in economic costs that surpass 4% of gross domestic product (GDP). ⁽⁴⁾

Poor mental health is on the rise

There are many types of mental health disorders and many reasons that cause them. In recent years, the COVID-19 pandemic, overstretched public health services and rising living costs have significantly affected people's mental wellbeing. In the UK, which saw one of the highest inflation rates earlier this year, food prices rose by 19.2%, a 45-year high. ⁽⁵⁾

While figures indicating a rise in the prevalence of poor mental health may be an indication that more people are talking about their wellbeing, affordability, social stigmas, and access to support are often barriers to effective treatment. This critical mental health care gap has been exacerbated by challenges across the health system, including dwindling staff numbers, and significant backlogs and wait times. Ensuring help is available to those who need it is vitally important, especially given

that those with severe mental health problems are at greater risk of premature death. Suicide is also the fourth leading cause of death among 15-29-year olds worldwide. ⁽⁶⁾

How Europe is supporting mental health

In June this year, the European Commission outlined how it will prioritise mental health in EU policymaking and adopt a cross-sectional approach to tackling mental ill health, focusing on education, the environment as well as employment and the digital world.

Supported by €1.23 billion in funding, the Commission has proposed 20 flagship initiatives to address the risk factors of poor mental health and which cover a broad area of policies. Efforts will focus on prevention and early intervention, wellbeing at work, safeguarding the mental health of youth and vulnerable groups, investing in training and capacity building, and leading by example at the international level by raising awareness and providing quality mental health support in humanitarian emergencies. The cost of non-action, it says, is significant and amounts to €600 billion every year. ⁽⁷⁾

Referring to poor mental health in Europe as a “silent epidemic”, Vice-President Schinas noted the timeliness of the strategy in light of the many “transformative stressors” that are impacting people’s everyday reality, including the COVID-19 pandemic, climate crisis, living costs and war in Ukraine, “non-action is simply not an option”, he said. “Our strategic initiative adopted today is an important step towards a healthier Europe, where the psychosocial needs of citizens, including the most vulnerable of our societies, are at the heart of our efforts. It is what defines us as European. Solidarity with and protection of people are core European values, key components of our European way of life.” ⁽⁸⁾

One in six people in Europe is estimated to have a mental health problem, with significant regional and social inequalities. Loneliness affects around a quarter of the EU’s population, double that of pre-pandemic levels. The Commission has pledged €6 million to aid in the creation and execution of policies for depression and suicide prevention throughout the bloc. It also plans to allocate €2 million to facilitate access to and promote online

evidence-based recommendations for those suffering from poor mental health.

As part of the Initiative Healthy Screens, Healthy Youth, the Commission wants to offer more comprehensive guidelines to ensure a safer and healthier digital space for minors. The Horizon Europe Cancer Mission will also provide young cancer survivors with a platform to bolster their mental wellbeing.

The strategy recognises the need to destigmatise mental health as this is often a barrier to accessing care: “We all speak out very easily about our physical health challenges but hide the mental pain often felt. This is often interpreted as a sign of personal failure.

“This must urgently change because the long-term cost of inaction, primarily for people, but also for our economies, is far greater”, said Commissioner Kyriakides.

Commissioner Kyriakides highlighted the Commission’s efforts to adopt a “comprehensive and holistic approach that begins with prevention and early intervention.” Part of this will mean creating environments that support positive mental health and wellbeing, as well as resilience, and ensuring services are known and easy to access for those who need them. Supported by stakeholders, the Commission also plans to create a European Code for Mental Health to help people to feel more empowered to look after their mental health and care for loved ones.

Another flagship initiative concerns mental health at work; 27% of workers have reported experiencing work-related stress, depression, or anxiety in the past twelve months. Commissioner Kyriakides added: “We want to raise awareness and work with companies to improve prevention, which is why we will present an EU-level initiative on psychosocial risks after doing a peer review and consulting social partners.

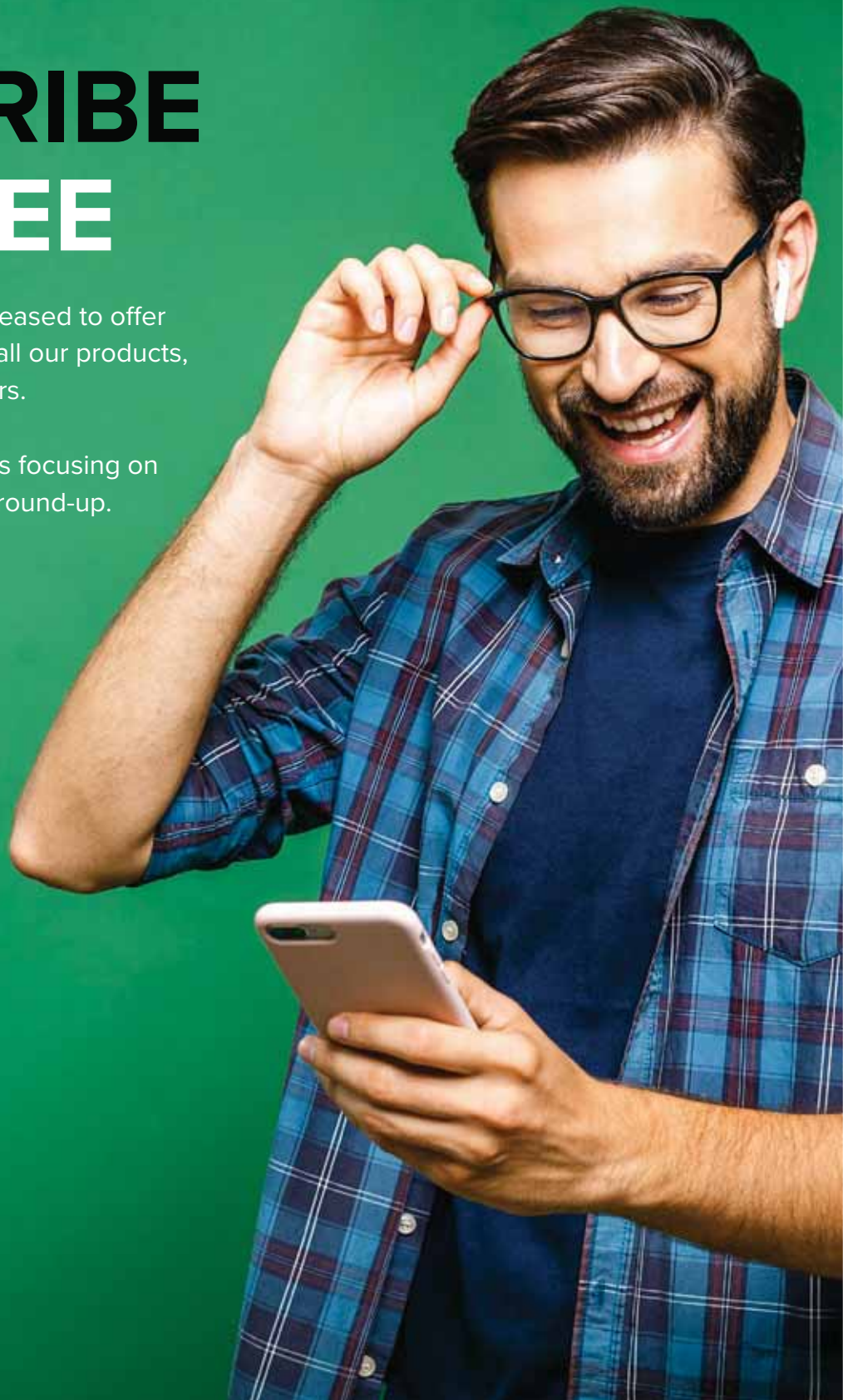
“We will also support EU-wide awareness-raising campaigns by the European Agency for Safety and Health at Work (EU-OSHA), including on Safe and healthy work in the digital age and psychosocial risks and mental health at work, with a focus on new and overlooked occupations.”

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Reflecting on the Commission's mental health strategy as a "vital step to put mental health on par with physical health and to ensure a new, cross-sectoral approach to mental health issues", Mental Health Europe said that "more reference to concrete actions or resources" are needed to support vulnerable people. It also said that while it applauds efforts to support Ukrainian migrants, it was "surprised" by the limited resources allocated to support other refugees and migrants.⁽⁹⁾

WHO/Europe mental health initiatives

According to the WHO, mental health disorders are the leading cause of disability in many Western countries, responsible for 30-40% of chronic sick leave. In 2021, more than 150 million people in Europe lived with a mental health condition, yet only one in three people with depression received the needed care. Part of the WHO/Europe's remit is helping to raise awareness of the unmet needs surrounding mental and ensure the vital interventions and investments needed to support those living with poor mental health are implemented. [Five overarching priorities](#) form the basis of WHO/Europe's response to mental health, including developing services, particularly community-based practice in low-and-middle-income countries.

Now in its third year of operation, the Pan-European Mental Health Coalition is a significant partnership established to address gaps in mental health services and support by gathering key stakeholders, from national leaders to professionals, members of civil society, and international organisations. The Coalition's key priorities include integrating mental health into emergency response and recovery efforts and preventing mental ill health across the life course. In June this year, ministers and high-level officials from WHO/Europe's eleven smallest countries adopted a landmark [Luxembourg Statement](#) pledging to take more robust measures to enhance the health of citizens in their respective countries. In a statement at the ninth High-level Meeting of the Small Countries Initiative, Dr Hans Henri P. Kluge, WHO Regional Director for Europe, referenced the proverb "Words are but dwarfs; examples are giants," and as people continue to face unprecedented challenges,

many will be eager to see if world leaders can follow through on proposals to transform mental health services to facilitate access to quality care to all those in need.

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WHAT IS THE IMPORTANCE OF FRIENDSHIP AND MENTAL HEALTH IN PANDEMICS?

Terence j Ryan, from the University of Oxford, explores the importance of friendship and mental health in relation to pandemics and immunity

In the last three years, there has been a significant rise in impaired mental health. Many have asked whether this rise is due to the COVID-19 infection itself or if it is a consequence of how officials managed the pandemic.

A close colleague of mine, together running NHS and academic departments without a cross word for fifty years, had suffered from mild dementia and COVID in a care home and, as a result, was isolated from seeing his family and friends for over a year, except through a window. This was during the same period that I was a trustee of [Actasia](#), working to prevent the cruelty and caging of wild animals. It is clear from conducting this work, that such cruelty impairs immunity and resistance and thus increases susceptibility to infection. It should be taken into account when generating good policies to prevent mental illness. In preparation for future pandemics. I make a case for friendship as a therapeutic power for Mental Health and for enhancing immunity⁽¹⁾. The French Covid -19 Scientific Council have led the view that it should be a One Health approach embracing humans, animals and the environment, and I believe friendship can be applied to all three, as it was by St Francis of Assisi.

Professor Dunbar of Oxford's Experimental Psychology Department wrote three years ago that the single most important therapy for wellbeing, health and happiness is friendship⁽²⁾. The balance between Science and Humanity can be reinterpreted as Care technology versus Care Attitude. Friendship has been argued to have the greatest therapeutic power for managing almost everything – it is a modern version of 'love one's neighbour as oneself' of Confucius and Jesus Christ.

“The Single most important therapy for wellbeing, health and happiness is friendship”⁽²⁾

This view is a consequence of my 50 years of experience managing leprosy, a disease famously managed by social distancing, and as a consequence of reading the works of the Father of Modern Medicine, Sir William Osler, whose therapeutic power was attributed to friendship by a then Minister of Health. Osler called for a friendly approach to treatment and campaigned for every health professional to be a knowledgeable scientist but always humane⁽³⁾.

Could friendship have healing power?

Dictionaries, encyclopaedias, and numerous sources underestimate

friendship. Even the Wikipedia entry is lightweight compared to the many sources one can find in the personal library of Sir William Osler at Green Templeton College Oxford.

Wikipedia begins its examination of friendship with a long discussion:

“Friendship is a [relationship](#) of mutual [affection](#) between people. It is a stronger form of interpersonal bond than an “acquaintance” or an “association”, such as a classmate, neighbour, co-worker, or colleague.

In some cultures, the concept of friendship is restricted to a small number of very deep relationships; in others, such as the U.S. and Canada, a person could have many friends and perhaps a more intense relationship with one or two people who may be called good friends or best friends or other colloquial terms include besties or [Best Friends Forever \(BFFs\)](#). Although there are many forms of friendship, some of which may vary from place to place, certain characteristics are present in many such bonds. Such features include choosing to be with one another, enjoying time spent together, and engaging in a positive and supportive role to one another.”

Friendship can take up any amount of our care attitude's emotions, sympathy, empathy, compassion, kindness, maintaining dignity, bringing cheer and joy and showing tenderness.

The importance of camaraderie and esprit de corps

It is important for some sections of society, such as the armed forces or sports, to include camaraderie and esprit de corps as a balance for fierce instruction. Contemporary UK TV viewers will have seen how it underlies the discipline that took soldiers 'over the top' to their death in the battle of the Somme, in 1917.

In recent history, camaraderie allowed more than two thousand males and females to tolerate, with good humour, the confinement for nine months in the aircraft carrier Queen Elizabeth. They met danger with skill and alertness and great control over the sexual consequences of togetherness. They too had the experience of isolation because of an epidemic on board but managed to maintain esprit de corps.

Of relevance to how friendship was enhanced was the storytelling and acting out of the whole of the uncomfortable meeting with Neptune and his team, being hundreds of seniors battling against some 1600 young recruits as they crossed the equator! The latter had their chance to beat up the seniors in their mess while the usual respect for authority was briefly lifted but instantly restored once the game was over.

Storytelling in children's education, including play, pets, and toys, was part of Sir William Osler's therapeutic power. Aboriginals in Australia would include the influence of trees, ponds, and rocks.

Anyone familiar with those saving lives at sea will observe that lifeboat crews have great technological skills. However, it is friendship that steers them through dangers and deaths, after which they are still able to carry out the next call to sea with undiminished effectiveness.

The Welsh miners of the 19th century frequented the large chapels and choirs, which were almost the only power-generating esprit der corps to keep them churning out massive amounts of coal and steel.

It was singing that featured in the 'Military wives choirs' showing that family members left behind had an experience through friendship when weekly zooming their husbands reinforcing their good spirits.

Bertrand Russell noted even in 1931, "The new powers that Science has given to Man can only be wielded safely by those who, whether through a study of history or their experience of life, have acquired more reverence for human feelings and some tenderness towards the emotions that give colour to the daily existence of men and women⁽⁵⁾".

Today it is the new knowledge of how the forebrain and limbic region of the brain uses emotions to control our hormonal and nervous system's embrace of our bodies to enhance immunity and mental health in the context of One Health that makes one confident to recommend friendship as a key to how social distancing and masking is used in future pandemics.

For the control of a pandemic it is necessary to know the science underlying it as well as to embrace in a friendly way both individuals and communities with their beliefs and feelings, both traditional and recently

acquired. Such an approach plays a great part too in the management of Neglected Tropical Diseases like leprosy in remote resource-poor regions. WHO will know that effective governance of all political parties in all countries requires that supporting the power of science must be embraced by a caring attitude of which friendship is the most therapeutic of all remedies to counter isolation and failure to bring people together in agreement.

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ANALYSING THE EFFECTS OF USING CANNABIS ON YOUTH MENTAL HEALTH

Mary Cannon, Professor of Psychiatric Epidemiology and Youth Mental Health at RCSI University of Medicine and Health Sciences, investigates the effects of using cannabis on young people's mental health

Cannabis is the most widely used drug among young people globally. The average age of initiation of cannabis use is mid-teens, and use tends to fall off later in life. Unfortunately, the peak period of cannabis use coincides with the peak time for brain development which continues up to age 25.

The main adverse effects of using cannabis during adolescence fall under three broad categories: dependence, underachievement and mental health problems (DUM). Let us deal with each of these in turn.

Cannabis dependence and addiction

Cannabis is an addictive substance and the earlier a person starts using the higher the risk of dependence, which is also called Cannabis Use Disorder. It is estimated that at least one in 5 regular users will become dependent. Higher addiction rates (up to 30%) are found among teenage heavy users (Irishpsychiatry.ie, 2019).

Cannabis dependence is now the most common reason for new presentations to adolescent addiction services in many countries. Withdrawal symptoms from cannabis include anxiety, irritability, anger or aggression, disturbed sleep/dreaming, depressed mood and loss of appetite.

A few risk factors can increase the likelihood of developing cannabis use

disorder. One is starting to use cannabis at an early age.

Another is having another psychiatric diagnosis, such as anxiety, depression, post-traumatic stress disorder or attention deficit hyperactivity disorder. The heavier a person's use, the more likely they are to develop dependence.

The relationship between using cannabis and underachieving

Cannabis use in adolescence has been shown to affect brain development due to its action on the CB1 receptors that are widespread throughout the brain.

A systematic review has shown that the use of cannabis during adolescence is associated with an IQ decline of approximately 2 points (Power et al., 2021), and continued heavy use is associated with even more significant losses of up to 8 IQ points (Maier et al., 2012). These changes may be irreversible.

Cannabis use in youth is associated with slower thinking and difficulty concentrating, affecting school performance. Young cannabis users fall behind their non-using peers by as much as three years of schooling. These effects of using cannabis are shown even in young people who are not yet dependent on the drug (Sultan et al., 2023). Cannabis use in youth is also associated with delinquent behaviours such as truancy, aggression, arrests and fighting (Sultan et al., 2023).

Such behaviours occurring at a crucial time of social and educational development will affect the young person's chance of graduating from school or college and establishing themselves in a career. Chronic cannabis use can be even more detrimental to a young person's life outcomes than chronic alcohol use (Cerdeira et al 2016).

Studies that have followed young people over many years show that cannabis use in the teenage years is associated with poorer social and financial outcomes in adulthood than their non-cannabis-using peers (Silins et al, 2014).

Young adulthood is crucial for establishing oneself on a good path in life for success and fulfilment. Opportunities lost at this time may never come again.

The connection between cannabis use and mental health problems

Over the past few decades, there have been numerous rigorous scientific studies showing that cannabis use in young people significantly increases the risk for mental health problems.

A systematic review showed that adolescent cannabis use was associated with a small but significant increased risk for depression and a strongly increased risk for suicidal thoughts and suicide attempts (up to

300% increase). (Gobbi et al., 2019). These increased mental health risks are found even in youth who use cannabis recreationally (Sultan et al, 2023).

Anxiety disorders are increased in youth who use high-potency cannabis (Hines et al., 2020). Psychosis is a serious mental health condition involving a loss of contact with reality characterised by hallucinations and paranoia. It has been shown by numerous well-designed epidemiological studies that cannabis use is associated with a later risk for psychosis (Marconi et al, 2016) by a factor of about three.

This risk is even higher for those that start using in adolescence (Arseneault et al, 2004) and those who have daily use of high-potency cannabis, accounting for up to 50% of schizophrenia cases in some areas (diForti et al, 2019).

Public health concerns on the effects of using cannabis

Many people are concerned about the increasing rate of mental health problems in young people, but this does not appear to have translated into concern about the mental health harms associated with cannabis in youth.

Although tobacco and alcohol have adverse effects on physical health (such as liver, heart and lungs), the evidence shows that cannabis is harmful to the developing brains of young people and has more severe effects on their life prospects (Cerdea et al, 2016).

Another concerning issue is that the strength of the cannabis young people use has increased dramatically over recent years. The cannabis available today is a very different type of substance from that available to the 'Woodstock' generation.

The potency of cannabis is measured by the percentage of the component called Tetrahydrocannabinol (THC), which has increased from approximately 3% in 1980 to more than 20% currently.

Cannabis with greater than 10% THC is generally classed as high potency. THC causes the 'high' associated with cannabis and is associated with dependence and risk for anxiety, paranoia and psychosis. The 'joints' of the 1970s contained perhaps 1-2% THC and were often shared around in groups so that users inhaled about 1 milligram of THC each.

Likely, today's users would hardly recognise this substance as 'weed'. Today a single joint could contain 100 milligrams of THC.

Young people are now being exposed to a much more addictive and harmful substance than their parent's generation, but at the same time the percentage of teenagers believing that there is no harm from cannabis has increased from 10% in 2011 to 19.5% in 2015 (Mariani and Williams 2021).

The public messaging has somehow changed regarding the effects of using cannabis and become very rose-tinted and complacent when we should get more alarmed. A public health response is urgently needed to inform youth and their parents, and the wider community, about the risks associated with cannabis use.

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Psychedelic therapies: The case for a new focus in the EU's mental health care approach

Tadeusz Hawrot, Founder and Executive Director of PAREA, states the case for a new focus in the EU's mental health care approach, that is the underserved area of psychedelic therapies

As we navigate deeper into the 21st century, the importance of mental health care is gaining increasing recognition. But we still have a long way to go.

The OECD estimates that mental illness affects one in two individuals during their lifetime, making it an ever-present yet often overlooked aspect of overall well-being. ⁽¹⁾ The World Economic Forum's Global Risks Report 2023 identifies mental health deterioration as a severe risk to economies and societies. ⁽²⁾ Yet, a startling reality is revealed in the WHO's 2022 report: governments allocate, on average, only 2% of their health budgets to mental health. Furthermore, though making up 30% of total mental health sector funding, philanthropic donations represent a mere 0.5% of all health contributions. ⁽³⁾

A recent discussion paper by the European Commission titled Scoping study on evidence to tackle high-burden under-researched medical conditions highlights these imbalances further. Predictably, it found that mental disorders top the list, despite research suggesting that investments in mental health could yield up to a 37% return – the highest of all biomedical fields. ⁽⁴⁾

Last year, the European Medicines Agency recommended 89 new medicines for approval; astonishingly, not a single one was for mental health conditions. ⁽⁵⁾ All the while, as many as 67% of people say they do not get the mental health support they need. This raises a crucial question: where is the innovation in mental health treatment? A white paper by IQVIA points out that only 20% of R&D in the Central Nervous System is dedicated to mental health. ⁽⁶⁾

These disparities underline the pressing need for a shift in our approach to mental health care, treatment, and research funding. Right now, the EU is revising its

pharmaceutical regulations, marking an opportune moment to reset our focus on mental health.

A beacon of hope: Psychedelic therapies

Amidst this bleak scenario, psychedelic therapies emerge as a beacon of hope. These novel treatments, still in their infancy, show great promise in clinical trials. Economic analyses, like the one by Elliot Marseille and his colleagues at the University of California, suggest they can be cost-effective. ⁽⁷⁾ Moreover, follow-up studies indicate lasting benefits, with significant proportions of patients reporting continued improvements months post-treatment (even though we still lack robust data on their long-term efficacy).

These innovative treatments' development and safe implementation require a supportive regulatory environment. The EU's largely successful approach to orphan drugs and paediatric medicines ⁽⁸⁾, and, more recently, new incentives targeting antimicrobial resistance (AMR) offers an instructive model. As of 1999, the EU has been crafting targeted incentives to support R&D in these crucial areas and recently proposed a transferable data exclusivity voucher scheme to incentivise the development of new antimicrobials. ⁽⁹⁾ A similar model could stimulate innovation in mental health by incentivising the development and deployment of psychedelic therapies.

Learning from stroke rehabilitation

Inspiration can also be drawn from developing and implementing stroke rehabilitation in Europe. Establishing stroke units – specialised teams of healthcare professionals providing comprehensive stroke care – has been a game-changer. It took several decades for these units to mature fully, but the investment has paid off with significant improvements in stroke care.



Tadeusz Hawrot
Founder and Executive Director

The lessons from stroke rehabilitation can be applied to developing and implementing psychedelic therapies. Both require a multidisciplinary approach, evidence-based practice, and significant resource investment.

Crucially, stroke rehabilitation gained prominence because stroke became recognised as a significant public health issue, leading to increased research funding focusing on developing effective treatments. A similar shift in perspective is needed for mental health. The recent resurgence of research in psychedelic research is a promising start and could accelerate the pace of development in this field.

The influence of policy: Role of the EU

The EU can play a crucial part in this shift. The EU initiative on a comprehensive approach to mental health is about to be published, and the current revision of pharmaceutical rules presents an ideal opportunity to prioritise and incentivise mental health care. Previously, the EU has demonstrated that it can prioritise certain therapeutic areas, such as antimicrobial resistance, in response to high societal needs. It's time we extended this approach to mental health treatments.

But our efforts shouldn't end with policy changes. We also need to ensure that psychedelic novel treatments are accessible and affordable for those who need them most. This will demand strategic planning and thoughtful preparation to prevent disparities in access and ensure the benefits of these therapies are available to those who might benefit from them.

Psychedelic therapies are a path forward

As we find our way towards a future where psychedelic therapies become integral to mental health treatments, we must ensure our strategies are as innovative and forward-thinking as the treatments themselves. Now is the time for Europe to prioritise mental health and invest

in a healthier future for its citizens. A shift in focus, combined with regulatory incentives, increased funding, and fostering a supportive environment for R&D in this field, could turn the tide in our battle against mental health conditions.

We are at a turning point for mental health care, with the potential to transform lives on a massive scale. We must seize this opportunity, not just for the sake of innovation, but because mental health matters. It's not just about resource allocation; it's about prioritising mental well-being and recognising the enormous potential that psychedelic therapies hold.

Only through concerted, comprehensive efforts can we hope to make significant strides towards improved mental health care. We are on the cusp of a mental health revolution, and we must take advantage of it to transform lives and prioritise mental health.

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LEVERAGING PSYCHEDELIC THERAPIES FOR BINGE EATING DISORDER: A NOVEL APPROACH BY TRYP THERAPEUTICS

Here Tryp Therapeutics examine the viability of using psychedelic therapies for Binge Eating Disorder and the potential results that using psychedelic-assisted psychotherapy could have on different eating disorders

Tryp Therapeutics is a clinical-stage biotechnology company dedicated to the development of exclusive and innovative formulations for administering psilocin in conjunction with psychotherapy, aiming to address unmet medical needs in various diseases. Our primary focus is on our lead program, TRP-8803, which represents a proprietary formulation of intravenous (IV) infused psilocin, the active metabolite of psilocybin.

This formulation overcomes several limitations associated with oral psilocybin administration. By directly administering psilocin via the intravenous route, we achieve the most precise form of dosing, ensuring the reproducibility of blood levels necessary for clinical efficacy, while preserving safety. In contrast, oral administration of psilocybin relies on enzymatic conversion of psilocybin to psilocin, resulting in substantial variability in drug blood levels among patients potentially confounding the planned outcome of clinical studies.

Leveraging psychedelic therapies for Binge Eating Disorder

TRP-8803 addresses additional limitations associated with orally administered psilocybin, including the time to onset of the psychedelic experience (1-2 hours) and the duration of the experience (6-8 hours).

	IV-infused Psilocin	Oral Psilocybin *
Short treatment duration of 1-2 hours	✓	✗ 6-10 hours
Quick onset of psychedelic state (15 minutes)	✓	✗ 1-2 hours
Precision targeting of drug blood levels in patients	✓	✗ Highly variable
Quickly reversible in emergency	✓	✗
Strong IP positioning	✓	✗
Commercially scalable	✓	⚠

* Companies developing oral psilocybin include: Compass Pathways, USONA

A treatment protocol utilizing oral psilocybin will be challenging to scale commercially due to the extensive time commitment required by both the patient and therapists.

In contrast, TRP-8803 enables a relatively rapid induction of the psychedelic experience within 10-15 minutes, while providing control over the depth and duration of the experience. This reduction in treatment time to a manageable 1-2 hours represents a significant advantage over orally administered psilocybin. And the ability to achieve precision targeting of drug blood levels is likely to provide significant efficacy advantages as well.

Tryp Therapeutics is concurrently identifying novel indications for psychedelic-assisted psychotherapy via its oral psilocybin program, TRP-8802. Where a preliminary clinical benefit is

demonstrated, subsequent studies are expected to utilize TRP-8803 (IV-infused psilocin).

These small pilot studies offer a cost-effective approach to identifying signals for new indications, whilst expediting and mitigating risks in the drug development process. The resulting data contributes to the establishment of novel intellectual property claims and assists in optimizing psychotherapy protocols for each respective indication.

Collaborating with esteemed institutions such as the University of Florida, the University of Michigan, and Harvard Medical School, Tryp's clinical focus with TRP-8802 is on eating disorders and chronic pain including fibromyalgia and abdominal pain associated with Intestinal bowel Syndrome (IBS).



Psychotherapy, BED, anxiety and depression

Tryp recently published the interim results from an eating disorder study conducted at the University of Florida in patients diagnosed with binge eating disorder (BED). These patients were enrolled in a 4-week run-in period, during which time patients were required to maintain a daily diary on their smartphones to record the number of binge eating episodes and their perception of losing control over their eating habits.

Additionally, they completed questionnaires assessing anxiety and depression. The first two weeks served as a baseline data collection period, while the subsequent two weeks involved 8 hours of psychotherapy administered by two trained psychotherapists, along with EEG and fMRI neurological evaluations. After the 4-week run-in period, patients received oral psilocybin (25 mg capsule) administered by one of the psychotherapists in a setting that met established set and setting requirements.

The following morning, patients returned to the clinic for an integration session with their therapists. The primary clinical endpoint, as agreed upon with the FDA, was the number of daily binge eating episodes four weeks after drug administration.

The results for the number of daily binge eating episodes and the frequency of perceived loss of control over eating behavior are presented in the graphs above. These findings reveal a remarkable reduction of over 80% in both the number of daily binge eating episodes and the instances of perceived loss of control over eating behavior compared to baseline following psilocybin administration.

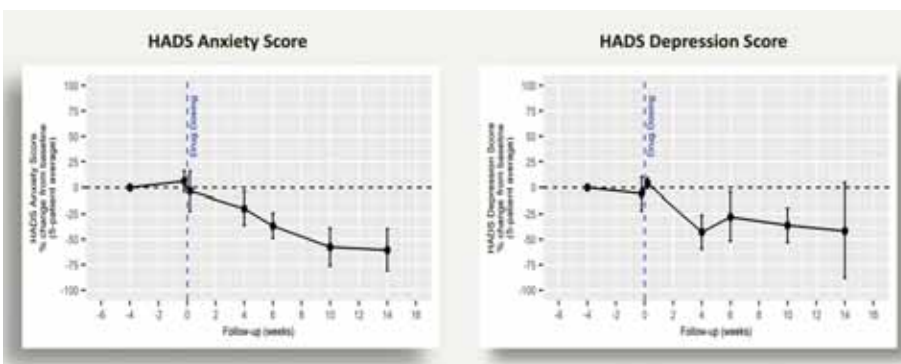
Importantly, continued monitoring of patients for up to 60 days demonstrated the durability of the effect of the treatment. These results provide substantial support and validation for the clinical potential of psychedelic-assisted psychotherapy to exert a meaningful clinical impact on eating behavior in patients with BED.

Patients with BED also frequently experience symptoms of anxiety and depression. During the 4-week run-in period, patients completed the Hospital Anxiety and Depression Scale (HADS) questionnaire to assess anxiety and depression levels. This assessment was repeated during the subsequent 4-week period following psilocybin administration. The results are depicted in the graphic below.

These findings demonstrate that psychedelic-assisted psychotherapy led to improvements in both anxiety and depression scores among these patients, aligning with previously published results in patients with treatment-resistant depression (TRD) and anxiety disorders.

The promising potential of psychedelic-assisted psychotherapy

The interim results from Tryp’s Binge Eating Phase 2a highlight the promising potential of psychedelic therapies for Binge Eating Disorder and, potentially, other eating disorders. Looking ahead, future studies hold even greater promise with the utilization of TRP-8803, an intravenous (IV) infusion of psilocin with its advantages of rapid onset, precise dosing, and control over the depth and duration of the psychedelic experience.



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Using psychedelics to mitigate Treatment Resistant Depression

Cosmo Feilding-Mellen, CEO, Beckley Psytech, charts the role of psychedelics in mitigating Treatment Resistant Depression

According to the [World Health Organization](#), there are 280 million people globally living with depression, and a third of those do not respond to initial medication. This leads to a condition called Treatment Resistant Depression (TRD) and, as the name suggests, it's difficult to treat. In recent years, however, we've seen increasing evidence that synthetic psychedelic compounds can help those with TRD where conventional therapies cannot. Here, we break down why a new approach is needed and what the latest science is telling us.

When it comes to treating neuropsychiatric and mental health conditions, we have to accept that one size does not fit all. For some, talking therapies like cognitive

behavioural therapy plus antidepressants like selective serotonin reuptake inhibitors (SSRIs) work wonders. But for millions of others, they don't.

Treatment Resistant Depression is diagnosed when a patient's first and second lines of depression treatment hasn't made them feel better or has only made them feel partially better. [Evidence suggests](#) that TRD can affect up to a third of people who have depression and we also know that [60% of patients](#) discontinue or switch their conventional SSRIs within 12 weeks due to side effects. This means there is a huge unmet need for better therapies for individuals suffering from TRD, with millions around the globe grappling with depression that

doesn't improve or relent – even by application of the 'best' that medicine currently has to offer. This is where psychedelics could make a big difference.

How synthetic psychedelic compounds are shifting the narrative

Psychedelics work by inducing a 'window of neuroplasticity' in the brain, which opens up the possibility for new synaptic connections to be formed. These connections play an important role in areas like learning, memory, and behaviour, so these compounds create the space for new behaviours or patterns of thinking to be developed. This ability makes psychedelics so interesting in the case of treating depression: the psychedelic experience can help patients unearth and address the source of an issue in a new way.

The science backs this up. A [2022 study](#) by the Centre for Psychedelic Research at Imperial College London found that psilocybin increased brain connectivity in people with depression, while [researchers at Johns Hopkins](#) demonstrated how a single psilocybin treatment for Major Depressive Disorder can be effective for up to a year for some patients.

There may be promise also for sub-perceptual doses or microdosing: [a recent study](#) showed how adults who microdose report lower levels of anxiety and depression compared to those who don't.

Latest trials & promising results

An example of a clinical trial in this space is the Phase IIa study of Beckley Psytech's synthetic 5-MeO-DMT compound, BPL-003, for Treatment Resistant Depression. In collaboration with King's College London, the Phase IIa trial is exploring the safety, efficacy, and pharmacokinetics of a single dose of BPL-003, in combination with psychological support, in patients with TRD with moderate to severe symptoms who are not taking concomitant antidepressants.

It's still early days and this is just one of many trials taking place around the world, but we are proud to play a part in developing alternative therapies for people in need which are safe, effective, and practical.

Globally, other progress is happening as well. From July, [Australia will allow](#) approved psychiatrists to prescribe MDMA and psilocybin to some patients to help them deal with post-traumatic stress disorder and TRD respectively. And in 2022, [it was revealed](#) that the Biden administration was looking into greenlighting some psychedelic therapies for PTSD and depression by 2024.

What's next for Treatment Resistant Depression

The psychedelic pharmaceutical market, valued at \$3.61 billion in 2021, is projected to climb to \$8.31 billion by 2028, according to InsightAce Analytic. This interest and growth are hardly surprising considering the huge unmet need and the promising research emerging from industry and academia.

However, for those living with depression, these novel remedies can't come quickly enough. Clinical trials and gradual progress are encouraging, but we must do much more. If and when the treatments make it to market, they'll be an entirely new type of treatment, and we'll need to work together to get them to the people that need them most.

That means patients, clinicians, payers, regulators, industry, and academia working together to build a new health infrastructure that can deliver these treatments in an affordable, equitable and scalable way. The time for collaboration is now.

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THE HISTORY OF PSYCHEDELICS AND WHY PSYCHEDELIC STORIES MATTER

Erika Dyck delves into the history of psychedelics, exploring how these substances have piqued the interest and influenced the attitudes of individuals across academia, culture, and medicine

Psychedelic drugs have had a long and colourful history.

Although the word psychedelic was not officially coined until 1957, botanists, psychiatrists, anthropologists, and historians had long encountered substances that altered consciousness or even produced psychotic-like symptoms.

These experiences had captivated researchers and adventurous spirits who often attempted to give meaning to the experience, whether in a therapeutic or introspective encounter. Anthropologists became fascinated with indigenous rituals that incorporated the consumption of plants that caused spiritual visions.

At the same time, chemists clamoured to isolate their active ingredients or alkaloids from such mysterious or magical plants or plant healers/teachers to study the pharmacological properties separately from a ceremonial context.

The fascination with drug-induced alterations in consciousness has attracted a variety of serious observers but has also been held responsible for inducing pathological conditions, exacerbating depression and psychosis, and in extreme cases causing suicides.

The history of psychedelics and its polarising effects

These polarising opinions on psychedelics have, until recently, often reflected contemporary trends in cultural attitudes towards non-medical

drug use in general and the role of consciousness-altering substances in clinical medicine.

For a brief period during the Cold War, these perspectives came into direct conflict: psychedelics represented a challenge to modern biomedical medicine by encouraging subjects to engage in a consciousness-altering and behaviour-changing psychotherapeutic experience.

This approach differed dramatically from a pain-dampening, or symptom-suppressing approach to healing, which became a more typical view of the role of psychopharmacology at the start of the mid-century. A decade later, the non-medical use of psychedelics also placed these substances at odds with the war on drugs and the mantra of 'just say no.'

Many early published writings on the topic were mainly anecdotal, providing testimonials about what these plant medicines did and claims about why they were so valuable for humanity.

That spirit of wonderment captivated authors and readers for several decades. It stretched beyond academic publishing – whether in science or literature, or philosophy – and began inspiring other minds and other writers. There was something about the psychedelic experience that was highly transformative and personal, which encouraged people to want to write theirs down.

Historians and journalists: Conflicting approaches when it comes to the history of psychedelics

Historians and journalists have not always followed the same path. Histories of psychedelics from the 1970s to the early 2000s were often more critical of the psychedelic culture – scientific trials and the counterculture connections.

Throughout this period, several historical accounts of this topic took a more pessimistic view, highlighting the unethical American CIA experiments or exposing Timothy Leary as a cult-like figure. Several historians and journalists since the 1970s seemed to take the side of the war on drugs and described psychedelics as dangerous, sometimes addictive, and often associated with a nefarious capacity to alter minds or change people's attitudes.

A growing but familiar tension exists in how we talk about psychedelics, particularly as we move beyond a psychedelic bubble or insider community. Academics tend to talk about legitimate research using scientific language, and social scientists consider the cultural impact or non-medical uses of psychedelics.

Still, we are trained to do this from a distance as dispassionate observers. Despite this writing tradition, more and more public conversations on psychedelics are coming from insider accounts, people with enthusiastic claims about the benefits of

psychedelic drug use that rely on severing the current culture of psychedelics from the past, and some might even suggest severing psychedelics from mainstream institutions which tend to be more conservative – like universities or food and drug administrations, or even healthcare systems.

Psychedelic popularisation both in and out of science

In the 1950s, psychedelic researchers faced many of the same questions regarding concerns about mainstreaming psychedelics or making psychedelic medicine or therapy more broadly available. As a result, some investigators promoted their findings through the scientific community exclusively. In contrast, others either broke ranks with their colleagues or pursued a path of psychedelic popularisation outside of science.

For example, Abram Hoffer, a Canadian psychiatrist and biochemist, worked closely with psychiatrist Humphry Osmond on developing guidelines for treating alcoholism with psychedelics. Hoffer presented and published widely but almost exclusively within professional contexts.

However, he was openly critical of randomised controlled trials (RCTs) and pharmaceutical profits, which he felt distorted the psychopharmacology science. On the other hand, Timothy Leary famously lost his position as a psychology professor at Harvard (along with his colleague Rich Alpert). He dedicated himself to spreading the gospel of psychedelics using his considerable charisma and extensive networks that extended well beyond the scientific community.

Psychedelics and the arts

We know, too, that writers, poets, and

psychedelic enthusiasts took to the pages of pulp fiction in the 1960s, writing accounts of their altered states and cosmic journeys. Some became counterculture icons, like William Burroughs, Ken Kesey, and Allen Ginsberg. Other LSD enthusiasts had more staid public images to uphold and discussed it more cautiously.

For example, Thelma Moss, a then-little-known actress who had taken LSD in therapy, wrote a bestseller about her experience under the pseudonym Constance Newland. The pen name allowed her to explore some of the darker sides of psychedelic therapy and the vulnerability experienced by women in this context. Still, others attempted to popularise psychedelics to profit off their knowledge without necessarily encouraging public use. R. Gordon Wasson wrote an article on his adventures seeking ‘the divine mushroom’ in Life magazine in 1957. It was many Americans’ first introduction to the reality that some mushrooms did have Alice-in-Wonderland properties.

In the 21st century, we are faced with a similar situation. Scientists and health researchers are competing with journalists and celebrities for political capital in the court of public opinion on the fate of psychedelics. For example, in 2018, food critic and best-selling author Michael Pollan entered the conversation when he published *How to Change Your Mind*, where he introduced readers to his voyages through consciousness by using different psychedelic substances. Pollan’s book brought much attention to psychedelics, broke from scientific or scholarly traditions, and relied on a testimonial-style intervention. And, more and more high-profile confessions or explorations are appearing from athletes, entrepreneurs, innovators, and actors, and the list grows daily.

How does the history of psychedelics affect our opinions on it today

How people learn about psychedelics today matters. Psychedelic researchers in the past were not simply victims of bad science or poor judgement. Public reactions and fears about psychedelics in the mainstream did not necessarily heed scientific or evidence-based reasoning.

How we manage the psychedelic message seems to rely on more than evidence. Still, it also concerns what kinds of stories we privilege and how we facilitate opportunities for diverse voices in this conversation.

Reconciling our relationship with this past, and building genuine platforms for diversity into our future, may offer a more sustainable path for confronting some of the prejudice that has been baked into current drug regulations. Considering diverse stories, including those that appear as psychedelic testimonials, may also help repair some of the damage caused by a war on drugs that celebrated abstinence and silenced drug consumers from sharing their expertise on harm reduction.



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LIFU FOR MAJOR DEPRESSIVE DISORDER – TARGETING THE NEURAL NETWORKS OF DEPRESSION

Tiago Costa, Assistant Professor at the Department of Microelectronics, Delft University of Technology, discusses opportunities surrounding low-intensity focused ultrasound in the treatment of major depressive disorder in a minimally invasive manner

Major depressive disorder (MDD) is a prevalent and debilitating mental health condition affecting millions worldwide. While various treatment options exist, including medication and psychotherapy, a significant proportion of individuals with MDD do not achieve full remission or experience adverse side effects from existing treatments. Consequently, there is a need for innovative and effective therapeutic approaches to address this complex disorder.

One emerging and promising area of research is the use of low-intensity focused ultrasound (LIFU) to treat major depressive disorder. LIFU is a non-invasive technique that utilises ultrasound waves at lower intensities compared to high-intensity focused ultrasound (HIFU), which is used for the thermal ablation of tissue. By focusing these ultrasound waves on specific brain regions, LIFU has shown potential in modulating neural activity and potentially alleviating depressive symptoms.

The underlying principle behind LIFU therapy is based on the concept of neuromodulation, which involves the selective alteration of neural activity in targeted brain regions. By precisely delivering ultrasound waves to specific areas, LIFU can potentially stimulate or inhibit neural circuits implicated in depression symptoms (Costa et al.,

2023). This localised, targeted approach holds promise for personalised and tailored treatment options for individuals with major depressive disorder.

One of the key advantages of LIFU therapy is its non-invasiveness. Unlike invasive procedures like deep brain stimulation, LIFU does not require surgery or the implantation of electrodes. Instead, it relies on the external application of ultrasound waves, which can be precisely guided using advanced imaging techniques, such as magnetic resonance imaging (MRI). This non-invasive nature of LIFU makes it a potentially safer and more acceptable treatment option for individuals who may be reluctant or ineligible for more invasive interventions.

Latest findings in LIFU for major depressive disorder

While LIFU for major depressive disorder is still in the early stages of research and development, preliminary studies have demonstrated promising results. In the first six months of 2023, three new studies have been published where the potential effects of LIFU were demonstrated. F. Wang and colleagues (F. Wang et al., 2023) have shown that LIFU significantly alleviated depression-like behaviours in rats by targeting the medial prefrontal cortex with LIFU after applying the chronic unpredictable stress (CUS) protocol.

Furthermore, these results were achieved with LIFU intensities below the safety limit of 720 mW/cm² as established in the field of ultrasound diagnostic imaging. These results show promise in the effective and safe application of LIFU for major depressive disorder. Another study (A. Forster et al., 2023) performed a randomised controlled trial by applying LIFU to the right lateral prefrontal cortex with 55 participants and monitoring EEG activity.

By analysing the recorded EEG data, the authors reported that applying LIFU was associated with alterations in the theta activity, correlated with psychological variables such as emotion, cognition, arousal, and other behavioural measures. Finally, in another report (S. M. Guinjoan, 2023), the author hypothesises that LIFU can play a vital role in the pre-surgical selection of optimal stimulation targets for deep brain stimulation. This can potentially improve DBS's success rate for major depressive disorder, for which only about half of patients show an adequate response.

Ongoing clinical trials exploring LIFU for major depressive disorder

The abovementioned latest results, together with previous years' findings, have motivated the emergence of several clinical trials for using LIFU for major depressive disorder. These trials

typically aim to evaluate the potential of LIFU as a treatment option for individuals with MDD, particularly those who have not responded well to other conventional therapies. In addition to clinical trials, LIFU has been approved as a treatment for MDD in South Korea.

Clinical trials involving LIFU for MDD follow a randomised controlled trial (RCT) design. In an RCT, participants are randomly assigned to different groups, such as an active LIFU treatment group and a control group (placebo or standard treatment). The trials typically assess the effects of LIFU treatment on depressive symptoms, overall mood, quality of life, and functional outcomes. The primary objective of these trials is to determine the safety and efficacy of LIFU for MDD.

They may also aim to identify optimal treatment parameters, such as the intensity, duration, and frequency of ultrasound waves and the targeted brain regions for LIFU application. Additionally, researchers may assess the duration of treatment effects and potential long-term outcomes. Clinical trial outcomes are measured using standardised rating scales for depressive symptoms, such as the Hamilton Depression Rating Scale (HDRS) or the Montgomery-Åsberg Depression Rating Scale (MADRS).

These scales help evaluate the severity of depressive symptoms and assess changes over time. Other measures may include self-report questionnaires, neuroimaging assessments, and functional assessments.

Clinical trials testing major depressive disorder for future treatment

Currently, at least [six clinical trials](#) are taking place in North America where focused ultrasound is being investigated for the treatment of MDD, five of which use LIFU rather than HIFU.

At the University of Utah, LIFU is being tested in terms of safety and efficacy across twenty participants while performing psychological and physiological monitoring. At the Laureate Institute for Brain Research, thirty participants have registered to evaluate the effects of LIFU in repetitive negative thinking (RNT), which can be seen as a construct of depression. At the University of Texas, Austin, and the Neurological Associates of West Los Angeles, LIFU is being applied to participants' amygdala and subgenual cingulate, respectively.

LIFU is applied during several sessions, with psychological and physiological assessments revealing the effects of the trial. Finally, a clinical trial with 50 participants is being conducted at the Ocean State Research Institute, Inc, where the Brainbox BX Pulsar 1002 focused ultrasound transducer is being used to deliver LIFU to the brain of participants, while the primary outcome is measured both via neurological assessment and fMRI.

Recent scientific discoveries and a surge in clinical trials have brought about promising prospects for the use of LIFU as a potential treatment for Major Depressive Disorder (MDD). To

make LIFU a viable therapy for MDD patients, it is crucial for physicians, medical researchers, and engineers to collaborate in developing optimal stimulation protocols, selecting the most effective targets, and optimising the LIFU technology. By doing so, LIFU can potentially demonstrate a favourable balance between its benefits and risks, leading to widespread acceptance among patients.

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Preparing for the future: Canada's aging population

Kamal Khera, Canada's Minister of Seniors, looks at supporting Canada's aging population



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Kamal Khera

Canada's aging population have contributed so much to building our country and that's why we need to ensure they can retire with dignity and respect. Seniors are the fastest-growing demographic in Canada and are projected to make up a quarter of the population by 2051, and it is more important than ever that we put in place the measures necessary to ensure that they have access to the services, knowledge, and resources they require as they age.

What is the country doing to prepare for Canada's aging population?

Our government has taken a number of actions to meet the evolving and diverse needs of seniors. In recent years, we focused on promoting social inclusion and safety, supporting aging at home, and making life more affordable.

Being able to respond to the unique needs of seniors, means you have to include them in the conversation.

For over a decade now, the [National Seniors Council \(NSC\)](#) has been a key platform for seniors to voice their concerns to the government on issues such as social isolation, elder abuse, financial security, and participation in the labour force. The NSC is currently exploring additional measures to support seniors who wish to age at home and remain in their communities for as long as possible, including a possible aging at home benefit.

Each year, the New Horizons for Seniors program empowers over 3,000 organizations across the country which offer hands-on activities that allow seniors to stay

active, expand their social network, and engage in learning experiences. Additionally, through our Age Well at Home Initiative, we support seniors to age in place by funding organizations that provide practical services like meal deliveries, housekeeping, yard work, and snow removal, as sometimes seniors just need a little bit of support to age within their homes.

But we won't be ready for Canada's aging population if we don't work together, learn from each other, and share best practices and innovative ideas. Forums such as the [Federal, Provincial and Territorial Ministers Responsible for Seniors](#) and the [United Nations Open-Ended Working Group on Ageing](#) are all the more relevant to ensure seniors can continue to count on their governments.

Seniors are struggling in face of the cost of living crisis

As we age, life becomes more expensive and seniors often face the rising cost of living. At our end, we are committed to providing targeted support to the most vulnerable seniors. Our efforts have included restoring the age of retirement back to 65 from 67, increasing the Guaranteed Supplement Income (GIS) for nearly 900,000 low-income single seniors, and a 10% permanent increase in the Old Age Security for seniors aged 75 and above. These measures have already lifted 45,000 seniors out of poverty by putting hundreds of dollars back in the pockets of seniors.

But we are not stopping there. In Budget 2023, we are doubling down on our support for seniors. Our new grocery rebate will provide seniors with more money to cover their grocery expenses, and our new Canadian Dental Care plan will give them access to much-needed dental care. We are also expanding automatic income tax filing to help more seniors access critical support like the GIS. Additionally, we are cracking down on predatory lending, particularly those who take advantage of the most vulnerable people in our communities, including seniors, by offering them high-interest rate loans.

Home care, community care services & health care

Being ready for Canada's aging population also means repairing our healthcare system, and preparing it for the future.

No senior should have to worry when they access healthcare services. Through [Budget 2023](#), we are making historic investments in healthcare, close to \$200 billion over 10 years, to support provinces and territories to improve health care services across the country.

And unfortunately, aging in place is not always an option. Yet, seniors should always be able to live in dignity, comfort, and safety, regardless of where they reside.

That's why through Budget 2017, we are making historic investments in home and community care representing \$6 billion over 10 years.

Since 2020, we have also taken action to raise the bar in long-term care (LTC) homes. We recently welcomed new national LTC standards and we are investing \$4 billion to support provinces and territories in their efforts to improve LTC in their jurisdictions. By working on a Safe Long-term Care Act, and supporting Bill C-295, we aim to truly protect seniors from abuse and neglect.

Those are important steps in helping ensure safe, respectful, and high-quality care for seniors across Canada, and best support whatever decision Canadians make regarding their health and well-being.

Working together toward the future

Seniors' needs and realities are multiple and complex. But this growing aging population also presents us with opportunities. It is up to us to seize them to ensure that seniors in Canada can age healthy, and remain engaged members of our communities. It takes a village to raise a child, and it takes a community to take care of a senior. The future is bright if we work together!

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SOLUTIONS FOR HEALTHY AGEING: HOW TECHNOLOGY CAN MAKE A DIFFERENCE

Professor Alex Mihailidis, Scientific Director and CEO of [AGE-WELL Network of Centres of Excellence](#), looks to improve wellbeing and healthy ageing in older people through innovative technology

The world is getting old. Today, living past the age of 80 is no longer a rarity in many parts of the world. This is a great achievement, but how do we help older adults maintain their independence and quality of life with healthy ageing?

Technology can play a significant role in making this happen. It can also support caregivers and ease pressures on healthcare systems. We live in an increasingly technologically advanced, digital world and there is an unprecedented opportunity to harness the power of technology. Systems that connect people, platforms that

promote physical and cognitive health, and remote therapies – are just a few of the innovations that can benefit older adults and caregivers.

But the timeline for implementing technology-based solutions has moved up dramatically. The COVID-19 pandemic exposed serious gaps in care and services for older adults, while highlighting the potential for technology to support seniors across all settings – hospital, community, home, and long-term care, where the pandemic has had such heartbreaking consequences.

We know that many older adults are receptive to technology

A poll conducted by Environics Research in July 2020 showed that COVID-19 had significantly increased the use of many technologies among older Canadians. Six in 10 of those aged 65+ agreed that technological advancements can help maintain relationships with family and friends, reduce social isolation, pursue hobbies, manage all aspects of health, and stay active and in their own homes as they age. Almost 7 in 10 were willing to pay for technology that allows them to stay

at home as they age, while about half would pay for technology that helps manage health and wellness.

Recent years have shown a surge of interest within the research community in the role of technology for older adults. Do a quick search of ageing and technology in PubMed and one sees an exponential increase in the number of papers published in this area. In 1996, there were only a handful. Last year, it was more like 6,000 papers.

AgeTech is a fast-growing sector

Globally, AgeTech is on track to be a [multi-trillion-dollar market](#). But we must remember that there is a digital divide between technology haves and have-nots. Technologies must be accessible, affordable and available to all. They must be user-friendly and practical. Connectivity is essential. Indeed, equitable access to technology is a human right.

Addressing the needs of ageing populations calls for networks that bring everyone together to drive innovation in AgeTech. For example, Aging2.0 is an international community striving to accelerate innovation in the healthy ageing space. The EU-based Active and Assistive Living (AAL) Programme, which just completed its 10-year mandate, is widely recognized as a global pioneer in the technology and ageing sector. Canadian networks include the Centre for Aging + Brain Health Innovation (CABHI) and AGE-WELL, Canada's technology and ageing network.

Real-world products that enhance lives and promote healthy ageing

As Scientific Director and CEO of AGE-WELL, I've seen up close how networks can break down barriers and spur

innovation. Funded through the federal Networks of Centres of Excellence program, AGE-WELL brings together researchers, older adults, caregivers, partner organizations (industry, government, community) and future leaders to accelerate the delivery of technology-based solutions that increase safety and security, support independent living and enhance social participation.

More than 170 technologies, services, policies and practices are being developed by AGE-WELL teams or already benefiting people and bringing socioeconomic returns. These include virtual exercise systems, non-intrusive health monitoring technology, and medication and daily life management services for people living with dementia. Smart home sensors are being created to identify potentially risky situations in the kitchen and signal people to take corrective actions. There's a "smart" glove designed to reduce hand tremors in people living with Essential Tremor; the Steadi-Two was created by one of over 60 AGE-WELL startup affiliates.

Another active area of research is public policy, and how it can support the growth of new technologies. AGE-WELL's APPTA National Innovation Hub supports governments in generating opportunities to assess the policy and practice challenges of a healthy ageing population.

Of note, two important new Canadian initiatives aim to promote technology adoption and innovative research. One is a federally-funded program called envisAGE, led by MEDTEQ+ and AGE-WELL, that will catalyze Canada's AgeTech ecosystem by helping companies deliver solutions. The other, Healthy Aging Canada, is a unique research collaboration

launched by AGE-WELL and the Canadian Frailty Network that is critical to driving research excellence that will feed the innovation pipeline.

The world needs AGE-WELL's expertise

It is not an exaggeration to say that the world needs AGE-WELL's expertise in research and innovation that connects different disciplines and sectors, while meaningfully involving older adults and caregivers to ensure that products will actually be used.

Technology can never replace the human touch, but it is an essential tool in the toolbox to support healthy ageing. More than ever, we must work together globally to address the universal challenges of ageing. Let's build on the networks we have, tear down siloes and rally to transform the lives of older adults and caregivers everywhere, now and in the future.



Canada's Technology and Aging Network

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Rethinking approaches to care for older adults

Older adults are among the most frequent users of emergency care; Open Access Government explains why this is and the suggested measures to improve and diversify care delivery and support the recovery of health and social care systems

Population ageing is progressing faster than it has ever done before. According to the latest figures from the World Health Organization (WHO), by 2030, one in six people globally will be 60 years or over. By 2050, the world's population of people aged 60 and older will double to 2.1 billion, and the number aged 80 or older is expected to triple, reaching 426 million by 2050. ⁽¹⁾ While this natural demographic shift is a positive reflection that people live in better health for longer, an ageing society is often cited as a significant burden on health and social care systems worldwide. In recent years, the rising demand for hospital inpatient care coupled with unprecedented workforce shortages and capacity pressures have significantly impacted hospitals and, most acutely, emergency departments. Longstanding challenges in caring for older adults have put them at greater risk of needing acute hospital care. Open Access Government looks at the key drivers behind this and the necessary measures to improve access to services and, more generally, reframe the narratives around ageing.

Why are more older people using emergency care?

Many older adults spend their twilight years living with comorbidities such as heart disease, hypertension, diabetes, joint disease, sensory impairment, and mental health problems; complex needs coupled with challenges in referral pathways across care settings have led many people to resort to emergency care services. Figures from an in-depth report by the charity Age UK released earlier this year noted that half (49%) of all people arriving at A&E by ambulance are over 65, and a third (35%) are over 75. The report also noted that the proportion of older people feeling supported to manage their condition has been falling consistently, almost 20% in relative terms since 2016/17. ⁽²⁾

Living with multiple health issues can make it difficult for older people to determine the health services they need, and this can be exacerbated if they live alone or have limited social support; as a result, they may dial emergency services when alternative services are inaccessible. Moreover, the number of older people living alone and at greater risk of crisis care is increasing. At the same time, the provision of care services that would enable them to be supported in their homes has decreased.

Social care services' ability to support older people's needs has become increasingly difficult due to the rise in vacant posts in the sector. In 2022, there were 165,000 vacant posts in social care in the UK alone, an increase of 50% and the highest rate on record. ⁽³⁾ Despite primary care practitioners working harder than ever, older people still attend hospitals and are re-admitted more frequently than other patient groups; they also typically stay longer and occupy more beds in acute care. ⁽⁴⁾

The impact of increased demand for acute care

Often referred to as the barometer of how the health and social care system is performing, increased A&E wait times usually indicate challenges in other services such as primary care, community-based care, social care services and ambulance services. Workforce shortages and longstanding problems across care settings have directly impacted EDs. Staff burnout, retention challenges and increasingly overcrowded hospitals can impact care quality and make clinical assessments of older adults all the more challenging for time-poor physicians. Due to multiple and sometimes atypical health conditions, acute medical problems in older adults can often be difficult to diagnose compared to younger generations, who more likely present classical symptoms. ⁽⁴⁾ Unfortunately, many frail older people who end up in acute care find their

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condition can deteriorate if the entirety of their needs is not suitably addressed.

Diversifying care delivery following the COVID-19 pandemic has been advocated to tackle care backlogs, but it has also created barriers for some patient groups. For example, many primary care services offer online bookings and video and phone consultations, but this is not always an option for older or disabled people who struggle to navigate these systems and must wait longer for a face-to-face appointment.

How can challenges across the care pathways for older people be tackled?

Hospital overcrowding, workforce retention challenges, and overstretched and underfunded social care systems; there is no doubt that urgent reforms and collaborative approaches to care are needed across the board. Without this, patients and practitioners face more significant risks and healthcare costs will continue to soar. As well as trying to define and implement clear referral pathways, diversifying healthcare delivery so that more vulnerable

adults can be treated safely at home has been a vital part of the UK Government's agenda to improve urgent and emergency care performance. It has allocated almost £50 million towards achieving this goal. The measure includes rolling out new ambulance hubs and discharge lounges and scaling up community services, including falls and frailty teams with up to 50,000 people a month supported by clinicians at home in high-tech 'virtual wards'.⁽⁵⁾

As in the UK, reforming social care and tackling workforce challenges is equally a top priority in Ireland. Skills and competencies training, fairer pay and recognition and support for unpaid carers have repeatedly been cited as vital measures to ensure older people and their carers are suitably supported. Ireland's Report of the [Strategic Workforce Advisory Group on Home Carers and Nursing Home Healthcare Assistants](#) was launched at the end of last year with recommendations to mitigate the social care crisis.⁽⁶⁾ These included supporting care workers' professional development, enhancing the qualitative evidence base for policymaking in the sector and

TAILOR-MADE PROMOTION

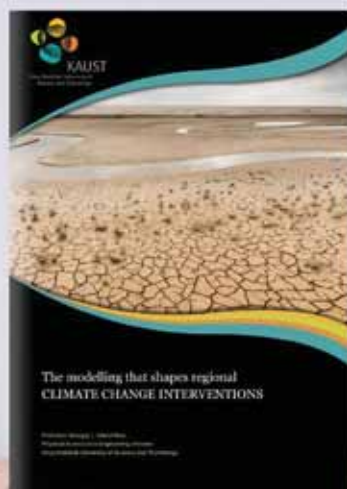
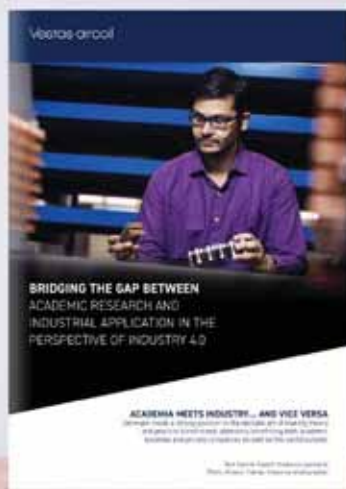
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ensuring greater equity in pay and conditions for care workers across the public, private and not-for-profit sectors. Reflecting on the Group's recommendations, Ireland's Minister for Mental Health and Older People, Mary Butler, said: "We need to show home support workers and healthcare assistants that we value the important work they do and make it a viable career option. I echo the Advisory Group's call for all private sector and voluntary providers to commit to pay home support workers and healthcare assistants the National Living Wage at a minimum (currently €12.90), and for home support workers to receive payment for all time spent travelling between people's homes and for other reasonable travel expenses."⁽⁶⁾

While physical health issues are drivers of emergency care demands, addressing mental health issues is equally integral to improving care for older adults. During the COVID-19 pandemic many older people had to isolate, sometimes cut off from friends and family, to protect themselves from the virus.

To tackle the growing problem of loneliness, ministers in Ireland launched the 'Hello Again World' campaign.⁽⁷⁾ Supported by Healthy Ireland, it aims to inspire and encourage older individuals to take proactive steps towards better health by reconnecting with their communities and enhancing their social interactions. Mary Butler said: "This campaign is especially aimed at older members of our society, who may have found themselves at a great risk of loneliness and isolation over the past couple of years. They don't have to continue feeling lonely, as there are so many opportunities to connect with others in communities around the country.

"We can all play our part in helping older people to feel more connected and encouraging them to get involved in enjoyable activities that help promote good health."⁽⁷⁾

Reframing our approach to ageing

Beyond health and social care reform, reframing society's attitudes to ageing and tackling age discrimination is vitally important, given the inevitable trajectory of demographic development. The consequences of not creating a more enabling and inclusive environment for all ages of society will mean older people are more at

risk of spending their later years with poor mental and physical health, and healthcare systems will continue to crumble under mounting pressures. We can predict population ageing, so there needs to be a step change and policies to support more preventative health and social care globally instead of a reactive approach, which is wholly unsustainable for today's ever-growing population.

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NEW CARE MODELS FOR OLDER ADULTS SEEKING EMERGENCY CARE

Professors Katie Robinson and Rose Galvin from the Ageing Research Centre at the University of Limerick describe research on new models of care for older adults seeking emergency care

One in four people attending the Emergency Department (ED) is over 65, and this number is set to grow in the coming decades as the population ages. ED crowding leads to long waiting times, treatment delays, increased costs, staff burnout and reduced patient satisfaction.

The ED is not an ideal environment to offer high-quality care to older adults with complex needs. Older adults consistently report negative experiences in the ED related to long waiting times, an uncomfortable and inaccessible physical environment and inadequate support from ED staff. Our research has found that older adults want models of care in the ED that promote positive staff/patient communication, active patient involvement in the care process and the feeling that they are in 'good hands'.⁽¹⁾

Finding new ways to help older adults seeking emergency care

The problem of ED crowding is multifaceted and complex, and no magic bullet will resolve the issue. Research at the Ageing Research Centre UL is exploring how new modes of care for older adults seeking emergency care can improve their

overall care experience and clinical outcomes while reducing unscheduled care use. We know that older adults attend the ED for various reasons, and some presentations may be better suited to alternative out-of-hospital pathways. To this end, there is an opportunity to provide timely specialist assessment and intervention to some older adults seeking emergency care to reduce the risk of long ED waiting times and avoidable hospital admissions.

Health and Social Care Professions (HSCPs) include social work, physiotherapy, occupational therapy and dietetics. HSCPs comprise a large proportion of the healthcare workforce but are often overlooked in policy debates. We are developing an evidence base⁽²⁾ to inform HSCP-led models of care for older adults seeking emergency care.

The OPTIMEND randomised controlled trial

The OPTIMEND randomised controlled trial (RCT)⁽³⁾ evaluated the impact of early assessment and intervention by a dedicated team of HSCPs in the ED on the quality, safety, and clinical effectiveness of care for older adults.

This single-site RCT included 353 patients aged 65 years or older who

presented with lower urgency complaints to the ED. Older adults in the intervention group received early assessment and intervention from a dedicated HSCP team comprising a senior medical social worker, senior occupational therapist, and senior physiotherapist.

Older adults in the intervention group (n = 176) experienced a significantly shorter stay in the ED than the control group (n = 177) (6.4 versus 12.1 median hours, $p < 0.001$), lower rates of hospital admissions from the ED (19.3% versus 55.9%, $p < 0.001$), higher levels of satisfaction with the ED visit ($p = 0.008$), better function at 30-day ($p = 0.01$) and six-month follow-up ($p = 0.03$), better mobility ($p = 0.02$ at 30 days), and better self-care ($p = 0.03$ at 30 days; $p = 0.009$ at six months). Our process evaluation⁽³⁾ highlighted the importance of establishing a team of HSCPs with a solid interdisciplinary ethos to ensure buy-in and integration within the busy ED environment.

OPTIMEND was also economically evaluated and resulted in staggering cost savings compared to treatment as usual (approx. €6k per patient). The reduced incidence of hospital admission in the HSCP group largely drove this cost-saving. Still, it provides

convincing evidence that dedicated HSCP teams should be adopted as part of treatment as usual for lower urgency older adults in Irish EDs.

Despite these benefits, OPTIMEND found no differences at follow-up between the two groups in terms of unscheduled ED re-presentation or hospital admission. After an ED visit, older adults are very much at risk of adverse outcomes (e.g., death, hospitalisation) as they encounter a period of increased vulnerability. This ties in with subsequent research where we have identified that the transition home from the ED is particularly problematic for older adults. Older adults often report unresolved symptoms on discharge from the ED, which negatively affects their return to daily life and is a major driver of ED re-attendance. Furthermore, older adults often experience discharge from the ED as unplanned and rushed with fragmented care at the point of transition home which causes difficulty coping.

Our ED PLUS pilot trial ⁽⁵⁾ focused on addressing these gaps in the care transition from the ED to the community by exploring the feasibility of a new interdisciplinary HSCP-led model of care to enhance the transition of care out of the ED for older adults.

The ED PLUS pilot trial

The ED PLUS pilot ⁽⁵⁾ feasibility RCT was conducted in the ED of a hospital in the Mid-West region of Ireland. Older adults presenting to the ED with undifferentiated medical complaints and discharged within 72 hours of an index visit were eligible for the study. Those who were randomly assigned to ED PLUS received early assessment and

intervention by a dedicated HSCP team in the ED (OPTIMEND), proactive case management from a senior physiotherapist, and a multidisciplinary intervention to bridge the gap between the ED and the community. The physiotherapist saw the older adults in the ED and visited them at home within 24 hours of discharge from the ED. On discharge, older adults received a six-week multidisciplinary, patient-centred self-management support and exercise programme. In addition, the same doctor who saw the older adult in the ED telephoned the older adult in week two to check medications. A dietitian and occupational therapist telephoned the older adults to check nutritional intake and if any aids were needed in the home. Findings indicate that it was feasible to deliver ED PLUS, and older adults were satisfied with the intervention. All older adults in the ED PLUS group had improved quality of life and mobility and did not need to return to the hospital or ED at six weeks and six months, unlike treatment as usual.

Future work at the University of Limerick plans to establish what outcomes should be evaluated in ED studies with older adults, develop standards of care for frail older adults attending the ED and a larger-scale evaluation of ED PLUS is also planned.

This work was supported by the Health Research Board (HRB) of Ireland through the HRB Collaborative Doctoral Awards under Grant CDA-2018-005 ("Right Care" Programme), the HRB Research Collaborative for Quality and Patient Safety (RCQPS-2017-02), the HRB Investigator Led Project (ILP-HSR-2022-010) and the HRB Research Leader award (RL-2020-010) granted to R Galvin.

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Can poor oral hygiene lead to dementia?

Dr Deborah Lee from Dr Fox Pharmacy shares evidence on the link between poor mouth care and dementia risk, and the steps needed to promote better oral hygiene



Image: © skynesher | iStock

We all live in fear of dementia, and despite extensive research – sadly, no single cause has been found. But one important factor which has recently come to light is the importance of good oral hygiene.

Could not brushing your teeth be a significant factor in developing Alzheimer's disease (AD), and if so, what can be done about it?

Dental hygiene and Alzheimer's disease

Alzheimer's dementia (AD) has a long [preclinical phase](#) of ten to 15 years, but it is only towards the end of this period that there is evidence of cognitive decline.

During this time, amyloid protein – the characteristic pathological finding in AD – slowly accumulates within the brain tissue, and as time passes, neuronal damage begins.

A [2023](#) publication in *Critical Reviews in Microbiology* suggested that the bacteria *P. gingivalis* may be a cause of AD. The bacteria produce enzymes called gingipains which kill nerve cells.

[P.gingivalis](#) is also a major cause of periodontitis. In addition, *P.gingivalis* DNA has been found in the brains of those who have died from AD, as they have large amounts of gingipains.

On its cell surface, *P.gingivalis* carries outer membrane vesicles (OMVs) that produce proteins and enzymes which damage the host cell and stimulate inflammation. These OMVs can enter the brain as they can cross the blood-brain barrier (BBB).

Once in the brain tissue, they accelerate the production of amyloid and abnormal tau proteins and disrupt iron

metabolism, leading to neuronal cell degeneration and death. As a result, [iron](#) and ferroptosis (cell death) are now being considered possible causes of AD. These changes occur before the diagnosis of AD. Hence *P.gingivalis* is thought to be a possible cause – not a consequence – of Alzheimer’s dementia.

The need to care for your mouth and teeth over a lifetime

In a [2021](#) systematic review and meta-analysis, the authors considered a possible link between tooth loss and dementia. They identified 14 studies, including 34,074 patients, of whom 4,689 had a dementia diagnosis.

Those with the greatest number of missing teeth had a 48% increased risk of cognitive impairment and a 28% increased risk of dementia. For each tooth lost, the risk of cognitive impairment increased by 1.4% and the risk of dementia by 1.1%. In addition, 20 or more missing teeth increased the risk of cognitive impairment by 31%, and losing all teeth increased the risk of dementia by 30%.

There appears to be a close association between tooth loss and dementia, but this observational study does not give any information about causation. Dementia patients have difficulty cleaning their teeth and with mouth care. How can poor oral hygiene lead to dementia?

Why could poor mouth care lead to AD?

Tooth loss is the result of poor oral hygiene. Not brushing the teeth regularly results in bacterial build-up in the mouth, causing inflammation of the gums.

Mouth bacteria cause beta-amyloid and abnormal tau protein deposition

[Bacteria](#) are transported via local blood vessels and nerve pathways from the mouth directly to the brain, along with inflammatory cytokines. Salivary treponemes have been identified in the trigeminal nerve ganglia. *Chlamydia pneumoniae* and *B. burgdorferi* have been found in the cerebrospinal fluid (CSF) of patients with AD. In addition, glial and other neuronal cells in contact with *B. burgdorferi* are known to produce beta-amyloid and abnormal tau proteins –significant pathological findings in AD.

Periodontitis causes a dental biofilm

Periodontitis occurs when plaque accumulates between the tooth and the gum, forming a dental biofilm. This adhesive membrane contains over [100 species](#) of bacteria, which are protected by a supportive extracellular matrix.

The biofilm has a restricted oxygen supply and is relatively impermeable to antibiotics. Most are carbohydrate-fermenting bacteria which cause an acidic environment, resulting in demineralisation of the teeth and dental caries (tooth decay). In addition, these mouth bacteria can be transmitted elsewhere in the body, leading to other infections such as endocarditis, pneumonia, and septicaemia (sepsis).

Symptoms of periodontitis include bleeding gums at tooth brushing, halitosis, pocket formation, halitosis and loose or wobbly teeth. As chronic inflammation sets in, an inflammatory exudate develops around the teeth and gums. Persistent low-grade inflammation contributes to the overall level of systemic inflammation.

How to remove dental biofilm

We should all understand how to [remove](#) biofilm. This involves:

Tooth brushing removes around 50% of the biofilm, but it will reform over the next three hours. Use fluoride toothpaste and clean your teeth for two minutes twice a day. This should be before breakfast and before going to bed at night.

Flossing removes biofilm from the interdental spaces between the teeth and under the gums. Use a strip of dental floss which you insert between the teeth and use a rocking motion up and down the sides of the tooth and into the gum line. Interdental brushes remove more plaque than dental floss.

Mouthwash containing chlorhexidine gluconate, essential oils (tea tree oil, thyme, and peppermint) and cetylpyridinium chloride have been shown to reduce biofilm.

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A dental hygienist is essential as it is virtually impossible to reach all the areas of biofilm at home by yourself. A visit once every six months is recommended, but some people may need to go more often.

Doctors, mouth care and dentistry

Better collaboration between doctors and dentists would have far-reaching improvements for public health. The UK medical curriculum makes little provision for [oral health](#). Your GP rarely asks you if you floss your teeth.

Doctors do not have the skills or equipment to assess dental issues. The World Health Organization (WHO) has recommended training GPs and others in primary care to manage emergency dental problems. However, in [one study](#) of 90 patients who presented at A&E with dental problems over six months, almost none received a dental diagnosis. Instead, all patients were treated symptomatically and advised to see a dentist.

GPs see families with small children daily and are in an ideal position to encourage them to practise good oral health. In the US, Harvard has instigated an [Oral Physician Program](#), which brings oral hygiene, primary care and family medicine together. Indeed this is something we should be adopting in the UK.

[Gum disease](#) can lead to:

- Cardiovascular disease
- Infective endocarditis
- Pneumonia
- Preeclampsia
- Premature deliveries
- Low birth weight babies
- Erectile dysfunction

And now it seems we can add Alzheimer's Disease to this list.

Preventive mouth care

It is high time to prioritise mouth care. [Dementia UK](#) stresses the need for good mouth care for patients diagnosed with dementia. But what about the need to encourage people to care appropriately for their mouths long before a diagnosis of dementia is made? When you look for advice on the internet about reducing the risk of dementia, good oral hygiene and dental care are usually not on the list.

In light of the new evidence discussed above, it would be heartening to see a campaign for better oral health for many health reasons – but including the all-important issue of trying to reduce the risk of AD. Although not proven, chronic mouth inflammation plays a significant role in the pathogenesis of the disease.

“Tooth loss is the result of poor oral hygiene. Not brushing the teeth regularly results in bacterial build-up in the mouth, causing inflammation of the gums.”

Doctors and dentists must take a united and reinvigorated approach towards getting the nation to brush, floss, use mouthwash and visit the dental hygienist.

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KEEP YOUR TEETH FOR LIFE, BUT HOW?

Drs Marcel Donnet and Neha Dixit discuss the importance of teeth cleaning and how the innovative AIRFLOW® PLUS powder can tackle biofilm and safeguard oral health

Hippocrates (around 300 B.C.) attributed greater importance to prevention than to treatment: 'It is nice to be considerate for the ill, owing to their health. It is nicer to be considerate for the healthy, owing to their non-illness.' Researchers have long discussed the importance of teeth cleaning and the link between a healthy mouth and providing a good foundation for a healthy body. Luckily, the association between oral and overall health is becoming increasingly well-known.

Oral health has been the driver of innovation since the foundation of EMS (Electro Medical Systems, Switzerland) in 1981. The company focuses on facilitating gentler and more effective professional tooth cleaning. If oral prophylaxis is to be successful over the long term, people must practice good oral hygiene at home with regular professional prophylaxis at the dental practice.

Together with researchers and clinicians, EMS has developed Guided Biofilm Therapy (GBT) to completely remove plaque (also known as biofilm) and calculus. In eight steps, patients are diagnosed, motivated by disclosing and treated to a wellness-like experience.

Receiving follow-up instructions for successful oral hygiene care at home

and providing effective and gentle professional teeth cleaning in the practice, GBT delivers the best results to keep teeth healthy for life.

The challenges associated with teeth cleaning

Do you know the size of a bacterium? It is around two microns, which is very small. The size of a toothbrush filament is about 100 microns. So, in terms of a bacterium, one toothbrush filament is like a giant – 50 times bigger.

This size difference could be compared to cleaning dust with a bundle of broom handles, instead of using a single broom's tufts. It then becomes clear that regular tooth brushing is never going to be able to tackle bacteria completely, as half of biofilm is hidden in areas that are difficult to reach for standard toothbrushes.

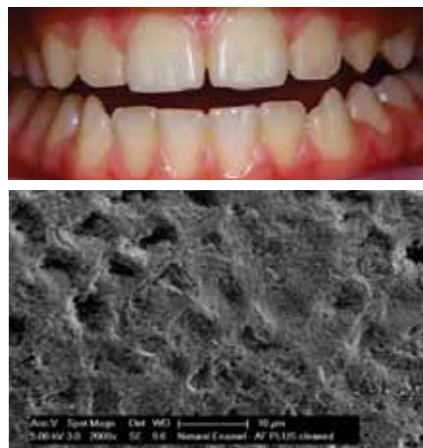


Fig 1a and 1b: Microscopic view of the natural roughness of enamel on the bacteria level



Fig 2: Microscopic view of a tooth and a toothbrush

Over time, if left untreated, these bacteria could result in the development of caries and/or gum disease. As an example, let's consider the natural roughness of enamel.



Fig 3: Harmful biofilm bacteria magnified 2.000x

Fortunately, due to the nature of bacterial growth, harm is not instantaneous. A good brushing technique plus adjunctive cleaning, with interdental brushes, for example, delays the impact of harmful bacteria but, unfortunately, does not stop it.

Therefore, from time to time, professional prophylaxis is needed to rectify the situation, facilitating a healthier oral environment.

How can dentists remove biofilm?

One method to remove biofilm could be to use small particulate material, like powder, projected against it. AIRFLOW technology combines sweet-tasting AIRFLOW® PLUS powder, warm water, and air spray. This combination supports patient comfort and the greatest efficiency while removing the disclosed biofilm, stains and soft calculus gently and completely - even in hard-to-reach areas.

Today, one of the most advanced materials in dentistry is the erythritol found in AIRFLOW PLUS powder, which has a mean size of about 14 microns. This is in the same order of magnitude of the bacteria to be removed and consequently has significant power to remove the bacteria down to the natural enamel roughness structure to aid teeth cleaning.

Bacteria particle AIRFLOW PLUS particle



Fig 4: Size ratio comparing the AIRFLOW PLUS mean particle size and mean bacteria size. There is no opportunity for the bacteria to escape the impact of the powder

Using GBT, AIRFLOW PLUS powder can remove all bacteria, even those hidden in uneven or difficult-to-access areas.

Thanks to the disclosing step within the [GUIDED BIOFILM THERAPY protocol](#), bacteria has nowhere to hide; all have been made visible, and the powder can remove all attached bacteria. This is because the impact of those particles disrupts all bacteria and their attachment to the surface.

Can powder have any negative impacts or damage the tooth surface or structure?

Choosing the right powder for teeth cleaning is very important to achieve efficient biofilm removal and preserve the tooth's surface. The erythritol in the AIRFLOW PLUS powder is specifically designed to remove the biofilm carefully without affecting the natural tooth surface⁽¹⁾; minimally invasive. Furthermore, the powder tastes pleasant, enhancing patient comfort during treatment.

In addition, one of the best hiding places for bacteria is the junction between the gums and the teeth, where toothbrush access is challenging. Therefore, it is important that thorough professional prophylaxis treatment carefully cleans this vulnerable area. The issue here is that the gums are often very sensitive, which can cause pain to the patient during treatment.

However, using a very fine powder of about 14 microns, like the AIRFLOW PLUS prophylaxis powder, is the best choice to overcome this issue. The small size of the particle means it is unable to initiate any pain reactions within the gum, but, at the same time, when repeated, the micro impulses are highly efficient in removing all biofilm and deposits on the tooth surface.

The struggle with oral bacteria never ends

This means that a very fine prophylaxis powder like AIRFLOW PLUS becomes the powder of choice for teeth cleaning, from a patient's perspective, for superior compliance and efficiency. Bearing in mind that the

struggle with oral bacteria never ends, it is essential to reset the bacterial equilibrium within the oral cavity during professional prophylaxis, to maintain a healthy situation over the long term.

GBT enables the clinician to perform thorough and efficient biofilm removal, minimally invasive and maximally preventive, using a powder perfectly suited to the job. From the patient's point of view, this will provide the most comfortable, pain-free treatment option for effective teeth cleaning.

Guided Biofilm Therapy is truly the best choice today to keep teeth for life. Find your next GBT certified practice
<https://gbt-dental.com/oag-switchtoGBT>

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Further reading

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Exploring the effects of medical cannabis for chronic pain

Dr Simon Erridge of Sapphire Medical Clinics discusses the therapeutic effects of medical cannabis for chronic pain, affecting 15.5 million people in England and why more evidence is needed to support greater patient access

In November 2018, medical cannabis was rescheduled in the UK, allowing for the prescribing of unlicensed products manufactured from the cannabis plant for the first time since 1973. Chronic pain is now the most common condition for which medical cannabis is prescribed, according to the UK Medical Cannabis Registry. ⁽¹⁾ Considering this increase in prescribing for eligible UK patients, it is important to understand the underlying science of how it affects the human body.

Medical cannabis is the term given to a broad spectrum of medications that can be derived from the cannabis plant. The cannabis plant is thought to contain more than 540 active pharmaceutical ingredients; however, the most abundant compounds are cannabidiol (CBD) and (-)-trans- Δ^9 -tetrahydrocannabinol (THC). ⁽²⁾ The main mechanisms of action of these are via the body's own cannabinoid system, which consists of molecules very similar to those found in the cannabis plant and receptors they bind to, causing downstream effects. One of the most important effects of this system is to regulate the firing of signals through nerves. ^(3,4) Some have therefore likened the endocannabinoid system to a dimmer switch for the nervous system.

What do studies say about prescribing medical cannabis for chronic pain?

In animal and cell-based studies, THC and CBD have been demonstrated to play a role through these mechanisms at all levels of the pain pathway. They can each act upon nerves which come from the peripheries of the spinal cord as well as those that travel through the spinal cord, reducing the intensity of pain signals that arrive in the brain. ^(4,5,6) In addition, activation of cannabinoid receptors within the primary area of the brain that detects sensory information from the body, and the areas of the brain involved in emotional processing, modify the way the brain not only interprets pain signals that arrive from the spinal cord, but also the emotional impact of pain itself. ⁽⁵⁾ Despite increasingly well-defined lab-based research, there is a gap in our knowledge, notably in high-quality human studies. Despite this, authors have attempted to characterise the role that medical cannabis may play in chronic pain to support its increasing use for this condition globally. The most comprehensive review of this evidence comes from a meta-analysis by researchers at McMaster University in 2021 which provided a recommendation to trial non-inhaled medical cannabis products if standard therapies had not provided

sufficient benefit.^(7,8) In addition to this evidence, researchers have begun to utilise the UK Medical Cannabis Registry to understand the outcomes of chronic pain patients prescribed medical cannabis in this country. In the most recent analysis, involving the study of 1,254 patients, changes were detected in pain severity and interference at up to six months of follow-up.⁽⁹⁾

In recent years, much has been made of the desire to transition away from prescribing opioid pain medications for chronic pain due to the lack of evidence of their effectiveness, but also the potential harm associated with their use.⁽¹⁰⁾ Between 2017 and 2018, 13% of the adult population in England had received one or more prescriptions for opioid medications.⁽¹¹⁾ Whilst progress has been made towards reducing the number of opioid prescriptions over recent years, NHS England is making further additional measures to tackle overprescribing of opioid medications through implementing new frameworks for General Practice.⁽¹²⁾ Whilst a large emphasis on these plans is to provide psychological and social support mechanisms, an oversight is that there is a need to have adjunctive pain medications available to those people who do not respond to these interventions, or who are not able to engage with them due to the severity of their pain. However, there is a real dearth of options available to GPs and pain specialists. This is one reason why so much hope has been placed on medical cannabis for chronic pain treatment.

Should medical cannabis for chronic pain be recommended as a treatment option?

At present, there is simply insufficient evidence to recommend medical cannabis as a first-line treatment option before licensed medications that are used in the setting of pain. This means patients and doctors are stuck in the challenging position of having relatively few medications available to them. As the incidence of chronic pain continues to increase in an ageing population, the collective aim of medical cannabis researchers over the next five to ten years should be to perform high-quality randomised controlled trials across a broad spectrum of conditions which cause chronic pain.

Medical cannabis for chronic pain or any other condition is never going to be a panacea, but identifying if it can be used more effectively than it is at present will be an important step in improving the array of options available to these patients, who are typically faced with a worse quality of life.

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CBD BENEFITS TO HELP YOU TAKE CONTROL OF YOUR HEALTH

Savage Cabbage Ltd discuss CBD benefits and how they specifically work to aid anxiety, stress, sleep problems and menopause symptoms

When it comes to taking control of your health, there are countless options for you to choose from. You can go on a targeted diet, start an exercise routine, or try alternative treatments like acupuncture and massage therapy – or, you can try CBD and test the range of varying CBD benefits for your health.

One thing that can support your health further and complement these healthy decisions is using CBD!

CBD benefits your overall health

CBD is a non-psychoactive ingredient that can benefit your overall health, being a natural compound that can help with discomfort, inflammation, anxiety and more. CBD works by interacting with [the endocannabinoid system \(ECS\)](#), found throughout your body and brain. The ECS consists of cannabinoid receptors that respond to cannabinoids from both inside and outside the body, including CBD.

CBD has been shown to support the regulation of the endocannabinoid system, which plays a part "[in maintaining homeostasis, or balance, in the body](#)".

For this reason, many people find that taking CBD helps them to manage stress and promote relaxation. Who doesn't need something to help them relax?

You may know that stress is one of the leading causes of anxiety. It can be a challenge to feel calm and relaxed under stress. CBD has been shown to relieve stress and promote relaxation by activating receptors in the brain that help regulate emotions.

Furthermore, CBD works in tandem with many other health-orientated activities, such as regular exercise and supporting a healthy balanced diet, helping your body recover after periods of exercise and supporting your body's normal functions throughout the day.

CBD, a natural way to tackle anxiety & stress

Using CBD during the day can significantly reduce the symptoms of anxiety and stress due to its regulation of the endocannabinoid system, which is responsible for balancing our emotions and moods, along with our body's natural functions, such as our appetite and sleep cycle, which are both linked and can be affected by anxiety and stress too.

So if you're suffering from anxiety or depression, [CBD](#) may be able to help regulate these symptoms as well!

CBD benefits include improved sleep quality by reducing insomnia, helping people fall asleep faster at night, and waking up feeling better rested and less fatigued. This is in part due to the CBD's regulating effect on the endocannabinoid system, which in turn improves the quality of REM sleep and lowers the chances of waking up





in the middle of the night, meaning you'll wake up feeling refreshed and energised in the morning!

A good night's sleep is vital for your health and well-being, as we all know, and not just to help you wake up feeling refreshed, but also helping to prevent chronic diseases such as diabetes and heart disease.

While there are several ways to enjoy a good night's sleep – such as eating well before bedtime or exercising regularly – you may want an extra boost to feel fully rested when you wake up in the morning. That's where CBD comes into play!

Sleep problems can affect your mood & overall health

Sleep is vital to our lives, but it's also something we often take for granted. Sleep problems can affect your mood and overall health, so it's essential to ensure you get enough sleep each night.

Individuals who do not obtain sufficient sleep are more likely to have depression or anxiety disorders than those who do. This can lead to more serious issues later on if left untreated

– and this isn't just limited to mental health conditions!

So, if you're trying out CBD oil for insomnia or another type of sleeping disorder (like restless leg syndrome), keep in mind that this could allow you to improve your overall health by getting around seven hours of sleep per night on average while [using CBD products](#) responsibly.

Can CBD oil help with menopause symptoms?

You're not alone if dealing with menopause symptoms. The average woman will experience them for about five years, ranging from mild to severe. The most common symptoms include hot flushes, restlessness and night sweats; however, some women also experience vaginal dryness or pain during intercourse.

Menopause can affect both your physical health and emotional well-being – so you must find ways to manage the transition into this new stage of life as best you can!

One of the main symptoms is hot flushes. A [published study](#) on CBD

benefits found that CBD can help reduce the frequency and intensity of hot flushes. It is believed that CBD interacts with serotonin receptors in the brain to regulate body temperature.

Additionally, [CBD helps reduce stressors](#), which can be common and more frequent during this time in your life. If you find it difficult to sleep at night due to anxiety or stress, CBD can promote a good night's rest so that you feel refreshed the next day!

We recommend CBD oil as a natural remedy for managing these problems because it has been shown to provide calm while relieving body aches caused by hormonal imbalances (this is especially true if taken at night).

CBD benefits, incorporated into your life routine

CBD is not a universal remedy but may help to address some health concerns. We recommend discussing the options and how CBD benefits can be fit into your treatment plan with your doctor.



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CB₂R AGONISTS IN THE CLINICS: A TREASURE CHEST FOR TREATING INFLAMMATORY DISEASES

Researchers give an update on clinical trials with CB₂R agonists and their potential for the treatment of inflammatory diseases

Activation of the type-2 cannabinoid receptor (CB₂R) holds great potential for treating diseases with an inflammatory component. This G-protein-coupled receptor (GPCR) is a key element of the endocannabinoid system (ECS), an important lipid signaling system.

Numerous small molecule activators, so-called CB₂R agonists, demonstrated high efficacy in preclinical disease models for treating a multitude of pathological conditions such as cardiovascular, gastrointestinal, liver, kidney, lung, neurodegenerative/ neuroinflammatory, skin pathologies, rheumatoid arthritis, endometriosis, and eye diseases. ⁽¹⁾

In addition, several of these CB₂R agonists progressed toward clinical stages and might soon provide solutions for high unmet medical needs and inflammatory diseases.

From Cannabis sativa to selective CB₂R agonists

Since at least 1,000 BC, Cannabis sativa has been used for recreational and medicinal purposes, including anti-inflammatory treatments. However, it was not until 1964 that its main active ingredient Δ⁹-tetrahydrocannabinol (THC) was identified. ⁽²⁾

The discovery of its pharmacological targets, the type-1 and type-2

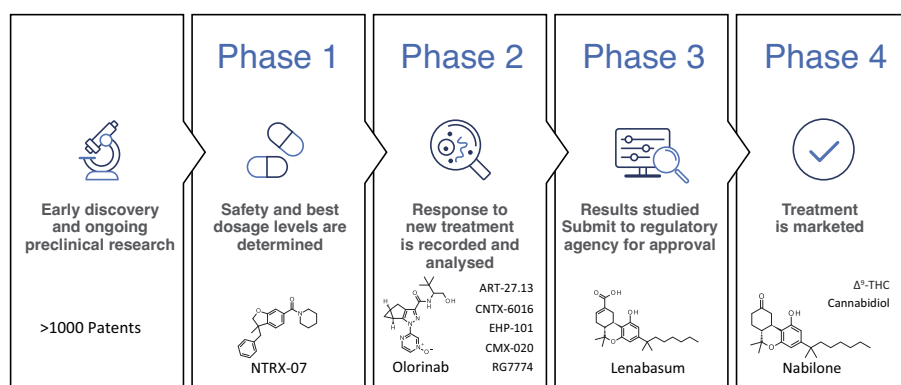


Figure 1: Preclinical and clinical phases and mapping of advanced CB₂R agonists

cannabinoid receptors (CB₁R and CB₂R) did not occur until 1988 ⁽³⁾ and 1993 ⁽⁴⁾, respectively. THC is a potent dual CB₁R and CB₂R agonist exhibiting multiple therapeutically relevant physiological properties, including anti-inflammatory, immunosuppressive and analgesic effects. However, central CB₁R-mediated psychotropic upshots resulted in the regulation of its usage. ⁽⁵⁾

To overcome this, two drug development strategies were followed by medicinal chemists: i) Limiting drug exposure toward the periphery in order not to engage with brain CB₁R; and ii) enhancing the selectivity over CB₁R.

Clinical trials with CB₂R agonists

Overall, more than 20 CB₂R agonists have been investigated in humans for a wide range of indications. The chemical drug structures in this context are highly diverse.

Fatty acid derivatives, classical and non-classical cannabinoids, and multiple diverse synthetic ligands are included, which also results in the coverage of a broad range of physicochemical properties. ^(1c, 6) In clinical trials data on dosage, safety and therapeutic efficacy in humans are generated (Figure 1).

The overall study design aims to ensure the scientific validity and reproducibility of the results. Generally, clinical trials are divided into four phases. ⁽⁷⁾ In phase 1 information on the pharmacokinetic profile of a new molecular entity is collected in a small group of people.

Furthermore, safe dose regimens and side effect profiles are determined. Phase 2 concentrates on establishing the preliminary efficacy of the drug in patients, usually against a placebo control group.

Phase 3 aims for final confirmation of the safety and efficacy data and is followed by the launch of the medicine. Finally, phase 4 studies continuously monitor a drug and delineate its risks, benefits, and optimal use over its lifetime.

Launched CB₂R agonists & ongoing clinical trials

The first mostly unselective CB₂R agonists, often bearing unfavourable overall absorption, distribution, metabolism and excretion (ADME) profiles and often focussing on pain indications, were halted in clinics for various reasons but did not raise any CB₂R-related safety concerns.⁽⁸⁾

Phytocannabinoids Dronabinol, which is synthetic THC, Nabilone and Cannabidiol (CBD) exerting their action partially through CB₂R activation, have been introduced to the market. Oral THC is used for treating anorexia, cachexia and chemotherapy-induced emesis.

At the same time, buccal THC has been launched for cancer pain. Nabilone is used for treating patients that suffer from chemotherapy-induced nausea and vomiting. CBD, a non-classical cannabinoid for which the main mode of action is still debatable, is marketed for treating infantile severe myoclonic epilepsy, Dravet and Lennox-Gastaut syndrome, and tuberous sclerosis.

Combinations of CBD and THC have been approved for treating MS-associated spasticity and pain management. Non-psychoactive dual CB₁R/CB₂R agonist Lenabasum is currently being investigated in phase 3 trials for treating systemic sclerosis and dermatomyositis.

The most advanced selective CB₂R agonists are the synthetic cannabinoids Olorinab and RG7774. The clinical focus of Olorinab is on pain related to irritable bowel syndrome (IBS) and IBS with predominant constipation or diarrhoea. RG7774 aims to provide oral treatment to patients suffering from diabetic retinopathy. Arachidonic acid analogue CMX-020 is studied in phase 2 trials to treat pain, osteoarthritis and diabetic neuropathy.

Pain, in particular, neuropathic pain, is also the focus of the selective synthetic CB₂R agonists CNTX-6016 (phase 2) and NTRX-07 (phase 1). Dual CB₁R/CB₂R agonist ART-27.13 is in phase 2, seeking to provide treatment options for cachexia and cancer-related anorexia. Cannabidiol derivative EHP-101, which activates besides CB₂R also PPAR γ , is aimed at multiple sclerosis and scleroderma patient populations (phase 2).

Together, these CB₂R agonists hold very high potential for treating multiple diseases in which inflammatory processes play a significant role or are the underlying reasons.

Furthermore, recent advances in expanding the knowledge of CB₂R protein structure and molecular pharmacology will enable the development of the next generation of CB₂R agonist drugs, allowing an even more precise pharmacological targeting, thereby unlocking the high therapeutic potential of CB₂R for treating inflammatory diseases.

Acknowledgements

We thank all colleagues who have contributed to our investigations on CB₂R over the years.

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Lack of access to treatment for opioid dependence is concerning

Monica Racoviță, Senior Researcher at The Health Policy Partnership, argues that opioid dependence is a pressing issue, yet treatment for it is still out of reach for many

Opioid dependence is becoming an increasing concern worldwide, and especially in the United States (U.S.).

Opioids can be divided into two groups: naturally derived substances obtained from the poppy plant, like heroin, and synthetic compounds, like fentanyl. When consumed, their effects are euphoric, relaxing, and pain relieving, but they can also cause dizziness, confusion, constipation, nausea or slowed breathing. Health practitioners prescribe some opioids to treat chronic pain, but many are illegal, and all carry a risk of addiction.

Long-term consumption of opioids can lead to opioid use disorder, a chronic condition [characterised](#) by the inability to stop using opioids despite physiological harm or other negative consequences. This is often known as opioid dependence. The disorder is associated with a

poor quality of life and several other serious conditions, including blood-borne infectious diseases such as HIV and hepatitis B and C, as well as complex psychiatric problems. The numbers of those affected are staggering – in 2020, [2.7 million people](#) in the U.S. were living with opioid use disorder and [1 million people](#) in the European Union used opioids. The [WHO estimated](#) that in 2019 alone, half a million people died worldwide due to illicit drug use, with opioids responsible for 70% of those deaths.

Rise in illicit use of synthetic opioids

Two particularly worrisome trends concerning opioids are the rise in the illicit use of synthetic opioids, particularly fentanyl, and the continuing high toll of addiction to opioid prescription medicines. Synthetic opioids display a wide variety of potency of the active



Monica Racoviță
Senior Researcher

compound, with some 10,000 times more powerful than morphine. In addition, they are [easy and cheap to manufacture](#). They can be sold on their own or come in the form of opioid mixtures; they are also added to other opioid or non-opioid drugs. Their [high potency](#) allows them to achieve the desired effect at very small doses, which makes them easy to hide and traffic but also difficult to identify in mixtures.

Perhaps unsurprisingly then, in the U.S., synthetic opioids dominate the illegal drug market and, in 2022, were responsible for [over 82% of all opioid-related deaths from overdose](#). In the [rest of the world](#), while not yet dominant, synthetic opioids are rising both in terms of their use and in the number of overdoses.

Addiction to opioid prescription medicines is a big problem in the U.S.

The second trend, addiction to opioid prescription medicines, is particularly an issue in the U.S., where it has been at epidemic levels since the 1990s. [Between 1999 and 2020](#), there was a five-fold increase in overdose deaths due to prescription opioids, totalling 263,000 cases. Rates of opioid prescriptions have been declining since 2012; however, in 2017, the [Centers for Disease Control and Prevention](#) reported that 17% of Americans had been prescribed at least one opioid, and the average number of prescriptions in this group was 3.4. In Europe, while the use of prescription opioids had slowly increased between 2004 and 2016, [this is not yet being considered a crisis](#) on a par with the one in the U.S.

Accessing comprehensive treatment can be challenging for those with opioid dependence

The medical community [recommends](#) a combination of pharmacological and psychosocial treatments to manage opioid addiction and prevent overdoses. Among the pharmacological options for treatment, substitution

opioids can stabilise dependency and reduce the risk of death from overdose by as much as [eight times](#).

However, for people with an opioid use disorder, accessing comprehensive treatment can be challenging. In Europe, only about [half of the people with opioid use disorder](#) have access to substitution drugs, and the situation is even direr in the U.S., where [four out of five people with the disorder](#) do not receive any type of treatment. Looking at these numbers, access to more advanced models of care, such as integrated and personalised pharmacological and psychosocial treatments, seems out of reach for most people who need them.

The reasons for this lack of access to life-saving treatments are complex. Many are systemic, either social or related to the specific healthcare system. Among them, stigma is a powerful barrier. For example, people with opioid addiction can often be [seen as criminals](#) rather than individuals with a chronic condition needing treatment. On the other hand, they have also reported [feeling dehumanised](#), as some care settings do not have measures in place to ensure their privacy and dignity are protected.

Is public opinion on opioids shifting?

There are signs that public opinion is gradually beginning to shift. For example, a nationally representative [survey](#) of adults in the U.S. conducted in 2019-2020 found that, on average, respondents agreed that opioid dependence was a medical condition and supported the right of those affected to access treatment. Translating this growing public support into policies might take time, but it is time that people with opioid addiction do not have.

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OPIOID USE FOR CHRONIC PAIN: PART 2

Norm Buckley and Jason Busse from the Michael G. DeGroote Institute for Pain Research & Care in Canada probe the effectiveness of opioid use in Canada as a treatment for chronic noncancer pain

Current best estimates suggest that 12% of individuals with chronic noncancer pain will achieve meaningful pain relief with opioids; however, there is a disconnect between the evidence for effectiveness and the ubiquity of opioid prescribing in North America.

Prescription opioid use for chronic pain

The growing practice of prescribing [opioids for chronic pain](#), particularly in the U.S. and Canada began in the early 2000s.

Doses also rose, facilitated by the development of sustained-release formats for opioids containing doses of up to 150 mg of morphine equivalents in a single tablet.

The situation was complicated by growing recognition of the extent of chronic pain in the population. For example, 20% of the Canadian population experience pain sufficient to interfere with daily life.

Physicians were encouraged to treat pain more aggressively ('pain-the fifth vital sign'), and there was a relative lack of effective pharmaceutical pain treatments.

Non-pharmaceutical care in much of Canada was not covered (and still is not to a large extent) by provincial



Norm Buckley
Scientific Director



Jason Busse
Director

healthcare programs, so there was a considerable need for treatment options.

This allowed aggressive marketing of opioids as a safe and non-addictive option for chronic noncancer pain in the United States.

Such claims were misleading and the target of subsequent federal lawsuits, but effective in increasing opioid prescribing.

As prescribing grew, so did the diversion of prescribed opioids into the illicit and 'recreational' markets to the extent that, in some regions, diverted prescription opioids significantly replaced illicit drugs such as heroin. Public attention was drawn to

prescribing practices, and there were calls for research and education to ensure that physicians were making appropriate use of opioids for chronic noncancer pain.

Canadian opioid use guidelines

The first Canadian Opioid Guideline, published in 2010, made recommendations mainly based on consensus among clinical experts. In 2017, the Canadian Opioid Guideline was revised considering evidence from systematic reviews of harms and benefits and patient values and preferences derived from published literature and focus groups.

Both intellectual and financial conflicts of interest were minimized among

voting panel members, who attempted to formulate 24 recommendations. The available evidence only provided sufficient support for 10 recommendations, of which seven focused on harm reduction.

Recommendation of the 2017 guideline for opioids use

The first recommendation of the 2017 guideline, which was strong, directed optimization of non-opioid pain control strategies prior to considering a trial of opioids.

The second recommendation, which was weak, advised that if adequate pain management was not achieved, a trial of opioids could be offered to patients that did not present with a current or past substance use disorder or other active mental illness.

A weak recommendation was made because of the close balance between harm and benefit, implying that shared decision-making was required to ensure that the final decision reflected an individual patient's values and preferences.

Specifically, a systematic review found that the average pain relief provided by opioids versus placebo was 0.69cm on a 10cm visual analogue scale, which equates to a 12% risk difference for achieving the minimally important difference of 1cm.

The prevalence of developing an opioid use disorder was 5.5%, the chance of an opioid overdose was 0.2%, and the risk of death was 0.1%.

At the suggestion of an expert advisory panel, the literature was examined for evidence that any specific clinical entity was amenable to improved analgesia with opioids (for example, pain arising from nociceptive sources such as arthritis, neuropathic sources such as

peripheral neuropathy or arising from central sensitization – for instance, fibromyalgia).

Despite common beliefs amongst clinicians that opioids were likely more effective for chronic pain arising from tissue injury, the evidence did not support differences in response based on the type of chronic pain.

There were limitations of existing clinical trials of opioid use for chronic pain, such as short follow-up (no more than six months) and the systematic exclusion of patients with co-morbid mental illness or those engaged in litigation or receiving disability benefits – associated with poorer prognosis.

The 2017 guideline's 9th Recommendation is that patients using high doses of opioids (≥ 90 mg morphine equivalents dose/day) should try to decrease their dose.

There are risks associated with reducing the dose, including opioid withdrawal.

Moreover, the evidence supporting the benefits of reducing opioid dose – decreased risk of unintentional overdose and improved function – comes from low-quality observational studies.

What are the benefits & risks of opioid use

It is thus reasonable for one patient, informed by their physician of the benefits and risks and the associated uncertainty, to choose to try lowering their dose.

Another might decide to leave well enough alone, particularly if achieving sufficient pain relief and not experiencing adverse events.

Subsequent evidence has emerged showing that 'forced' tapering is

associated with worse outcomes, partly due to some patients replacing their prescription opioids with illicit sources.

The Canadian Opioid Guideline is currently undergoing further updating and revision and will look to make recommendations for the 14 topics that did not have sufficient evidence in 2017.

A key consideration will be to incorporate current evidence for the benefits and harms of opioid tapering.

The guideline, and its associated evidence syntheses, will also identify key research gaps that require study to inform the role of opioids in managing chronic noncancer pain.

Many of these gaps speak to the need for independent funding of clinical trials to address important questions focused on complex areas of clinical practice.



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Sight loss research: Looking forward to an equitable future

Keith Valentine, Chief Executive of Fight for Sight and Vision Foundation, shares how these newly merged organisations are driving efforts in sight loss research to improve patient care



Image: © webphotographeer | iStock

We can save sight and change lives. It is a statement that drives me daily as the Chief Executive of the newly merged Fight for Sight and Vision Foundation.

Research is at the core of our mission – and Fight for Sight is proud to be the UK's biggest charitable funder of sight loss research. As of 31 March 2022, our [overall research commitments](#) amounted to £6.9m across 118 research projects at 35 different institutions across the UK. In addition, new grants in 2022/23 amounted to £2.31m.

We have just announced funding for [eleven new projects into sight loss](#), with more to come.

Why does sight loss research matter?

We are committed to funding leading researchers, many of whom we have supported from early on in their careers. Our funding is vital, given that sight loss research is underfunded compared to other research areas. By comparison, the personal and societal costs [are high](#).

In 2018, just over 1.5% (£24m) of the £1.4bn that UK Research and Innovation, government and other public bodies invested in medical research was for eye research.

People with severe sight loss reported one of the lowest quality-of-life scores compared with many other serious conditions. Every year, sight loss costs the UK economy more than £25bn – the majority of which lies outside health and social care.

Some 50% of sight loss is preventable; science can save sight and change lives.

Much of the research we fund is lab-based studies and clinical trials. For example, [Professor McLaren's](#) clinical trial discovered that gene therapy could significantly reverse sight loss. Before that, we had only talked about slowing retinal degeneration, not reversing it. Listen to a podcast featuring Professor MacLaren and one of the trial participants [here](#).

At the cutting edge of sight loss research developments

We are leveraging scientific and technological discoveries to accelerate breakthroughs. For example, we are funding [Dr Nina Milosavljevic](#) at the University of Manchester, who is working in optogenetics, a cutting-edge new treatment approach to restore some vision in people with retinal degeneration.

Sight loss research is also tapping into developments in genetics. For example, one researcher has developed a genetic test that could identify children at [risk of developing short-sightedness in later life](#). Many of our researchers have benefited from the [Human Genome Project](#) which has allowed opportunities to investigate the underlying genes causing sight loss conditions. Others are using technological breakthroughs in Artificial Intelligence (AI) to advance research into sight loss; they are using AI to improve the diagnosis and treatment of [birdshot uveitis](#) and to detect [Alzheimer's disease in the retina](#).

Our research supports breakthroughs in varying forms of sight loss from rare inherited conditions to those prevalent in an ageing population – and at every stage of a person's journey from prevention to diagnosis and treatment.

Impacting the lives of people living with sight loss

However, research is just the start of the journey and legislative changes are needed if we are to bring research out of the lab to where it can impact people affected by sight loss. Professor MacLaren's potentially life-changing work is a prime example of this.

“Some 50% of sight loss is preventable; science can save sight and change lives”

We are also experiencing a [nationwide skills shortage of ophthalmologists](#).

Through our merger with Vision Foundation, we are also funding social impact studies to enhance the lives of people with sight loss.

It is an exciting time for me, the charity, and researchers in the field. I look forward to creating a better and more equitable future for people affected by sight loss. As our strategy evolves, we will do this through grant-making for research and social impact studies.

We will monitor our impact closely and use this to shape policy, save sight, and change lives. Plus, we will listen closely to the patient's voice and amplify it to drive future policy.

Learn more about our research funding and [how to apply](#).

Keith Valentine
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Vision Foundation
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IMPROVING AI/ML SERVICES FOR OPHTHALMOLOGY AND MEDICINE

Eric Buckland, PhD of Translational Imaging Innovations, delves into how we can achieve better transparency, traceability, and reproducibility in AI/ML for ophthalmology and medicine

Biomarkers are indispensable to finding cures and developing new therapies for [degenerative eye diseases](#). Biomarkers are objectively measurable characteristics or indicators of normal biological processes, disease processes, or responses to therapeutic interventions. Biomarkers are essential to decision-making throughout drug development and patient care management.

Biomarkers in ophthalmology

In ophthalmology, biomarkers derived from bodily fluids, tissues, functional vision tests, and imaging are under constant development. New drug development relies on biomarkers to promote, redirect, or terminate therapeutic candidates at all phases of the drug development process.

More effective biomarkers are essential to increasing drug safety and effectiveness, reducing total development costs, and accelerating time to market. In the early phases of drug development, biomarkers play a critical role in categorizing pharmacodynamics.

At later stages, biomarkers help to define clinical outcomes. Biomarkers directly correlated to a patient's journey through illness, including the progression of symptoms, changes in quality of life, and even survival, form an essential class of surrogate endpoints for clinical trials.

Biomarkers and clinical endpoints in ophthalmology

In ophthalmology, biomarkers and [clinical endpoints](#) is an area of active

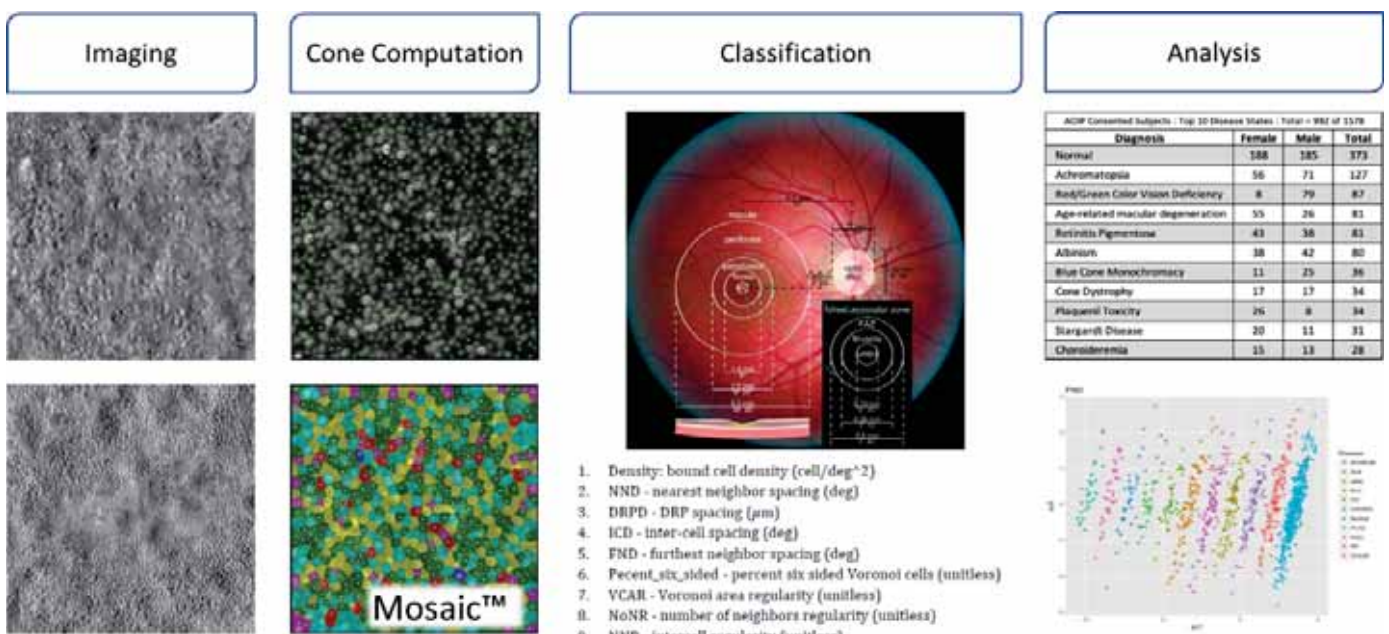
research to support innovations in treating macular degeneration, glaucoma, and inherited retinal diseases responsible for vision impairments impacting 200 million people worldwide.

Advancing new biomarkers and [clinical endpoints](#) necessitates using artificial intelligence (AI) in ophthalmology.

The techniques of AI are proving indispensable for completing complex data analysis tasks and uncovering relationships in images and data that may have been simply impossible without AI.

AI and ML for healthcare applications

A recent publication ⁽¹⁾ provides a meta-analysis of activity in the



Imaging Biomarker Discovery Process: Photoreceptor Cone Analysis for Retinal Gene Therapy

Medical AI space: 130,000 papers were published, and \$12 billion of venture capital was invested in 2021. For this investment, as of October 2022, the FDA lists 521 AI and Machine Learning (ML) Enabled Medical Devices⁽²⁾; seven are in ophthalmology, and five clearances address one disease: Diabetic Retinopathy.

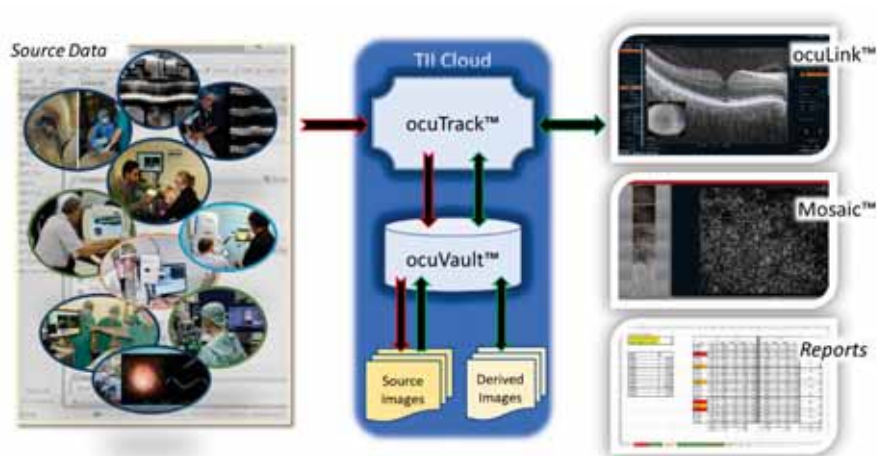
Developing AI for healthcare applications presents a different challenge than developing AI for consumer or business applications. For one, the stakes for patient healthcare outcomes are high. For another, access to training data is significantly more difficult. OpenAI deployed thousands of technicians scouring and annotating undisclosed scores of public domain records at the cost of hundreds of millions of dollars to develop the remarkable ChatGPT natural language processing (NLP) engine.

Medical AI requires both NLP and image processing, and the data – where digitally available – is protected in electronic health records and medical PACS systems. Data accessibility, problem complexity, and personal protections are among the challenges facing medical applications of AI/ML.

Regulatory and ethical considerations demand transparency, traceability, and reproducibility in AI/ML applied to biomarker development and clinical endpoint validation. If you have not had a chance to experiment with ChatGPT, I recommend you do so. Here is an abridged answer to a question that I recently posed⁽³⁾:

How does biomarker development rely on transparency, traceability & reproducibility?

Biomarker development relies on transparency, traceability, and



TII Cloud™ with ocuTrack™ and ocuVault™ for Transparent, Traceable, and Secure Image Management

reproducibility to ensure the validity and reliability of the biomarker's performance and its potential applications:

- 1. Transparency:** Transparency refers to the availability of clear and comprehensive information about the biomarker development process, including data sources, methodologies, and analytical techniques used. This transparency allows for critical assessment and facilitates the identification of potential biases, limitations, or sources of error.
- 2. Traceability:** Traceability involves maintaining a detailed record of all steps and decisions during the biomarker development process. Traceability allows for identifying and resolving any issues that may arise during development and the ability to reproduce the process or make improvements based on previous work.
- 3. Reproducibility:** Reproducibility is obtaining consistent and comparable results when repeating a study or experiment using the same methodology, data, and conditions. In biomarker development, reproducibility is crucial to validate the biomarker's

performance across different laboratories, populations, or clinical settings.

Clinicians, healthcare providers, and industry stakeholders rely on robust biomarkers that have been developed with rigorous methodologies and can be reproduced across different patient populations or settings. Transparency, traceability, and reproducibility in ophthalmology support the adoption and integration of biomarkers into clinical practice, ultimately benefiting patients and improving healthcare outcomes.

Accelerate biomarkers and clinical endpoints
Translational Imaging Innovations aims to accelerate the development and deployment of biomarkers and clinical endpoints and reduce the friction in AI/ML processes for medical applications. At the core of the Translational Imaging Innovations software suite are ocuVault™ and ocuLink™.

ocuVault™ is our advanced database constructed around the large volumes of images, data, and workflows that drive ophthalmic AI/ML development,

biomarker discovery, clinical research, and clinical trials. **ocuVault™** provides registry, security, and accessibility of images and associated data to a growing library of application.

Mosaic™, referenced in the figures, is our computational engine for efficient batch processing of images for biomarker development and clinical research.

Whether locally deployed or deployed in the **TII Cloud™**, **ocuVault™** supports automated validations, analysis, and transfers of images and data in natural history studies and clinical trials. **ocuVault-in-the-Cloud™** (now called **ocuTrack™**) provides convenience, traceability, and control in multi-site research projects and clinical trials.

ocuLink™ is our flagship application for curating, visualizing, and annotating images. **ocuLink™** allows investigators to organize images into meaningful collections and grade, label, and annotate images for supervised or unsupervised algorithm development projects. **ocuLink™** is the perfect environment for automating multi-step

workflows from biomarker discovery through automated analysis.

ocuLink™ and **ocuVault™** provide the Transparency, Traceability, and Reproducibility required for the successful development and deployment of AI-enabled biomarkers and clinical endpoints:

- Build stable collections of images and data.
- Construct reusable and sharable palettes of labels and annotations.
- Link annotated collections to external AI/ML development environments.
- Label images, and train, test, and validate algorithms in managed projects linked to collections.
- De-identify and mask images and data for unbiased analysis.
- Trace all images, algorithms, and results with automated database registrations tied to unique identifier codes for all objects and processes.

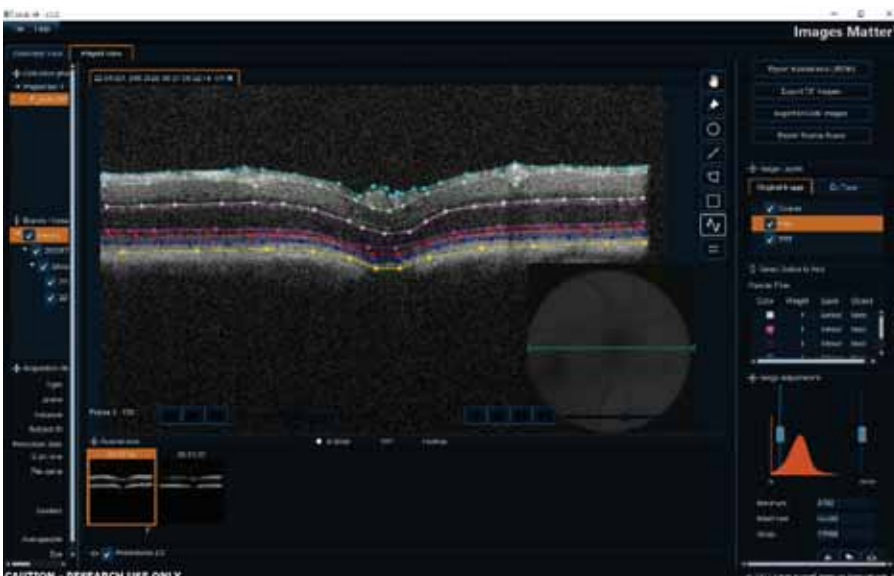
“Delivering the most convenient and productive solutions for ophthalmic biomarker discovery and clinical endpoint validation”⁽⁴⁾ is the commitment of Translational Imaging Innovations. TII aims to enable translational researchers to develop better diagnostics and better therapies with more predictable benefits – faster, cheaper, and less frustrating.

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Further reading

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ocuLink™ Image Curation Visualization and Annotation Application



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What is age-related macular degeneration?

Age-related macular degeneration is known to affect millions of people around the globe and is fourth on the list of diseases that commonly lead to blindness, behind cataracts, preterm birth and glaucoma

Macular degeneration, also called age-related macular degeneration (AMD), is a medical condition that results in blurred or total vision loss in the centre of a person's visual field.

The macula is a small but extremely important area located at the retina's centre; the retina is the light-sensing tissue that lines the back of the eye. It is this area that is responsible for seeing details clearly.

A person with macular degeneration will retain normal peripheral vision. For example, when looking at a clock, they may see the outside but not the time.

In the early stages of the disease, there are often no symptoms. An individual will usually experience a gradual loss of their vision. Loss of vision may affect either one or both eyes.

Although the condition will not necessarily lead to total vision loss, weak central vision can make daily activities difficult, and it will also make recognition of faces and objects more challenging. In addition to this, it is not uncommon for someone with AMD to experience hallucinations.

Two types of macular degeneration

There are two types of macular degeneration known as 'wet' and 'dry'. Most cases of AMD are dry.

With dry macular degeneration, the blood vessels in the eye do not leak. There are usually minimal symptoms in the early stages; however, it progressively worsens as time goes on. Vision loss tends to occur within the intermediate to late stages.

Dry AMD usually affects both eyes; however, in cases where only one eye is affected, vision changes are more



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noticeable sooner as one eye starts to make up for the vision loss in the other.

Wet AMD is when abnormal blood vessels grow in the eye and leak below the macula, resulting in permanent vision loss. It is a more advanced form of AMD, and dry AMD can progress to wet AMD.

At what age does age-related macular degeneration usually begin?

The risk of macular degeneration increases with age and usually begins at 50 and over. However, in some rare instances, the disease affects younger people, called juvenile macular degeneration.

What causes age-related macular degeneration?

While the exact cause of AMD is unknown, several different risk factors can contribute to macular degeneration, including:

- **Age** – this disease is most common in people over 60.
- **Genetics** researchers have identified several genes that are related to developing the condition.
- **Smoking** – or being regularly exposed to smoke significantly increases your risk of macular degeneration.

- **Obesity** – can increase the chance of early or intermediate macular degeneration progressing to a more severe form of the disease.
- **High blood pressure.**

What are the symptoms of age-related macular disease?

The symptoms of macular degeneration are similar to other eye conditions, making it difficult to detect initially. Early AMD is usually asymptomatic, meaning symptoms won't be noticeable. It's advised you see an optician for diagnosis with an eye exam.

Symptoms may include any of the following:

- Decreased visual acuity.
- Difficulty distinguishing between colours and shades.
- Metamorphopsia – seeing a grid of straight lines as wavy or as having blank areas.
- Seeing blurry areas on a printed page.
- Hallucinations.
- Extra sensitivity to glare.

Does age-related macular degeneration get worse?

Age-related macular degeneration can get worse and affect your vision. AMD's worsening can happen over several years or at a more rapid rate over a few weeks or months.

There is no treatment for dry AMD, but vision aids can help with lifestyle.

Wet AMD is usually treated with injections in the eye. These injections stop vision from worsening, but they will not recover visual acuity that has already been lost. Therefore, getting treatment as soon as possible is essential if you have been diagnosed with wet AMD.

How long does it take to lose vision with macular degeneration?

According to reports by the [American Optometric Association](#), it can take around ten years for people with AMD to experience complete vision loss.

Those with dry AMD will lose their vision gradually as the retinal cells die off. On the other hand, wet forms of macular degeneration can cause your vision to deteriorate at a rapid rate. Some even lose their sight within days of having symptoms.

How is age-related macular degeneration treated?

There is no complete cure for AMD, although there are treatments that can slow the process. Different procedures are used to treat different types of AMD.

Treatment for dry AMD

There is no treatment for dry AMD; however, visual aids can keep your vision sharp and eyes safe from dry eye, thus reducing its effect. These include large, printed books, magnifying glasses, bright reading lights and smart screen reading software.

Treatment for wet AMD

Also known as neovascular AMD, wet AMD relies on medications called anti-vascular endothelial growth factor drugs for treatment. These stop blood vessel growth which leads to sight damage.

The medication gets injected into the vitreous: a gel-like substance inside the eye. Before the injection, the doctor will give you an anaesthetic drug to ease pain and an antibiotic drop to prevent infection.

Side effects include blurry vision for a short time after the injection. Injections are usually given in a course for one or a few months, at first.

Anti-VEGF medications have a high success rate. However, starting treatment as early as possible would be best as this treatment cannot repair underlying damage.

Occasionally Wet AMD is treated with 'photodynamic therapy', a light treatment that will prevent your vision problems from worsening.

Preventing age-related macular degeneration

It's essential to have routine eye exams to identify early signs of macular degeneration. The following measures may help reduce your risk of developing dry macular degeneration:

- **Managing your other medical conditions** – for example, if you have cardiovascular disease or high blood pressure, take your medication and follow your doctor’s instructions for controlling the condition.
- **Avoiding smoking** – smokers are more likely to develop macular degeneration than non-smokers. Ask your doctor for help to stop smoking.
- **Maintaining a healthy weight and exercising regularly** – if you need to lose weight, reduce the number of calories you eat and increase the amount of exercise you get each day.
- **Choosing a diet rich in fruits and vegetables** – these foods contain antioxidant vitamins that reduce your risk of developing macular degeneration.
- **Including fish in your diet** – omega-3 fatty acids found in fish and nuts such as walnuts may reduce the risk of macular degeneration.

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A guide to blurry vision
(<https://www.feelgoodcontacts.com/eye-care-hub/a-guide-to-blurry-vision>)

A guide to cataracts
(<https://www.feelgoodcontacts.com/eye-care-hub/a-guide-to-cataracts>)

A guide to peripheral vision loss
(<https://www.feelgoodcontacts.com/eye-care-hub/a-guide-to-peripheral-vision>)

THE FUTURE OF EYE CARE ACCORDING TO IAPB

Imagine “a world where everyone has universal access to eye care”, this is the vision of The International Agency for the Prevention of Blindness (IAPB).⁽¹⁾ They envisage a world without preventable or unnecessary sight loss; hence, IAPB’s Love Your Eyes campaign calls on businesses and governments to “make eye health accessible, available and affordable for everyone by 2030”.

Let’s hope that World Sight Day 2023 ⁽²⁾, taking place on 12 October, will help ensure that more decision-makers and the public get on board to help the world learn more about how important eye health is. Also, IAPB wants to persuade employers to “promote eye health habits” and make sure “eye health initiatives are standard practice” to “benefit the well-being, safety and productivity of millions of employees.” ⁽³⁾

In today’s world, many individuals are visually impaired or blind from preventable or treatable causes.⁽⁴⁾ Age-related macular degeneration (AMD), for example, is a disease that impacts “the central area of the retina (macula) at the back of the eye,” IAPB explain.

AMD is the “third most common cause of blindness” globally and “the leading cause of blindness in higher income countries with ageing populations,” IAPB tell us. Unfortunately, there is currently no effective way to treat dry AMD, but newer treatments for wet AMD have lowered the risk of blindness.⁽⁵⁾

Let’s finish by reminding ourselves of the bold vision of IAPB, where “eye care is available, accessible and affordable to all.” ⁽³⁾

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UNDERSTANDING AGE-RELATED MACULAR DEGENERATION

Tunde Peto, Professor of Clinical Ophthalmology at Queen's University Belfast, describes the symptoms, causes and treatments for age-related macular degeneration and how the prevalence of the disease could be reduced

Imagine living your life without being able to see the face of your loved ones, being able to read your phone, book a show, rebook a cancelled flight, or read the labels in the supermarket. Such tasks we do without giving these much thought until suddenly, one day, we realise that we cannot do them.

Age-related macular degeneration (AMD) can lead to the loss of central vision, causing sight loss or even legal blindness. This disease is the most common cause of blindness in those over 65, ⁽¹⁾ and while it is genetically driven in most cases, not everyone will get the disease, even if they are at risk. Its effect can be devastating, especially for those with multiple comorbidities, who have no immediate social support and for whom reading, writing, or watching television or the birds might have been the major contributor to maintaining good mental health.⁽²⁾

Recognising age-related macular degeneration in the early stages

Lengyel et al. showed that age-related macular degeneration changes start early in life.⁽³⁾ Some early manifestations of the disease are sub-clinical and might not even be visible when examining a person's retina.⁽⁴⁾ As time passes, abnormalities become more and more apparent, with small yellow deposits called Drusen appearing. These Drusen, for many individuals, have grown steadily over the years. On the image panel, we can see the changes in the same eye that were followed for nine years. There were

already large deposits at the baseline (top left-hand image). Over the years, the area and size of the deposits grew steadily before irreversible changes occurred, manifesting as the loss of cells and the development of end-stage disease (see characteristics below) accompanied by irreversible vision loss.

At the small, early Drusen stage of the disease, the central vision, as we measure it in a clinical setting, is unlikely to be affected. However, patients might complain about difficulties in seeing at dusk and dawn. Eyes with large Drusen can take a long time to recover from the incoming headlights, making the individual feel unsafe to drive. Giving up driving can lead to social isolation.⁽⁵⁾

Visual consequences of late-stage age-related macular degeneration

There are two significant forms of late-stage disease, commonly known as 'wet' and 'dry' AMD. ⁽⁶⁾ In the last 15 years, we have been fortunate enough to have treatment for wet AMD by direct injections into the eye.⁽⁷⁾ These injections have returned some lost sight or stabilised remaining vision instead of further deterioration in millions of people. The stabilised vision enabled them to live a better quality of life. Still, eventually many lose sight due to scar tissue forming and the cells dying away (atrophy).⁽⁸⁾ The injections must be repeated regularly and place a substantial burden on the patient, their carers, society and the health system.⁽⁹⁾

Until recently, there was no treatment for the dry form, called geographic atrophy (GA), as the changes resemble a map. ⁽¹⁰⁾ GA tends to progress slowly for many patients and is unlikely to lead to vision loss as fast as wet AMD. The first promising GA treatment was approved earlier this year, and we eagerly await long-term outcomes.

Prevention, prognostication, and risk stratification

As there is no known treatment for the early disease, a lot of effort has been devoted to finding strategies to slow disease progression.^(11, 12, 13) Dietary supplements are beneficial in some cases. Others have shown that a well-balanced, healthy diet throughout life will likely reduce the risk of the disease developing later in life. Smoking is one of the strongest risk factors for developing AMD; hence it is good practice to discuss stopping smoking to prevent this disease as well.

The disease affects both eyes, but for many, there is a difference in the stage of the disease, so one might be late-stage and the other one Drusen-only stage. As aforementioned, the central vision is still good for most people at the Drusen-only stage. Knowing when the second eye is likely to be affected is essential for the patient, their families and for planning clinical pathways. The EDNA study ⁽¹⁴⁾ showed that over three years, about a quarter of the second eyes converted to wet AMD, which is important information for those at risk and those planning clinical services for patients.

There is time to intervene in AMD before end-stage disease occurs



Peripheral vision and age-related macular degeneration

While the disease is called age-related macular degeneration, there is compelling evidence that the retinal periphery is also affected.⁽¹⁵⁻¹⁶⁾ This matters to the patients as the peripheral retina helps spatial navigation and better vision in the dark. So, in addition to losing sight due to central retinal (macular) disease, patients will also have difficulties with their peripheral vision. This will result in bumping into things more often and taking longer to see in the dark. This impairs daily activities even further and can cause further anxiety and frailty.

Reducing the burden and impact of AMD

We need an even more detailed understanding of the genetic, structural, and functional changes and their interactions to categorise our patients better. This will improve targeted interventions based on individual risk profiles. We will need population-level interventions to promote good, healthy diets for all, and we need to double our efforts to keep reducing the level of smoking in the population. These, in turn, should slow the progression of the disease.

Once late disease occurs, we will need effective, affordable, safe, and long-lasting treatments. The treatment should prevent further visual loss and stop the end-stage disease from developing. Only then will we see the societal impact of this disease lessen with more older adults being able to enjoy a visually healthy life for longer.

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Learning mobility for improved and robust education cooperation

Open Access Government charts the priorities of the European Commission when it comes to learning mobility, including Erasmus+, plus stronger education cooperation with Ukraine

Earlier this year, Open Access Government provided an update on the European Commission's support for innovation, research and education. We examined some of the priorities of Mariya Gabriel, the then European Commissioner for Innovation, Research, Culture, Education and Youth. ⁽¹⁾ Before that, Mariya Gabriel kindly wrote a piece that examined education and training to improve education inclusivity across Europe. ⁽²⁾

An update on Mariya Gabriel

More recently, we heard that Commissioner Gabriel resigned from the Commission, effective from 15 May 2023. We discover that Executive Vice-President Vestager takes responsibility for innovation and research policy areas. ⁽³⁾

Mariya Gabriel is now in the position of Deputy Prime Minister and Minister of Foreign Affairs in Bulgaria. ⁽⁴⁾ She is now tasked with the Bulgarian Government cabinet's interrelations with the Nuclear Regulatory Agency, the State Agency for Child Protection, the Archives State Agency, plus the State Agency for Metrological and Technical Surveillance. ⁽⁵⁾

Understanding policy on learning mobility

But let's take a step back to March 2023 when the European Commission opened a fresh Citizens' Panel, in which citizens from the 27 Member States discussed how learning mobility could be made available to everyone in the EU. We know Erasmus+ and its predecessor programmes enable learning mobility for various levels of education, plus projects for young people, sports coaches and apprentices.

The former Commissioner for Innovation, Research, Culture, Education and Youth said: "Learning mobility is crucial for a borderless and interconnected Europe and to achieve the European Education Area. This life-changing

personal experience can be a powerful instrument to develop employability, skills and knowledge. ⁽⁶⁾

Erasmus+ in 2023

In March 2023, the Commission took forward a revised version of the Erasmus+ Annual Work Programme for 2023, with a budget of €4.43 billion that will underscore the Erasmus+ priorities concerning active citizenship and democratic participation, inclusion plus on digital and green transitions in the EU and beyond.

The former Commissioner for Innovation, Research, Culture, Education and Youth said the 2023 Erasmus+ programme is being reinforced, especially concerning its support for the people of Ukraine who have fled their homeland.

Mariya Gabriel said: "We invite our Erasmus+ community to continue expressing the solidarity that they have already shown over the past year towards learners, educational staff, institutions and organisations impacted by the war in Ukraine." ⁽⁷⁾

MSCA4Ukraine initiative

On this note, Open Access Government looked at the [MSCA4Ukraine](#) initiative earlier this year, which assists displaced researchers from Ukraine. It's well worth jogging our memories about this important research initiative. ⁽¹⁾

"The MSCA4Ukraine initiative is yet another proof of our solidarity with the Ukrainian people. We are proud that 124 scientists will be able to continue their research work and will have access to training, skills and career development opportunities. It is our hope that they will be able to contribute to the reconstruction of their home country once the war is over," Mariya Gabriel explained in February 2023. ⁽⁸⁾

Stronger Education cooperation with learning mobility

More recently, Vice-President for Promoting our European Way of Life, Margaritis Schinas, signed two Arrangements for Cooperation with Ukraine. An [Arrangement for Cooperation on Education between the European Commission and the Ministry of Education and Science of Ukraine](#) was jointly signed in June 2023 by Ukraine's Minister of Education and Science, Oksen Lisovyi and Vice-President Schinas.

This arrangement enables the Ukrainian authorities, invited by the Commission, to participate in peer learning activities and working groups within the [European Education Area Strategic Framework](#). The Commission has also enabled access to the Eurydice Network so that the Ministry of Education and Science in Ukraine can obtain a deeper understanding of their cooperation in education, the respective education systems, and their cooperation in education.

Vice-President Schinas wants Ukrainians to take up the opportunities available via the [Erasmus+ Programme](#), including stronger cooperation between schools and making the most of the Commission's online [platforms](#), particularly [eTwinning](#) which is a community for European educators and teachers online.

In June 2023, the Vice-President heralded the extension of Ukraine's role in the EU's flagship Erasmus+ programme. Indeed, the Commission wants Ukraine from 2024 to participate in international cooperation projects within Erasmus+ Capacity Building Actions in Youth and Sport. Let's leave the last words to Margaritis Schinas, Vice-President for Promoting our European Way of Life, who commented on the abovementioned areas and the cooperation's health aspect.

"I am glad to be in Kyiv to express my full solidarity with the Ukrainian government and its people. Since the outbreak of the war, we have been providing continuous support and assistance to Ukrainians who stayed in their country or fled the war.

"We are taking new concrete steps together to further strengthen our cooperation in the fields of education and

health for the benefit of Ukrainians and the EU. Both sectors are crucial to heal today's damages and support the next generations. The challenges are numerous. But we are driven by an unwavering dedication to our shared goal: to help affected Ukrainians recover as soon as possible, and to continue to bring hope to the valiant people of Ukraine."⁽⁹⁾

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GOTRIPLE: DEVELOPING A MULTILINGUAL, INTERDISCIPLINARY DISCOVERY SERVICE

Dr Suzanne Dumouchel, Scientific Coordinator of the [TRIPLE project](#), Partnership Coordinator of OPERAS Research Infrastructure & Head of International Cooperation at CNRS & her team developed the multilingual, interdisciplinary discovery service GoTriple that aims to foster collaboration & interdisciplinary research

In the social sciences and humanities especially, the accessibility and the outreach of research, its results, and resources have suffered from being fragmented along the lines of disciplines and languages. The platform [GoTriple](#), developed by the TRIPLE project (2019-2023), presents a multilingual, interdisciplinary solution for this issue. The interdisciplinary discovery service is designed to support collaboration, multilingualism and interdisciplinarity in the social sciences and humanities while simultaneously offering a broad spectrum of additional features and improving the access, use and reuse of research resources in the social sciences and humanities.

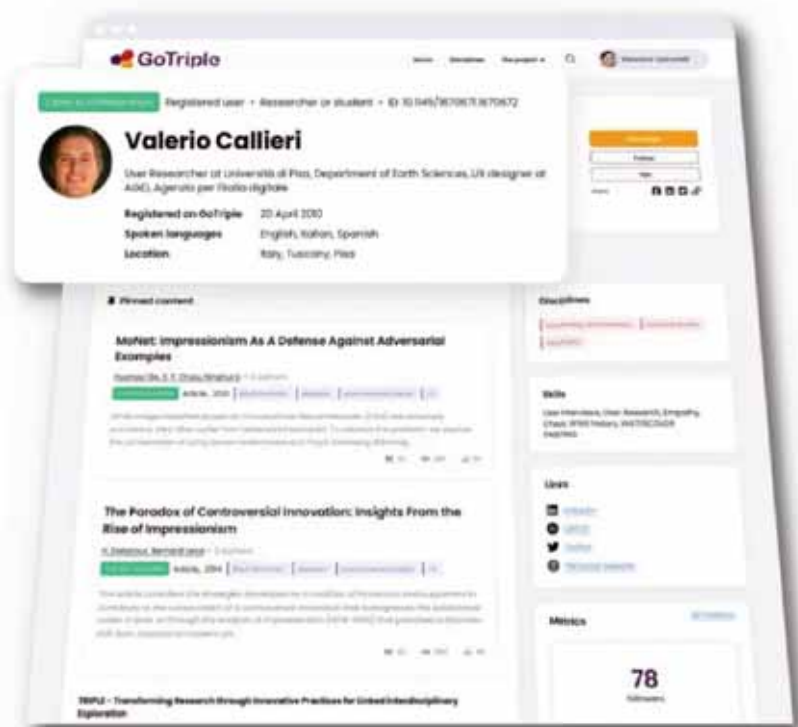
Since the end of the TRIPLE project in March 2023, the platform has been under the supervision of OPERAS, the research infrastructure seeking to drive open scholarly communication in the European Research Area forward. GoTriple is maintained and updated as part of the OPERAS service portfolio.

The homepage of GoTriple is available at gotriple.eu.

Discovering research & collaboration

As an interdisciplinary discovery service, GoTriple stands out because the platform comes with an inbuilt thesaurus that was specifically developed to allow multilingual search queries in 11 languages and is expendable. The multilingual design of

the platform will enable its users to broaden their research scope easily. Researching scientific publications automatically in several languages takes only one search query. Metadata regarding publications and projects for the Social Sciences and Humanities are automatically harvested, mapped in the TRIPLE data model, curated, enriched



and finally saved in the GoTriple platform's indexes. This poses not only a significant improvement in efficiency but is a contribution to the discoverability of these publications as well as they are neither hidden behind barriers of language nor limited to disciplines.

To take that experience of interdisciplinarity and connection even further, GoTriple also allows users to register and set up a profile, allowing them to claim articles written by them and display their expertise and projects in which they are involved. As of May 2023, the platform grants access to 9,362,924 documents, 21,823 projects and 7,766,737 profiles. Steadily increasing, these numbers not only prove GoTriple already enables access to research for anyone but provides an insight into the platform's potential for the future.

"The vision that is GoTriple really consists in the idea that anyone, really anyone, regardless of language, profession or anything else can access research and participate in it; in short, that the results of research are an integral part of society and that all of these results should be as available as possible," Dr Suzanne Dumouchel says.

Innovative features enhance the discovery experience and foster collaboration

Additionally, the platform combines several innovative features to enhance the discovery experience and foster collaboration among projects and scholars alike:

- A Recommender System specifically designed to point users to research, profiles and projects of interest to them.

- The Trust Building System, a social network built to enhance collaboration based on trust.
- Pundit, an online annotation tool, allows users to annotate articles online, save and organise their annotations, and share them with their peers for easier collaboration.
- The OPERAS crowdfunding channel, the first crowdfunding service for projects from the social sciences and humanities dedicated to exploring innovative ways of funding and communication.
- A visualisation tool, which allows search results to be displayed either as a knowledge map or a streamgraph.

All of these features have been integrated into the interdisciplinary discovery and are available via the platform directly – all with the user experience in mind, as Suzanne Dumouchel explains:

"Researching means using a lot of different resources and tools, often simultaneously. Switching services, tools, websites takes up a lot of time. With GoTriple, we offer a European hub for research, combining tools with the access to resources in one place."

This innovative approach is a model functioning well that opens up opportunities for projects from the social sciences and humanities: For example, a crowdfunding campaign run in the summer of 2022 for the project "[SUES - Supporting Ukrainian Editorial Staff](#)" initially raised more than €20,000 via their campaign. Donations continued after the official end of the crowdfunding campaign due to the

communication campaign drafted as part of the crowdfunding initiative. As a result, the project raised more than €73,000, allowing the organisational team to support more than 45 journals.

The multilingual, interdisciplinary discovery service tends to the needs of a growing international community

This example highlights that the platform's innovative features and its decidedly multilingual, interdisciplinary design do indeed tend to the needs of a growing international community. Still, it also underlines that research and society are intrinsically intertwined. With its combination of metadata enrichment, innovative features and multilingual design, GoTriple offers the international research community in social sciences and humanities the opportunity to take interdisciplinarity and collaboration to the next level. Moreover, GoTriple allows companies or public organisations to use and reuse scientific outputs for their own purposes, especially in improving economic, societal, and scientific innovations.

The vocabulary developed for GoTriple is openly available by clicking [here](#).

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EMERGENT DIMENSIONALITY: EXPLORING ALL POSSIBLE (AND UNOBSERVABLE) EXTRA DIMENSIONS

Dr Szymon Łukaszyk, Łukaszyk Patent Attorneys, explains emergent dimensionality, exotic R^4 , 'life as the explanation of the measurement problem', and personal motivations

Image: © KanawatTH | iStock

Can you explain the meaning of emergent dimensionality?

Each observer perceives reality as 3-dimensional. But that does not mean that such 3-dimensional reality [exists observer-independently](#). Instead, it is instantaneously generated for a given observer (emerges) every passing moment from an omnidimensional graph of nature that stores all possible (and unobservable) extra dimensions. That is why I called it emergent dimensionality (ED).

Can you summarise your understanding of imaginary (time in particular), negative, and fractal dimensions?

Imaginary dimensions are not very different from real dimensions at first sight: a real dimension is formed by real multiplicities of a real unit "1", while an imaginary dimension is formed by real multiplicities of an [imaginary unit](#) "i" (with the property $i^2 = -1$). However, the similarities stop here. For example, contrary to real dimensions, a square formed by two imaginary edges "ia" would have a real but negative area ($ia \cdot ia = i^2 a^2 = -a^2$), while a cube would have a negative and imaginary volume ($-ia^3$). Imaginary dimensions are - in a way - hard

to imagine, or in other words, counterintuitive to study. It's groping in the field of invisible things. Since $0i = 0$ is the only imaginary real number, time is imaginary. $0i = 0$ represents "now" for a given observer.

What is more puzzling than imaginary dimensions are negative and fractional (or fractal) ones. Fractal dimensions are consistent with experimental results obtained, e.g., from [examining multiphase fractal media](#) or [magnetic monopole motions](#). However, fractal dimensions are not independent as are natural ones. Negative dimensions, on the other hand, refer to densities.

An area of a (-2)-dimensional square having an edge length "2 m" is 0.25 1/m^2 , for example. On the other hand, edge lengths do not have to be [non-negative](#).

What is exotic R^4 , and what is its relevance to your discipline?

[Exotic \$R^4\$](#) is a peculiar property of 4-dimensional space, absent in other dimensionalities. Thanks to this property, the space we perceive (3 real dimensions of space + 1 imaginary dimension of time) provides a continuum of "homeomorphic but non-diffeomorphic differentiable structures". This means that each piece

of individually memorized information preserves the form of the corresponding piece of individually perceived information (it is homeomorphic). Still, this preservation is non-smooth (it is non-diffeomorphic). Thus, everyone sees the world differently, allowing for variations of phenotypic traits within populations of individuals. Ergo: only "our" dimensionality allows biological evolution. We could not live in - say - 10-dimensional space, as every individual would be the same as their neighbor in this dimensionality. Exotic R^4 solves the problem of extra dimensions of nature.

Can you discuss your most recent study into 'Life as the explanation of the measurement problem'?

The measurement problem of the quantum theory, commonly explained as wave function collapse, is nothing other than the instantaneous perception of reality. Perception is a sequence of quantum measurements performed by an observer bit-by-bit with the Planck frequency ($\sim 10^{42}$ Hz) through triangular Planck areas ($\sim 10^{-70} \text{ m}^2$), each corresponding to a bit of information, where a qubit reduces to a

bit during each measurement. Unlike artificial intelligence, only living organisms can perform such measurements, as they are immune to [Alan Turing's halting problem](#).

What motivates you to research quantum theory, black holes, black-body objects, etc.?

ED is neither a philosophy nor a theory. It's a fact of nature and reverse engineering. Engineering requires concrete, quantifiable objects, and black holes are the best for this study. A black hole is in perfect thermodynamic [equilibrium](#); it is defined by a single parameter (its Schwarzschild radius, its mass, its temperature, etc. - all these parameters transform one into the other upon multiplication by a constant). A black hole emits black-body (Hawking) radiation, also dependent on a single parameter. This led me to extend my [research](#) to two other known stellar, compact objects emitting black-body radiation: neutron stars and white dwarfs, and also to the [perfectly spherical](#) collisions of such compact objects. However, sphericity pertains solely to real dimensions. In complex spacetime, an object is spherical only in the present moment of perception.

What do you think the future holds for your research and the research of others in this field?

ED explains, or can be further researched to explain, most of the [unsolved problems in physics](#). The [black hole information paradox](#) (which looms over all black-body stellar objects) is explained by the patternless nature of its radiation. The [Cosmic Censor](#), the [Chronology Protector](#), and other [block-universe](#) concepts are irrelevant in ED. The holographic

principle and the problem of time are related to perception. The [axis of evil](#) should be resolvable within the framework of ED and [dissipative structures](#) (introduced to science by Ilya Prigogine, who coined this term and received the Nobel Prize for his pioneering research on them). Unverifiable and unfalsifiable [multiverses](#) contradict ED. Fine-tuned universe concept is meaningless, as fine-tuned physical constants are simply the result of our observations induced by exotic R^4 . The cosmological constant, dark matter/energy/fluid/etc. contradict or are obsolete within the framework of ED. [Anyons](#), etc., should be resolvable by ED in 2-dimensions and imaginary time. Fast radio bursts (FRBs) should be explainable by mergers of black-body objects. And so on.

What seems more important, however, is that every particle (electron, proton, quark, etc.) and antiparticle acquires a new meaning in ED, along with [quasiparticles](#) and other emergent phenomena.

What has your latest research on emergent dimensionality looked at, and why?

My [previous research](#) concerned convex polytopes and balls in complex dimensions. A polytope is an extension of the concept of two-dimensional polygons and three-dimensional polyhedra. There is an infinite number of regular 2D convex polygons (equilateral triangle; square; regular penta-, hexa-, hepta-, octa-, etc.-gon,...), five regular 3D convex polyhedra (otherwise known as the [Platonic solids](#)), six regular 4D convex 4-polytopes, and only three in nD, where n is five or more: n-simplex (n-dimensional companion of triangle and tetrahedron), n-cube (n-dimensional companion of square and cube), and

n-orthoplex (n-dimensional companion of square and octahedron). I proved that these objects are omnidimensional, i.e., well-defined in any complex dimension. It was an extension of my previous research on [n-balls in negative dimensions](#).

My [current discovery](#) concerns the complementary, negative [fine-structure constant](#) yielding the imaginary set of [units of measurement](#), which led me to the conjectured correction of the [photon sphere](#) radius. The proposed model of complex energies explains the anomalously high masses of black-body mergers, as registered by LIGO and Virgo interferometers, and the associated fast radio bursts without resorting to any hypothetical types of exotic stellar objects, such as quark stars.

What has led you to study emergent dimensionality, and why?

I have always thought that the fact that quantum measurement is performed by any observer "now" is obvious. However, when it occurred to me that it is not the case, I began researching and exploring this field, which led me to ED.



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INNOVATIVE DYNAMIC MOLDING TO REDUCE DEVELOPMENT COSTS OF PERSONALIZED MEDICINE

3Deus Dynamics has raised €2.5 million for the industrialization of its 3D process, to expand internationally and revolutionize personalized medicine with Dynamic Molding



3Deus Dynamics, a start-up specializing in the development of personalized medical devices made of silicone thanks to its innovative Dynamic Molding process, has just obtained €2.5 million in grants from the European EIC Accelerator program.

This grant will allow the start-up to deploy its process by setting up a first production line dedicated to the manufacture of customized silicone medical devices. This funding will greatly contribute to the development of tomorrow's personalized medicine while having a positive environmental impact.

3Deus Dynamics, a Deeptech start-up created in 2020 and incubated by PULSALYS, is one of the 78 innovative companies to have been awarded a grant by the EIC Accelerator program in the last wave of winners in December 2022. This European program is one of the most selective and retains only 6% of applications.

Developing the personalized medicine of the future

One of the first markets addressed by 3Deus Dynamics is the healthcare sector for mass customization needs thanks to the manufacturing of patient-specific medical devices in silicone with total freedom of design without chemical reformulation or support structure, excellent mechanical fidelity and durability.

The EIC Accelerator will allow 3Deus Dynamics to continue its breakthrough in this extremely promising market with the implementation of a first integrated production line dedicated to the manufacturing of customized silicone medical devices.

3Deus Dynamics has developed a range of anatomical models (class 1 medical devices) covering all specialties of modern medicine and used for preoperative simulation/planning or validation of medical devices under design.

They are exceptionally flexible, allowing them to mimic the mechanics and morphology of native tissue. These models are waterproof, suturable and perfusable and compatible with the use of medical imaging. They are a responsible alternative to the use of cadavers or animals and allow a return of touch to a specific pathology.

3Deus Dynamics' Dynamic Molding is also used for the manufacturing of external prostheses/orthoses and higher-class medical devices, which allows a shortening of the R&D and regulatory validation phase, thus drastically reducing the development costs of a medical device and the time to market.

Promising growth prospects in industrial Dynamic Molding

"We are very proud that Dynamic Molding, a process resulting from the research work of the 3d.FAB academic platform (ICBMS: Claude Bernard Lyon 1 University, INSA Lyon, CPE Lyon and

CNRS), has been recognized by Europe as strategic. Our teams have worked hard on this ambitious project, which will undoubtedly contribute to tomorrow's medicine, and this is a great reward for us.

We are also aware that our industry must contribute to the improvement of healthcare while having a positive environmental impact for future generations. That's why we've worked to ensure that Dynamic Molding uses raw materials that are recycled, reusable up to 100 times and recyclable, with the goal of producing more efficiently.

We hope that the EIC will allow us to create new opportunities by encouraging many manufacturers to use Dynamic Molding for the development of their patient-specific medical devices," says Julien Barthès, CEO of 3Deus Dynamics.

In addition to the healthcare sector, Dynamic Molding is also very attractive for the development of high-value-added composites, particularly in the aeronautics, aerospace and defence sectors. By adapting the nature of the granular medium, it is possible to manufacture flexible materials with additional properties such as conductive, electromagnetic or flame retardant.

The next milestone for 3Deus Dynamics is the achievement of ISO 13485 certification scheduled for June 2023 for the manufacture of class 1 medical devices and the design of all classes of medical devices.

From the beginning, regulatory constraints have been integrated into all processes to meet the requirements of customers in the medical sector. In



Dr Edwin-Joffrey Courtial, Dr Julien Barthès and Dr Christophe Marquette

parallel, 3Deus Dynamics is currently in the process of finalizing its fundraising, always with the aim of becoming a leader in Industry 4.0.

Following this, the next step planned in 2023 is the industrialization of the process to anticipate the hypergrowth through the relocation of the activities in nearly 2000 m² of industrial premises, a nice step to ensure the scale-up of the process, to accommodate the future machine park and the next recruitments.

Dynamic Molding: a freeform and "zero gravity" 3D printing process

The promise of 3Deus Dynamics: print the impossible. To achieve this, printing is carried out within a controlled granular medium (powder), behaving like a dynamic mold in which the manufacturing materials (inks) are distributed. The granular medium supports the material during printing and is self-repairing after each movement of the print head.

Thanks to this disruptive innovation, all existing viscoelastic manufacturing

materials (thermoplastics, elastomers, ceramics...) will have the possibility to be printed without any limitation of the initial properties of the material (rheological, mechanical, kinetic, or solidification/hardening mechanism) but also with unlimited freedom of 3D complexities.

In 2022, the startup is ramping up with the design of a Dynamic Molding 3D printer, the 3Deus Light, integrating the constraints of industrial production.



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VESTAS AIRCOIL: KEY INSIGHTS FROM SUCCESSFULLY BRIDGING THE GAP BETWEEN ACADEMIA AND INDUSTRY

Open Access Government engages in a conversation with Kevin Jose, a recently graduated PhD student who concluded his research and successfully defended his thesis at the University of Southampton. In this interview, Kevin shares his insights on transitioning from academia to industry

Kevin Jose



As part of the InDEStruct project, which received funding from the European Union's Horizon 2020 research and innovation programme through the Marie Skłodowska-Curie grant, Kevin Jose became the first among his four

engineering colleagues to complete his work at Vestas aircoil and defend his PhD thesis.

Vestas aircoil is currently expanding its research and development facilities

and activities in Denmark, actively engaging interns and PhD students to bridge the gap between academia and industry. In this article, Kevin Jose and his colleagues at Vestas aircoil candidly discuss their experiences, insights, and

the outcomes of Kevin's research in academia and industry.

What was your role on the InDEStruct project?

In the InDEStruct project, I was one of the four early-stage researchers (ESRs) at the University of Southampton. Each of us, being PhD students, approached



a common problem from different perspectives. For instance, one of our colleagues focused on materials research for the next generation of heat exchangers, particularly in additive manufacturing with metals such as

steel. Another colleague explored the heat exchange and fluid flow aspects. As for myself and another colleague, we worked on vibration problems related to the project. I specifically contributed from an analytical and computational modelling angle.

You recently defended your PhD thesis. Could you tell us about its topic?

My PhD thesis revolves around the problems we encountered during the industry project. It consists of four substantive chapters, two of which were directly inspired by the challenges we faced regarding the dynamic behaviour of heat exchangers.

One chapter even involved the development of a graphical user interface tool that we transferred to Vestas aircoil as part of a technology transfer initiative. We packaged our analytical model and provided it as a computer code.

The other two chapters focused more on theoretical problems, which were, nonetheless, inspired by manufacturing tolerances and uncertainties inherent in industrial processes. Hence, half of the dissertation addresses specific problems that arose during the project, while the other half draws inspiration from industry-related issues.

How does your research relate to your previous work with Vestas aircoil?

The primary focus of my research, which is of immediate interest to Vestas aircoil, is gaining a better understanding of the dynamic behaviour of heat exchangers, particularly the critical component known as the tube-and-fin array or bank. My contribution involved

computational and analytical modelling aimed at estimating the vibrational characteristics of these structures. While computationally expensive finite element simulations typically took anywhere from 20 minutes to a few hours, I leveraged the underlying physics to develop analytical or semi-analytical descriptions that reduced the computational costs to less than a second. Although this approach sacrifices some resolution and accuracy, it proved valuable in the early design phase where numerous parameter and material choices were being evaluated. Additionally, this reduced dimensionality technique helps to cope with the vast parameter search space, which renders comprehensive finite element-based investigations infeasible.

What is your perspective on bridging the gap between academia and industry?

I believe there are significant benefits for both academia and industry in bridging the gap between them. For academia, collaborating with industry provides access to real-world problems that hold immediate significance. On the other hand, industrial partners benefit from the fresh perspectives and unique tools and techniques brought in by academics, who offer a different vantage point from their day-to-day operations.

We started with a simplified model, gradually adding details as necessary. Applying the Pareto principle, also known as the 80/20 rule, we found that valuable insights could be obtained by focusing on the essential aspects while disregarding excessive details. Additionally, considering the diminishing returns curve, we recognized that adding more

complexity might not necessarily yield proportional gains in understanding or practical benefits.

Claus Ibsen, Group R&D Director for Vestas aircoil, shared his perspective on the project: “As Kevin mentioned, this project brought a new and essential dimension to our company’s research endeavours. One valuable lesson we learned from the project is that we have to be able to scope the tasks correctly. When industry challenges can be effectively communicated through a toy problem, it facilitates efficient collaboration. The concept of a useful toy problem is instrumental in bridging the gap between academia and industry, describing what is needed to foster closer collaboration between the two.”

Do you have any plans for future collaborations with Vestas aircoil? What are your aspirations moving forward?

I have reached out to Claus Ibsen, and we are in the process of arranging a collaboration. There is an existing collaboration between my academic advisor and Claus Ibsen, which sets a foundation for our future collaboration.

Recently, we also discussed my transition towards material science and the application of machine learning in that field. I expressed my interest in finding potential areas of collaboration between my work and Vestas aircoil. It would be great to explore new opportunities together.

Is your current position a result of your previous industrial work?

There are multiple factors that contribute to my current position.

Firstly, I am motivated by the intriguing research questions that arise at the intersection of academia and industry, particularly in the fields of engineering and physics.

Secondly, there is an understanding that machine learning and AI are becoming increasingly important and are likely to remain relevant for the foreseeable future. It is advantageous to acquire training in these emerging tools, as they are valuable skill sets and can enhance funding applications. These considerations align with the interdisciplinary approach often required in industry.

“My PhD thesis revolves around the problems we encountered during the industry project. It consists of four substantive chapters, two of which were directly inspired by the challenges we faced regarding the dynamic behaviour of heat exchangers.”

Although my previous industrial work did not involve machine learning in material science, it now forms a significant focus of my research. I can leverage my academic training as a mechanical engineer, which encompasses a strong foundation in material science.

In the application for the InDEStruct project in 2017 Vestas aircoil and project partner University of Southampton emphasized

“the collaborative research program’s goal of developing technology leaders who can apply scientific methods

from academia to interdisciplinary industrial design.

The proposed doctoral training program offers broad science-based training applicable to a wide range of engineering products and systems, whilst using the development of advanced heat transfer technologies enabling more efficient and lower emission engine systems as a focus for training in interdisciplinary design.

A training program built upon the central theme of Engineering Design, providing a coherent structure for integration/application of distinct engineering approaches, highlighting the interdisciplinary nature of industrial research and development”.

In conclusion, Claus Ibsen remarked that “Kevin’s current position at the University of Cambridge, which focuses on a different topic than his PhD, has demonstrated our successful collaboration and exactly what we were looking for with this research programme”.

Vestas aircoil

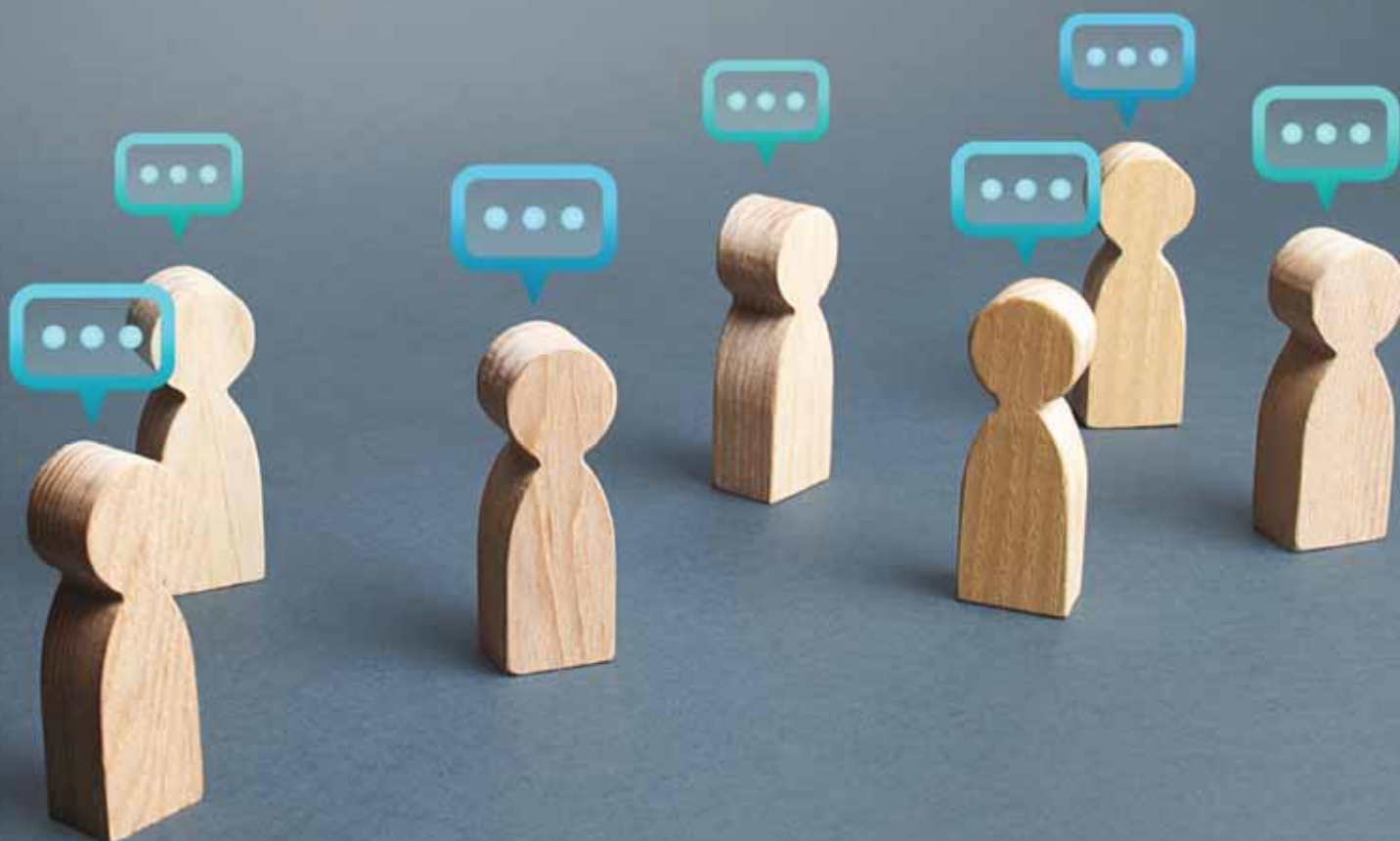
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THE ROTATING LEPTON MODEL: ELECTRON AND POSITRON CATALYSIS OF CHEMICAL AND NUCLEAR SYNTHESIS

Professor Emeritus Constantinos Vayenas from the University of Patras and PhD student Dionysios Tsousis from Stanford University discuss electron and positron catalysis in the CERN e^+e^- annihilation experiments via the Rotating Lepton Model

Electrons and positrons play a central role in heterogeneous catalysis^(1,2) and electrochemistry^(3,4) since they can interact directly via electrostatic interactions with molecular or ionic reactants, intermediates, and products. Electrochemistry's entire science and technology is based on electrostatic electron – or positron-atom interactions.

Interestingly, it has also been known for some years from the positron-electron annihilation experiments⁽⁵⁾ that beams of electrons and positrons can produce significant amounts of a variety of hadronic particles^(5,6), hadrons and bosons “in a vacuum”.

The mechanism of this startling behaviour has been unclear for many years. One might initially argue that the energy released from the exothermic positron-electron neutralisation is somehow converted to the masses of the plethora of products observed, among which the Z boson is the dominant product (Figure 1). However, no physical mechanism is known for producing hadrons and bosons from energy alone.

The elementary particles

Careful examination of the decay products of all known particles reveals that the ultimate final dissociation products of all known composite

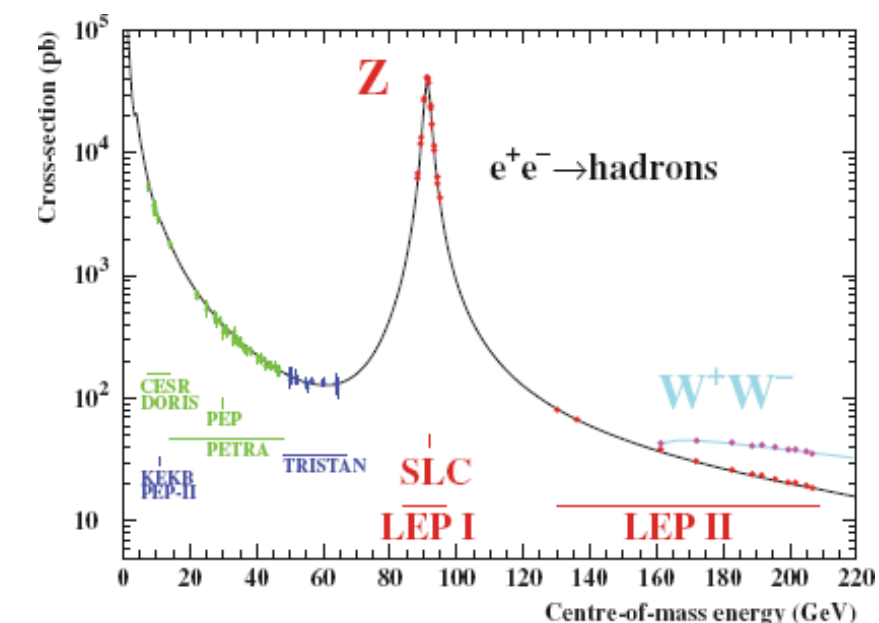


Fig 1. Positron-electron annihilation products observed at CERN⁽⁶⁾

particles are only five, i.e., the positron, the electron and the three neutrinos with masses m_1 , m_2 , and m_3 .^(7,8,9) These are the only real elementary (“atomic” in the Democritian sense) particles. Neutrinos are also commonly classified in terms of their “flavor”, i.e., e-neutrinos, μ -neutrinos and τ -neutrinos, depending on the particle (e, μ or τ) appearing with them upon detection.

The reason for this simultaneous emergence is discussed in the last section. However, as shown recently and analysed here based on the structure of hadrons and bosons revealed by the Rotating Lepton Model (RLM)^(9,10,11), the fundamental neutrino

classification in terms of their masses (i.e. ν_1 , ν_2 and ν_3) is more fundamental rather than that according to their “flavors”.

Microscopic reversibility and the Rotating Lepton Model

Since a combination of neutrinos, positrons, and electrons is the final product of the dissociation of all composite particles (hadrons, bosons), it follows from the principle of microscopic reversibility that all composite particles can be constructed by combining positrons, electrons, and neutrinos.

There is a critical difficulty with this

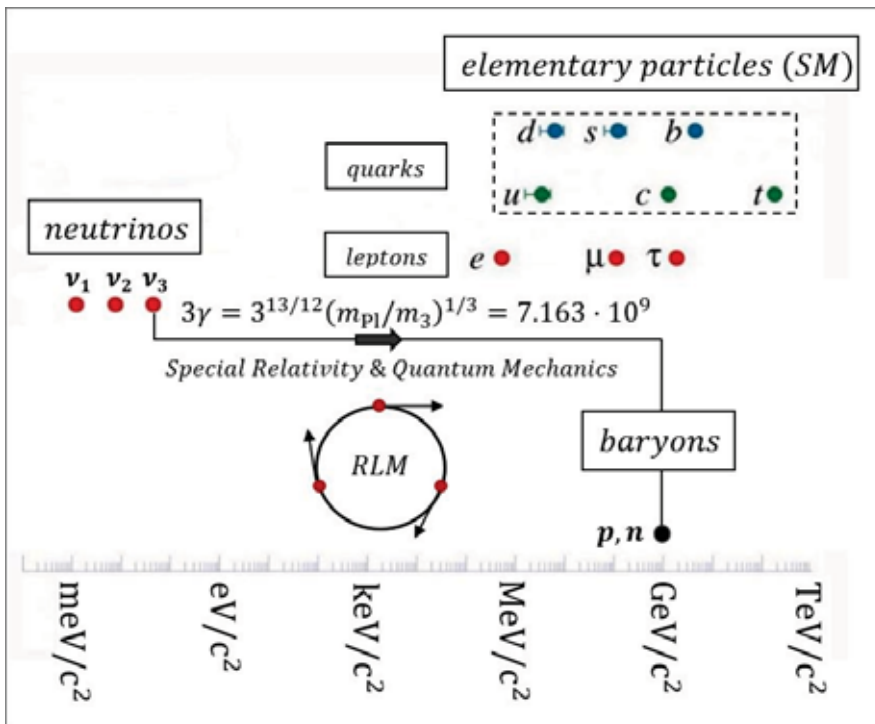


Fig 2. Rest masses of the Standard Model (SM) Elementary Particles and the three neutrino eigenstates. ^(13,14) The arrow shows how the Rotating Lepton Model (RLM) via Special Relativity increases the heaviest neutrino mass from the rest eigenstate mass value m_3 (~ 45 meV/c²) to the relativistic mass value, $\gamma m^3 \approx 313$ MeV/c² of the s quark, which corresponds to one-third of the mass of the neutron formed ⁽⁹⁾

simple view having to do with the range of masses of neutrinos (10^{-3} to 10^{-1} eV/c²), hadrons (1 to 10 GeV/c²) and bosons (80-120 GeV/c²) (Fig. 2) and with the fact that quarks are commonly perceived to be the components of hadrons.

As shown in Figure 2, Special Relativity, a basic component of the Rotating Lepton Model (RLM), directly solves this problem. In the RLM, hadrons, such as the neutron, are modelled as a triad of ultrafast relativistic gravitating neutrinos. The tremendous speeds ($\gamma \approx 10^{10}$ ^(9,10,11)) reached by the three rotating neutrinos cause their masses to increase (from $\sim 10^{-2}$ eV/c²) by a factor of γ .

Thus, surprisingly, the neutrino masses reach the values of the quark masses, and, in this way, the masses of hadrons (baryons) are obtained (~ 1 GeV/c²), which are ten orders of magnitude heavier than those of neutrinos. In this way, the RLM provides a quantitative fit

to the masses of hadrons and the masses of bosons (such as the Z, W and Higgs bosons) which contain a rotating electron in their rotating ring (Fig. 3).

Experimental validations of the RLM

The positron-electron annihilation (PEA) experiments carried out at CERN ⁽⁷⁾ provide direct proof of the validity of the RLM. As shown in Figure 1, the main product of the PEA is the Z boson. The RLM has already demonstrated this to comprise a rotating positron-electron-neutrino triad ⁽¹²⁾ (Fig 3). Furthermore, the computed via the RLM mass $m_z = (m_p m_e m_\nu)^{1/3} \approx 92$ GeV/c²

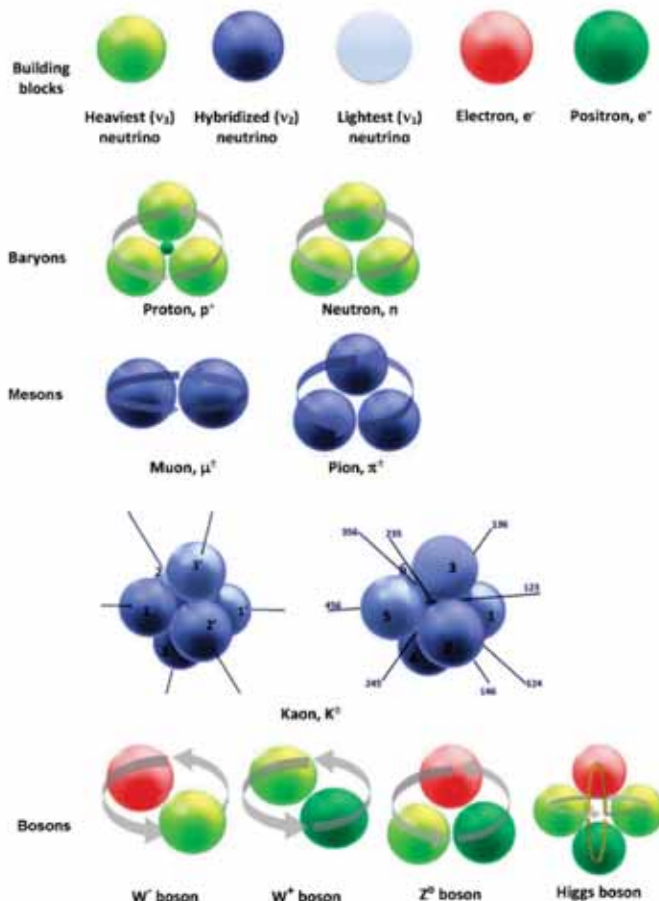


Figure 3. The elementary particles of the Rotating Lepton Model (RLM) (top line) and the RLM structures and composition of baryons, muons, pions, kaons and bosons ⁽¹⁰⁾

is in quantitative agreement with the location of the Z peak (Fig. 1).

A thorough validation of the RLM for a total of 25 composite particles (hadrons), including the proton, the neutron, bosons, and the deuteron nucleus⁽¹¹⁾, is shown in Figure 4. As shown in this Figure, all the corresponding points fall (within 2%) on the y=x line. The agreement is also quantitative. Figure 5 presents the RLM methodology. It comprises only three equations:

1. The equation of motion which accounts for special relativity via the relativistic masses, γm_0 , and utilises the gravitational particle masses in Newton's gravitational law. Gravitational masses are equal to inertial masses according to the equivalence principle, i.e., are equal to $\gamma^3 m_0$ where $\gamma = (1 - v^2/c^2)^{-1/2}$ is the Lorentz factor.

2. The de Broglie wavelength equation which states that each particle's angular momentum, $\gamma m_0 v r$, equals the Planck constant \hbar . There are only two unknowns in these two equations, i.e., γ and r , the radius. The solution of these equations together with the energy balance equation of fig.5 gives:

$$\gamma = 3^{1/12} (m_{PI} / m_0)^{1/3}; E = 3\gamma m_0 c^2 = 3^{13/12} (m_{PI} m_0^2)^{1/3} c^2$$

(1)

and thus

$$m_n = 3^{13/12} (m_{PI} m_0^2)^{1/3}$$

(2)

For $m_0 = 0.0437 \text{ eV}/c^2$ (within the mass range measured at Superkamiokande), this gives the experimental neutron mass of 939.565 MeV/c².

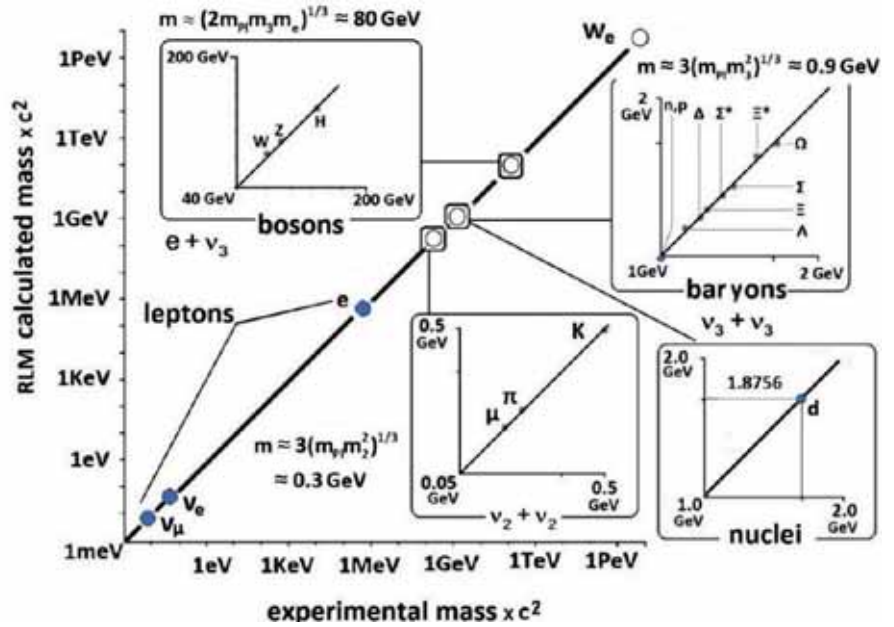


Figure 4. Comparison of the RLM computed masses of composite particles with the experimental values. The agreement is better than 2% without any adjustable parameters. The three approximate mass expressions shown in the Figure provide the order of magnitude of hadron and boson masses.^(10,11)

Neutrino rest masses computation

Conversely, one may rewrite equation (2) as:

$$m_0 = \frac{m_n^{3/2}}{3^{13/8} m_{PI}^{1/2}} = 0.0437 \text{ eV} / c^2$$

(3)

This allows for the computation of the heaviest neutrino mass, m_3 , which agrees with the value obtained at the Superkamiokande facility.⁽¹³⁾

Structural information

Figures 3,4, and 5 underline the usefulness and importance of the RLM. They also show that:

(a). Bosons contain rotating electrons in their structure, and this leads to their significantly larger (by a factor of $(m_e/m_{\nu_3})^{1/3} = 10^2$) values of boson masses vs hadron masses.

(b). The Z boson is a rotating $e^+e^- \nu_3$ triad, and this explains why it is the dominant product of the PEA experiments formed by the interaction of e^+e^- pairs with ambient neutrinos.

(c). From the structure of the W boson (i.e. a rotating $e^+ \nu_3$ pair), it follows why an electron (or positron) is always appearing simultaneously with each observed ν_3 neutrino.

In summary, the CERN positron-electron annihilation experiments shed new light on the interactions between neutrinos, positrons and electrons and confirm the mechanism of the Rotating Lepton Model by showing that the Z boson is a rotating positron-electron-neutrino (m_3) ($e^+e^- \nu_3$) particle.

The neutrino in the Z boson structure is

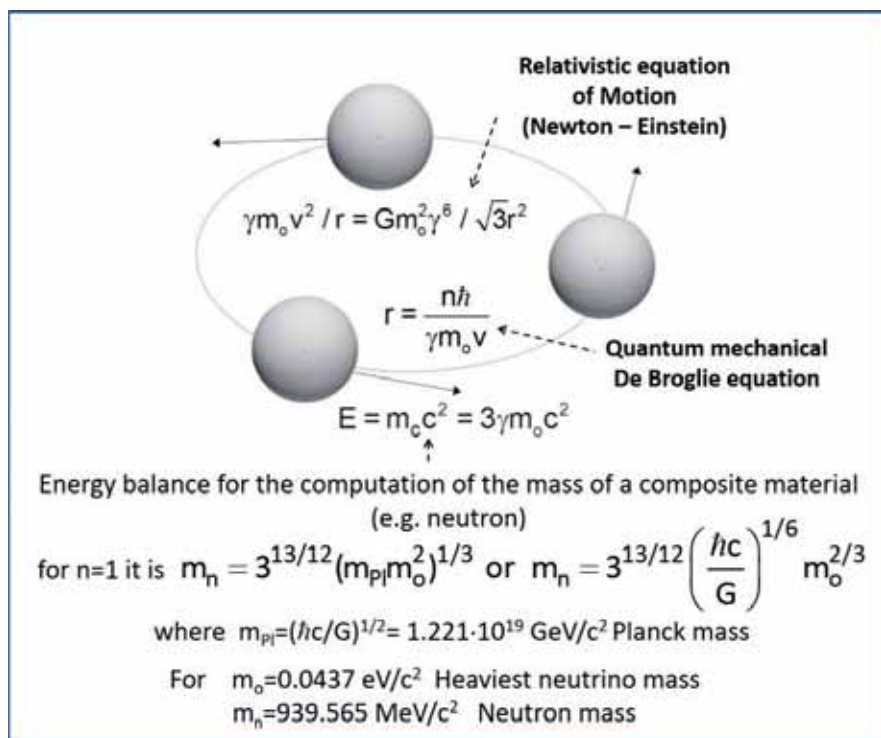


Figure 5. Combining Special Relativity and Quantum Mechanics in the RLM for computing the neutron mass ^(9,10,11)

already rotating at a tremendous speed. Thus, upon Z boson decomposition, it can accelerate many more neutrinos to highly relativity speeds, thus further catalysing hadronization.

Z boson-type bosons can also form via the interaction of electrons with ambient m_2 and m_1 type neutrinos, and this explains why each electron neutrino (which comprises a mixture of $e-\nu_1$, $e-\nu_2$ and $e-\nu_3$ bosons) has an average mass between those corresponding to m_1 , m_2 and m_3 type neutrinos. This appears to clarify the neutrino-flavor concept, i.e., an electron neutrino has emerged via the dissociation of a W boson. In contrast, a muon neutrino is the result of the dissociation of a pion complex, and a tau neutrino is the dissociation product of a tau-neutrino complex.

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ROTATING LEPTON MODEL of Matter *ebook*

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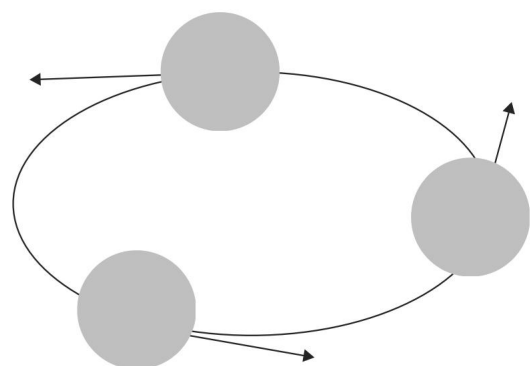


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ΑΘΗΝΑΝ

Strengthening science & basic research in Austria and beyond

Open Access Government charts the sterling efforts and funding to make science and basic research in Austria stronger and beyond



The Austrian Science Fund (FWF) funds basic research strengthening Austria's science and humanities. However, the FWF's purpose goes beyond the country in that science and basic research in Austria must be supported "at a high international level." As such, the FWF significantly advance knowledge-based society and cultural development, creating value. ⁽¹⁾

Research in Austria at the international level

Picking up on the international theme, we know that enhancing Austria's visibility as a research location is a

crucial FWF objective. We hear that more high-level research occurs in global networks where competition and international cooperation are equally valid.

As well as prominent people in the research world and respected research institutions with international visibility, the overall conditions established by national funding agencies play an essential part in bolstering global integration into such networks. One apparent aim for FWF is to heighten the status of Europe in this vein, "not least...to advance the integration of basic research funding in the European Research Area".

The FWF takes precise measures to support “the internationalisation of Austrian science and research”. International integration is seen in individual cooperation arrangements and specific international programmes regarding FWF projects. Did you know over 50% of all continuing FWF projects take place in cooperation with research partners from beyond the borders of Austria? ⁽²⁾

Funding cutting-edge research in Austria

But what about the funding of cutting-edge research? What can we say about this? As the basic research community in Austria grows, so does the FWF financing provides. Research investments rose in 2022, achieving €273 million and 743 projects at the country’s research institutions, paving the way for prosperity, progress and innovation.

We hear that the FWF Distinguished Professor program, the third pillar of the excellence initiative *excellence=austria*, commences this year. The Ministry of Education, Science and Research (BMBWF) will fund FWF with €1.124 billion between 2024 and 2026. At the FWF annual press conference earlier this year, Austria’s Minister of Education, Science and Research Martin Polaschek underlined the crucial role of basic research for the years ahead.

“FWF funding gives researchers the opportunity to pursue fundamental research questions at the highest international level. All of these researchers are making a valuable contribution, helping us find new answers to current and future challenges. My goal is to ensure the best possible conditions for scientific progress and, at the same time, to further strengthen the public’s confidence in research findings.”

Advanced research in Austria continues to progress, and this growth reflects in third party-funded research. In 2022, natural sciences and technology projects received €115 million, biology and medical sciences €100 million, and humanities and social sciences €58 million. As of April 2023, we find out that FWF funds 4,842 researchers in continuing projects at Austria’s universities and other research institutions, a level unprecedented.

Despite intense inflationary pressures, this is a funding success and a positive boost to the country’s cutting-edge research. It is fitting, therefore, that we now digest the insightful comments of Christof Gatttringer, President of the FWF, about this research success story. “The need for new knowledge is growing in all areas of life, from medicine to the climate to digital technologies, or to give us a better understanding of history and current events.

“In the face of multiple crises and the transformation to a sustainable future, basic research plays an important role in triggering innovation and expanding our knowledge base. For the 2024 to 2026 period, we will have to continue to work together to ensure that all planned projects can be fully implemented with the announced budget and any additional funds.”

Basic research in Austria for the future

The volume of basic research planned by Austria’s Federal Government is vital to the research community and FWF in the future. €1.124 billion from 2024 to 2026 provided by the BMBWF means that most FWF programmes and the excellence initiative can continue, and long may they do so. ⁽³⁾

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BIOCONTROL FUNGI FOR PLANT DISEASE RESEARCH

Susanne Zeilinger, University Professor for Microbiology, underscores sustainable solutions for plant disease research, focusing on the power of biocontrol fungi

Plant diseases represent a significant threat to global food security and agricultural sustainability.

Fungal pathogens, in particular, can cause massive agricultural losses by infecting and damaging crops, resulting in reduced yield, poor quality and economic losses. ⁽¹⁾

Traditional approaches to managing phytopathogenic fungi include resistant crop varieties, cultural practices, and chemical fungicides.

While the latter can effectively manage fungal diseases, their frequent use negatively impacts the environment and raises concerns regarding safety and potential harm to human health.

In recent years, a growing interest in sustainable alternatives has emerged.

Biological control using living microorganisms to manage pests and diseases in agricultural systems is among the most promising solutions.

Microbes with biocontrol activity, such as biocontrol fungi, are natural antagonists, and respective research contributes to developing safer and more environmentally friendly fungicide options.

Understanding their modes of action, advantages, and applications can harness the power of biocontrol fungi for sustainable disease management.

Understanding biocontrol fungi

Biocontrol fungi are among the naturally occurring microorganisms and can suppress plant diseases.

They live in the plant rhizosphere, competing with pathogens for nutrients and space, and may colonise the plant roots.

Several of these natural antagonists can produce substances that inhibit the growth and development of plant pathogens.

They may also induce systemic resistance in plants, enhancing their defence against diseases. ⁽²⁾

Among the fungal antagonists being researched and used as microbial fungicides, *Trichoderma* spp. are the most prominent.

These biocontrol fungi are effective against a broad range of fungal plant pathogens, including *Fusarium*, *Rhizoctonia*, *Botrytis* and many more, and are considered opportunistic plant symbionts. ⁽³⁾

Advantages & applications of biocontrol fungi

The advantages offered by biocontrol fungi are manifold.

First, they are environment friendly as they do not leave toxic residues in soil or water sources, which reduces the

risk of ecological damage and reduces the chemical load in agricultural systems.

Secondly, they have a high degree of specificity, thereby minimising the impact on non-target organisms. This keeps the ecological balance within the agroecosystem. ^(4,5)

Biocontrol fungi suppress a wide range of plant diseases. These include soilborne pathogens like *Fusarium*, *Rhizoctonia*, and *Phytophthora* species that are effectively antagonised by biocontrol agents such as *Trichoderma* spp. and *Beauveria* spp., which directly attack the pathogens and form a protective barrier by colonising the plant roots.

Certain biocontrol fungi, such as *Ampelomyces quisqualis*, have proven effective against foliar pathogens like powdery mildews and rusts.

Furthermore, entomopathogenic fungi that naturally infect and kill insect pests, such as *Beauveria bassiana* and *Metarhizium anisopliae*, are a practical agricultural insect pest management approach. ⁽⁶⁾

Trichoderma mycoparasites as biocontrol agents

Trichoderma spp. are known as potent mycoparasites due to their ability to attack and feed on fungal plant pathogens directly.

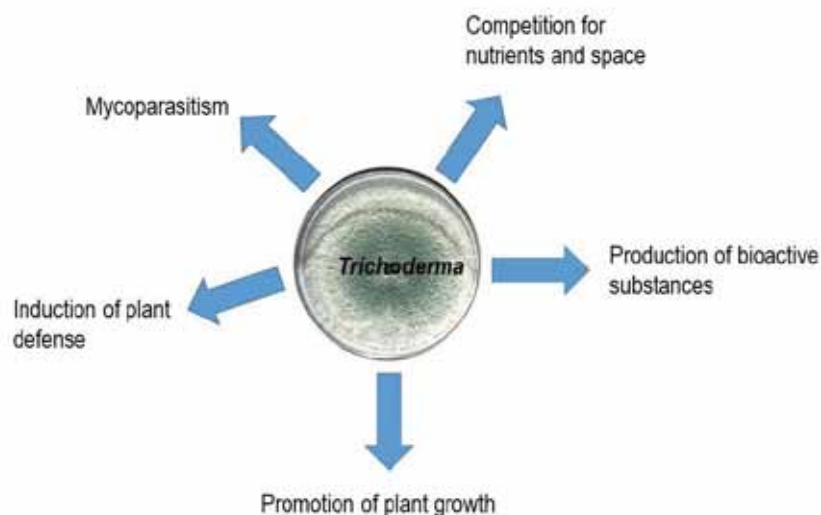


Figure 1: Overview of the modes of action of *Trichoderma* biocontrol fungi. We investigate the mycoparasitic interaction of *Trichoderma* with fungal plant pathogens at the molecular level and explore the *Trichoderma*-plant interaction to understand in detail the processes contributing to its biocontrol activity.

These biocontrol agents produce enzymes like chitinases and glucanases that degrade the cell walls of pathogenic fungi and inhibit pathogen growth.

In addition, *Trichoderma* produce bioactive substances with antifungal activity and metabolites that stimulate the natural defence mechanisms of plants, thereby promoting their disease resistance. ^(3, 7)

Trichoderma-based products are used as seed treatment, soil amendments, or foliar sprays. Plant seeds can be coated with *Trichoderma* spores that then germinate and colonise the emerging plant roots, protecting the seedlings from soilborne fungal pathogens.

Alternatively, *Trichoderma* can be incorporated into compost or organic matter resulting in an enhancement of the population of the biocontrol fungus in the soil and subsequent long-term pathogen suppression.

Trichoderma-containing suspensions can be used as foliar sprays that are applied to the above-ground plant parts to control foliar diseases.

Additional biocontrol approaches include combining *Trichoderma* with other beneficial microbes, such as biocontrol bacteria or mycorrhizal fungi. ⁽⁸⁾

However, challenges remain, such as the fact that the biocontrol capacity of *Trichoderma* is determined by the plant host and by environmental cues. ⁽⁹⁾

In the Molecular Mycology Research Group at the Department of Microbiology, University of Innsbruck, we strive to investigate how the interaction of *Trichoderma* with fungal plant pathogens is affected by environmental conditions, how the interaction partners communicate and recognise each other, and which role signaling molecules and phytohormones play during mycoparasitism and biocontrol.

Future plant disease research

We aim to improve our understanding of the interactions of *Trichoderma* with plant pathogens under different environmental conditions, including the natural soil microbiome.

The same applies to the *Trichoderma*-plant interaction, for which a detailed

understanding of the mechanisms triggered by the fungus is essential for developing effective products for different crop plants.

Therefore, interdisciplinary efforts are needed to investigate the various aspects of *Trichoderma* biocontrol fungi leading to innovative and sustainable solutions for agricultural plant protection.

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Research and innovation investments in Norway

Open Access Government explores the importance of funding research and innovation investments in Norway for the future of sustainability and technology

Imagine a society that encourages the creation, application, and sharing of research, which helps restructure and improve sustainability. The country is Norway, one of the Nordic countries, and this is the bold vision seen through the eyes of the Research Council of Norway.

Research and innovation investments across 16 portfolios

The Research Council of Norway invests in innovation and research via 16 portfolios. ⁽¹⁾ As an example, one of these 16 areas concerns the enabling technologies, nanotechnology, biotechnology and ICT, which have the scope to play a part in significant societal changes and be used for a wide array of applications.

“The technology areas will be further developed and used in a socially responsible manner in close interaction with each other, with different disciplines and...actors in the private and public sector,” the Research Council of Norway continues. ⁽²⁾

Natural sciences and technologies demonstrate how research and innovation investments made will foster revolutionary and high-quality research. For instance, regarding space research, the assets will also contribute to central Norwegian participation in priority satellite and rocket projects through the European Space Agency, plus other scientific projects. ⁽³⁾

The other portfolios are Climate and polar research; Democracy, administration and renewal; Education and competence; Energy, transport and low emissions; Global development and international relations; Health; Humanities and social sciences; Industry and services; Land-based food, the environment and bioresources; Life science; Oceans; Petroleum; Sámi; Welfare and culture and society. ⁽⁴⁾

It’s interesting to note that the Sámi portfolio mentioned above concerns enabling the Sámi people to develop further their language, community life and culture by generating new knowledge. ⁽⁵⁾

Funding research, including the public sector

The Research Council of Norway funds research organisations, businesses and public sector entities. However, private individuals don’t receive research funding. ⁽⁶⁾ County authorities, municipalities, and other public sector entities can apply for funding to foster research-based innovation and grow knowledge. ⁽⁷⁾

For example, the Health Pilot is one of the most visited calls at the time of writing in late June 2023, which will fund up to NOK 80,000 000, with a funding scale of NOK 15,000,000-25,000,000 for a project duration of 24-48 months. ⁽⁸⁾ As the Research Council of Norway succinctly describes: “Through the Health Pilot initiative, we will finance innovation processes that can increase sustainability in health and care services and stimulate value creation in Norwegian trade and industry.” ⁽⁹⁾

Innovation in Norway

An innovation project for the public sector seeks to encourage research activities to promote the innovation sector and sustainable value creation for the users. It also aims to result in public sector administration, infrastructure and services innovations. The requirement for innovation is hot on the heels of the fast changes occurring worldwide, but stripping back to basics, what is innovation?

“Innovations in this context are defined as new or significantly improved goods, services, processes, organisational and governance forms or models that are introduced to enhance value creation and for the benefit

of society,” the Research Council of Norway tell us. Also, the Research Council’s task is to ensure that relevant research develops and stays accessible so that knowledge secured benefits society. ⁽¹⁰⁾

The Centres for Research-based Innovation scheme aims to develop essential innovation and value creation expertise. “Through long-term research conducted in close collaboration between research-performing companies and prominent research groups, the SFI centres are to enhance technology transfer, internationalisation and researcher training,” the Research Council of Norway reveal. An announcement may follow in 2024 that seven to nine new SFI centres may start in Autumn 2025. ⁽¹¹⁾

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FAIR PRINCIPLES – AN INTRODUCTION

“Findability, Accessibility, Interoperability, and Reuse of digital assets” is how FAIR Principles are summed up, as GO FAIR tells us. FAIR Principles provide a free and welcoming environment for people, groups, and organisations cooperating through Implementation Networks (INs). The following three activity pillars involve the INs: GO CHANGE, GO TRAIN and GO BUILD. Let’s look at these three pillars.

GO CHANGE – Concentrates on FAIR implementation priorities, policies, and incentives; a sociocultural shift involving relevant parties at all levels necessary for Open Science to flourish.

GO TRAIN – Coordinating the development of FAIR awareness and skills; training the necessary data stewards capable of designing and implementing proper data management plans that include FAIR data and services.

GO BUILD: coordinating FAIR technology – Building and designing the infrastructure, technical standards, and best practices required to implement the FAIR data principles.

GO FAIR Initiative will contribute to and coordinate the Internet of FAIR Data & Services (IFDS). “The dominance of a very limited number of private or public parties should be avoided by copying the internets ‘hourglass model’ of minimal, rigorous standards and protocols, such as http. This will allow open and common implementation and participation from different stakeholders,” GO FAIR says.

GO FAIR, as Europe’s “virtual environment for all researchers to access, store, manage, analyse and re-use data for research, innovation and educational purposes” also contributes to developing the federated European Open Science Cloud (EOSC). ⁽¹⁾

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EMPLOYING ROBOTICS FOR INSPECTION OPERATIONS

Kostas Alexis of the Autonomous Robots Lab, Department of Engineering Cybernetics at the Norwegian University of Science and Technology, explores the use of autonomous robotics for inspection operations

Inspection operations maintain a crucial role within our societies. Industrial inspection is essential to ensure the safety of critical assets such as underground mines, maritime structures, power plants, and aerospace facilities.

Notably, the costs associated with such inspection operations can be immense, while the underlying activities often expose humans to various risks and hazards.

Inspection operations for the maritime sector

Let us consider, for example, the case of inspecting enclosed spaces for the maritime sector, such as ship ballast water tanks and cargo holds.

With the world greatly relying on maritime transport and other marine structures, human surveyors must deal with a fleet involving more than 100,000 ships as per the "Handbook of Statistics 2022" of the United Nations Conference on Trade And Development.

During such inspections, surveyors inspect within dangerous, confined, enclosed and GPS/GNSS-denied environments that are hard to access, difficult to traverse, with low-light and slippery surfaces, while some of the areas may have low oxygen levels.

Reflecting these challenges, the European Maritime Safety Agency reports many accident conditions even with anchored ships. Considering the

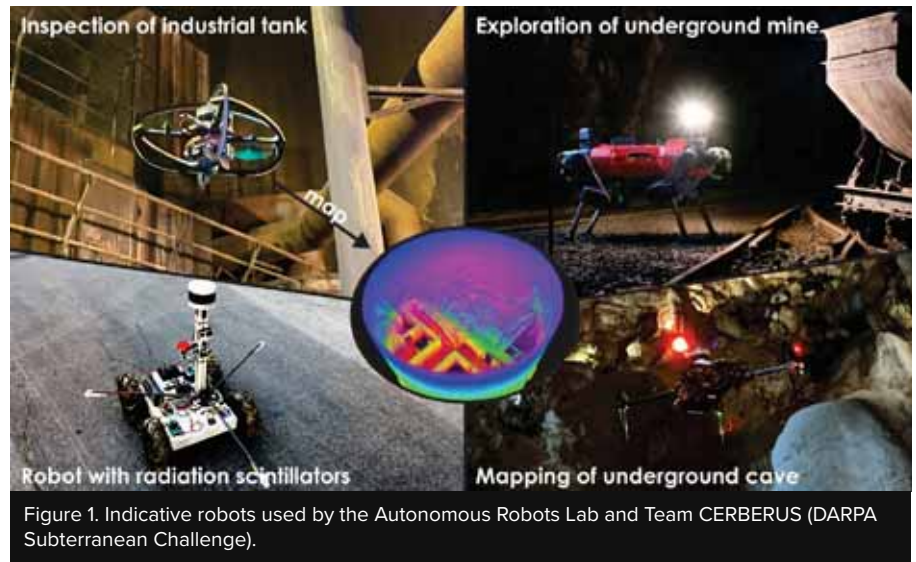


Figure 1. Indicative robots used by the Autonomous Robots Lab and Team CERBERUS (DARPA Subterranean Challenge).

above and other similar examples across application domains (e.g., Figure 1), it comes as no surprise that robots have long been sought as the ultimate solution for automating inspections, eliminating risks for human personnel, and minimising the associated costs, while also significantly reducing possible dead-time of the assets involved.

Significant progress has been registered towards that goal. Robotic systems of diverse configurations, on the ground, in the air and in the water, are currently being used to either complement or partially replace human-based inspection operations in diverse industries. A galaxy of different robotics for inspection operations, therefore, exists in the market. Nevertheless, two limiting observations are pertinent across most such utilisations of robotic technologies.

Limitations to the use of robotics for inspection operations

First, teleoperation or some other form of densely human-supervised methodology is typically still employed for the robots to execute inspections. Second, robotics for inspection operations are not always reliable, especially in the most challenging environments, which implies that human surveyors often must still be on-site. These factors limit the potential benefits offered by robotics for inspection operations.

However, the current limitations of the state-of-the-art and industry adoption can be overcome. At the epicentre of solving the underlying technological challenges and enabling autonomy in diverse industrial inspections anywhere and subject to any conditions are two research directions, namely:

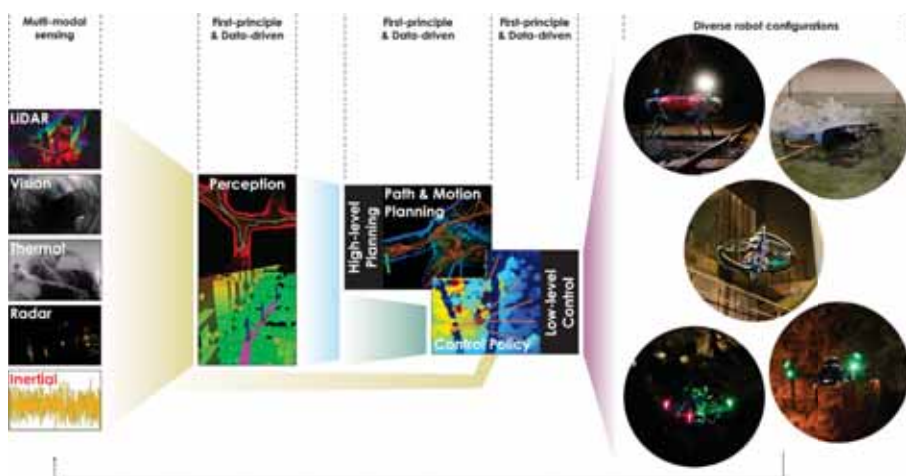


Figure 2. Core functionalities of autonomy in which resilience has to be instilled to facilitate versatile inspection operations.

Enabling resilient robotic autonomy

First and foremost, robots must operate autonomously in all applicable environments and conditions relevant to industrial inspection. Settings such as ship ballast water tanks, underground mines or oil and gas facilities present strenuous navigation challenges. Those areas are GPS/GNSS-denied and often present sensor degradation (e.g., the presence of obscuring agents such as dust and smoke).

At the same time, they involve geometries that are highly complex, often large-scale but also narrow requiring multi-storey navigation and traversing through hard-to-access passages such as manholes. This calls for fundamental contributions towards resilient robotic autonomy.

Autonomous systems must present five instrumental virtues, namely:

- resourcefulness in how they combine and fuse their resources to execute their mission,
- redundancy across their components,
- robust performance across conditions,
- effective response to disturbances and uncertainties, and the ability of;
- recovery from strenuous events.

To that end, progress in the core technologies of a) multi-modal robotic perception, b) multi-objective path planning, and c) learning-based high-speed navigation subject to uncertainties and disturbances is necessary.

Developments in this direction are the key to eliminating the need for outsourcing navigation intelligence and planning inspection activities to human pilots and other means of teleoperation. Figure 2 presents an overview of the main functional blocks of robotics for inspection operations, with resilience being a goal that must be instilled within and across their inter-dependencies.

Facilitating semantically driven reasoning

Beyond the core necessity of resilient autonomy, inspection operations of high quality also require the transition from robots that “sense” and “map” the world to robots that also “reason” about it. Specifically, this refers to semantics-driven reasoning tailored to industrial inspection.

This, for example, can enable a robot to reason that a certain structural component (e.g., a ballast tank web frame) necessitates specific inspection behaviours and has a specific relative

value for the quality of an inspection. Such semantics must be detected, localised, and exploited by informed planning algorithms onboard the robotic systems.

Projects serving to push robotic technology for inspection operations forward

Fortunately, the above directions are heavily investigated by the community. A host of projects or coordinated activities, such as the [DARPA Subterranean Challenge](#), serve to push technology forward. Furthermore, the practice of open-sourcing results is widely adopted within the robotics community, accelerating the pathways to innovation and technological maturity.

It is thus clear that robotics for inspection operations will sooner rather than later present the potential to undertake complex inspections in diverse industrial – and natural – environments with full autonomy and mission completeness.

Both academia and industry, and their synergy, have a core role to play towards this exciting goal that pushes forward the vision of ubiquitous utilisation of robotics for inspection operations.

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THE FAIR PRINCIPLES: TRUSTING IN FAIR DATA REPOSITORIES

Andy Götz, ESRF data manager and PaNOSC coordinator, discusses the impact of applying the FAIR principles to research data

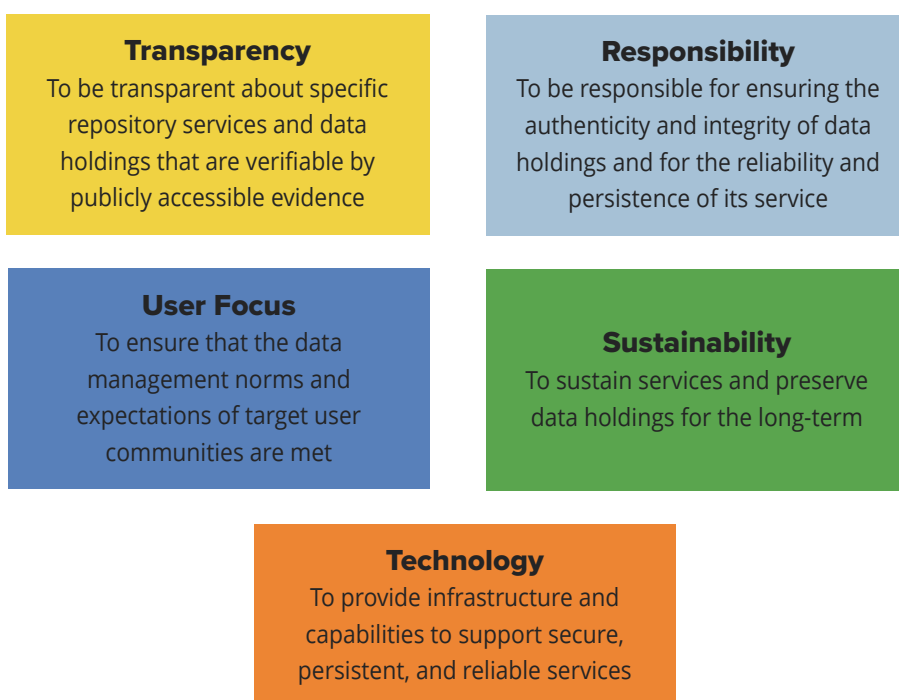
In the previous article in this series on FAIR data, we explained how the scientific world is undergoing a major change with the widespread adoption of the so-called FAIR principles for research data. FAIR stands for Findable, Accessible, Interoperable and Reusable and was first published in a paper in Nature in 2016.⁽¹⁾

The FAIR principles were proposed to ensure research data are made available to the scientific community so that they can be found, downloaded, understood, and reused. The goal is to make data used in scientific publications available to the community so they can verify the results, reproduce them, and eventually derive new results from them. Applying the FAIR principles systematically for research data will address the reproducibility - also known as the replicability - crisis⁽²⁾ in science and make scientific data available for verifying results and used beyond their original purpose.

Making FAIR data the norm

The major European, international, and national scientific organisations, funders and governments have recognised the necessity of making FAIR data the new norm in science and have adopted them. The European Commission is leading projects like the European Open Science Cloud (EOSC).

Figure 1



Scientists are uploading data to well-known data repositories like Zenodo, Figshare, and Dryad to make data available for publications and FAIR. In addition, these data repositories, which serve all communities, research facilities, universities, and scientific communities, play an important role in storing data in self-hosted and managed data repositories. Scientific data repositories almost all aim to be FAIR nowadays. This raises the question of how to know when a data repository is trustworthy and that the data stored there can be trusted to represent what they claim to.

The TRUST principles

Data are the raw material of scientific evidence. Trusting data downloaded from a data repository depends on the data being FAIR and the repository trustworthy. The Research Data Alliance and a group of data stewards have proposed the TRUST principles for digital repositories⁽³⁾ (see Figure 1).

The TRUST principles are similar to the FAIR principles in that they are guiding principles and not a set of metrics. The principles address the services which data repositories provide, their transparency and verifiability by the

public, the responsibility of data stewards for the data in the repository, the focus on user communities and their metadata standards, the sustainability in the long term and capacity of technical infrastructure to be secure and persistent. The principles help data repository stewards and administrators focus on the quality of their repositories.

A growing number of repositories are going further by certifying their repository to be trustworthy. Three levels of certification can be identified: self-certified with a reviewer approving the self-certification, e.g., CoreTrustSeal; certification by an external body, e.g. Nestor; and ISO certification by an external auditor according to the ISO16363 standard.

The most popular self-certification for scientific data repositories is CoreTrustSeal (CTS).⁽⁴⁾ Over one hundred and sixty repositories have been certified to date. This is still a modest number compared to the more than a thousand repositories listed on Fairsharing.org.

Reasons for this are the extra work involved in certification, the fact that it is not a hard requirement for data repositories (yet) and finally, because the added value is not always clear to the repository managers. Nonetheless, going through the certification process is a strong indication of the commitment of the repository managers to provide high-quality data and services for the data they store.

The EOSC offers an opportunity for more repositories to be certified to

improve the trust in data repositories. An example of such an approach is the CLARIN ERIC for language resources. All CLARIN data repositories must have CTS certification or have initiated the process to be integrated into the CLARIN.

Another example in the Photon and Neutron community is the ESRF data repository⁽⁵⁾, which recently received CTS certification. The ESRF is the first PaNOSC⁽⁶⁾ repository to be certified and will hopefully inspire other PaNOSC sites to follow suit. In France, the national plan for Open Science, Ouvrir les Données,⁽⁷⁾ proposes support for data repositories to become CTS certified through training, tools, and financing.

The EOSC and the RDA are excellent opportunities to promote trust in data repositories through certifications like CTS and others. We see a grassroots movement towards making data FAIR which could be boosted by building confidence in data repositories through certification. An example of such a grassroots community which serves scientists is the Science Clusters projects which received EOSC funding from the EC and have continued to work together to create a science-driven community.⁽⁸⁾

Can FAIR data increase trust in science?

The verdict is still out on if making data FAIR is enough to restore and increase trust in science. We can say that for data to be accessible over a long period, scientists will require trustworthy data repositories. The increased adoption of certification and

the TRUST principles for data repositories are stepping stones towards this goal. We expect that implementing the FAIR principles for data will become a requirement for certified data repositories.

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Exploring science, research & innovation in Canada

Open Access Government charts the continuing efforts of the Government of Canada to support science, research and innovation

Writing for Open Access Government in 2022, The Honourable François-Philippe Champagne, Minister of Innovation, Science and Industry of the Government of Canada, shared his thoughts on developing Canadian Leadership and excellence in science and innovation. Daily, the Minister sees the opportunities and challenges the world faces, which have been visceral for the people of Canada over the last few years.

“Whether it’s COVID or climate change, it’s become clear how important it is to invest in science and innovation. Because when we make these investments, we protect our loved ones and our environment. We grow our economy. And we find opportunities for Canada to be a world leader,” the Minister went on to tell us. ⁽¹⁾

Science, research and innovation support

Since Minister Champagne’s editorial for us last year, we have seen the continuing story of science, research and innovation supported in Canada. In October 2022, the Government of Canada launched the Advisory Panel on the Federal Research Support System to give expert but independent advice on the governance and structure of the federal system that supports talent and research.

Minister Champagne commented on this initiative, starting with today’s science’s impact on tomorrow’s economy. “Because we know that today’s science is tomorrow’s economy, our government is committed to ensuring that our talented, world-class researchers have the right support for the crucial work they are doing. That is why we requested this report by experts and will thoroughly consider the report’s recommendations as we advance our efforts to strengthen the federal research support system.” ⁽²⁾

In April 2023, we heard that \$1.4 billion was invested in 11 large-scale research initiatives at postsecondary institutions via the [Canada First Research Excellence Fund \(CFREF\)](#). These 11 initiatives will encourage

partnerships throughout Canada’s academic, private and not-for-profit sectors and beyond for research that provides crucial economic and social benefits for Canada’s inhabitants.

Whether it’s preventing and treating heart and brain disease, reducing carbon emissions in communities or making discoveries concerning AI, advanced computing and robotics, the Government of Canada underlines the vital role of scientists and science, research and innovation in society.

“The initiatives announced today will lead to breakthrough discoveries that will improve people’s lives, nourish our innovation ecosystems, and shape Canada’s prosperity for years to come. Such is the value of universities, and of our Canadian researchers who think outside the box to tackle the greatest challenges of our time,” Minister Champagne continued. ⁽³⁾

Also, in April 2023, the Government of Canada funds no less than \$200 million for Canadian-led interdisciplinary, international, high-reward and high-risk research utilising the New Frontiers in Research Fund (NFRF). The Government supports 195 projects through three different NFRF competitions. This investment in 1,054 researchers, with 338 early career researchers included in that, underscores a commitment by the Government to keep “interdisciplinary research at the forefront to build a global brand that will attract talent and capital for years to come”, we are told.

Minister Champagne commented that science and research are crucial to solving humanity’s most significant challenges today and beyond. “That’s why our government is committed to continuing support for researchers who are pushing the boundaries of innovation, by investing in transformative, high-risk / high-reward research that will address issues that impact Canadians in all sectors of our economy and society.

“With our highly educated workforce and world-class research institutions, we are well positioned to meet the needs of the next century and remain a global leader in science and innovation,” the Minister added. ⁽⁴⁾

Collaboration in science, technology and innovation

Collaboration is also crucial in science, technology, innovation and research. In April 2023, a joint committee between Canada and France was established to bolster the two countries’ longstanding partnership on science, technology and research. This fits with the broader notion of the Government of Canada that to meet the world’s most pressing challenges; we need the best and the brightest working together.

“Canada and France will continue to foster greater collaboration in science, technology and innovation through the work of the new joint committee. Together, our two countries are helping create more opportunities for researchers, innovators and businesses to partner on projects that will shape the economy of the future,” Minister Champagne remarked. ⁽⁵⁾

Interestingly, in the same month, we see a very similar story when the Governments of Canada and Switzerland sign a joint statement on science, technology and innovation research. As Minister Champagne so succinctly described: “Canada and Switzerland will continue to foster greater collaboration in science and research. Together, our two countries are helping create more opportunities for researchers, innovators and businesses to partner on projects that will shape the economy of the future.” ⁽⁶⁾

On 8th June 2023, the Governments of Canada and the UK advanced a partnership in quantum science and biomanufacturing. Minister Champagne elaborates on this further, yet his comment also highlights his positive thoughts regarding encouraging more collaboration in science, technology and innovation today to shape the future economy of Canada.

“Today’s memorandum of cooperation on biomanufacturing and the joint statement on quantum science and technology are important steps in making the most of our world-class capabilities, which will drive innovation and economic growth in both our countries. We will continue to work together to foster greater collaboration in science and research to shape the economy of the future.” ⁽⁷⁾

Research of today, the innovation of tomorrow

There are so many more exciting examples we could explore in science, research and innovation, such as support for quantum science and technology ⁽⁸⁾, life sciences ecosystem ⁽⁹⁾, artificial intelligence research ⁽¹⁰⁾ and advancing the semiconductor industry ⁽¹¹⁾ to illustrate further the sterling efforts the Government of Canada makes to support science, technology, research and innovation. As Minister Champagne so brilliantly remarks, “Today’s research is tomorrow’s innovation” ⁽¹⁰⁾ and “economy”. ⁽³⁾

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FUTURE TECHNOLOGY: MULTI-PURPOSE PLASMAS WITH MICROWAVES

Professor Michel Moisan and his team at Université de Montréal (UdeM) explore reliable, energy-efficient and multi-purpose plasmas with microwaves for research and technology

The ability to generate ionized gases (gaseous plasmas) under required operating conditions (shape and volume of the plasma, nature of the gas (including various mixtures), and pressure) is central to many aspects of science and industry. In that respect, of particular interest are low-temperature plasmas where the electrons have high energy while the ions remain slightly above room temperature allowing, among other things, low-energy chemistry.

To achieve reproducible and low-contaminated (electrodeless) gaseous discharges, it is better to call on high-frequency (HF) electric field: it initially accelerates a few electrons that are randomly present in the gas, which then go on to strip the outer electrons of atoms in a source gas, creating an 'avalanche' process, which culminates in a stationary fluid of electrons and ions – a plasma.

Professor Michel Moisan and his team at Université de Montréal (UdeM) explored the capabilities of various devices they patented [\[2\]](#) (e.g. surfatron, surfaguide: now in the public domain) that provide plasma torches or plasma columns simply and efficiently, using radiofrequency (RF: few MHz-100 MHz) or microwaves (above 100 MHz in the present case), both commonly designated as HF fields. These original devices launch an electromagnetic

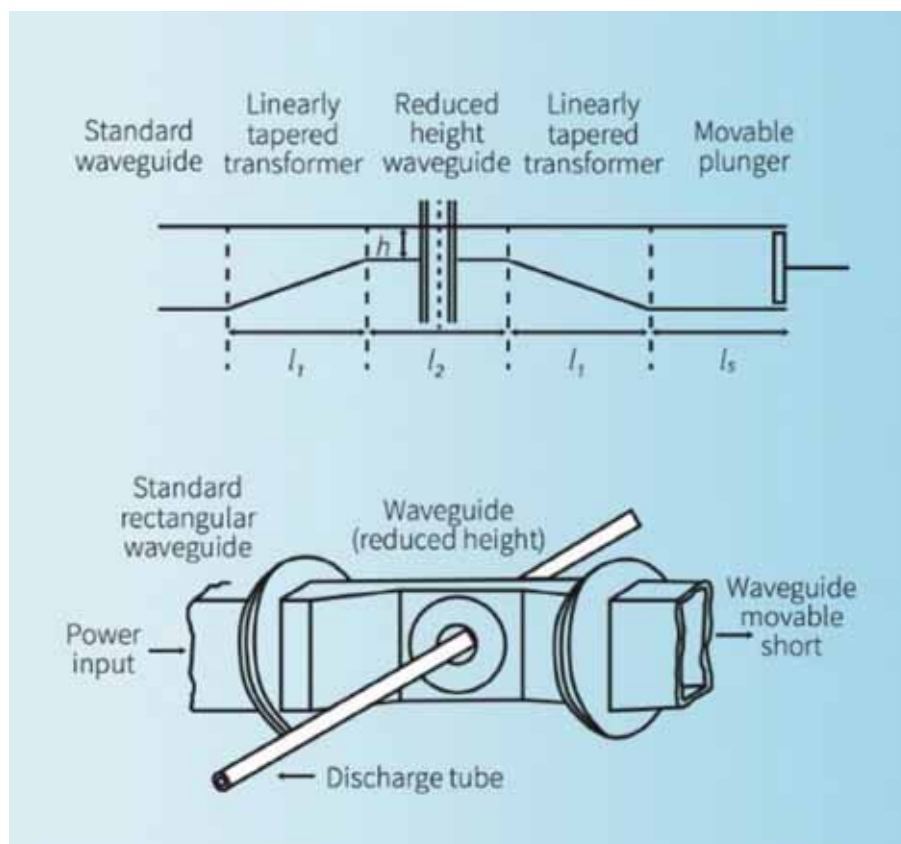


Figure 1: Schematic illustration of the surfaguide

surface wave that propagates guided along the plasma jet surrounded by a gas (e.g. air) or along a plasma column filling a dielectric vessel (transparent to HF field) in which it is generated.

Understanding surface-wave (SW) sustained plasmas

"A critical comparison of the properties of RF and microwave (MW)-produced plasmas by different field applicators shows that the possibilities of the surface-wave-produced plasma in

many ways exceed those of other existing RF and MW microwave-produced plasmas. In addition, since the plasma is sustained through wave propagation, the wave launcher can be small compared to the length of the plasma column. A further advantage of surface-wave-produced plasmas is that they can be obtained both in the RF and in the MW frequency domain" ⁽¹⁾. It is thus possible to optimize the plasma parameters for a given application through varying the wave

frequency since ions and electrons are entrained by RF fields whereas only electrons respond to MW fields.

The surfaguide: a power-efficient MW field applicator for plasma generation which is easy-to-build and operate

For plasma generation to work effectively, it is crucial for power to be transferred from the RF or MW generator to the plasma as efficiently as possible, while also ensuring that stable gas discharges can be sustained for extended periods of time.

In addition, this must be done across a broad range of operating conditions – including (abruptly) varying compositions and pressures in the gas. SW launchers (a family of HF field applicators) like the surfaguide (fig. 1) have been investigated and worked out such that they can be designed to withstand these types of changes, without running off (no impedance retuning with the HF power generator needed).

The plasma column is produced within a dielectric tube (e.g. fused silica (high-temperature discharge), AlN ceramic (resistant to fluorine)) and extends from both sides of the launching interstice. The surfaguide illustrated in the figure is based on a WR-340 rectangular waveguide, which ensures efficient operation at 2450 MHz, provided the discharge tube diameter does not exceed 15% of the waveguide wide wall area (here 12 mm) to operate on a large range of varying conditions and not needing retuning; at 915 MHz with a WR-975 frame ⁽²⁾, the tube diameter could reach up to 36 mm similarly. Continuous 6 kW operation at 2450 MHz is customary in the industry. The waveguide height h is chosen

such that the intrinsic impedance of the SW plasma column acting as a transmission line be close to the impedance of the surfaguide device at height h .

Some applications of surface-wave discharges (SWDs)

1. A compact cw chemical HF/DF laser with a surfatron at 915 MHz

Fluorine atoms (from dissociated SF₆ molecules) are mixed with hydrogen (or deuterium), and the chemical reactions which follow generate a large number of HF (or DF) molecules in excited vibrational states, creating a population inversion. Electrical efficiency calculated at the maximum laser output power is 0.6 % (at 600 W MW power, it makes 3.6 W: caution). From application 2, it was found better that the Al₂O₃ ceramic discharge tube be replaced by an AlN ceramic that resists fluorine corrosion and, additionally, that the input gas flow be vortexed to prevent the tube from breaking due to local overheating ⁽⁵⁾.

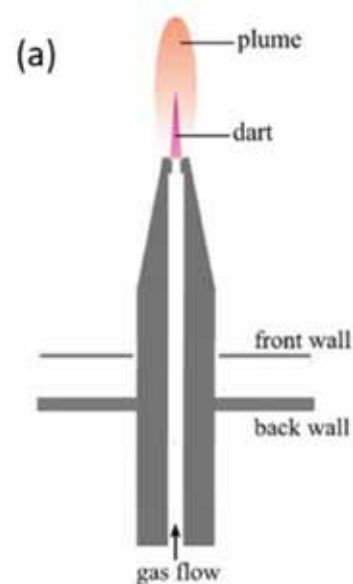


Figure 2a: High-power (kW) MW plasma-torch: schematic representation of the TIA/TIAGO microwave field-applicator: a hollow conducting rod, terminated by a conical nozzle, emerges from a surfaguide field-applicator, represented by the front (thinned) and back wide-walls of a reduced-height section of the narrow walls from a regular rectangular waveguide ⁽³⁾.

2. Eliminating greenhouse gases and purifying rare gases obtained from cryogenic air distillation

Surfaguide-based plasma systems were used to remove fluorinated

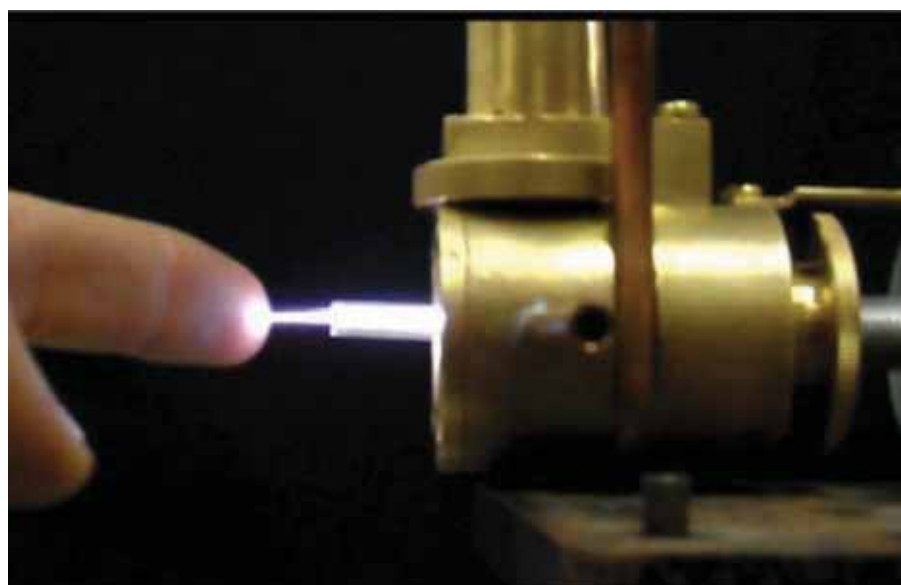


Figure 2b: Low-power MW plasma torch produced by a surfatron wave launcher ⁽⁴⁾.

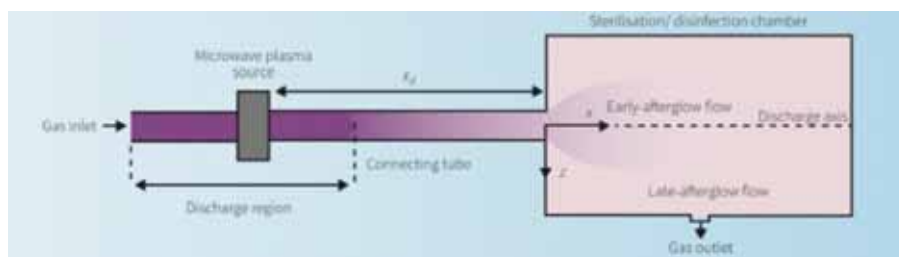


Figure 3: Representation of the N_2/O_2 discharge outflow of long-lived N and O species as they enter the sterilisation/disinfection chamber after travelling from the microwave-plasma source, before finally recombining anywhere within the microorganism external structure into NO excited species, providing local UV photons damaging the DNA ⁽⁸⁾.

greenhouse gases such as CF_4 and SF_6 , which can remain in the atmosphere for over 50,000 years before degrading. These two gases are used in the plasma reactors required to fabricate computer chips. To avoid damaging the pumping system, the fluorinated gases were “drowned” in a nitrogen stream requiring plasma effluents carried in rapid nitrogen flows. The process, which takes place at atmospheric pressure with the addition of a few per cent of oxygen (oxidizing the fragmented molecules, preventing them from reassociating and giving them an acid-like nature facilitating their scrubbing on an alkaline bed), is ecologically clean and electrically very efficient when compared to burners previously used. These systems are employed industrially in abating fab-reactor greenhouse gases as well as purifying noble gases ⁽⁶⁾.

3. Sterilising medical equipment

Sterilisation implies that at the most, only a single microorganism is left among initially one million. A surfatron, a lower-frequency microwave field applicator (915 MHz), is used rather than the surfaguide where 200 W is absorbed in the 50-litre sterilization chamber ⁽⁸⁾. An optimised mixture of

N_2 and O_2 is used to generate a plasma column of NO excited molecules that emit an intense afterglow of ultraviolet light: the afterglow designates the region far enough from the surfatron where no electric field from the surface wave is present and, sufficiently farther along it, to reach the late-afterglow domain where there are no more electrons. Ultraviolet light with wavelengths of between 180 and 350 nanometres induces lesions in the DNA of microorganisms, ultimately when these are numerous enough to lead to their inactivation. The advantage of the present SW sterilisation technique over all other plasma sterilisation systems is that it relies on the far flowing-afterglow (Fig. 3). This is an original and unique feature of the late-afterglow method since with all other plasma sterilization techniques electrons charge up on microorganisms, which are then released by an electrostatic force acting on the substrate so rapidly that they do not become inactivated, eventually contaminating the sterilization chamber and flowing out into the “outside world” ⁽⁹⁾. Compared to chemical sterilization processes (e.g. ethylene oxide), no post-process vent time is required with the afterglow technique since no toxic components have entered polymeric materials,

ensuring absolutely safe sterilization, e.g. for contact lenses.

The development of new applications based on plasma produced by microwave fields is now facilitated by the recent publication of a fluid (hydrodynamic) model ⁽¹⁰⁾ allowing us to better understand the particular kinetics of the electrons in these plasmas and to benefit from them: only the electrons are accelerated by the microwave electric field. These “electronic” plasmas are complementary to RF plasmas where the important role of ions is distinctive, by the presence of ionic sheaths offering to benefit from the directionality of the ionic bombardment without which it would not be possible to manufacture microelectronic chips. On the other hand, the treatment of gases by microwave fields seems to offer a huge field of applications that were previously unimaginable. For example, the decomposition of CO_2 gas, which is prevalent on Mars, could make it possible to obtain the oxygen necessary for the establishment of “terrestrial” life bases on this distant planet. (ref.)

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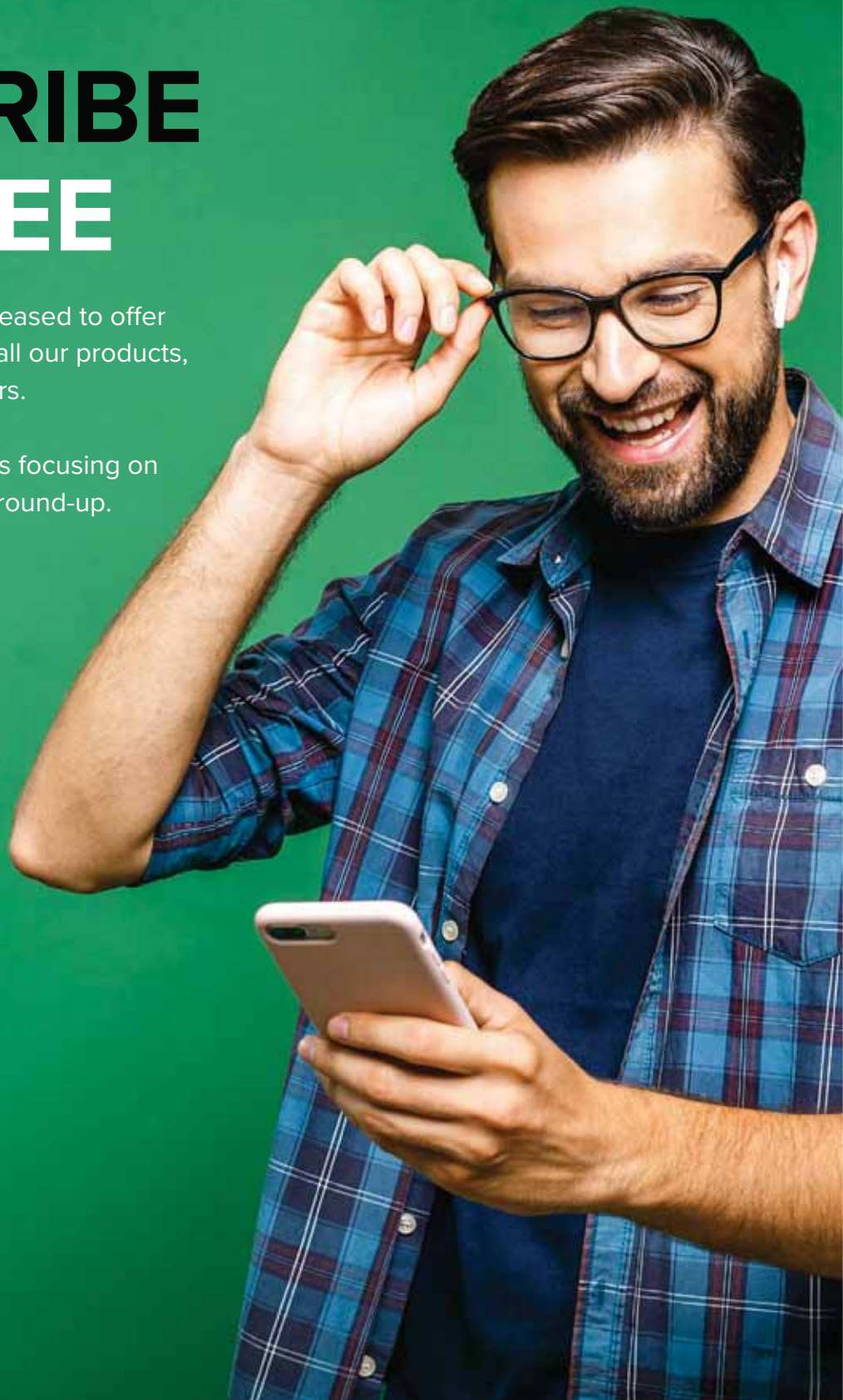
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UNDERSTANDING THERMOLABILE PROTECTING GROUPS FOR NUCLEIC ACID-BASED DRUGS

Serge L. Beaucage investigates thermolabile protecting groups for the amine functions of purine and pyrimidine deoxyribonucleosides for the development and implementation of synthetic DNA sequences as nucleic acid-based drugs

The high demand for nucleic acid-based drugs, earmarked for treating human diseases, requires improved chemical methods for rapid and efficient chemical synthesis of synthetic DNA and/or RNA sequences with protecting groups before being processed and manufactured in sufficient quantity and purity for clinical indications.

Given that the purity of synthetic DNA/RNA sequences is of the utmost importance for their intended purposes, sustained research efforts have been made.

Examining DNA sequences and so much more at the Beaucage lab

Over the years, researchers at the Beaucage lab have tried to improve the solid-phase chemical synthesis and solid-phase purification of DNA and/or RNA sequences.

Specifically, the thermolabile 4-methylthio-1-butyl and 2-(*N*-formyl-*N*-methyl) aminoethyl groups ([Cieślak et al.,] [<https://doi.org/10.1021/jo035861f>]; [Grajkowski et al.,] [<https://doi.org/10.1021/ol0156852>]) for phosphate/thiophosphate protection of synthetic DNA sequences, are distinctive in terms of structural simplicity and coupling efficiency of their respective deoxyribonucleoside phosphoramidite derivatives.

DNA sequences have been shown to have several phosphate and thiophosphate protecting groups that can eventually be cleaved through an efficient intramolecular cyclodeesterification reaction.

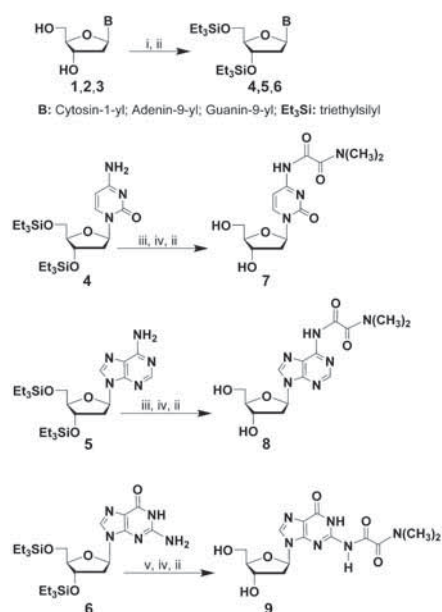
This occurs within minutes up to hours when exposed to temperatures ranging from 37°C-90°C under near-neutral (pH 7.4) or mildly basic (pH 9) conditions in an aqueous buffer ([Ausin et al.,] [<https://doi.org/10.1016/j.tet.2009.10.096>]; [Grajkowski et al.,] [<https://doi.org/10.1039/B9NJ00692C>]).

Thermolytic cleavage of protecting groups

Inspired by the implementation of the thermolabile 2-(*N*-formyl-*N*-methyl) aminoethyl phosphate/thiophosphate protecting group ([Grajkowski et al.,] [<https://doi.org/10.1021/ol0156852>]) in the solid-phase synthesis of model oligodeoxyribonucleotides, protection of the purine and pyrimidine amine functions of deoxyribonucleosides, as *N*, *N*-dimethyloxalamides, is reported herein along with the conditions used for thermolytic cleavage of these protecting groups.

As presented in scheme 1, the hydroxyl functions of the native deoxyribonucleosides **1-3** are first protected as their respective triethylsilyl ethers **4-6**. The exocyclic

amine functions of **4-6** are then protected as *N*, *N*-dimethyloxalamides, under the conditions described in the caption of scheme 1, to provide the *N*-protected deoxyribonucleosides **7-9**.



Scheme 1: protection of the exocyclic amine functions of deoxyribonucleosides **4**, **5** and **6** as *N*, *N*-dimethyloxalamides affords **7**, **8** and **9**, respectively. Reagents and conditions: (i) chlorotriethylsilane, anh. pyridine, ~25 °C, 16 h; (ii) chromatography on silica gel; (iii) *N*, *N*-dimethylloxamic acid, HBTU, DMF, *N*, *N*-diisopropylethylamine, ~25 °C, 18 h; (iv), triethylamine trihydrofluoride, anh. CH₂Cl₂, ~25 °C, 30 min; (v) 2-(dimethylamino)-2-oxoacetic anhydride, anh. pyridine, ~25 °C, 18 h.

The thermostability of *N*, *N*-dimethyloxalamides, as amine-protecting groups, has been investigated. Indeed, heating **7** in a

Trizma hydrochloride solution (pH 9) at 90°C over one hour has led to complete thermolytic cleavage of its amine-protecting group.

Furthermore, as illustrated in figure 1, the RP-HPLC profile of **7** demonstrates quantitative N⁴-deprotection to provide deoxycytidine compared to the RP-HPLC profile of a commercial deoxycytidine sample.

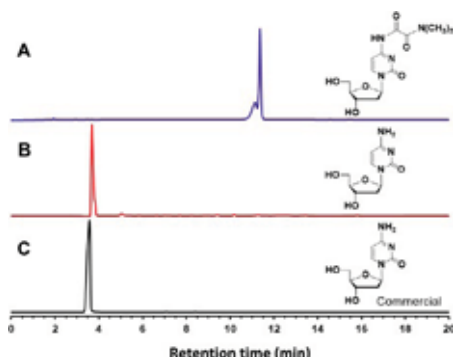


Figure 1: RP-HPLC analysis of the thermolytic N⁴-deprotection of **7**. (A) RP-HPLC profile of purified rotameric N⁴-protected deoxycytidine (**7**). (B) RP-HPLC profile of the thermolytic N⁴-deprotection of **7** when subjected to a Trizma hydrochloride solution (pH 9) for one hour at 90°C to give deoxycytidine. (C) RP-HPLC profile of a commercial deoxycytidine sample.

The RP-HPLC profile of **8** presented in figure 2 validates the quantitative N⁶-deprotection of **8**, within one hour at 90°C in a Trizma hydrochloride solution (pH 9) to provide deoxyadenosine,

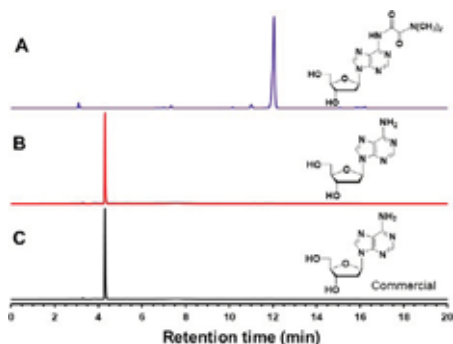
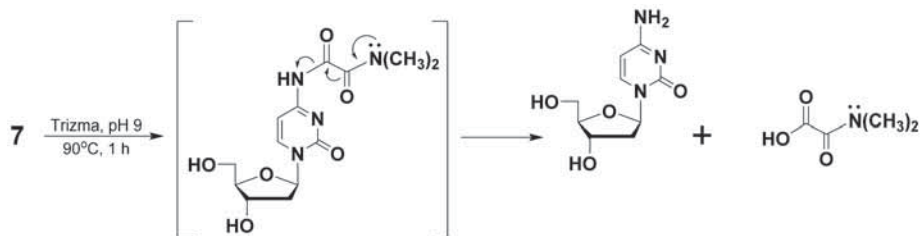


Figure 2: RP-HPLC analysis of the thermolytic N⁶-deprotection of **8**. (A) RP-HPLC profile of purified N⁶-protected deoxyadenosine (**8**). (B) RP-HPLC profile of the thermolytic N⁶-deprotection of **8** after exposure to a Trizma hydrochloride solution (pH 9), over a period of one hour at 90°C, to yield deoxyadenosine. (C) RP-HPLC profile of a commercial sample of deoxyadenosine.



Scheme 2 depicts a proposed mechanistic pathway for the thermolytic cleavage of *N,N*-dimethyloxalamides, as amine protecting groups, yielding deoxycytidine, deoxyadenosine or deoxyguanosine.

when compared to the RP-HPLC profile of a commercial deoxyadenosine sample.

Like the chromatographic profiles supporting the facile thermolytic deprotection of the amine-protecting group from the deoxyribonucleosides **7** and **8**, RP-HPLC analysis of N²-protected **9** also shows quantitative amine deprotection under essentially identical thermolytic conditions to those reported in the caption of figure 1.

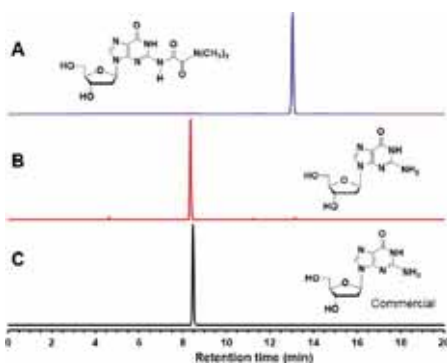


Figure 3: RP-HPLC analysis of the thermolytic N²-deprotection of **9**: (A) RP-HPLC profile of purified N²-protected deoxyguanosine (**9**); (B) RP-HPLC profile of the thermolytic N²-deprotection of **9** after heating in a Trizma hydrochloride solution (pH 9) over one hour at 90°C to produce deoxyguanosine, and (C) RP-HPLC profile of a commercial sample of deoxyguanosine.

The mechanistic pathway for thermolytic deprotection of *N,N*-dimethyloxalamides, as amine protecting groups, is very likely to proceed through thermal hydrolysis and/or potentially through an intramolecular deamidation pathway, as proposed in scheme 2.

Protection of the amine function of deoxyribonucleosides and the application of *N,N*-dimethyloxalamide protecting groups

The outcome of the proposed strategy for the protection of the amine functions of purine and pyrimidine deoxyribonucleosides, and the facile thermolytic cleavage of *N,N*-dimethyloxalamides at pH 9 without the formation of DNA-modifying side products, strongly encourages the application of such protecting groups to the preparation of synthetic DNA and RNA sequences given the comparable chemical properties of the purine and pyrimidine amine functions of ribonucleosides to those of deoxyribonucleosides.

Thus, using thermolabile protecting groups for the amine functions of purine and pyrimidine deoxyribonucleosides or ribonucleosides can significantly facilitate the manufacture of pure, efficacious, and safe nucleic acid-based drugs for therapeutic applications.

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AARS URZYMES: EXPERIMENTAL BIOCHEMISTRY TO MAP GENETIC CODING

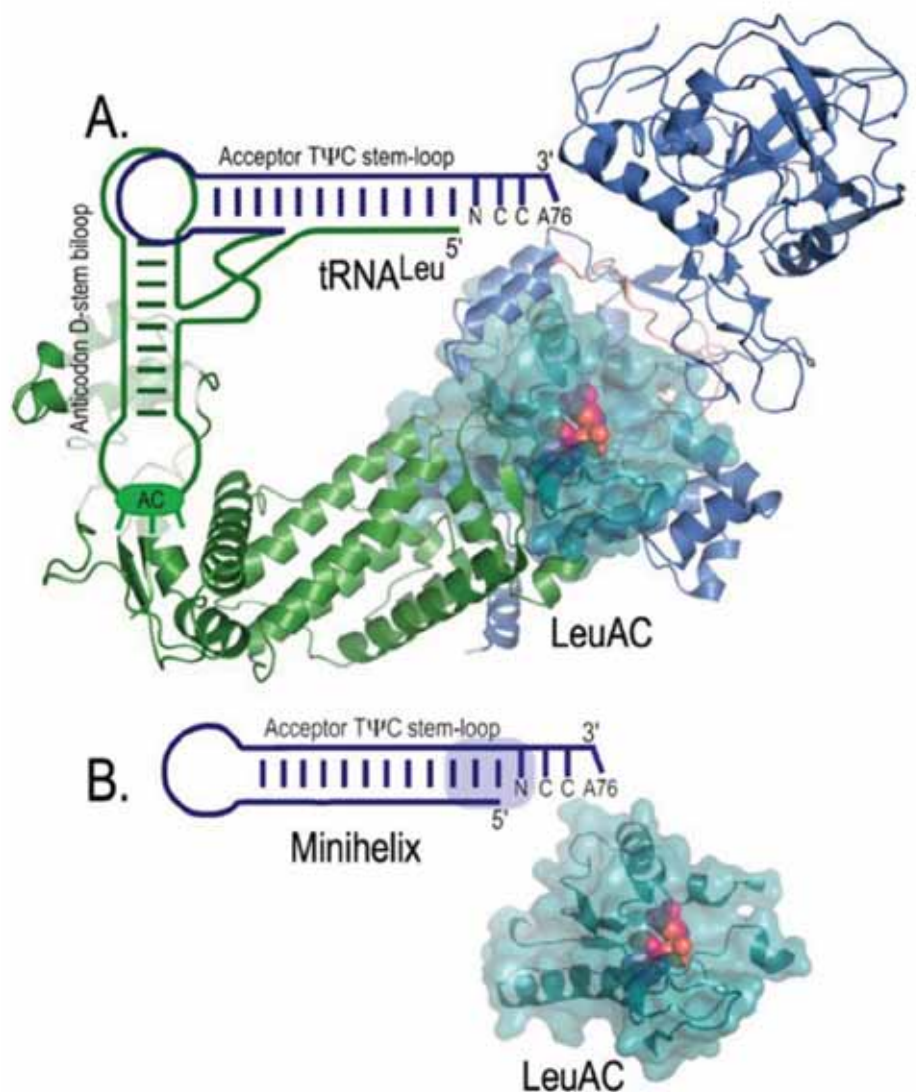
Dr Charlie Carter from the University of North Carolina at Chapel Hill explores how advances in enzymology and phylogenetics enable biochemical measurements that could map the ancestral development of genetic coding

Chemical reactions in the cell degrade energy-rich food molecules and rearrange their chemical bonds into other molecules necessary to construct and sustain living things far from chemical equilibrium. Those reactions occur spontaneously at rates that span an extraordinary range, the fastest going up to 10^{25} times faster than the slowest. ⁽¹⁾ All these reactions must be accelerated by different amounts to maintain adequate concentrations of chemical components in the cell. Enzymes perform that differential acceleration exquisitely well.

Enzymology and phylogenetics

Enzymes are the nanomachines that transform random chemistry into regulated metabolic pathways that sustain life. Their precisely shaped cavities, called active sites, can tell one molecule from another by how well they fit within the site. That unique talent enables enzymes to speed reactions up by the astronomical amounts required to synchronise life's chemistry. It also provides the specificity necessary to build metabolic pathway networks.

Enzymes are proteins that the cell assembles according to genetic blueprints (genes). Reading those blueprints is the main information flow in living cells. Molecular evolution is the



(Fig 1.) A system for exploring the experimental biochemistry of ancestral genetic coding. A. represents the contemporary leucyl-tRNA synthetase•tRNA^{Leu} cognate pair. LeuRS and tRNA^{Leu} have two domains: a catalytic domain that interacts with the tRNA acceptor stem and another domain which interacts with other parts of the tRNA. B. shows a functional single-domain system. The leucyl-tRNA synthetase urzyme, LeuAC, catalyzes acylation of the tRNA^{Leu} minihelix, facilitating experimental measurement of the spectrum of functional amino acid and minihelix substrates, as well as the impact of the three base pairs (light blue shading) that determine cognate recognition.

study of how enzymes assumed their present form. Phylogenetic studies find successively more distant relatives and use those comparisons to construct family trees. Those trees, in turn, suggest the amino acid sequences of common ancestors.

The ample gene sequence databases open access to the recent evolutionary history of enzymes and related regulatory proteins. ⁽²⁻⁴⁾

The remote origins of the proteome, however, pose a greater challenge. Three-dimensional structures must guide the phylogenetic approach. Such analyses reveal that contemporary enzymes have a hierarchical modularity. Evolutionarily related enzymes use the same active sites to speed similar chemical reactions up. Nature then embeds these active sites, like Russian matryoshka dolls, into successive 'layers' of supplemental polypeptide that enhance function in mature enzymes and differentiate one family from another. That hierarchy points to the deeper roots of modern enzymes.

Urzymology

A major step forward was deconstructing that modular hierarchy and expressing just the active site module from the two families (Class I and II) of aminoacyl-tRNA synthetases (AARS). ⁽⁵⁻⁷⁾ AARS are the nanomachines that actually translate the genetic code. They are central to how information is read from genes. To our surprise, these small excerpts require minimal re-design to behave like the mature contemporary enzymes. They are just weaker and less discriminating. We call them 'urzymes', contracting the prefix 'ur' (= 'first') with 'enzyme'. Their amino acid sequences are also closely related, and their catalytic activities and substrate specificities resemble their full-length counterparts. These two properties

make urzymes useful experimental models for the primordial emergence and early evolution of enzymes. ⁽⁸⁾

Catalysis by full-length Class I AARS depends on two different active-site signature sequences, HIGH near the N-terminus and KMSKS at the C-terminus of the catalytic domain. Mutating the polar histidine and lysine residues in these signatures separately and in combination with both full-length leucyl-tRNA synthetase and its urzyme, LeuAC ⁽⁹⁾ allowed measurement of the energetic coupling energy coordinating the impact of the two signatures on catalysis. Remarkably, the two signatures function synergistically in the full-length LeuRS but oppose each other's effects in urzymes. That result is *prima facie* evidence both that urzyme catalysis is real and that the domains eliminated to make the urzyme impose the coordinated behaviour of these signatures in the mature enzyme.

Urzymes enable experimental studies of how genetic coding began

It was never obvious how to investigate the molecular ancestry of genetic coding experimentally. Recent developments in urzymology now make that possible (see Fig. 1). While we were developing AARS urzymes, other groups found that full-length AARS could acylate the acceptor-stem domains of their cognate tRNAs. A pivotal step in developing an experimental system came when we recently showed that AARS urzymes also acylate tRNA minihelices. ⁽¹⁰⁾ Generation of additional such pairs could be a game-changer by facilitating experimental measurements of the ranges of amino acid and tRNA minihelix substrates that can be aminoacylated by different urzyme•minihelix cognate pairs.

My previous piece ⁽¹¹⁾ noted that AARS•tRNA cognate pairs are the computational AND gates that make genetic coding work. The specific coding properties of ancestral urzyme•minihelix cognate pairs Fig. 1B can help us understand what catalysts can be made using fewer coding letters. Experimental access to that novel type of information can help us map the growth of the coding alphabet.

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U.S. quantum information science research initiatives

Open Access Government lifts the lid on the work of one of America's oldest physical science laboratories, focussing on their quantum information science research work

The National Institute of Standards and Technology (NIST), within the U.S. Department of Commerce, began its life in 1901. "From the smart electric power grid and electronic health records to atomic clocks, advanced nanomaterials and computer chips", many services and products depend on the standards, measurement and technology NIST provides.

Did you know that today, NIST measurements are helpful for the smallest of technologies to the most enormous and most complicated human-made creations – from tiny nanoscale devices to global communication networks and earthquake-resistant skyscrapers?

The mission of NIST is to advance measurement science, standards, and technology in ways that boost economic security and improve quality of life to support American industrial competitiveness and innovation. NIST seeks to be a global leader in creating robust measurement solutions and advancing just standards. Their endeavours promote industrial competitiveness, innovation, and the quality of life. ⁽¹⁾

This editorial will focus on NIST's quantum information science initiatives and news before reminding us of where this fits into the more expansive view.

Quantum information science initiatives

The Quantum Communication and Networks Project is a NIST initiative to develop quantum devices for quantum communications and networking use. They aim to bridge the theoretical foundations of information theory and quantum physics with their practical applications in information technology. The Quantum Communication and Networks Project do research and development on quantum repeaters and related measurement technologies. Their study aims to advance American innovation and industrial competitiveness and enhance national security. ⁽²⁾

Similar to how computers, electronics, and lasers revolutionised technology in the 20th century, quantum science and engineering has the potential to do the same for 21st century technology. As such, NIST's Quantum Information Program aims to understand how

quantum-based technology can revolutionise computing and communications and develop the measurement and standards infrastructure required to realise this potential fully. ⁽³⁾

Quantum information science news

We heard Ana Maria Rey, Theoretical Physicist and Fellow at NIST and JILA of the U.S. Department of Commerce in May 2023, was elected to the National Academy of Sciences, among the highest professional distinctions a scientist can receive. The research group Rey heads up and develops fresh ways to control quantum systems, which paves the way for new applications in measurement, quantum simulation and quantum. In particular, Rey's research played a part in creating the most precise atomic clock ever worked on.

Under Secretary of Commerce for Standards and Technology and NIST Director Laurie E. Locascio provides her comments on this remarkable achievement in the field and the impact this will have on the researchers of the future. "We are so proud of the incredible work Ana Maria Rey does on behalf of the nation. Her research is helping us to understand how the world works at the most basic level, so that we can create innovative technologies and improve our quality of life. We also appreciate her tireless mentorship of the next generation of researchers." ⁽⁴⁾

It is fitting, therefore, to mention that in September last year, we heard how Physicist Adam Kaufman of NIST was awarded the 2023 New Horizons in Physics Prize from the Breakthrough Prize Foundation ^(5,6) for his work to advance the control of molecules and atoms to make quantum information processing and atomic clocks better.

"Adam's work has opened new possibilities for quantum physics, for atomic clocks and more, and we are proud to see his accomplishments recognized," Under Secretary Locascio said. "This award recognizes not only his scientific achievements, but how those achievements have already advanced the research of others in this field. I am confident there are many more scientific breakthroughs in his future." ⁽⁶⁾

Quantum information science & other research

It seems appropriate to conclude this article by noting that Under Secretary Locascio was accepted into the

National Academy of Engineering in February, one of the highest professional honours an engineer can achieve. Locascio leads NIST's collaboration with academia, industry and government to unlock American innovation through technology, measurement, and standards advancement.

Locascio's key priority is successfully implementing the \$50 billion CHIPS for America initiative to revitalise and strengthen American leadership in semiconductor development, research and manufacturing. Locascio works to expand and advance NIST's work in critical emerging technologies such as quantum information, but also science, biotechnology, artificial intelligence, cybersecurity and privacy, energy, plus advanced communications.

Finally, Locascio advocates for NIST's continued role in promoting federal and international standards that help ensure U.S. technology leadership and economic competitiveness. ⁽⁷⁾ The work of America's oldest physical science laboratories continues creating vital measurement solutions and advancing just standards. ⁽¹⁾

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QUANTUM NETWORK TECHNOLOGY

Prof Dr Stephanie Wehner, Director of the European Quantum Internet Alliance, explains how quantum network technology and a quantum internet could revolutionise communication and connectivity

The internet, an intricate network connecting devices across the globe with classical communication, has profoundly shaped our world. We now stand on the brink of a new type of internet. Imagine an evolution of the internet, one that intertwines the principles of quantum mechanics with our existing digital technology. This is the vision of a quantum internet - an innovation that promises to redefine our understanding of communication and connectivity.

Working in tandem with our traditional 'classical' internet, a quantum internet would connect quantum devices globally. Such a network would unlock capabilities that are fundamentally unattainable through classical communication alone. Take, for instance, Quantum Key Distribution (QKD), a striking application of quantum communication. QKD allows two distant nodes to create an encryption key guarded by the immutable principles of quantum mechanics.

This allows secret communication that is future-proof; that is, it is secure even against an eavesdropper equipped with a large-scale quantum computer now or in the future. In a world where data security is paramount, this quantum advantage could be greatly beneficial and is now commercially available in metropolitan areas.

Beyond secure communication, however, we already know an array of transformative applications that highlight the potential of quantum network technology. The potential is

immense, and the vision of a quantum internet is to build a universal quantum network that can be programmed to run any type of future quantum network application.

What is a quantum network?

At the heart of these applications lie quantum bits, or 'qubits'. Unlike classical bits that exist as either '0' or '1', qubits can simultaneously inhabit a state of '0' and '1'. Intriguingly, it is impossible to copy arbitrary qubits. Any attempt at duplication can be detected, making them an ideal tool for secure communication. Two qubits can also be entangled, where entanglement forms an inherently private connection that cannot be shared with anything else.

A quantum network allows the transmission of qubits or, more generally, the creation of entanglement between nodes in the network (Figure 1). Such nodes may be simple photonic devices that only allow measuring one qubit at a time or more sophisticated devices.

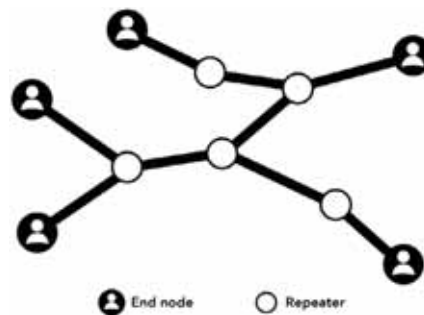


Figure 1: A quantum network contains end nodes on which applications are run, analogous to laptops or phones running applications on the classical internet. It is a great technological challenge to develop a quantum repeater that can be used to unlock long-distance quantum communication. Quantum bits can travel over standard telecom fiber already deployed

Unlike in quantum computing, where one can only draw real-world value once one has built a quantum computer that can outperform classical (super-)computers, the path towards bringing benefit to users is more gradual in the domain of quantum networking. Simple photonic devices can already unlock applications such as quantum secure communication in metropolitan areas.

Today, quantum communication is commercially available in metropolitan areas (short distances of up to 100km in fiber) when restricted to simple use cases enabled by QKD. No long-distance quantum networks are deployed today that enable end-to-end quantum communication and, thus, end-to-end quantum secure communications.

Ongoing R&D efforts worldwide work to advance quantum networking in three directions: (1) distance - to connect users in different metropolitan areas and beyond using end-to-end quantum communication; (2) functionality - to enable applications beyond secure communication; and (3) accessibility - to create cheaper devices. Global reach may eventually be attained using a combination of quantum repeaters in fiber networks on the ground, and quantum satellites.

Both are the subject of ongoing R&D efforts. Stages of functionality (Figure 2) have been identified for the development of a quantum internet, where each stage unlocks a larger class of possible user applications. ⁽¹⁾

What can one do with quantum network technology?

Using the stages of functionality as a guideline, let us briefly provide more information about applications and potential use cases of quantum network technology.

Prepare and measure stage

This stage contains QKD, which addresses the critical challenge of securing communication in transit and using keys to authenticate access.

It is interesting to note that many devices that can do QKD could, in principle, also be used to provide an advantage in other security-sensitive domains, including, for example, password identification or privacy-preserving analytics.

Entanglement generation stage

This stage unlocks versions of the aforementioned use cases in security with the additional guarantee that the quantum devices are not trusted – a feature known as device independence in quantum cryptography.

Moreover, this stage enables all use cases that exploit the fact that entanglement allows for stronger correlations ⁽⁴⁾ when measuring the

qubit than is allowed classically. It has been shown that practical applications exist for this, enabling remote Bridge players to gain an advantage. ⁽³⁾

On a more speculative note, it may be interesting to explore whether pre-shared entanglement generated using a quantum network can enhance efficiency in other tasks that require coordination, such as high-frequency trading.

Quantum memory stage

This stage can be reached if the devices connected to the quantum network are quantum processors, that is, quantum computers capable of storing and manipulating a few qubits. Examples of possible use cases in this stage include secure quantum computing in the cloud. ⁽²⁾

To highlight the breadth of potential use cases, we also remark that a Quantum internet can combine remote sensors for higher-resolution imaging. ⁽⁵⁾ This has potential applications in astronomy, obtaining sharper celestial images, geological exploration, and identifying potential materials in the ground.

Few qubit fault tolerant stage

This stage is distinguished from the last one in that the quality of the qubits in the quantum processor is very high –

specifically, their quality is protected by fault-tolerant quantum computing.

For example, Quantum internet could reduce communication requirements for solving specific tasks. ⁽⁶⁾ This could have the potential to enable, for example, faster appointment scheduling across multiple calendars, comparisons of data stored at different network sites, or faster image processing in image recognition tasks. Other examples in this stage include enabling proofs of data deletion. ⁽⁷⁾

Quantum internet alliance

The Quantum Internet Alliance (QIA) is a partnership of presently 40 members, including leading actors from academia, and industry in Europe, to build a prototype Quantum Internet. This prototype network will connect two metropolitan area networks via a long-distance backbone.

QIA also provides a platform for Quantum Internet Innovation with opportunities to connect.

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Stage of quantum network	Examples of known applications
Quantum computing	Leader election, fast byzantine agreement, ...
Few qubit fault tolerant	Clock synchronization, distributed quantum computation, ...
Quantum memory	Blind quantum computing, simple leader election and agreement protocols, ...
Entanglement generation	Device independent protocols
Prepare and measure	Quantum key distribution, secure identification, ...
Trusted repeater	Quantum key distribution (no end-to-end security)

Figure 2: Stages of Quantum Internet Development (1): Each stage can provide more functionality to the user, but the quantum hardware required is more challenging to build



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THE DEVELOPMENT OF RESEARCH SOFTWARE ENGINEERING AS A PROFESSION

Dr Joanna Leng at the School of Computing explores Research Software Engineering (RSE) as an emerging profession, and how computing technology is core to many professions

Research Software Engineering is a young and emerging profession. This article looks at how it compares to other more mature professions and how all these professions handle two factors that are particularly important to the RSE profession, the stability of computing technologies and the adoption of these computing technologies by each profession.

What makes a profession mature?

Mature professions have a developmental path that includes (McConnell & Tripp, 2005):

- Initial professional education – probably a degree
- Accreditation – oversight body approves qualifications
- Skills development – work experience through apprenticeship
- Certification – voluntary examinations
- Licensing – mandatory examination
- Professional development – continual retraining, is especially important in roles where technology changes
- Professional Societies – for the exchange of knowledge
- Code of Ethics – to encourage responsible behaviour

Factors that separate Research Software Engineering from the general path

Computing technologies and research practices are two factors that have an impact on the core practices and methods used by RSEs but are not so significant to other professions. The stability of computing technologies gives an interesting comparison to the related profession Software Engineering (SE) and considers if this is a key factor in the maturity of SE and RSE. The adoption of computers gives a viewpoint on whether RSE is a subset SE or whether it is in an intersect with SE and the other professions/disciplines that are in the process of adopting computers into their practices.

Research Software Engineering in comparison to other professions

Medicine is a very old and mature profession. There are many well-accepted practices, standards and bodies that mean that it meets all the elements of the developmental path identified by McConnell and Tripp. There is no subdiscipline of computational medicine, computers are used and adopted into medical practice through continual professional development.

Engineering is a very old and mature profession. Not all engineers use computers but the use of computers is so widespread through the use of CAD and simulation that computational

engineering is not considered a sub-discipline but a core practice of the profession. Changes in computing technologies are absorbed through continual professional development.

Linguistics is again an old and mature profession. The adoption of the computational method is going from the natural sciences to the social sciences and from the developed world to the developing world. Linguistics is fairly new to the computational method and computational linguistics is seen as a sub-discipline of linguistics.

Software Engineering is a fairly mature profession. Here are four areas that indicate it is not yet there. Firstly, the IEEE SWEBOK (Software Engineering Body of Knowledge) calls their work an “Emerging Body of Knowledge” for three reasons “Practices Change”, “Other Viewpoints Emerge” and “The Body of Knowledge Grows”, all indicating emerging standards for an emerging profession. Secondly, the engineering part of the role can be understood by a set of rules and logic which makes it ideal for future automation, currently a discussion point with the release of ChatGPT. Thirdly, the instability and continual development of computing technologies means that unforeseen changes could occur that may drastically change the practices and profession. Fourthly and finally, there is not yet a fully legal and ethical

framework for all application areas, in particular for AI and the lack of this is often reported in the news.

Research Software Engineering is a young and emerging profession. In recent years the role has gained recognition and awareness but some of the indicators that it is relatively young are that:

- It does not have a clear standardized framework or practices.
- There is no educational pathway and skills development varies, there is a strong emphasis on continuous learning and staying updated with rapidly changing trends.
- It can offer exciting and dynamic career opportunities driven by emerging technologies and industries.
- There is the chance to be at the forefront of innovation and make significant contributions to the development of a new field e.g., new professions and disciplines emerge from it such as Data Science and Virtual Reality.
- There are more entrepreneurial opportunities.

The importance of the diversity of the Research Software Engineering Role

The Research Software Engineering community represents High-Performance Computing (HPC) and simulation expertise more than other areas.

As the adoption of computational methods moves from the natural sciences to the social sciences it seems likely that this bias in the RSE

community represents a snapshot of the adoption of computing across all disciplines. As an RSE with expertise in visualization and a variety of cross-disciplinary areas, this dominant view does not represent my concerns and practices.

Some problems that can result from not representing the full diversity of the RSE role:

- Limited perspectives lead to a narrower range of perspectives and experiences resulting in a limited understanding of the challenges, needs, and aspirations of different professional roles.
- Incomplete representation can create a disparity in recognition, visibility, and career opportunities.
- Narrow skill development can limit the development of a broad range of skills and expertise.
- Missed opportunities for collaboration which are often catalysts for innovation and growth.
- Potential bias and inequality can perpetuate existing biases and inequalities within the profession.

It is worthwhile pausing and taking the time for all parts of the Research Software Engineering community to catch up. Otherwise the profession will only be mature in places.

Without everyone being in the same place, fault lines in the profession are likely to appear:

- Limited experience and expertise can lead to subpar outcomes or may even harm clients or stakeholders.

- Ethical concerns – there is a risk of neglecting ethical considerations or not having robust ethical codes in place. This can lead to ethical lapses, misconduct, or inadequate protection of all the stakeholders.

- Limited and incorrect career development can hinder professionals' career development, making it difficult for them to progress, specialize, or gain the recognition they deserve.

- Stifled innovation and adaptability as professionals may be hesitant to embrace new approaches, technologies, or methodologies, fearing that it goes against the perceived maturity of the profession.

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Acknowledgement: This work was supported by the EPSRC grant number EP/R025819/1



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THE CHALLENGES OF PRACTISING INTELLECTUAL HUMILITY WITH DEEPLY HELD RELIGIOUS BELIEFS

In this fourth of a five-article series in Open Access Government on the topic of intellectual humility (IH), Peter C. Hill explores the challenges associated with practising IH with deeply held religious beliefs

Given the contentious nature of much religious dialogue and strongly held religious beliefs – where roughly two-thirds of the world’s population consider religion to be important for daily living – it is no surprise that the domain of religion is fertile ground to study the social effects of intellectual humility (IH).

For several reasons, religion can be a powerful and successful meaning system which can impact how people see, interpret, and function within their world. For example, religion can serve as a philosophical orientation that provides individuals with a core schema or cognitive map to help navigate their experiences.

In addition, it provides a means of transcendence and association with what is beyond us, a concern and interest for many. Religion also contains other sources of meaning, such as creativity, relationships, work, ideals, and values. On top of all this, religion is often a direct provider, with explicit claims, of meaning and purpose in life.

As with political beliefs noted in the [third article](#) of this five-part series in Open Access Government, there are strong headwinds to practising IH in the religious domain.

Religion, because its concerns are heavily weighted with strong existential issues, is, for many, a certainty-driven motivation. Thus, one may fear discovering that they could be wrong, which, in turn, can undermine one’s religious meaning system’s sense of coherence and certainty reinforced by strongly held religious beliefs.

The intellect in intellectual humility

Before summarising the IH and religion research, we should consider our understanding of what the word intellect means as part of intellectual humility. One may (falsely) conclude that IH is strictly a rational process, suggesting it is entirely devoid of a-rational human functioning.

However, what has been emphasised in this five-part series is that IH involves fundamental motivational components that extend far beyond just rational functioning.

Psychologists have long recognised that important beliefs and values are supported by two fundamentally different psychological processes, one that involves the ability to evaluate evidence and arguments and another that involves generating affective meaning, including meaning found through social relationships and moral considerations.

The types of psychological processes and reasoning

At the cognitive level, these two psychological processes also involve two types of reasoning. One type, frequently called Type 2, is what we usually associate with the word ‘reasoning’ in that it involves deliberate, effortful, and controlled cognitive processing of information.

But people, even those considered extremely rational, also use Type 1 reasoning, which is more automatic, implicit, and even intuitive in nature (such as the belief in human dignity). It is important to note that different tasks call for different types of reasoning and processes beyond strictly a cognitive analysis.

For example, some situations may require a degree of empathy that extends far beyond what an analytical approach can provide.

It is tempting to consider religious beliefs and values as a social and emotional process that involves Type 1 reasoning and religious disbelief (or at least agnosticism) as an empirical/analytical process that involves Type 2 reasoning. This, however, is too simplistic.

Recent neuroscience evidence suggests that in everyone, there are at least two

anatomically independent neural networks (the analytically oriented task-positive network and the social and emotional default-mode network) that are functionally antagonistic to each other, resulting in psychological tension such that when one network is activated, the other network is deactivated. Simultaneously engaging the cognitive processes of both networks appears to run contrary to how the functioning brain is organised.

The psychological and reasoning processes at work will depend upon which network is most salient and given priority, both in terms of individual differences (e.g., the religious person versus the non-religious) and situational demands.

What does the research say about religious beliefs and teachings?

Indeed, though many religions teach humility, including IH, as an important virtue (e.g., acknowledging that we see only a 'dim likeness of things' – I Cor. 13:12, NIV), most of the evidence suggests that IH is either negatively correlated or unrelated to many aspects of religiosity; for example, IH appears not to be associated with religious activity and intrinsic religious motivation (i.e., religion as an end rather than a means to some other desirable end).

One study found that religious fundamentalism, religious belief salience, prayer fulfilment, and universality (the belief that one's religious beliefs apply to all people regardless of culture or station in life) were all associated with less IH. Another study found that a greater reliance upon religious beliefs as a

“religion can be a powerful and successful meaning system which can impact how people see, interpret, and function within their world. For example, religion can serve as a philosophical orientation that provides individuals with a core schema or cognitive map to help navigate their experiences.”

foundation for a specific view on an issue is associated with lower IH.

Yet, for many religious people, IH has a positive value. For example, one study found that IH is associated with positive attitudes toward God and, inversely, related to anger toward God.

Such findings are important given the well-documented association between religiousness and spirituality with overall mental health and (though less well-established) physical health.

It may well be, as one study with Christians has found, that IH for religious people should consider what can be called a vertical IH (an IH that acknowledges human finiteness and divine authority) in addition to the horizontal interpersonal IH that heretofore has been exclusively characterised by measurement in the empirical literature.

That study found that considering the vertical theistic dimension in religious people's meaning system, IH predicted greater flourishing and less depression, anxiety, and religious struggle.

Changing one's religious beliefs should not be a necessary criterion for intellectual humility

As pointed out in previous articles of this series, religion will likely serve as a non-negotiable moral conviction and,

as such, changing one's religious beliefs should not be considered a necessary criterion for IH.

That said, an openness to what can be learned by transcending religious barriers is perhaps an indicator of the wisdom required to properly discriminate between those religious beliefs that should be open to revision and those that are justifiably held as non-negotiable.

Funding for this article and the research undergirding much of what is expressed herein was generously provided by the John Templeton Foundation (Grant Numbers 60622 and 62265).



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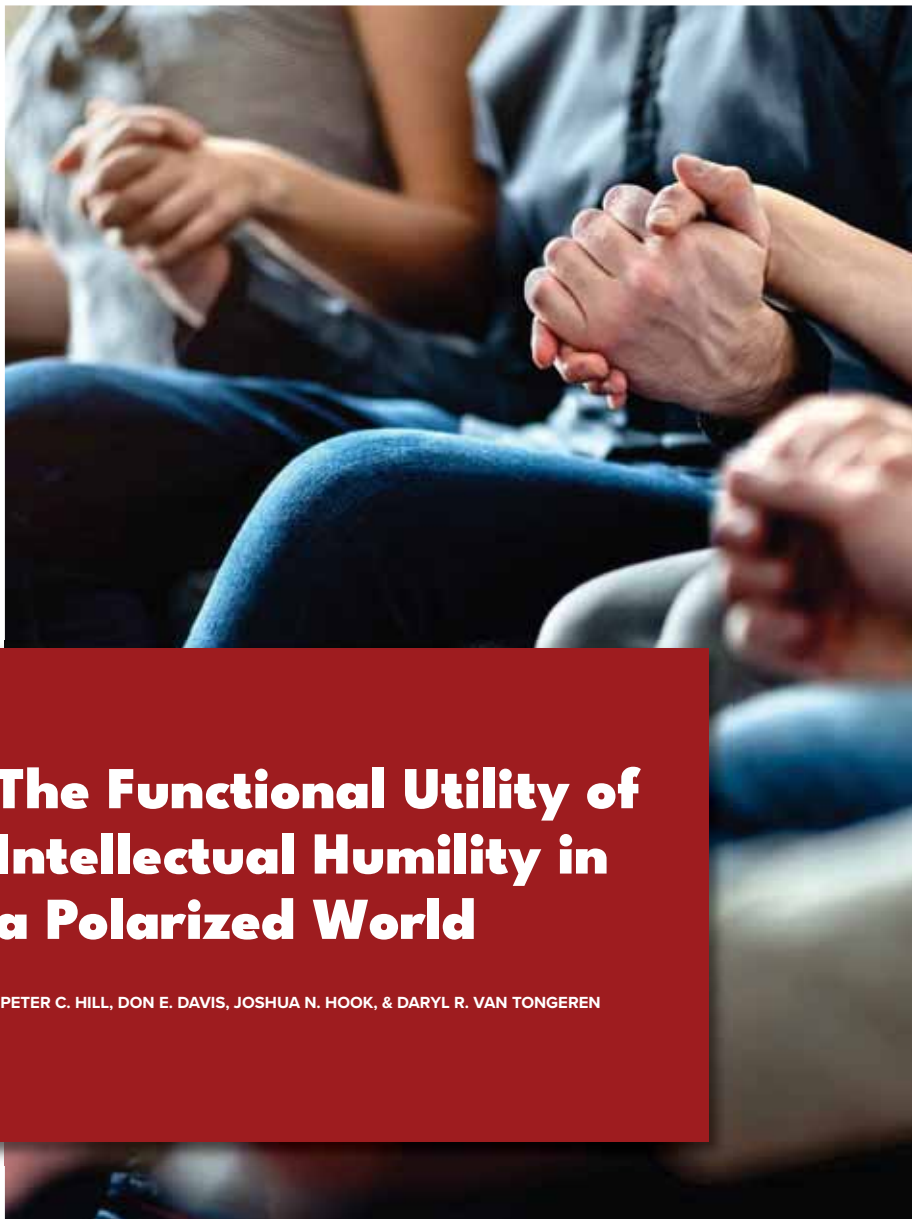
The Functional Utility of Intellectual Humility in a Polarized World

PETER C. HILL, DON E. DAVIS, JOSHUA N. HOOK, & DARYL R. VAN TONGEREN

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The Functional Utility of Intellectual Humility in a Polarized World

PETER C. HILL, DON E. DAVIS, JOSHUA N. HOOK, & DARYL R. VAN TONGEREN

PIONEERING BIOMASS TRANSFORMATION TO UNIQUE MULTIFUNCTIONAL/ BIOCOMPATIBLE ULTRANANOCRYSTALLINE DIAMOND (UNCD™)

O. Auciello's group at The University of Texas-Dallas is developing a new revolutionary low-cost microwave plasma pyrolysis process, implemented in a kitchen microwave oven, for biomass transformation

The novel process transforms biomass materials (e.g. fungal-mycelium, flexible hemp) from natural soil on Earth into a unique best biocompatible Ultrananocrystalline Diamond (UNCD™) material.. The (UNCD™) material is made of Carbon atoms/elements of life in human DNA, cells, and molecules, enabling the development of new generations of high-tech and external/implantable medical devices/prostheses to improve the quality of life of people worldwide.

Biomolecular polymer chains

Biomass is biological matter derived from agricultural processes for power generation, producing 233 Mega-Tons (MT in 2016 in the USA. ^(1,2) Research demonstrated that biomolecular polymer chains (e.g., cellulose) exposed to pyrolysis, i.e., high temperature-induced decomposition of hydrocarbons, yield carbon-material (char), liquids/resins and gasses.

These transformations are influenced by biomass type/process parameters (heating rates, temperature, moisture or oxygen content in the process gas). Pyrolysis was explored theoretically and experimentally for transforming biomass into amorphous-carbon material. ^(3,4)

Chitin/cellulose (natural biomolecules) can yield fiber bundles/fibril-matrix carbon-based char structures. Chitin is

in crustacean shells and fungal mycelium walls, while cellulose is in nearly all vegetation. Methods to produce biochar from chitin/cellulose transformation were induced by nature long before humans developed processes. However, modern techniques can achieve fast/higher throughput for chitin/cellulose transformation to carbon materials for key products. The processes require drying/digestion/etching before the final thermal pyrolysis yielding powder biochar or pellets with C-atoms with graphite bonds on the surface. ⁽⁴⁾

In analyzing fungal mycelium transformation into carbon materials, via microwave plasma processes (MPP), it is relevant to describe previously used methods to produce carbon films, such as microwave plasma chemical vapor deposition (MPCVD) used to produce CNT, graphene, and Ultrananocrystalline Diamond (UNCD™) coatings, in the market today. ^(5,6,7)

However, MPCVD requires expensive equipment that costs hundreds of thousands of dollars. The MPP process described earlier can transform biomass into solid structured UNCD™ material at a low cost, just a few thousand dollars. If developed to produce UNCD™ coatings, it could provide orders of magnitude lower cost process than MPCVD. ⁽⁸⁾ Thus, the novel

MPP process described here represents a revolutionary approach for biomass transformation into the unique UNCD™ material, currently as a structured solid and potentially as a coating.

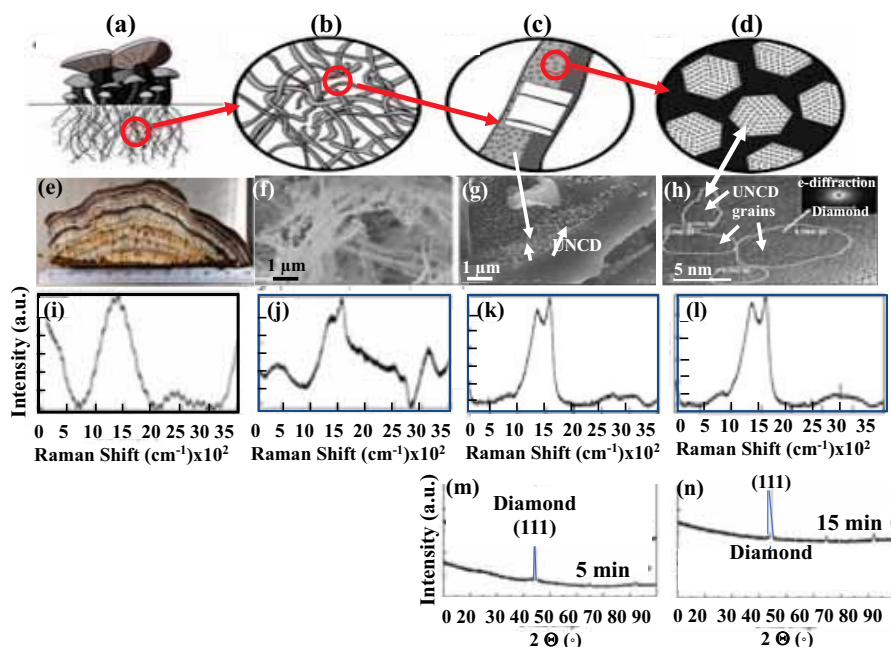
Biomass transformation to solid carbon-materials

Microwave Assisted Pyrolysis (MAP), involving microwave (MW) energy coupled to biomass directly or via microwave absorbers (activated carbon), was demonstrated for biomass-char transformation. ⁽⁹⁾ The MW energy induces pyrolytic biomass decomposition via photons penetrating the biomass, forming volatiles escaping the surface.

Alternatively, Argon/Hydrogen plasma processing of biomass induces pyrolysis, transforming wood and rice husk into H₂, CO, C₂H₂ and CH₄ gases for fuel production. ⁽¹⁰⁾ However, the plasma processing of fungi was not investigated for transformation into nanocarbon or UNCD material described here.

Innovative Microwave Plasma Process (MPP) for fungal-mycelium transformation into multifunctional UNCD™

The MAP process involves energy transfer fundamentally different from the MPP process, such that MW energy is directed to polar water molecules in the biomass or mixed activated carbon.



The MPP process delivers MW energy to a low-pressure (<10 Torr) Argon (Ar) gaseous environment via Ar gas flow through a glass tube inserted into a low-cost kitchen microwave oven. The MW power produces a plasma containing Ar⁺, N⁺ and O⁺ ions (from atmospheric residue), neutral atoms, and free electrons, inducing physical/chemical biomass transformation.

The MPP process transforms fungal-mycelium into UNCD via key steps (schematics in Figs. 1 (a-d)). The mycelium body exhibits a filamentous root network (Fig. 1 (a)) /schematic in Fig. 1 (b)/ SEM image in Fig. 1 (f), each thread/tube having a cellular structure for transporting water and minerals/nutrients, held together by a cellular wall made of chitin molecules (biopolymer).

The MPP process preserves the filamentous mycelium-network (Fig. 1 (c) schematic / SEM image in Figs. 1 (g)), although with high shrinkage/weight loss. The chitin walls change into the initial graphitic matrix (Fig. 1 (c) schematic) / SEM image in Fig. 1 (g) with dispersed diamond grains (3-5 nm diameter), characteristic of UNCDTM, as demonstrated in years growing UNCDTM films via MPCVD.⁽⁷⁾

The ≥ 5 minutes MPP process produced fungal mycelium transformation to extended UNCD material (schematic-Fig. 1 (d)) / HRTEM image (Fig. 1 (h)). Complementary analytical techniques were used to confirm fungal mycelium-UNCD transformation. Raman analysis spectrum (Fig. 1(i)) revealed fungal mycelium. Fig. 1(j), corresponding to three minutes of MPP processing of fungal mycelium, shows the initial appearance of peaks (1300-1550 cm⁻¹), fully defined in Fig. 1 (k) (5 minutes MPP processing) and Fig. 1 (l) (15 minutes MPP processing), showing characteristic Raman spectra of UNCD as films grown by MPCVD.⁽⁷⁾

The XRD analysis (Figs. 1 (m) and 1 (n)), correlating with Raman spectra of Figs. 1 (k) and 1 (l), respectively. The X-ray diffraction spectra (Figures 1 (m) and 1 (n) show the diamond (111) fingerprint peak, confirming the diamond structure of the UNCD grains, as done extensively for UNCD films grown by MPCVD⁽⁷⁾.

The power of the MPP process

The MPP process can provide a new biomass transformation pathway to produce UNCD material in a solid structural form now and potentially in film (coating) form in the future.

Figure 1. a) fungal mycelium schematic, showing filamentous roots (interconnected threads / tubes transporting water/mineral-nutrients, shown in schematic in (b)); (c) schematic of chitinous cellular walls converted into graphitic matrix with integrated UNCD grains (3-5 nm diameter), shown in SEM image in (g), confirmed by HRTEM in (h), characteristic of UNCD, (m) and (n) XRD spectra confirming the diamond structure of UNCD grains.

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Unleashing the power of science, research and innovation in Asia

Preethi Kesavan, Head at the School of Advanced Technology and Digital Media, LSBF Singapore, highlights the transformative role of science, research and innovation in Asia



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Asia is transforming, focusing on establishing itself as a leading hub for innovation in science, technology, society, and research.

Prominent efforts to foster a vibrant research culture are evident in higher education institutions across Asia, like Nanyang Technological University (NTU) and National University of Singapore (NUS), Private Educational Institutes (PEI) and in the establishment of world-class research and development hubs such as the Agency for Science, Technology and Research (A*STAR).

Asia's commitment to knowledge-driven development has propelled it to the forefront of global scientific advancements. As a result, Asia's scientific community is reshaping the world from ground-breaking discoveries to technological innovations. In this editorial, we explore the transformative role of science, research, and innovation in Asia and highlight some remarkable achievements driving progress in the region.

Scientific excellence and collaboration

Asian researchers are at the forefront of breakthrough discoveries and have significantly contributed to education, medicine, physics, and environmental

sciences. For example, The University of Petroleum and Energy Studies (UPES), Dehradun, India, hosted the Global University Systems-GUS Academic Summit on transformation for future-proof education.

This summit was intended to facilitate the exchange of knowledge and experience related to educational transformations in the future to provide students with the skills and knowledge they need to succeed in a rapidly changing digital workforce and strengthen the research community within GUS.

The summit effectively leveraged research resources and partnerships by connecting experts from various GUS institutes, ultimately achieving global impact. This platform enabled researchers to forge connections and tap into a vast network of international collaborations and research opportunities, fostering the growth of research initiatives and positioning GUS as a catalyst for global research development.

Driving economic growth through innovation in Asia

Science, research, and innovation are catalysts for economic growth in Asia. Governments across the region

have recognised the importance of investing in scientific research ecosystems to spur economic development.

China, India, Malaysia, Japan, and South Korea have made substantial investments in research and development, creating vibrant innovation hubs. These investments have attracted global talent and nurtured local expertise, leading to cutting-edge industries in sectors such as artificial intelligence, biotechnology, material science, biomedical sciences, agriculture, and renewable energy.

In addition, Asia's commitment to international collaboration has accelerated scientific progress. Regional initiatives like the Association of Southeast Asian Nations (ASEAN) and the Asia-Pacific Economic Cooperation (APEC) have fostered knowledge exchange among member countries. Sharing resources, data, and expertise has accelerated research and enabled countries to tackle common challenges such as climate change, public health crises and sustainable development.

Harnessing technology for social good

One example of Asia harnessing technological innovations to address pressing social and environmental challenges is India's ambitious space programme, enabling the country to tackle issues like disaster management, weather forecasting, and rural connectivity.

Through the development of low-cost technologies, India's space agency, ISRO, has revolutionised access to education and healthcare in remote areas. Similarly, other countries in the region are leveraging technology to bridge the digital divide and improve the quality of life for their citizens. With a strong emphasis on collaboration and cutting-edge infrastructure, Singapore continues establishing itself as a premier destination for research and innovation.

Sustainable development and environmental conservation

Asia's scientific community is at the forefront of efforts to achieve sustainable development and environmental conservation. Conscious of the urgent need to fight climate change and preserve biodiversity, countries in the

region have invested in research and innovation that promote green technologies and practices.

For instance, China, the world's largest emitter of greenhouse gases, has made significant strides in renewable energy, becoming a global leader in solar and wind power production. This transition towards cleaner energy sources has reduced carbon emissions and created new economic opportunities.

The Future of science, research and innovation in Asia

Asia's commitment to science, research, and innovation has placed the region at the forefront of global progress. National borders do not confine the boundaries of science, research, and innovation, and researchers from diverse backgrounds are instrumental in driving innovative breakthroughs.

Asia is shaping a brighter future by investing in cutting-edge research, fostering international collaboration, harnessing technology for social good, and championing sustainable development.

While Asia has made remarkable progress in science, it also faces challenges that have to be addressed. The region must ensure the ethical use of emerging technologies and invest in science education and infrastructure to foster a sustainable knowledge ecosystem.

Moreover, fostering an inclusive and diverse scientific community will be crucial for unleashing the full potential of Asia's scientific endeavours.

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BUSINESS AND HUMAN RIGHTS IN JAPAN: AN OVERVIEW

Professor Emi Sugawara from Osaka University of Economics and Law, Faculty of International Studies, walks us through the critical development of Japan's policies concerning business and human rights

Recently, policy trends related to business and human rights have been characterised by their rapid and overwhelming nature. Since the United Nations Guiding Principles on Business and Human Rights (UNGPs) was endorsed in 2011, 26 countries, including Japan, have formulated a national action plan on business and human rights (NAP). As national legislations have emerged to mandate human rights due diligence and information disclosure, the EU's proposal on the Directive on Corporate Sustainability Due Diligence draws attention. The effective abolition of forced labour in global supply chains

was also discussed at this year's G7 summit hosted by Japan. ⁽¹⁾ Additionally, the crackdown against the opposition to military rule in Myanmar, Russia's aggression against Ukraine, and a just transition to climate change are also important issues in the context of business and human rights.

How have business and human rights developed in Japan in response to this global trend?

Japanese companies have a long history of human rights initiatives, such as human rights training against Buraku discrimination. ⁽²⁾ However,

their focus was on eliminating discrimination in the workplace and hiring. Corporate Social Responsibility (CSR) has enlarged this focus, emphasising adherence to international standards, exemplified by the United Nations Global Compact launched in 2000. ⁽³⁾ 2003 is said to be the first year of CSR in Japan, and after that, the creation of reports in accordance with the Global Reporting Initiative standards and the efforts to refer to the ISO26000 issued in 2010 spread.

With the introduction of the United Nations Sustainable Development

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Goals (SDGs) in 2015, the recognition of business and human rights has gradually spread across Japanese society. The Japanese government advocated for the formulation of NAPs in the 2016 SDGs Implementation Guiding Principles. ⁽⁴⁾ It established a liaison committee comprising relevant government ministries and agencies, as well as Working Groups and an Advisory Committee for NAP consisting of stakeholders such as companies, labour unions, civil society, and academia.

In October 2020, the Japanese government launched the National Action Plan on Business and Human Rights (2020-2025) (J-NAP). ⁽⁵⁾ In J-NAP, the following cross-cutting issues are discussed:

- Labour (promotion of decent work), including measures for foreign technical intern trainees;
- Promotion and protection of children's rights;

- Human rights associated with the development of new technologies;
- Rights and roles of consumers;
- Equality before the law (persons with disabilities, women, persons of diverse sexual orientation and gender identity, and other groups); and
- Acceptance of and coexistence with foreign nationals.

However, the J-NAP's priorities lie in promoting understanding and awareness of business and human rights in 'government', 'companies' and 'society', as well as respecting human rights in 'supply chains' and establishing effective 'remedy procedures'. Emphasis was placed on promoting understanding and awareness. The plan lacks specific details on priority issues, such as the issue of foreign technical interns, which has been criticised amid international concern regarding forced labour. Furthermore, Japanese government did not conduct a policy gap analysis, resulting in the majority of the 85 measures outlined in the J-NAP, being continuations of existing measures, lacking novelty and clear prioritisation.

Following the launch of J-NAP, the Japanese government conducted the first official survey, Questionnaire Survey on the Status of Efforts on Human Rights in the Supply Chains of Japanese Companies ⁽⁶⁾ in 2021, to understand the status of Japanese companies' business and human rights efforts. In response to the many voices of companies wishing to formulate guidelines in the questionnaire, in September 2022, Japan's Guidelines on Respecting Human Rights in Responsible Supply Chains ⁽⁷⁾ was formulated and released. Based on international standards, the guidelines

aim to provide companies with concrete and comprehensible explanations, and emphasises the need for dialogue with stakeholders, including workers, consumers, and local communities, in all processes involved in companies' efforts to respect human rights. However, the guidelines contain elements that do not fully align with the UNGPs, such as the concept of 'responsible exit' from conflict-affected areas and other situations. Although due diligence is emphasised, the guidelines lack sufficient details on remedies, and do not include the 'Remediation' specified in Principle 22 of the UNGPs.

On April 3, 2023, the Japanese government decided that, in addition to disseminating the guidelines so far, it would strive to promote human rights respect based on the guidelines in public procurement work. ⁽⁸⁾ On the following day, April 4, 'Reference Material on Practical Approaches for Business Enterprises to Respect Human Rights in Responsible Supply Chains' was released. ⁽⁹⁾ Thus, the Japanese government now requires companies to make efforts at a more practical level to realise respect for human rights throughout their businesses, including their supply chains.

On the other hand, what about companies and stakeholders? Before the formulation of J-NAP, NGOs created Japanese translations of UNGPs ⁽¹⁰⁾ and the United Nations NAP Guidance ⁽¹¹⁾ and the Guidance for Human Rights Due Diligence (Japan Federation of Bar Associations, 2015). ⁽¹²⁾ One notable characteristic of Japanese society is that companies and stakeholders have developed a gradual but constructive partnership through the NAP formulation process while deepening their awareness of the issues in their



counter-relationship with the government. For example, a platform for civil society organisations was established,⁽¹³⁾ and companies, investors, labour unions, civil society, academia, and international organisations involved in NAP formulation have collectively voiced their request^(1st⁽¹⁴⁾ and 2nd⁽¹⁵⁾). Multi-stakeholder initiatives addressing consultations and remedies related to business and human rights have also emerged, such as the Japan Platform for Migrant Workers towards Responsible and Inclusive Society (JP-MIRAI)⁽¹⁶⁾ and the Japan Center for Engagement and Remedy on Business and Human Rights (JaCER).⁽¹⁷⁾

In response to the formulation of government guidelines, companies and stakeholders have also released materials focusing on how to respect human rights in business activities and supply chains. In December 2021, Keidanren (Japan Business Federation) published the Handbook for Management Respecting Human Rights;⁽¹⁸⁾ in February 2022, the Center

for International Economic Collaboration published guidelines for small and medium-sized enterprises,⁽¹⁹⁾ and in July 2022, Japan Textile Federation published 'Guidelines for Responsible Business Conducts for the T&C'.⁽²⁰⁾ In August 2022, Japan Council of Metalworkers' Unions released action points to be taken by labour unions in human rights due diligence,⁽²¹⁾ and in May 2023, Global Compact Network Japan announced the Manual for Practicing Human Rights Due Diligence.⁽²²⁾ Notably, the business and human rights initiatives of Japanese companies vary. According to the 2021 government survey, approximately 70% of companies have formulated human rights policies, and approximately 50% have implemented human rights due diligence. Furthermore, according to the FY22 Japan External Trade Organization (JETRO) survey⁽²³⁾ involving 9,377 companies with a strong interest in overseas business, 64.8% of large companies have already established human rights policies, while 27.6% of SMEs have already formulated them. In addition, as an

issue in realising respect for human rights in overseas supply chains, more than 40% of the companies planning to implement or considering implementing human rights due diligence are uncertain about the specific actions to be undertaken. In a more in-depth survey of member companies of the Global Compact Network Japan,⁽²⁴⁾ only 22% of companies are working on correcting their own QCD (quality, price, delivery) requirements and ensure decent work in the supply chain.

Regarding the establishment of consultation desks and complaint mechanisms, there is a disparity in efforts for overseas support and multilingual support compared to Japanese support, such as 37% (for workers in the company's group) and 19.3% (for workers at suppliers). With such growing practical interest in dealing with business and human rights, 'the dilemma of normalisation', as pointed out by John Ruggie,⁽²⁵⁾ is a severe concern in Japanese society. Human rights risk management differs



Emi Sugawara, Professor

from other risk management, which is relatively easy to standardise, because 'it is an inherently dialogical process that involves engagement and communication'. Identifying the problem/risk through dialogue with the rights holder is more important, rather than how to deal with it.

Although there are some developments in public procurement, the Japanese government has consistently emphasised encouraging companies to take voluntary actions through the guidelines and promoting business and human rights in the supply chains considering the local context Japanese companies operate. However, the international community is now paying more attention to the progress of business and human rights in Japan than ever before. In April 2023, the United Nations Special Rapporteur on the situation of human rights in Myanmar visited Japan and highlighted the involvement of Japanese companies in the worsening situation in Myanmar, pointing out their failure to consider the perspective of respect for human rights when expanding their business there in addition to the role of the Japanese government.⁽²⁶⁾ Furthermore, the United Nations Working Group on Business and Human Rights is scheduled to visit Japan in July and August.

In addition to the previously mentioned inadequate efforts, concerns have arisen regarding Japanese companies that have not sufficiently conducted due diligence even in the face of the suppression of democratisation in Myanmar, the Uyghur issue, and the invasion of Ukraine. As a response, in April 2023, a collaborative letter from Japanese NGOs calling for the introduction of mandatory due diligence legislation was released, and an NGO proposal for human rights due diligence legislation was announced.⁽²⁷⁾

However, it is undeniable that the argument for making human rights due diligence obligatory is taking on a life of its own. When formulating business and human rights policies, considering a range of measures, including not only public procurement and non-financial disclosure but also international cooperation, trade and investment, sustainable finance, and sustainable consumption (smart mix), is essential. Policy design changes depending on what kind of obligations are imposed on companies. As 2023 marks the midpoint of the J-NAP, it presents a unique opportunity to review Japan's past business and human rights initiatives and reassess issues from both domestic and international perspectives.

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FOSTERING SELF-REGULATED LEARNERS THROUGH CHILD-CENTRED EVALUATION ACTIVITIES

Emiko Izumi, PhD from Kwansei Gakuin University, discusses child-centred evaluation activities, including enhancing thinking, judgment and expression skills

Introducing compulsory foreign language studies in upper grades of Japanese elementary schools in 2020 posed challenges in integrating instruction and evaluation. In this context, extensive research over thirteen years has been conducted to foster self-regulated learners, focusing on children and child-centred evaluation activities.

[Following our piece in the January issue](#), we provide an overview of our research undertaken and its key findings.

Classroom research into child-centred evaluation activities

Our research encompasses three main areas:

Firstly, it emphasises designing child-centred evaluation activities during classes that facilitate learning and enhance children's sense of competence and self-efficacy.

This involves creating Can-Do assessment criteria, which outline the skills and knowledge students should acquire, and employing reflection sheets as a tool for formative assessment, encouraging students to reflect on their progress and develop a strong sense of achievement.

By adopting this approach, our research aims to foster self-regulated learners actively engaged in their own learning journey.

Secondly, the research focuses on developing thinking, judgment, and

expression skills, crucial components outlined in the Japanese Ministry of Education's Courses of Study.

To cultivate these skills, problem-solving performance tasks require critical thinking and effective communication. These tasks are evaluated using rubrics, providing clear assessment criteria and guidelines.

What sets this research apart is the active involvement of children in co-creating these rubrics. By participating as evaluators, children gain a deeper understanding of the evaluation process and take ownership of their own learning.

This promotes assessment for learning, where assessment becomes a valuable tool for students' growth and development.

Thirdly, our research explores evaluation methods, interventions, and transformations that contribute to improving children's learning and teachers' instruction.

Classroom research serves as a foundation for investigating the effectiveness of various evaluation strategies. The insights gained from reflection sheets and surveys provide valuable feedback for refining instructional practices and evaluating the impact of these strategies on student learning outcomes.

Student instruction & evaluation strategies

Our research underscores the importance of creating meaningful

learning experiences using English authentically. To enhance thinking, judgment, and expression skills, students are given tasks designed to have a clear purpose or situation for using English, enabling them to develop their language skills through trial and error.

By engaging students' bodies and emotions, we emphasise the importance of meaningful communication activities that foster an active learning environment.

Collaborative learning in pairs or groups is also encouraged, as it facilitates peer interactions and mutual learning. Distributing individual tablets through the government's GIGA School initiative has further enhanced research-based learning. Providing students with choices in their learning is crucial for fostering self-regulated learners.

Shared evaluation criteria & rubrics

Clear evaluation criteria and standards are shared with students. The research employs a four-level Can-Do assessment scale to set reachable and appropriate levels for students. The scale reflects students' confidence and proficiency in achieving specific language activities.

Rubrics play a vital role in setting clear expectations and facilitating consistent assessment. They are created to establish each unit's short-term and long-term goals and develop and acquire skills.

Mountain climbing unit design: Backward design

Using the metaphor of mountain climbing, one of the research collaborators, Sayaka Okuhira, a public elementary school teacher, seeks to promote students' motivation by setting clear goals and working persistently toward their achievement.

Teachers and students co-created rubrics. The process involved watching an initial animated story, brainstorming activity ideas, developing a learning plan through backward design, and integrating instruction and assessment using the rubric. The following steps were taken:

- 1) Initially, the teacher and the whole class engaged in a dialogue format to discuss what had been learned and studied.
- 2) Groups collaborated to present their ideas and expressions, sharing ideas individually.
- 3) The class decided whether the ideas generated by the groups should be shared and included in the rubric.
- 4) Once created, the rubric was immediately put into practice, customised, and used to provide feedback during practice presentations.

By co-creating rubrics, students emulate positive behaviours, recognise their strengths, and gain confidence, promoting more room for child-centred evaluation activities.

Transformation of teachers through the co-creation & utilisation of rubric

The co-creation of rubrics enabled teachers to recognise that students internalised previously taught content. Students generated creative

ideas and improved upon the guidance provided by teachers. Teachers could make improvements in their teaching by observing students' progress.

Rubrics fostered metacognitive skills and self-assessment abilities. Reflection sheets in a mountain climbing format allowed students to write their own learning plans, make revisions, and visualise their learning progress. The pie chart showing four levels of ability indicators represented their sense of achievement and self-efficacy.

Achievements & challenges of child-centred evaluation activities

The research yielded several significant achievements. Co-creating learning plans and performance tasks empowered students to take ownership of their learning, utilising their own ideas and envisioning their progress towards specific goals.

The co-creation of rubrics allowed students to refer to their peers' ideas and practices, promoting self-monitoring and self-assessment. Peer assessment activities using rubrics enabled students to reflect on their tasks and reassess their level of achievement, fostering a sense of accountability and continuous improvement.

However, the research has also highlighted challenges. Teachers must develop the ability to determine the appropriate intervention and instructional support timing in various learning situations. Shifting from a class rubric to personalised rubrics can enable students to evaluate themselves effectively. Encouraging students to create their mission and align it with their goals further enhances their assessment literacy and fosters a sense of agency and well-being.

Our research provides valuable insights into fostering self-regulated learners through child-centred evaluation activities. By emphasising co-creation, student agency, metacognitive development, visual representations of learning, and teacher professional development, this study offers practical strategies for implementing student-centred evaluation practices.

Creating inclusive & engaging learning environments

The innovative approaches presented in this study contribute to creating inclusive and engaging learning environments that empower students and enhance their learning experiences.

By nurturing individual goal-setting and collaborative learning, this research not only facilitates the growth of students but also empowers teachers, leading to an overall transformation in the education landscape. Our research findings have the potential to inspire further studies and influence educational practices worldwide. We hope to continue researching with children in the future.



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An introduction to spina bifida and its available treatments

Dr Nauf AlBendar, Doctor of Clinical Medicine & Founder of The Womb Effect, introduces spina bifida, the primary cause of foetal loss and substantial disabilities in newborns

Neural tube defects stand for some conditions which occur before birth and during early pregnancy.

What is spina bifida?

Spina bifida is defined as a neural tube defect, including the abnormal closure of the neural tube and the incomplete development of the spinal cord, brain, or meninges around the fourth to sixth week of pregnancy. Consequently, it is the primary cause of foetal loss and substantial disabilities in newborns and is considered a significant public health matter.

It happens in approximately one in every 1,000 births. However, the birth prevalence varies among specific populations and can be as high as one in every 100 births in some areas, such as northern China.

Spina bifida occulta and spina bifida cystica are the two main types of spina bifida.

Spina bifida occulta (closed forms of spina bifida) is a failure of fusion of the vertebral arches covered by the skin and typically does not involve the spinal cord. The defect is usually marked by a patch of hair overlying the affected region.

Spina bifida cystica (open forms of spina bifida) is a more severe type in which neural tissue overhangs through an opening in the vertebral arches to form a cyst or sac. It can occur at any site of the vertebral column, but the most common site of the overhang is the lumbosacral area, where the spine joins the pelvis.

These conditions can be diagnosed prenatally by imaging techniques such as ultrasound and by identification of alpha-fetoprotein levels in the amniotic fluid or serum. Any malformation or abnormality in the vertebral arches can be seen by the twelfth week of gestation.

An infant born with spinal bifida cystica might have lifelong cognitive, mobility, urinary and bowel disabilities. But most infants with spina bifida live long lives.

What are the main causes of the condition?

While the precise causes are not explicitly understood, we know it is multifactorial and involves, as NIH put it, "a combination of environmental and genetic risk factors".⁽¹⁾

"A child born with spina bifida may not have any relatives with the condition even though"⁽²⁾ there is a genetic factor through mutations that naturally arise during the earliest stages of an embryo's development, which may cause severe neural tube defects.

Various epidemiological studies have shown a connection between high glucose levels and having a child with spina bifida. About 10% of pregnant women with diabetes will have embryos with neural tube defects.

Strong associations were also found between neural tube defects and pesticides, pollutants, disinfectants, preservatives, household, and personal products containing quaternary ammonium compounds or 'quats', and "high concentrations of polycyclic aromatic hydrocarbons (PAHs)"⁽³⁾, which are by-products of burning fossil fuels such as oil and coal.

Other vital factors that could cause spina bifida include maternal obesity, folate deficiency, and some medications.

Prevention & treatment of spina bifida

A variety of nutritional factors influences neural tube defects. The quality of a mother's diet before and during pregnancy can predispose to malformations of the brain, spinal cord, or orofacial clefts, such as cleft lip and cleft palate.

The best-known nutrient factor is the intake of 400 micrograms of folic acid daily, also known as vitamin B-9, and folate-rich foods before conception continuing through early gestation and beyond, which could decrease the incidence of spina bifida by as much as 70%.

SUPPORTING REPRODUCTIVE HEALTH AND CHILD DEVELOPMENT

The National Institute of Child Health and Human Development (NICHD) is part of the National Institutes of Health (NIH). It is dedicated to supporting human development across the entire lifespan and works to assuage the prevalence of disabilities and significant events during pregnancy. As part of this, the NICHD conducts and supports vital research and training to improve reproductive health and, in turn, the lives of families and communities.

Some of the NICHD's key accomplishments include the creation of safe and effective vaccines for childhood infections, such as the first vaccine against *Haemophilus influenzae* type b (Hib). This commonly occurring bacterial infection was once the leading cause of meningitis; Hib infection has now been reduced by more than 99% in the U.S. thanks to this creation. Similarly, it supports newborn screening and dietary therapy to reduce the incidence of conditions that impact cognitive development, including phenylketonuria (PKU) and congenital hypothyroidism, once responsible for many cases of intellectual disability.

More recently, NICHD scientists developed a potential gene therapy for hereditary spastic paraplegia 50. This rare neurodegenerative disorder, which begins in childhood, causes developmental delays, cognitive impairment, and eventual paralysis. Such research could help researchers in designing gene therapies to treat other neurological conditions in the future. Likewise, for spina bifida, a condition affecting about 1,500 babies annually in the U.S. alone and which does not have a clear cause or cure, the NICHD conducts and provides research on the precursors and causes of the condition, as well as its detection, treatment, and impact on children's motor and cognitive development. For example, a current clinical trial conducted by The University of Pennsylvania School of Medicine and The Texas A&M University Health Science Center is studying the genetic risk factors for spina bifida and anencephaly.

Funding research and improving awareness of reproductive health issues and challenges that can occur during pregnancy is vital, especially given that this area of research has historically been under-recognized and relatively few new treatments or diagnostics have emerged in recent decades as a result. New solutions could mitigate complications in pregnancy and delivery and drastically improve the lives of families and communities, particularly in resource-limited settings.

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Since about 50% of all “pregnancies are unplanned, it is recommended that all women of childbearing age”⁽⁴⁾ take multivitamins containing 400 micrograms of folic acid daily.

Choline is another essential nutrient that impacts brain and spinal cord defects. It plays a significant part in the formation of neurotransmitters and can be found in egg yolks, soy, wheat germ and organ meats.

Even though traditional in-utero and infant surgery is encouraged in some circumstances, there are promising non-invasive treatments of spina bifida in the pipeline, which include cellular therapy and bioengineered reverse thermal gel (RTG) to patch and repair neural tube defects.

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FIRST INTERNATIONAL MEETING TOWARDS ELIMINATING PARALYSIS AFTER AORTIC ANEURYSM SURGERY

Professor Hamdy Awad, MD, FASA, from the Ohio State University Wexner Medical Center, examines the dangers of aortic aneurysm surgery and the importance of continued research towards eliminating paralysis

Aortic aneurysmal disease is a rapidly growing problem in the United States. Ruptured aortic aneurysm is the 12th leading cause of death in the U.S. with 43,000–47,000 deaths per year ⁽¹⁾.

Risk factors associated with aneurysmal disease include old age, smoking, male sex, and a family history of aortic aneurysm. Aortic aneurysms inevitably rupture due to their thin and weakened walls, resulting in massive internal bleeding, which is usually fatal. This necessitates timely surgical intervention.

Aortic disease and the dangers of aortic aneurysm surgery

Currently, the only treatment for aortic disease is surgical repair. During the surgery, blood flow in the aorta is temporarily interrupted. Since the aorta gives rise to blood vessels that supply the spinal cord, one of the most feared complications of aortic surgical repair is postoperative leg weakness and even paralysis.

Paralysis costs \$2.3 million per patient in their lifetime and there is an ongoing need to tackle this problem both in and out of the clinic ⁽²⁾. Patients who experience any spinal cord injury after surgical repair have a significantly lower 1-year survival compared to patients who do not experience spinal cord injury ⁽³⁾.

FIRST INTERNATIONAL MEETING
Eliminating Paralysis After Aortic Aneurysm Surgery

Funded by NHLBI-NIH and OSU's Dept. of Anesthesiology

Biomedical Research Tower
The Ohio State University Wexner Medical Center
460 West 12th Avenue, Columbus OH, 43210

February 25th, 2023
Contact: Hamdy.Elwad@osu.edu
In-person and over Zoom, free of charge

THE OHIO STATE UNIVERSITY
WEXNER MEDICAL CENTER

Paralysis following aortic surgical intervention has been recorded since the procedure's advent. Before the first aortic repair, Dr. Alexis Carrel, a Nobel prize-winning surgeon who pioneered many vascular techniques, predicted that "the main danger of the aortic operation does not come from the heart or from the aorta itself, but from the central nervous system."

The danger of paraplegia following surgical repair

Dr. Carrel's prediction was proven correct when the first recorded instance of paraplegia following

surgical repair occurred in 1951, which was also the first successful resection of an aortic aneurysm.

Dr. John L. Doppman, former director of NIH Clinical Center for Imaging Sciences, stated in 1993 that paraplegia after aortic aneurysm surgery is a "Russian roulette" for vascular surgeons. He also stated that "as long as we don't understand the pathophysiology, we can propose no reasonable remedy." This point remains salient due to the current lack of scientific knowledge on the mechanism of neurological damage causing paralysis.

The past fifty years of research have not yet resulted in a pharmacological treatment to prevent paralysis, and there exists no approved mechanistic therapeutic intervention to prevent this dreaded complication. To advance scientific knowledge, our group developed and published animal models to model surgical aortic intervention. Furthermore, investigation of the mechanism of neurological damage to the spinal cord shall follow to develop and test therapeutics for potential clinical use.

International meetings towards “Eliminating Paralysis After Aortic Aneurysm Surgery”

Recognizing the need for worldwide collaboration, in February 2023, we hosted the first multisession, international meeting at The Ohio State University Wexner Medical Center, titled: “Eliminating Paralysis After Aortic Aneurysm Surgery”. This meeting was funded in part by the National Heart and Lung Institute in the U.S.

The meeting was attended by 400 individuals from over 25 countries, including Dr. Joseph Coselli, an eminent aortic surgeon who presented “The Past, Present, and Future of Ischemic Spinal Cord Injury and Paralysis after Aortic Aneurysm Surgery.” Two patients were invited to discuss personal experiences with paralysis after aortic aneurysm surgery, which served as a poignant and humbling reminder to the physicians and scientists addressing this issue.

The future for paralysis research

The meeting revealed multiple future directions of research in spinal cord ischemia. In the Basic Science Solutions to Eliminate Paralysis session, Dr. Arthur Burghes, a researcher of the

molecular basis of neuromuscular disorders, discussed efforts to develop a small molecule to achieve the neuroprotective effects of hypothermia without its maladaptive responses.

Dr. Esmerina Tili highlighted the role of microRNAs as biomarkers for ischemic spinal cord injury. Dr. Jim Vaught, former editor-in-chief of Biopreservation and Biobanking, discussed the standard of care of collecting biofluids from patients with and without paralysis. Upon collection, analysis can be performed to compare biofluids between experimental groups.

The omics approach for collected biofluids may help further the understanding of pathophysiology.

Two objectives emerged from the final session’s discussion about the effectiveness of the prophylactic spinal drain in patients after thoracic endovascular aortic repair who are high-risk for spinal cord injury.

One is that there needs to be a global effort to understand and eliminate this dreadful surgical complication due to its multidisciplinary nature. Two, the omics analysis of biological fluids is key to developing biomarkers and future therapeutic treatments.

NO disease more conducive to clinical humility than aneurysm of the aorta

William Osler’s statement still holds true today, “There is NO disease more conducive to clinical humility than aneurysm of the aorta.”

We hope to continue studying small- and large-animal models of pathophysiology and to employ genomics and systems biology to characterize the mechanisms of spinal cord injury and paralysis after aortic aneurysm repair.

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Acknowledgements:

Chris Janyelle Auman¹, Katherine Choi, BA², Andrew Denney, BS², Bradley Gigax¹, Alim Habib, BS², Rafia Baig¹, Amar Dabbagh¹, Brendan Sieber, BS², Jacob Christofi, MSc², Alexander Efanov, BS², Hamdy Awad, MD, FASA³

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Microbial electrosynthesis: Transitioning towards a bioeconomy

Aarthi JanakiRaman, Research Director of Chemicals and Advanced Materials TechVision at Frost & Sullivan, discusses the broad potential of microbial electrosynthesis in supporting the green-energy transition and circular economy

As we continue to move towards a circular economy and explore various alternatives to reduce the dependence on fossil fuels for energy and industrial needs, research advances are geared towards exploring alternative manufacturing pathways that can produce value-added chemicals to alternative fuels.

In the last five years, microbial electrosynthesis has gained attention as a potential method for energy and waste resource, reuse, and recovery.

An microbial electrosynthesis (MES) platform can be integrated into various waste biorefining platforms. It can operate with multiple substrates, ranging from wastewater, and solid waste, including cellulosic biomass and activated sludge, to gases such as carbon dioxide to produce value-added chemicals and energy (mainly hydrogen); this is one of the main reasons for continued interest in exploring the technology as an alternative to conventional fossil fuel-based processes.

While acetate is still the key chemical produced using MES, various studies have established the viability of using MES to synthesise other chemicals, including organic acids, biofuels, and biogas, for metal recovery.

Chemical synthesis to hydrogen economy

A well-established use for MES is the synthesis of chemicals and chemical intermediates. Apart from acetate, other organic acids, such as formate and butyrate, are also produced.

The focus of MES systems is still on producing short-chain acids, considering the value-added benefit of using wastes and by-products, thereby helping in environmental remediation.

However, it can be used to manufacture other chemicals, mainly alcohols, such as ethanol and butanol. Research is also underway to study the feasibility of using MES to synthesise other chemicals and intermediates, including various short and medium-chain fatty acids and industrial chemicals such as nitrogen, phosphorus, and potassium.

One of the promising applications of MES is its role in the hydrogen economy. Substrates such as acetic acid, alcohols, cellulose, activated sludge and even industrial and domestic wastewater can produce hydrogen.

It can also address issues such as low yield that is associated with the use of photo fermentation technologies.

While the yield is still dependent on the type of substrate used, pure substrates offer a higher yield than waste and wastewater streams; integrating MES with fermentation processes can optimise yield and help in the remediation of organic matter.

In addition, its ability to produce biogas, such as methane from solid waste, CO₂ and activated sludge etc., is also being explored, considering the increasing focus towards using methane as an alternative energy source.

Another interesting use of MES is for metal recovery from industrial wastewater streams and contaminated soil. Various research studies have established the theoretical potential for removing and recovering heavy metals, even at low concentrations.

Furthermore, by modifying the cathode materials used and optimising the reactor design, sequential recovery of

various metals and even mixed metals can be achieved while treating waste streams simultaneously.

What's next for microbial electrosynthesis?

MES platforms have come a long way from being considered part of MXC technologies to being treated as a viable technology platform that can significantly contribute to the transition to a bioeconomy.

However, for it to become an economically viable solution, a comprehensive, integrated approach that addresses all aspects of MES is required, from developing viable microbes, optimising reaction steps to ensure yield, and modifying reaction design to integrating renewable energy for powered requirements.

Challenges still need to be addressed to make MES acceptable on an industrial scale.

Developing a viable microbial toolbox is the first step towards industrial use of MES.

In addition, advances in synthetic biology and genetic engineering can help design microbial cultures that can withstand harsh environments and help synthesise a broader range of chemicals from various feedstocks and waste streams.

Changes in the reactor design, including adapting electrodes, membranes and process conditions depending on the type of input used for chemical and energy synthesis, are needed to improve efficiency and yield.

For example, solid waste will require pre-treatment and careful monitoring of pH and temperature to help in effective hydrolysis and fermentation for hydrogen or methane generation.

Most of the research studies in the last few years focused on studying reaction conditions, improving catalytic reactions, and developing many cathodic materials.

However, to move towards a successful industrial deployment, other aspects of MES must be equally

established, including improving productivity and yield and optimising reactor design, to name a few.

In addition, virtual modelling and simulation techniques, and leveraging the advances in computational modelling, can be used in designing a best-fit, modular bioreactor system that can be easily scaled up.

Another critical step towards industrial use is the need for a Life Cycle Assessment (LCA) of MES systems, mainly used for waste and wastewater remediation and hydrogen generation. Successful LCA studies can help mitigate risks and address bottlenecks compared to other biological processes while establishing techno-economic feasibility.

As a step towards industrial use of MES, its potential use in existing systems can also be simultaneously explored, especially in solid waste and wastewater treatment systems.

Integrating MES with other platforms, such as anaerobic membrane bioreactors, dark fermentation reactors, etc., can help address reactors' challenges and help establish economic viability, especially for hydrogen production.

Considering the similarities of the MES platform to that of microbial fuel cells (MFCs), mimicking the success of reactor and process design and energy management etc., from those platforms to MES can mitigate some of the challenges towards industrial deployment and help reduce the time to market.

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HOW TO CONVERT CO₂ TO BIOPLASTICS IN THE AGE OF GLOBAL WARMING

Arpita Bose, PhD, Associate Professor, describes how to convert CO₂ to bioplastics through new bugs and novel tools with a focus on fighting global warming

Global warming, caused by greenhouse gas emissions such as carbon dioxide (CO₂) which trap heat in the atmosphere and warms the globe, is becoming increasingly prevalent with unsustainable human activity and mass production. To tackle this, we need to begin looking to bioplastics to transition away from traditional petroleum products polluting our environment.

While some sources of emissions causing global warming are natural, (e.g., volcanoes), the rate and intensity of natural emissions are not enough to cause the drastic temperature change observed in past decades. Nature is not contributing significantly to global warming; we are.

Citizens across 19 countries rank global warming as the greatest threat facing their country in the [upcoming year](#). Explaining the increase in average global temperature, global warming is bringing hotter days and more severe hurricanes, wildfires, and other natural disasters.

Widespread deforestation, unsustainable agricultural practices, and the immense release of fossil fuels cause anthropogenic global warming. While burning fossil fuels generates the energy required to power our electricity, it also emits greenhouse gasses – mainly CO₂ – that totalled [5,891 million metric tons in 2020](#).

The plastic production industry

One industry powered by fossil fuels is the plastic production industry. We would produce 56 gigatons, or roughly [13% of total carbon emissions, by 2050](#) at the current plastic production and consumption rate. Plastic contributes to global warming by emitting greenhouse gasses at every stage of its lifecycle.

From its humble beginning as fossil fuel, plastic is extracted from the earth using energy generated by burning fossil fuel. It is then transported to refining sites and refined through energy obtained by burning fossil fuels. Plastics are distributed to consumers and eventually moved to landfills or recycling centers using fossil fuels. Plastic production and consumption drive the emission of greenhouse gasses, causing more intense climate change and impacting millions of lives.

It's not difficult to see why. Petroleum-based plastics – everyday plastics – are durable, thermoresistant, waterproof, moldable, and inexpensive, allowing them to be industrialized for single-use packaging. As a result, plastics are mass-produced, consumed, and immediately disposed of, contributing to [79% of waste accumulated in landfills in 2015](#) and the emission of [850 million metric tons of greenhouse gasses in 2019](#).

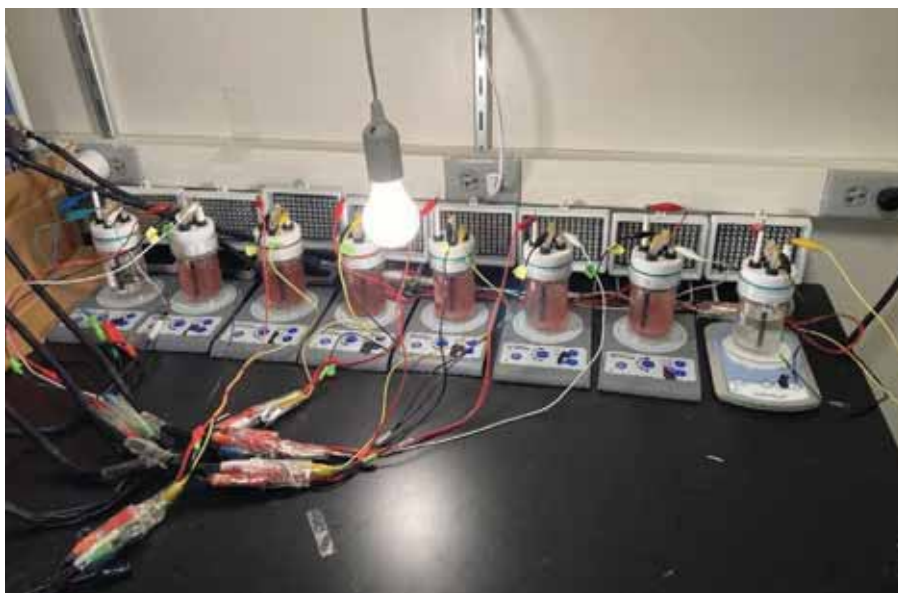
Produce biodegradable plastics using renewable resources

To address the global impact of plastic pollution and greenhouse gas emissions, the Bose lab uses an interdisciplinary approach to produce biodegradable plastics, or bioplastics, using renewable resources, creating a zero-carbon footprint.

Polyhydroxybutyrate (PHB) belongs to a class of polymers (PHA) with similar properties to petroleum plastics, making it a suitable candidate for bioplastics.

Unlike petroleum plastic, PHB is naturally produced as intracellular carbon for energy storage in many microorganisms. Since these organisms can also degrade PHB, PHB-based bioplastics may last only several weeks in landfills instead of petroleum plastics, which last hundreds to thousands of years. While PHB is a promising alternative to conventional plastics, its high production cost and low-efficiency yield make it too expensive for everyday consumers.

Genetic engineering can fix these shortcomings, which seeks to insert PHB genes into model organisms such as *Escherichia coli* and *Saccharomyces cerevisiae* to produce PHB. Model organisms are typically favored – numerous genetic tools are available for integrating genes, allowing easy manipulation.



However, these model organisms use organic carbon substrates to make bioplastics, contributing to high bioproduction costs and CO₂ emissions. Thus, to achieve the mission of a zero carbon footprint and cheaper input cost, we would need to completely alter model organisms' metabolism so they could fix CO₂ – or discover new bugs that can already use CO₂.

Old bugs & new tools for bioproduction

At the Bose Lab, researchers are conducting their experiments on the bacterium *Rhodospseudomonas palustris* (TIE-1), which has four primary metabolisms that center around fixing either organic or inorganic carbon sources to produce PHB during photosynthesis.

TIE-1 can thrive in Microbial Electrosynthesis, a system that supplies electrons via electric current to microorganisms. This paints a picture of TIE-1 fixing CO₂e in solar-panel-powered MES to produce PHB, thus producing bioplastics without the need for expensive carbon and electron sources.

While there's a relative lack of genetic tools available for TIE-1, [researchers](#) were able to increase the production of PHB from TIE-1 by up to 5-fold through the over-expression of RuBisCO, an enzyme responsible for CO₂ fixation during the Calvin-Benson-Bassham (CBB) cycle that is active during photosynthesis.

While the highest overproduction (5-fold) is mainly observed when mutant TIE-1 is grown in photoheterotrophic conditions with an organic carbon source, mutant TIE-1 still produces 2-fold more PHB than wild-type TIE-1 when fixing CO₂. As more genetic tools are developed for TIE-1, researchers can better manipulate its genome to yield more efficient bioproducts.

New bugs & old tools

Besides promising preliminary research with TIE-1, researchers at the Bose lab are investigating distant relatives of TIE-1: *Rhodomicrobium vannielii* and *Rhodomicrobium udaipurense*. Like TIE-1, these bugs are versatile in their metabolism and can produce PHB, making them a suitable candidate for bioproduction.

However, [Rhodomicrobium appears to convert electrons to PHB more efficiently than TIE-1](#) when grown in the same conditions, thus potentially reducing input costs. However, minimal genetic tools exist for *Rhodomicrobium*, with the most recent technique [described in 2023](#).

While a lack of tools makes studying these bugs harder, it also means these organisms have a lot of potential once genetic tools are developed. *Rhodomicrobium*'s superior electron yield to TIE-1 shows that it's crucial to investigate non-model organisms, for they could be a cheaper and a more reliable replacement to model organisms when producing certain bioproducts like bioplastics.



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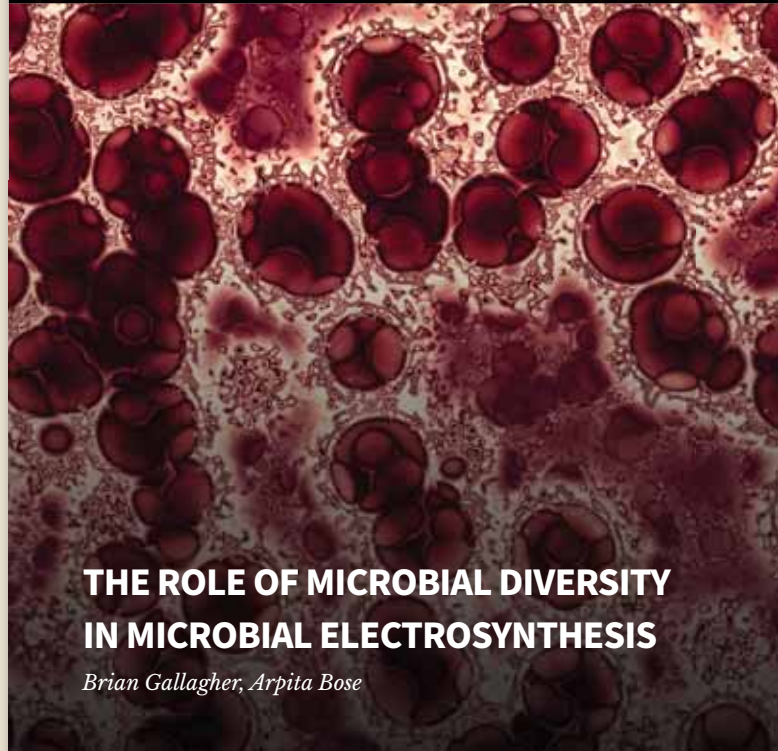


Bacteria are often painted as the enemy of humanity. Before the discovery of antibiotics, a wound getting infected was frequently a death sentence.

Even with modern medicine, infections such as *C. difficile* and infectious diseases such as tuberculosis continue to kill many people globally. Crop blights and diseases among livestock cause extensive monetary losses and threaten food security in affected areas.

With all of these reasons to distrust bacteria, it may come as a surprise that certain microbes are immensely beneficial to humanity. Unfortunately, they rarely get to enjoy the limelight.

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THE ROLE OF MICROBIAL DIVERSITY IN MICROBIAL ELECTROSYNTHESIS

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Exploring the science behind gene therapy in treating genetic diseases

Professor Alan Boyd explains the science behind gene therapy, the challenges in treating genetic diseases, and current trends in the sector

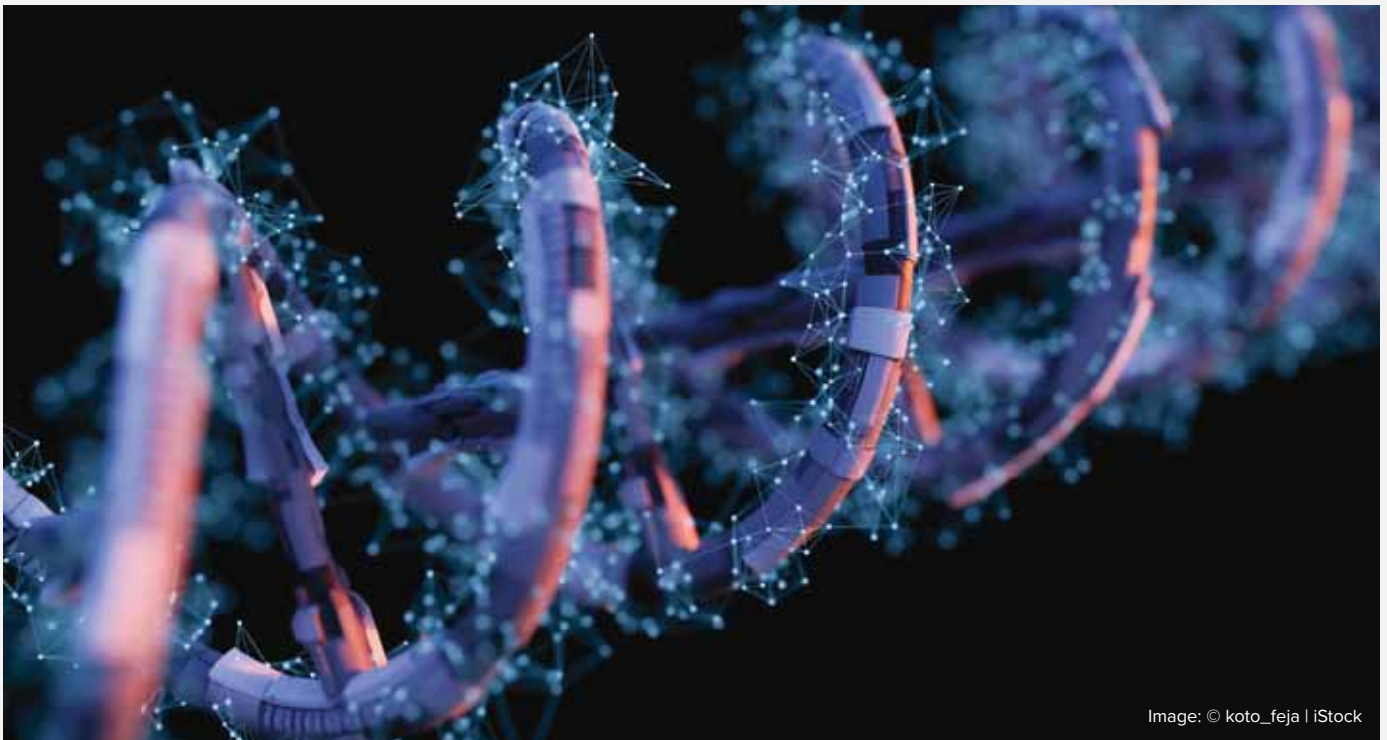


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There are hundreds of genetic diseases that occur in humans, and over the last two decades, a significant amount of research has been undertaken to see if gene therapy can be used in treating genetic diseases, with a lot of progress being made.

What is gene therapy?

Gene therapy uses DNA/RNA as a pharmaceutical agent to treat disease. The use of gene therapy falls into two distinct areas. It can involve the use of DNA/RNA that encodes a functional, therapeutic gene to replace a mutated gene, or in a more sophisticated way, whereby DNA/RNA is used to encode a therapeutic protein drug (rather than a natural human gene) to provide treatment.

The first gene therapy clinical study took place in September 1990 at the National Institute of Health, Washington, DC. It was performed on a four-year-old girl

as a treatment for a genetic defect that caused her to have an immune system deficiency (SCID). The treatment effects were only temporary, but successful. Since then, approximately 3,200 clinical trials have been conducted using a range of techniques for gene therapy.

How does gene therapy work?

In gene therapy, a carrier vector is typically used to deliver the therapeutic gene to the patient's target cells. The majority of these vectors are viruses that have been genetically altered to carry normal human DNA. This is because viruses have evolved a way of encapsulating and delivering their genes to human cells in a pathogenic manner.

Vectors are utilised to take advantage of this capability. The virus genome is manipulated to remove disease-causing genes and insert the therapeutic genes that are useful in treating a disease.

Next, the target cells in the patient are infected with the viral vector. The vector then unloads its genetic material containing the therapeutic human gene into the target cells, generating a functional protein product from the therapeutic gene and restoring the target cell to a normal state.

Challenges of treating genetic diseases

The main challenge we have in treating genetic diseases is finding a direct route of administration to the site of action. Indeed, the majority of gene therapy products that have reached an advanced stage of clinical development require special routes of delivery and administration to get them to the site where they are needed and to bring about their therapeutic effects locally.

Another challenge is that because we are using viruses to deliver gene therapies, the body will develop an immune response to that virus meaning it will attack and try and eliminate it. This is another reason why we need to try and get it to the site and the organ where it is needed. To dampen the immune response, steroid therapy and/or immunosuppressive agents are commonly administered at the same time as the gene therapy.

Trends in gene therapy

We are seeing significant growth in the use of adeno-associated viruses (AAV) to treat conditions of the eye, nervous system, and blood. AAVs are 'helper viruses' that we all carry in our bodies. Whilst they are non-pathogenic and do not cause any symptoms, they help other viruses get into cells in the body and, therefore, can be used as vectors to deliver gene therapy. A key advantage of AAVs is that they tend not to be destroyed by the body's immune response and can remain there for a long time, using the DNA to churn out the protein needed to treat the disease. This means that, with most gene therapies, we only need to administer a single dose to humans. An example of this is the gene therapy product Luxturna developed by Spark Therapeutics, approved for the treatment of inherited blindness in children.

Another area increasing in popularity is the use of lentivirus as an ex vivo gene therapy. Lentivirus can deliver a significant amount of replacement DNA into the

DNA of the host cell and has the unique ability to infect non-dividing cells, making them one of the most efficient methods of gene vector delivery.

"..viruses have evolved a way of encapsulating and delivering their genes to human cells in a pathogenic manner."

It is an exciting time for gene therapy, with many products in phase 3 late-stage development. The recent approval of the gene therapy product Adstiladrin for the treatment of non-muscle invasive bladder cancer was an exciting landmark for the industry in being the first time a gene therapy has been approved to treat a cancer, and demonstrating it is possible to effectively target more challenging cancers such as solid tumours. We are proud that of the 23 cell and gene therapy products that have been approved globally, Boyds has worked on nine of these at some time.

Boyds is the trading name for Alan Boyd Consultants Limited in the UK, Boyds Consultants Limited in Ireland, and Alan Boyd Consultants Inc in the USA.

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THE CHALLENGE OF TREATING GENETIC DISEASES: THE EXAMPLE OF CREATINE TRANSPORTER DEFICIENCY

The vast majority of genetic diseases remains beyond possibilities of treatment with research continuing to be able to offer therapies to the affected patients

Treating genetic diseases is a challenge. A restricted number of these diseases can be treated through specific diet, medics, chaperone molecules or enzyme replacement therapies, while some rare recent advances brought gene therapy to the panel of treatments.

Treatable and so far untreatable genetic diseases

Creatine deficiency syndromes (CDS) are perfect examples of this difference between treatable and so far untreatable genetic diseases. CDS are caused by mutations in the genes coding for arginine:glycine amidinotransferase (AGAT) and guanidino-acetate methyltransferase

(GAMT) (creatine synthetic pathway), as well as for the creatine transporter (SLC6A8). These three diseases show a lack or very strong decrease of creatine (Cr) in the brain, measured by proton magnetic resonance spectroscopy (1H-MRS), and develop severe neurological symptoms. CDS account for 1-2% of all mental retardations, Cr transporter deficiency (CTD) being the most frequent (1% of all mental retardations in boys, as the SLC6A8 gene is located on the X chromosome).

Since a very long time, Cr is known for its role in ATP regeneration and cell storage of high energy phosphates under its phosphorylated form

phosphocreatine (PCr) (through the Cr / PCr / creatine kinase system). More recently, Cr was also recognized as one of the main osmotically active molecules of the brain, and may also act as neuromodulator or even true neurotransmitter.

AGAT and GAMT deficiencies can be treated by Cr supplementation. In contrast, despite more than 20 years of research since its discovery, CTD (SLC6A8 deficiency) is so far remaining refractory to any efficient treatment. Cr supplementation was tried without any success to replenish brain Cr. The reason for this is that SLC6A8 is the sole way for Cr to enter the brain from periphery at blood-brain barrier (BBB).

Cr precursors, arginine and glycine, as well as Cr derivatives being transported independently from SLC6A8 (but keeping Cr capacity to regenerate ATP) have also been tried but without any success either.

CTD is the archetype of a genetic disease extremely challenging to treat. CTD essentially affects the brain, and the only way to treat it signifies being able to restore sufficient levels of Cr (or Cr derivatives playing the same roles as Cr) within the brain tissue. The difficulty resides in the way a molecule can enter the brain from periphery. To reach neurons or oligodendrocytes (the cells making myelin sheath in the white matter), a molecule transported from the blood has 1st) to cross microcapillary endothelial cells at BBB (one uptake and one efflux mechanisms), 2nd) to cross astrocytes surrounding BBB (another uptake and another efflux mechanisms), to finally reach the target cell (neuron or oligodendrocyte) through a third uptake mechanism, having thus in total five membranes to cross.

AAV-transduced gene therapy

Whatever these difficulties, hopes for treating SLC6A8 deficiency are arising nowadays in particular through new gene therapy technologies. Recently, the use of adeno-associated viruses (AAV) as attenuated viral vectors to treat genetic diseases by gene therapy has gained considerable attention, with successes already obtained for genetic diseases affecting both peripheral tissues and nervous system. As the brain remains challenging to treat, we and others are developing optimized AAV vectors able to efficiently transduce the brain tissue, with the aim of re-establishing the expression of a functional Cr transporter within the brain of CTD patients. We test different delivery routes of our AAV vectors to

CNS, through intravenous (to reach brain through BBB) or intrathecal (direct intracerebral delivery) injections. We are in the first pre-clinical phase of this development, using a new in vivo rat model of CTD, the Slc6a8Y389C/y knock-in rat, to demonstrate the proof of concept of our AAV strategy to treat CTD. We have already demonstrated that our AAV vectors efficiently transduce the desired brain cells after intravenous and intrathecal injections. We have also performed our first injections of AAV vectors transducing the functional SLC6A8, with the hope to demonstrate in the following months that we can correct CTD.

Our first results are promising as we could demonstrate partial prevention of CTD phenotype in the Slc6a8Y389C/y knock-in rat. However an important amount of work is still ahead to optimize our AAV treatment protocol. In particular, the optimal AAV doses have to be determined for each delivery route. The long term expression of the AAV-transduced gene has also to be evaluated.

The validation of our approach by AAV-transduced gene therapy consists in the analysis of the expected correction of the CTD phenotype. 1H-MRS is performed in central nervous system to demonstrate the expected replenishment of brain Cr. The weight gain of AAV-SLC6A8-transduced animals is also followed up: indeed, Slc6a8Y389C/y knock-in male rats, as male human patients, show a progressive attenuation of their weight gain in comparison of wild type littermates. Different behavioural tests are being performed, for which Slc6a8Y389C/y knock-in rats demonstrated altered results in comparison to wild type animals. A correction of the performances of these tests is expected.

While AAV viruses are known to elicit no or very low immunogenicity, this aspect of AAV gene therapy is also being carefully analysed within our Slc6a8Y389C/y knock-in rat model transduced by AAV-SLC6A8. Apart of potential elicitation of anti-AAV antibodies in transduced animals, other potentially AAV-driven toxic mechanisms are carefully evaluated, both in peripheral tissues and in central nervous system (cell death, alterations of cell morphology, tumorigenicity). We are also analyzing another aspect of potential toxicity of our treatment: the eventual AAV-transduced (over) expression of SLC6A8 at ectopic localization.

Promising results for the future of gene therapy and genetic diseases

In conclusion, while still ahead of a validated pre-clinical protocol to treat CTD by AAV-driven gene therapy, our promising results, and the panel of tests described above aiming to refine treatment efficiency and safety, make us confident to develop a long-awaited way to treat this so far untreatable metabolic disease affecting brain development.



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The importance of inclusion when studying history

Dr Leanna Brinkley, Study Group's Head of Quality Assurance and Enhancement at Cardiff University International Study Centre, shares her stance on respectful dialogue in the classroom when studying history



Historians of the past have tended to focus on the establishment of historical fact'. However, history cannot be studied in a vacuum, and researchers will inevitably be influenced by the social, cultural and institutional landscapes in which they operate.

While it is imperative that we ensure our claims are accurate and supported by sound evidence, it is unproductive - some may say futile - to try and establish a definitive historical truth. Part of constructing a rigorous historical narrative is acknowledging how our experiences and the belief systems we subscribe to shape our interpretations of studying history.

Decolonising the curriculum

The notion of decolonising the curriculum for history is often framed as a mere trend or an attempt to rewrite history; this is simply untrue. What it means is challenging the dominant Eurocentric view of historical events that created an established narrative for empire-building through colonialism. The account has typically celebrated the achievements of a cultural pervasion that undoubtedly had great benefit and impact for empirical leaders, but without exploration of the events from alternative viewpoints.

The concept of interrogating historical theories has always been fundamental to studying history. It is a

natural evolution to review and re-review chapters of history as our knowledge expands and our intercultural connections develop. Decolonisation of curricula is no different.

Historical analysis is a dialogue that re-evaluates positions based on new evidence. To understand this, one need look only to the annals of English kings and queens – or parliamentarians – through the ages. The discourse on whether their leaderships were successful, disastrous, just or biased is ongoing. New evidence and research contribute to such debates, but as a global society, we are changing, which also impacts the lens through which we look at the past.

As we become more connected around the world and more engaged with other viewpoints, our ability, capacity and appetite to analyse historical events through the lens of multiple social, cultural, and political backgrounds have developed.

Studying history has evolved to be more diverse

We have seen this happen across the globe. For example, when scrutinised with newfound evidence or perceived through alternative angles, early narratives of the 'Wild West', which centred around the good and the bad of cowboys and Indians, and the promise of fortune for gold seekers, are easily challenged.

A broader range of interpretations of that period of American history and, similarly, in Australia, has supported a conscious move away from the romantic and binary view of manifest destiny as propagated by 1950s Hollywood Western movies.

Efforts to move towards a more nuanced view that attempts to depict Native American life and culture more accurately can be seen in films such as 1990's Oscar-winning *Dances with Wolves* and 1998's *Smoke Signals*, which remain among the best-received films to emerge from Native American cinema to date. Although both films have received fair criticism, they have been considered key milestones in the shift towards more balanced depictions of life in early America.

Ensuring respectful dialogue when studying history

To ensure broad-spectrum inclusion, our role as educators is to create an environment where healthy, inquisitive discussions can occur with respect and without discrimination or inflammatory provocation.

But we must also embed skills acquisition into our teaching. Indeed, the skills associated with participating in meaningful and respectful debate need to be taught, not assumed. This is particularly true for students who missed out on much education and social development during the pandemic years and came of age surrounded by the echo chambers provided by social media. This often requires a gentle touch to ensure those skills are built up gradually. We need to be conscious of the fact that these skills are not a given and provide our students with the necessary tools to develop as debaters.

University and school debating societies can provide a further platform for opposing arguments outside the classroom. Rules demand the use of evidence to support statements, and the format is designed to give equal support to the making of all cases.

While these events are not without risk of bias arising, for example, from the demographics in the society or those to which the society is available, and passions can surface, hosts – much like tutors – can manage the discussion to deliver civility and successful discourse.

Suppose we can build up individuals that can voice diverse opinions with respect, kindness and compassion. In that case, we may go some way to negating the negative impacts of the binary and divisive political discourse that has dominated in recent years.

In debates, classrooms, lecture halls and history books, a curriculum or agenda from a singular or polarising stance will present barriers to inclusion. Students who feel their own cultures or histories are marginalised risk feeling excluded and disengaging with the discipline. Creating space and respect for multifarious views, perceptions, and voices when studying history can enrich

THE QUESTION OF BEING 'ROMAN': EXAMINING ANCIENT HISTORY MORE CLOSELY

[Prof Dr Felix K Maier](#), Professor for Ancient History at University of Zurich, provides an intriguing and instructive analysis of the question of being 'Roman' in his most recent ancient history focus



Painting from Pompeii, now in the Museo Archeologico Nazionale (Naples), showing a banquet or family ceremony

My history research project analyses [the dynamics of different identities in the Roman Empire from around 50-150 AD](#).

Identities in a multicultural empire

This project seeks to understand the often-paradoxical dynamics of different identities in a multicultural empire and to stimulate a discussion about hidden aspects of social interactions that we still need to understand correctly.

Although the Roman era is entirely different to our times, some critical questions relate to today's world, where social and political distinction mechanisms also lead to open or concealed conflicts.

In my research project, I focus on different voices in the Roman Empire, building on existing studies of how the different people in the Imperium Romanum saw themselves: as Romans, as Gauls, as Syrians, as Graeco-

Romans? Or something in-between? Which identity did non-Romans have, and how did this correlate with a supralocal identity of the Roman Empire? The answers to these questions are indeed fascinating.

By studying how people in these times defined their identity, we learn much about the "identity" concept and how fluid compared to the often-restricted ideas we have about people's self-definition. I have already shown one

Image: Matthias Kabel - Licensed under creative Commons



Roman military diploma which grants Roman citizenship as a reward for service

example in [my most recent article](#) and will present another one here, which is both intriguing and instructive.

The example of Juvenal in ancient history

Juvenal, also known as Decimus Junius Juvenalis, was an ancient Roman poet and satirist who lived during the late first and early second centuries AD.

Born in Aquinum (today called Aquino), Italy, Juvenal is renowned for his biting and often scathing satires that critiqued the vices and corruption of Roman society. His works provide a vivid and cynical portrayal of his time's social, political, and moral decay.

In his satires, Juvenal often addresses a particular issue: the "foreign infiltration" ⁽¹⁾ of the Roman Empire and especially the capital Rome itself. In his satire no 3, for example, Juvenal's text introduces a particular (fictional) Umbricius, a Roman citizen, who escapes from the city of Rome, bringing forward two main reasons for this: First, Umbricius complains that Rome would be overrun by foreigners, particularly by people from the Greek-speaking East, coining the famous sentence that (the Syrian river) "Orontes has long since flowed into the Tiber, and brought with it its language and morals." ⁽²⁾

Following up on this, Umbricius also laments that the "invasion from the East" ⁽³⁾ would leave no space for 'real' Romans like him, who would have to flee the city.

Researchers have struggled with this text as it needs to be clarified whether it provides a glimpse into Juvenal's perspective or if Juvenal is mocking people in the city who act like Umbricius.

Today, scholarship tends to favour the latter because Umbricius supports his view with a couple of contradictory arguments, which makes every reader realise that his perspective no longer applies to the new context, i.e., the mixing of different peoples in the capital of the Roman Empire and the fact that Rome grew even more multicultural than it had been previously.

Furthermore, in another satire, Juvenal again addresses the issue of how to distinguish a 'true' Roman from a Non-Roman. Whereas one voice of the text considers the ancestral tree as the most essential aspect, pointing to traditional Roman families like the Claudii or the Aemilii, another voice in the text claims that moral traits like a virtuous life are the real distinguishing feature of a human being,

emphasising that ethnic criteria are no longer crucial.

Adapting to a changing world

When we analyse these ancient texts, we obtain a fascinating insight into how people in a highly multicultural environment such as Rome in the first/second century AD struggled with adapting to the new circumstances in a changing world and – at the same time – how other people (perhaps like Juvenal) were making jokes about those who could not accept what other contemporaries accepted as a new reality.

Furthermore, although one should be cautious about drawing a line from Antiquity to today's world, it seems that phenomena that never change are indisputably before our eyes.

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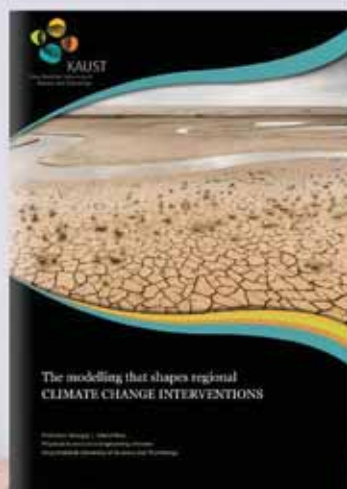
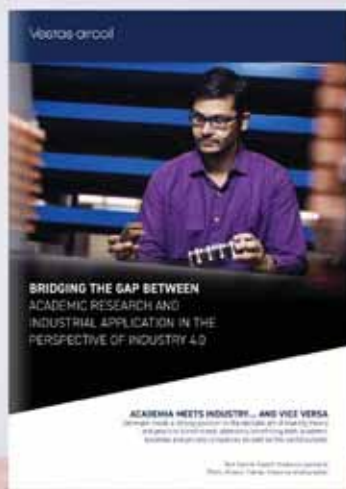
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← Continued from page 309

understanding and learning experiences for all in the classroom, regardless of their backgrounds.

Making history a more inclusive subject

It is paramount that we foster respectful dialogue in the classroom to enable discussion of sensitive topics. The

HISTORICAL ARCHAEOLOGY FOCUS

Historical archaeology concerns “the material remains of past societies that also left behind some other form of historical evidence,” according to the Society for Historical Archaeology (SHA), which is interested in the modern world’s archaeology from A.D. 1400-present. ⁽¹⁾

The SHA is concerned with identifying, excavating, interpreting, and conserving materials and sites underwater and on land. “Geographically the society emphasizes the New World, but also includes European exploration and settlement in Africa, Asia, and Oceania,” the SHA helpfully add. ⁽²⁾

It’s interesting to note that by examining the documentary record and physical record of sites underwater and on land, historical archaeologists seek to find out about “the fabric of common everyday life in the past and seek to understand the broader historical development of their own and other societies.” ⁽²⁾

Digging a bit deeper, Dr Richard Veit, Associate Professor of Anthropology at Monmouth University, observes that historical archaeology spans the globe and concerns all people groups, not just those from Europe. “Even though many earlier societies had writing: Sumerians, Egyptians, Greeks, Romans, Olmec, and Mayans, specialists in other fields study the archaeological remains of these societies,” Dr Veit said. ⁽³⁾

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Dr Leanna Brinkley

potential ramifications of supporting generations to tackle the big questions with mutual respect, interest and empathy are substantial.

One of the qualities that students hold in common is the goal to learn. As scholars, we should value respectful, inclusive and challenging discussions as essential to our craft. Respectful discourse and a broad debate will, ultimately, result in a more insightful, honest study of history. In turn, this presents history as a subject with the opportunity to widen and sustain its relevance to society and play a foundational role in fostering diverse and inclusive communities.

Today’s global challenges require rounded resolutions that span geo-political boundaries. Studying history and the capacity to collaborate, interrogate, incorporate, and understand will help foster tomorrow’s leaders with the skills we need today.

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BRINGING HISTORY TO THE SURFACE: HOW DO HISTORICAL INVESTIGATIONS AFFECT THE WAYS WE VIEW OUR HISTORY?

Associate Professor of Anthropology, Dr Liza Gijanto, outlines how archaeological and historical investigations are vital in revealing important insights into society's past

As a historical archaeologist, my research is collaborative and interdisciplinary by necessity. I have partnered with chemists, geologists, historians and architectural historians.

I have worked with museum professionals and government officials in the United States and The Gambia. And while research was my main focus as a graduate student to complete a Master's and ultimately PhD, the most important aspect of all projects I have worked on during that time and since is the public benefit that can arise from archaeological research, particularly from projects that involve a range of professionals and stakeholders.

The field of historical anthropology is in a privileged, though often uncomfortable, position that addresses many of the inequities in the present.

What role does archaeology play in understanding our past?

On the most basic level, archaeology helps us understand our past by revealing how people lived, worked, and interacted in different societies throughout history.

Archaeologists can reconstruct the past and provide insights into the evolution of human behaviour, beliefs, and cultural practices by studying archaeological sites, artefacts, and other material remains.

I focus broadly on the creation and experience of the modern world on a global scale beginning with the European exploration and expansion into Africa and the Americas starting in the mid-1400s. We focused on the Atlantic World, that initial contact period between Europeans, Indigenous Americans and Africans until the early 1800s.

We seek to understand the complex interactions on all sides of the Atlantic and their legacy through the material remains that form archaeological sites.

During this period, the foundation of twentieth-century understandings of race, gender, and capitalism were formed. In addition, activists involved in various social and climate justice movements worldwide are in some way reacting to the decisions made during this period of history.

Understanding the Atlantic slave trade through historical investigations

Archaeological investigations of the Atlantic slave trade include multiple sites such as submerged shipwrecks, trading ports or towns on the West and Central African coast, port towns and cities in the Americas and Europe, and plantations.

My involvement in this area began as a graduate student at sites now forming

the Cane River Creole National Historical Park (Louisiana, USA).

Excavations were directed by Dr Kevin MacDonald, current Director of the University College Institute of Archaeology and Dr David Morgan, Senior Archaeologist at the Submerged Resources Center, US National Park Service.

I was tasked with finding the location of nineteenth-century quarters using magnetometry—a non-invasive survey technique that 'reads' magnetic signatures below the surface created by soil movement or architectural features such as brick walls.

A magnetic signature differs from the surrounding soil when clay material is fired. Therefore, metal objects will give off a high magnetic reading. Former quarters in this area were likely raised structures on brick pilings, but the presence of old nails or trash pits would help us locate such structures.

After this experience, I moved across the Atlantic to focus on the slave trade in The Gambia, the smallest nation in West Africa and a previously contested space between the British and French during the seventeenth and eighteenth centuries.

As a PhD student, I developed a project with the support of my advisor Dr

Christopher DeCorse. As a foreign archaeologist from the global north, engagement with the local community was an important facet of my experience.

A continued lack of funding to develop an archaeological programme

My goal in 2006 was to partner with the Gambia National Center for Arts and Culture (NCAC) to continue the archaeological training many of the staff had received through an exchange programme between themselves and Historic St. Mary's City (Maryland, USA) partnering with St. Mary's College of Maryland where I am now an Associate Professor.

“...archaeology helps us understand our past by revealing how people lived, worked, and interacted in different societies throughout history.”

However, it became apparent very quickly that the impact I had hoped to make would be minimal. The NCAC did and still does not have an official position for an archaeologist.

Furthermore, in conversations with NCAC staff, the lack of funding and resources required to develop an archaeological programme of their own was an indefinite problem.

Based on these circumstances, I entered a long-term partnership with them, whereby my research agenda was secondary, and my skills were directed towards developing different heritage sites that are part of the UNESCO World Heritage Area (Kunta Kinteh Island and Related Sites). This partnership included documenting historic structures before renovation or needed stabilisation and collecting and

analysing artefacts for a museum exhibition or site interpretation.

Working with descendant communities

The main stakeholders in any project tied to enslavement are the descendants. While the Cane River project engaged enslaved descendants and plantation owners, my first direct experience collaborating with descendants was with the Liberated African community and the Half Die neighbourhood residents in Banjul, The Gambia. The Banjul Heritage project was initiated by Architectural Historian Orlando Ridout and Annapolis City Planner Bob Agee in 2008, in partnership with the NCAC, to document the rapidly disappearing colonial architecture due to development.

The project comprised archaeological and architectural components and interviews with residents and city council members. Working with NCAC staff, we collected oral histories regarding kirinting architecture unique to Senegambia, and abundant in the Half Die neighbourhood, giving it a distinct appearance.

This was a salvage project. Archaeology was limited to one site for one day. Ultimately, our goal was to document disappearing historic resources.

Drawing on these experiences, I recently began working with descendant communities. Cremona Farm in Mechanicsville, Maryland, was a site of slavery beginning in the late seventeenth century.

The descendants of the nineteenth-century enslaved have a strong oral history preserved. As a project team, we have started to develop plans for future archaeological and historical



investigations focused on questions they have about their ancestors.

This is possible because of their work making connections among themselves and with the current property owner and various staff at the farm. In this partnership, I see myself as a facilitator who brings knowledge and skill sets unique to my training. I am not the driving force but simply a partner.

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THE HISTORY OF SCIENCE

and its relevance to the modern world

with **Professor Ute Deichmann**

Image: © ilbusca | iStock - Antique photograph: Faraday's table in the Royal Institution

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SCIENCE

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THE HISTORY OF SCIENCE

and its relevance to the modern world

with Professor Ute Deichmann



Image: © XH4D | Stock - Ancient Chinese traditional herbal medicine ancient book (Golden Mirror of Medicine), from qing dynasty (18th century)

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Essentiality of diversity in STEM education

Nadeem Ahmad, Founder and Managing Director of Templeton and Partners, discusses his thoughts on the essentiality of diversity in STEM education

Diversity in STEM education is absolutely paramount to the future of STEM itself. Only 19% of UK tech professionals are female, IT professionals of ethnic minority backgrounds are much less likely to be promoted to management level jobs, and every diverse group is underrepresented in the tech sector, which is also mirrored in STEM as a whole. The saying 'you can't be what you can't see' is true: girls and children from diverse backgrounds don't see themselves in STEM due to a lack of visible role models, which continues the cycle of a lack of diversity in the industry.

The STEM sector, UK & globally

The STEM sector, particularly in the UK and globally, suffers from an increasingly urgent skills shortage. Templeton's recent [Hiring Diversity Report](#) found that despite 68% of tech leaders trying and struggling to recruit diverse skills, one in four companies are not investing in any D&I initiatives. Of those who are, most do not see a return on investment. Although one in three (35%) companies are investing in recruiting more women, half that number is still significantly struggling to recruit female STEM professionals. Part of the problem is a tiny pipeline: Templeton's charity partner [Tech She Can](#) work to increase careers awareness amongst schoolchildren, as the vast majority of children and young people don't view STEM as an ideal or even second-best career choice for them, despite having grown up with and through technology. For those diverse young people who go into STEM higher education, many graduates choose an unrelated industry or drop out of STEM jobs while still young due to overt discrimination and feeling like they don't belong.

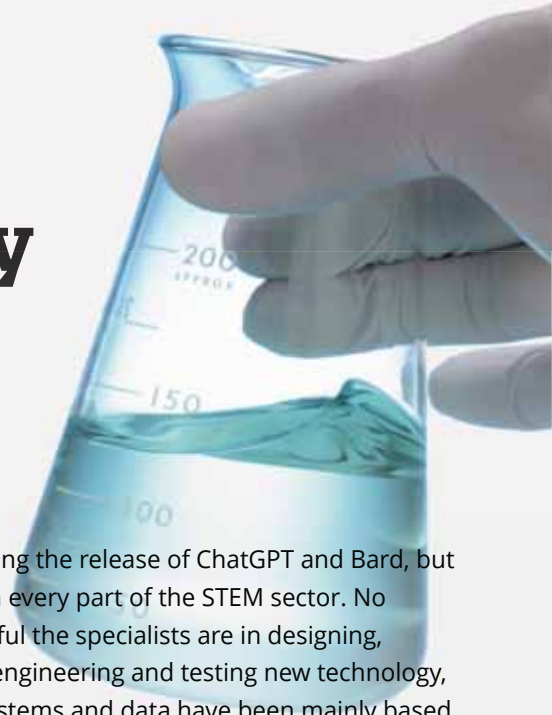
Our societies are increasingly diverse but, despite government targets and corporate investment, not increasingly inclusive. Sexist and racist bias has hit the

headlines following the release of ChatGPT and Bard, but this bias exists in every part of the STEM sector. No matter how careful the specialists are in designing, manufacturing, engineering and testing new technology, when existing systems and data have been mainly based on white men, and when bias has occurred in related human decision-making, that bias will be carried through. Teams of individuals with the same experience and background will have similar ways of thinking and working; in the case of prejudiced chatbot content, more diverse tech teams could have used personal knowledge and experience to anticipate specific scenarios to root out bias, whereas a group solely consisting of white men don't have this broader life experience to draw on.

More diversity in STEM education

Gen Z are more ethnically and racially diverse compared previous generations and are much more likely to be aware of and open about their LGBTQ+, disability and neurodiversity status. The youngest demographic to enter the workforce increasingly connects their day jobs to their identities, wanting organisational values and missions to match their own. Growing up as digital natives able to access world issues and instant news from their pockets means young people are also fluent in climate change and sustainability: arguably the world's most important challenge of the near and long-term future.

1 billion people will need to be upskilled or reskilled in the next decade to meet the demands of emerging technologies. Girls, young people from ethnic minority backgrounds, and children and teenagers who identify as LGBTQ+, neurodiverse or having a disability present a huge potential talent pool with a wealth of future skills and knowledge – but only if they receive the right education and support at school.



U.S. STEM POLICY INITIATIVE

Raise the Bar: STEM Excellence for All Students initiative ⁽¹⁾ seeks to make Science, Technology, Engineering and Mathematics (STEM) education in the United States (U.S.) stronger. The U.S. Department of Education hosted the [YOU Belong in STEM](#) National Coordinating Conference, which for the Biden-Harris Administration, is a key policy initiative. We hear that this initiative will ensure excellent STEM education, leaving no student out from PreK to higher education levels.

Having more diversity in STEM education should be available to all students regardless of their background to ensure what the U.S. Department of Education described as “global competitiveness” and “career readiness”. Cindy Marten, U.S. Deputy Secretary of Education, shared her thoughts on not excluding any students from STEM. “Research shows how a sense of belonging in rich and rigorous classrooms is directly correlated to students’ long-term academic success. Moreover, the Department’s Civil Rights Data Collection continues to demonstrate that students of color and students with disabilities are disproportionately excluded from learning opportunities in STEM.”

The U.S. Department of Education says with no doubt that all educators and students are a part of STEM and “deserve to have rigorous and relevant educational experiences that inspire and empower them to reach their full potential as productive, contributing members of our nation’s workforce,” Cindy Marten adds. Did you know that the Department partners with [Beyond100K](#) to identify the main challenges to staffing schools 100% with STEM teachers who create classrooms of belonging and reflect the diversity of their students? In addition, the [Smithsonian Science Education Center at the Smithsonian Institute](#) supports 20 education entities, which, together, reflect no less than over 10,000 STEM teachers, to ensure “a diverse STEM teacher pipeline”?

This STEM initiative brings together government, non-profits, industries, philanthropies, professional organizations, and other community stakeholders to take decisive action towards demolishing barriers to student success in STEM. \$120 billion for K-12 education in the American Rescue Plan (ARP) and additional federal education funds will help enormously. ⁽²⁾

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Due to a lack of visible role models and career awareness in education, STEM is still seen as a typical career path for white males. Young people are increasingly engaging with science, engineering and technology in their daily lives through social media and smartphone apps, but their interest must be recognised and channelled well before choosing GCSE and A-level options; girls and diverse young people who are not actively encouraged into relevant school subjects soon see STEM careers closed off from them forever. From the arts and healthcare to sports and gaming, children and teenagers need to see that STEM plays a role in every industry and way of life to imagine themselves with a future career path in STEM.

Diverse teams are vital in creating a future where STEM is fair, accessible and beneficial globally, and dedicated STEM education is needed to empower the STEM workforce of the future.

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USING LIVE THEATER TO FOSTER FACULTY INCLUSION

Florida International University's Bystander Leadership™ programme has collaborated with professional live theatre artists to increase awareness of gender and race bias among faculty through evidence-based practices

Bystander Leadership™ uses live theatre to teach participants the five steps of bystander intervention and leadership. The first two steps are to notice and interpret when workplace interactions reflect gender or race bias.

The US National Science Foundation ADVANCE program funds the AWED Theatre programme.

How can Applied Theatre foster interactive engagement?

To foster interactive engagement with these concepts, Jeffrey Steiger, the

programme's Creative Director, created and facilitates two theatre sketches which are performed by professional actors. Applied Theatre, the practice of using theatre-based techniques to foster reflection and action, is an engaging, non-threatening way to address controversial topics.

Applied theatre uses live theatre techniques as a visual tool to reflect issues of concern to communities, inviting a collective identification of problems. After examining the problems, participants are encouraged

to participate on stage actively, utilising their agency to rehearse solutions as a catalyst for social change.

The first sketch, 'The Joke', focuses on a senior faculty member and a newly hired assistant professor conversing before other hiring committee members arrive. After establishing subtle power dynamics, the senior professor tells the assistant professor a joke. The 'joke' is crafted to align with the cultural norms and values commonly found in the United States/Western society and relies on



Suzanna Rose, Ph.D.
Associate Provost

negative stereotypes of women, Blacks, and Hispanics.

Two performers depict the assistant professor's inner 'Greek chorus', debating whether to go along with the joke and gain admission to the 'boys club' or to do the right thing and object to these stereotypes. Steiger facilitates a dialogue following the scenario that invites attendees to share their inner 'Greek chorus,' unpacking the often unsaid forces that deter or encourage action.

The second sketch, Faculty Mentoring Faculty, portrays a senior male providing critical and discouraging feedback to a junior woman faculty concerning her performance to date.

In the post-performance discussion, observers identify the issues of gender, power, and privilege that defined the interaction and discuss possible interventions. Steiger also guides participants to reflect on how the junior man or woman might perceive the situation and to identify indicators of implicit bias, as well as to consider the difference between intent versus

impact (expressions of bias may not be intentional, but even so, the actions may harm women and minorities).

The theatre component of the workshop prepares participants to take the following three steps in Bystander intervention:

- Lead by deciding to say or do something;
- Decide what to do; and
- Act.

The rest of the programme includes skills training concerning various interventions that could be used to increase inclusion.

The Bystander programme indicates successful results

Of the more than 800 faculty that have attended the AWED Theatre programme for the Bystander Leadership™ Workshop, 97% indicated that the live theatre performances enhance their understanding of the issues presented. 100% indicated that the facilitator effectively encouraged discussion.

Evidence collected three months after participating in the program revealed that attendance increased faculty members' awareness of bias, their confidence to intervene, and their actions to intervene in observed instances of bias or exclusion.

Other topics that these live theatre sketch address include addressing burnout in medicine, sexual harassment prevention, equity in tenure and promotion, equity in the faculty search process, and the history of engineering education.

Five Days to Friday is a one-act play focusing on burnout in medicine and has been performed internationally and nationally at more than fifty medical schools or conferences and at the National Academies of Science, Engineering and Medicine. The play was written and directed by Steiger and choreographed by Peter Sparling, José Limón Dance Company and principal dancer with Martha Graham Dance Company.

Many AWED Theatre performances have been successfully offered in live and Zoom formats. Information about how to arrange a theater performance is available at <https://awedtheater.fiu.edu>

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INSPIRING STEM EDUCATION FOCUSED ON SOLUTIONS

Nancy Butler Songer, from the University of Utah, makes a call for collective action to create a new curriculum focused on the design of solutions

June 5, 2023, marked The United Nations Environment Programme's (UNEP) fiftieth anniversary of [World Environment Day](#), the largest global platform for environmental public outreach. Hosted by Côte D'Ivoire, this year's celebration emphasized a need for [collective action and policy](#) to realize known solutions, such as the sustainable design of products and materials to reduce how much plastic waste flows into aquatic ecosystems.

Celebrating World Environment Day

World Environment Day helps us to recognize that to address many current environmental, educational, health, and economic challenges that have foundations in Science, Technology, Engineering, and Mathematics (STEM) disciplines, we cannot rely on individuals or even experts within one area of science, technology, engineering, mathematics, or education. We must innovate with, study, and empower students, teachers, community members, and university and industry partners toward collective action.

Our planet is home to 1.8 billion young people between 10 and 24, who comprise the largest generation of youth in our history. Many young people are increasingly aware of the challenges of environmental and health



issues, and many are motivated to explore solutions even if their formal schooling rarely provides learning opportunities to innovate and design.

Lack of interest in STEM education

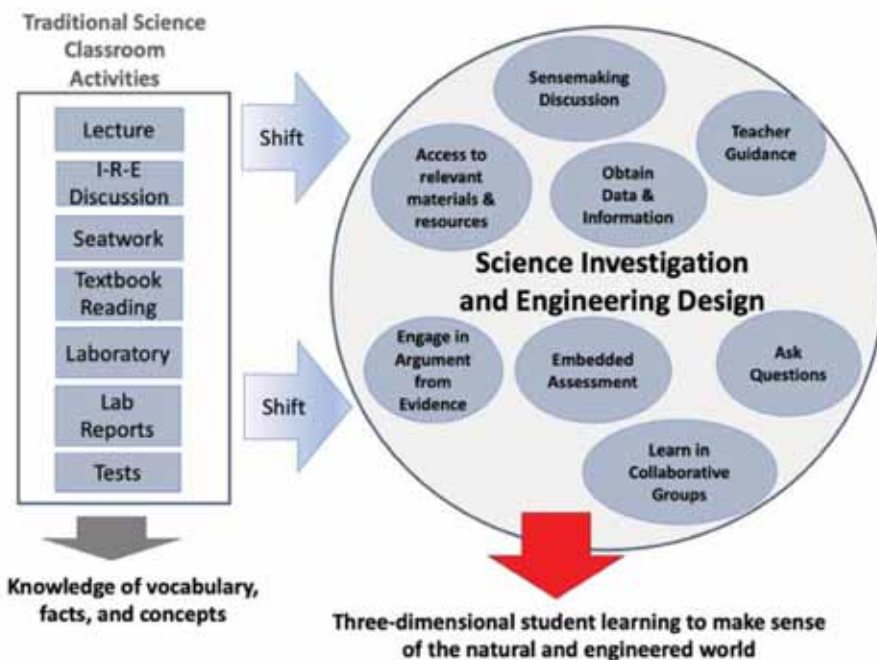
In the United States, research shows that students begin losing interest in core subjects such as math and science as early as middle school (George, 2006). This lack of interest is understandable; many STEM curriculum programs for pre-university students emphasize textbook-driven learning, formulaic laboratory exercises, or lectures. Research studies suggest that traditional learning approaches can lead to knowledge of vocabulary, facts, or concepts but not to conceptual understanding of STEM topics or problem-solving (NASEM, 2019).

To train the solution-creators we desire, we need curricular programs that foster problem-solving, collaboration, communication, creativity, and the generation of solutions to local problems so that students know their STEM education has value, not only during their school years but long after.

We must rebuild curricular programs toward activities that shift student learning from the passive learning of facts to active learning emphasizing problem-solving and engineering design.

Pre-college learning emphasizing the engineered design of solutions

We have created and evaluated a learning approach for students aged 10-18 called [solutioning](#) that guides



Shifts needed in science curricular programs (From NASEM, 2019, p.83)

youth in scientific investigation and engineering design to solve local environmental problems. This approach mirrors the work of professionals, as, for example, engineers do not isolate their knowledge of engineering and science but instead rely on a natural interchange between scientific reasoning and engineering design to address real-world problems.

The solutioning curricular approach consists of five phases: Engage, Explore, Explain, Engineer, and Educate. The unit begins with a local government agency inviting young people to use their STEM expertise to help design solutions to a particular environmental issue, such as non-native insects' disturbance of ecosystems.

Participating in engaging science activities and sharing what they have learned allows students to develop a sense of identity as a member of the scientific community, thus driving interest to pursue other experiences, or even careers, in science.

Perhaps most importantly, it helps youth to have productive outlets for their expertise and STEM education

and to realize the value of their knowledge when they educate others.

The learning activities and final products of a solutioning program often look different than those in a traditional STEM classroom. For example, students charged with designing a trap to collect the invasive Spotted lanternfly began by conducting field-based observations on local organisms and researching their chosen invasive insect.

An engineering design process followed the research, including a review of brainstorming rules and creating multiple sketches. Teams then worked cooperatively to evaluate their designs, build their optimal solution, test it, and share it with others.

Research studies demonstrate that curricular programs with these design elements can increase interest and motivation, test performance (Songer & Ibarrola Recalde, 2021), retention of learned content, and an increased sense of agency (NASEM, 2019).

Embracing STEM education

As we recognize the essential need for problem-solvers and designers, let's

embrace the idea that formal schooling must provide more than exposure to or memorization of STEM topics. We must embrace programs like solutioning that empower and train the leaders we need to realize the policies and solutions for our futures.

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Brainstorming rules

1. Don't judge. There are no bad ideas now, and plenty of time to narrow them down later.
2. Encourage wild ideas. Even if an idea seems unrealistic, it may spark a great idea for someone else.
3. Build on the ideas of others. Think "and" instead of "but."
4. Stay on topic. Brainstorming is more productive when it's focused on the topic.
5. One conversation at a time. Listening can encourage more ideas to flow.
6. Visualize. Draw your ideas when it's helpful. Stick figures and simple sketches can say more than many words.
7. Aim for quantity. If you want to find one good idea, produce many ideas.



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DOES ENGLAND HAVE A BIAS AGAINST ETHNIC MINORITY TEACHERS?

85% of teachers in England are White British, and 46% of schools have no racially diverse teachers at all. Does this mean England has a bias against ethnic minority teachers? Beng Huat See from Durham Evidence Centre for Education explores

Evidence of ethnic disproportionality in the school workforce?

Around 70% of the working population is recorded as White British, but 85% of all teachers in state-funded schools in England are White British. This makes teaching a particularly White profession.

Around 66% of the student population is White British, but 86% of teachers and teaching assistants and 93% of school leaders are White British by ethnic background (Gov.UK 2021).

There represents a mismatch between the ethnic makeup of teacher and pupil numbers overall.

Ethnic minority teachers and students are overly clustered in particular areas or schools. For example, they are far more common in London than in the North East. Around 46% of schools had no ethnic minority teachers at all (Morgan & Scarlett, 2021).

Although there has been an increase in the proportion of ethnic minority teachers in the last decade, it still lags behind that of the student population, which has dramatically increased.

The proportion of ethnic minority teachers has increased from 11% in 2011 to 15% in 2021, while that of pupils from ethnic minority backgrounds is now 35%, a rise from 24% a decade ago (Figure 1).

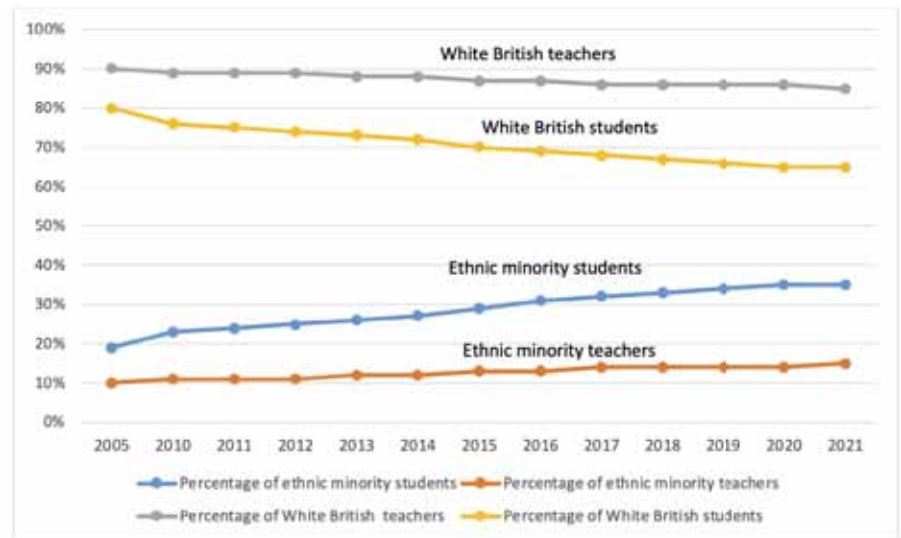


Figure 1: The widening gap in the proportion of minority ethnic teachers and pupils

It is this increasing gap in the proportion of minority ethnic teachers and pupils that is a cause for concern for policymakers and school leaders.

Why does diversity in teaching matter?

Diversity in the teaching workforce matters for two important reasons:

It tackles educational inequality and closes the achievement gap of ethnic minority pupils

[International evidence suggests that exposure to teachers from a similar race/ethnicity](#) can raise the achievement of ethnic minority students (e.g. Villegas and Irvine 2010; Egalite et al. 2015; Gershenson et al. 2016; Haddix 2016; Grissom et al. 2020; Harbatkin 2021).

Ethnic minority pupils with teachers

from similar ethnic backgrounds are less likely to be excluded (Grissom et al. 2009; Lindsay & Hart 2017) and suspended from school (Wright 2015) or drop out (Gershenson et al. 2017). They are less likely to be classified as needing special education (Steifel et al. 2022) and more likely to be referred to a gifted programme (Grissom & Redding 2016; Grissom et al. 2017; Nicholson-Crotty et al. 2011).

Ethnic minority teachers have higher expectations of ethnic minority pupils; they raise their aspirations and are positive role models for them.

It creates a more inclusive and diverse school community that reflects the wider society

Minority ethnic teachers bring different perspectives and life experiences,

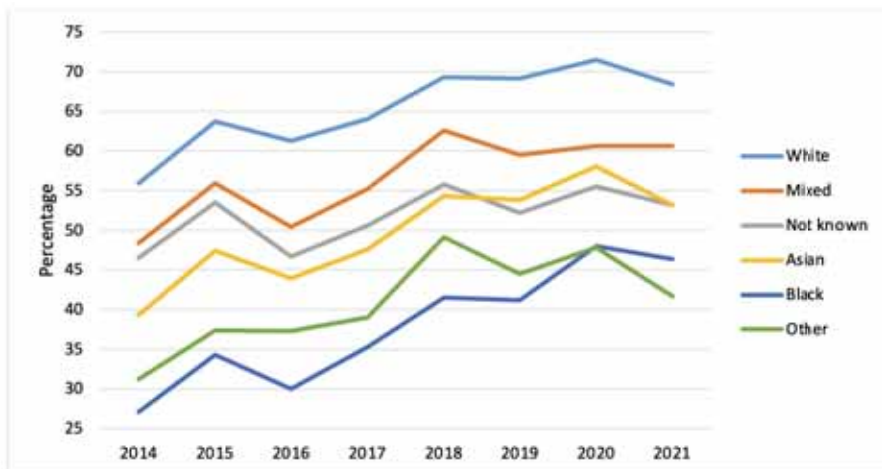


Figure 2: Percentage of applicants accepted by ethnic groups (2014 to 2021)

Source: <https://www.ucas.com/data-and-analysis/ucas-teacher-training-releases/ucas-teacher-training-end-cycle-2020-data-resources>

exposing our children to cultural diversity, which reflects the languages, cultures and ethnic backgrounds of the local community and society at large.

Why are there not more ethnic minority teachers in our schools?

First, ethnic minority applicants in England are less likely to be accepted into teacher training. This is especially so for applicants identified as Black and Other. Only under 50% have been accepted into initial teacher training across all years, compared to over 70% of White applicants.

Universities and Colleges Admissions

Service (UCAS) data showed that 569 (32%) of initial teacher training providers had accepted no ethnic minority applicants at all between 2014 and 2021. While it is possible that some of these providers may not have any ethnic minority applicants, the data also shows that 337 providers had at least over 100 ethnic minority applicants over the eight years. Of these, 37 (9%) had accepted no ethnic minority applicants.

The question had to be asked: Are minority applicants less qualified, have lower entry qualifications, or is there an unconscious bias among teacher training providers, or even institutional

discrimination? Or is it the lack of access to application and selection process information? These questions need to be investigated.

Second, even if accepted into training courses, they were less likely to gain a qualified teacher status (QTS) and a teaching post in a state-funded school in England than White British trainees.

What must be done to address the situation?

Identify the root causes of these disparities so that effective solutions can be implemented to address them.

Create more targeted initiatives and programmes such as scholarships, mentorship programs to encourage and support individuals from minority ethnic backgrounds to pursue a career in teaching.

Provide support and professional development opportunities to help retain these teachers in the profession.

Address unconscious bias in relation to recruitment, training, appraisal and professional development of ethnic minority teachers.

Provide appropriate support to newly qualified ethnic minority teachers who may experience a greater sense of isolation as a result of their different cultural background.

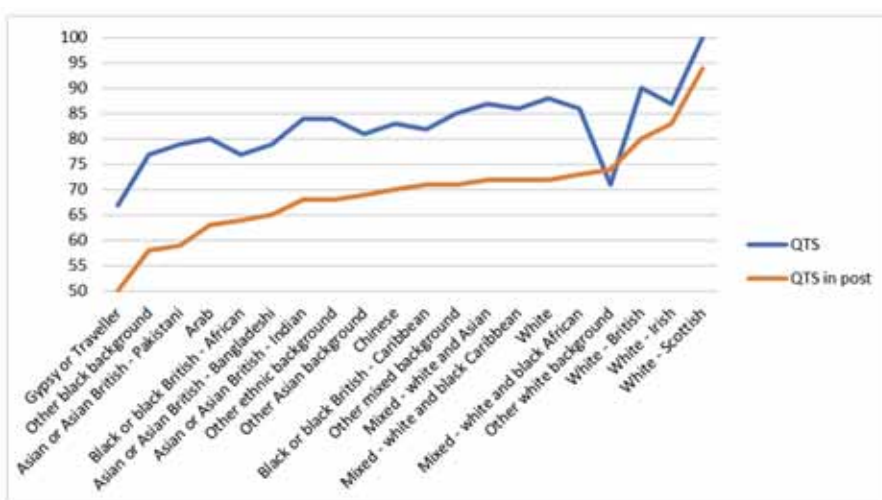


Figure 3: Ethnic disparity in success rates in initial teacher training and securing a teaching post (2021)



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Why must we increase representation for female entrepreneurship?

Although we live in a diverse world working towards equal opportunities, the statistics show that females are less likely than males to start businesses. Shalini Khemka, CBE, explores why female entrepreneurship is essential to foster sustainable economic growth



Shalini Khemka CBE

There is plenty of evidence that women are more than capable of setting up and running successful businesses, but the statistics reveal a disappointing situation. While there has been a slight increase in female entrepreneurship, women are still only 60% as likely as men to be self-employed in the EU, according to an OECD survey. ⁽¹⁾

It does not appear to be an age issue as young women (20-29 years old) were not any higher up the rankings in relation to either confidence in their abilities or in comparison with their male counterparts.

Despite the rapid increases in educational qualifications, the World Economic Forum's Global Gender Gap Report ⁽²⁾ predicts that we have another 99.5 years to wait before

we achieve gender parity. This is not only for the UK; the charts show a similar pattern worldwide across the 40 countries that participated in the survey.

Female entrepreneurs in countries of different economic statuses

Gender gaps in startups are more significant in middle-income countries but tend to be narrower in lower-income countries. This may be due to many women starting businesses out of necessity.

Interestingly, women in poorer countries tend to be more self-confident about their abilities (skills and knowledge) to become entrepreneurs and less afraid of failure than women in middle and high-income countries. This may

be due to the still evident societal influences, generating subjective and, possibly, biased perceptions about self-confidence and fear of failure. It may also be affected by the existence of or access to fewer opportunities.

Despite the evolution of the working woman and the two-income family, it is still more likely to be the male partner who embraces entrepreneurship. Married women with young children are more likely to enter entrepreneurship than take a paid position and are more likely to be entrepreneurs than unmarried women.

This may be because it is the only way they can earn money without being tied to a regular schedule, so they can be available to meet family needs without having to beg for time off. There is also the issue that, sometimes, when women start a business, it is seen as work partly supported and made possible by having a partner who can provide the funds that support the family.

Like their counterparts in more developed countries, women in developing countries rely more on their husbands and extended families. This is often constraining since women's marital status, assets, and incomes are brought into their marriages. These are important influences on their entrepreneurial decisions.

Of course, there are exceptions to every rule, and there are women who are the main breadwinner in the family, but they are exceptions.

The potential

In the book, *We See Ourselves as Entrepreneurs, But Others See Gender and Race* by Trish Cotter, there are some interesting statistics on female entrepreneurship, albeit for the US sector:

Women started an average of 1,817 new businesses daily, representing 42% in the US – generating a revenue of \$1.9 trillion;

Women-owned businesses are growing two times faster on average than all businesses nationwide. In particular, women of colour are starting businesses at 4.5 times the rate of all businesses; and

The most significant growth in women-owned businesses happened at the extremes of low-revenue and million-dollar-plus businesses.



The demise of the services provided by (UK) organisations such as Business Link and local Enterprise Agencies (axed in 2011) has removed some opportunities for UK-based entrepreneurs to get invaluable advice and support. Today entrepreneurs are mainly dependent on private sector consultancy for these services.

New female entrepreneurship demands support to help women establish and grow robust businesses that embrace best practices. That is where strong networks are essential.

In the right network, new female entrepreneurs will have access to the people who can help them negotiate the business minefield and get support, advice, and feedback from people ahead of them on their journey.

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SEX-BASED LABOUR MARKET SEGREGATION AND WOMEN'S PERCEPTIONS OF ENTREPRENEURSHIP

Professors Tonoyan, Strohmeyer, and Jennings investigate

As noted in a [prior Open Access Government article](#), women tend to participate in entrepreneurial activity at lower rates than men within most countries included in the Global Entrepreneurship Monitor.

Numerous plausible reasons for this gender gap exist.

A large-scale study by Professors [Vartuhi Tonoyan](#) (California State University, Fresno), [Robert Strohmeyer](#) (University of Mannheim), and [Jennifer E. Jennings](#) (University of Alberta) put forth and examined the argument that women are likely to possess less favourable perceptions than men, on average, of how easy it would be to start a business. These scholars further argued that this disparity can be attributed to sex-segregated positions within traditional wage-and-salary employment, which present structural disadvantages for women's entrepreneurship.

Sex-based labour market segregation

What are the different forms of sex-based segregation that characterise traditional wage-and-salary employment? One type, vertical sex segregation, refers to the tendency for women to be under-represented relative to men in higher-level managerial positions, a phenomenon commonly referred to as the 'glass ceiling'.

A second type, horizontal sex segregation, refers to the tendency for women and

men to be overrepresented in gender-stereotypic occupations (such as elementary school teacher versus engineer, respectively). A third type, industrial sex segregation, refers to the tendency for women or men to be disproportionately represented in entire employment sectors (such as public administration, which is now female-dominated in many countries). Although much is known about how these forms of labour market segregation affect the career-related outcomes of employees, comparatively little is known about the implications for entrepreneurship.

Hypothesised implications for entrepreneurship

Tonoyan, Strohmeyer, and Jennings reasoned that the vertical, horizontal, and industrial sex segregation evident in the general labour market is likely to contribute to gender differences in the perceptions that employees hold of how easy it would be to start a business.

More specifically, these scholars hypothesised that a woman's greater likelihood of being employed in a non-managerial position, a female-dominated occupation, and/or female-dominated sector will result in a lower likelihood of securing entrepreneurship-relevant resources, entrepreneurial career previews, and exposure to environments conducive to entrepreneurship.

The researchers further hypothesised that these differences will manifest as a

gender gap in perceived start-up ease – and that this gender gap will be wider in countries with higher levels of sex-based labour market segregation.

Large-scale, multi-country investigation

To assess the empirical support for their hypotheses, the research team analysed secondary data from the European Social Survey (ESS).

The 2005 version of the ESS was ideally suited for testing their hypotheses as it included a measure of perceived start-up ease as well as detailed information on the types of jobs and career experiences of respondents who were wage-and-salary employees at the time of data collection.

The large size and multi-country nature of the 2005 ESS enabled the researchers to test their hypotheses using data collected from over 15,700 employees across 22 European countries.

How and why sex-based labour market segregation affects start-up ease perceptions

The findings unearthed by Tonoyan, Strohmeyer, and Jennings offer rigorous evidence that the persistent and pervasive sex-based segregation that characterises traditional wage-and-salary employment possesses negative implications for women's entrepreneurship.

After documenting that the female employees reported significantly lower start-up ease perceptions than the male employees, the researchers demonstrated that almost 30% of this gender gap could be attributed to the women's greater likelihood of being employed in a non-managerial position, a female-dominated job, and/or the public sector.

More nuanced analyses also offer important insight into why the above-noted indicators of sex-based labour market segregation contributed to the observed gender gap in perceived start-up ease. Specifically, Tonoyan, Strohmeier, and Jennings found empirical support for their argument that the types of jobs that women are more likely than men to hold as employees provide less opportunities to:

- a) Acquire resources relevant to starting a venture (especially business connections and financial capital);
- b) Experience previews of an entrepreneurial career (through job autonomy and involvement in organisational innovation); and
- c) Be exposed to environments conducive to entrepreneurship (especially industries with a high level of self-employment and/or dynamism).

The findings from the research team's cross-country analysis further revealed that the gender gap in start-up ease perceptions was more pronounced in the European countries with higher overall levels of sex-based labour market segregation. Intriguingly, the gaps were widest in the Scandinavian countries of Denmark, Finland, Norway, and Sweden – and lowest in Luxembourg and the Southern European countries of Italy, Spain, and Portugal.

Linking start-up ease perceptions to entrepreneurial activity

In a supplemental analysis, the authors also investigated the behavioural implications of working in a female-dominated occupation. They established that individuals in such occupations were significantly less likely to transition to entrepreneurship than those working in male-dominated or gender-integrated jobs.

These findings highlight how sex-based labour market segregation can stifle the path to business ownership, making it more challenging for women, in particular, to unleash their entrepreneurial potential.

Implications for public policy related to gender and entrepreneurship

What are some key takeaways of this study for public policy initiatives at the intersection of gender and entrepreneurship?

Most fundamentally, the findings highlight the importance of recognising that the differing perceptions that women and men tend to hold of entrepreneurship are partially attributable to the different (and gender-stereotypic) positions that they hold in the general labour market.

Thus, to ensure equality in entrepreneurship, policymakers need to address gender disparities in traditional employment by reducing vertical, horizontal, and industrial sex segregation. By doing so, they can level the playing field, fostering an environment that promotes equal opportunities for female and male employees to formulate non-gendered perceptions of how easy it would be to start a business.

Click [here](#) for the full research article published by Drs. Tonoyan, Strohmeier, and Jennings.



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FORMATION

Digital transformation: Legacy ICT challenges

Crown Commercial Service (CCS) technology experts discuss how public sector customers can overcome some of the challenges associated with legacy ICT and outline a better way forward towards digital transformation

What is the government's Cloud First policy?

The government's [Cloud First Policy](#) and desire for digital transformation to improve outcomes have produced demonstrable benefits across the public sector. In the government roadmap for digital and data, [mission 4](#) lays out how departments will modernise across the public sector, moving away from legacy ICT systems, and making sure all major systems operate in appropriate environments which are safe and secure. Additionally, [mission 6](#) seeks to improve digital skills across government, which includes understanding and skills in cloud.

What is legacy infrastructure or legacy ICT?

Legacy infrastructure means the information and communications technology (ICT) devices or applications that are old and out of support. It can also refer to hardware and operating system architectures that are not typically offered by mainstream public cloud vendors.

How is cloud better than legacy ICT systems?

Adopting the public cloud is key because it offers tools, features and ways of working that maximise organisational adaptability and scalability. It is a great way to improve operating models and workforce skills. It provides:

- Increased security and resilience.
- Improved carbon net zero outcomes.
- Improved value for money and scalability.

One example of the benefits of public cloud is that the vendor's underlying ICT is located in large hyperscale data centres. These buildings are extremely efficient, which lowers the cost and reduces carbon.

This has led to increased cloud spend. The cloud spend for organisations of all sizes is growing at a Compound Annual Growth Rate (CAGR) of 17% per annum, compared to 7% on legacy (Gartner, 2022).

Balancing cost & performance

Picking the right migration strategy is key to getting the best value for money out of the cloud. It's important to balance performance with cost to make the right choice for your organisation.

At CCS, we know the balance is difficult. For some services, the choice of public cloud is obvious. For example, for some organisations, migration may be easy and once complete, will lower operating costs. For others, migration may be time-consuming, expensive and potentially increase operating costs.

To manage this transition effectively, most IT leaders in the public sector are leaning towards a hybrid strategy. This enables them to benefit from the best of traditional ICT, private cloud and community cloud alongside public cloud.

As part of the government's review of its Cloud First Policy, the Central Digital and Data Office is further developing the advice and support they provide to promote smaller-scale changes, cloud adoption and to move to more cloud-like automation, including private cloud examples and the move to platform as a service (PaaS) and infrastructure as a service (IaaS), all of which will help you move away from legacy ICT.

Crown Hosting – an alternative to public cloud

For those ICT services that are not yet ready to be migrated to public cloud, our [Crown Hosting](#) agreement is an option. Crown Hosting uses the same campus-based

hyperscale data centre technology as the public cloud vendors, and shares the same sites. It provides you with a low cost and minimal carbon footprint for traditional ICT, private cloud and community cloud.

The commercial benefits of Crown Hosting fall into two categories, direct and indirect. Directly, customers that relocate to Crown Hosting, with no ICT changes, will reduce their electricity consumption and their bill by 75% on average. Crown Hosting also offers better pricing of the services when compared against other equivalent providers in the UK market. Indirectly, Crown Hosting can help you make further savings.

These sites are home to a large community of public sector organisations, all of which need network connectivity, ICT service provision and related products and services. This large community generates demand, leading to opportunities for further savings through competition.

As organisations continue to develop transformation strategies, the Crown Hosting hybrid environment provides a technological solution for cost savings and advancing carbon reductions.

Next steps & how we can help you

Our dedicated commercial specialists have deep category knowledge and can help you to understand your organisation's requirements. They can advise on strategy, fulfilment and best practice to support your commercial strategy.

To find out more about how we can help you start or progress on your migration journey, get in touch:

- Complete [our online form](#) with details of your requirement.
- Explore our [Digital Future solutions webpage](#).
- Take a look at our agreements: [Crown Hosting](#),
- [G Cloud](#) and [Cloud Compute](#).

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VERTICAL APPLICATION SOLUTIONS FOCUS

With the Crown Commercial Service's (CCS) Vertical Application Solutions framework, customers in the public sector can access "software focused solutions" like associated hardware, app-related consultancy services, software licences, maintenance, plus software support. Such solutions cater for the specific requirements of their industry, services or business application.

This agreement replaces [Data and Application Solutions \(DAS\)](#). All public sector entities, including government departments and bodies, third-sector organisations, devolved administrations and the broader public sector, can use it. Customers in the blue light (emergency services), local authority, education, and social care sectors are very much included.

The agreement, Vertical Application Solutions, can be used to, for example, purchase on-premise and cloud hosted software or a mixture of both as part of a single agreement. Also, it can be used to provide, test and implement a variety of software solutions and access professional services plus solution-essential hardware.

Vertical Application Solutions commenced on 07/03/2023 and will end on 06/09/2025, with five lots and 80 suppliers. The benefits include wholly supported solutions for cloud, hybrid or premise (or a mixture) of systems plus the means to purchase many software solutions that seek to cater for specific sector needs, such as local authority benefits and revenues. ⁽¹⁾ This agreement is one example of how CCS plays a crucial part in assisting the UK's public sector save money when purchasing required services and goods. ⁽²⁾

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2. <https://www.crowncommercial.gov.uk/about-ccs/>

RISK MANAGEMENT: TO QUANTIFY OR NOT TO QUANTIFY?

Patrick Parker, Director of CGR Ltd, explores whether a qualitative or quantitative risk assessment is optimal for risk management in your organisation

Those who are averse to a qualitative risk approach will complain that it is a 'wet finger in the air' exercise with no substance. Those opposed to a quantitative risk approach will complain that it removes human judgment from the equation. In reality, this is a false dichotomy.

Risk management, whether you consider it to be an art or science, requires an effective balance between analysis, treatment, and monitoring. Although there may be merit in a quantitative approach to risk analysis, there are also pitfalls – and a disproportionate focus on complex risk assessment at the expense of monitoring means you won't know whether the assessment is correct (however you reached it).

Risk monitoring lends itself more to a quantitative approach: well-targeted risk indicators should guide your risk assessment, and their trends over time will support your understanding of the risk vector. This, in turn, will mean your risk treatment (controls and actions) can be more effective in keeping the risk within your appetite. If the focus is overwhelmingly on risk assessment, you will simply admire the risk rather than manage it.

Risk Analysis – What's behind the number?

In a former public sector career, I undertook postgraduate studies in safety risk management. This included technical probability of failure assessment through failure mode analysis based on Boolean logic and algebra.

The message was that this would deliver much-needed objectivity into an overly subjective world of risk. The resulting probability figures did indeed appear more specific but were dependent on subjective assumptions feeding the algebra. The numbers just amplified the assumptions. Worst case, this meant that rubbish in led to 'rubbish squared' coming out.

I saw this dynamic in practice in an aircraft technical hazard assessment which sought compliance with a regulatory target of 10^{-7} for fatality likelihood. The input data involved historical accident rates, and the initial result didn't meet the target – so the date period for accident data was adjusted until the 'right' answer was achieved.

The decision on accident data may actually have been appropriate in this case – the problem was that the

accountable risk owner would have been briefed on the 'right' number without being aware (or have a chance to approve) the assumptions behind it. Quantitative assessment may have utility or even be a requirement – but any baseline assumptions must be transparent and understood.

Risk monitoring and the 'ivory tower'

There is an inherent danger in the upper layers of business having an ivory tower view of risk which may be overly positive: either because of distance from the business 'front line' or subconscious cognitive bias driven by proximity to objectives and targets.

Risk monitoring should actively seek dissonance between any prevailing ivory tower view and reality. It needs to embrace an approach that looks for reds, not greens, giving you a chance to get in front of a risk event. This is a cultural mindset that needs to be driven from the top.

Risk intelligence – 'The bringers of bad news'

There is a saying that to avoid failure, 'the bringers of bad news must be celebrated'. Far better to learn the bad news in time to prevent an incident

than to learn it during a subsequent inquiry.

An ivory tower view of risk might assume that a risk control is effective – for instance, an audit policy (for a business risk) or an alarm (for a safety risk). However, questioning those on the ground may yield challenging insights – the policy might not be followed correctly, or the alarm may not be functioning. This may be discovered through a qualitative regime of safety conversations and observations or through a more quantitative survey approach.

Risk intelligence can also be sought from other sources and monitored in a structured and quantitative way – for instance, the number of non-compliances, or near-miss events, or the number and severity of issues where the risk event has occurred. This could be taken from internal business data and/or external reporting within the industry sector. The monitoring is essentially a quantitative exercise, although the thresholds of severity will be a matter of judgement.

In any case, the aim is to detect dissonance between the risk assessment and reality on the ground. Analytics will tell you a lot, and a quantitative approach to monitoring indicators will pay dividends. You should be able to gain insights into indicator performance over time. This may allow you to correlate recurrence with specific time periods or events – and then act pre-emptively.

The importance of data integration

Effective and efficient monitoring requires an open approach to data integration. In my former career, flight data monitoring was a very tactical exercise involving huge data sets that could yield significant insights on aviation risks – but the risks were typically managed separately by people who operated above that level of detail.

For instance, the data could usefully show an increasing trend in aircraft landing long on a particular runway, thereby increasing the risk of accidents from insufficient stopping distance – but the data didn't feed the risk unless the dots were joined manually. Automated monitoring can trigger alerts without you drowning in data, detail, and process. API connectors make this increasingly possible, and you should challenge your business and suppliers to explore this.

You need to take action

Without effective action management, your business won't be able to respond to any of the above – and risk management doesn't happen. Risks depend on the performance of the controls. You will need to place actions on people to put controls in place or improve control performance, and you must hold those people to account – whoever they are. Dealing with people is an inherently subjective exercise. Action performance and verification can and should be measured.

Risk assessment is a starting point,



not an end in itself. It shouldn't be disproportionately complex, whatever approach you use. If you want to manage your risks rather than admire them, you need to get beyond risk assessment: focus on the controls, and monitor indicator performance over time.

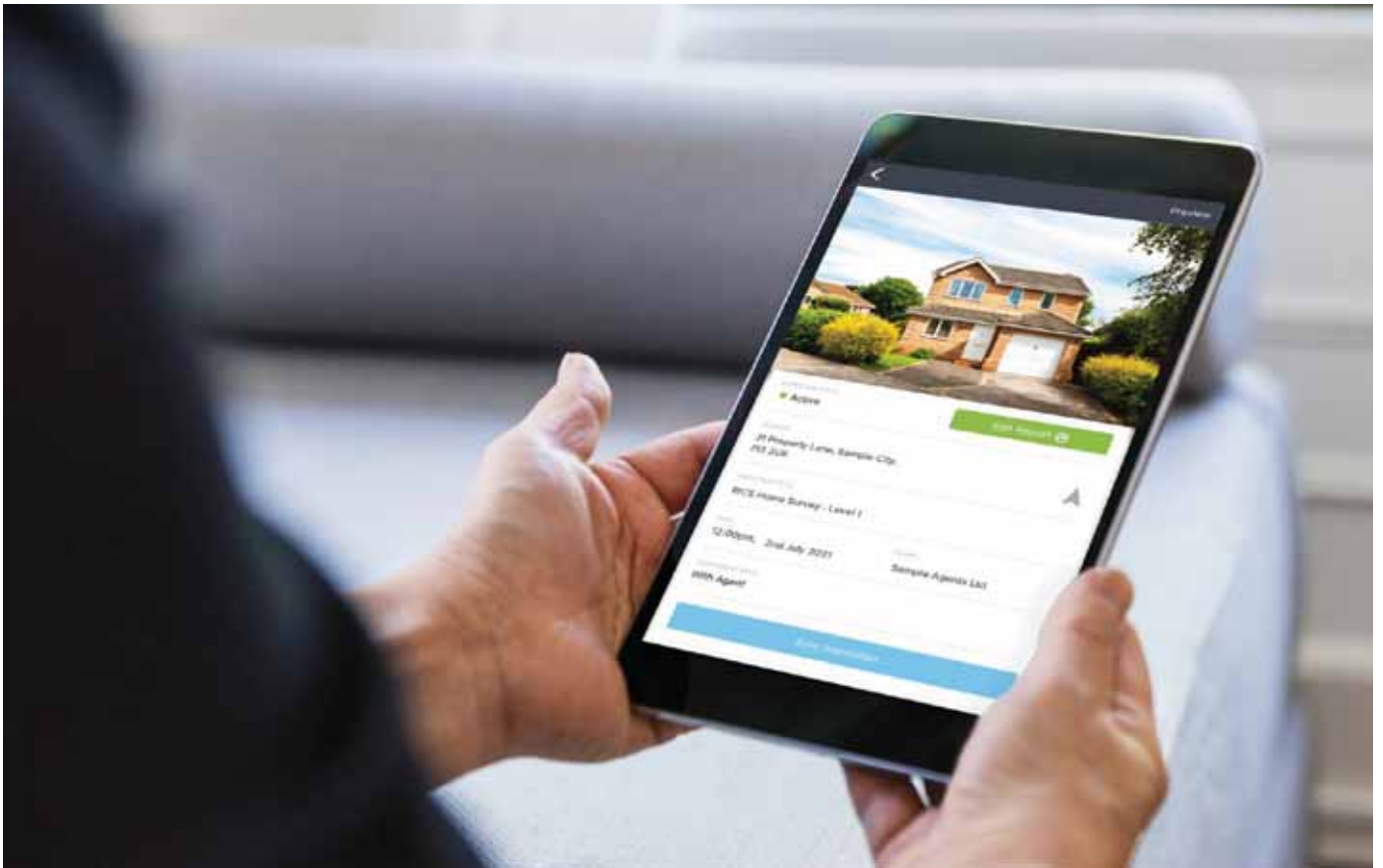
This will avoid an ivory tower view and detect changes in risk exposure in time to respond. An effective response requires a robust action management system that lets you hold people to account. However complex and sophisticated a risk assessment may appear, without action nothing happens – until it's too late.



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THE CUTTING-EDGE PROPERTY INSPECTION AND OPERATIONS SOFTWARE EMPOWERING THE PUBLIC SECTOR

Property Inspect has been awarded 'Crown Commercial Service Supplier' to provide award-winning property inspection software to the public sector



In the UK, approximately a quarter of all construction projects are in the public sector. From major infrastructure works to public housing to facilities, public sector output can be wide-ranging and varied.

However, to see these projects move successfully and efficiently from design to build and beyond requires a seamless blend of communication, collaboration, transparency, and resource management at every level.

This is where the Crown Commercial Service comes in. Established in 2014, the CCS is an executive agency of the UK government. It plays a pivotal role in the procurement and management of approved suppliers, thus ensuring that goods, services and works for the public sector are cost-effective and of a high standard.

The CCS engages in policy, strategy, and framework development, with a remit to deliver value for money in the [public](#)

[sector procurement process](#).

Frameworks provide pre-negotiated conditions for goods and services to facilitate access to a wide range of suppliers at competitive prices.

Award-winning property inspection and operations software

Here at Property Inspect, we're proud to be counted among the select handful of approved Crown Commercial Service providers, offering

our award-winning property inspection and operations software to the public sector in order to streamline and protect public sector projects.

Although we operate globally with established footholds in markets across South Africa, Europe and the United States, we were founded in the United Kingdom in 2015 and we care passionately about the built environment in our home country.

Our mission, therefore, is to empower departments and professionals across the real estate landscape to streamline property operations and improve the lives of the people that invest, build, own, manage, work and live in them. We aim to achieve this by making every building compliant, transparent, and safe.

Our CCS Vertical Application Solutions Framework Contract cements our position as a trusted supplier, enabling us to deliver software that does exactly that – streamlining property inspections and operations to improve property management throughout the public sector.

Smarter solutions for safe public sector procurement

Obtaining the CCS award enables us to establish connections with government organisations that are in desperate need of smarter and safer solutions to enhance their operations for the benefit of society, while at the same time improving processes, increasing efficiency and saving money.

The Property Inspect platform allows for seamless administration and operations of a property, or a property portfolio, through property inspection and operation solutions that place emphasis on efficiency and compliance.

We do this using a range of smart features, such as automated tasks and seamless communication and collaboration tools for stakeholders like contractors and teams, ultimately enabling everyone involved in the process to become more agile and efficient with their processes.

Property Inspect removes the many barriers pen and paper formats have presented in recent years, digitising core areas in the property inspection process to keep all departments informed and efficient throughout the lifecycle of a project.

Whether that's through maintenance tracking, digital property inspections, client logins, scheduling or invoicing, the Property Inspect platform has been built with efficiency, compliance and safety in mind.

Maintenance is of significant importance for the continued success of any public sector project, so we've made it easy for maintenance teams to log, manage and report on maintenance issues, organise cleaning schedules and track replacements for sensors, smoke alarms, and more, thereby aiding compliance.

In addition to this, the work order option makes it easier than ever to create checklists and assign tasks to contractors, notifying them when and where to carry out essential maintenance. With clear cost breakdowns for each task, they can be quickly marked as complete, with outstanding lists updated and distributed automatically.

Another area where Property Inspect really excels is through the use of pre-built and customisable report templates. Every public sector project in the UK requires one or many

inspections, but these can often be time-consuming and manual. So, from simple risk assessments to in-depth building surveys, we've built a range of ready-to-use digital templates, speeding up the process enormously.

These customisable, pre-made report templates include:

- Condition Reports
- Risk Assessments
- Snagging Reports
- Fire & Safety Inspections
- Facility Inspection Checklists
- Asset Registers
- Electrical Performance Certificates
- Gas Safety Certificates
- VOID Management
- HMO Fire & Safety
- Audits
- RICS Surveys

Reduce time spent at properties by 50% with digital inspections

Whether you're out in the field or in the office, our desktop, iOS and Android app allows you to deliver faster, more detailed and more accurate property inspection reports, capturing building and asset conditions and tracking maintenance issues, all whilst reducing time at the property by over 50%.

Used in over 40 countries, Property Inspect is designed to give stakeholders total control and complete clarity over their property assets, enabling them to efficiently capture and accurately report on property conditions and property maintenance issues in a timely manner.

With Property Inspect, compiling reports becomes effortless, and there is also the option to work offline, edit reports and share them with project stakeholders from anywhere, at any time.

Other features of the Property Inspect app include:

- A comprehensive reporting system for efficient property management
- Analytics dashboard to control costs and optimise budget allocation
- Intuitive workflows to create efficiencies and save time
- Client-level controls to provide flexibility and a personalised service
- Digital signatures to ensure compliance and streamline documentation
- Live availability to manage teams effectively
- Audit and sharing trails for compliance and accountability
- Integration options to connect with other software tools
- Live data fields to embed real-time data
- Assisted scheduling to manage report and task bookings
- Embed high-definition photos
- Automatic report sharing with stakeholders
- Offline capability to ensure uninterrupted access to essential information

The importance of data security in the public sector

At Property Inspect, we take data and security seriously so that people can be confident in the services we provide and the data held in our cloud-based software. All of Property Inspect's services and data are hosted with Amazon Web Services (AWS), the industry leader in secure cloud hosting. This provides the highest level of reliability and security. AWS has a highly reliable infrastructure with multiple availability zones and data centres, meaning that Property Inspect has had 99.99% uptime over a 365-day period, so will always continue to run even if there is a failure in one availability zone.

On top of that, to add even further security, AWS offers a variety of data security measures, including encryption, network security, and identity and access management.

To further show our commitment to security, we're also Cyber Essentials Plus certified. This is a scheme by the UK government to help organisations improve their cybersecurity and protect against common cyber threats. This certification enables Property Inspect users to demonstrate compliance with complex data regulations, offering improved security by undergoing a more rigorous assessment of measures reducing the risk of cyber threats.

What this all amounts to is a secure, efficient, and comprehensive solution for public sector projects.

Property Inspect is an essential tool for any property inspection or management professional working in the public sector who wants to streamline operations and achieve greater efficiency, driving down costs and boosting security and compliance.

Through smart workflows, audits, and assisted scheduling, together with online and offline training and support, we empower our users to deliver faster, more detailed and accurate reports whilst removing the barriers to effective property operations.

To learn more about Property Inspect, book a demo, or contact us, [visit our website](#).



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CLOUD SECURITY NEEDS A NEW PLAYBOOK, AND IT STARTS WITH WIZ

A practical guide to transforming security teams, processes, and tools to support cloud security development

Every day, we see new challenges emerging with cloud security which teams struggle to tackle.

For example, how do you get visibility into your decentralised, rapidly changing environment? How to prioritise the real risks and eliminate the noise of legacy tools? How do we ingrain security into the culture of cloud teams and get developers to remediate?

Organisations are adopting the cloud in more significant numbers, from small businesses to large enterprises. They see the benefits of scalability, flexibility and cost-effectiveness for their business.

But the cloud has also led to the most significant transformation to security in

our lifetimes, and organisations are grappling with the unique new security challenges to protect their resources and data in the cloud.

Understanding security risks and the appropriate measures to take

Cloud security operations are a critical aspect of protecting an organisation's cloud. Organisations must clearly understand the security risks and the appropriate measures to protect their environment.

In this practical guide, we will detail the journey organisations can take to achieve a cloud security operating model that enables visibility across a rapidly growing environment and appropriate measures to secure that environment efficiently.

This guide will provide a series of simple steps to build a cloud security foundation and mature your practice over time. By following these best practices, organisations can improve their overall cloud security posture and better protect their assets in the cloud.

The cloud has fundamentally transformed security

The cloud is the most significant transformation to security in three important ways. The environment is entirely different – development teams are now building in the cloud faster and with more decentralisation than ever before.

As a result, the environments are highly dynamic, with resources constantly being created, updated and deleted. This dynamic nature of the cloud



Image: © da-kuk | iStock

makes it more challenging to keep track of and secure all resources across clouds and architectures.

Decentralised teams are also bringing in countless technologies that improve their efficiency. As a result, security teams must increasingly cover a multi-cloud, multi-architecture, constantly changing surface area. 2021's Log4Shell crisis demonstrates the difficulty for teams even to identify where they may have exposure across an increasingly complex and dynamic environment.

The risks are entirely different in cloud environments

Cloud environments are now shared and controlled by third-party providers. With the public cloud, these environments are, by default, on the

Internet or can be easily exposed to the Internet with a single configuration.

While exposure can happen simply, the underlying risk factors can be challenging to spot. Verizon's annual DBIR report routinely cites complex intrusion attacks that combine two or more risk factors as the most common attack vector for data breaches.

This becomes even more difficult to monitor for and protect amid the unprecedented velocity and scale of attacks of today's landscape, where exposure can be exploited to become a breach in hours. Exposed databases are consistently one of the top breaches we read about in the news, underscoring the difficulty of securing an organisation's crown jewels.

Understanding different ownership models

Development teams own their infrastructure, and each team chooses and deploys its own technologies. Centralised architectural choices can quickly become obsolete if they are not approved or adopted by decentralised teams.

An organisation's people, processes and technology also face challenges in light of the new environment and risks. Many organisations must adapt their security practices and redefine traditional security approaches and processes that are not well-suited for the cloud environment.

There must also be a concerted focus on education as an increasing number of cloud teams building in the cloud often lack cloud security expertise. Security teams themselves need to learn the security risks of the cloud and

implement new security processes and technologies to protect their resources. Many organisations need experts with deep domain expertise in cloud, architecture or risk vector.

Finally, teams must reconsider their tooling as many legacy technologies amplify overall cloud challenges with siloed views of the cloud environment and risk. For example, traditional tools may only look at a single architecture, such as containers or are only used by security teams, not DevOps teams. This leads to organisational siloes that make it more difficult for security and development teams to identify and remediate security issues.

[Download your copy today](#), which includes a cheat sheet that sums up the four phases.



Wiz
www.wiz.io

CCS Mobile Voice and Data Services agreement update

CCS provide an update on the Mobile Voice and Data Services agreement, illustrating the broader aim to enable the best pricing on core services for the public sector



Image: © miniseries | iStock

In December 2022, Crown Commercial Service (CCS) awarded a new [Mobile Voice and Data Services \(MVDS\) agreement](#) - with improved mobile options and transparent pricing.

The agreement replaced Network Services 2 - Lot 6 and covers the full spectrum of mobile usage across the public sector, from small users such as schools all the way to large government departments.

A four-lot structure provides options on how a customer can buy its core service (airtime) requirements, including a commoditised catalogue. The catalogue ordering option enables simplification of the customer journey and is supported by a new free mobile standard tariff price comparison tool that calculates potential savings.

Mobile Voice and Data Services will be live for two years with two optional extension periods of one year. There is no maximum duration for call off contracts.

CCS has created commoditised product offerings within the agreement

As mobile phone use continues to mature, CCS has created commoditised product offerings within the

agreement to allow customers to select standard requirements that have targeted prices. This helps to reduce the time to develop requirements and compare supplier offers, whilst minimising overspend and out-of-bundle charges.

Innovations offered include:

- eSIM advanced technology enables seamless change of networks over the air without the need for a physical "SIM swap" to minimise the effort to migrate from one supplier to another.
- MVDS is a multi-supplier/Lot framework agreement with an enhanced future-proof scope covering the full life cycle of mobile services. It provides improved mobility options delivering against work/life balance objectives and smarter working to support increased productivity.
- It provides customers with maximum nationwide coverage through a choice of access to all 4 (EE (BT Group), Virgin Media O2, Vodafone and Three via Gamma) Mobile Network Operators (MNOs) networks either directly or through a number of Mobile Network Virtual Operators (MVNOs).

- The framework's design gives the customer transparent pricing, greater control and choice over their purchasing decisions, which can result in significant savings of around 60% for core airtime services.

G-CLOUD 13 – A SHORT UPDATE

G-Cloud 13 replaces G-Cloud 12 and will continue to provide many cloud-based services from various suppliers. Public sector customers can buy cloud-based computing services from the online catalogue, G-Cloud 13, which consists of [three lots](#). These solutions include off-the-shelf, pay-as-you-go cloud solutions plus, of course, hosting, software and cloud support. A fourth Lot has been introduced for further competition for cloud support for larger, more complex requirements. In the CCS customer newsletter for May, we learn of a forthcoming webinar, [G-Cloud 13: what can I buy and how can I buy it?](#), with dates that run between December 2022 and August 2023.

G-Cloud 13 runs for a year [from November 2022](#), but Crown Commercial Service (CCS) may extend the agreement beyond this up to a maximum of 12 months more. All UK public sector organisations can use the agreement. We hear that British overseas territories, devolved administrations, charities and blue light (ambulance, ambulance plus search and rescue) can also use G-Cloud 13.

In an interview, Clemmie Smith, Deputy Director for Health and Education Workforce at CCS, summed up nicely what the organisation is about, which helps us consider the broader view here. She explains that [CCS is a massively crucial part of the public sector procurement landscape](#). Let's leave the last word to Clemmie, who conveys the commercial benefits CCS helps many organisations achieve. "Last year CCS helped the public sector achieve commercial benefits of almost £3 billion pounds and this is growing every year," she remarks.

Lotting structure

The lots comprise:

- Lot 1 Mobile Voice and Data Solutions Catalogue.
- Lot 2 Mobile Voice and Data Solutions.
- Lot 3 Telecommunications Audit and Health Check.
- Lot 4 Professional Support Services.

Customer & supplier engagement

The Mobile Voice and Data agreement has been designed and developed using an extensive discovery and consultative process with many CCS customers, suppliers, and partners.

We hosted several successful engagement days and webinars prior to launching the framework. The new framework reflects and represents their expectations and provides the platform to grow the economy with the right mix of quality and innovative suppliers, including SME providers.

The new agreement aims to build on the progress made in making it easier for small and medium-sized enterprises to become suppliers. Ten suppliers have been awarded a place on the agreement, 60% of which are small and medium-sized enterprises (SMEs).

Customer webinars to celebrate the launch of the Mobile Voice and Data Services agreement

To support the launch of Mobile Voice and Data, our team of category experts will be holding a live webinar on Thursday, 27th April. [Click here](#) to secure your place.

If you have any questions about buying through the Mobile Voice and Data Services agreement, please [get in touch](#).

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TOP 5 CHALLENGES FACED WHEN MIGRATING TO THE CLOUD

Firstserv's Sebastian Tyc outlines the risks of migrating to the cloud and how to best approach them

Cloud computing is seeing an inexorable rise as organisations worldwide continue to transition more services online.

The trend towards hybrid working, accelerated by the COVID-19 pandemic, has resulted in a huge increase in migrating to the cloud. Gartner research and consulting services firm recently forecast worldwide public cloud end-user spending to grow 21.7% to \$597.3 billion in 2023.

While cloud adoption has its challenges, it is vital to protect against cybercrime. Experts like Firstserv can guide organisations through the process, ensuring a smooth transition.

“At Firstserv, we have enabled many organisations to realise their cloud ambitions using our Cloud Adoption Framework. We springboard workloads safely from legacy on-premises data centres to cutting-edge public, private and hybrid cloud environments.”

Using the Cloud Adoption Framework, Firstserv seamlessly navigates the challenges faced by organisations taking the plunge.

Data security and compliance risk

Data security and regulatory compliance are major concerns as organisations move to the cloud. Data and applications hosted on the cloud must be secured at the same level as on-premises data centres. Some cloud deployment models are better suited to this than others.

For example, a company shares servers and other infrastructure with other cloud customers in public cloud deployments. Vulnerabilities in the underlying servers or the isolation of the virtual machines (VMs) hosted on these servers could result in data leakage or other security incidents.

Additionally, an organisation may not have visibility into where its data and applications are hosted, which can be problematic for some data privacy laws, such as the General Data Protection Regulation (GDPR).

In addition to managing these risks, Firstserv will carry out a Cloud Assessment to evaluate redundant workloads that can be merged, ensuring more optimised costs in the future. Migrating to the cloud is more cost-effective than maintaining and managing a legacy on-premises infrastructure.

Unnecessary project spend

The most common mistake preventing organisations from fully reaping the benefits of the cloud is the lack of clear business objectives behind the move and/or a good migration plan.

Clients approach us after attempting cloud migration in-house, having already undertaken a great deal of work. In these cases, we often must go back to square one, helping formulate business goals and rebuild migration strategies from scratch.

A solid strategic plan ensures that you can easily navigate the transition and avoid analysis paralysis during later stages. This is especially important given the variety of choices along the

way, starting from whether you opt for private, public, or hybrid cloud infrastructure to choosing between Infrastructure as a Service (IaaS), Platform as a Service (PaaS), or Software as a Service (SaaS) models.

Carefully planning each phase of the migration ensures that companies make the right choices, arrive at their target, and avoid unnecessary spending.

Skills gap

One of the primary challenges of migrating to the cloud is finding people with the skills to manage an effective migration. Despite the many benefits of cloud computing, the project's complexity stops many organisations in their tracks.

Competition for migration experts has intensified. Unfortunately, the demand for cloud experts exceeds the supply, at least for now.

Firstserv's team fills an organisation's skills gap, enabling a seamless transition to the cloud without having to upskill, increase, and potentially decrease the current headcount.

Cloud migration complexity

Cloud migration involves moving data storage and applications from on-premises environments to cloud infrastructure. Often, this is accomplished in stages to ensure that one step is completed entirely successfully before moving on.

If an organisation has a complex IT architecture, developing and executing a cloud migration strategy may be difficult.

Certain systems may need to be collocated, and a complex architecture may make it challenging to identify and document interdependencies and develop a phased strategy for moving specific components or systems to the cloud.

Firstserv's experience in providing managed solutions and secure cloud hosting, including disaster recovery, managed backups, and server monitoring, ensures the security of an organisation's system during the migration project and beyond.

Resistance to cloud adoption

Regarding cloud adoption, the biggest challenge is not technology but people. We all tend to resist change, and migrating to the cloud brings a lot of change and disruption. Teams need to adapt and change their working processes.

Good people management is extremely important to ensure a successful migration. A properly thought-out change management plan can assist in this transitional journey.

Buy-in from the top level is crucial, heavily influencing employee engagement and adoption. By demonstrating support, excitement, and value for the new project, the leadership team will help disseminate these values to the rest of the team.

Constant communication encourages the workforce to adapt and progress. Investing in a strong onboarding programme and employing experts like Firstserv to train and support employees will ensure employee acceptance faster.

Embrace innovation, move to the cloud

Moving to the cloud is not a challenge but rather an opportunity to make existing business processes more agile and innovative.

Firstly, they can take stock of all the infrastructure components, business processes and in-house expertise at their disposal. Then, build a strategy that encompasses their organisation's needs on their cloud migration journey. Firstserv can help develop and execute a cloud migration strategy that makes the most sense from the standpoint of businesses' own objectives.

Based on an organisation's actual and target digital maturity levels, our experts customise the migration programme for the organisation's processes, people, and technologies.

Book a free one-hour consultation to see how Firstserv can help you migrate to the cloud faster and achieve scale optimisation.

[Book a free consultation](#)



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WHAT IS NEEDED FOR ENTERPRISE COMMUNICATIONS

In this opinion piece, Charles Stephenson, Divisional Director from YUDU Sentinel, explores the way ahead when it comes to enterprise communications

While a messaging app such as WhatsApp can be helpful for everyday communications, such a social messaging app is unsuitable for crisis communications. [The Business Continuity Institute \(BCI\) explicitly warns organisations not to rely on WhatsApp in a crisis situation.](#)

I believe that WhatsApp is not designed to be an enterprise or crisis communications system and has significant limitations when used this way. Limitations that can hinder your ability to respond to a crisis and cause long-term damage to the reputation and financial stability of your organisation.

The UK Government is living proof of this, with the Cabinet Office claiming it was [not in possession of Boris Johnson's WhatsApp communications](#) required for the official COVID enquiry; perpetuating negative media headlines and threatening potential legal proceedings.

This article highlights YUDU Sentinel's view on these limitations and clarifies why you should avoid WhatsApp for crisis communications.

Information overload

Information dissemination is essential during a crisis, but WhatsApp groups can quickly become overwhelmed with messages, leading to information overload.

Critical updates or instructions will get buried in a sea of unrelated or repetitive messages, making extracting and prioritising vital information challenging. They are slowing your ability to respond to a crisis event.

Data collection and sharing

Did you know that WhatsApp collects various types of user data, including phone numbers, contacts, profile photos, status updates, device information and more? Data which it shares with third parties.

WhatsApp retains metadata but not the message. Metadata, such as whom you communicate with, when, and for how long, provide valuable information to third parties, and this metadata may be subject to surveillance or analysis, potentially compromising user privacy.

Additionally, WhatsApp shares some user data with its parent company,

Facebook (Meta), for targeted advertising purposes, though it claims not to share messages themselves.

Contact sharing

WhatsApp prompts users to grant access to their phone's contact list, which may result in unintended data sharing. If users give access, WhatsApp uploads contact details to its servers, even for people who don't use the platform.

This practice has raised serious GDPR concerns about user consent and the privacy of individuals who have not explicitly agreed to share their information. In fact, [WhatsApp was fined €225 million for GDPR violations](#) in September 2021, with a further €5.5 million fine in January 2023.

The responsibility to gain sharing consent continues to lie with the individuals, not WhatsApp, a task that is almost impossible to fulfil.

Compliance and accountability

A record of the actions taken and instructions given in a crisis is essential for compliance and legal defence, especially in the event of a death or serious injury resulting from a crisis event.

In this situation, WhatsApp doesn't meet multiple compliance requirements. For example, individual users can auto-delete or modify messages after sending them, which tampers with the audit trail. Worse still, there is no way to recover this information as WhatsApp does not keep a record of any changes made or messages deleted.

A court will likely consider any message deletion or amendment of audit trails negatively, and the company will have no defence.

Lack of centralised control

WhatsApp is a decentralised platform, meaning there is no central authority or control over the flow of information or the membership of groups.

Members can be added easily but fail to be removed when they should not be in a group resulting in sensitive enterprise information being shared with unauthorised persons.

The lack of control can also lead to difficulties in managing and disseminating accurate information during a crisis. False rumours, misinformation, and unverified content can easily be posted into the group, which may conflict with the verified intelligence causing confusion and unnecessary clarification.

Security and privacy concerns

WhatsApp was never designed for enterprise communications, so it does not offer the security or privacy levels required to protect company data.

While WhatsApp uses end-to-end encryption to secure messages sent, they can still be exploited and captured on the device itself, where they remain unencrypted. In addition, chat backups do not have end-to-end encryption

unless the individual explicitly turns it on in their settings. This creates significant security vulnerabilities where company data can be leaked.

This is amplified further still by the portability of data in WhatsApp. As a social messaging platform designed for personal use, every individual can download their conversations with the attached media files. This means any company communication occurring in WhatsApp can be downloaded and publicly shared in a few clicks.

Lack of advanced collaboration features

Crisis management often requires collaborative features such as document sharing, real-time collaboration, task assignment, and tracking. While WhatsApp offers some basic file-sharing capabilities, it lacks the comprehensive collaboration features that dedicated crisis management tools or platforms provide.

Limited integration with other systems

Crisis management often involves integrating with various additional systems, such as emergency alarms and response systems, data analysis tools, or public alert systems.

While WhatsApp continues to build out its integration features and API access, it will not always seamlessly integrate with these types of external systems. This can prevent you from having a comprehensive and streamlined crisis management approach, hampering your response efforts.

Coverage

WhatsApp relies on a stable internet connection to properly send and receive messages. This can present

significant issues in a crisis event where network infrastructure may be damaged or overwhelmed.

When coverage is compromised or lost entirely, WhatsApp's dependency on internet access can delay crisis communications when needed most. This can place staff and the public at significant risk and have catastrophic consequences.

Crisis management – conclusion

While some still use WhatsApp in a crisis, it is vital to recognise the severe limitations and liabilities and consider using a dedicated crisis management platform that seeks to address these challenges effectively.

[Sentinel Chat Channels](#) is an ideal solution, as easy to use as WhatsApp but secure and controlled by you. The instant messaging module is dedicated to crisis management and is managed by your crisis team. You retain visibility of all channels and messages, nothing can be deleted to offer and complete audit trail, and all data is encrypted and secure.

Reach out to [find out more](#).



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WHY COMPETENCY MATTERS AND REQUIRES MORE THAN JUST AN L&D APPROACH

Roberta King, Chief Executive Officer at SQEPtech, outlines the concept of competency and the importance of collaboration between teams

Competency and how it is handled by organisations is a huge concern for managers. Workforce competence is crucial for managing risks and avoiding potential disasters, as well as making sure that customers receive excellent service (and we all know that the customer comes first).

While many professions have competency frameworks in place (think healthcare, policing, and fire and rescue) in other cases, these frameworks cover scenarios within specific sectors.

For example, the recently published PAS built environment competency frameworks address the competence of those who provide services and products into the built environment, covering aspects of building safety criteria.

The whys and whats of competency

So, what exactly is competence? How can you manage and understand the level of competency within your workforce? How can you ensure your employees are fully competent for their roles? And how can you demonstrate this to regulators and stakeholders?

I know it's not always an easy concept to get your head around, but I like to think of competency as the way in which individuals combine their

knowledge, training, skills, experience, and behaviour when performing a work-related activity.

Because competency encompasses these four key elements, it often (incorrectly) falls in the lap of Learning & Development when really it should be the remit of Operations.

Assessing competence: whose job is it anyway?

Competency assessments are carried out in the application of skills in a

context, using real or simulated scenarios. Operations staff have a deep understanding of what it takes to be a competent professional in their field. They've also got the expertise to assess whether an employee is competent or not.

Unless Operations are brought into the equation early on, then L&D staff may well resort to measuring competency by length of service and this is a very poor proxy indeed. This is seen time and time again.

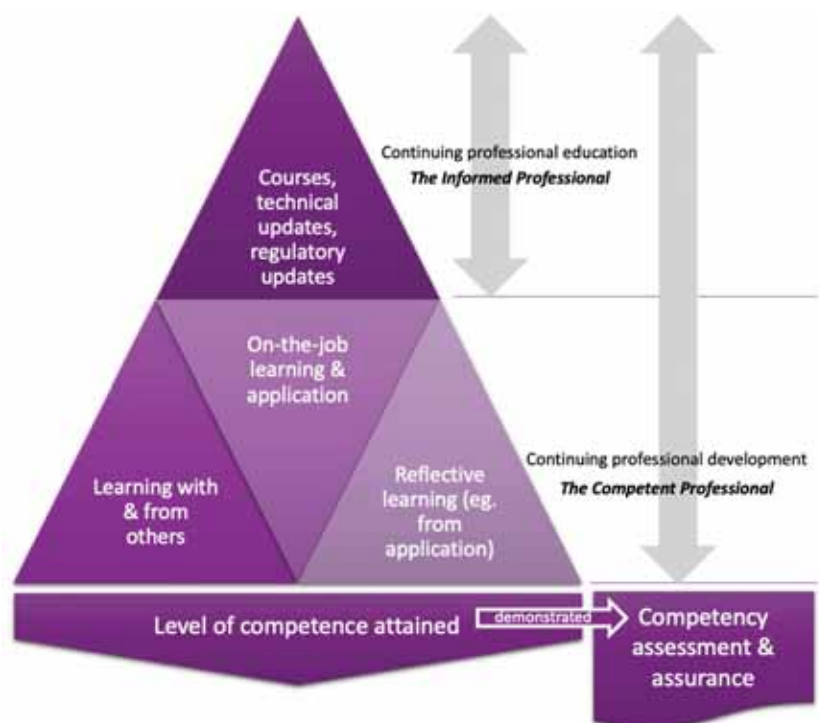


Figure 1: Continuing professional development makes a Competent Professional (adapted from Lindsay, 2016)

Granted, L&D departments hold a huge amount of data in their learning and performance management systems (we're talking performance reviews and training records etc.). This can be useful in supporting competency assessments.

However, it's never going to work as a single-pronged approach. Competency management and assurance only succeed when L&D and Operations departments work in tandem.

As Figure 1 shows, training courses, academic learning and keeping up to date with industry and regulatory updates, are all just one element of competency. And not all of these will be organised or managed by L&D teams.

There are also three other building blocks to consider – on-the-job learning, learning from others, and reflective learning. In my opinion, managing and assuring competency requires all three of these.

While L&D staff might organise courses and hold training records, they're never going to be the ones making sure employees are kept up to speed on specific technical, industry, regulatory or technology changes.

Instead, developing and deepening competence will come from a variety of sources such as relevant professional bodies, communities of practice, publications, mentoring and conferences. Not to forget reflecting on how you did an activity and whether you may do it differently next time.

For these reasons, it's often assumed that competency management and

assurance will take place as part of a training or performance process, rather than something that requires its own process.

But don't make this mistake. By treating competency management merely as an aspect of training or performance, you might struggle to show stakeholders that your employees are competent.

Practicing makes perfect

To add to an already complex scenario, competency also comes with other important dimensions. Time and practice can seriously affect an individual's ability to competently apply their knowledge and skills.

I always think it's a bit like learning to ride a bike. If you've not cycled for a while, you might well be a bit wobbly at first, but that's ok. The wobbling indicates that although you do know how to ride, your balance techniques are a little rusty and must be relearnt.

Forgetting something you've previously learnt (mastered, even) like riding a bike, is down to your transient memory, and this is explained brilliantly in Ebbinghaus' Forgetting Curve.

Conversely, the Experience Curve (aka Henderson's Law) helps build up and maintain competency levels, but of course, like everything, there's a catch.

For the experience curve to really work you must keep practicing and applying your learning (see the 'on-the-job learning' and 'reflective learning' blocks, Figure 1). Take a break from applying the learning and just like riding a bike, you'll 'wobble' as you bring your competency back up to scratch.

HRBPs and Operations Managers should work together

So how can managers and HRBPs really understand what the competency map of their organisation looks like, and be assured that their people have the right skills, at the right level, for their specific roles?

The answer's simple and involves HR and Operations Managers working together to define roles which include qualifications, training, skills, and level of competencies.

By having an HRIS ecosystem that includes learning management, auditable competency management, and assurance, you're supporting the overall business process.

Working together, HRBPs and Operations Managers can take the lead in reducing competency-related risks for their organisations.

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ACCURATE PAYROLL BEGINS WITH A RELIABLE DUTY MANAGEMENT SYSTEM

Crown Workforce Management emphasises the need for digitised duty management systems to optimise police force operations, reduce costs, and improve efficiency

A digitised, automated duty management systems approach to police forces recording and managing shifts is needed now more than ever to save money and improve efficiencies, argues Crown Workforce Management's Rebecca Dutton, as forces juggle between recruiting more police officers whilst trying to maximise value from public funds.

Having an efficient duty management system (DMS) should be the cornerstone of any well-run police force as, without it, there is the risk that staff are not paid correctly, which can instantly have a detrimental impact not only on a force's financial performance but also on morale in a workforce that is there to perform a crucial role for wider society.

At Crown Workforce Management, we have decades of experience in helping to provide bespoke automated time and attendance/payroll services to police forces and we are currently

working with 16 forces across the UK & Ireland to help them accurately pay more than 65,000 employees a month.

So, how does Crown Workforce Management make a difference to these police forces?

In practice, Crown's DMS collects, stores and analyses data in its time and attendance system – and any time that is worked above an employee's standard hours is passed over to each force's payroll department on pre-agreed finance codes linked to a particular activity. If an employee has worked less than their regular hours, this is also flagged to a supervisor.

This removes the need for employees to manually input all of this data into a system, saving significant work hours. The system also provides verified shifts worked, as the digital system records in real-time, meaning there can be no dispute over hours worked.

Bespoke service

We know from experience that each force has its interpretation of how to pay its officers and staff for overtime worked – which Crown can facilitate by creating a DMS with bespoke payment rules.

Helping forces understand all of the elements of Crown's DMS so that they can accurately pay from Crown's system is something that we as a business pride ourselves on and is a key way to build strong relationships with each force.

For example, if a police officer is retained on duty, are they paid at a special rate? Or are they paid a different rate after a certain amount of overtime if it keeps occurring? Or if someone works into a rest day, are they compensated with a rest day in lieu, or are they paid?

These payment rules play a core role in the close relationship that Crown's duty management system has with various

police force payroll departments so that when a police force's payroll department receives each employee's hours for any given month, those payment rules have already been applied.

Saving time and money, but how?

Such is Crown's commitment to providing a bespoke service and we work closely with each police force to design, test and implement a duty management system over a 12-to-18-month period.

Police forces are dynamic environments that may see officers working overtime across different operations on any given day – and as such, these operations will have other cost codes attached to them to ensure the right part of the organisation is paying for this resource. To do this manually for thousands of people and get it correct would be nearly impossible – as would staying up-to-date with overtime records.

To avoid errors from manual entry, Crown's DMS can automatically code and pay overtime based on the hours worked by an employee; the overtime payments are visible to the employee, enabling them to check what pay they will receive and remove the need for overtime submissions.

This forward-thinking, joined-up capability from Crown has been harnessed through our in-depth experience of working with many police forces over the years, and it plays a crucial role in helping forces to free up employees' time to concentrate on

other pressing matters – and ultimately – providing better value for money from the public purse.

The automated duty management system brings a culture change for organisations and for it to be influential, forces need the buy-in from their finance department as well as the business, as it will be them who will need to decide and produce the necessary cost centres and finance codes for operations, as well as monitoring how much they are spending.

A great example of how the Crown helps police forces to boost its operational efficiency is [through the work it has done with The Civil Nuclear Constabulary \(CNC\)](#), which has seen CNC moving away from a standalone Microsoft Excel application and paper-based approach in favour of a digitised, cross-force platform.

Flexible approach to a duty management system

As we are an agile business ourselves, Crown expects the volume and type of demand to flex and as such, each police force we work with has a quarterly service meeting with a dedicated Service Delivery Manager to address any trends that are emerging in their work patterns, whilst also looking at future priorities.

With police forces continuing to recruit new employees amid a backdrop of increasing scrutiny of how public money is being spent during the cost-of-living crisis, implementing a duty management system is a prudent way of providing long-term value to the public sector.



Rebecca Dutton

To help those public sector organisations that can adopt a fast procurement process, we are part of the reputable [G Cloud 13 framework](#), which will enable organisations to start using our tailored systems quickly after initially contacting us.

To find out how Crown Workforce Management can support your organisation, [click here](#).



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BUILDING A PRACTICAL CYBER SECURITY RISK AWARENESS STRATEGY

Nick Denning, CEO of IT consultancy Diegesis and veteran of multiple public sector IT transformation projects shares his thoughts on what makes a successful risk cyber security risk awareness strategy

Risk management involves identifying, assessing, mitigating, and planning for potential events that could impact a business.

This article explores risk management in practice including the difference between operational and project risk. It highlights characteristics of poor risk management and the priorities for a successful cyber risk awareness strategy.

It emphasizes the dynamic nature of cyber risks, the need for constant vigilance, and the importance of practical training, communication, and proactive measures to mitigate risks.

Risk management involves:

1. Identifying possible future events which could impact the business.
2. Assessing the probability of each materializing and the size of the potential impact.
3. Identifying possible mitigation actions to reduce the probability or impact.
4. Preparing contingency plans to recover after a risk has materialized.
5. Deciding whether carrying out mitigation tasks is worth it at the appropriate time given the risk level then applying.

Risk management in practice

A practical example of risk management is pouring concrete for building foundations. If more than a certain amount of rain falls within 24 hours, the foundations may be ruined. After identifying such a risk, we need to assess the likelihood and impact of rain, including costs, delays and financial penalties.

Mitigation activities to reduce the probability of the risk occurring might include:

1. Pay for advanced weather forecasting.
2. Cost the digging of a protective trench, ensuring adequate drainage.
3. Obtain insurance costs/lead times.

Contingency planning in the event of the risk happening might identify the cost and resources needed to dig out the foundations and have them ready for a re-pour. This is practical risk management carried out by experts based on an informed decision to deliver the best outcomes for the project.

The difference between operational and project risk

Operational risks affect an organization carrying out its regular business, and there are two sorts.

Frequency risks are expected to occur regularly, and we can predict these

costs over a period. Catastrophe risks are unexpected and might happen only once every 20 years.

Project risks relate to a plan to deliver a particular outcome. For example, external threats might include a new competitor affecting the business case. Delivery risks relate to the ability to complete the required tasks on time, within budget and to the specification needed.

Cyber security risk is an operational risk issue

Cyber security risk is predominantly an operational risk issue, where persistent though changing security threats are ever present. Cyber security applies to projects in that any technology being used or delivered by a project must embrace security by design and comply with applicable standards.

An organization's defence needs to be proportionate to the level of risk. It should be balanced so that weaknesses in one area do not circumvent a major investment in other areas.

It also needs commitment at a senior/board level to ensure it is taken seriously across the organization.

The difference in cyber security risk management when compared to other risks

We manage cyber risk using the exact mechanisms we use for any other risk

management. However, there are significant differences in cyber threats compared to other risks.

For example, in traditional risk management, the risks associated with a particular requirement or business function change slowly. In the cyber world, the landscape is far more dynamic.

Data stored by an organization or department is attractive to criminals. In addition, new technology can introduce new vulnerabilities. Threat actors can exploit these before software patches or fixes can be implemented. These factors necessitate a more rigorous approach to cyber risk assessment.

Rather than carrying out a point-in-time exercise, potentially every configuration change, product patch or upgrade needs to be risk assessed and authorized by the organization potentially via a Change Advisory Board.

A key element of a cyber risk management strategy is acknowledging that some attacks will succeed. Creating multiple layers of protection with appropriate monitoring and alerts means a successful attack on one layer can be detected, giving time to enact contingency plans before the next layer is penetrated and the overall attack is defeated.

Cybercriminals use psychology to manipulate individuals and deceive them into compromising security measures. Therefore, we need to ensure that cyber security risk is constantly in people's minds and that they are regularly reminded how to recognize threats.

An effective cyber security risk awareness strategy needs to include:

1. Onboarding training, including all topics in the organization's security policy in digestible sections relevant by job function.
2. Regular exercises to verify staff have absorbed training and are following policies with reminders of the consequences.
3. Re-assessments and changes to the probability/size of impacts need to be communicated so people realize when there is a heightened risk level.
4. Engage everyone to report attacks or near misses to update the threat level so colleagues can take immediate action.
5. Staff understand they must report suspected attacks without blame.

The most significant risk is complacency resulting in people discounting the probability of a risk affecting them.

Characteristics of poor risk awareness

The tell-tale signs of an inadequate cyber security risk awareness strategy include:

- A policy ignored, creating a sense of false security
- No method of detecting whether attacks are occurring
- No way of disseminating information
- No effective security officer responding to alerts and taking action.
- No support systems

- No security assessment process as part of procurement

Priorities for a successful risk awareness strategy

The Director of Security must be able to monitor and audit policy compliance and take action if required.

Create a 'White List' of approved software products/apps to increase protection. Any other software must be removed and improper installations investigated. Despite clear instructions, individuals often neglect to remove unapproved software.

To tackle compliance challenges, use Vulnerability Assessment tools to detect and remove or disable non-compliant software, outdated software or software containing new vulnerabilities.

Deploy a system administration tool enabling administrators to remove unauthorized software remotely. Taking concrete action makes it evident to employees that failure to follow the policies is unacceptable and that a technology solution will be monitoring and maintaining a secure environment.

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AI: CHALLENGES TO DEPLOY RESPONSIBLE & ETHICAL SYSTEMS

Dayna Arnold, Project Manager at Zest Consult, a leading digital technology consultancy, discusses the challenges businesses face with AI and the struggle for ethical systems

Innovation is crucial for business growth today, with artificial intelligence (AI) being a key driving force. AI can enhance customer engagement, streamline operations, and provide a competitive advantage when implemented effectively, but, without ethical systems, could result in serious challenges of bias.

Machine learning, a subset of AI, utilises large amounts of data and algorithms to mimic human learning. As a result, it has numerous applications, including object recognition, text translation, decision-making, and smart devices.

However, deploying AI models can present challenges with the use of ethical systems which must be addressed if successful implementation and business objectives are to be achieved.

AI systems may perpetuate bias and discrimination if they are built using biased data. For example, real-world data sets have the potential to exclude certain populations or contain errors that can lead to inaccurate models of real-world scenarios, which prove to be unsuccessful during testing or produce results that are inaccurate or biased.

Additionally, AI can introduce new ethical challenges, not just in terms of bias and inclusivity, but also around how it may be used in automation, decision-making, and the potential impact on safety and jobs. We argue here that ethical systems for AI are a must for your business.

Why you need a consultant for AI advice

Most organisations do not have the experience and skills in-house to navigate these ethical systems and bias

challenges associated with implementing AI.

It, therefore, makes sense for organisations to seek help from consultants who are experts in ethical systems to advise them before and during AI deployment, so they can avoid various ethical pitfalls by meeting or staying ahead of upcoming legislation in this area.

In addition, a clear set of policies and processes for using AI helps ensure an organisation avoids the potential risks associated with AI technology. Finally, it provides quality and security assurance for its customers.

Zest Consult is an experienced team of consultants and engineers producing digital technology solutions for CCTV, AI, and Situation Awareness. They guide organisations on their AI

deployment journeys with expert research-based advice and present best practices for ensuring their AI systems are designed and deployed responsibly and ethically. This includes identifying potential sources of bias in data and algorithms and implementing measures to mitigate their impact.

Zest Consult have provided their expertise and experience within various sectors (i.e., construction, transport, defence, etc.) and guided them in preparing to deploy AI systems within their organisations. For example, using the latest research in AI and machine learning, Zest Consult collaborated with Costain (a Leading UK Construction Company) and the University of West England to develop and apply a synthetic data approach to the design of a leading-edge AI machine learning system as a viable solution for mitigating the risk of bias posed by using real-world data.

AI & data technology, without the bias

[Synthetic data is created using AI algorithms](#) that represent data with the appropriate balance, distribution, and other parameters instead of using real-world events where there is less control over such parameters. This reduces bias in datasets, ultimately increasing the accuracy of predictive modelling used in machine learning.

This synthetic data approach addresses the challenges of protecting sensitive data as well. The data generated is new with the same characteristics as the original real data, thus producing the same results. However, instead of merely altering the data, the synthetic data replaces the original data mimicking only the statistical

properties while maintaining the same predictive ability.

Therefore, it is almost impossible to recreate the original data, which keeps the original data secure. This removes the barriers associated with privacy and security regulations, which would otherwise make obtaining information more difficult, costly and time-consuming.

Zest Consult has also been working with Transport for London (TfL), a leading UK transport authority since 2021, to overcome such ethical challenges and empower them to embrace emerging AI and data technology.

Zest is providing TfL with guidance to help them navigate these challenges, enabling them to achieve their strategic objectives and deliver significant advancements using visual derived data and information.

To achieve this, our team have been working with a cross-section of business areas, including Data & Privacy and Diversity & Inclusivity, to ensure that these key business areas are represented in the use of any new technology to ensure that it is used ethically and with privacy and inclusivity in mind.

Ethical systems are needed in organisations adopting AI

As AI systems become more sophisticated, they may gain access to sensitive information, raising concerns about bias and how that information will be used and protected. Therefore, organisations must develop ethical systems, policies, and processes for using AI in their business.

These ethical systems, policies and procedures must be reviewed regularly, especially given the pace of change in this technology and the current lack of legislation in this area; otherwise, they risk legal action and costs in fines and re-visiting technology deployment processes.

Developing and implementing secure, accurate, and reliable AI systems is critical to achieving strong ethical system standards in protecting the public's rights and safety while minimising associated risks of bias so they may positively impact the lives they are entrusted to serve.

By working with consultants like Zest Consult, businesses can ensure their use of AI aligns with their values and meets the highest ethical standards. Zest Consult helps organisations purposefully address privacy and bias as they deploy their AI systems, improving their ability to overcome such challenges, protect against emerging threats, and seize new technological opportunities in this era.



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HOW CAN WORKFLOW MANAGEMENT PLATFORMS DRIVE DIGITAL TRANSFORMATION?

Marc Hoogstad, Head of Product Management at Finworks, explains how workflow management platforms can boost workforce digital dexterity, optimise organisational agility, and support businesses in implementing new ways of working to achieve desired outcomes

The public sector is faced with core activities that are either unsupported or not supported well by existing digital applications, making it difficult for teams to maximise efficiency and productivity. In real-world situations, there is little time to define processes, especially more complex ones involving data exchange between applications or external systems.

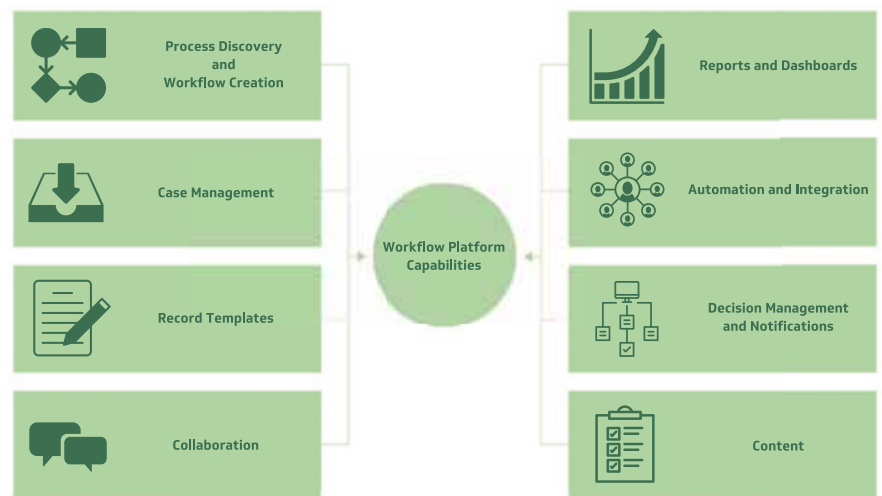
Often these processes are associated with significant security, access, and permission risks.

Alongside these challenges, there is a need to foster digital skills within teams. Gartner's Digital Worker Experience survey, published in 2023, found that more than 90% of workers see improvement in their digital technology skills as important to their career advancement, work effectiveness and work autonomy.

Implementing a robust workflow management platform will not only support operational improvements and mitigate risks but also allow all teams to gain valuable skills.

Collaborative workflow management platforms

Transformation initiatives, whether aimed at launching new digitally enabled products and services, enhancing customer experience, or transforming operations, require rethinking underlying processes.



A workflow management platform automates end-to-end business processes across organisational and ecosystem boundaries.

Various teams can use workflow management platforms to plan, standardise and track activities making it possible to introduce control, visibility, automation, and collaboration into otherwise disjointed value chains. Workers in a digital workplace can benefit from more tangible examples of the impact of their efforts.

Workflow management platforms enable process stakeholders to collaborate with other stakeholders to achieve the desired outcomes. Effective technology is designed around the key concept of continuous improvement to drive efficiency, scalability, accountability, visibility, and accuracy for predictable steps in a process.

The figure above describes the functionality and capability of workflow management platforms that support digital collaborative working.

Workflow management platforms play a significant role in transformation initiatives by providing business rules and process creation, workflow configuration and detailed reporting and metrics for management information (MI). Through workflow, actions can be automated to improve productivity and audited so dashboards and SLAs can be implemented and outcomes measured.

Implementing a digital transformation strategy

Demand for tools that enable digital transformation is on the rise: digital optimisation and innovation result from discovering new ways to improve and transform the business process.

Digital workplace leaders implement workflow management platforms to increase organisational agility and establish scalable automation that can be applied across the enterprise. Some of the best cases for change apply to the management of long-lived business processes that span functional boundaries.

When building a solid case for digital transformation, it is recommended that leaders:

- Create the business case for workflow platforms by enlisting support from service design stakeholders involved in digital transformation;
- Qualify technology use cases by identifying inefficient or failing customer-facing work activities where customisation and integration capabilities are needed. Use cases include:
 - Business-led projects
 - Executive dashboards
 - Case management
 - Coordinating multiple activities
 - Resource allocation and tracking
 - Strategic operations
 - Product life cycle operations; and
- Identify the anticipated business value, employee experience goals and collaboration advancements to measure digital transformation outcomes.

Increasing digital dexterity

Rapidly changing work dynamics are creating new opportunities for digital workplace leaders to boost workforce digital dexterity, help drive organisational alignment and improve personal and team health.

Workforce digital dexterity, ambition and ability to use technology to drive better business outcomes will be critical in ensuring future organisational prosperity.

The implementation of a workflow platform supports the building of digital dexterity skills in three key areas:

Content - the ability to collaborate in real time.

Data - effective use of prebuilt dashboards and use of data to make business decisions.

Process - the ability to plan and follow workflows and processes, create notifications, and explore low-code configuration and administration.

Realising the business value of digital transformation and the associated products and services goes beyond providing modern platforms focusing on productivity.

To enable new ways of working to achieve business outcomes, digital workplace leaders must create a strategy that builds workforce digital dexterity with experiential training and development opportunities.

Without this enablement support, employees will continue to use less-productive and less-impactful ways of working.

Building digital dexterity skills impacts other departments and organisations. Empowering autonomy within business units reduces workload that would otherwise fall to IT specialists. The shift to business control has implications for roles and responsibilities in quality

control, data management, case management, maintenance, and support.

Finworks workflow management platform

Finding a trusted technology partner with long-term experience in achieving collaborative process change is important. Finworks is a mature, niche supplier of [industrial strength low code workflow platforms](https://finworks.com/).

We primarily work with government departments and private institutions with a need to solve large, complex process challenges.

Our digital transformation projects are delivered collaboratively on time and to budget and provide the means for our clients to run their operations with lower costs, improved efficiencies, less complexity and enhanced business insight and agility, all supporting a modern workforce and sustainable organisational prosperity.



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DRIVING INNOVATION AND EFFICIENCY IN UK PUBLIC SECTOR PROCUREMENT

With digital transformation emerging as a catalyst for driving public sector procurement practices, we examine how technology and software continues to change the world around us

The procurement process plays a vital role in the UK public sector, ensuring the acquisition of goods and services to support efficient operations and deliver public services effectively.

In recent years, digital transformation has emerged as a catalyst for driving procurement practices forward and driving the best outcome, not just for procurement teams within the public sector, but also aiming to benefit society at large.

But how can digital technologies really drive change? A simple software solution could be the first step.

Software as an enabler of innovation

Technology has transformed various sectors, and public sector procurement is no exception. By taking inspiration from how we have become more efficient in business and our daily lives, the UK public sector can look to similar solutions in procurement practices.

Framespan is a public sector framework database tool designed to enable procurement professionals to save time and increase compliance. The software platform works in a similar way to consolidation websites such as Compare the Market and

Rightmove, enabling public sector professionals to leverage technology to streamline processes and facilitate easier decision-making.

Consolidation websites enable simplicity in our everyday lives by ensuring we only need to go to one simple website to find what we're looking for from various providers in the insurance market.

Similarly, in procurement, with a vast amount of frameworks in various different locations, identifying the best ones procurement professionals require must become more efficient in



Ed Bradley, CEO & Founder

order to support the needs of these key teams.

That's where Framespan can really help procurement professionals simplify processes and embrace efficiency.

Enhancing efficiency and cost savings

Efficiency and cost savings are crucial objectives in public sector procurement. Procurement Directors in hospitals, as an example, spend a large amount of time searching for frameworks on various sites to try and source what they need.

Framespan dramatically reduces the amount of time spent searching for the right framework by giving a complete view of the market on one, intuitive directory, making finding the compliant route to market quick and easy.

By consolidating frameworks and enabling easy search using keywords, Framespan can save significant time for procurement teams and directors. With more time to focus on valuable tasks, more benefits can be made to hospitals, and the wider public sector, from a commercial perspective.

Using Framespan can help save these hours by simply consolidating

frameworks enabling all relevant ones to be found using simple keywords and phrases.

Aligning procurement with social values

Despite saving money being a key driver of the need for better investment in technology, public sector procurement should not solely focus on financial considerations but also align with social values.

The NHS Central Commercial Function recognises this by outlining five guiding principles: Sustainability, Value for Money, Collaboration, Innovation, and Fairness. Technology can aid in implementing these principles effectively. For instance, by leveraging technology such as Framespan, there are ways procurement teams can evaluate a supplier's social impact by seeing publicly available documentation around areas such as environmental impact, diversity, and inclusion.

Furthermore, consolidation platforms provide the ability to quickly find local businesses, supporting the local economy, saving the environment and fostering community development.

Strengthening supplier relationships

Effective supplier relationships are crucial in public sector procurement. Technology can help nurture these relationships by enhancing transparency and trust. Software can enable transparent and auditable procurement processes, minimising the risk of corruption and ensuring fairness for all parties involved.

By promoting trust and collaboration, technology-driven procurement practices can attract a broader range of suppliers, including small and

medium-sized enterprises (SMEs), promoting fair competition and supporting local economies.

Technology has the power to revolutionise public sector procurement in the UK by driving innovation and efficiency while upholding social values. By embracing innovative software, the public sector can streamline processes, enhance decision-making, and achieve cost savings.

By leveraging technology to strengthen supplier relationships and engage with local businesses, the UK public sector can drive economic growth, ensure public trust, and deliver better outcomes for society as a whole.

How to get started

Transform your procurement processes with a simple software solution. Head to <https://hubs.ly/Q01S31Lv0> to sign up and get started on Framespan.

What Framespan customers say...

“Framespan has been a real game-changer for us!”

- David Murtagh - Procurement Manager at Salisbury NHS Foundation Trust



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WHY GOVERNMENT AGENCIES SHOULD INVEST IN ETHICAL AI FOR HIRING DECISIONS

Barb Hyman, CEO and Founder of Sapia.ai, explains the benefits of employing AI to assist in decision-making and mitigate human biases

Organisations increasingly use artificial intelligence (AI) tools as part of decision-making to improve efficiency, raise the quality of outcomes, and mitigate human biases.

A 2022 survey conducted by the Society of Human Resources Management (SHRM) found that very large organisations (5000+ employees) are leading the adoption: 42% are using AI and/or automation, and 79% of those who are using AI and/or automation used it in recruitment, making it the most common use case for AI in HR.

Increased efficiency is the top reason for using AI in recruitment (85%), followed by the ability to identify top candidates (44%) and reduce potential bias (30%). Government agencies facing similar challenges to large organisations can benefit from adopting AI tools in their people decisions.

The only proven way to interrupt human biases

Government agencies are, of course, entrusted with ensuring equal opportunities and fair treatment at a societal level by leading systemic changes to mitigate harmful human biases.

Most biases are unconscious.

Unconscious bias training has not been effective against such biases, making the UK civil service abandon such training. Data and ethical AI are the only proven way to interrupt human bias in this area.

Inclusion starts with the hiring process. Many TA leaders default to the 'human touch' to attract, engage and win over talent. This can sideline candidates who identify with a disability at the top of the funnel, which accounts for 17.8% of the population. They are less likely to apply for a role that forces the candidate through an asynchronous video interview or a timed assessment.

Ethical AI tools, like Sapia.ai, can increase the diversity of the candidate pool at both the sourcing and application stages. A recent study by researchers in Australia and Sweden found that AI can improve gender diversity when hiring for a male-dominated technical role.

Using Sapia.ai's Smart Interviewer as the underlying AI tool, the study found a 33% improvement in women's interview completion rate when they were informed that their interviews were assessed by AI.

Would there be less bias when assessed by AI versus human reviewers?

Survey results suggest that the improved gender diversity was driven by females' belief that there would be less bias when assessed by AI versus human reviewers. The study also found that human reviewers scored women lower when names were revealed. However, providing evaluators with AI-derived unbiased scores removed the gender gap, even when gender was known.

AI algorithms can be programmed to make objective assessments based on specific criteria, reducing the impact of human biases in the selection process. These models can be trained on diverse and representative data sets to ensure fair and inclusive outcomes, avoiding discrimination based on race, gender, age, or other protected characteristics.

These models can also be put under rigorous bias testing before deployment and monitored in real-time for adverse impacts once live.

AI can enhance efficiency and accuracy

Government agencies often receive many applications for job vacancies,

AI assessment checklist: The must dos	
Do you store/process all data in your region ?	✓
Do you conduct bias testing for multiple minority cohorts ?	✓
Do you conduct continuous bias testing , making results live/transparent?	✓
Do you use only first-party data , that are free of demographic data?	✓
Do you use/share model cards showing transparency on data inputs/bias testing results?	✓
If ANY of your answers are ❌, you should be concerned.	

which is time-consuming and resource-intensive to review manually. Ethical AI can streamline the hiring process by leveraging advances in natural language processing (NLP) and machine learning techniques to analyse and evaluate candidate data.

While AI-based automation can increase efficiency, it is important to consider the type of data used to avoid encoding biases and privacy concerns. For example, research studies and publicised industry experiments have shown how résumé data can lead to biased AI models, even after removing gender-indicating information.

Another benefit of AI systems is that they can continuously learn and improve over time. This iterative process ensures that the AI algorithms

evolve to align with the evolving needs of government agencies and the changing dynamics of the job market.

Providing transparency and accountability in decision-making

Government agencies hold a unique responsibility to follow rigorous and transparent processes in their hiring decisions. The AI vendors they use must then demonstrate adequate levels of transparency to promote accountability and foster trust.

Sapia.ai has published our own FAIR™ framework (available at sapia.ai) for building and applying AI models responsibly, including the best practice use of model cards and publishing our core research in peer-reviewed journals and conferences for transparency.

The critical ethical questions of AI

While AI can be invaluable in achieving efficiency, fairness, and quality of hiring, there are several questions a government agency should be asking before partnering with a vendor to mitigate human biases.

Sapia.ai has a proven history of helping government agencies improve hiring practices. We fully comply with relevant UK data privacy and security laws and are included in the G-Cloud 13 Framework. As a global leader in ethical AI for recruitment, we can help you successfully adopt a fair, transparent AI system.



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Ensuring the digital futures of the UK's local authorities

Joanne Green, Head of Public Sector at Neos Networks, outlines how local authorities can harness smart technologies and digital tools to drive infrastructural, social and economic improvements across their local areas



Local authorities are in the driver's seat when it comes to regional economic and social development. Over the years, several governments have adopted the phrase 'levelling up', a message that has now become part of a UK government initiative as it pushes to drive opportunities and growth across the nation, including in often overlooked regions. This has led to the establishment of frameworks for how local authorities can go about regenerating the towns and cities they serve. With technology and digital infrastructure set to play a central role, it is up to local authorities to embrace these initiatives to secure their digital futures and better serve their citizens.

One of the core pillars of the levelling up agenda involves enabling the right infrastructure to be built where it is

needed. Crucially, this must focus on network connectivity improvements to help most of the UK's towns and cities get on a level footing with the UK's biggest, most densely populated urban areas.

According to [The World Bank](#), the urban population will more than double in size by 2050, at which point nearly seven out of ten people will live in cities across the globe. With urbanisation happening at a rapid rate and the population growing, it is imperative that local authorities introduce changes at a foundational level to ensure the infrastructure of our towns and cities can withstand this trajectory. With these challenges on the horizon, and regional development a central priority for the government, local authorities are increasingly looking to enhance the lives of their citizens through smart technology.

The blueprint for smart communities

At the very core of these projects is data. Smart cities rely on insights collected through smart technologies, such as sensors, to inform infrastructural improvements.

By deploying smart technologies, local authorities can gather information on traffic rates, carbon emissions, footfall, public transport movement, weather trends and more. Besides improving our cities, energy efficiency is at the top of the agenda. Today, local authorities want technologies that support their decarbonisation and energy-saving goals. From monitoring traffic flow to installing motion-detection sensors, smart technology can pave the way to a greener future for generations to come.

From an economic perspective, carrying out these development plans may also bring greater prosperity to the region. From planning to construction and management, incorporating infrastructural changes requires knowledge, experience, skill and expertise, creating job opportunities across various areas. Public services that operate efficiently and infrastructure with transformative, sustainable benefits can also be valuable in attracting more people and investment from businesses into a region, thus boosting the local economy. By embracing digital transformation through improvements to digital infrastructure, local authorities can deliver on their promise for smart cities and smart counties.

Foundations for future growth

Underpinning these technologies, however, is the availability of reliable, high-capacity, low-latency connectivity. Moreover, as the Internet of Things (IoT) and smart devices produce multiple streams of data every second and transmit these outputs between hundreds of other connected devices in real time, resilient connectivity is critical as a foundation. When planning their region's digital futures, local authorities must therefore ensure that the connectivity in place can support such data-intensive tasks.

Alongside the technology requirements, the disruption from network congestion, connectivity not-spots, and legacy infrastructure must also be addressed. As cities experience periods with higher footfall, unexpected weather changes and regeneration, the connectivity infrastructure must meet these demands well into the future. While implementing a smart city project can bring

many benefits, smart cities will not stay smart for long without the appropriate future-proof infrastructure, skills and resources.

Rebuilding local pride

The importance of resilient connectivity is a stance that the UK Government shares, having set a target for achieving the nationwide availability of [gigabit broadband by 2030](#). Fibre builds are accelerating across the UK; some would say we are in the middle of a fibre gold rush. Deployments will be instrumental in connecting rural areas to instil local pride and create opportunities outside of the UK's capital.

On a regional level, local authorities must partner with suppliers with the expertise and resources to deploy and manage new connectivity solutions while educating them on the potential for fibre to act as a springboard to support the local community. As every region has its requirements, there is not a 'one size fits all' approach to connectivity. Therefore, partnering with a supplier that understands local needs and can provide tailored solutions to address that region's digital goals is imperative.

While the public sector has typically lagged behind the private sector in technology adoption, the benefits of embracing a digitally enabled future are increasingly being recognised nationwide. With improvements to local infrastructure, operational efficiency, digital transformation and training the future workforce all priorities to local authorities, digital infrastructure will be a fundamental competitive requirement to improve social and digital inclusion across the UK.

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HOW SMALL CELLS ARE EMPOWERING LOCAL GOVERNMENTS TO BUILD SMARTER CITIES

Ian Newbury, Business Development Director at BT Wholesale, describes how small cells can support greener and more sustainable technology infrastructure and facilitate a better digital future for everyone



Speak to anyone working in the sector today, and it is clear that promoting digital inclusion and achieving a decarbonised future are among the key aims of most local authorities. From connecting communities to businesses unlocking smarter ways of working, meeting these goals requires greater connectivity – and this is where small cells have an important role to play.

What are small cells?

Small cells are mobile radio cells that help to provide greater network coverage and connectivity in densely populated areas, where it is often impractical to install larger mobile masts or where an offloading capability is required (such as cities or shopping centres).

As well as improving mobile coverage, small cells can help support greener technology solutions for cities and their residents. This infrastructure can also work towards tackling digital inequality by unlocking the benefits of better connectivity for more people. Take the work BT has done [with Leeds City Council](#) to make it the largest gigabit and 5G-capable city outside of London. Allowing highly dense mobile coverage networks to be built out in urban areas, the project aims to address real economic needs in society and deliver on the sustainability promises of super-connected smart cities.

Working together to connect for good

Connectivity can help drive a better digital future for everyone. But achieving these goals requires local authorities and mobile network operators (MNOs) to work closely together.

One example is partnering to boost mobile coverage in city centres with shared network models – where two or more MNOs share new or existing network infrastructure. This approach provides connectivity to customers of different networks, and by sharing active components such as antennae and transceivers, and passive infrastructure like towers, it is significantly more cost-effective and energy efficient.

BT Wholesale works with local authorities to reuse existing infrastructure, avoiding the expense and carbon footprint of building something from the ground up. As part of BT Group, sustainability is in our DNA; we have pledged to become a net zero emissions business by the end of March 2031 for our operations and by the end of March 2041 for our supply chain and customers' emissions.

Smart cities: Paving the way for the future

By providing the necessary infrastructure and working to deploy and manage small cell networks, BT's ambition is to enable its local authority partners to build greener, more inclusive places to live.

Smart cities are a vital part of this. Using Internet of Things (IoT) technology – connected sensors, devices, and applications – to gather information, employing analytics to understand it, and connectivity to deliver actionable insights needs a high-capacity, resilient network. And a network of small cells can help provide the rock-solid digital foundation for this IoT technology.

Unlocking smart cities can enhance communities socially. For example, data from existing projects has shown that areas benefit from a 25% decrease in crime rate due to AI prediction and detection on CCTV and a 20% reduction in waste collection using bin sensors which inform fill rate. Embracing smart city technology can also help meet sustainability targets, with past projects using air quality sensors to inform measures that led to a 44% reduction in nitrous oxide and vehicle telemetry, which helped lead to a 15% reduction in fuel consumption.

BT Wholesale prides itself on its unparalleled small cells expertise, and working with MNOs, local authorities, and other industry partners, we are working towards better deployment of this technology across the UK. With this cost-effective, energy-efficient connectivity, we are proud to stand alongside local authorities as they build more sustainable, inclusive communities.



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SECTION

GOVERNMENT





NIJ puts science to work for justice system stakeholders

Nancy La Vigne PhD, Director of the National Institute of Justice, shares perspectives on how the Institute advances justice across the nation and beyond, strengthening the scientific tools and discoveries that support justice system stakeholders

Evidence-based science lights the path to better, more reliable ways to stop and prevent crime, identify and support its victims, and help build and preserve a more just and equitable society.

The National Institute of Justice's job is to generate the science that advances justice, mostly through research grants it awards to colleges, universities, and research institutes.

As Director, I manage our efforts to ensure that NIJ, firstly, invests in research that addresses today's problems while working toward a safer future and, secondly, disseminates that research widely.

NIJ works closely with state, local, and federal law enforcement, correctional agencies, those who speak for incarcerated individuals or individuals serving community confinement, tribal justice agencies, victims' rights groups and victim service agencies, school safety organizations, the courts, and others.

These collaborations help articulate the needs of justice system stakeholders in ways that can inform evidence-based policy and practice solutions that work.

New research must engage justice system stakeholders in clear, practical terms they understand

We know that products summarizing key findings from rigorous research inquiries can help justice system stakeholders only if presented to them in clear, practical terms that address real-world challenges and opportunities.

To that end, NIJ has embraced a new theme that informs all our research priorities and strategies: Evidence to Action.

Three seminal areas of NIJ research investment highlight the enormous potential of evidence translated into action:



Nancy La Vigne PhD

- Advances in DNA technology, which have aided in the identification of suspects and supported case clearances and exonerations for wrongful convictions.
- The development of body armor standards that ensure that the equipment's materials and design meet the highest standards to protect officers' lives.
- Investment in tools, software, and methodologies that support the spatial analysis of factors associated with crime, which have informed both police- and community-based approaches to improving community safety.

All, in their own ways, have transformed public safety and the broader pursuit of justice.

Those prime examples of actionable science were a focal point of NIJ's May 2023 National Research Conference for researchers, practitioners, and policymakers.

Yet for more than 50 years, thousands of NIJ-supported research projects have made a meaningful difference for the justice system and its stakeholders.

Other representative, widely impactful NIJ research areas include:

- Studies on the causes, effects, and potential answers to gun violence.
- New social science that informs solutions to domestic terrorism and violent extremism.
- Vital research on violence against women, which has prompted improvements in investigations, prosecutions, and victim services.
- Development of model programming to identify and support a wide array of other types of crime victims and their needs and rights.
- Essential school safety research.
- Investments in research leading to reforms and refinements of law enforcement policy and practice.
- The creation and enhancement of hundreds of forensic tools, methodologies, technologies, and programs to bring justice to victims and their families.

A need for research through an equity lens

As NIJ strives to translate and disseminate sponsored research to justice system stakeholders in the field, we are prioritizing research that approaches issues and problems through an equity lens.

That means that researchers should be intentional in examining potential structural inequalities that may generate disparate outcomes based on an individual's gender, race, ethnicity, religion, or citizenship status, regardless of the research topic.

One recent example of [NIJ-sponsored research](#)⁽¹⁾ discovered that forensic medical examiners who use violet light and yellow goggles are five times more likely to detect bruising on assault victims who have dark skin.

NIJ is Part of the Office of Justice Program's Team of Justice Entities. As the scientific research, technology, and evaluation agency of the U.S. Justice Department, the National Institute of Justice partners with five other agencies under the umbrella of the Department's Office of Justice Programs to advance the Department's mission

across multiple subject areas. One key partner is NIJ's sister science agency, the Bureau of Justice Statistics. The other OJP entities are:

- Bureau of Justice Assistance.
- Office of Juvenile Justice and Delinquency Prevention.
- Office for Victims of Crime.
- Office of Sex Offender Sentencing, Monitoring, Apprehending, Registering, and Tracking.

Together, OJP and its component agencies work to improve the nation's capacity to prevent and reduce crime, assist victims, and enhance the rule of law.

Putting science to work for justice requires clear communication of practical applications

As it partners with state, local, and federal justice agencies, including its OJP sister agencies, the National Institute of Justice is committed to an Evidence to Action philosophy.

Underlying that mindset is recognizing that when we communicate new science products to justice stakeholders in clear and practical terms, we can extend the justice system's reach in all communities.

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HONOURING THE SOCIAL CONTRACT: TOWARD ENDING THE “AWFUL BUT LAWFUL” ERA

Charles E. “Chuck” MacLean, J.D., PhD¹, walks us through his research about honouring the social contract toward, in his opinion, ending the “awful but lawful” era when it comes to criminal justice in the United States

The United States Constitution, arisen from the Age of Enlightenment, formed the social contract between the American People and their Government, with limited, shared powers exercised by the Government and defined and circumscribed by and with the consent of the People. In a word, the Government must stop authorizing – largely led by U.S. Supreme Court decisions – the wholesale erosion of the constitutional social contract in the quest to serve majority preferences and law enforcement expedience at the expense of individuals’ and minorities’ rights and privileges. Simply put, during the “awful but lawful” era, 1969 to the present, unconstitutional government action has been repeatedly celebrated and cemented by successive Supreme Court decisions devoid of true jurisprudence and guided instead, in my opinion, by elitist tropes empowering monied and White interests over all others.

This brief article presents just two paradigm features of the “awful but lawful” era – courts blessing police deceit in interrogations and the ethereal nature of what passes for a right to defense counsel – then proposes, even begs for a return to the pre-era jurisprudence of the U.S. Supreme Court as led by Chief Justice Earl Warren when individual rights, particularly for criminal suspects and

defendants, were rigorously memorialized, defended, and expanded.

Coercion by police in securing confessions

The Fifth Amendment, ratified in 1791, precludes compulsion and coercion by police in securing confessions:

[“No person... shall be compelled in any criminal case to be a witness against himself... \(U.S. Const. amend. V\).”](#)

The U.S. Supreme Court soon clarified based on assessment of federal and state constitutional language on point that the “right to remain silent” extended beyond direct courtroom testimony to include the right to remain silent in questioning even long before trial (*Counselman v. Hitchcock* [U.S. 1892]). The touchstones then became whether compulsion (or coercion) led one to speak in ways that may involuntarily compromise the speaker’s penal interests (*Columbe v. Connecticut* (U.S. 1961) (“If [his confessions] were coerced, Culombe’s conviction, however convincingly supported by other evidence, cannot stand”). That all sounds clear enough: confessions may not be admitted unless they were knowingly, voluntarily, intelligently proffered, and uncoerced.

But by the 1960s, American law enforcement had pushed those boundaries to and beyond the breaking point until, in *Miranda v. Arizona* (U.S. 1966), the non-unanimous Court

majority had seen enough police physical and psychological coercion in interrogations to create a prophylactic rule to ensure that custodial suspects understood their constitutional rights and could not be questioned unless they had voluntarily waived those rights (to silence and defense counsel). “The cases before us raise questions which go to the roots of our concepts of American criminal jurisprudence: the restraints society must observe consistent with the Federal Constitution in prosecuting individuals for crime... We start... with the premise that our holding [in *Miranda v. Arizona*] is not an innovation of our jurisprudence but is an application of principles long recognized.” Consider those words: *Miranda* was more than mere jurisprudence; instead, it stated the natural law and compelled only that which all humans had a natural right to enjoy. That case yielded “*Miranda* warnings,” now a fixture of the U.S. criminal justice landscape. But ever since, court majorities subsequent to Chief Justice Earl Warren’s Court have degraded that basic human right toward the vanishing point.

In *Kuhlmann v. Wilson* (U.S. 1986), the Court of Chief Justice Warren Burger held that officers were free to place a jailhouse informant in close proximity to Wilson, a murder suspect, to talk about the murders without informing the suspect of his *Miranda* rights or



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Professor

disclosing that the informant was working with police.

In *Illinois v. Perkins* (U.S. 1990), while defendant Perkins was in custody on unrelated charges, officers placed an undercover officer posing as a cellmate to question Perkins about a murder; Chief Justice Rehnquist's Supreme Court, betraying no concern whatever for the right to remain silent or affirmatively waive it, held Perkins's non-Mirandized admissions were nonetheless admissible against him at trial.

In *Berghuis v. Thompkins* (U.S. 2010), for the first two hours and 45 minutes of a three-hour custodial police interrogation, the suspect sat absolutely silent while officers peppered him with questions; Chief Justice John Roberts's Supreme Court held 165 minutes of the defendant's absolute silence was not enough to be considered invocation of his right to remain silent. The confession was admitted without regard to the suspect's clear wish to remain silent.

The ethereal right to counsel

To touch on just one other category where the U.S. Supreme Court has favored social contract erosion, the Sixth Amendment to the United States Constitution provides, "[In all criminal prosecutions, the accused shall... have the Assistance of Counsel for his defense](#)" (U.S. Const. amend. VI [emphasis added]). And in *Gideon v.*

Wainwright (U.S. 1963), Chief Justice Earl Warren's Supreme Court held, clear-eyed, that an indigent's right to counsel in a criminal case is meaningless without a public-funded attorney. Sounds simple enough, but every U.S. Supreme Court majority has likewise eroded that fundamental constitutional right.

In *Strickland v. Washington* (U.S. 1984), the Burger Court held the constitutional right to counsel does not require a very effective counsel – in that death penalty case, where the counsel offered no mitigation evidence in the sentencing phase of the trial, the Court deemed that will occur within the ambit of reasonable representation by defense counsel. However, one could ask, what purpose is served by the Sixth Amendment right to counsel if the defense counsel fails to offer even the most rudimentary defense?

In *Texas v. Cobb* (U.S. 2001), the Rehnquist Court, apparently finding the right to counsel not that important after all, held that the Sixth Amendment right to counsel is offense-specific not incident-specific and thus does not extend to other offenses that may have arisen from the same criminal behavior.

And in *Marshall v. Rodgers* (U.S. 2013), where the defendant had represented himself at trial and been convicted, and the trial court then refused the defendant's three sequential requests for court-appointed counsel to help him draft a motion for a new trial, the Roberts Court held that refusal to honor that defendant's right to counsel did not violate a clearly established federal requirement (apparently the Sixth Amendment notwithstanding).

The U.S. Supreme Court has favored social contract erosion
This same erosion has played out in

dozens of criminal procedure contexts since the Warren Court drew to a close in 1969, including so-called "good faith" exceptions, police mistakes, police excessive force and qualified immunity, use of unconstitutional evidence in a variety of contexts, rights to counsel on appeals, limiting habeas corpus, defendant waivers of rights to discovery and appeal, re-initiating contact with represented defendants, arguments related to invocation of the right to remain silent, DNA seizures from unconvicted arrestees, double jeopardy, and many others. Americans are sleeping on their rights as the U.S. Supreme Court erodes them. And we all – and the Republic – are weaker for it. We must embrace the social contract again and move toward ending the "awful but unlawful" era.

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THE PRISON SEMINARY MOVEMENT AND THE IMPACT OF FAITH-BASED PROGRAMMES

Byron R. Johnson and Sung Joon Jang share key challenges affecting America's prison system, the prison seminary movement and the positive impact that faith-based programmes can have

Early correctional practices in the US were more collaborative than those used in today's prisons. They combined state resources with philanthropic, religious, and civic assets to manage better and foster offender rehabilitation. The overarching goal was rather basic – incentivise future good behaviours, not simply punish former bad ones. More than 200 years later, it would be hard to overstate the challenges currently facing the American prison system – overcrowding, widespread mental illness, high levels of post-traumatic stress disorder, violence, only the most

basic of programmes, high employee turnover, costly recidivism, and significantly higher mortality rates upon release from prison. Because of these challenges and shrinking resources, today's prisons fail to 'correct' and often worsen things. And at great expense to taxpayers.

The role of faith in contemporary prison reform

The work of faith-based organisations and faith-motivated volunteers in prisons is often overlooked or mischaracterised. Regrettably, policymakers largely ignore decades of

criminological research documenting how such programmes reduce social isolation and shame among prisoners and offer emotional and network pathways that support fresh starts. Consistent with this mounting body of empirical evidence, a new model of corrections is quietly taking hold in the United States – built in part on old ideals but also putting into place more unique practices developed in response to the painful experience of warehousing inmates. By necessity, these new approaches are being developed in some of America's largest maximum-security prisons.

Corrections officials faced with rising populations and shrinking budgets are increasingly open to 'faith-based' providers offering services at no cost to help meet the needs of inmates. Prominent among these is something being referred to as the 'prison seminary movement.' In 1995, at the Louisiana State Penitentiary (infamously known as 'Angola'), America's largest maximum-security prison, Burl Cain, the new warden, approached the New Orleans Baptist Theological Seminary (NOBTS) about offering an accredited college degree at the prison. NOBTS would accept that offer and launch the programme later that year.

Angola's unique prison seminary

A first-of-its-kind programme, Angola's unique prison seminary trains and deploys graduates of NOBTS as inmate ministers in bi-vocational pastoral service roles throughout the prison (Hallett et al., 2017). They serve in lay-ministry capacities in hospice, cell block visitation, delivery of familial death notifications to fellow inmates, 'sidewalk counselling' and tier ministry, officiating inmate funerals, and delivering 'care packages' to indigent prisoners.

Inmate ministers enter service and leadership positions within Angola's pre-existing network of inmate churches. Inmate ministers led most of Angola's roughly two-dozen autonomous churches, but their ministry transcends these formal gatherings. Their unique status also grants them relative freedom of movement to minister among their peers daily. While legal doctrine has long rejected the notion that inmates have anything positive to contribute to

the management of prisons, the Angola prison seminary movement and its unique inmate minister operation challenge this notion. We found that participation in the seminary and inmate-led congregations helped prisoners change their behaviour and improve their lives. We also found that prisoners who are themselves the beneficiaries of inmate-led field ministry, in turn, help other prisoners make positive social changes (Jang et al., 2020). Research is helping us understand how faith may be linked with reconciliation, service to others, offender rehabilitation, identity transformation and re-offending reduction.

The impact of faith-based programmes

Correctional facilities face unprecedented challenges. Rampant violence, extremely high levels of recidivism, mounting taxpayer cost, and difficulty retaining employees typify recent headlines from the world of American corrections. And with the additional challenge of tightening correctional budgets, prisons lose precious vocational, educational, and treatment programmes. However, as we document through our on-site research, innovative approaches are being developed in desperately under-resourced maximum-security institutions. Both in the US and in other countries, a growing number of volunteer-based religious programmes are the dominant source of prisoner rehabilitation in custodial settings (Jang et al., 2018; Jang, Johnson et al., 2022a; Jang, Johnson et al., 2022b; Johnson et al., 2022).

Empirical evidence supports the notion that by embracing religious faith, inmates can and do transform their

lives in meaningful ways, including the opportunity to choose a better self, the development of a new-found sense of their humanity, and a marked increase in their concern for others. In addition, faith-based programmes, such as prison seminaries, are helping us think more meaningfully about how to make prisons and our criminal justice system more restorative and less punitive.

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Post-Brexit economy: Where are we now, and where are we going?

Nigel Wilcock, Executive Director at the Institute of Economic Development (IED), discusses the post-Brexit economy, examining the critical economic challenges that have emerged following the UK's departure from the EU



The ability to provide a clear-headed economic analysis of a change in policy has a habit of being obscured by wider events.

So, it has been with Brexit; no sooner was the Trade and Cooperation Agreement in place than the global economy was reeling from the impact of COVID and any steady recovery from that crisis was thrown out of kilter by the Russian invasion of Ukraine.

Dealing with continued economic damage and trade friction

The economic haze of these events is beginning to clear, and the true state of the post-Brexit economy is becoming clearer. There is little doubt that the decision to leave the European Union has caused economic damage.

Why, given that we signed a Trade and Cooperation Agreement, would that be the case? In general terms, there are four areas where Brexit has been detrimental to the UK economy: trade friction, unequal adoption of regulations, movement of labour and sentiment.

Trade friction has been somewhat brushed off in the media as extra paperwork, but this underplays its impact – and for some, dealing with some of our largest trading markets has become impossible or prohibitively costly. The impact on small businesses and some specific sectors across the UK has been severe even if the headline trade figures with the EU in 2022 were at their highest level by value.

The UK has also adopted a position that, since Brexit, it has yet to put the regulations it could enforce on EU

imports in place. Creating friction on inbound products would harm the UK economy. Still, in the agri-food market, in particular, UK exports are more complex than ever, whilst there is a continued free flow of imports unrestricted by the regulations the UK could put in place.

The post-Brexit economy and the “productivity penalty”

From a workforce perspective, it is becoming clear that some industries are suffering from staff shortages, and at least some of this can be attributed to the inability to backfill vacancies through the employment of EU nationals.

Finally, against the backdrop of these various issues, there is a risk that businesses simply do not prioritise the potential benefits of working with Europe, given the sentiment that Brexit created.

The extent to which this has all impacted the post-Brexit economy is difficult to assess accurately, but both the Bank of England and the Office for Budget Responsibility are clear that, overall, the impact is negative.

In February 2023, the Bank of England stated, ‘Brexit has dealt the UK economy a “productivity penalty” of £29bn, or £1,000 per household’. In March 2023, the OBR stated that Brexit ‘will reduce long-run productivity by 4% relative to remaining in the EU’.

The economic headwinds from Brexit are still ongoing. Some longer-term issues are baked into the Trade and Cooperation Agreement. One example is that UK-originated content will need to significantly increase in electric vehicles if tariffs of 10% are not to be imposed on UK exports by 2027.

This issue helps highlight the potential risk of sunk investment in the UK. International businesses have long invested in the UK as an attractive country from which to export to Europe.

A business with a production plant in which it has sunk millions of pounds was not going to walk away from the UK immediately – but when there is a change in the product or the need to upgrade the production line, will more money be poured into their UK production base?

There has been a trickle of announcements suggesting that the existing stock of UK inward investment is now

having its competitive position undermined when UK factory managers seek reinvestment decisions over competitor plants in Europe.

Brexit may be most damaging because of the position that the UK now finds itself in. At the time of the Brexit referendum, few overlaid the issue of the ageing workforce in the UK or the need for increased growth to raise the taxes to help pay for services.

Two issues prominent in the UK press recently have been the rise in economic inactivity (or people choosing to leave the labour market) and the need for growth. Neither issue has been helped by Brexit.

The continuing effects of Brexit are being felt everywhere

Brexit remains a toxic and divisive issue, and it does not look like the decision to leave the EU will be reconsidered anytime soon.

It is equally clear that the UK needs growth and will need to address the coming decline in working-age people.

This is likely to mean the UK is searching for ways to reduce its friction in trade and investment with as many markets as possible and the attraction of a larger workforce.

How this is framed in policy terms is a political rather than an economic issue.

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WHAT HAS BEEN THE IMPACT OF BREXIT ON THE UK ECONOMY?

Sarah Hall, University of Nottingham, discusses and assesses the impact of Brexit on the UK economy, in combination with COVID-19 and the Ukraine war

It is now three years since the UK left the EU at the end of the Brexit transition period. During that time, the terms of UK-EU trade is governed through the EU-UK Trade and Cooperation Agreement (TCA). However, it is still relatively early in implementing the TCA to fully assess its economic impacts on the UK economy. This means that the UK is still in the early stages of the Brexit process, and there remains considerable uncertainty and public and political debate concerning the economic impacts of Brexit.

This uncertainty has been compounded by two further significant changes that are impacting the UK economy post-Brexit: the impact of COVID-19 both in terms of initial lockdowns and its longer-term effects in terms of decreased labour market participation; and the economic impacts of the war in Ukraine, which has led to significant inflation driven by rising energy prices.

We must consider COVID-19 and the war alongside Brexit

Untangling the economic impacts of COVID-19 and the war in Ukraine from Brexit is critical if the economic impacts of the UK's new trading arrangements with the EU and the rest of the world are to be fully understood. More research and data are being conducted

across various disciplines, including economics, sociology, legal studies and geography, that aim to do precisely that. Examining some of these research highlights provides a valuable starting point for understanding the impact of Brexit on the UK economy.

Before examining the real-world impacts of the TCA, it is helpful to step back and set out what economists anticipated the effects of Brexit on the UK economy. This is important because during the period of EU membership since 1973, UK economic growth and GDP per capita [grew](#) as the economy developed more significant trade and capital flow with the EU alongside more incredible migration. This gave rise to [arguments](#) from leading economists that reduced access to the EU's single market, alongside uncertainty which would likely reduce international investment into the UK, would likely lead to lower wages, a lower sterling rate and the need for higher taxes or reduced investment in public spending.

Impact of Brexit on different regional areas

Crucially, however, the economic benefits of EU single market membership were distributed unevenly across the UK. Whilst London and the South-East benefited from marked

increases in financial and related professional services activity in particular, provincial regions did not see the same GDP growth. As such, the period of UK EU membership did not reverse the long-term pattern of marked regional differences in economic performance across the UK. Research has [argued](#) that voters living in places that had not benefitted from rising GDP at the national level, which were also often the places that were most impacted by austerity policies in the 2000s were influenced by these experiences and registered this in part through a Leave vote.

What do economic experts and forecasters say?

However, the role of economic experts, and forecasting in particular, have been the subject of continued debate and criticism since the Brexit referendum in 2016. This partly stems from early initial [forecasts](#) of the economic impacts of Brexit that predicted a negative economic impact that would be felt relatively quickly, driven by negative effects on financial markets, consumer and business confidence.

The most damaging elements of these initial forecasts did not materialise by enlarge. On the one hand, the pound did fall largely as expected, but the



predicted house price fall did not occur. Similarly, the labour market remained relatively strong, and there was a slight fall in unemployment.

shows a 25% decrease in UK imports from the EU compared to imports from the rest of the world. Their research suggests a smaller and more

EU with a smaller proportion of jobs relocating.

“...the UK is still in the early stages of the Brexit process, and there remains considerable uncertainty and public and political debate concerning the economic impacts of Brexit.”

However, the longer-term predictions made during the referendum, particularly concerning the impacts on trade and migration, have been more accurate.

How do we really understand the impact of Brexit?

To understand these impacts, the nature of the TCA itself needs to be set out. Broadly, the TCA does more to liberalise goods trade between the UK and the EU than it does for services trade. This is significant because services have historically been a strength for the UK economy whilst goods have dominated in the EU. The TCA provides zero tariffs and quotas on goods but very little around the mutual recognition of regulatory standards or to support labour mobility which is important in services.

In terms of goods trade, following the implementation of the TCA, [research](#)

temporary decrease in UK exports to the EU. However, they report a large reduction in the number of trade relationships between UK exports and their EU counterparts. This suggests that smaller firms were more likely to decrease their exporting activity to the EU compared with larger firms who had more capacity to address any additional costs that they incurred with exporting to the EU.

In terms of services trade, the quality of data is not as strong as it is for goods. In services there is evidence of a decline in UK services exports to the EU in the immediate period post referendum, prior to the implementation of the TCA. This has been [placed](#) at around 6% in 2019. In terms of financial services in particular that are especially important in the UK, there is evidence that around 10% of total banking assets have moved to the

Taken together, this analysis suggests that the early economic impacts of Brexit on the UK economy do not neatly follow the estimates made by economists immediately following the referendum. There have been negative impacts on trade which can be largely separated from the impacts of COVID-19 and the War on Ukraine. Crucially, the devil is in the detail with such changes varying significantly by economic sector and by location in the UK. Whilst Brexit is only in its early stages economically, it is clear that its impacts are sectorally and regionally variegated.



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FINDING COMMON GROUND: THE DELICATE BALANCE OF POLITICAL COMPROMISE IN DEMOCRACY

Associate Professor of Political Communication, Mariken A.C.G. van der Velden, explores the complexities of political compromise, including its impact on political representation and citizen support

Political compromise plays a crucial role in representative democracies, especially in multiparty consensus democracies. In such systems, nearly all political decision-making is subject to compromise among political parties. Political theorists have long emphasised the significance of compromise for liberal democracy.

They argue that compromise is essential because it reflects a pluralistic view on partisanship and acknowledges the legitimacy of competing political claims for the common good.

Additionally, compromise signals the recognition that one's own views are partial and temporary. It is seen as a desirable democratic process that aggregates competing views and facilitates the realisation of policy goals.

Challenges associated with political compromise

Political compromises can have a diluting effect: when a party compromises on its principles, it downplays its ideational commitments, which can confuse its electorate. This paradox of compromise presents a conundrum for political parties during coalition negotiations, as they must navigate the tension between policy representation and responsibility.

On the one hand, parties need to maintain their ideological association with their voters, while on the other hand, they have the opportunity to realise their policy goals in office.

Gaining citizens' support

Understanding citizens' perspectives on compromise is key in this context.

Many citizens value the principle of political compromise, despite the rise of populist thought. Observational evidence suggests that citizens tend to support political compromise, and voters are more likely to support a political candidate who explicitly embraces compromise.

However, explicit support may differ from citizens' implicit attitudes towards compromise. Implicit approaches can provide a better understanding of how compromise affects trust in political parties in practice.

In the context of coalition formation, the key question is whether citizens prioritise the virtue of holding unflinching policy commitments or accept concessions to facilitate government participation.

On the one hand, citizens may prefer responsible parties willing to make policy compromises to conclude coalition negotiations successfully. Research shows that winning in elections clearly affects regime support, and citizens tend to be more satisfied with democracy when their preferred party is in government.

They also value coalition participation and consider the composition of future coalitions when voting. On the other hand, citizens may also prefer parties that are firm in their policy commitments, as a clear ideological and programmatic profile sets a party apart from its competitors. Repositioning and compromise can adversely affect electoral success and contribute to a party's demise.

To understand why some people reject compromise, individual-level mechanisms are examined. A significant factor is the 'uncompromising mindset' consisting of principled tenacity and mutual mistrust. Citizens with strongly principled views on the issue and those who adhere to an absolutist worldview are more likely to reject compromise. These individuals perceive compromise as a violation of their core beliefs and principles.

What is the cost of compromise?

In my recent experiment, conducted immediately after the 2021 Bundestag elections in Germany, I shed light on the question, 'what effect does compromise acceptance during these negotiations have on the political reputations of parties?'

The findings reveal that political compromises come at a cost, eroding

voters' trust in the process. The study, which involved 7,562 respondents, demonstrates that voters tend to favour parties that remain steadfast in coalition negotiations, irrespective of the negotiation outcomes. This suggests that voters prioritise 'policy representation' over 'responsibility' during the delicate phase of coalition talks.

These findings align with previous research by Gutmann (2014), supporting the notion that individuals' principled tenacity and mutual trust play a role in accepting compromises. Respondents with high levels of principledness and low social trust tend to show lower support for political compromise. Additionally, compromise acceptance is lower among highly populist citizens but higher among individuals with high political interests and those who consider the issue at hand to be salient.

The study also includes an observational cross-sectional analysis based on a Comparative Study of Electoral Systems (CSES) data from several West European countries to provide a comprehensive view.

Compromise acceptance and trust in politicians

The analysis confirms the relationship between compromise acceptance and trusts in politicians and satisfaction with democracy in most countries. These findings highlight the broader implications of compromise acceptance on political trust and satisfaction.

Although the study focused on compromises during coalition negotiations in Germany, its findings suggest that compromise rejection was prevalent among voters from various political parties.

However, interestingly, supporters of the Social Democratic Party (SPD), the winning party in the elections and likely to lead the new government, did not show a higher likelihood of supporting a steadfast candidate. This indicates that the political context can influence perceptions of party compromise. Therefore, comparative studies examining how voters appraise compromises in the context of coalition negotiations would be valuable.

My study's findings paint a somewhat discouraging image of political representation in European democracies. Affective polarisation increased electoral volatility, and the decline of mainstream parties characterised many democracies worldwide, including those in Europe.

As coalition governments become more diverse, cooperation and compromise among ideologically distinct parties become evermore complex.



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Improving rural digital connectivity and broadband

As digital infrastructure, tech, and connectivity evolve, investment in rural digital connectivity must be prioritised for economic growth, social inclusion and improving quality of life

Image courtesy of OneWeb



Digital technologies have enabled businesses to remain competitive and stay ahead of the curve. To achieve profitability and drive economic growth, companies, world-over, should be investing in digital tech as a top priority, which enables them to streamline operations, reach new customers, improve customer experience, and tap into new markets and opportunities.

Getting access to everyday essentials like healthcare, education, financial services, and even entertainment for social interaction can be extremely difficult for those living in remote or under-served areas. Therefore, access to the internet can be lifesaving but also provide greater flexibility and convenience and, in turn, bridge the social inclusion gap, positively impacting mental well-being.

UK improvements in both urban and rural digital connectivity

Across the UK, improvements in digital connectivity have, and are still, being made, with 97% of premises now benefitting from superfast broadband coverage, with gigabit-capable broadband serving 70%. However, more work must be done to connect the disconnected.

As of two years ago, there were still an estimated 1.5 million homes in the UK that did not have connectivity or access to the internet. The UK's current approach of considering a range of digital technologies, including fibre, mobile and satellite, is the right one and essential to ensure everyone, everywhere, can be connected.

An example is DSIT's Alpha Trial programme, testing the viability of Low Earth Orbit (LEO) satellites to provide high-speed connectivity for businesses and homes in hard-to-reach areas.

To ensure that no part of the UK is left behind, this increasing demand must be met by providing robust and resilient connectivity across the country.

This will be essential to ensure households, businesses, and local government can have access to the services they require – such as banking, healthcare and education. Providing these to all will reduce the digital divide and ultimately improve the economic and social prosperity of the UK.

Prioritising approaches to digital infrastructure in rural areas must happen to ensure that these communities have access to the same digital services as those in well-served areas. We see this happening through the UK government's Universal Service Obligation and Rural Gigabit Connectivity programme.

However, there is still a digital divide between urban and rural areas - and it remains crucial that a range of connectivity approaches are considered (e.g. satellite communications) – especially for those regions where traditional means of connectivity are not economically feasible or physically possible.

Improved digital connectivity

Improved digital connectivity has become a critical aspect of our daily lives. The internet has revolutionised how we shop, work, live and interact with others, making our lives easier and more efficient.

“Better rural digital connectivity ensures the local population can access essential services...which will encourage individuals to remain in their hometown...instead of relocating to urban and better-connected areas, which will inevitably benefit the local economy.”

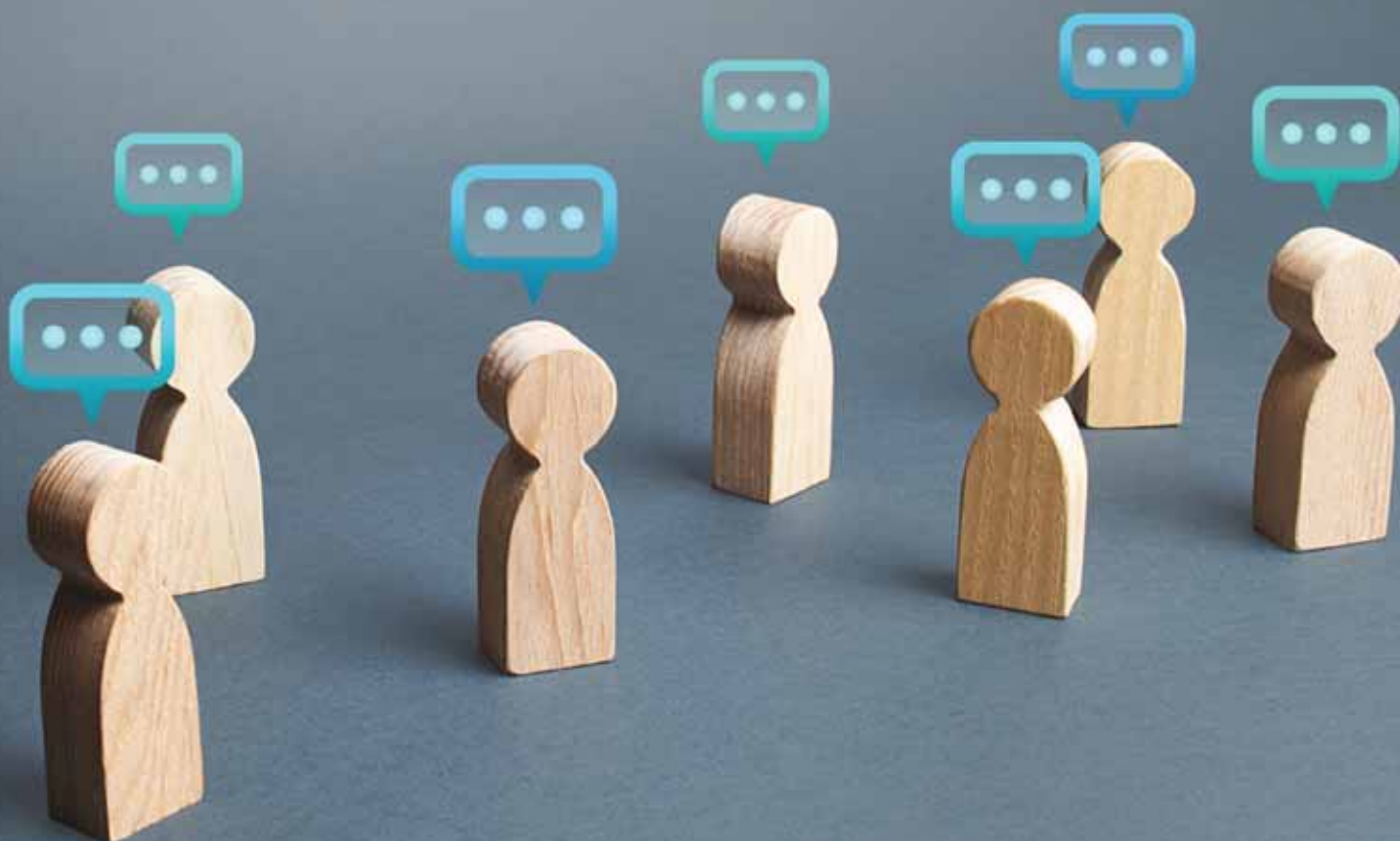
There are several benefits to improved digital connectivity:

- **Innovation in digital connectivity** has been fundamental to economic growth. It has created new job opportunities, increased productivity, and facilitated the growth of small businesses. It enables businesses to operate more efficiently, increasing access to markets and customers and facilitating innovation and development of new products and services.
- **Social interaction** - how we communicate with each other, locally and globally has transformed over the years. This developed and enhanced ability to connect via instant messaging and video conferencing has allowed people to communicate more easily and in real-time, regardless of location.
- **Improved access to healthcare services** as a result of digital connectivity, especially in remote areas. For example, with telemedicine, patients can consult with healthcare professionals remotely, reducing the need for physical appointments. This can improve access to healthcare in underserved areas.

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- **Enhanced digital connectivity** has made it easier for people in rural or remote areas to access financial services, education, job opportunities, and other services – giving greater social inclusion. With education, for example, better internet access has made it easier for students to attend virtual lessons, access educational resources, communicate with teachers, and collaborate with peers.

This is all fair and well when generation cellular networks are available and/or broadband connection is reliable, but what happens when that connectivity fails or there isn't service availability to remote areas? In these instances, an alternative back up of resilient connectivity is critical in keeping people connected.

“Getting access to everyday essentials like healthcare, education, financial services, and even entertainment for social interaction can be extremely difficult for those living in remote or under-served areas.”

LEO satellite network services can be accessed wherever a direct line of sight exists to the sky above. Unlike terrestrial backhaul solutions, distance to the gateway is irrelevant to the rollout cost. This integrates seamlessly with any last mile technology to create a connection with low latency, high throughput, and secure internet access for unconnected communities.

Furthermore, satellite-based connectivity is essential in responding to human or natural-made disruption when terrestrial networks become disabled.

In addition, satellite systems can provide vital interim infrastructure in areas where new generations of terrestrial systems may eventually arrive.

Digital investment driving economic growth

Digital investment plays an essential role in driving economic growth. It increases access to markets and customers, especially for small and medium-sized enterprises (SMEs). Digital platforms and e-commerce can enable SMEs to reach a national and global consumer base, which can help them grow and compete with larger firms. It's also an enabler to stimulate innovation and develop new products and services.

In addition, it can increase productivity by improving efficiency and reducing costs. For example, automation and digitisation can streamline processes and increase the speed of operations, leading to greater productivity and output.

Better rural digital connectivity ensures the local population can access essential services (e.g. healthcare, education, ability to work). In turn, this will encourage individuals to remain in their hometown – be it rural or remote – instead of relocating to urban and better-connected areas, which will inevitably benefit the local economy.

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BROADBAND DELIVERY SOLUTIONS: SOLVING THE PROBLEM OF RURAL CONNECTIVITY TODAY

David Hennell from National Broadband explores alternative broadband delivery solutions that local, regional and central government authorities need to be aware of

In today's digital age, access to fast and reliable internet connectivity is no longer a luxury but a necessity. Digital connectivity has become ingrained in our daily lives, and its importance to businesses and communities is on par with other essential utilities. However, digital discrepancy persists, leaving many rural areas significantly disadvantaged and stuck in the broadband slow lane.

Despite the Government setting itself the goal of building a world-class digital infrastructure for the UK, there remains a substantial gap between those who have access to high-speed broadband and those who do not. [Ofcom's latest report](#) reveals that well over 430,000 properties in the UK still lack access to what it calls a "decent" fixed-line broadband service of 10Mbps or more, with rural areas being disproportionately affected.

However, cost-effective and immediately deployable connectivity solutions exist today to bring much-improved broadband on a per property basis to those most in need.

Broadband delivery: current challenges and central government initiatives

While the UK government has recognised the need to improve rural broadband connectivity with some

efforts being made to address [the so-called Digital Divide](#), there are still significant challenges to "Levelling Up" and achieving fit-for-purpose universal access.

Central government's initial target was to deliver gigabit-capable broadband to all UK properties by 2025. However, this has been revised downwards [with the latest objectives](#) now aiming for 85% of properties to have gigabit-capable connections by the end of 2025, with a further goal of reaching "as close to as possible" to 100% by 2030.

To achieve these more modest goals, the government is investing up to £5 billion into its Project Gigabit scheme, but it is evident that at least 15% of UK properties will not benefit from such initiatives over the next three years.

Furthermore, the properties set to receive no assistance very much tend to have the poorest current broadband speeds, meaning that they are in fact the ones most in need of help.

The problem at the heart of current government strategy to improve connectivity

The government's current approach to improving connectivity across the nation is exclusively focused on the roll-out of full-fibre broadband. Unfortunately, this is set to do little to

help the UK's most digitally deprived premises.

Provisioning the infrastructure required to connect more remote and rural properties with fibre broadband is both cost-prohibitive and time-inefficient. As a result, the majority of deployments commissioned under Project Gigabit target premises in more densely populated and easily accessible locations while neglecting harder-to-reach areas where improved connectivity is most needed.

Consequently, by primarily addressing areas where broadband connectivity is already more than adequate, current policy not only fails to bridge the Digital Divide, but actually risks exacerbating digital inequality.

The crucial role of alternative broadband solutions

Every county council and regional authority will be well aware of pockets of homes and businesses falling under their remit which are simply not covered by any current broadband procurement projects or plans. This is despite these properties most likely being those with the poorest landline broadband speeds.

Fortunately, alternative broadband delivery solutions to provide the most digitally disadvantaged homes and

businesses with significantly improved connectivity already exist today, with one prime example being [4G-delivered broadband](#).

4G broadband is nigh on immediately deployable on an individual property basis and at a very low capital outlay per premises. Moreover, it's available almost anywhere, [with Ofcom itself reporting](#) that over 85% of the 430,000+ broadband-starved properties in the UK could in fact be supplied with significantly improved connectivity over 4G.

This is because coverage by 4G networks is extensive, with 99% of the UK now being covered. Crucially, even areas with weaker signal strength can still benefit from 4G connectivity by having [an outdoor 4G antenna installed](#) on any given property, enabling the provision of high-performance and reliable broadband to the most problematic of so-called broadband white areas.

The benefits to regional authorities of utilising alternative broadband solutions

Simply put, leveraging alternative broadband delivery solutions gives local and regional government bodies an immediate way of radically improving the connectivity of the most digitally excluded (and, as such, the most vocal) communities within their areas of responsibility.

The immediate deployability of alternative broadband delivery technologies such as 4G – and its ability to be provisioned on a “one property at a time” basis – could not be more different from the lengthy and

resource-intensive timescales required by any fibre roll-out. Connecting any property to a 4G broadband service typically takes no more than a week or so, as opposed to the months or years required for fibre provisioning. This accelerated deployment time obviously allows rural premises access to high-speed internet far sooner.

Similarly, the costs involved in the deployment of 4G broadband are far lower. Fibre infrastructure requires substantial investment, making it far less viable for connecting properties in more rural and sparsely populated areas. In contrast, because 4G broadband leverages existing mobile network infrastructure, any need for capital expenditure is vastly reduced, with full “per premises” connection costs amounting to [no more than £300](#).

These two inherent advantages give regional authorities the means to address and solve their thorniest connectivity challenges directly, immediately and cost-effectively.

Solutions are already being put to use

Some more forward-thinking regional authorities across the UK have recognised the value of alternative broadband solutions and have implemented initiatives to further address the Digital Divide within their areas of control.

The Welsh Assembly continues with [its Access Broadband Cymru scheme](#), subsidising the set-up cost of alternate technology broadband connections for the principality's most digitally deprived properties. The Scottish Parliament has a similar action in place with its [SBVS program](#) and county councils

such as [Herefordshire](#) have also put in place smaller alternative technology local procurement schemes to bring much-improved broadband to some of their hardest-to-reach properties.

Bridging the Digital Divide by using alternative broadband delivery solutions

If the Digital Divide is to be bridged effectively, the role that alternative broadband delivery solutions can play is key. Technologies such as 4G broadband offer a tried, tested and immediately available way of significantly improving connectivity for the nation's most digitally disadvantaged communities.

This is without doubt something that government at all levels needs to be aware of and leverage in order to achieve digital inclusivity for all.

For more information, visit [National Broadband](#).

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Can social dialogue identify answers to the challenges of our time?

Pekka Ristelä, EESC Member and Rapporteur for the opinion on Strengthening social dialogue, argues that social dialogue is vital to identifying answers to the challenges of our time



Image: © VioletaStoimenova | iStock

Europe faces profound challenges. The climate emergency is a global matter of survival. The Russian invasion of Ukraine has brought large-scale war to the borders of the EU and forced Member States to reassess their security policies and spending. The ageing population challenges our welfare systems, while digitalisation changes how we work and the skills we need.

Many of these challenges are often portrayed as something that can be dealt with via technocratic problem-solving. Ultimately, however, they are deeply political. How can the legitimacy and acceptance of the necessary transformative policies be ensured when the

trust that glues our societies and political systems together is getting weaker? What will be the response when people inevitably ask about fair distribution and burden sharing?

European Commission's initiative on strengthening social dialogue

The European Union needs answers to these questions, so the European Commission's initiative on strengthening social dialogue could not come at a better time.

Social dialogue – defined as negotiation or consultation between representatives of workers and employers or between these and government representatives – is the

cornerstone of the European social model. That has been the case at least since the days when Jacques Delors made it one of his priorities as Commission President.

Since then, social dialogue has seen ups and downs but has been regaining ground under Mr Juncker and Ms von der Leyen. The recent Commission initiative follows a raft of legislative reforms that strengthen social dialogue, including the necessary Directive on adequate minimum wages currently being implemented in the Member States.

At the national level, however, the picture is less rosy – and in the Member States, people experience European policies and their social consequences. From economic and social policies to climate policies, what matters most to people’s lives – their employment and income, economic security, health, and well-being at work – are primarily matters for national decision-making.

What is the value of social dialogue?

This is where social dialogue can, if successful, be of immense value. From sustainable pension reforms to adequate wage developments, social dialogue has proven to be a fair and effective method of solving tricky societal questions.

However, there are prerequisites for successful social dialogue. There can be no real social dialogue without a solid basis of freedom of association and the right to collective bargaining and action. Suitable institutional frameworks are also important, although these can and do vary between the Member States.

Effective social dialogue also requires representative and autonomous trade unions and employer organisations able to engage in bipartite and tripartite dialogue, a culture of dialogue and compromise, and finally, a degree of underlying respect and trust that survives the inevitable and, at times, tumultuous conflicts of interest between the two sides of the labour market.

The Commission initiative, particularly the proposal for a Council Recommendation that it includes, seeks to foster precisely these basic conditions – as far as they can be influenced through political decisions.

Strengthen social dialogue

The Council still needs to adopt the Recommendation, and there is no way to know what compromises may water it down. Safe to say, though, that one non-binding Recommendation won’t enhance social dialogue as much as we could hope. Other instruments, like the Directive on adequate minimum wages, can be even more important: that Directive constitutes binding EU law. Moreover, it promotes one of the core aspects of social dialogue, namely collective bargaining.

“Social dialogue – defined as negotiation or consultation between representatives of workers and employers or between these and government representatives – is the cornerstone of the European social model. That has been the case at least since the days when Jacques Delors made it one of his priorities as Commission President.”

In any case, with its recent initiative, the Commission is making an effort worthy of support – an effort that we welcome in our EESC opinion, with strong backing from both sides of social dialogue. The Commission is ready to strengthen social dialogue, and the social partners share that ambition. Now it is up to the Member States to commit to it.

Pekka Ristolä

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Is welfare spending distinct from health spending?

Paul Christie, Co-Founder and CEO of Tachmed, examines the benefits of a more joined-up approach in health and welfare spending to combat threats to global health



According to one [McKinsey report](#), health inequity worldwide remains a major problem - with huge disparities in access and outcomes between (and within) countries and regions.

The same report highlighted the fact that there is currently an 18-year gap in average life expectancy between low and high-income countries and a 30-year gap between the lowest and highest life expectancy.

Experts are increasingly looking at the role of social policy and welfare spending in combating this problem.

Dealing with never before seen disease outbreaks

The more that a country invests in its healthcare systems, scientific research and new technologies designed to improve the health of its population, the greater the reward.

While the COVID-19 pandemic revealed a lack of resilience of some health systems, it also highlighted how quickly whole nations can - when required, mobilise. While the response was undoubtedly far from perfect, it demonstrated how scientific breakthroughs and significant behaviour change are possible when the right resources are made available, and government departments come together.

One recent study looking at the prospect of another novel disease or infectious illness outbreak, such as cholera, influenza, and typhoid, found that, statistically, extreme events are not as rare as many hoped. Experts believe the annual probability of extreme epidemics occurring could increase thrice over the next ten years.

It is clear that bold action is required if nations are to improve how they manage and overcome threats to global health, and through smart investment in both welfare and health systems, this can be achieved.

The benefits of a more joined-up approach in health and welfare spending

The [World Bank's Human Capital Project](#) is a key example of how investing in health and welfare spending can improve the overall prosperity of a nation. 'Human capital' refers to the knowledge, skills, and health people invest in and accumulate throughout their lives.

Investing in the population through nutrition, healthcare, quality education, jobs, and skills helps develop human capital, and this is key to creating more inclusive societies and ending extreme poverty and increasing overall economic output.

As part of the project, the [Human Capital Index \(HCI\)](#) was launched in October 2018 and updated in mid-September, 2020. There is also a significant research effort working alongside the HCI, designed to help countries take effective action and improve their score.

For example, credible measurement of education and health outcomes will reveal what has worked and where to target resources in future. It also increases policymakers' awareness of the importance of investing in human capital, creating momentum for government action.

The intrinsic link between health and welfare spending

Of course, no government has unlimited resources, and effectively tackling the problems that put a strain on services, such as the ongoing management of chronic health conditions, requires a new way of thinking. By empowering a population to take charge of managing their health, significant resources can be saved across both healthcare and welfare services.

Given society's increasingly digital and joined-up nature, the mass roll-out of at-home digital diagnostics technology would easily enable this to happen. Moreover, with a device in their home, people could proactively manage their health, reducing the burden on government services.

Whether keeping on top of an existing condition or identifying a problem before hospital treatment is required, prevention is the best form of cure. The

deployment of this technology would also skip the delay of waiting for a GP appointment and subsequent referral - hopefully preventing their condition from deteriorating.

Results of the tests taken at home would instantly be shared via a secure connection with the relevant healthcare professional, and action taken accordingly; this might also involve notifying the relevant welfare service should the person need to take some time off work or require support to cover their living costs.

While adjusting to this new way of thinking may take time, as we saw during the pandemic, the population can quickly adapt if there is a clear incentive. With resources scarce and budgets stretched, transforming how a population accesses services can enable government departments to work smarter and operate as effectively as possible.

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WELFARE ECONOMICS: PROMOTING EQUALITY THROUGH GENERAL POLICIES

Yew-Kwang Ng, Emeritus Professor at the Department of Economics, Monash University, continues a discussion about welfare economics, focusing on efficiency supremacy in specific areas, arguing that equality should be promoted through general policies

In the April issue, I published a piece on '[An Economic Analysis of Social Welfare](#)' and in an [Open Access Government eBook](#), a piece on 'The Welfare Foundation of Public Policies and Its Implications'. Here, and in subsequent pieces in October 2023, January and April 2024, I will discuss some important messages of welfare economics for public policies.

Efficiency versus equality/distribution in welfare economics

Now, we will discuss the vital issue of efficiency versus equality/distribution. Efficiency is necessary but not everything. For example, if some people are wealthy, but many are very poor, efficiency alone may still involve a very undesirable outcome. Thus, public policies should pursue both efficiency and equality.

However, virtually in all cases, this simultaneous pursuit is not done efficiently. If this pursuit is done more efficiently, we could have more efficiency, equality, or both. Moreover, this may be achieved just by following a simple principle.

A simple principle to pursue efficiency and equality efficiently is to promote equality in the general (re)distributional policies of taxes and transfer and let efficiency rule supreme in specific measures. Contrary to this simple

principle in welfare economics, most, if not all, pursuits in practice use many inefficient though equality-promoting policies in specific measures/areas, getting lower outcomes in both efficiency and equality.

To understand why this is so, first note that whether one is poor or not cannot be identified by one's consumption of a particular good.

Goods consumption and its relation to welfare economics

Madonna may consume little or no rice, while Yew-Kwang consumes a lot. That does not show that Yew-Kwang is richer than Madonna. Similarly, Yew-Kwang may consume no lipstick while Madonna consumes a lot; that does not indicate Madonna is richer than Yew-Kwang, though she likely is.

Instead, we must look at the total purchasing power or total income/consumption/wealth.⁽¹⁾ Thus, to increase equality in the whole society/economy, we should try to increase the total incomes of the lower income groups, not by subsidizing and taxing certain goods on equality grounds.

A common way to promote equality inefficiently is to suppress the prices of certain necessities like rice, housing, water, electricity, etc., by subsidies or price controls.

This is especially popular when the relevant prices have increased significantly due to higher demand and/or lower supply. For example, in 2023, rents for housing have risen substantially in Australia. As a result, the Green Party of Australia has advocated imposing a two-year rent freeze.

Since renters are taken as having lower incomes than landlords, such measures to depress rentals are believed to help the poor.

However, economists know rent control is 'the most efficient way to destroy a city, other than bombing'.⁽²⁾ The immediate effects of rent control may benefit the renters by having lower rentals than otherwise would be. However, the lower rentals reduce the rental accommodation supply, worsening the shortage.

Also, unable to increase the rentals, many landlords have no incentives to keep up with essential maintenance, significantly reducing the quality of rented units. Thus, the gains to renters (if any) of rent controls are typically much lower than the losses to the landlords, at least in money terms.

Nevertheless, if renters have much lower incomes than landlords, their gains, though less than the losses of landlords in money terms, may be higher in welfare terms.

This is so since the welfare significance of an additional thousand dollars is typically much higher if one is poor than when one is rich. Since welfare is of more fundamental value than money, should we not go by welfare comparison?

Yes, ultimately, we should go by welfare comparison. However, we may show that, following efficiency supremacy in specific measures (supplemented by appropriate general equality-promoting policies), we will achieve not just higher outcomes in money terms, but also in welfare terms.

The role of efficiency supremacy policy

On the issue of rent control here, following the efficiency supremacy policy means not imposing any rent control/freeze. As shown above (but in the opposite direction), this would make the landlords better off by more than the renters' losses in money terms.

However, in welfare terms, the opposite may be true. Thus, efficiency supremacy in specific measures alone cannot ensure a higher overall social welfare level.

We must supplement the efficiency supremacy policy (such as not imposing rent control) with appropriate general equality-promoting policies. We can design these policies in a way that makes all income groups better off in welfare terms, achieving a Pareto-optimal improvement.

This is so because, in money terms, the renters' losses (from the absence of rent control) are less than the gains to the landlords. Thus, we only have to transfer (through the general

tax/transfer system) less money from the groups of higher incomes (landlords) to the lower income groups (renters).

Nevertheless, the taxation of the higher income groups and the transfer to lower income groups will likely generate disincentive effects.

Taxing the higher income groups and transferring to the lower income groups

Economists, in particular, are emphatic about the importance of these disincentive effects. Thus, many of them also do not see the superiority of the efficiency supremacy policy (in specific areas and supplemented by appropriate general equality-promoting policies).

There are another more subtle points missed even by many economists (including myself before I wrote the 1984 paper), as explained below.

The supplementing equality-promoting policy of taxing the higher income groups and transferring to the lower income groups (denoted Policy A) is to offset the distributional effects of the efficiency supremacy policy like foregoing rent control as discussed here (denoted Policy B).

Thus, we have to look at the combination of both Policy A and Policy B. Policy A alone may have disincentive effects, but in combination with Policy B, the combined package can be designed to have zero disincentive effects.

This is so if, at each income level, the distributional effects of Policy A and Policy B are designed to offset each other exactly.

Then, the package has zero net effects in welfare terms at each income level, achieving zero disincentive effects. This is so as the amounts of disincentive effects depend on the combined outcomes of the whole package in welfare terms⁽³⁾, not on its specific component only.

While all income groups are made indifferent in welfare terms, the package generates a surplus (as the additional taxes on the higher income groups are less than the additional transfers to the lower income groups) which may be used to make all groups better off, achieving a Pareto improvement, as proved more rigorously in my paper (Ng 1984) in the American Economic Review, a top journal in economics.⁽⁴⁾

Rent controls and incomes in consideration of careers and age

An additional point may be made on the specific issue of rent controls. Though renters may generally have lower incomes than landlords, the following considerations may offset this. First, many rentals are received by retirees who have invested in housing using their incomes while working.

On the other hand, many renters are young persons in the early stage of their careers. Though their incomes may be relatively low now, they will earn much higher incomes as they age and gain experience, and as the economy grows richer through technical progress.

Hence, taking an overall and long-run perspective, the presumption that landlords have much higher incomes than renters may have to be seriously qualified.

Some qualifications/considerations to our simple principle of efficiency supremacy may be added (discussed more in Section IV of Ng 1984). First, this principle requires some effective general equality-promoting policies to supplement the efficiency measures in specific areas.

Thus, for countries where such policies are absent or very ineffective, especially where the rich are cunning and powerful enough to avoid the higher taxes with impunity, our principle may have to be qualified, and the pursuit of equality using inefficient measures in specific measures may then be justified.

However, this qualification itself needs to be qualified. Suppose the rich are cunning and powerful enough to avoid higher taxes. In that case, they will likely avoid the effects of specific equality-promoting measures.

Considering environmental disruption

Secondly, while our simple principle precludes inefficient measures in specific areas, it does not rule out certain taxes/subsidies justified on efficiency grounds.

One important example is that if the consumption or production of certain goods involves important external effects like pollution and other environmental disruption, they should be taxed more. This is justified on efficiency, not on equality/distributional grounds.

In fact, it may be further noted that if certain taxes on pollution or other environmental disruption can be justified on efficiency grounds,

they should be implemented for all consumers/producers irrespective of income levels. Instead of giving exemptions to such efficient taxes to lower income groups, it is better not to exempt them but to help them more through general equality-promoting policies.

Motivation for writing the 1984 paper

My initial motivation in writing the 1984 paper was provoked by a lunchtime conversation in 1974 with my mentor, Professor Ross Parish.

He told me that he was against the practice of some economists (including the eventual Nobel laureate James Mirrlees and his co-author Ian Little) in using income/distributional weights, making a dollar of the poor worth four times that of the rich, in cost-benefit analysis; to him, 'a dollar is a dollar'. Due to the diminishing marginal utility/welfare of income, I argued that such weighting makes sense.

However, one may debate about the value of four times. Neither of us convinced the other during lunch.

Thus, I wrote a paper trying to show that a dollar to the poor should be worth around 16 times that of the rich. However, my right-wing brain beat my left-wing heart, and I concluded instead that 'a dollar is a dollar (irrespective of income groups)' or the efficiency supremacy principle discussed above.

This incident shows that the efficiency-supremacy conclusion of my 1984 paper was not due to right-wing ideology but logical analysis (though the validity of this may be open to debate).

In addition, I may also declare that, though my economic thinking is somewhat right of the centre compared to the general public, it is much left of the centre compared to economists. I can provide documentary proof of this declaration; the subtitle of my 2000 book is: *With a Case for Higher Public Spending*.

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Footnotes

1. For simplicity, we use the a-temporal framework ignoring savings, the stock and flow distinction, and other dynamic complications. Thus, consumption, income, and wealth are treated similarly.
2. I read this many decades ago in a first-year textbook on economics. However, my googling shows a source (Noah Smith of Bloomberg) that attributes this statement to Professor Assar Lindbeck (1930-2020), a Swedish economist who chaired the economics Nobel prize committee for many years.
3. For simplicity, we ignore some possible divergences between welfare (equivalent to happiness) and utility (representing preference). On these divergences, see Ng (2022, Ch.2).
4. Recognizing the practical difficulties of fulfilling the conditions at all income levels down to the difference of only one cent, the paper claims only a quasi-Pareto improvement, where all persons within an income group are better off as a group, but not necessarily every person individually.



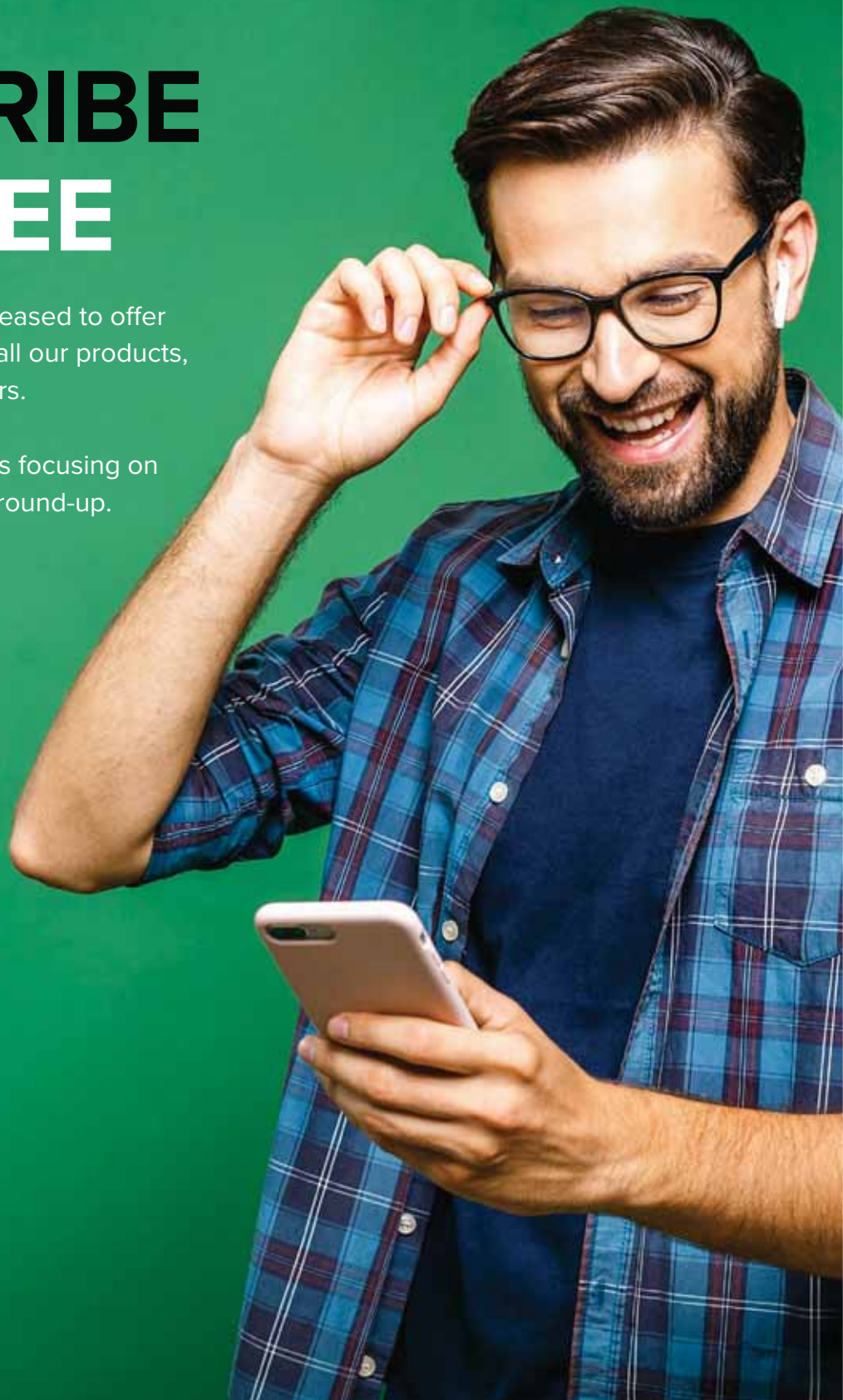
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ELOPMENT





European integration and the single market perspectives

Prof Dr Kyriakos Kouveliotis, Provost and Chief Academic Officer at [Berlin School of Business and Innovation](#), outlines the challenges and perspectives around European integration and the single market

The ideas of the “United Europe” and the “Single Market” have always been and continue to be a revolutionary and innovative vision, especially if we take into consideration the first moves towards the development of European integration mechanisms that took place into the turmoil that existed in the European continent just after the end of the Second World War.

In essence, when the six founding members of the European Coal and Steel Community created this Organization in 1951, they actually merged their industries of war. Six years ago, they were enemies and took part in the most catastrophic war the human race has ever encountered.

However, gradually and with the creation of the European Economic Community (EEC), the Euratom – the European Atomic Energy Community, the European Commission and the European Union (EU) at the end, huge milestones regarding integration have been achieved: the free movement of people, capital and goods, the harmonisation of legislation, all big infrastructure projects to name of few.

Above all stands, of course, peace and security that European citizens have enjoyed ever since.

Following this reference, though, the EU is a victim of its success. All these great achievements today are to be

taken for granted. It is very difficult for young Europeans to imagine the situations and living conditions their grandparents and great-great-grandparents encountered in the previous century. Even the Cold War sounds remote today.

Challenges for European integration & the Single Market

The last 15 years were full of global challenges for European integration and the Single Market. Especially the period 2010-2014 was a highly eventful one, with the implementation of the new constitutional framework established by the Treaty of Lisbon, the European elections, the affirmation of the European Council's role as a crisis-management institution, the formation of the new European Commission, the sovereign debt crisis, the Arab Spring, the conflict in Syria and the migrant crisis.

In addition, we have experienced the biggest challenges recently: the COVID-19 Pandemic, the global logistics crisis, Ukraine and alarming signals from the banking sector.

The aftermath of the global economic crisis in Europe

The EU's capacity for adaptation and action was tested with each successive event. As a result, the dynamism and the very nature of the integration process within the EU were called into question. ⁽¹⁾ If we also consider the aftermath of the global economic crisis in Europe, which in some sectors, we still experience, the whole perspective looked highly problematic.

In this framework, European Integration and its Single Market have turned from a revolutionary, innovative, and, why not, radical movement to a regime with symptoms of a decline. Inevitably, it has lost a huge percentage of its dynamism, popularity and public acceptance.

Additionally, its inadequacies, eurozone problems and the austerity measures that are imposed on Member States gave impetus to enormous criticism. In this framework, many Eurosceptic and anti-systemic movements have been developed. It is very easy for them to find appeal and support the European citizens, especially from the South European Member States that

have suffered from the hard-economic policies they feel are dictated by Brussels and Germany.

Nevertheless, it was German Liverpool football club manager Jürgen Klopp that has mentioned something very true: ["The EU is not perfect, was not perfect, is not perfect, will not be perfect. But it is the best idea we have had so far."](#) Sometimes you do not need an expert to see the reality.

The Single Market made all goods accessible and, at the same time, facilitated commerce. It has enhanced competitiveness and provided a variety of choices. On the other hand, it strengthened the market value of the powerful Member States and their economies of scale.

EU: Single Market challenges ahead

The EU and its Single Market must face in the near future, but also today, seven important challenges: immigration, energy, internal and external security, banking and fiscal unification, ethnicism, ageing and future enlargement.

The only viable solution as a strategic plan but also as a remedy to these challenges is a new route towards the deepening process, not just a new enlargement that will further strengthen Eurosceptic voices very shortly. ⁽²⁾

For years, the EU has tried to widen and deepen in parallel. But since the Treaty of Maastricht took effect in 1992, the deepening process has stumbled, pattering ahead with the Amsterdam and Nice treaties but making little real progress.

The EU will, therefore, have to quickly work out the tensions between wider enlargement and deeper integration. Simply put, the enlarged EU has to answer the question of whether it can be a political union after this and subsequent enlargements. ⁽³⁾

However, the EU has to solve its internal problems and regain momentum; otherwise, if new members join in, there will be even more problems. More members mean more opinions which inevitably means more disagreements. Another perspective argues that the European economic crisis will spur the development of new governance mechanisms that will ultimately deepen EU integration.

TAILOR-MADE PROMOTION

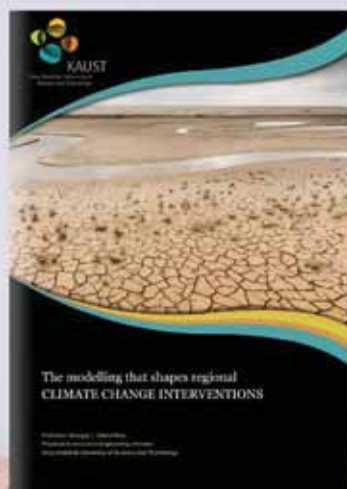
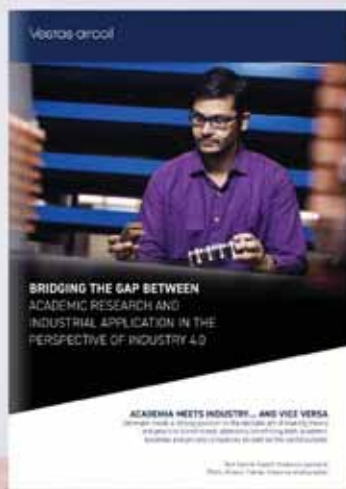
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30 YEARS OF THE SINGLE MARKET

In March 2023, the European Commission celebrated the 30th anniversary of the Single Market and set out how to secure the EU's competitiveness in the long term. Thierry Breton, Commissioner for Internal Market, concisely touched on what the Single Market is all about, and it's pretty interesting to read what he had to say. "The Single Market is more than just a free trade area - it is an area of freedom, prosperity and resilience for all. And we are working hard to ensure that it remains so for at least another 30 years!" ⁽¹⁾

Returning to January 2023, we learn that the Commission published the 2023 Annual Single Market Report ⁽²⁾ and the 2022 Single Market Scoreboard ⁽³⁾. Both reports note the Single Market stays a vital tool to address Europe's challenges today and continually improve its functioning. The Single Market's impact concerning increased added value for the EU's economy was also noted. Commissioner Breton said that both reports give extra proof of the central role of the Single Market and the part it plays in assisting SMEs and businesses in expanding and our everyday lives.

"Building on the success of the past 30 years, we will continue to work with Member States to ensure that they apply EU law properly and their administrations do

not draw up new barriers in particular in the area of services. In the current geopolitical context and with fierce global competition, a well-functioning Single Market will be particularly vital for the EU's competitiveness, job creation and resilience," Commissioner Breton adds. ⁽⁴⁾

When the Single Market turned 30, Commissioner Breton said this landmark gave him the "confidence and determination to face the challenges ahead", ending this extra focus positively. ⁽⁵⁾

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Further reading

https://ec.europa.eu/commission/presscorner/detail/en/ip_22_7897

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In any case, the EU definitely needs reform towards integration. The Commission could initiate a new intergovernmental conference as in the past, which, if productive, will move things forward. ⁽⁴⁾

Let us conclude that the Union is at a crossroads, as is the whole world. We have entered the so-called "De-globalisation" era. So maybe the solution is a view to the past and to return to the original values and rationale of the Single Market. In other words, we take two steps back to move one ahead.

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INDUSTRIAL ORGANIZATION: UNDERSTANDING THE MECHANISMS OF MARKET STRUCTURES

Patrick Legros, Professor of Economics at Université libre de Bruxelles, explores how Industrial Organization can help understand the positive and normative consequences of different market structures

In the Industrial Organization (IO) field, we understand the positive and normative consequences of different market structures. For instance, fewer firms yield higher prices. But we have a poorer understanding of the reasons for the emergence of these market structures, which require answers to two basic questions:

1. When and why do mergers or divestitures happen?; and
2. It is now well-documented that degrees of integration vary within and across industries, even when controlling for exogenous differences. How can we explain the heterogeneity in performance among seemingly identical firms?

The literature tends to explain merger waves by industry shocks that imply a financial need to reallocate assets or a behavioral approach linking booms to “over-optimism” that allows managers to have discretion and engage in mergers that are not necessarily wealth-enhancing. But traditional Industrial Organization does not

provide a unified mechanism to answer both questions easily. ⁽¹⁾

We have shown recently that if we can extend the traditional approach by considering firms from an organizational perspective (where all decisions cannot be contracted upon and where the identity of the decider matters for production efficiency), the two questions are linked.⁽²⁾ Indeed, from an Organizational Industrial Organization (OIO) perspective, integration decisions tradeoff coordination benefits versus private costs to the managers.

This tradeoff provides a simple answer to the two previous questions and opens the door for another view of the relationship between price levels and degree of integration.

- Mergers happen because the product market conditions are “right”. For instance, if there is a higher demand for the industry product, there are more monetary benefits from coordinating activity (to integrate), even if this will entail higher private costs (e.g., loss of decision-making power); and

- There is heterogeneity in organizational forms and performance among seemingly identical firms because agents make decisions to integrate with control and decision rights, trade off the benefits from higher productivity (therefore more monetary benefits) and the private costs they incur in each organizational form. In a stable market outcome, less productive firms are associated with higher private benefits for the decision-makers, explaining why heterogeneity is consistent with stability when firms are identical otherwise.

The OIO approach and reverse causality

To put these answers in perspective, let us take stock of what we already know about integration. Two basic effects of integration have been identified: efficiency and market power enhancement.

Efficiency can arise because integration solves agency problems (lack of commitment on prices, distributors free riding on each other for brand

advertising). Market power enhancement can be due to foreclosure (increased rivals' costs, refusal to supply) or increased ability to engage in collusive agreements to raise prices.

In both cases, we expect prices to rise at the wholesale or retail level and for market shares to be reallocated to the integrated firms. Hence, current Industrial Organization theory suggests that integration may lead to higher or lower prices and market shares depending on whether the dominant effect is foreclosure or efficiency.

Therefore, causality is perceived as flowing from integration decisions to price levels. But there may be a reverse relationship between integration and prices. If integration is privately costly to the parties, the price has to be high enough for firms to decide to integrate.

Integration is a consequence rather than a cause of high prices. Since integrated firms are more productive than non-integrated firms, they also have larger market shares. This reverse causality obtained from our OIO approach is important when considering when to regulate a market, e.g., whether to force firms to divest assets, but also to understand how market structures evolve.

Market power enhancement: Regulation and divestitures

For instance, when regulators observe a pattern of increasing prices and market shares to the integrated firms in a time series, they may conclude that the efficiency motive for integration is not at play and that the price increase is due to market power enhancement.

The regulators may then advocate divorce policies with the expectation that by removing the instrument for market enhancement —

integration — the price levels will decrease after divorce. ⁽³⁾

This happened in the US retail gasoline and British beer markets. Regulators imposed divorce policies following long periods of increasing integration and rising prices. A surprising continuation of rising prices instead of the expected fall ensued. What is more, firms' profitability also fell despite the price increases.

These patterns are difficult to reconcile with the view that concentration causes price increases. But the pattern is consistent with the reverse causality between prices and integration. Indeed, if integration arises because demand is high, prices are high, and the higher prices are, the more integration should be expected, together with larger market share differences between integrated and non-integrated firms.

In this world, integration generates more output than non-integration, and divorce policies will decrease output and, therefore, higher prices.

Market power and the quiet life

In ongoing work, we inquire about the emergence of oligopolistic structures and consider situations where firms are powerful when they have many production units.⁽⁴⁾ The decider in a powerful firm has market power and will want to increase the price by restricting output, concerning what a decider in a "fringe" firm without market power will do. Therefore, production units in powerful firms enjoy a quieter life (they will work less and have lower private costs) than in a fringe firm.

Production units can join powerful or fringe firms, anticipating that all firms face the same product price. Still, the

revenue per production unit in powerful firms is inferior to that of fringe firms. An oligopoly emerges and is stable only if the monetary benefit of joining a fringe firm is compensated by the quieter life in powerful firms.

We show that fringe firms can co-exist with powerful firms and that concentration increases with the market size, suggesting a demand-side driver of recent trends that profit margins and market concentration increase in many industries.⁽⁵⁾ Moreover, stable oligopolies may lead to a market price that is inferior to the price in a perfectly competitive structure.

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NATIONAL FRAUD INITIATIVE (NFI) CREDITORS – “CLAIM, VET AND MATCH”

Ray Dorney talks us through Rockford Associates Limited’s Accounts Payable Recovery Audits used to detect and prevent overpayments in the public sector and beyond

The National Fraud Initiative (NFI) matches data from 1,300 public sector and 77 private sector organisations, including police authorities, local probation boards, fire and rescue authorities as well as local councils, NHS Trusts and other agencies. It flags up inconsistencies in data that may indicate fraud, errors, and potential overpayments, signalling the need for participating organisations to further review those findings, conduct internal investigation with Accounts Payable Recovery Audits and implement any necessary corrective actions – which is no small task.

NFI Data Matches

The main NFI matching exercise takes place every two years, whilst Council Tax and Electoral Register matching takes place annually. Participating organisations submit data to a secure website.

The NFI system matches data within and between bodies to identify potential anomalies, referred to as ‘matches’. ‘Matches’ are made available to participating organisations for them to review, investigate and record outcomes from those investigations.

NFI Motives

Good motives underpin NFI match reports, and this article places the spotlight firmly on NFI Creditor and Duplicate Payment reports.

They help prevent or detect fraud, support good governance, provide

transparency, and essentially assist provide greater scrutiny of Tax- Payer spends.

NFI Dilemma

Theoretically the NFI reports are a WIN-WIN for participant organisations; they deliver the identification of potential errors and positive reassurance no errors exist. The issue or NFI dilemma arises with the sheer size of some reports.

These may contain matches that are “false positives” or potential “duplicate payments” which may have already been corrected. Despite this internal staff are compelled to vet and address each matched line item.

Accounts Payable teams are frequently under time pressures and resources stretched to maximum working capacity.

Few if any, have the desire or wish to divert valuable and often expensive resources to the rather mundane task of investigating data matches and potential duplicate payments which may prove to be “false positives”. The match reports are simply the first step in a process of queries.

Those yards get even harder when valuable time is absorbed verifying and validating if a duplicate or overpayment has taken place and organisations find themselves under time pressure to report back their findings to the NFI. This is before any recovery, claims from

suppliers can even commence which in of itself, can often be measured in months rather than weeks.

12,000 NFI line matches for just one client

To help provide an indication of scale participating organisations are compelled to investigate NFI matches and where Rockford delivers regular risk-free Accounts Payable Recovery Audits, it provides an ideal opportunity to “lighten that load” and assign the mundane task to us.

Over 2 months, we analysed and reported on over 12,000 NFI line matches for a single client mapping their NFI matches with our Accounts Payable Recovery Audit.

This enabled the update and reporting of findings to the NFI within project timescale. Moreover, it provided time to “deliver the day job” and apply corrective actions to their respective payable ledgers.

So how can Rockford help? A “Belt & Braces Approach”

From an Accounts Payable and duplicated payments perspective, NFI creditor reports are similar to Rockford’s “Pathfinder” data mining outputs. Potential duplicated supplier reports also mirror our Electronic Data Analysis Reports. Dual vetting provides a “belt and braces” approach with errors highly unlikely to escape the scrutiny of two systems.

Cross Matching Capabilities

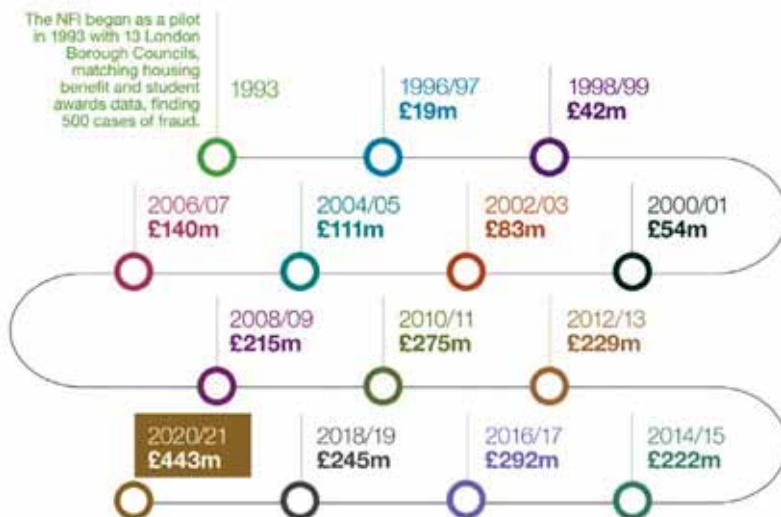
Rockford can match the relevant NFI duplicate payment reports to the Pathfinder outputs; and we can validate each item establishing the action to be taken (essentially: not a duplicate, already cleared by a matching credit, duplicate but not paid, still to be investigated, Etc).

Thereafter we can advise on the response to each item. Rockford regularly performs such exercises whilst undertaking risk-free Accounts Payable Recovery Audits and there is generally no cost incurred.

Accounts Payable Recovery Audits & NFI

Rockford Associates Accounts Payable Recovery Audits include a ready-made resolution for NFI duplicate payment reports, save organisations time and monies by the release of valuable internal resources enabling them to focus on higher priority tasks. The benefits include:

- Contingency Risk-Free Agreement
- Full range of error resolution
 - Duplicate / incorrect payments
 - Wrong Supplier / Currency
 - Paid Credit Notes
 - Missed Credit Notes
 - Overpayments (E.g., unused deposits, incorrect invoice values)
- No Disruption to AP Team
- No Need to Hire Temp Agency Staff
- Reduction in Workload on AP Team
- Quicker Recovery of Funds
- NFI Compliant Reporting



Win-win results when preventing fraud

The National Fraud Initiative, based in the Cabinet Office, has enabled participating organisations to prevent and detect/recover £443 million fraud and error across the UK in the period April 2020 to March 2022.

This takes the NFI programme cumulative savings to £2.4 billion since its creation in 1996. These outcomes exclude the non-financial benefits also experienced by participants, such as improvements in the accuracy of records, or a greater knowledge of the extent and types of risks their organisations might face.

Recommended Next Steps?

Step 1: Implement planned Accounts Payable Recovery Audits

Rockford encouraged long standing Clients to transition away from undertaking accounts payable recovery audits on an ad-hoc basis. The need for vigilance in respect of overpayments never ceases. We pioneered an on-going multi-year audit programme, enabling regular delivery pre-planned Accounts Payable Recovery Audits on an Annual, Biennial or Triennial basis.

Step 2: Map Accounts Payable Recovery Audits To NFI Match Reports

The benefits of ongoing Accounts Payable Recovery Audits are abundantly clear and proved popular with Clients now requesting we schedule them to coincide or “dovetail” directly with the timescales of the NFI match reports enabling them to meet the challenge of NFI reporting requirements in a timely manner.

Step 3: Get in touch with us

To discover how we can assist you with NFI match reports and Accounts Payable Recovery Audits, or if you would like to see some case studies of how we have assisted others please feel welcome to get in touch.



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Boosting economic progress through digital transformation in Egypt

Usama Elsayed, COO and Managing Director for MEA region, [BPC](#), charts how digital transformation in Egypt is boosting economic progress and financial inclusion



Image: © m.elyoussoufi | iStock

With a [population of more than 100 million](#), Egypt is confronting significant demographic challenges in its labour market. The country strives to advance its economic development by implementing the National Sustainable Development Strategy (Egypt Vision 2030), aligning with the UN Sustainable Development Strategy (2030 Agenda), and adhering to the 2063 Agenda.

Despite these efforts, Egypt continues to face challenges with escalating unemployment rates and a growing influx of new entrants into the labour market. However, digital transformation may offer a potential lifeline.

Demographic pressures in Egypt

Unemployment in Egypt has consistently shown a structural tie to demographics, predominantly affecting young, educated individuals entering the labour market for the first time. In other words, Egypt's burgeoning youth population is one of the main drivers of labour

market pressures. More than [60% of Egyptians are under 30](#), creating a massive need for job creation. The traditional industries have been unable to absorb the high number of new entrants, leading to urban unemployment rates [hovering around 7-10%](#). This situation is further exacerbated by the mismatch between the skills offered by the education system and the labour market requirements.

The digital economy presents a possible beacon of hope in the face of these challenges. The rapid expansion of the Information and Communication Technology (ICT) sector in Egypt has created numerous job opportunities, with start-ups, technology companies, and e-commerce platforms significantly contributing to the growth of the digital economy. Digital transformation in Egypt also has the potential to reduce the financial exclusion rate by offering accessible financial services to the unbanked and underbanked population.

But can the digital economy create enough employment opportunities to address the unemployment challenge in Egypt? The answer is nuanced. While the ICT sector has experienced rapid growth, it is not enough to absorb the vast number of new labour market entrants. However, it does offer opportunities for growth in other sectors through increased efficiency and productivity.

Opportunities of digital transformation in Egypt

Investing in digital transformation in Egypt can enable businesses to streamline operations, automate processes, and reduce costs. This can lead to the creation of new jobs in various sectors, such as logistics, agriculture, and healthcare. For instance, adopting digital technologies in agriculture can enhance food production and create new employment opportunities in the agri-tech sector.

To harness the potential of digital transformation, Egypt needs to invest even more in education and skill development. This includes improving the quality of education, focusing on STEM subjects. So far, the ICT sector has experienced significant growth in labour demand in recent years, providing a welcoming environment for women in particular.

As Selwaness et al. (2023) note, while ICT jobs accounted for a small portion of total employment (1.8% in 2021), private sector employment in this field expanded rapidly at a rate of [5.5% per annum](#). This growth far outpaced the 2.1% per annum rate for non-ICT jobs between 2009 and 2021. Interestingly, while women's employment in non-ICT jobs within the private sector declined at a rate of 1.4% per annum, it surged at an impressive 10% per annum in ICT positions. These suggest that the rapid expansion of the digital economy could generate employment opportunities that align with the aspirations of the increasingly educated workforce set to enter the Egyptian labour market.

Investing in Egypt's digital infrastructure

Egypt should continue to prioritise investing in digital infrastructure. Ensuring the availability of high-speed internet across the country, including rural and remote areas, is paramount to achieving this goal. Access to reliable and affordable internet services will facilitate the growth of the digital economy and create a conducive environment for start-ups and technology companies to thrive.

Investing in digital infrastructure also involves developing efficient data centres, reliable cloud services, and robust cybersecurity measures. These support the growth of digital services, e-commerce platforms, and technology-based businesses that require a dependable digital ecosystem. By investing in digital infrastructure, the government can help bridge the digital divide that exists between urban and rural areas, ensuring that all citizens can benefit from the opportunities provided by the digital economy.

In addition, Egypt should encourage public-private partnerships to foster innovation and drive digital transformation. Finally, the government must create a

“The rapid expansion of the ICT sector in Egypt has created numerous job opportunities, with start-ups, technology companies, and e-commerce platforms significantly contributing to the growth of the digital economy ”

supportive regulatory environment for the digital economy. By implementing progressive policies and regulations, Egypt can attract local and foreign investment, further driving the growth of the digital sector.

In conclusion, the digital economy offers significant growth and job creation opportunities. By investing in education and digital infrastructure, and fostering a supportive regulatory environment, the Egyptian government can harness the potential of digital transformation to alleviate some of the demographic pressures on its labour market. The path ahead may be challenging, but with a strategic commitment to a more digital future, Egypt can create a sustainable and inclusive labour market for its burgeoning youth population.

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SUPPORTING ICT EMPLOYMENT OPPORTUNITIES FOR WOMEN IN EGYPT

Ragui Assaad and Irene Selwaness examine the increase of women in ICT jobs in Egypt, as well as gender disparities and the efforts to promote ICT employment growth

With the increasing withdrawal of the public sector as a major employer in Egypt, the Egyptian labour market has become increasingly inhospitable for women. Female employment rates declined steadily from 19.5% in 2009 to 13.7% in 2021.

Women's employment has been falling in absolute terms at a rate of 1.1% per year from 2009 to 2021, while the female working-age population has been increasing at 2.5% annually. Information and communication technology (ICT) jobs are a major bright spot in this bleak landscape.

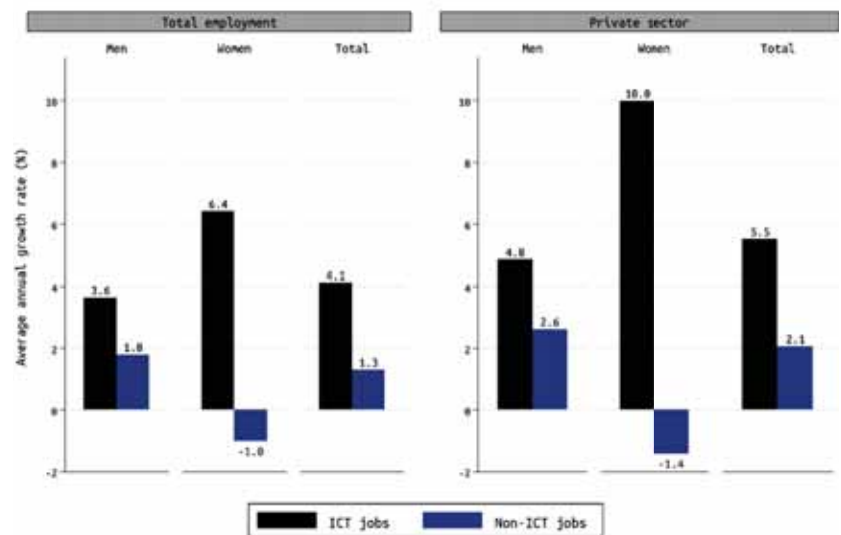
According to a recent report on Egypt's ICT jobs, ICT employment for women has been growing much faster than in other segments of the economy and much faster than for men (Selwaness, Assaad and El Sayed, 2023). The report defines ICT jobs as all jobs in ICT industries and jobs in ICT occupations in non-ICT sectors.

Although these jobs still make up a small percentage of overall employment in Egypt, their share has grown from 1.4% in 2009 to 1.9% in 2021.

Is ICT employment in Egypt making enough space for women?

In fact, the share of ICT jobs in total employment occupied by women has risen from 1% in 2009 to 2.3% in 2021, a much more rapid increase than for men.

Source: Selwaness, Assaad, and El Sayed (2023)



The contrast between the growth of female employment in ICT versus other segments of the Egyptian economy is even more impressive when one examines growth rates. Economywide, female employment in ICT jobs has grown at a compound rate of 6.4% per annum compared to a decline of 1% per annum for non-ICT jobs.

The contrast is even more significant in the private sector, where female ICT employment has grown at an explosive 10% per annum, relative to a decline of 1.4% per annum in non-ICT jobs. ICT jobs have also been growing faster than other jobs for men, but the contrast is not as large as for women.

The occupational structure within Egypt's ICT sector is quite different for men and women. In 2021, nearly half of

women in ICT jobs in the private sector were in data entry, receptionists, and call centre operator jobs, compared to only 16% for men.

In contrast, a third of men in ICT were in technical assistant and sales jobs, compared to only 19% for women. Men are also much more likely than women to be in blue-collar ICT occupations such as electronic fitters, mechanics, and assemblers.

Surprisingly, the proportion of men and women in ICT jobs who have professional occupations such as computer professionals and engineers is almost equal (18-20%).

The report indicates that recruits into ICT jobs are increasingly more likely to be educated at the tertiary level, with

the proportion of workers with tertiary education increasing from 43% in 2009 to 63% in 2021 in the private sector.

The ratio of workers in Egypt's ICT jobs with ICT-specialised educational credentials is also growing, especially among ICT workers with tertiary education (from 28% in 2009 to 37% in 2021).

Conditions for ICT workers have not improved over time

Despite the rapid growth of ICT employment, conditions for ICT workers have not necessarily improved over time. Like in the rest of the economy (Amer, Selwaness, and Zaki 2021; Selwaness and Ehab 2022), the proportion of ICT jobs providing social insurance coverage, i.e., formality, has been declining, and the decline has been steeper for women than for men.

The peak of social insurance coverage in ICT jobs was reached around 2014 when 67% of men and 60% of women were covered. Coverage rates have fallen since then, reaching 59% for men and 47% for women in 2021.

Similarly, wage rates in ICT employment in Egypt are not much higher than the average in the rest of the Egyptian economy for either men or women. Like other wages in the Egyptian economy, they have not been keeping up with inflation and have been declining in real terms over time. These challenges can hamper the potential role of ICT in boosting women's employment.

Government efforts to promote ICT employment growth in Egypt

The Egyptian Government has been prioritising Egypt's ICT jobs in its development plans. It launched the

'Digital Egypt' strategy to promote digital transformation by providing e-services and increasing digital inclusion.

The National Structural Reform Programme (NSRP) aims to substantially increase Egypt's digital services exports by 15% annually and double services and digital goods exports from \$4 billion in 2020 to \$8 billion by 2024.

To further promote the growth of service exports, the NSRP plans to increase Egypt's attractiveness to international Business Process Outsourcing (BPO) companies to set up their operations in Egypt through well-serviced specialised industrial zones.

The NSRP programme aims to create 120,000-140,000 jobs by 2024 and increase the number of beneficiaries of different education and training programmes provided by the Ministry of Communications and Information Technology and its affiliated institutions by an average of 20-25% yearly (MPED 2022).

More can be done to realise the promise of ICT employment for women. Further efforts are necessary to improve the investment climate for both domestic and international ICT firms. Measures should encourage international training organisations with ties to global IT firms to set up shops in Egypt and train Egyptian workers, especially women, for remote jobs in the worldwide IT industry.

Training programmes should capitalise on increased global demand in data analytics and artificial intelligence to enable the participation of Egyptian workers in the global IT industry without leaving home.

Finally, the Egyptian Government needs to develop mechanisms to ensure that Egypt's ICT workers and remote and platform workers have decent working conditions and adequate social protection.

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SECTION

TRANSPORT





Transitioning to a long-term sustainable transport system in Europe

Thord Stefan Back, Member of the EESC, charts the transition to a long-term sustainable transport system to achieve climate neutrality in Europe by 2050



Image: © RossHelen | iStock

For some time now, the European Union (EU) has aspired to lead the green transition – including transport – by aiming to achieve climate neutrality in 2050. The Fit for 55 package is seen as a significant step in this process by making a 55% cut to CO₂ emissions by 2030 a legal obligation.

The trilogues are advancing well – most recently, the agreement on the amendments to the Emission Trading System (ETS), which includes road transport, maritime transport and aviation, as well as the ReFuelEU aviation proposal, where a provisional agreement has just been reached.

These agreements clearly demonstrate a high level of ambition to decarbonise transport, as do the recently adopted rules on CO₂ emission levels for cars and vans and the newly submitted proposal for strengthened rules on CO₂ emissions of heavy-duty vehicles.

The EU demonstrates that it can wield “a stick” on all these points. For instance, the blend of obligations on EU

aviation and rules on eligible sustainable fuels are probably the strictest in the world.

Sustainable aviation fuels

But a few problems remain. Taken together, ETS, fuel, and CO₂ regulation mean increased costs. For instance, the current production of sustainable aviation fuels worldwide is about 25 million tonnes, while the needs of aviation will be 350-450 million tonnes by 2030 under the agreed-upon rules. These fuels are also about four times as costly as the currently used kerosene. According to the airlines association, Airlines for Europe (A4E), the cost of guaranteeing sustainable aviation fuels by 2030 would amount to €20 billion.

In concrete terms, this means reduced competitiveness for European airlines and increased ticket prices and freight costs.

The situation in the U.S. under the Inflation Reduction Act is different, simply because financing is there to promote fuel production and support airlines to reduce the extra

costs. The Commission is considering such “carrots” or support initiatives, but the proposed resources are very limited.

Essential aspects of the Green Deal for creating a sustainable transport system

And this brings me to the key elements that I, and in fact, the whole of the EESC in the opinion on the green transition of transport adopted in April 2023, consider essential elements for the Green Deal to be a success and not a dead letter.

To us, the key for the Green Deal to succeed and for the EU to really take the lead in the green transition is acceptance by the public and businesses. They must be ready to buy into both the 90% emissions reduction target by 2050 and, in particular, the means used to get there.

We see three main conditions for such success:

1. First, businesses must feel that they are not burdened with excessive costs and will remain competitive within and outside the EU.
2. Second, employees must see the transition as acceptable and be given the real possibility of adapting to new working conditions in a socially acceptable manner.
3. Third, citizens – in both urban and rural areas – must be guaranteed accessibility and mobility at a reasonable cost and under good overall conditions.

This means, for instance, that the framework must appear realistic and attractive in all parts of the transport sector – zero or low-emission solutions for aviation or heavy-duty road transport must seem workable and financially attractive to consumers and businesses.

Alternative fuels conditions vary in Member States

Regarding alternative fuels, it is also necessary to remember that conditions in different Member States vary. For instance, Sweden, Finland, Estonia and Italy are struggling to get a better deal for biofuels – so far, with very limited success. Technological neutrality is, in fact, key both because of the diversity of Member States and because the long-term perspective of a sustainable transport system means that new solutions and new means of propulsion will emerge, which require openness and a focus on results.



Pushing forward positivity in the transport sector

We at EESC highlight the importance of sending positive signals, such as promoting multimodality by getting the best out of each mode and enhancing efficiency through digitalisation and capacity optimisation, for instance.

Coherence is also essential, for example, between developing sustainable fuels and the infrastructure needed for distribution.

Social sustainability is another key element, including both good accessibility at a reasonable price and employee participation in the green transition and broad consultations with all concerned.

There may be a danger of backlash if there is too much pressure and little real encouragement in the actions taken to implement the Green Deal.

It would be excellent if the action taken in the EU to implement the Green Deal were seen as more attractive to businesses and people.

The focus should be on the best way of getting sustainable transport system results, with more emphasis on encouragement than restrictions!

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POWERING UP LIVERPOOL'S PUBLIC CHARGING NETWORK TO BECOME THE NORTH OF ENGLAND'S MOST EV FRIENDLY CITY

Here Shell Fleet Solutions discuss how ubitricity is working with Liverpool City Council to help Liverpool expand its public charging network to become the north of England's most EV friendly city

In the UK, road transport is the most significant contributor to greenhouse gas (GHG) emissions, making up nearly a quarter (24%) of total emissions. ⁽¹⁾

The Government has outlined measures to decarbonise the transport sector, banning the sale of petrol and diesel vehicles by 2030, with all new cars and vans being fully zero emission by 2035. ⁽²⁾

Those targets can only be met if businesses and drivers alike are confident that they can reliably transition to EVs, by having the right infrastructure in place to support adoption. Scaling EV infrastructure cannot be achieved alone; it requires collaboration between businesses, industry, and Government.

Governmental support driving EV adoption

The Government has already taken measures to drive EV adoption, targeting the installation of around 300,000 public EV chargers, by 2030.

Shell is also joining this effort, with plans to have 100,000 chargers, 11,000 of which will be rapid chargers, in public locations such as charging hubs, forecourts, and supermarkets by 2030. The aim is that [90% of UK drivers will be within a 10-minute drive of a Shell rapid charger](#).



Equally, the proliferation of public charging will only be possible with investment to support it.

Earlier this year, the UK Government announced £56 million of funding to expand the Local Electric Vehicle Infrastructure (LEVI) grant and boost the existing On-Street Residential Chargepoint Scheme (ORCS), contributing to the deployment of 2,400 charge points. ⁽³⁾

One city is currently at the forefront of the transition. Soon, Liverpool City Council will have one of the North of England's largest EV networks, more than quadrupling their capacity by installing 300 on-street EV charge points.

This expansion was made possible thanks to Government ORCS funding and working with ubitricity, a subsidiary of Shell, to deliver the extensive rollout.

Leading the charge for an EV-friendly city

In 2019, Liverpool City Council declared a climate emergency, laying out a roadmap to address the city's carbon footprint, culminating in an ambitious target of becoming net zero by 2030 – two decades ahead of the UK's broader 2050 timeline.

To reach that goal, the city would need to decarbonise its transport, which was identified as the second largest contributor to emissions – most of

which was attributed to road traffic. ⁽⁴⁾ Encouraging widespread EV adoption plays a crucial role in the city's journey to net zero.

However, one of the major barriers to EV adoption is access to public charge points, particularly in cities like Liverpool, where many residents do not have access to off-street parking.

In Liverpool, over ten requests for new public charging points are received each week, as most EV motorists rely on on-street parking. ⁽⁵⁾

Deploying more public charge points requires significant planning. It took Liverpool City Council around 9 to 12 months to secure stakeholder alignment and ORCS funding before any installations could be made.

Once the correct funding was in place, Liverpool City Council began working with ubitricity – who are listed suppliers across ESPO, CCS, YPO, Oxford EV DPS, and Hydrogen Dynamic Purchasing Scheme frameworks – to support the planning and installation of the charge points, to areas that needed them the most.

On the road to greener transport

Taking a community-led approach when deploying the charge points was essential. To support the needs of existing EV drivers, and encourage EV adoption across ICE motorists, the on-street charge points had to be conveniently placed and readily accessible.

ubitricity consulted with residents throughout the process, to negate any concerns about where charge points were going to be placed and conducting surveys to determine where demand for new charge points was highest.

After this public consultation, Liverpool City Council and ubitricity worked to install the charge points directly into existing street lampposts, taking just 2 hours to install each charge point.

Within the first three months of 2023, Liverpool City Council and ubitricity had installed 200 chargers, each with a charging speed of up to 5kWs. This means, using the newly installed chargers, residents can fully charge their vehicles overnight – as they would with a home charger – in around 8 hours. ⁽⁶⁾

The new on-street chargers are managed via the Shell Recharge App, making it easier for residents to plan and manage charging. In addition to this expanded on-street charging network, the Shell Recharge App offers residents access and visibility to Shell's entire network of more than 400 public charge points across the Liverpool City Region. ⁽⁷⁾

Equally, this improved network also supports Liverpool City Council's own electrification journey as they begin converting their corporate fleets to EVs, beginning with their highway inspectors' vehicles later this year.

The impact of creating an EV-friendly city

The impact of Liverpool City Council and ubitricity's work to expand public charging has not only helped to accelerate the EV transition amongst its residents but has contributed to the city's wider decarbonisation goals.

Liverpool City Council will no longer have to consider introducing a Low-Emission Zone in the city centre, as they are on track to meet their emissions targets without it.

Yet, this significant progress was only made possible through collaboration. Consultancy between Liverpool City

Council and ubitricity, and then the residents themselves, played a critical role in determining how best to approach the installations, to ensure that the charge points were deployed where they would be used and benefitted from the most.

Liverpool City Council's work of ubitricity highlights one way Shell can support customers with the transition to EVs. Shell Fleet Solutions offers a range of home, office, depot and on-the-go charging solutions to support fleets at every stage of their journey and help support an ev-friendly city.

Learn how Shell and ubitricity could help you to accelerate your EV transition:
www.shell.co.uk/fleets

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DECARBONISING PUBLIC SECTOR COMMERCIAL VEHICLES AND ENSURING THE AVAILABILITY OF EV CHARGING STATIONS

From harnessing data to support EV uptake to ensuring the availability of EV charging stations, Beverley Wise, Webfleet Regional Director UKI at Bridgestone Mobility Solutions, shares key criteria to help make the switch to greener transportation more straightforward and cost-effective

Local authorities face mounting pressure to accelerate our journey to net zero transport by helping expand local EV charging stations.

At the same time, they have been tasked with leading by example by developing and implementing plans to electrify their commercial vehicle fleets. As a result, public sector budgets may be stretched like never before. Still, all electric vehicles (EVs) adopted to replace fossil-fuelled equivalents will ultimately help contribute to long-term carbon reduction.

With careful planning and management insights, the total cost of ownership (TCO) of electric vehicles over the fleet lifecycle – the cost of procuring, operating, and maintaining them – can prove lower than like-for-like internal combustion models.

How can the public sector's fleet sustainability ambitions be best realised?

Careful decision-making calls for meaningful, actionable insights, which have been made possible by advances

in dedicated EV software solutions. Such solutions, and the data they impart, underpin the following key steps to ensuring electrification takes place cost-effectively and with minimal disruption.

Plan the operational nature of journeys and telematics insights

The Department for Transport advises local authorities to 'identify which vehicles would be relatively straightforward and cost-effective to switch to zero-emission equivalents.'

Digital tools such as the Webfleet Fleet Electrification Report can simplify this task, helping establish the typical mileage drivers undertake.

Drawing upon data from existing vehicles, maximum daily 'real world' mileages can be selected by transport managers, along with criteria ranging from road types to standstill times. By doing so, they can identify their internal combustion engine (ICE) vehicles that could be readily replaced with EV alternatives without compromising service delivery.

Consideration should also be given to the operational nature of journeys; telematics insights can also shed light on these.

Although EV choice is improving, fleets should pay heed to payload requirements. The greater the payload weight requirements, the greater the impact on a commercial vehicle's range, which can, in some cases, put a question mark over their suitability for longer journeys. Other business prerequisites, such as the need to tow civil plant or other equipment, should be considered.

Fleet financing models need to be carefully reviewed to ensure they dovetail with adoption timelines. For example, a large proportion of public sector vehicles are leased so that EV deployment will be carried out on renewal.

Consideration of EV charging stations and availability

Electric vehicles must be charged to meet daily journey requirements and operated in a way that maximises range and optimises productivity.

Consideration of EV charging stations and availability is therefore crucial. This should include local public charging provision, opportunities for charge station installations at drivers' homes, should they take vehicles home overnight, and the requirements for chargers at council depots or car parks.

For Leeds City Council, for example, constrained supply at several council sites led to the introduction of a home charging scheme, which proved a less expensive option than energy capacity upgrades.

Whatever the preferred strategy, a clear EV charging policy will need to be drawn up and shared with all employees, outlining charging and payment procedures, car park charging practices, and the processes for reimbursing charging expenses, either on a per-mile or per-kWh basis. But, again, automated systems for reimbursement can help reduce the administrative burden.

EV software solutions can once again support effective charging practices. Webfleet, for example, enables businesses to monitor the real time battery levels and remaining driving ranges of their vehicles. Managers have visibility over vehicle charging statuses and remaining charging times, while mapped coverage of charging points helps drivers find the closest EV charging stations via their navigation devices.

Upskilling your drivers needs to be meaningful

Driving technically advanced EVs requires appropriate employee support and training to equip them with the knowledge and skills to drive their vehicles safely and efficiently.

Beyond a simple list of dos and don'ts at handover, a comprehensive training

programme should be introduced, covering all the nuances of EVs, such as regenerative braking and preconditioning.

Coaching should be prolonged and tailored to meet individual driver requirements for standards to be sustained. This calls for meaningful performance insights.

Telematics platforms enable fleet managers to compare drivers' energy performance or analyse kinetic energy recovered through regenerative braking. Miles per kWh can also be optimised by monitoring speeding incidents, harsh acceleration, and braking.

“With careful planning and management insights, the total cost of ownership (TCO) of electric vehicles over the fleet lifecycle – the cost of procuring, operating, and maintaining them – can prove lower than like-for-like internal combustion models.”

Optimising operational efficiency

Once EVs have been introduced, a plan should be in place to minimise energy costs and optimise fleet performance and productivity.

Fleet management solutions can again play a helpful role, enabling the best routes for electric vehicles to be calculated, taking account of vehicle battery levels, capacity, energy consumption and charge point locations.

Access to information on charging statuses can also prove helpful. For example, the Webfleet Charger Connection Report helps fleets understand why electric vehicles are at their current charge level, offering

insights into the charging process, including time, location, and duration.

The power of empiricism

There is always something new to learn as the e-mobility landscape evolves. Thankfully, information is becoming more readily available each week, with a growing corpus of empirical advice, shared knowledge and guidance from organisations ranging from the Local Government Association to the Energy Saving Trust. Taking heed of those that have blazed a successful trail before you – and how they have leveraged digital insights – can be invaluable.

For example, Oxford Direct Services (ODS) manages a fleet of over 300 vehicles to maintain the Oxford City Council's housing stock, parks, highways, streets, and waste disposal, teamed up with Bridgestone Mobility Solutions. Vehicle insights from Webfleet have been fed into Oxford's Fleet Reporting Database, with outputs used to support learning and evaluation at Energy Superhub Oxford, an ambitious initiative to decarbonise Oxford by 2040.

With access to data intelligence, the journey to an electric transport future that is both environmentally and financially sustainable promises to be less challenging and all the more rewarding.

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Energy storage in the electric vehicle & renewables revolution

Alan Greenshields, Director of Europe at ESS Inc, charts the road to net zero, highlighting the crucial role of energy storage in the electric vehicle and renewables revolution

The transition to renewable energy and electrification of everything is accelerating rapidly as the world works to decarbonise and address climate change.

However, this transformational change in how we produce and use energy is not without challenges. While the electrification of household appliances is relatively straightforward, the transition from petrol- and diesel-powered cars to EVs will require a rapid reimagining of fuelling and grid infrastructure and energy storage.

The European Union seeks to ban the sale of non-electric cars by 2035, while the UK has a more aggressive target of 2030, and Norway will be the first to enforce a ban in 2025. To achieve these goals, the deployment of electric vehicle (EV) charging infrastructure will need to dramatically accelerate, which will have significant implications for the grid that will power it.

The UK is struggling to keep pace in EV adoption following a string of problems with charging points. There are [~664,000 EVs on the UK's roads and currently 17.8 EVs per available charger. Of those chargers, only a sixth are 'rapid' or 'ultra-rapid'](#), with slower versions requiring between three and eight hours to charge one vehicle which leads to queues, unreliable charging access and ultimately creating headwinds to EV adoption. This is illustrated by [recent downgrades in 2023 UK EV sales projections](#).

This loss of momentum may pose challenges for the UK's climate and air quality goals. To stay on track, investment in infrastructure and technology will be essential to improve charging, encourage consumer confidence, and boost EV uptake while ensuring enough clean energy to power the transport revolution.



Alan Greenshields
Director of Europe, ESS Inc

Recharging the electric vehicle fleet

A major challenge to expanding EV charging is the availability of grid capacity to recharge the EV fleet. As the vehicle fleet electrifies, the grid will need to supply the entirety of the energy provided by petrol and diesel today. Studies have shown that the transition to EVs will [result in a 25% increase](#) in electricity demand over current levels by 2040.

Meeting this challenge with thermal or nuclear power would be challenging enough. Phasing out these conventional energy sources and replacing them with renewable energy adds an additional layer of complexity: the intermittency of wind and solar. Meeting the needs of a much larger, fully renewable grid will require new long-duration energy storage technologies and infrastructure to deliver cost-effective clean energy to drivers and consumers when needed.

The impacts of decentralised renewable generation on the grid

Today's grid was designed for large, centralised generating stations and relatively predictable residential and light commercial energy loads. However, as the energy mix shifts to decentralised renewable generation



and EV charging increases, demand and shifts consumption patterns in residential and light commercial settings, outdated grid infrastructure will need to adapt.

Currently, access to adequate grid capacity is a critical constraint in the deployment of EV charging infrastructure. Ultimately, the UK must rely on sophisticated energy solutions to overcome the increased peak demand, voltage instability and reduced reserve margins caused by mass EV charging.

Energy storage technologies for distribution

New energy storage technologies can bridge the gap and reinforce local distribution networks to support peak demand caused by EV charging. These technologies provide long-duration energy storage, with four to 24 hours of storage capacity. By charging during periods of low demand and discharging to power EV charging infrastructure during periods of high demand, these systems supplement local distribution capacity to meet demand. And new technologies are now commercially available that are safe for siting even in populated areas, and that can be manufactured using commonly available materials, unlike incumbent lithium-ion batteries.

By deploying these technologies as 'buffers' at EV charging stations, surges in demand by drivers charging

can be smoothed, reducing strain on the grid. This is all without adding capacity, as existing infrastructure can meet charging needs during periods of otherwise low demand.

Examples of this use case in operation already exist. For instance, Amsterdam's Schiphol airport is deploying an ESS iron flow battery system to support the charging of a fleet of smaller battery trucks which will replace diesel generators that currently provide power to planes on the ground.

The promise of new energy technologies is exciting. Today we have the tools to decarbonise and transition to a sustainable, electrified future rapidly. Now we need to pick them up and work to meet net-zero targets, improve energy network resilience, reduce environmental impacts and create long-term benefits for years to come.

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LEVI FUNDING – WHAT DOES THIS MEAN FOR YOUR LOCAL AUTHORITY?

£380.8m has been promised for the Local Electric Vehicle Infrastructure Fund or LEVI fund in an effort to push transport towards net zero through the expansion of EV charging infrastructure

On 30 March 2023, the Department for Transport (DfT) announced they were launching a further £380.8m for the LEVI fund.

This fund supports local authorities in England to work with the charge point industry in the roll out of electric vehicle infrastructure – a major player in reducing our adverse effects on climate change.

The funding has been broken down into two parts:

1. Capital Fund

A £343m Capital Fund has been allocated to contribute towards the cost of installing electric vehicle charging points. This includes, charging hardware, electrical connections and civil engineering costs.

The energy saving trust website states that the capital fund aims to:

Deliver a step-change in the deployment of local, primarily low power, on-street charging infrastructure across England

Accelerate the commercialisation of, and investment in, the local charging infrastructure sector.

A breakdown for your local authority region capital funding allocation can be found [here](#).

2. Capability Fund

A further £37.8m Capability Fund has been made available to help support the resources needed to build an electric vehicle charging strategy - a programme to deliver it and finally maintain it.

With the government's ambition to achieve a target of 300,000 public electric vehicle charge points by 2030, the funding is welcomed news to support local authorities as they look to roll out electric vehicle charging infrastructure.

VolkerSmart Technologies has been supporting the rollout of electric vehicle charge points (EVCPs) since 2017. Since then, VolkerSmart Technologies has established itself as a market leader and have installed over 5,000 EVCPs.

As a contractor, rather than a charge point operator (CPO), they have a unique view of the market, whereby working with various partners and local authorities to install a range of EVCPs. This provides clients with an independent view on what charging point is right for your local authority, location and budget.

On your journey to rolling out electric vehicle charging, there are some challenges to consider along the way. We have picked out the ones we give our clients the most advice on:

Charging infrastructure and financial models

In principle there are three financial models to consider. Deciding which financial model is right for you depends on your initial budget, the amount of ownership you would like over the charging infrastructure and revenue you would like to generate.

- **Publicly owned** – The local authority has full ownership of the charging hardware and electrical assets. This gives the authority the highest potential revenue share, which is generated from the usage of the EVCPs. However, this is the costliest to deliver.
- **Concession** – part public and part privately funded. Typically, the local authority will contribute towards the capital costs (which can be the LEVI fund), with a CPO providing the remainder. In this instance, any revenue from vehicle charging will be split, as agreed, between the two parties.
- **Fully funded** - fully funded by the CPO, including the hardware and installation costs. The CPO would take the main share of any revenue from vehicle charging and the assets would remain the CPO's property.

On-street and off-street locations for EV charging

As part of the local authority's electric vehicle strategy, we typically see the project separated into two main

categories: on-street and off-street. In general, most EV charging is done at home, overnight, so an understanding of how many of your residents rely upon on-street parking is essential.

Residents who live in more rural areas will also need consideration. This is because the demand for electric vehicle charging in rural areas is typically lower, making it less appealing for private investment.

Charging point product selection and LEVI fund requirements

There are four main charging speeds: slow, fast, rapid and ultra-rapid. LEVI funding is primarily intended to support slower-speed charge points.

Slower speed charge points have an output between 3kW-6kW and are best suited for home charging.

There are various options available to best support on-street home charging. This can include lamp column chargers, wall or pedal stool mounted and unique flat and flush solutions.

Fast charger output ranges between 7kW-22kW and are normally labelled as 'destination chargers.' These are typically installed for off-street parking and can be found in car parks, retail estates and supermarkets.

Rapid chargers and beyond have an output of 43kW. The majority of rapid chargers would be found at service stations/public rest stops, and for everyday car users, you will typically find an output between 43kW – 150kW.

Rapid chargers are still eligible for LEVI funding, but it is expected that LEVI funding supports slower home-based charging.

The need for continued maintenance for an EV charging network

It is essential that the EV charging network is reliable. The user experience is an important part of the journey, and maintenance of your EVCPs forms part of that journey. A Service Level Agreement (SLA) should be considered to keep charger downtime to a minimum.

SLA's can be tailored to meet your needs and range from planned services to reactive maintenance. Using the charge point software, many faults can be diagnosed remotely, so disruption can be kept to a minimum, with an engineer only required to attend site to carry out the repairs.

Who are VolkerSmart Technologies?

VolkerSmart Technologies is part of leading integrated highway services provider, VolkerHighways. We've been delivering a range of highway infrastructure solutions, in live and complex locations, for over 50 years.

We're part of VolkerWessels UK – a group with a turnover in excess of £1bn, which brings together five business units to collaborate across multidisciplinary projects across the UK. This means we have the financial stability and strength to give our clients complete confidence in an emerging industry.

VolkerSmart Technologies work with premium manufacturers and specialists to bring our clients the latest technology, best value for money and optimal, high-quality installations. Whether you require a full turnkey solution or bespoke service, we can support you on your EV infrastructure journey.

This includes:

- Project management
- Providing detailed electrical design
- Supplying site surveys securing you the best solution to meet your needs
- The installation of hardware and equipment
- Managing the interface with local authorities and other impacted parties, e.g. power network operators
- The installation of civils works, including reinstatement, surfacing, bay markings and traffic management, when required
- Being a certified independent connections provider – connecting directly onto the local power network, improving efficiencies and securing on-time delivery
- Providing a full aftercare package including servicing, planned and reactive maintenance of installations.

For more information, please email business.development@volkerhighways.co.uk

 **VolkerHighways**

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WORKING TOWARDS A FUTURE OF ZERO-EMISSION FLEETS

Robert Austin, Sector Lead for UK Power Networks Services, discusses the challenges of zero-emission fleets, including balancing a resilient energy supply, meeting capacity requirements and sustainability pressures



Image: © SouthWorks | iStock

As the UK government works towards zero-emission fleets with both cars and vans by 2050, and a new petrol and diesel car ban in 2030, logistics companies and fleet operators face increasing pressure to move towards electric vehicles.

When running zero-emission fleets of electric vehicles, reliable and resilient charging is essential to avoid the risk of vehicle downtime and charging should not affect other on-site equipment and operations.

Logistics companies and fleet operators must plan their electric vehicle adoption to ensure it is future proofed. They will eventually reduce the costs of operating their fleets.

An expert in distributed energy solutions

UK Power Networks Services is an expert in distributed energy solutions and power distribution, delivering energy technology consulting, asset financing, major project delivery, design and build, operations and maintenance, and asset management.



Robert Austin

Our business is uniquely placed to support the development of your electric vehicle strategy or your transition from fossil-based technology towards the electrification of your entire fleet.

That includes optimising your existing assets, integrating electric vehicle

charging infrastructure and delivering commercial benefits. We provide an end-to-end integrated solution, from initial feasibility studies to design, build, smart operation, and ongoing maintenance.

Our world-class engineers serve industries such as airports, rail, defence, water, logistics and zero-emission fleets, manufacturing, ports, local and central government, and commercial buildings – exposing us to the broadest range of different operational environments.

Our high-profile public and private sector clients with critical infrastructure in complex environments, trust us to deliver safe, reliable and innovative energy solutions - allowing them to concentrate on their core business.

We have a proud 50-year history, and our current portfolio includes a number of the UK's major airports, High Speed 1, Network Rail, London Underground, Docklands Light Railway, EDF (Hinkley Point C), Ministry of Defence, Felixstowe Port, UPS and Canary Wharf.

EV chargers for Yorkshire Water

UK Power Network Services has recently been appointed to install up to 1,000 EV chargers for Yorkshire Water. We will install an integrated operations, maintenance, and management solution for hundreds of chargers over the next five years as the water provider pivots towards zero-emission fleets.

We are a vendor agnostic CPO (Charge Point Operator). This allows us to select the most appropriate hardware and software by leveraging our supply chain frameworks to tailor end-to-end solutions to individual clients' requirements like Yorkshire Water.

Our experts will install chargers at Yorkshire Water employees' homes and the utilities' sites across its areas. The system will bring together all aspects of EV charging, including installation, operation, maintenance, and management: making it simple and efficient for the utility to continue its ambitious sustainability plans.

Staff drivers can charge at home, at work, on the go, and public chargers. Fleet managers can access a centralised digital platform of their zero-emission fleets to monitor and manage operations. UK Power Networks Services will also provide a 24/7 support line for all drivers and a team of experts to proactively maintain the chargers.

Achieving the carbon net zero target by 2030

The move forms part of Yorkshire Water's carbon net zero target by 2030. Among a range of initiatives over the next ten years, the company plans to install renewables, lower overall energy use, and switch its entire fleet of vans and cars to electric by 2030.

We are committed to assisting Yorkshire Water to achieve its sustainability targets. We often receive enquiries asking how a large vehicle

fleet can electrify in a matter of years. This project proves that with strong collaborative partnerships, the right strategy and expertise – "it can be done."

It's, therefore, fitting to leave the last word Nicola Shaw, CEO at Yorkshire Water, who says: "We have committed to achieving net zero operational emissions by 2030, and part of that ambition includes transitioning all our vehicles to zero or ultra-low emissions.

Working with UK Power Networks Services to develop the supporting infrastructure for all our light commercial vehicles to be electric-powered is an important step to making that a reality. It will allow our teams to use electric vehicles to their full potential."⁽¹⁾

Reference

1. <https://www.yorkshirewater.com/news-media/news-articles/2023/yorkshire-water-invests-in-electric-vehicle-in-frastrucure/>



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MAKING EV CHARGING INFRASTRUCTURE AND EV UPTAKE EASIER FOR LOCAL AUTHORITIES

With over 30 years of experience in developing smart electronic solutions, EZ-Charge explains how it is supporting a seamless uptake of electric vehicles by working with local authorities to offer user-friendly and reliable EV charging infrastructure

Image: © nrqemi | iStock

With local authorities across the UK busy developing their electric vehicle (EV) infrastructure strategies, EZ-Charge is uniquely qualified to offer expert insight and support. As the largest charge point operator in Oxfordshire, with 250 charge points across 20 council car park charging hubs, there is not much we do not know about installing and running an ultra-reliable public EV charging infrastructure.

Partnership with Oxfordshire County Council and its four districts

Our partnership with Oxfordshire County Council and its four districts – Cherwell, South Oxfordshire, West Oxfordshire, and the Vale of the White Horse – is now seen as an exemplar of how the public and private sectors can work in unison to create EV infrastructure that works perfectly for the residents and businesses of any community, as well as visitors to it.

This award-winning project, [Park & Charge Oxfordshire](#), has formed a vital part of the Oxfordshire Electric Vehicle Infrastructure Strategy and has played a significant role in Oxfordshire leading the nation in electric vehicle uptake, with EVs making up a higher proportion of new car registrations in the county than anywhere else in the UK.

Our project was voted Public Sector Infrastructure Strategy of the Year

Best of all, the project, which was named Public Sector Infrastructure Strategy of the Year at the 2022 Electric Vehicle Innovation & Excellence Awards. This gives EZ-Charge an unparalleled ability to accurately inform other local authority-led EV infrastructure projects currently in the planning stages.

Rob Newbould, Sales Manager of EZ-Charge, explains: 'When we started planning for Park & Charge Oxfordshire

a couple of years ago, we made a deliberate decision with our partners to democratise the network as best we could.

'In reality, that meant that we did not just want to install chargers in the county's biggest and most populated towns but also in smaller market towns and villages.

This fitted perfectly with the overarching vision of the project, which was to accelerate the adoption of electric vehicles in the county by providing EV charging infrastructure for those without access to off-street parking.

'With that in mind, we configured a network of 20 charging hubs, all located in council-owned and operated car parks. Each car park has between a dozen and 16 dual 22kW AC charge points installed.

'As an aside, these chargers were designed by EZ-Charge and manufactured at our headquarters in Bicester, Oxfordshire, with funding from Innovate UK.'

While the democratic design of the Park & Charge Oxfordshire network and the roll-out of private sector EV charging infrastructure means some hubs have been better utilised than others, the project has indeed been an enormous success.

The EV charging infrastructure has delivered in excess of 702,238 kWh of electricity

To date, the network has delivered in excess of 702,238 kWh of electricity – enough to power more than 2.17 million pure electric vehicle miles and saved an estimated 600 tonnes of CO₂ equivalent from being emitted into the atmosphere. In addition, although all our charge points can be activated via contactless payment and without membership, over 3,700 people have now signed up for the purpose-built app to access additional user benefits.

But the project's success can also be measured in more human terms through the customer feedback received through sites like the industry-leading Zap-Map. Recent comments have included, '*Great charging experience. Very straightforward and easy-to-use; 12 chargers all working. Why can't all car parks be like this one?*' and '*The best non-Tesla charging network.*'

As if all that was not enough proof of the scheme's success, the fact that a number of hubs are already nearing full capacity at peak times is further testament. So, what is the secret to the project's success?

'Well, if I had to single out one factor that's made Park & Charge Oxfordshire so successful, it would have to be reliability', said Rob. 'Our 22kW EZ-Charge AC charger is ultra-reliable and has lots of clever technology built-in, including fans for hot weather, heaters for cold weather, and self-diagnostics that ensure they're fully operational more than 99% of the time.'

'From speaking to customers and watching our utilisation data very closely, we have been able to watch the volume of charges grow steadily as EV drivers have not only learnt where our sites are but come to appreciate that there will almost always be a charge point available and, importantly, that it will be working every time.'

EZ-Charge works with local authorities to deliver bespoke EV charging infrastructure networks

You may be asking yourself how this can be applied to help other local authorities develop EV infrastructure solutions for their own conurbations and communities. Rob explained: 'At EZ-Charge, we specialise in working with local authorities to develop bespoke EV charging infrastructure networks, drawing on all our experience and insights. Importantly, our record of working in synergy with public sector partners means we understand the unique set of challenges councils face and the goals they are working towards.'

'Our approach is always to sit down with commissioning organisations and plan solutions to suit the demographics and requirements of the area. Crucially, each step in this process is fully informed by the real-world data we continue to generate from our fully operational hubs.'

'We can, for example, help councils identify the right locations for chargers and use all the tools and state-of-the-art analytics at our disposal to calculate the correct ratio of off-street to on-street infrastructure.'

'We are also mindful that some locations where communities and or individuals want to see charge points may not be commercially viable in the short term. In these instances, our goal is to find a solution that uses the revenue from more commercially viable sites to support the delivery for those that are less viable, but socially critical.'

'Given its importance to the overall picture, we are also perfectly placed to support local authorities in receipt of LEVI funding to deploy infrastructure in the best possible way.'

Rob added: 'We'd be delighted to hear from any local authority looking into EV charging, no matter how limited or extensive the scale of their ambition.'



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ACCELERATING EV CHARGING FACILITIES AND INFRASTRUCTURE ROLL-OUT

Perran Moon, CEO of electric vehicle charging network provider Believ, tells us how local authorities can overcome common hurdles when implementing EV charging facilities in their local areas

Local authorities are an integral part of the government's plans to provide 11 million households in the UK with public EV charging facilities by 2030. It is a complex, challenging task that must be delivered at pace. With the resources of most local authorities already stretched, how can they overcome some of the challenges they face and provide a charging network which their local community will love?

Integrating an EV network into a wider sustainable local transport system, which is accessible to everyone and has the right charging speeds in the right locations, requires funding, planning and expertise. Yet, when surveyed, only 14% of local authorities had dedicated EV infrastructure resources; they had no individual accountable for project delivery and needed additional expert resource and support.

To overcome these challenges, several local authorities such as Croydon, Hammersmith and Fulham, Wandsworth and West and North Northamptonshire Councils have successfully partnered with charge point operators (CPOs) like Believ, who have in-house planning, delivery and operational expertise and specialise in deploying charge point infrastructure at zero cost to local authorities and businesses.

Developing the right strategy for EV charging facilities

Local authorities can use the experience and expertise of CPOs to

help develop the implementation strategy and overcome obstacles in the planning phase. From the outset, stakeholders from procurement, legal, engineering, public highways, and parking teams within the local authority should be aligned with a unifying vision for the EV charging facilities.

Expectations must be managed, decisions governed, and everything delivered promptly. The scale and complexity of the project may lead to some pushback from various departments, which will need careful management. An experienced third party can offer and negotiate solutions to any objections that might be raised.

The key to success within the organisation is to focus the team on the future benefits for everyone involved, including local businesses and the general public. Externally, the key is consultation. Residents may be opposed to installing charge points along their roads and outside their homes simply because they misunderstand EVs and charging infrastructure.

Through public consultation, a familiar process for local authorities, residents are given the opportunity to question, clarify and correct any concerns or potential misconceptions they may have.

CPOs who have previously worked with local councils to install EV infrastructure can provide advice on working with a network of internal and external stakeholders and help gain support for

the implementation plan. Some local authorities use third-party consultancies, but they can be more costly.

On the other hand, a CPO's planning team of experienced and highly skilled professionals can create bespoke EV infrastructure plans for each town and city across the country more cost-effectively. Whether there is a need for ten or a thousand slow and/or ultra-rapid charge points, an experienced CPO like Believ can work with local councils, communities, and customers to deliver the right strategy and ensure all charging needs are met.

Choosing the right charging speed in the right location

The decision of where to locate each EV charge point in the network needs to be strategically intelligent, data-driven and benefits from using a Geographical Information System (GIS) data to assess current and future demand. Such data helps to identify and assess a location's suitability for charge points, the optimal charging speeds, the commercial viability, and social inclusion of each site.

This type of data-driven approach to the planning process can help local councils take a long-term portfolio approach to implementing EV charging facilities. Believ will, for example, package more and less commercially viable sites, including e-mobility or car-club hubs plans, into a single concession. This approach provides good coverage and equitable access

to chargers for all local residents, including those living in deprived areas or those where the installation cost can be disproportionately high. It means no one in the local community is left behind.

Believ uses this approach to plan the delivery of a highly accessible, reliable EV charging facilities at scale and at pace. Its trusted delivery partner, Virgin Media O2, works on local infrastructure projects throughout the UK and can deliver the network with minimal disruption to local communities.

Finding funding for EV charging facilities

Building infrastructure, of course, requires funding. It can be challenging to balance timely delivery with applying for and gaining funding from the LEVI fund. It can take two years from the initial LEVI application to receipt of funds, and the administrative burden is significant, with no guarantee of success.

To make best use of the time between application and funding availability, experimental Traffic Regulation Orders (TROs) or Traffic Management Orders (TMOs) in London and trials can be adopted. Such orders allow local authorities to understand the most suitable CPO solution long before funding is available. The infrastructure design and roll-out plan can be refined using the data collected during such trials. It may also be used to build the business case for capital investment during the second phase of the LEVI application.

During the LEVI application process, a CPO's procurement team can use their expertise to help the local authority build a financial case for the local infrastructure by offering revenue generation schemes. This can provide long-term revenues for the local

authority through profits. It also means shared liabilities and administration for the future network.

Another alternative is for the CPO to take complete ownership and fund the project at zero cost to the local authority. All future liabilities, administration and maintenance of the EV network remain with the operator.

Local authorities may also choose to work with CPO, which offers a fully funded model. This reduces the administrative burden for the local authority, and with the confidence of having funding available, the team can continue with the roll-out programme quickly. Believ offers private funding to build scalable EV charging facilities at zero cost to the taxpayer and local authorities.

Futureproofing the EV charging network

Once the funding and operating model have been decided, the local authority may award the contract(s) directly or start a tender process to find the right long-term partner. To avoid long-term structural challenges in any relationship, each party's financial and public liability responsibilities must be clearly defined. For example, if the charger is faulty or there is a trip hazard at the site, where does the CPO's liability begin and the local authority's end? Knowing if all the right questions have been asked and how to answer them isn't easy. A CPO like Believ can advise on the 'dos and don'ts' of developing tenders based on their experience working with local authorities.

During the tender process, the local authority can ask the CPO about their capabilities in delivering the infrastructure and a long-term maintenance programme. Using

multiple charge points, each providing different charging speeds, can become complicated if there are multiple contracts and maintenance schedules to manage or oversee. Believ is a one-stop-shop CPO offering all charging speeds from slow to ultra-rapid, simplifying procuring and maintaining the infrastructure hardware.

The local authority should ask about the reliability of any existing EV networks they have installed. Believ, for example, provides an annual service, offers 24/7 emergency assistance, and dispatches engineers rapidly when something isn't right. That results in a 98% uptime record for its EV charging facilities. A CPO interested in a long-term relationship with the local authority should have similar processes in place to ensure their chargers are 'always on' so their use is optimised and local residents are happy with the service.

Designing and implementing local public EV charging facilities is a daunting task. But local authorities don't have to face that challenge on their own. The experience and expertise of CPOs like Believ can be invaluable. They have resources and expertise to help deliver accessible, sustainable transport at pace to ensure cleaner air for all.



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DEBUNKING ELECTRIC VEHICLE MYTHS: WHY EVs ARE THE FUTURE OF TRANSPORT

Olivia Serrage, Group Marketing Manager at evec, looks to the future of transport, explaining why sustainability will be better achieved with the adoption of electric vehicles

As advocates for sustainable transport, we firmly believe that electric vehicles (EVs) are the future of transport, and the way forward in the fight against climate change and air pollution.

Despite the [growing popularity of EVs](#), there are still prevalent myths that hinder their widespread adoption. Our mission is to dispel these myths and misconceptions through evidence-based facts.

Myth: Electric vehicles have limited charging infrastructure available

In the United Kingdom, the government has taken significant steps to improve the charging infrastructure to make EV charging more accessible across the country. As outlined in a report by [Edie \(2023\)](#), the UK government has set out a comprehensive plan to make smart EV charging the norm.

Last year, there were [8,700](#) public EV chargers installed, with plans to install a further [127,000](#) by 2025. Furthermore, the plan also emphasises the use of smart technologies to optimise the charging process, enabling better management of energy demand and grid integration in the future of transport.

The UK's commitment to expanding the charging infrastructure is evident through various initiatives and partnerships. For instance, the government's [Electric Vehicle Homecharge Scheme](#) provides grants to support the installation of domestic

EV charging points, making it easier for individuals to charge their EVs at home.

Additionally, collaborations with private companies and organisations have resulted in the establishment of extensive charging networks, including fast-charging stations at popular public locations such as shopping centres, service stations and car parks.

Myth: Electric vehicles strain the electrical grid

Fact: The transition to EVs can be effectively managed by the electrical grid. As the adoption of EVs increases, so does the deployment of renewable energy sources and grid optimisation technologies. In fact, according to the [International Energy Agency \(2021\)](#), the electricity demand from EVs can be met without significant infrastructure upgrades in most countries.

[National Grid](#), the UK's electricity system operator, is actively involved in the transition to a greener future. They are implementing various measures to ensure the grid can handle the rising demand for electricity from EVs and accommodate for new innovation for the future of transport.

As more EVs are charged, there is a greater need for clean energy to power them. National Grid is working towards increasing the share of renewable energy in the overall electricity generation mix. By expanding the capacity of wind, solar, and other renewable sources, they can meet the

growing demand for electricity without relying heavily on fossil fuel-based power plants.

The road ahead: Embracing the electric revolution

The myths surrounding EVs are being debunked, revealing the future of transport where EVs play a crucial role in combating climate change and creating a sustainable transport system.

With their environmental benefits, supported by research showing reduced greenhouse gas emissions, even when accounting for electricity generation, EVs have emerged as a viable and sustainable transport option.

The positive trajectory of EVs, coupled with the National Grid's preparedness for increased demand, presents a significant opportunity to embrace the electric revolution and build a greener and more efficient future for generations to come.



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Promoting green travel with sustainable aviation fuel

Sarah Wilkin, Founder & CEO of Fly Green Alliance (FGA), looks at how the airline industry is working to reduce its carbon footprint through the use of sustainable aviation fuel

Photo by Ivan Shimko on Unsplash



The airline industry being grounded is now just one of the biggest challenges aviation has faced since the first commercial flight in 1914.

Climate action and carbon reduction of an industry responsible for 3% of global CO₂ and using [95 billion gallons of aviation fuel per year \(2019\)](#) is an enormous challenge to handle.

However, it is a challenge that is now being met head-on. Every sizeable and commercial airline across the globe is carrying out action to reduce its footprint.

Governments and the airlines themselves are working to produce and procure sustainable aviation fuel (SAF). What could be called the 'golden bullet.'

The Jet Zero Council

In the UK, the Jet Zero Council, established in 2020, is moving the industry forward with grants, strategies and public-private partnerships in a bid to start the flow of investment into the nascent industry.

COP26, held in Glasgow in 2021, brought a group together, including BA, Heathrow, Department for Transport and fuel producers, to pilot an approach to SAF use for delegates to be used and replicated at major event level, work that Fly Green Alliance was involved with.

Last year, five projects were granted in the UK through JZC with the plan to be online by 2025 in a bid to reduce carbon in the industry by 2050. Aviation won't meet 2030 targets, but a start to carbon reduction and tech development is underway. It has been for ten years already, with greater acceleration within the last few years.

Granted projects include: LanzaTech, alfanar, Velocys x2, and Fulcrum BioEnergy ⁽¹⁾ Each plant will cut CO₂ emissions by 200,000 tonnes on average every year ⁽²⁾ when fully operational – equivalent to taking away 100,000 cars from the road.

Supporting sustainable aviation fuel

Public-private partnerships, such as through the Jet Zero

Council, begin to demonstrate to investors that the government is supporting SAF.

Although the investment of £165 million is relatively small compared to what is needed to scale the industry, billions are required. It is now moving from an investment and policy perspective across the EU, UK and U.S.; and testing production issues at scale is underway.

Tim Alderslade, Chief Executive of Airlines UK, said: “The jet zero strategy was a real statement of intent from government that aviation, without the carbon, is an achievable end goal by 2050.

“This £165 million of funding – alongside the 10% SAF mandate by 2030 shows the government shares our ambition of a home-grown SAF industry here in the UK.

“This could generate tens of thousands of jobs and huge GVA, levelling up and exports potential for the UK. It’s a big prize and one we are committed to working with ministers to achieve.”⁽³⁾

Sustainable aviation fuel can lower emissions by up to 80% on the lifecycle. What we are discussing here is a hydrocarbon-based fuel for combustion engines. Molecule-for-molecule, the renewable or alternative fuel will match jet fuel and be certified safe to fly on by ASTM.⁽⁴⁾

Synthetic fuel developments

The Federal Aviation Administration (FAA) in the U.S. first started to test synthetic fuel developments when fuel security was a risk in 2006-09 when it was thought that petroleum reserves would run out. It was discovered that it is indeed possible to manufacture fuel from waste and hydrocarbons already within the system.

We now have an immediate need to reduce fossil fuels being taken out of the ground, and we already have abundant material. Producers, scientists and innovators are currently working on shifting the need and burden on fossil-based oil to above-ground readily available material.

As Will Walsh, Director General of the International Air Transport Association (IATA), succinctly put it: “You’re recycling the CO₂ – that’s what it’s about, reducing or maintaining or not increasing the levels of CO₂.”⁽⁵⁾

eFuels, which can also use carbon from the air and green hydrogen, does exist, and some projects are coming online soon, but the economics are still a challenge, and the scales of the economy need to improve quickly.

Can the planet handle carbon safely?

Yale⁽⁶⁾ scientists discuss that the planet can safely handle around 1 trillion tonnes of carbon. Since 1860, we have used 500 billion tonnes. As we now use 50 billion per year, we have about ten years to reduce CO₂ emissions and switch our energy supplies.

Even in 1923, scientist JBS Haldane stated to be making sense for the planet, our [energy system](#) should be hydrogen and renewables.

People and society are said to be able to reduce carbon by 27% - (BBC Sounds - Rethink Climate), meaning the industry needs to handle the rest.⁽⁷⁾

Promoting green travel

Fly Green Alliance, amongst other pioneers, have been working to promote green travel, low-carbon fuels, sustainable travel policies; and developing products, financial mechanisms and further application of Science Based Targets. Work is ongoing, but a tipping point was reached on SAF post-pandemic.

Sustainability is a competitive advantage in aviation, with most attention going to sustainable aviation fuel. Are you ready to pay to fly green?

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AVIATION POLICY: EUROPE & THE UK FOCUS

European Commission Executive Vice-President (EVP) Frans Timmermans ⁽¹⁾ at FESTA Sustainable Tourism Summit Albania stressed the need to reduce the carbon footprint of travel. “We need to work with the airline industry to reduce their carbon footprint, to develop new fuels, to develop new airplanes, we’re working on that as much as we can,” he explained to the audience. ⁽²⁾

In April, the Commission heralded the ReFuelEU Aviation proposal to help decarbonise the aviation sector. As such, fuel suppliers must blend sustainable aviation fuels (SAF) with kerosene in more significant amounts starting in 2025. EVP Timmermans commented on the action projected to reduce aircraft CO₂ emissions by roughly two-thirds before 2050.

“The EU is setting all sectors on a pathway to climate neutrality, with the measures necessary to meet our 2030 and 2050 climate targets. We have now taken another important step towards reducing emissions in the aviation sector. Fuel suppliers at EU airports must provide an increasing share of sustainable aviation fuels and aircraft operators increase their use. The EU is ready for take-off towards a more sustainable future for aviation.” ⁽³⁾

In the UK, Transport Secretary Mark Harper commented on cleaner aviation fuel as part of a transport decarbonisation package to increase the UK’s net zero endeavours. “From expanding our charging network to boosting the production of cleaner aviation fuel”, the announcement on 30 March 2023 “is a great stride forwards, offering people more choice on how to stay connected while delivering the carbon reductions needed to achieve net zero.” ⁽⁴⁾

In May, we heard that the UK and U.S. will collaborate to speed up SAF development, combat climate change and harness the scope of the SAF industry for economic growth. ⁽⁵⁾

The Jet Zero Council 2-year plan ⁽⁶⁾ will help to speed up SAF production, evidence that the UK Government will work with the aviation industry in various ways, including “helping accelerate new technology and fuels”, as the Transport Secretary puts it. ⁽⁷⁾

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Applying data in real-time to global shipping operations

Dom Couldwell, Head of Field Engineering EMA at DataStax, charts the role of data in global shipping operations, which we discover improves the real world in real-time

Shipping is responsible for 90% of all transportation for goods and products worldwide – without global shipping operations, economies cannot function effectively.

The most recent International Maritime Organization (IMO) [report](#) found that shipping represents 2.89% of all greenhouse gas emissions, and went up by 9.6% in two years. The continued growth in emission volumes will threaten the global shipping sector's ability to meet its net zero targets by 2050, as emissions are predicted to grow by between 90% and 130% of 2008 emission levels.

To reduce shipping emissions, we have to improve the performance of individual vessels, develop more energy-efficient fuels, and refine trade routing in global shipping operations. To achieve this, we need more data. The IMO now [requires](#) all ships to track their energy efficiency using the Energy Efficiency Existing Ship Index (EEXI) to measure their energy efficiency and report their annual operational carbon intensity indicator (CII) and CII rating. But we need to apply this data in real-time scenarios as well.

The economic benefit of global shipping operations

Alongside the environmental impact of these decisions, there is a direct economic benefit. According to the Maersk McKinney Møller Center for Zero Carbon Shipping, [international and domestic shipping uses about 300 million tonnes of fuel per year to power vessels](#).

Reducing fuel consumption by 1% per year – equivalent to 8% by 2030 – would reduce fuel usage by 24 million tonnes overall. Not only would this provide a significant reduction in global shipping operations emissions, but it also represents a huge cost saving for ship operators. Starting early is also more cost-effective. The Clean Shipping Coalition [suggests](#) that the cost of decarbonisation is \$100 billion per year, so embracing change earlier would free up budgets in future.

Picking the right options around shipping can therefore deliver on both cost and emissions. But where can you make those improvements?

Finding the right approach to global shipping operations

There are several areas where data can be used to improve performance and reduce costs.

The first of these is around fuel optimisation. When you have to transport goods, you will have different options available to you. Should you pick the next available ship to get something done quickly, or should you plan ahead for more efficiency?

Looking at the products themselves, you can make the right decision on which vessel to charter based on delivery timescales, routing and fuel costs.

Each of these elements can impact how cost-effective it is for a given journey. At the same time, real-world changes can also affect how efficient a journey is in reality compared to the anticipated cost. For example, weather conditions may change, affecting the route that a vessel has to take, leading to increased fuel consumption and a change in profitability.

While weather forecast data can be used in prediction models and help guide your choice, you will also have to look at real-time recommendations to the ship captain and the commercial team involved so that potential savings and efficiencies can be delivered in the real world.

The role of vessel hull efficiency

Similarly, looking at vessel hull efficiency in global shipping operations can make a huge difference. Vessels should sail at a given speed and fuel efficiency level, but this can be affected by how clean the hull is as well as how efficient the propeller is at driving a ship forward.

The [ISO standard 19030](#) measures changes in hull and propeller performance, helping ship operators understand the impact that their decisions have on overall efficiency.

According to Jotun Marine, tracking hull efficiency and responding faster to requirements can account for a reduction of 10% of the world fleet's energy costs, equivalent to around \$30 billion in spending plus the associated greenhouse gas emissions. Getting real-time data can flag when improvements are needed.

Predictive maintenance to prevent waste in global shipping operations

Lastly, looking at more predictive maintenance can maintain efficiency and prevent waste. By using techniques such as machine learning and artificial intelligence, ship operators can identify potential anomalies in components within their vessels and detect potential failure early. This allows them to replace components before any equipment breakdowns, preventing waste.

Similarly, using data from components over time enables you to adopt condition-based maintenance approaches and ensure that all equipment is used based on its remaining useful lifespan, delivering greater sustainability. By keeping ships running at peak performance levels and avoiding downtime due to component failure, ship operators can use real-time data to avoid breakdowns, minimise their fuel use and contribute to decarbonising the entire maritime industry. At the same time, it avoids unnecessary costs and improves sustainability.

Real-time data & demonstrating accountability

All these measures rely on data from sensors within ships that can monitor performance and provide alerts where things are not working effectively. At the same time, all ships will run different systems so this data will have to be normalised. Once this step is taken, ship operators can get a like-for-like overview of performance before they make the decision on any particular journey.

For ship owners, this data can provide a comparison against other vessels and flag any areas where

performance is lacking. By ensuring that operators and owners can understand the wider picture for ship efficiency, they can all make improvements and reduce costs.

This industry move relies on real-time data to function effectively. For example, [Alpha Ori used real-time data from 260 ships and saved 137,000 tonnes of CO₂](#), equivalent to about 44,000 tonnes of fuel in one year. Without this insight, it is impossible to make the right decisions when they must be made.

Ship operators will have to demonstrate their EEXI and CII levels and how they continue to make their vessels more efficient. Equally, this data has to be available when it is needed during voyages, as this ensures that decisions are made based on current situations rather than on abstract ideas or predictions that are no longer accurate.

As global shipping operations aim to meet net zero targets, data will continue to be essential to that goal.

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SECTION

ENVIRONMENT







Feeding the world: A productive and sustainable fishing industry

Phil Haslam, Managing Director of North Atlantic Fishing Company (NAFCO), walks us through feeding the world through a productive and sustainable fishing industry

Fishing is a cornerstone of countless communities nationwide, providing employment opportunities and economic stability. The sustainable seafood sector and the sustainable fishing industry will not only be critical to more significant economic growth in the UK and beyond but are also fundamental to promoting and achieving global food security.

As the government urges all food producers to minimise their emissions on the road to UK net-zero by 2050, fishing will play a crucial role in providing a sustainable, lower-carbon food source. Central to this will be dispelling the myth that the fishing industry is inherently damaging to the environment: a sustainable fishing industry exists.

The development of the sustainable fishing industry

Hunger is one of the world's most pressing issues and has been on the rise since 2014. The COVID-19 pandemic further exacerbated this – in 2020, between [720 million](#) and [811 million](#) people experienced hunger, around 161 million more than in 2019.

Food insecurity is the third-largest global emergency we face. In 2020, [2.4 billion people](#) were classified as either moderately or severely food insecure, an increase of almost 320 million from the previous year.

The United Nations Sustainable Development Goal Number Two is to '[end hunger, achieve food security and improved nutrition and promote sustainable agriculture](#)'. Many of the world's population already depends on fish as their main source of healthy animal protein, and pelagic fish in particular, are a sustainable food source. Pelagic fish are found in the ocean's mid-water column, away from the seabed and far out at sea.

Catching them is cost-effective, given it can be done at scale, with food immediately frozen in factories onboard ships; they are low in cholesterol and packed with essential nutrients such as iron, riboflavin, calcium, and healthy long-chain omega-3 fatty acids.

As the world population grows, so does the demand for affordable, high-protein food. Currently, the global population sits at 7.9 billion, which the UN predicts will climb to 8.5 billion by 2023 and 11 billion by 2100. Meeting the food demands of this population undoubtedly requires fish, both wild-caught and from aquaculture.

Put simply, fishing is imperative if we want to feed the world. However, fulfilling these needs depends on the sector's ability to adapt and prove its sustainability credentials. Furthermore, we must communicate that fishing is predominantly conducted responsibly within a strict regulatory regime and is sustainable; it represents a

key solution to our global food sourcing and security issues.

So, what steps are we taking – both as a country and globally – to ensure a productive, sustainable fishing sector?

Climate and biodiversity is a core tenet of a thriving, sustainable fishing industry

Sustainability is a core tenet of a thriving fishing sector, keeping bycatch to a minimum and helping to conserve marine biodiversity. At the same time, meeting the demands of an ever-growing population will require marine food production to be scaled up.

Industry-led moves towards more sustainable fishing will be essential if we are to feed the ten billion-strong population expected by 2050.

Currently, 82.5% of wild-captured fish is sourced from sustainable stocks (which account for 66% of total stocks worldwide). With more people expected to be sourcing food from the oceans to support global food security, we must build on this sustainability while increasing output to meet demand.

Research and innovation are critical in understanding and addressing the environmental impact of fishing. For example, the pelagic fishing sector invests heavily to ensure that all catches are scientifically analysed, assessing operations and catch quality. The information gathered is widely circulated among the scientific community, which helps government-led fisheries management to make better decisions informing regulation and policy.

International cooperation – between nations, fisheries and supranational bodies – will also be vital if we wish to realise sustainable yet plentiful fishing stocks. This cooperation must consist of agreements, policing waters for illegal fishing and collaboration between fisheries and national governments to produce fisheries management policies.

Within this, Fisheries must account for continual investment in innovations such as modern fishing equipment, greener fuels and propulsion technologies.

UK fisheries management for sustainability goals

With the established global context, we can turn to what the UK specifically does to promote sustainable fishing.

The UK Fisheries Act of 2020 laid out eight objectives, which all UK fisheries must adhere to: sustainability, precaution, ecosystem, scientific evidence, bycatch, equal access, national benefit, and climate change.

These objectives are the foundation of the UK's new fisheries strategy. By combining the latest innovations with a strong drive to protect marine life, they serve as a blueprint to ensure productive and sustainable fishing in UK waters.

Fisheries management policies provide essential regulation of fishing stocks, maintaining a steady supply of fish to global communities that need it. These policies are continually updated through research and innovation to preserve marine biodiversity and prevent overfishing.

UK government funding for the Fisheries and Seafood Scheme

The UK government has pledged up to £100 million for the Fisheries and Seafood scheme to help fund new developments in catching, processing and aquaculture. Namely, it aims to:

- Create a more sustainable and resilient sector.
- Boost the demand for English seafood in new markets.
- Improve participation through co-design and co-management.
- Achieve good environmental status through conserving and restoring the marine environment.
- Support net-zero through reducing emissions within the industry.

With the ambition of meeting sustainability goals, this scheme includes funding for marine conservation – protecting habitats and ecosystems and encouraging

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OCEAN POLICY IN EUROPE SPOTLIGHT

In our April 2023 edition of Open Access Government, Charlina Vitcheva, Director-General, DG MARE, European Commission, described a holistic approach to the sustainable use of ocean resources, thriving coastal communities and a profitable fishing sector. Improving and preserving our ocean is essential for coastal communities and our future. “At the European Commission, we work to keep Europe’s and the world’s oceans and seas clean, healthy, and productive,” Vitcheva explained. ⁽¹⁾

It’s also essential to remember maritime security, which is crucial for the EU and the Member States within. The Commission adopted a [Joint Communication on an enhanced EU Maritime Security Strategy](#) in March 2023 to protect the maritime domain from new threats and ensure “a peaceful use of the seas”. The Commission underlines that “the global maritime domain must be secure to unlock the full potential of the oceans and the sustainable blue economy”.

Commissioner Virginijus Sinkevičius stressed we should not underestimate the strategic importance of oceans in Europe: “The maritime dimension is key to the EU’s strategic autonomy, as the prosperity of the European Union and its Member States depends on a safe and secure ocean. The updated Maritime Security Strategy will better protect our citizens and promote our blue economy activities and our interests at sea.

We will tackle the impacts of climate change and environmental degradation on maritime security, strengthen maritime surveillance tools, enhance our defences against cyber and hybrid threats, and reinforce the protection of critical maritime infrastructure.” ⁽²⁾

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further biodiversity. Vibrant, healthy ecosystems do not just ensure sustainable fishing stocks but also work to safeguard the well-being of other marine life.

This pledge from the government is particularly important given that the fishing industry provides clear economic benefits and employment opportunities to coastal communities around the UK, many of which depend on the sector. Well-managed fisheries will be essential to the viability of these opportunities, ensuring fishing communities’ success in the long term.

Sustainable stocks and communities

As a cost-effective foodstuff packed with nutrients, we cannot feed the world without fish. It is a part of the solution - not the problem - when it comes to the sustainability of food supply.

Increasing consumption is inevitable as the global population grows, but it must be done sustainably. We must also recognise the value of fish in the fight against hunger and its potential to provide nourishment for generations. Therefore, international investment in research and innovation within the sector will be essential.

The UK government’s commitment outlined here will go a long way towards ensuring more sustainable fishing stocks and practices. In addition to protecting marine life, the investment will also stimulate economic growth, providing much-needed opportunities to fishing communities across the country.

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THE FISH-X PROJECT: SUPPORTING EU SMALL-SCALE FISHERIES GOING DIGITAL

The implementation of innovative data management and data collection tools will help support the sustainable development of EU fisheries; learn how the Fish-X project will support this digital transition of small-scale fisheries



The Farm-to-Fork Strategy and the Common Fisheries Policy, aligned with the European Green Deal, aim to ensure sustainable and healthy fisheries. Within these frameworks, advancing digitalisation can enable more sustainable management.

Small-scale fisheries (SSF) play a crucial role in the EU fisheries sector, accounting for approx. 75% of the active fishing vessels and approx. 48% of employment ([Lopes, 2022](#)).

Implementing digital tools designed for SSF holds the promise of tackling some of the most pressing challenges. Hence, data obtained from SSF vessels through digital tools like electronic logbooks and vessel monitoring systems can enhance safety at sea, improve compliance, promote sustainable and transparent practices, as well as increase visibility and economic returns for fishers.

The importance of sustainable fishing is emphasised by Šime Barić, a small-scale fisher from Croatia: "It's

not rocket science; I want fishing to become sustainable because I'm not only looking that I'm able to fish during my lifetime, I want my kids to be able to fish after I'm gone. New technologies offer a glimmer of hope for the future of fishing, but true progress towards long-term sustainability requires not just innovation but also a commitment to responsible management and conservation practices that protect the health of our seas for generations to come."

The successful implementation of digital tools to empower SSF depends on collaborative action and co-management. This requires incentivising fishers to collect and share data and enabling key stakeholders (e.g., maritime authorities) to access and utilise this information.

The Fish-X Platform: Digitally monitoring sustainable fishing

Focusing on SSF, the EU co-funded project [Fish-X](#) (06/22-05/25) will identify

opportunities and bottlenecks in the digitalisation of EU fisheries. Further, the [consortium](#) will develop the framework for an open, secure and interoperable digital platform integrating three main elements that will be designed following the [Gaia-X](#) framework to ensure data sovereignty and security: i) the Fish-X Dataspace, ii) the Insight Platform, and iii) the Traceability Platform.

- **The Fish-X Dataspace** will facilitate effective access to fisheries data from SSF vessels. Following a consultative approach, stakeholders like fishers, control and monitoring authorities, institutions, and industry will be enabled to share and receive data, thus eliminating data silos and deciding on data accessibility for third-party consumers. The goal is to prioritise fishers in the seafood supply chain, promote transparency, and foster accurate data exchange.

- **The Insight Platform** will serve as the user interface of the Fish-X Dataspace

while complementing national monitoring systems for fisheries administration and previous efforts (research projects etc.). In addition, a dedicated portal with some free data and simple maps related to fishing activities, such as fish stock status, level of exploitation, and responsible practices, will be made publicly accessible.

- **The Traceability Platform** will enable transparent and comprehensive mapping of a seafood product from harvest to sale. Utilising blockchain technology, documented data will remain accurate, safe, and unalterable. In addition, a traceability app will allow consumers to scan a product to access the documented information, thus enabling informed purchasing decisions and improved economic returns for responsible fishers.

It is important to note that Fish-X will not replace existing monitoring and control systems but rather propose a complementary option for the collection, AI-supported analysis and sharing of fisheries data, able to cover the high numbers of SSF vessels within the EU.

Continuous information gathering

The development of the Fish-X Platform will be accompanied by continuous stakeholder engagement and event [series](#) (e.g., webinars and expert working groups) to gather relevant insights regarding the requirements, needs and barriers for the digital transition of fisheries. Additional information will be generated by conducting three practical use cases testing the three platform components, one each on the Atlantic, Mediterranean, Baltic and/or Northern Sea coast. Within these use cases, digital technologies (e.g., tracking, digital logbooks, fishing effort

analysis) will be applied to validate scalable approaches to improve the sustainability of fisheries, the digital skills in this industry and the existing control and inspection mechanisms, as well as to reduce IUU fishing.

EU fisheries roadmap for digitalisation

Gathered insights will also be used to develop a strategic roadmap that provides solution-oriented recommendations for a just digital transition. In December 2022, the Fish-X consortium published its [preliminary EU Fisheries Roadmap for Digitalisation 2030](#), which maps out required actions for the four identified key areas: i) governance and policy, ii) data collection and traceability, iii) digital infrastructure and equipment, and iv) EU fisheries skills, behaviours and practices. The final roadmap, to be published in spring 2025, will be a targeted effort by maritime authorities, EU fisheries and communities to harness existing and emerging knowledge, tools and practices for the sector's sustainable development. In addition, it will propose the necessary steps for effectively engaging EU fisheries and relevant stakeholders in the digital transformation process by 2030.

What does the future hold for the sustainability of the fishery industry

EU policies and regulations, as well as practices in the fisheries industry clearly show that digitalisation is crucial for the effective and sustainable management of fisheries. Some of the most impactful benefits are improved data management, multi-stakeholder cooperation, and enhanced monitoring, control, and traceability.

The Fish-X project is vital in the EU roadmap 2030 for the digital transition of EU fisheries and the Farm-To-Fork

Strategy by prioritising fishers within the seafood supply chain.

The Fish-X consortium actively collaborates with relevant stakeholders to address these key challenges:

- Electronic catch reporting and control using reliable and cost-efficient tools designed for SSF;
- Demonstration of the added value of these electronic tools for fishers, especially for SSF (traceability, safety, access to environmental data, access to certification); and
- Engagement with key sectors (i.e., public, private, science, and civil society) to take advantage of more accessible fisheries and seafood datasets.

You can support the project as a promotional partner and/or by sharing your insights and best practices to empower EU SSF in its digital transition towards a more sustainable future.

Disclaimer

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FOOD WEBS AND FISH: OCEAN CLIMATE CHANGE IN ALASKA

Open Access Government talks to ocean climate expert Dr. Robert Suryan, who is the lead of an ecosystem studies program at the Alaska Fisheries Science Center's [Auke Bay Laboratories](#)

Dr. Suryan, who is also the science lead for [Gulf Watch Alaska Long-term Ecosystem Research and Monitoring program](#), focuses on understanding population and community dynamics in response to changing food availability and ocean climate in Juneau, Alaska.

His specific research topics and research methodologies include food web and trophic ecology using diet and stable isotope analyses, predator foraging ecology using individual-based

tracking integrated with prey and habitat data, and environmental change effects on fish health and survival using lipid, energy, and morphological measures to assess overall body condition.

His research collectively contributes to understanding effects of changing climate on ecosystems, ecosystem-based fisheries management, and conservation of protected species such as marine birds and mammals.

What would you say is the biggest challenge facing Alaska fisheries and the fishing industry?

Fisheries in Alaska are very dynamic, and I expect that you would obtain different answers from each fishing sector or participant that you ask. From my perspective as a marine ecologist, I would suggest that adapting to extreme events associated with climate change is the most challenging. Long-term changes from climate change can

have major impacts, but there is time to plan for those.

However, shorter-term climate extremes causing fluctuations in abundance and age, or size structure of fish populations pose a major challenge to the fishing industry, managers, and scientists. For fisheries managers, it is extremely challenging to anticipate ocean climate changes and estimate harvest limits when conditions affecting fish survival and abundance change rapidly and are outside the range of previous observations.

For fisheries scientists, it is a race to collect information and identify mechanisms of change to estimate future outcomes and inform fisheries managers and industry in their decision-making process. Recent examples of these occurrences in Alaska include the rapid declines of Pacific cod in the Gulf of Alaska and snow crab in the Bering Sea.

How do fish contribute to the overall balance of marine ecosystems by influencing other animals in the food chain?

There are many ways that fish can influence other animals in the food chain, and in terms of balance, the primary two are top-down and bottom-up processes. A top-down process is when one species of fish at a higher level in the food chain reduces the abundance - primarily, but not exclusively, through consumption - of another species of fish lower in the food chain. In contrast, bottom-up control is when a fish species affects the abundance of other fish species higher in the food chain.

For forage fish in the middle of the food web, if the abundance of one species declines without a corresponding increase in another forage fish species of similar quality (energetic value), then a "bottleneck" is created, restricting energy flow to species higher in the food chain. We observed this during the 2014-2016 Pacific marine heatwave in the Gulf of Alaska where large-scale marine bird and whale mortality events ("die-offs") occurred along with observations of "skinny whales", emaciated individuals and females with low reproductive rates.

There are also lateral effects, for example, when the decline of one forage fish species causes predators to increase consumption of another fish species to balance energy budgets in the system. If predators switch from preying on a non-commercially important species to one that is commercially important, this can cause immediate or future (if young fish are target) reductions of commercially important fish species. Or if the alternate prey item is of lesser nutritional value, the health or abundance of the predator population, including many commercially harvested species could be reduced.

How do changes in fish populations, such as overfishing or declining numbers due to environmental factors, affect the entire food chain and the survival of other animal species dependent on them?

Food chain interactions are very complicated, carrying with it an unknown number of potential interactions and outcomes. The examples that I described about

top-down and bottom-up processes are two of the most prominent, and if prolonged can lead to regime shifts, where one species, or similar group of species (a "guild") becomes abundant over time.

For example, the balance of the system shifting from more abundant mid-food-chain forage fishes and crustaceans such as herring, shrimp, and crab to large predatory fish such as pollock, cod, and halibut. Large-scale regime changes often occur due to environmental changes, but can be influenced in combination with fishing pressure.

"For fisheries scientists, it is a race to collect information and identify mechanisms of change to estimate future outcomes and inform fisheries managers and industry in their decision-making process."

To address these questions, we use computer models relying on a wide variety of observational data as inputs, some of the most valuable data coming from long time series. Given the many possible interactions and outcomes, we have to focus on the major pathways of interaction with species of interest.

Much like weather forecasting that has greatly improved (though we still complain!) with modern computing power, improved computer models, and greatly expanded real-time data collection from weather stations and satellites, our ecosystem models benefit from the same advances.

One major difference however is that biological data are more challenging

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logistically to collect and inherently more difficult to interpret than purely physical data inputs for weather system modelling.

Even so, the effects of ocean climate changes on fish populations and the impacts up and down the food chain, like I described during recent heatwaves, provide a stress test for understanding interactions and calibrating ecosystem models for improved forecasting when similar or more extreme conditions are expected to be encountered in the future.

One of our primary limitations is the relatively short duration of our biological data collection relative to long-term climate cycles and we often

lack a baseline for the rapidly changing conditions that we are currently experiencing.

How is ocean climate change influencing the size and growth patterns of fish populations?

Fish are ectothermic, meaning their internal body temperature is regulated by external water temperatures. As waters warm, their bodies warm, their metabolism increases, and they must increase food consumption to compensate for this increased energy demand. The opposite is true when ocean waters cool, and in fact this is a key strategy for overwinter survival of many marine ectotherms from zooplankton to fish, that is seek cold

waters at depth to slow metabolism over winter when food is scarce.

The temperature range that each fish species can tolerate also varies, and when thermal thresholds are reached, growth and survival decline. The warming ocean climate is particularly challenging for cold-adapted species as energy demand increases, yet if food is scarce or of low energetic value, body condition could suffer and result in reduced survival.

How is ocean climate change altering the availability and abundance of key food sources for fish?

Compared to warm oceans, cold oceans tend to have a lower diversity of

species but a greater abundance of the fewer species present. Furthermore, abundant prey species in the cold ocean waters contain the highest lipid reserves which greatly increases foraging efficiency – energy acquired per unit time and effort – of consumers and predators.

This is one important reason why many species migrate to high latitudes or productive coastal upwelling regions to feed during productive spring and summer periods.

Warming or other effects of changing climate alters the species composition and abundance of prey species in the middle of the food chain, which in turn can decrease the carrying capacity for fish species higher in the food chain that rely on those prey. An example of this in Alaska is the decline of four key prey species (herring, capelin, sand lance, and krill) during recent climate-driven heatwaves.

This left fewer and less efficient energy pathways to species higher in the food chain, thereby reducing carrying capacity for many species and resulting in large mortality events and declines in the abundance of many fish, bird, and mammal species.

In what ways is ocean climate change impacting the dietary preferences and feeding habits of fish species, and how does this affect their interactions with other organisms in the food chain?

Two primary ways that diets are affected by climate relate to energy allocation and prey switching. Energy allocation is a combination of acquisition, storage, and use. In colder oceans, especially in high latitudes and

arctic regions, animals throughout the food chain, from zooplankton to whales, produce or accumulate lipids to store energy for future use when food is less plentiful or absent.

As water temperatures warm in the ocean, nutrients and other essential ingredients for building lipid energy stores are reduced. In the case of zooplankton, species that grow and reproduce faster without accumulating energy tend to be favoured in warm conditions.

Fish can switch to these alternative prey species and even jellyfish for some species, but these prey contain fewer of the essential nutrient and lipids. This is particularly challenging for fish during relatively rapid ocean climate change and extreme events that we are experiencing. For example, during an extended warm spring and summer season, an ectothermic fish is obligated to grow at the expense of accumulating lipid stores for winter. If a typical or extremely cold winter follows, the fish does not have enough stored energy to survive, even though winter might be shorter and ultimately leading to population-level changes.

What does this mean for the ecological role of fish within aquatic ecosystems? What does this mean for humans?

Collectively, this means that marine ecosystems are changing in concert with the same changing weather patterns that humans are experiencing. Fish species more tolerant of warm water are expanding their range into higher latitude regions, while cold water adapted species are more restricted in where they can move and are contracting their ranges. Changing ocean climate temperatures and

associated oxygen levels are also changing food web energy pathways, resulting in large algal blooms (some toxic) or jellyfish populations that have few consumers and become energy dead ends.

This effectively reduces the amount of energy passing through the middle of the food chain and reduces the abundance of some animals at the top, which includes many species harvested commercially or for subsistence by humans. Current efforts include helping ocean-dependent businesses and communities become more resilient by preparing for and adapting to these changes. This is not the first-time fisheries-dependent communities have had to adapt, but the changes anticipated from the current climate change are far greater and occurring faster than recent history and collective memories.



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Sustainable & equitable futures through placemaking

Maria Adebowale-Schwarte, CEO of Foundation for Future London, analyses and promotes sustainable and equitable futures through placemaking

With the climate crisis worsening, governments worldwide must take a more sustainable approach to urban planning. This is particularly important for lower-income communities, who can feel the effects of climate change harder.

In the context of climate change and rapid regeneration, placemaking is a powerful tool for promoting sustainability in urban communities, encouraging residents to actively become involved in and have agency over how their communities change. Sustainable placemaking should focus on providing and making green spaces accessible to all and ensuring communities are safe and inclusive – strengthening the creation of sustainable futures in the fight against climate change.

Climate change affects lower-income communities

Impacts of climate change

The effects of climate change on lower-income communities are substantial. Many communities are already being squeezed by cost-of-living pressures, and climate-related issues, such as frozen pipes, worsen this. For example, in London, one in every ten households is in fuel poverty and choosing to eat or heat their homes can be a daily decision.

These communities suffer the fallout of extreme weather events the most – they tend to live in areas more vulnerable to floods, droughts, and extreme heat. Lower-income communities also suffer from higher



Maria Adebowale-Schwarte
CEO

pollution levels in their water, air and soil and tend to have poor access to nature and recreational spaces. Many areas, such as East London, also have large swaths of derelict industrial plants that are now being regenerated.

The physical threat posed to people's homes, local infrastructure and community facilities by climate change is also higher – many residents do not have home insurance.

These communities then have higher rates of disease owing to air and water pollution in the area, which is especially worrying for more vulnerable groups such as children, the elderly, those with pre-existing conditions and people of colour.

Access to green space

A lack of available green space can also impact the well-being of communities. For example, in London, 35% of those from lower socioeconomic backgrounds visit green spaces [less than once a month](#), and this is linked to a lack of green space in poorer areas. But even when available, this space is often limited, and lower-income families can typically only access around six yards per person – the size of the goal area on a football pitch.

Combining all this with a lack of access to quality healthcare leads to a marked decline in mental and physical health – lives can be cut short by as much as a decade in these postcodes.

While climate change is on many Londoners' minds, over a third (37%) of respondents to a [London Council survey](#) said a green heating alternative is too expensive. A further 16% reported that low-carbon alternatives to gas heating were also out of their reach. As a result, many boroughs are calling for the government to allocate more funding to projects by delivering £98 billion on retrofitting to make London's homes more energy efficient and the £3.8 billion Social Housing Decarbonisation Fund.

Crucially, securing a more equitable, sustainable future for London will require effort from sectors across the capital.

Placemaking: Sustainable & fairer futures

Placemaking is a participatory approach to the planning, design and management of public spaces, harnessing the ideas and assets of local communities to create areas that are inclusive to and representative of them.

Placemaking projects focus on inclusive public places and cultural spaces that support progressive shifts: from genuinely affordable housing for low-income households to public parks, areas and buildings where people meet, create thought-provoking culture, explore heritage, and champion diversity and innovation.

By inviting individuals to co-design, develop and create their local spaces, placemaking supports sustainable development that is accessible to everyone whilst also promoting environmental benefits and community well-being.

Environmental sustainability

A major driver of sustainable development in local communities is placemaking, which promotes environmental sustainability by encouraging community projects that centre around reconnecting with nature and designing inclusive green spaces and sustainable facilities.

For example, placemaking supported the creation of "in-between spaces" in Waltham Forest. As part of the project, students and other community members collaborated to design new, green walking paths to fight back against the effects of air pollution on residents.

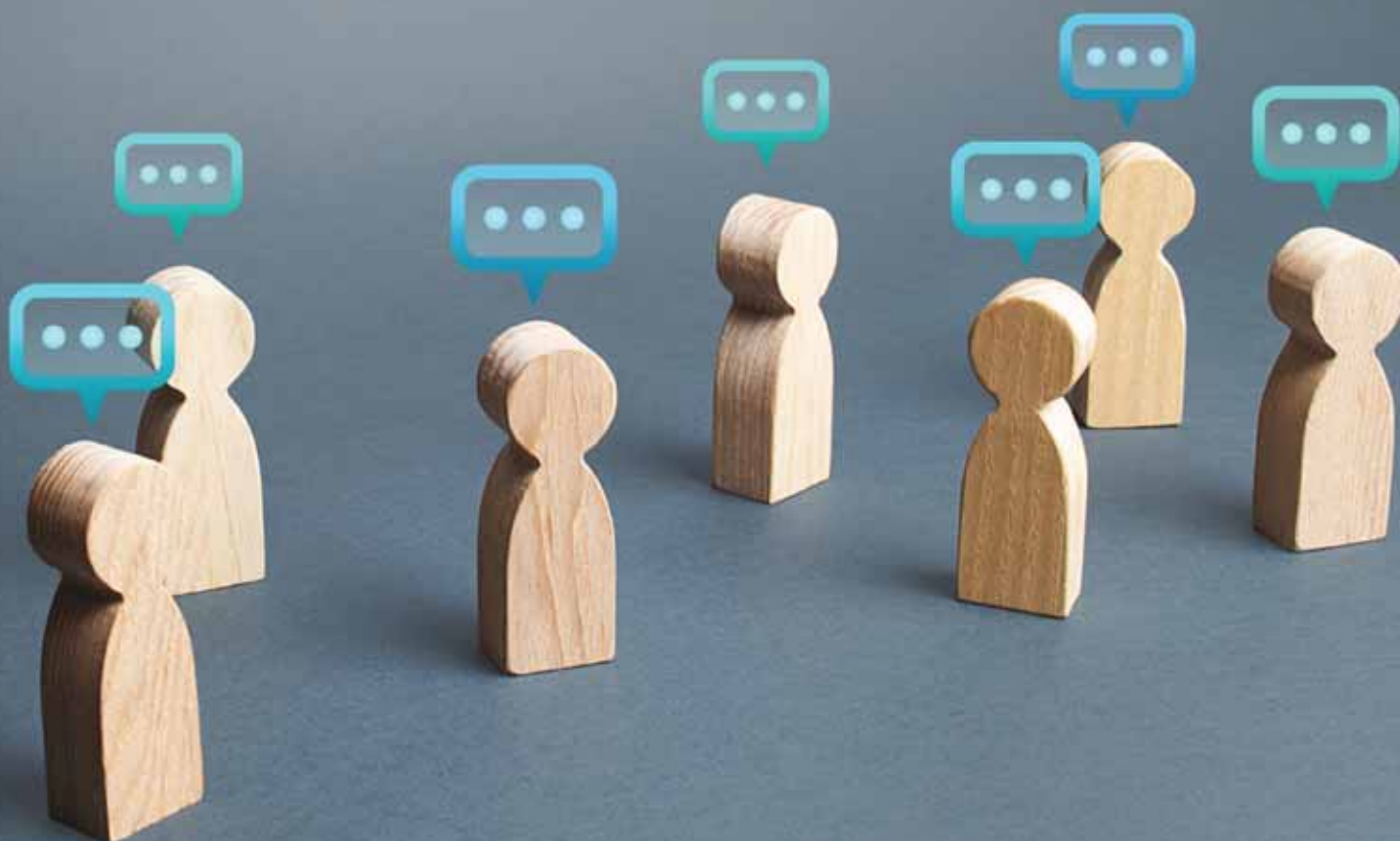
Another recent Hackney project funded by Foundation for Future London saw a collaboration between an architect, estate residents and local authorities to turn urban spaces, such as a disused car park, into vertical farms for fruit and vegetables to grow.

These collaborative projects crucially take a co-design approach to placemaking, enabling residents to reconnect with their surroundings with fellow community

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members and work towards a collective goal – an inviting, inclusive green space.

Significantly, adding parks, green roofs, stormwater infrastructure and greenways should be at the heart of any placemaking strategy. In addition, urban greening can benefit lower-income communities by enabling them to offset the effects of climate change in ways that reflect their community.

Therefore, working to strengthen the green economy through community-led projects in these areas will empower them with tools to combat the effects of the climate crisis better and become natural agents of change in their communities.

Physical & mental well-being

Urban greening is not just beneficial from a climate point-of-view. People living near parks and other green spaces display fewer psychological concerns and are more active.

Generally, when an area is greener and walkable, its residents have more space to share and meet as a healthier community. The £250 million Greenwich Square regeneration project – delivering communal gardens and a piazza, is an excellent example of how collective mental anxiety can be alleviated by connecting communities to nature.

Having these green places also puts an area back in touch with itself. Because people will be more inclined to spend time outside, they will be more likely to connect with other residents, build trust and share their thoughts on life in the community. The result is a happier, more social and, importantly, stronger community.

Broader socioeconomic issues

Placemaking addresses wider socioeconomic issues in communities

Placemaking enables projects that bring the community together to address socioeconomic issues. It allows creatives, businesses, and social enterprises to flourish, as development is centred around the local community and contributes to arts and culture.

Through placemaking, community-led projects that

support urban redevelopment can bolster employment and spur innovation at a local level, crucially helping tackle socioeconomic inequalities.

In Waltham Forest, for example, local people have been raising funds to purchase solar panels. These panels will then be used to power the community centre to help alleviate the damage of soaring energy costs – including the homes of those most affected.

Other projects centred around green space to fight against food poverty and social justice includes the Waltham Forest-based “Green Forest Gate,” which features Loop Labs and Forest Gate Community Garden. (WEBCFF 2022).

From supporting initiatives that focus on providing clean air technology and sustainable energy sources to projects looking at localised food systems, placemaking brings about sustainability that also boosts the social and economic vitality of the community.

Creating sustainable futures for all

Placemaking makes communities more resilient and inclusive, supporting them by creating urban sustainability that is accessible to everyone. Therefore, placemaking helps communities combat climate change at its source and rejuvenate the area as a social organ – turning it from a “postcode” into a community.

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THE TOXICOLOGICAL IMPLICATIONS OF E-WASTE

Here, Donald A. Bruun and Pamela J. Lein discuss the toxicological implications of e-waste and how to address this global problem

The planet's increasing thirst for technology comes at a significant cost: the global problem of electronic waste or e-waste. E-waste is any product containing electronic components that has reached the end of its usable life cycle. In 2019, the world discarded an estimated 53.6 million tonnes of e-waste, a volume expected to double in the next 15 years. The United Nations estimates less than 17.4% of e-waste is recycled, so most ends up in landfills.

Unbeknownst to many consumers, electronics contain over 1,000 chemicals considered hazardous to human health, and the consequences of improper e-waste disposal pose serious threats to human health and the stability of ecosystems.

The Basel Convention

The Basel Convention, an international treaty designed to reduce the movement of hazardous waste between countries, began addressing e-waste in 2002. Current action items include preventing the illegal trafficking of e-waste to developing countries and building environmentally sound capacity around the globe to better manage e-waste. Unfortunately, e-waste regulations are largely unenforced, particularly at the local level.

In the United States, which did not participate in the Basel Convention,

e-waste currently constitutes 2-3% of the U.S. municipal solid waste stream, yet it represents almost 70% of the toxic waste stream. For example, the average cathode ray tube (CRT) computer screen contains at least five to eight pounds of lead, representing 40% of all lead in U.S. landfills. Researchers at Carnegie Mellon University estimate there are 70 million computers in U.S. landfills, indicating a significant missed opportunity for recycling CRTs.

Disposal of e-waste

Improper disposal of e-waste in regular landfills or illegal dumping of e-waste has resulted in the leaching of flame retardants and heavy metals, such as mercury, lithium, lead and barium, into the soil and groundwater. These contaminants eventually enter ponds, streams, rivers and lakes, a process that is accelerated by acidic water (e.g., from acid rain, industrial and consumer waste), which increases the leachability of heavy metals. When mercury is combined with anaerobic decaying organic waste, it generates methylmercury, a more toxic form of the metal. Burning e-waste can generate dioxins, furans, polycyclic aromatic hydrocarbons (PAHs), polyhalogenated aromatic hydrocarbons (PHAHs) and hydrogen chloride, some of which are carcinogenic, all of which are toxic. Thus, animals, plants, and communities - even those miles away from a recycling site - may be exposed.

Many consumers in developed countries conscientiously recycle their e-waste, but are unaware that it may be shipped miles away to be processed at unregulated or "informal" recycling centres in developing countries. A study by the watchdog group Basel Action Network found that 40% of the e-waste supposedly recycled in the U.S. was actually exported. Most of it ended up in developing countries - usually in Asia and Africa - where recycling is typically unlicensed and unregulated. Two of the largest informal recycling centres in the world are in the Guiyu area, China and Agbogbloshie in the heart of Accra, Ghana, both considered to be among the most polluted places on Earth.

Recycling centres in developing countries

Studies of recycling centres in developing countries have found elevated levels of hazardous metals and organic compounds in the soil, water, and air of surrounding communities, and in the blood, urine and hair of not only e-waste workers, but also people who reside or work close to e-waste recycling sites. Men, women and children who recover valuable materials at unregulated recycling sites often dismantle devices by hand to reclaim materials of value. Devices are often burned to melt away non-valuable materials, while mercury and acids are used to recover gold. Typically, workers are not aware they

are handling hazardous materials and so do not wear protective equipment. Individuals engaged in “cottage” recycling within the home have no protection at all. These attempts to earn a living wage often result in early death.

The problem of e-waste toxicity

Exposure to the harmful chemicals present in e-waste can occur by inhalation, skin absorption, or ingestion. Inhaling toxic chemicals or direct contact with hazardous e-waste materials (even in some formal e-waste recycling settings) is associated with increased incidence of spontaneous abortions, stillbirths, premature births, reduced birth weights, mutations, congenital malformations, abnormal thyroid function, decreased lung function and neurobehavioral disturbances.

To address the growing worldwide problem of e-waste toxicity, manufacturers need to prioritise the easy disassembly of electronics rather than exacerbate the problem. For example, Apple computers now have the battery glued in with no removable components. Regulations that are in place need to be better enforced. There are powerful incentives to develop and enforce more effective approaches for recycling e-waste. It is estimated that \$60 million in gold and silver enter the U.S. e-waste stream every year from discarded phones and precious metals in circuit boards are more concentrated than in the most productive mines. In 2016, the gold in the world’s e-waste equalled more than a tenth of the gold mined globally that year. Although valuable metals and rare-earth elements are scarce and some,



like cobalt, are found mostly in conflict zones, much of this treasure is currently being buried in landfills.

These factors – coupled with the increasingly efficient and eco-friendly methods for extracting metals from e-waste – are compelling tech manufacturers to investigate obtaining raw materials from their own end-of-life products rather than from the Earth. Many new processes for recovery of the precious metals from e-waste, such as crushing electronic materials and separation by sieving or chemical means are coming online. To reduce toxic dust created by these processes, some groups are exploring nanotube technology and others are looking at sound waves to break components into smaller sizes. In the Swedish town of Skellefteå, local smelters are using automated technologies to smelt 88,000 tonnes of e-waste per year. Another company in Belgium claims it obtained 95% useful products from e-waste.

Minimise the toxicological impacts of e-waste

As the world demand for electronics increases, we must develop responsible legislation to increase the use of new recycling technologies to minimise the toxicological impacts of our growing e-waste.

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A sustainable government for a sustainable economic policy

Claire Benson, Founder and Director at SDG Changemakers, argues that implementing a sustainable economic policy intervention requires a sustainable government

Climate change is taking its toll on every aspect of our living environment. Not only is inaction exacerbating inequalities and pushing millions into poverty, but according to [research from Deloitte](#), climate change will cost the global economy a staggering \$178 trillion over the next 50 years.

Businesses and organisations must play their part in acting against climate change. However, market forces alone cannot solve this problem.

Strong leadership from the government to cull inaction is crucial.

Many governments, such as the UK, have set targets, such as 'reaching net zero by 2050' and meeting the 17 Sustainable Development Goals (SDGs), per the Paris climate agreement.

But more still needs to be done.

Achieving the SDGs is imperative to counteract the consequences of historic climate change inaction. If approached with total commitment, they can transform society.

But, unfortunately, the second '[Measuring Up](#)' report from the UN Global Compact Network UK reveals scant progress has been made.

We must go beyond simply addressing generic concepts such as 'net zero' or 'economic recovery' and tackle poverty, economic growth, education, and inequality.

We need speed and direction to make meaningful progress. This requires national leadership that aligns these separate but interconnected issues.

So, how can governments begin the journey?



A clear action plan for sustainable economic policy interventions

Sustainable economic policy interventions can boost investor confidence and send the right market signals.

And while there have been several targeted strategies to reform the energy system, decarbonise industry and transport, and improve housing and heating, money talks.

According to a [review](#) of G20 fiscal stimulus spending, the UK performed poorly, with only 10% going toward reducing emissions.

There have been missed opportunities. 'Levelling Up' and 'Build Back Better' would have been natural partners for sustainable policies.

Yet, 'green' was missing in action.

It's not to say that these plans didn't have admirable goals, nor that they won't impact the SDGs. But the connection isn't explicit, leading to a policy and strategy environment lacking the focus and cohesion to tackle each goal collectively.

For example, last year, the UK government [reviewed its net zero policies](#) to "ensure delivery of legally-binding climate goals are pro-growth and pro-business".

According to the [European Parliament](#), not only may the revised policies cause delays, but its support for fracking and increasing North Sea oil and gas production caused alarm.

It's an oversight of green investment's ability to impact growth and business. Due to our lack of vision, we are headed in the wrong direction.

Local and national governments must provide detailed sector-specific action plans in collaboration with industry.

Climate goals may conflict with policies, so a holistic plan – or “systems thinking” approach – is imperative to align the efforts of all government departments because any change can have unintended consequences.

For example, selling farmland for forestry can hugely impact rural communities and the commodities they produce.

Facing economic pressures

It's worth noting that the government is under substantial pressure.

As the public purse is stretched, green investments and private-sector climate plans can fall behind when more desperate measures are needed.

Some of this pressure is potentially seen in the greenlighting of the coal mine in my home county, Cumbria. Coal contributes substantially to GDP and employment.

As such, it is a simple solution to mobilising more deprived areas by making them more productive.

However, the steel industry is looking for alternative fuel sources. The mine will likely become obsolete, leaving residents and employees no better off. Regions need jobs that have a future.

A climate-positive Cumbria has the potential to employ across industries and sectors, resulting in a more resilient working environment.

A report by local organisation [Cumbria Action for Sustainability \(CAfS\)](#) calculates that around 9,000 jobs could be created during the 15-year transition period

toward the county reaching net zero (Cumbria aims to be the first carbon-neutral county in the UK by 2037).

However, the government must recognise that communities may need help with higher fuel prices and costly conversions during the transition process.

Diversifying the economy in regions that risk losing jobs or livelihoods and providing green employment opportunities will be essential.

To enact this, we must relinquish control of short-term, carbon-intensive industries and anticipate demand for new know-how plus skills for delivering green initiatives.

An investment in funding and a national plan for green skills can identify which skills are needed, where to locate green jobs, and how to invest in education and retraining to diversify the economy, ensuring that costs and benefits are more fairly distributed.

Although it would cost more initially, it would boost productivity. There's a reason it's [forecast](#) that a successful ecological transition could increase global revenues by up to \$43 trillion.

Incentivising people & industry to live sustainably

Changing behaviour or consumption choices have been difficult due to a lack of understanding.

According to [Kantar's Sustainability Sector Index 2022](#), beyond affordability, a lack of knowledge about sustainable alternatives is the main barrier preventing people from living sustainably.

People need to be educated about the effects of their lifestyle choices to make more sustainable consumption and behaviour choices – such as investing ethically, driving electric vehicles, retrofitting homes, or changing diets.

Furthermore, [research](#) shows that people will change their lives if they see it as part of a broader national effort to reduce emissions.

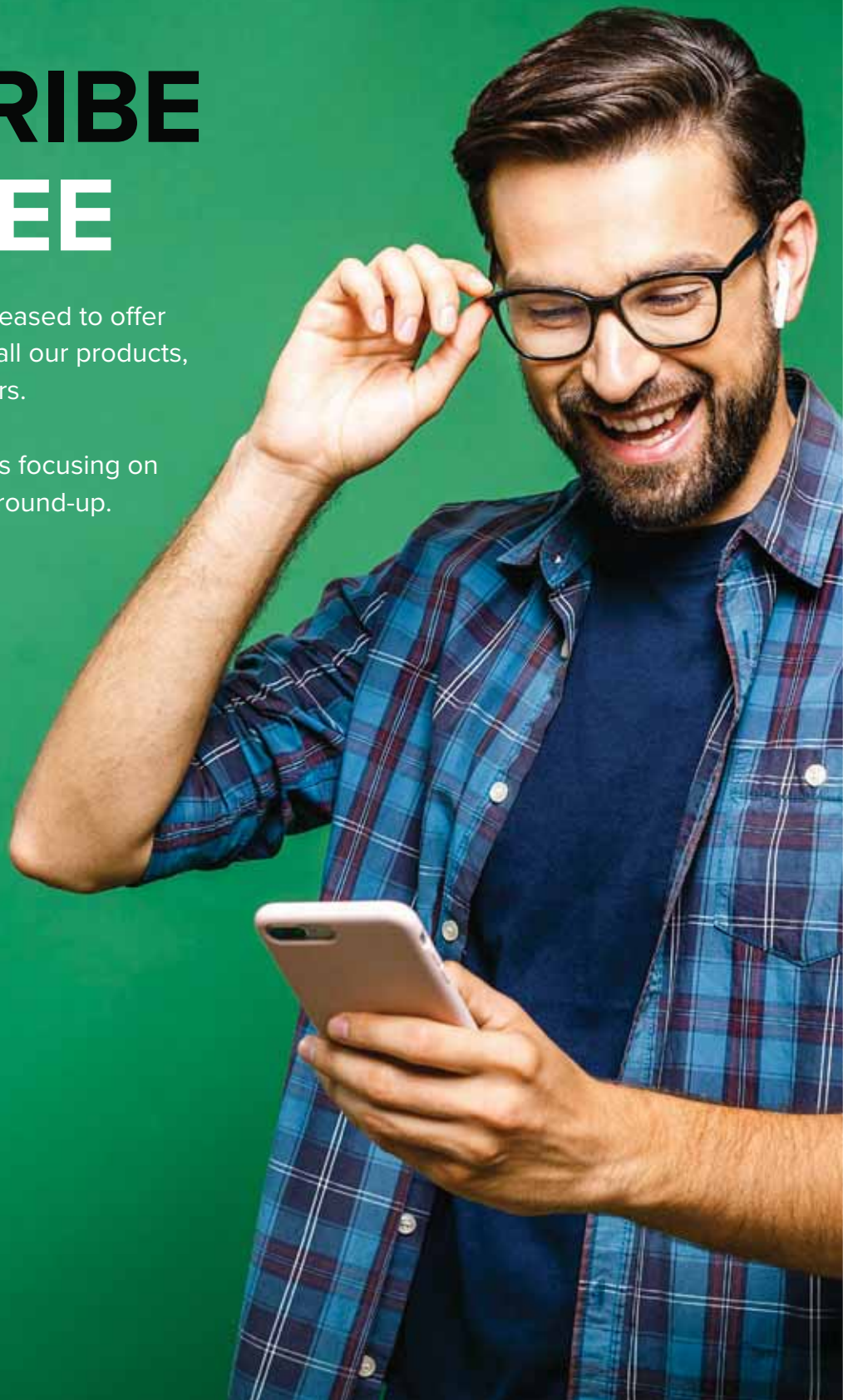
In addition to incentivising people, we need to mandate a change in the market. Incentives and penalties encourage businesses to align activities with climate goals.

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It was a massive step in 2022 when the UK became the first G20 country to enshrine mandatory [Taskforce on Climate-related Financial Disclosures \(TCFD\) – aligned reporting](#) of its largest companies and financial situations.

However, an [FCA review](#) found that disclosures remain inconsistent with TCFD standards; businesses struggle with a lack of guidance.

Thus, the government must also provide tools to help businesses understand their emissions, how to combat them, and how to share this information with the public.

The government acknowledges the need to grow sustainably. However, it has yet to achieve a coherent sustainable economic policy.

Ultimately, climate change requires a collaborative effort and understanding from all parties. Government decisions now will set the economic trajectory for years to come, influencing how climate action is implemented globally at the necessary speed and scale.

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NORTH AMERICAN ENVIRONMENT FOCUS

On a policy level, did you know that the U.S. Environmental Protection Agency (EPA) heralded the final Good Neighbor Plan in March this year, a rule that will heavily reduce smog-forming nitrogen oxide pollution from industrial facilities and power plants in 23 U.S. states, thus improving air quality for many residing in downwind communities, such as Connecticut? Let's have a brief look at this crucial policy development.

"Air pollution doesn't stop at the Connecticut state line," says David W. Cash, EPA New England Regional Administrator. "EPA's 'Good Neighbor' plan will help our state partners meet stronger air quality health standards within and beyond their borders, saving lives and improving public health in impacted communities across the United States. This is especially important in communities that have been overburdened by pollution for decades," he said. ⁽¹⁾

In other news from the region, in April 2023, we learn that the EPA set forth "proposed federal vehicle emissions standards" to speed up the continuing move towards a future of a clean vehicles future and combat the climate crisis.

"By proposing the most ambitious pollution standards ever for cars and trucks, we are delivering on the Biden-Harris Administration's promise to protect people and the planet, securing critical reductions in dangerous air and climate pollution and ensuring significant economic benefits like lower fuel and maintenance costs for families," says Michael S. Regan, EPA Administrator.

"These ambitious standards are readily achievable thanks to President Biden's Investing in America agenda, which is already driving historic progress to build more American-made electric cars and secure America's global competitiveness." ⁽²⁾

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GAMIFIED ECO-DRIVING TO MOTIVATE SAFE AND SUSTAINABLE DRIVING

With young drivers at the greatest risk of accidents on the road, eco-driving could offer a solution that promotes safer driving techniques while reducing the environmental impact

Young drivers are a high-risk group on the roads due to their lack of experience and risk-taking behaviour. Eco-driving has emerged as an effective solution that helps young drivers reduce their carbon footprint and drive more safely and responsibly. Gamification can be effective in promoting eco-driving habits in young drivers, making the learning process more engaging and enjoyable.

A high-risk group in road traffic accidents

According to the World Health Organization (WHO), approximately 1.3 million people die yearly in road traffic accidents. Road traffic accidents are also the leading cause of death in children and young adults aged five to 29.

The over-representation of young drivers in accidents is predominantly due to their inexperience and risk-taking behaviour, such as speeding, hard braking, and aggressive acceleration.

This not only puts their lives at risk but has a significant impact on the environment. According to the United States Environmental Protection Agency (EPA), the transportation sector is the leading contributor of greenhouse gas emissions. Eco-driving techniques are one way young drivers can learn to drive more safely while reducing fuel consumption and GHG emissions.

What is eco-driving?

Eco-driving involves smooth acceleration and braking, maintaining a constant

speed, and avoiding excessive idling.

Studies have shown that eco-driving can result in fuel savings of up to 15%, which can translate into significant cost savings for drivers. In addition, eco-driving can help to reduce emissions of carbon dioxide (CO₂), nitrogen oxides (NO_x), and particulate matter (PM), which are significant contributors to air pollution.

Eco-driving can also enhance the driving range of an electric vehicle (Günther, Kacperski, and Krems, 2020). In addition to the environmental benefits, eco-driving can improve road safety by encouraging drivers to adopt a more responsible and defensive driving style.

How can we encourage eco-driving among young drivers?

Self-Determination Theory (SDT) is a broad framework for the study of human motivation and personality and argues that to foster the most volitional and high-quality forms of motivation and engagement for activities, the individual's experience of autonomy, competence, and relatedness must be supported (Ryan and Deci 2000; 2017).

SDT further proposes that the degree to which any of these three psychological needs is unsupported or thwarted within a social context will have a detrimental impact on wellness in that setting. Therefore, motivating young drivers to adopt safe driving habits must support their autonomy, competence, and relatedness needs.

Gamification is one such technique.

Gamification refers to the use of typical elements of game mechanics (e.g., storylines, avatars, points, leader boards, feedback, and challenges) to enhance engagement and motivate individuals in non-game applications (Deterding et al. 2011). It is effective in various domains, including education, healthcare, and marketing.

In a gamified eco-driving application, a driver's eco-driving ability can be recorded as a driving score that rewards safe speeds, acceleration, and braking. This score can be displayed relative to other drivers on a leaderboard. The leaderboard provides a sense of competition and social pressure, which can potentially motivate young drivers to improve their driving skills.

First, by using a leaderboard system, drivers are encouraged to be the best, thus creating a sense of community and belonging and making eco-driving a social norm.

Secondly, by providing feedback on the driver's performance, a gamified eco-driving interface can help reinforce positive and correct negative behaviours, thereby supporting the need for competence. Lastly, gamification can help create a sustainability culture among young drivers.

Promoting eco-driving as a fun and rewarding activity can help shift attitudes and behaviours towards more sustainable practices. This can have

(a) Driving Scores

Device	Total
Driver 4	9.28
Driver 3	9.11
Driver 8	8.9
Driver 2	8.72
Driver 9	8.67

(b) Aggressive Driver Grid



Figure 1: Peer-to-peer comparison

long-lasting benefits for the environment, as young drivers are likely to continue practising eco-driving as they grow older and become more experienced drivers.

Supporting research for gamification and eco-driving

In my Gamification and Transportation lab at the University of Minnesota Duluth, I track drivers' speeding, acceleration, braking, and cornering

cornering (RightCrn), left cornering (LeftCrn), and speeding scores (SpdScore).

Their SpdScore is given the highest weight, followed by AccScore and BrkScore. The grid in Figure 1(b) is unique to my research. It assists the driver in visually making sense of their driving score. For example, for the drivers 'FordEscape' and 'Driver 4', although their scores are the same, the grid shows that Driver4 engaged in a

Preliminary results showed that study participants were interested in engaging with the analytics presented to them. In addition, a reduction in aggressive driving was also observed when drivers were presented with the gamified eco-driving interface.

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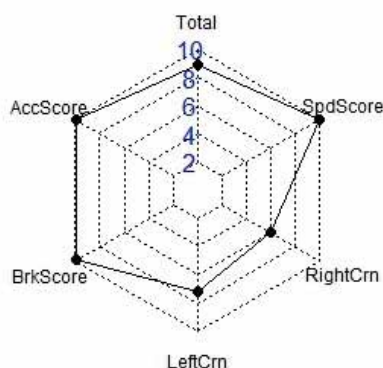
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(a) Score Breakdown



(b) Aggressive Driving Locations

Driver	Characteristic	Location	Distance (miles)
Driver 9	Speeding	Address 1	0.35
Driver 9	RightCrn	Address 2	1.00
Driver 9	LeftCrn	Address 3	1.00

Figure 2: Personalised feedback for driver Driver 9

using a telematics device plugging into the On-Board Diagnostics (OBD II) port of their vehicle. Then, the drivers log onto a website that displays their gamified driving analytics. The analytics they see are shown in Figures 1 and 2.

Figure 1 shows their analytics relative to other drivers in a cohort. Figure 1(a) shows their driving score in a leaderboard style. The driving score is a weighted average of their acceleration (AccScore), braking (BrkScore), right

higher frequency of aggressive driving instances than FordEscape.

Figure 2 presents personalised feedback to an individual driver; in this case, it is Driver9. Figure 2(a) shows a breakdown of the driving score. Visually, the driver can see their right cornering ('RightCrn') and left cornering ('LeftCrn') are the two areas that reduced their score. Figure 2(a) helps inform the driver where their aggressive driving habits took place.



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UNDERSTANDING THE CLIMATE CHANGE IMPACT ON HEALTH

Scientists at the Climate Service Center Germany (GERICS) help society to prepare for climate change impacts on health in a multi-faceted approach

Health becomes a pressing topic since the pandemic, while climate change and other crisis continue to rise. Therefore, it is important to look at different impacts in climate change and health for the vulnerable groups.

Rising energy prices have become an urgent topic and impose challenges for households and the economy. Another demographic challenge is the higher demand for long-term care and countries investing higher expenditure in elderly long-term care.

In addition, an older population in society is more vulnerable to climate change effects, plus temperature extremes impose significantly higher health and mortality risks on older adults.

Climate change impact on health, energy demand & elderly care

There is a research gap in understanding how climate change affects energy demand, elderly long-term care and health, and their socio-economic status, plus how their behaviours and energy efficiency in the living environment could affect

senior citizens' health and economic outcomes when accounting for future climate trends.

The BMBF Junior Research Group [CoCareSociety](#) (Co-creating Climate Services for Care Economy and Caring Society), hosted at GERICS, examines long-term care and health in ageing societies and their energy needs and efficiency.

CoCareSociety aims to support aging societies by integrating knowledge and solutions for climate change mitigation and adaptation measures that enhance the support for the aging population facing the impacts of climate change, while also improving energy efficiency in living environments.

To bring together knowledge and practical experience from the fields of health, climate change, energy efficiency and future ageing societies, an integrated, transdisciplinary and solution-oriented research approach is required.

Together with societal users, CoCareSociety will map the complex

relationships of systemic risks and interrelationships between climate change, ageing society, and energy demands and co-create knowledge to improve the measures of the interdependence of the health-climate-energy nexus through a participation process.

Preparing for future heat extremes

With the increase in extreme heat events caused by climate change, policymakers, urban planners, and public health officials must act to protect the health of urban citizens, for example, by implementing climate adaptation measures, preparing for emergency response, and establishing heat warning systems. Hence, there is a growing need for detailed climate information for urban areas, which create their own local climate (i.e., urban climate).

At the same time, cities must plan and implement climate mitigation measures because they are responsible for over 70% of global CO₂ emissions. However, these measures can have unintended negative impacts on the

exposure of urban dwellers to heat stress, which can lead to increases in respiratory, cardiovascular, and renal diseases.

The conflicts and synergies between climate mitigation and adaptation measures still need to be fully understood because such an effort requires a very high-resolution representation of future urban climate conditions.

The BMBF Junior Research Group [CoSynHealth](#), hosted at GERICS, will close this gap using an integrative urban system approach, considering complex interactions between the urban environment, urban morphology, urban society, urban citizens, and urban health.

Based on this approach, new climate services will be co-developed together with relevant stakeholders to fulfil the need for climate – and health-related information during the planning phase of urban neighbourhoods. In particular, future heat stress will be assessed using high-resolution urban climate modelling combined with climate change information from regional climate model output.

Furthermore, future exposure to heat stress as a function of different lifestyles will be explored by integrating the future thermal comfort assessment with agent-based modelling. Finally, these climate service tools will be used during innovative scenario workshops for test cases in German cities.

Infectious disease risk under climate change in Europe Improved projections, adaptation options & critical infrastructure management

GERICS is contributing to a better understanding of the causes of

increasing infectious disease occurrence and spreading, including pandemics, and possible adaptation measures in two projects that the European Union funds:

The **IDAAlert** project will generate tools to assess the cost-benefit of climate change adaptation and mitigation measures across sectors and scales to reveal novel policy entry points and opportunities. Surveillance, early warning and response systems will be co-created and prototyped to increase health system resilience at regional and local levels and explicitly reduce socio-economic inequality. Indicators and tools will be co-produced for selected hotspots in Spain, Greece, The Netherlands, Sweden, and Bangladesh, experiencing rapid urban transformation and heterogeneous climate-induced disease threats.

GERICS leads the development and application of climate and land-use scenarios for projecting future infectious disease risk. GERICS will also contribute to policy analysis in selected case study areas and co-lead the capacity building of the project, including developing an E-Guide.



More information: Infectious disease decision-support tools and alert systems to build climate resilience to emerging health threats (IDAAlert, Horizon Europe) can be found at <https://idalertproject.eu/>

The **SUNRISE** project will facilitate the active collaboration of CIs across Europe to share best practices and jointly tackle future pandemics. By the

second half of 2025, this collaboration will result in a new stable working group for resilience to pandemics with at least 100 members.

With a group of CI authorities and operators, researchers and software developers, we will identify pandemic-specific vital services and CIs, their dependencies, risks, cascading effects, and effective measures to tackle them at the European level; and develop a comprehensive strategy and innovative tools to ensure greater reliability and continuity of pandemic-specific vital services in Europe.

In addition, GERICS contributes to the analysis of extreme weather events and projected climate change, which puts a risk to CIs, but also influences the occurrence of pandemic events and demand side changes for several services. Such weather-sensitive services include energy, drinking water supply, and transport.

More information: Strategies and technologies for united and resilient critical infrastructures and vital services in pandemic-stricken Europe (SUNRISE, Horizon Europe) can be found at <https://sunrise-europe.eu/>



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BAMBOO CIRCULATION IN SATOYAMA AND SATOUMI: JAPAN'S HILLY AND COASTAL AREAS

Professor Saijo Kiyoshi at the Miyagi University of Education explains the work behind the bamboo circulation project of 2020, focusing on bamboo growth and utilization in Satoyama and Satoumi

Bamboo has been traditionally utilized for rural life in Satoyama (hilly area) as materials, food ingredients, religious tools, festivals, toys etc., and bamboo forests has been an important component of Satoyama landscape.

Places of bamboo utilization, however, are not only limited in Satoyama but also in Satoumi (coastal fishing villages) in Japan surrounded by the sea on all sides.

This article introduces bamboo utilization in oyster farming, relevant problems, and just started the project for bamboo circulation in Matsushima Bay of northeast Japan (Fig. 1) which has heavily damaged by the tsunami disaster in the 2011 East Japan Earthquake.

Bamboo utilization in oyster farming

We have the long rias coast on the Pacific Ocean side of northeast Japan (Fig.1).

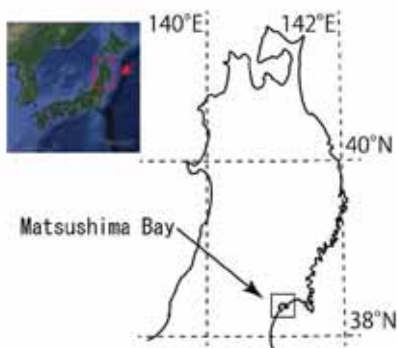


Figure 1: The Matsushima Bay, northeast Japan

Matsushima Bay, one of the three most scenic spots of Japan, located at the southernmost part of the coast, is famous for oyster production. (Fig. 2).

Due to the shallowness (less than 4 meters) of Matsushima Bay, the aquaculture shelves are made with a combination of vertical and horizontal bamboos. These structures, installed in the sea, are convenient for seedling picking and oyster growth (Fig. 2).

This means that oyster farming is supported by a lot of bamboos from Satoyama.

Abundant waste bamboo from the oyster farming system

The bamboos used for oyster farming shelves become degraded within about three years as they are continually soaked in sea water and need to be replaced by new ones.



Figure 2: Oyster farming in the Matsushima Bay

With one shelf needing around one hundred bamboos and the dense distribution of them, it has been theorised that the number of bamboos composing them amounts to approximately one hundred and twenty thousand in the whole Matsushima Bay.

As a result, this used bamboo is becoming waste.

Rough estimates suggest that the number of waste bamboos amounts to about forty thousand per year (Saijo and Abe, 2023).

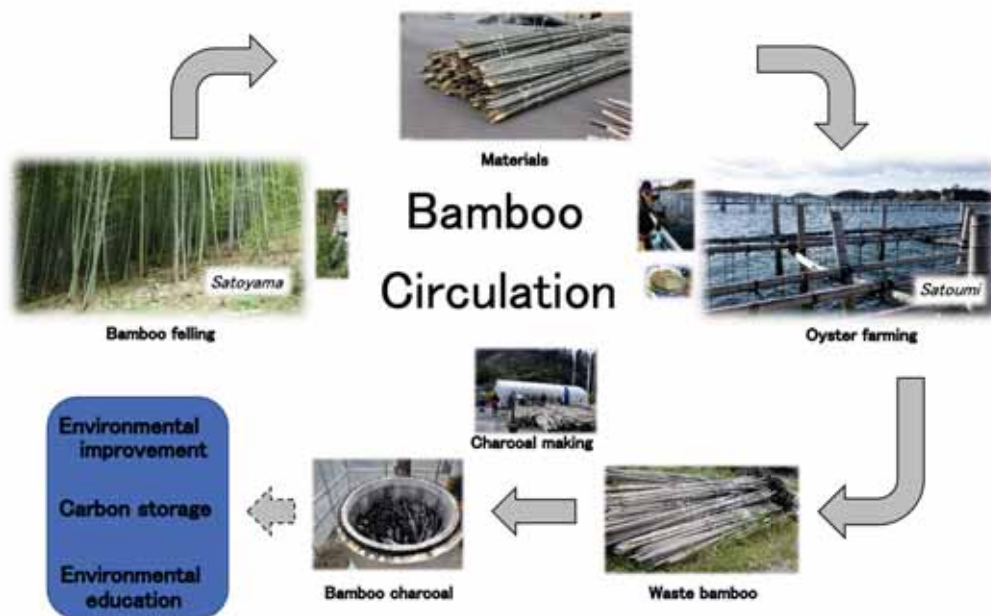


Figure 3: Basic principle of the bamboo circulation project between Satoyama and Satoumi

The newly started bamboo circulation project

We launched a bamboo circulation project in 2020 in an effort to utilize waste bamboo as a local resource by means of charcoal making.

Our patented charcoal-making method (Abe and Takahashi, 2017) can change bamboo into charcoal only within two hours.

The basic principle of this project involves a combination of reducing local waste, improvement of the physical environment by using the positive effects of charcoal as carbon storage to help global climate change countermeasures, and environmental education (Fig 3). A few of the other useful positive effects of charcoal include:

- Deodorizing
- Water quality purification
- Soil improvement

This project started from the research activity of the Miyagi University of Education in the initial stage and is now

spreading to several stakeholders such as fisheries, citizens, and local government under the cooperation with the NETOM (general incorporated association) established in 2022.

It is expected that one ideal style of bamboo circulation between Satoyama and Satoumi will be established in the near future.

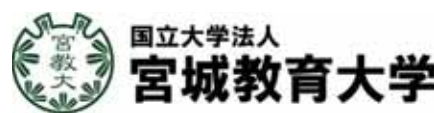
Despite the potential for solving various problems, there are concerns surrounding this project, the largest being the remaining salinity in the waste bamboo and its negative effects.

Although undertaking research into this, a few results indicate the safety of charcoal from the waste bamboo, and a more detailed investigation into the data is desired for the full-scale development of the project.

The process of handling waste biomass from local fisheries is a widespread problem in Japan. The future achievement of this project would hopefully help local regeneration, and act as a solution for similar problems around the world.

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Monitoring ecosystems from space to calculate biodiversity net gain

Shashin Mishra, Vice-President of EMEA at AiDash, examines how monitoring ecosystems from space can revolutionise biodiversity net gain progress and aid the eco-crisis

The global crisis of rapidly declining biodiversity has risen to greater public awareness in recent years. Studies warning of the sixth mass extinction of life on Earth, and that species are dying off 1,000 times more quickly than before the arrival of humans 60 million years ago have prompted action on the international stage.

Most notably, COP15 oversaw the introduction of the Global Biodiversity Framework, which aims to conserve and restore 30% of the world's land and oceans by 2030. ⁽¹⁾

The biodiversity crisis

The consequences of biodiversity loss are severe. Biological diversification is essential to the resilience of ecosystems which perform vital functions such as climate regulation, flood control, and pollination. It is also increasingly recognised as a business concern and was ranked as the third highest risk to business in the World Economic Forum's 2022 Global Risks Report. ⁽²⁾

The UK is understood to be the most biodiversity-depleted country in the world. In response, the Government has passed the Environment Act into law to drive Biodiversity Net Gain, targeting goals such as ensuring "that species abundance in 2042 is greater than in 2022, and at least 10% greater than 2030". ⁽³⁾

Challenges holding back biodiversity net gain

Despite the urgency of the crisis, only 3% of UK businesses say that they monitor nature or biodiversity-related risks, according to a recent Office for National Statistics study. ⁽⁴⁾ This figure stands in contrast to the stated aims of chief sustainability officers (CSOs) in businesses around the world. In a global survey of over 500 CSOs, 24% told AiDash that they currently include biodiversity impact in their sustainability strategies, and 66% said they already have a role dedicated to biodiversity.

So, while there is certainly room for businesses to do more to effect positive change in restoring ecosystems for biodiversity net gain, having the right tools to do so is just as much the problem, if not more so, than a lack of desire to act.

Nowhere is this challenge more glaring than in land planning, where the Environment Act mandates that 10% biodiversity net gain must be achieved for all development projects in England and comes into effect this November.

When the local planning authorities (LPAs) – who are responsible for ensuring this – spoke to Defra, 90% of them revealed that their current expertise and ecological resources would be inadequate to deliver biodiversity net gain, and just 5% believed they had what they needed to scrutinise all applications that might affect biodiversity thoroughly. ⁽⁵⁾

Over the last decade, the supply of qualified ecologists has consistently decreased while the demand for qualified ecologists to monitor ecosystems has consistently increased. There is no quick fix to this issue as it takes years to train ecologists to the point where they can measure ecosystems and test biodiversity impact to the level required for LPAs to carry out their duties or for businesses to put strategies in place that they can report on.

The solution to the biodiversity crisis from space

One of the critical steps in preserving ecosystems and working towards biodiversity net gain is working out the baseline of the land biodiversity for the area in question. Without this, it is difficult for landholders and authorities to calculate what they need to do to meet their targets. The task of baselining sites is extensive and relies upon making ecological surveys more efficient.



Shashin Mishra
Vice-President of EMEA

With time being of the essence, and in the absence of a deep pool of ecologists to deploy on the ground, a solution is waiting to be used in space. Technological advances allow businesses to automate ecological surveys by taking advantage of satellite imagery and cutting-edge AI models.

Traditional ecological surveys are highly manual and complex, requiring a team of ecologists to be dispatched to a site – often for weeks on end – to collect data from key sample areas and, from this, deduce the overall data for the entire space that is being monitored. Inevitably, these measurements suffer from incompleteness and unconscious bias and, in addition to this, they are expensive to obtain across larger areas or distributed estates.

By contrast, satellites can quickly cover 1,000s of sites, and AI models can analyse them in mere weeks to accurately measure biodiversity in a given ecosystem and provide insight into how biodiversity net gain might be achieved in this ecosystem. Crucially for the users of this technology, it also works out as a cheaper way of managing biodiversity operations.

Satellite technology promises to revolutionise the current biodiversity net gain methods

Legislation around biodiversity impact and what strategies businesses employ to address it will only become stricter. As LPAs struggle with rapidly declining deadlines and a massive shortage of skills in ecology, adopting satellite technology is the only way they can meet looming biodiversity net gain mandates.

More broadly, businesses with large corporate land holdings, such as utilities or agriculture companies, also have a crucial role to play in improving and protecting biodiversity. Utility providers control over 450,000 acres across the UK. By using satellite technology – they can unlock the potential of their land quickly and effectively

The key to enabling different parties to play their part lies in streamlining and simplifying the process of monitoring ecosystems. Satellite technology promises to revolutionise the current methods used for biodiversity net gain progress.

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Transition to the biobased economy: Integrated approach needed

Aarthi JanakiRaman, Research Director, Chemicals and Advanced Materials TechVision, Frost & Sullivan, charts the transition to a biobased economy, stressing the need for an integrated approach



Circularity has been the cornerstone of various global developmental efforts since the UN proposed the 2030 Agenda for Sustainable Development. The SDGs and their associated targets are the focus of multiple countries to move towards sustainable production, process strategies, and consumption with effective reuse and management, ensuring holistic health and wellness of the global population.

Countries have established national strategy plans and roadmaps to transition towards a circular economy. Europe has been at the forefront of its efforts to become the first climate-neutral continent and achieve net zero emissions by 2050.

From its Circular Economy Action Plan (CEAP) in 2015 to the current Circular Bio-based Europe Joint Undertaking (CBE JU), the focus has been on establishing a circular economy with an emphasis on sustainable research and circular product development.

A biobased and circular economy go together and adopting bio-based and renewable resources contributes significantly towards establishing a net zero economy.

A thriving bioeconomy heading for carbon neutrality

A bioeconomy is not restricted only by using bio-based renewable resources and feedstock for manufacturing and production; it also includes a transition to clean energy, establishing sustainable food production and agricultural systems, plus resource conservation, optimization and reuse during manufacturing and processing, amongst others.

Continued R&D efforts, technology development, and adoption are critical to a thriving bioeconomy and achieving carbon neutrality in all industrial and consumer sectors.

The European Commission is actively fostering an innovation ecosystem that is actively involved in research, testing, and deploying sustainable technologies that can reduce the dependence on fossil fuels and smoothen the transition to a cleaner and greener economy.

Various technological advances are being pursued that can help in sustainable socio-economic development, including:

Biotechnology advances

Due to their robust methodology and scale-up ability, fermentation technologies and biocatalysis are essential tools of interest. With advances in cloud-based fermentation and highly specific enzyme catalysis emerging, bioproducts with enhanced efficiency are expected during the next three to four years.

Omics technology and systems biology can increase the efficiency of cell factories and biorefineries. Most biotechnological processes such as fermentation, bioremediation, and metabolic engineering need omics technologies to understand biological systems and their functions to optimize yield and productivity and devise apt processing conditions.

Using computation tools and analytical data platforms to decipher complex data can help improve cell factories' processes and design parameters.

Biomanufacturing

Biomanufacturing involves the integration of different biotechnology approaches, including genetic, protein, metabolic engineering, and synthetic biology.

Although these approaches are independent, they must be combined to achieve the desired product and functionalities.

Using biological processes in manufacturing encourages sustainability and holds significant global expansion possibilities for industrial stakeholders.

Biomanufacturing uses less energy, fewer resources, and less chemical processing, and when economies of scale can be achieved, lower costs compared to traditional processes, especially in chemicals, pharma, life sciences and allied areas.

While most of its use is centred around the production of chemicals and biological molecules, mainly primary metabolites such as butanol, ethanol, acetone, and citric acid, secondary metabolites, and large biomolecules, it has the potential to be expanded for the development of materials, especially biopolymers, food and feed ingredients, engineered cells and tissues to name a few.

Although several biotechnology strategies exist, computational, molecular biology and fermentation tools are widely adopted in the chemicals industry to produce high-value chemicals and products.

TAILOR-MADE PROMOTION

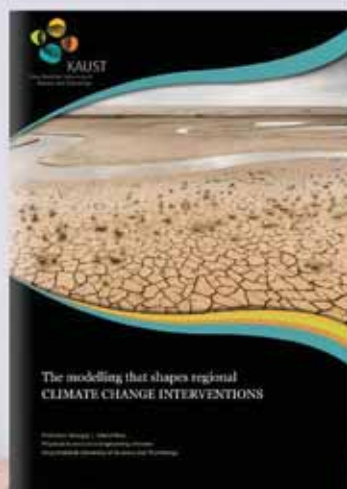
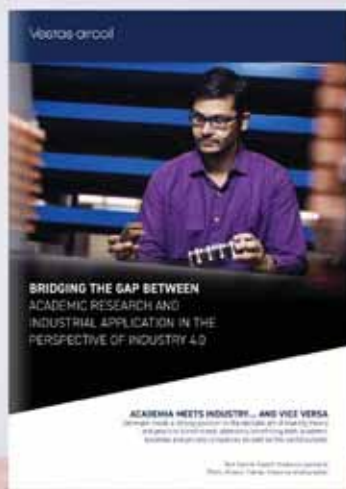
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An added advantage of using biomanufacturing processes, especially biorefineries, is the ability to produce value-added products. Bio-based energy in the form of biofuels, bioplastics, and materials can be synthesized to improve overall commercial economies of scale of bio-based alternatives.

Waste management and recycling are becoming vital components of a circular economy. Apart from chemical and mechanical recycling processes, emerging approaches such as enzymatic recycling, anaerobic digestion, bioremediation, and biofiltration are seeing increasing adoption in different types of waste treatment from residential and industrial facilities and treating end-of-life plastic products.

In addition, researchers are trying to use a combination of the approaches mentioned above to recycle multi-material-based products and packaging.

Apart from these, alternative feedstock, from plant biomass to byproducts of waste streams and gases captured from industrial and direct air emissions, can generate renewable energy, chemicals, and other value-added products, including agricultural inputs, packaging materials and feed ingredients, to name a select few.

Achieving a sustainable economy is complex

Achieving a sustainable economy requires the involvement of both public and private stakeholders; it needs the participation of various industries to establish a sustained growing economy.

While technological advances can ensure a smooth transition to a circular economy, large-scale deployment is often hindered due to a lack of timely support, clear guidelines, and consumer acceptance. It is, therefore, essential to devise a systemic approach involving stakeholders' participation across the industrial value chains.

Under Horizon 2020, the Commission laid the groundwork for various research programs. It fostered innovations to help solve potential challenges and mitigate risks faced during the transition to a more circular economy. It is imperative to build on it.

Public-private partnerships are crucial in ensuring continuous R&D efforts and devising clear guidelines and standards for technology deployment, product development, and commercialization to prevent ambiguity and ensure consumer satisfaction.

An integrated approach will fast forward a biobased economy

A joint approach across industrial sectors with the active participation of non-profit, standardization agencies, and regional and national governments is needed to ensure successful industrial adoption.

An integrated approach will also help gain access to the requisite funding and help lower potential risks that might become a burden for a single stakeholder. It can also help stakeholders explore industry opportunities to increase profitability and market expansion.

Despite various initiatives that encourage multistakeholder involvement and continued focus on the commercialization of much-needed technologies for a bio-based European economy, the efforts still need to be more streamlined and spread across all sectors.

Dependence on non-renewable resources is still dominant, mainly due to price-performance issues, and sustainable technologies still face challenges related to scale and technical performance.

However, more focus towards capacity building, clearer guidelines and standards, knowledge sharing and information dissemination, and access to enabling technologies for product development can solve market and commercialization challenges towards a carbon-neutral Europe.

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MICROALGAE AS A SUSTAINABLE SOURCE OF PROTEIN AND FOOD INGREDIENTS

Microalgae can be an alternative sustainable source of protein and functional food ingredients that have the potential to improve gut and liver health

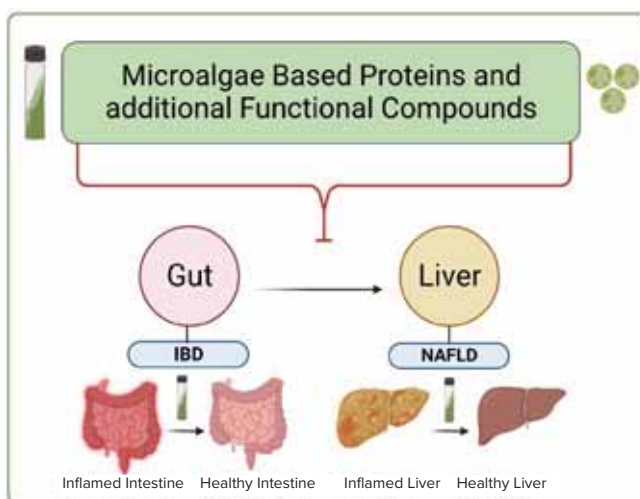
Protein is a key component of a healthy diet and is found in a variety of foods, including those obtained from animal sources. Although animal-derived proteins are rich in essential amino acids, they are also associated with an increased risk of chronic diseases, such as heart disease, non-alcoholic fatty liver disease (NAFLD) and inflammatory bowel disease (IBD).

Increased demand for animal-derived proteins is also a major contributor to climate change, with animal agriculture being a significant greenhouse gas emitter and a major driver of deforestation and biodiversity loss.

Due to population growth, demand for meat is expected to increase substantially in the coming decades. The meat industry already consumes more food than it produces and currently, more than 75% of agricultural crops are used for animal feed.

This increased demand for dietary protein combined with the need to ensure food security worldwide has led to a growing interest in alternative protein sources, both to improve human health and to address environmental concerns.

In a recent review article published in the journal *Global Challenges*, researchers from the MIGAL- Galilee Research Institute in Israel described the use of microalgae as a sustainable source of protein and as functional foods to promote gut and liver health.



Microalgae produce compounds that can help treat chronic inflammation in the gut or liver. (Adapted from *Global Challenges* 2023,7, 2200177)

Can microalgae be used to improve gut and liver health?

Chronic diseases, such as IBD and NAFLD, have become increasingly common in the last few decades, with Western, high-fat, high-carbohydrate diets now recognised as being a significant contributing factor.

IBD affects millions of people worldwide and the number of patients is increasing in both Western and newly industrialised countries. It is associated with distressing symptoms and there is currently no cure. Treatments are available to dampen the inflammatory process, but not all patients respond well to them.

NAFLD, which is characterised by the accumulation of fat in the liver, is the most common chronic liver disease worldwide and is estimated to affect approximately 25% of the global population. Due to its close association with the Western diet, it often occurs in

patients who are affected by other metabolic diseases such as type 2 diabetes, obesity, high blood pressure, and elevated levels of cholesterol or triglycerides in the blood. Symptoms are variable but it can progress to more severe liver conditions such as non-alcoholic steatohepatitis (NASH), hepatocellular carcinoma and end-stage liver disease.

Recently, data have begun to emerge showing that anti-inflammatory and antioxidant compounds derived from microalgae may be beneficial in patients with chronic inflammatory diseases such as IBD and NAFLD.

To date, promising results have been obtained from cell-based and animal studies, with these compounds exerting positive effects on fat metabolism, insulin sensitivity, and inflammatory processes. Clinical trials are now required to fully examine the efficacy and safety of these products in humans.

What are microalgae?

Microalgae are single-celled, microscopic organisms that grow in aquatic conditions. Although there are an estimated 200,000 species of microalgae, only a few have been extensively investigated so far.

Some types of microalgae, such as *Spirulina* and *Chlorella*, have been consumed since ancient times and are classified as Generally Recognised as Safe (GRAS) by the US Food and Drug Administration (FDA). In addition, several products derived from microalgae are also classified as GRAS by the FDA and have been approved as novel food ingredients by the European Union.

Certain species of microalgae have a protein content that is significantly higher than that provided by traditional plant sources and may be comparable to animal sources. They are also a good source of essential amino acids that cannot be synthesised by the human body.

A wide range of bioactive compounds, such as carotenoids, vitamins, pigments, phenolic compounds and fatty acids can also be obtained from microalgae. These are of great interest to the scientific community due to their anti-inflammatory and antioxidant properties and potential health benefits.

Microalgae can also potentially be used as a sustainable source of feed for livestock. This could improve animal health and meat quality as well as reducing the land area required for growing animal feed crops.

How can we grow and use microalgae?

Microalgae can grow in a variety of aquatic environments and have a very low impact on the environment. Growing up to ten times faster than



Outdoor photo-bioreactors seize natural sunlight to cultivate microalgae (left), while the light conditions could be controlled for indoor photo-bioreactors (right). Credit: Necton and Yemoja Ltd

traditional land-based crops, they can produce up to 7.5 tons of protein per hectare per year, without the need for large areas of land or for fertilisers that pollute the water supply.

They also capture carbon dioxide more efficiently than land-based plants, which means that they can be grown on an industrial scale with low greenhouse gas emissions.

Although microalgae are relatively easy to grow, there remain challenges associated with their large-scale cultivation and the extraction of proteins or food supplements. Commercial microalgae cultivation needs expensive photobioreactors to provide enough light for the cultures. This can be overcome by adding an organic food source to the growth medium to allow improved growth to take place.

Multiple steps are also required to extract and purify proteins and bioactive compounds from microalgae and the processes require optimisation for microalgal proteins and bioactive compounds to be produced on a commercial scale.

Despite these challenges, cultivation methods for microalgae are already improving, as does the understanding

of how production of a target compound can be triggered by changing cultivation conditions. For instance, microalgae produce more anti-inflammatory compounds when facing nutrient starvation, extreme temperature and intense light.

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RENEWFOOD MANUFACTURING: FOOD PRODUCTION FOR A NOURISHED, RESILIENT NATION

Dr Kang Lan Tee, Matthew Hutchinson, Joe Price and Professor Tuck Seng Wong from the University of Sheffield explain the importance of re-imagining food production to support people and the planet

Food transcends its basic role as a human necessity, encompassing a multifaceted significance in our lives. Beyond its fundamental function of providing nutrition and sustenance, food is a profound social instrument, it not only nourishes our bodies but also nourishes our relationships and interactions. Food production is undoubtedly vital to livelihoods everywhere.

We gather around a shared meal with our family and friends, using this communal experience to foster and maintain deep interpersonal connections. In business, food is a catalyst for successful negotiations as we convene with clients or customers over a meal, forging bonds and laying the groundwork for prosperous partnerships.

When we extend an invitation to dine, it becomes a gesture of gratitude and appreciation, a heartfelt expression of our acknowledgement for the kindness we have received. Likewise, food becomes a means of reward, allowing us to acknowledge and honour the exceptional achievements of others by treating them to a well-deserved meal.

Furthermore, food is an integral part of celebrations, symbolising joy and shared experiences. Many derive pleasure from exploring the culinary world, seeking Michelin-recommended restaurants to indulge their senses. With its profound impact on our social fabric, food has surpassed its utilitarian roots, assuming a prominent role in human connection and shared experiences.

Feeding the growing population and tackling hunger

As conscientious food consumers, we must look beyond the contents of our dining table and consider the broader implications of food production. Several compelling reasons underscore the need to examine how our food is manufactured.

Firstly, with the global human population reaching 8.0 billion in mid-November 2022, projections indicate a staggering increase of nearly two billion individuals within the next three decades, ultimately reaching 9.7 billion by 2050 and potentially peaking at around 10.4 billion in the mid-2080s (United Nations).

This begs the question: is our current food production and manufacturing process equipped to sustainably support such a vast population? Secondly, despite the world producing enough food to feed everyone, the harsh reality remains that 828 million people continue to suffer from hunger.

Fourteen million children endure severe acute malnutrition. Shockingly, hunger and related causes account for 45% of child deaths globally (Action Against Hunger). Thirdly, it is crucial to recognise the substantial environmental impact associated with food production.

A striking 26% of greenhouse gas emissions stem from the food sector, while 70% of global freshwater withdrawals are allocated to agriculture (Our World in Data). Lastly, the UK's average price of food and non-alcoholic beverages has experienced the sharpest increase since 1977, as the Office for National Statistics reported.

Factors such as poor harvests and conflicts like the Ukraine war have contributed to mounting challenges to our food supply, placing immense

strain on household budgets. The need for immediate action to revitalise and innovate our food production and manufacturing processes has become exceedingly apparent.

How can precision fermentation support global food needs?

Fortunately, in the face of our food crisis, we possess a formidable biotechnological solution at our disposal: precision fermentation. Fermentation itself is not a novel concept. It stands as one of humanity's oldest and most effective biotechnological practices.

Many of our beloved foods and beverages owe their existence to the transformative power of fermentation. This process has been embraced and integrated into diverse cultures worldwide. From beer and wine to bread, cheese, yoghurt, kefir, sauerkraut, kimchi, miso, and kombucha, the extensive repertoire of fermented foods exemplifies the widespread acceptance and consumption of products created through fermentation.

We have grown accustomed to enjoying foods that involve microbes in their production or have undergone microbial processing. The question is whether we are prepared to embrace food derived from precision fermentation.

Precision fermentation harnesses microbial hosts as efficient "cell factories" to manufacture targeted functional ingredients. Simply put, it involves cultivating genetically engineered microbes capable of producing specific products (product precision) within controlled conditions and using carefully selected starting materials (process precision) in large-scale bioreactors.

Fermentation, conducted with high precision, offers enhanced food traceability (i.e., clear knowledge of food origin) and bolsters food safety standards.

For example, we can employ genetically modified yeast to synthesise bio-identical milk proteins such as whey and casein. This breakthrough technique holds extraordinary potential. Conventional dairy production methods release a substantial 3.51 kg of CO₂ per litre of milk produced (Our World in Data).

Reducing greenhouse gas emissions by 97%

In contrast, precision fermentation for dairy production can reduce greenhouse gas emissions by an astounding 97% (Perfect Day)! This significant environmental advantage is just one of the many benefits offered by precision fermentation, highlighting its capacity to revolutionise food production and address the pressing challenges of sustainability and climate change.

At the University of Sheffield, we are dedicated to pushing the boundaries of [precision fermentation](#), taking it to unprecedented heights. Rather than simply replicating what conventional agriculture can provide, such as dairy and meat proteins, we delve into the realms of nature to uncover protein-based molecules that bestow familiar flavours upon us, such as meatiness, sweetness, saltiness, and even bitter-taste masking.

Our explorations are not limited to the familiar; we actively seek proteins that offer unique sensations or challenge our taste buds, expanding the realm of culinary experiences. These protein-based molecules have potential applications in food production and can be sustainably and consistently

manufactured through precision fermentation, ensuring both quality and a reliable supply.

This opens up exciting possibilities for introducing new and innovative food products to the market. It is worth emphasising that our bodies are naturally attuned to digest proteins, making them a healthier and more nutritious option compared to chemicals. Through our research, we strive to unlock the immense potential of protein molecules, revolutionising the food industry with sustainable, flavourful, and wholesome offerings.

Securing the enjoyment of food for future generations requires us to take immediate action to renew our food manufacturing practices. By embracing the power of biotechnology, we can pave the way for a sustainable and thriving food future. Our responsibility is to preserve the luxuries we enjoy for generations to come.

Grants

1. BBSRC 20ALERT award (BB/V019341/1)
2. BBSRC ICURe Lean Launch Programme
3. BBSRC ICURe Explore Programme
4. The University of Sheffield's IP Development and Commercialization (IPDaC) fund



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WASTE MANAGEMENT: WASTE-FREE CONCERTS & EVENTS

Bengt Fellbe, Program Leader, [SSEC, Swedish Surplus Energy Collaboration](#), directs our thoughts to waste-free concerts and events and reckons that for the first time, this remarkable waste management notion may work

From table to soil

Reduces 90% of food waste in 24 hours



The summer concerts at Sofiero Gård, Helsingborg in Sweden, will be free of waste and rubbish. Everything is composted on-site and becomes organic fertilizer. Solserv has composting machines that work perfectly for the home, office, restaurant, hotel, industry, etc. The machines can handle everything from 5kg to as much as 100 tons of food waste daily.

Composting technology

The composting technology transforms food scraps and packaging with the

help of microbes. It is an entirely circular and sustainable solution, which ultimately contributes to sustainably fertilized agricultural land instead of using mineral fertilizers, says Patrik Johansson, CEO of Solserv.



Waste-free concerts & events to promote sustainability

There have, of course, been attempts to arrange sustainable events and waste-free concerts in the past. The



Compostable Salad
Bowl Bagasse



Compostable Salad Bowl,
Paper



Compostable Trough
Bagasse



Compostable tray,
Five-compartment, Bagasse

Image: © Stefan Lindqvist, Helsingborgs Dagblad



Patrik Johansson, Hasse Jönsson, och Jessica Nederman outside Sofiero gård, where the summer concerts and the waste management pilot project will be carried out.

problem arises because it was then always a matter of placing great responsibility on the visitor. It must be sorted into different fractions, which has proven too difficult to work. This leads to everything becoming residual waste and going to incineration - it needs to be better and sustainable. With composting technology and the right choice of materials in packaging, everything can be composted in the same machine and process. Visitors do not have to make conscious choices that are complex.

Another advantage is that the entire process takes place on-site, and given that the waste is reduced by up to 90%, the need for transport subsequently reduces, further reinforcing a reduced climate footprint.

Towards solutions for a sustainable society

In addition to great concerts in fantastic surroundings, you should not miss out on the future's technical solutions for a sustainable society.

The pilot project is possible through a collaboration between [Sofiero Gård](#), [The Tivoli](#) and [Solserv](#).

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Ecology conservation and truly valuing our environment

Dr David Smith, Director of Ecological Planning & Research (EPR), gets us up to speed with ecology conservation research and what we can do to help our environment thrive

If you or a loved one is ill, one of the first things you might do is take their temperature. One way policymakers, wildlife charities and others check on the health of the environment is to monitor the populations of wild birds. It's one way of quickly gauging the 'temperature' of the environment.

Ecology conservation of birds

Birds are towards the top of the food chain, and consequently, anything affecting lower parts of the food chain, such as our plants and insect populations, will ripple up and impact our wild birds.

Migratory bird populations will not only indicate the health of the environment in one place, but they can be early warning alarms of environmental pressures across their entire migratory flyway: for example, from southern Africa all the way to northern Europe.

Migratory birds also connect people and communities. Colour ringing and satellite tags can allow professional scientists and amateur wildlife enthusiasts to track individual birds as they move from wintering to breeding grounds.

I recall finding a wintering Sanderling, a wading bird, on the north Kent coast that has been tracked over several years, moving from Iceland, through the Orkney Islands to the north Kent coast. Such data, known as evidence-based conservation, is the rock upon which wildlife conservation is built.

Another example is the monitoring studies that show how specialist farmland birds, some of our migratory woodland birds and many others have suffered significant declines to the point where it has recently been estimated Britain has lost 73 million birds over the last 50 years. ⁽¹⁾

This includes losing close to 30 million House Sparrows, 20 million Starlings, and four million Skylarks, much of it driven by changes in agricultural practice and land use.

Encouraging a stronger relationship with our environment

While scientists are still putting the pieces together of this complex puzzle, which has no obvious end-image or edges to provide context or guidance, enough of the puzzle has been assembled to provide hope.

Hope because by understanding many of the reasons behind the declines, it allows individuals, companies, charities, landowners, land managers, local councils, and national government to work together to address the issues and contribute to positive change, which will help protect birds and reverse some of the declines.

A better understanding and connection with wildlife in a personal way, creates a more positive relationship between society and our environment, each reliant on the other.

Sustainable development practices help maintain natural habitats

One way to help ensure we maintain the integrity of natural habitats is through sustainable development practices. Some areas, however, hold more ecological importance than others and are protected under legislation originally derived from the EU for any proposed development projects.

The location I found the colour-ringed Sanderling occurred in a Special Protection Area (SPA), which is generally selected to protect one or more vulnerable bird species or important assemblages of birds, such as coastal winter waterbird communities.

Here, local authorities are legally obligated to consider the impacts of development – carrying out a process known as a Habitat Regulation Assessment (HRA) to determine the impact on wildlife.

SPAs can cover immense land areas, as seen with the Thames Basin Heaths, that cover 8,400 hectares of Sites of Special Scientific Interest (SSSI), affecting 15 local authorities. The site is a network of heathlands designated for their internationally important bird populations, yet recreational use of the heathlands could negatively impact the wildlife.

To encourage people away from SPAs, Suitable Alternative Natural Green Space (SANGs) are created to provide attractive spaces that provide an enjoyable natural environment for recreational use. SANGs help to absorb recreational pressure whilst also providing an opportunity to restore and create wildlife habitats in such a way that encourages communities to connect with nature.

The built development provides opportunities for restoration

Additionally, built development on intensive agricultural land provides opportunities to restore what is likely to be an agricultural desert to a landscape of managed wildlife habitats, including wildlife-friendly grasslands, mixed native species scrubland and native woodlands, which in turn will benefit invertebrates, which in turn will benefit many bird species.

The new homes can also provide habitat, and research by the RSPB has shown that new homes with integrated Swift bricks provide new nesting opportunities for Swift, House Sparrow, Starling, and House Martin.

However, there is no doubt there are some special areas of the UK, where the existing farmland bird populations still include Grey Partridge, Corn Buntings, Yellowhammers, Yellow Wagtails and Turtle Dove.

Delivering new homes on agricultural land is particularly challenging in these essential areas.

Placing the natural world at the forefront

In these circumstances, local authorities have a special role in balancing the needs of local communities, for example, the need for more homes, with the needs and importance of existing ecological features.

However, they cannot do this without objective data collected by ecological consultants. Whilst consultants can be viewed as 'hired guns,' those that are members of the Chartered Institute of Ecology and Environmental Management (CIEEM) are bound to a professional code of conduct, and a critical element of this is providing objective data and advice to enable clients and local authorities to make informed decisions.

Furthermore, providing data clearly and transparently ensures all parties involved in the development process can understand it. Professional bodies that support ecologists in raising the standards of ecology conservation and environmental management are helping benefit both the environment and society.

We must place the natural world at the forefront of our interactions regarding development, striving for an economic future that meets the needs of communities and the environment.

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STORED FUEL'S IMPORTANCE FOR MIGRATING MONARCH BUTTERFLIES: IMPLICATIONS FOR CONSERVING ALL MIGRANT ANIMALS

In his latest research, Keith A. Hobson, Research Scientist and Professor at Western University, explores why stored fuel is critical to migrating animals, such as monarch butterflies

Conserving migratory animals in a rapidly changing world requires we quickly and efficiently determine the most critical or vulnerable points in their annual cycles that typically involve numerous locations spread over hundreds to thousands of kilometers.

Although we know migration routes or connections between breeding and wintering regions for many species of concern, how animals fuel their migration along migratory paths and how their nutritional needs are affected by various factors generally remains unknown.

In times of current and predicted climate change, the added burdens of weather extremes add to the many threats facing migrants. So it is ever more urgent to ensure that our conservation efforts and funds are directed at the most critical locations temporally and spatially.

With this in mind, our research focus has been on determining how a long-distance migratory insect of great conservation concern fuels not only its autumn migration but also how it might recover from droughts and adverse weather conditions experienced along its migration route.

Examining monarch butterfly migration patterns

The eastern North American breeding population of the monarch butterfly (*Danaus plexippus*) has become an iconic example of long-distance insect migration.

Each year, millions of adults migrate from their natal sites in the eastern United States and Canada to favorable thermal environments at the overwintering sites in central Mexico's high-altitude oyamel fir (*Abies religiosa*) forests, a journey that can exceed 3000 km.

Once monarch butterflies reach these overwinter sites, they must store enough lipids to last them for the three to four-month overwinter fast. The dynamics of lipid acquisition and storage then is critical to their survival. It is well established that the fall migration is fueled by nectar. Interactions between weather and nectar availability, the source of the carbohydrates converted to lipids during migrations, and weather conditions at overwintering sites clearly deserve much attention.

Despite considerable interest in the conservation of migratory monarch butterflies in North America and

recognition of the importance of nectar availability to their conservation, little is known of the dynamics of lipid synthesis and storage during migrations. This stands in contrast to conservation concerns directed at the breeding and wintering grounds where the availability of host milkweed plants (*Asclepias spp.*) and mature high-elevation fir forests, respectively, are known to be important.

Analysing lipid stores

Previous research assumed that monarchs generally increase lipid stores as they approach their wintering grounds and that Texas and northeast Mexico provide the bulk of the lipids required for both overwintering and subsequent reproduction in spring. [Our team have used stable isotope tracking approaches](#) on bulk lipids to demonstrate that, at least in some years, much of the [overwinter lipid stores are likely obtained throughout the floral corridor in Mexico](#) leading to the wintering grounds.

In an extensive collaborative study involving colleagues in Canada, the United States and Mexico, we examined indices of stored lipid and water levels together with measurements of wing loading of



monarch butterflies collected at 14 locations during the fall migration from southern Ontario (42.6°N) through to two overwintering sites (Chincua and Cerro Pelon, 19.4°N) in central Mexico.

Samples were obtained during the fall of 2019, a period of moderate to extreme drought in central Texas, and during the fall of 2020 and 2021, when conditions in that region improved. Since monarchs that reached overwintering sites represent migratory success, by comparing the conditions of monarchs at these sites with values obtained along the migratory route, we aimed to evaluate the importance of nectar foraging during the latter portion of the migration.

As predicted, the extreme drought in Texas in 2019 resulted in extremely low lipid levels of monarch butterflies staging there. However, the monarchs reaching the overwinter sites that year had “recovered” lipid levels sufficiently to allow overwintering. That result was also found in the next two years of the study, even though conditions in Texas had improved. So, clearly, monarchs nectared on flowers during the last phase of their migration in central

Mexico and the availability of nectar there ‘rescued’ them from the severe drought conditions farther north.

Our results emphasize the importance of suitable nectar foraging sites, especially through the Mexican portion of the migration and underline both the hazards posed by climatic events but also the resilience of this species.

Optimising conservation efforts

Despite extensive conservation concern among the three countries involved and substantial funding directed at monarch conservation in North America (especially given the recent albeit questionable listing of monarch butterflies as endangered by the International Union for the Conservation of Nature), few studies have considered eco-physiological connections linking weather and population status, and there is a paucity of studies on direct effects of weather on any stage during the lifecycle.

While the importance of nectar has been recognized, until now, there has been very little attention to how we can

use such information for the effective conservation of monarch butterflies. Our research suggests that conserving the nectar corridor close to the overwinter sites in Mexico may be crucial for the long-term survival of the migratory phenomenon. Currently, a worst-case scenario that we have luckily avoided is the occurrence of an extensive drought from Texas to the overwinter colonies in autumn.

Although presented here are the results of our work on energetic constraints faced by a long-distance migratory insect, the need to understand how all migrant animals of conservation concern fuel their migration is clear. Stopover sites that provide safe opportunities for rest and refueling during long journeys are a critical link in the migratory chain. These sites’ national and international conservation and understanding how their value can be maintained or increased will be a major challenge.



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A FOCUS ON GLOBAL BIODIVERSITY FRAMEWORK TARGET 7: APPROACHES TO POLLUTION

Dr Christoph Neumann analyses the Global Biodiversity Framework Target 7, and explains the need for a qualified risk-based approach to pollution from the COP15 convention

The key outcome of the COP15 Convention on Biological Diversity (CBD) meeting in December 2023 in Montreal was adopting the Global Biodiversity Framework.

Target 7 of the Global Biodiversity Framework, as adopted, reads as follows: “Reduce pollution risks and the negative impact of pollution from all sources, by 2030, to levels that are not harmful to biodiversity and ecosystem functions and services, considering cumulative effects, including:” (a) “reducing excess nutrients lost to the environment by at least half including through more efficient nutrient cycling and use;” (b) “reducing the overall risk from pesticides and highly hazardous chemicals by at least half including through integrated pest management, based on science, taking into account food security and livelihoods; and also” (c) “preventing, reducing, and working towards eliminating plastic pollution.”⁽¹⁾

This article focuses on the relevance of Target 7 to pesticides specifically targeted under (b), explaining the need for a qualitative risk-based approach.

A comprehensive definition of pollution

There is no generally agreed definition of what constitutes “pollution”. The specific context and goals of different legal instruments shape the definitions, which often relate to specific parts of

the environment to be protected from defined undesirable effects from specific sources.

A workable definition of “pollution” must include a clear appreciation of “risk” instead of hazard. Since pesticides are specifically spelt out in Target 7, the dedicated regulatory regimes in a specific jurisdiction that explicitly assess risks from using a pesticide should apply.

These risks include undesirable effects on human and animal health, fate and behaviour in the environment and impacts on a range of non-target species. Based upon a detailed risk assessment, environmental risk mitigation measures are prescribed.

Treating pesticides as unregulated by imposing overall non-qualified quantitative restrictions on the total number or volume of pesticides used – without regard to the individual risks which have been assessed and determined acceptable – would ignore the well-established regulatory frameworks for pesticides.

It is hence vital to acknowledge that the off-target residues and their effects which have been assessed and approved in a risk management process mandated by law, should not be legally qualified as pollution.

A qualified risk-based approach to pollution

Albeit earlier versions of Target 7 focused on a quantitative reduction of pesticide use, the adopted Global Biodiversity Framework refers to “reducing the overall risk from pesticides”, with a further reference that this should be “based on science” and “taking into account food security and livelihoods”. Therefore, it is essential that national action plans define and implement such a qualitative risk-based approach.⁽²⁾

Ongoing innovations will enhance the farmers’ toolbox, enabling more sustainable use and protection of biodiversity, ecosystems, and their services in agricultural production systems. Besides Integrated Pest (IPM) and Integrated Weed (IWM) Management, developing biological pesticides and using digital tools will increasingly make inputs more precise and data-driven and support risk reduction of agriculture on biodiversity.

Those innovations could also deliver reduced pesticide use rates depending on local conditions of pest and disease pressures, and yield expectations linked with respective food security needs and farmers’ livelihoods.

The discussion on agricultural practices and impact reduction and addressing the nexus of increasing demand for



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food and food security as well as the challenges of climate change, should also be linked to Target 10, which aims to define the balance between people's need for nutritious food and food security while sustainably managing biodiversity and natural resources plus safeguarding ecosystem services.

The need for a meaningful indicator in the Global Biodiversity Framework

At COP15, the headline indicators of the monitoring framework of the Global Biodiversity Framework were also agreed, which for T7 and the pesticide component is "Pesticide environment concentration".⁽³⁾ However, given the lack of any context and guidance enabling effective implementation, it will be further discussed by an expert group established under the CBD.

To better reflect what evidence-based pollution reduction constitutes in terms of pesticides, a comprehensive and applicable definition of "pollution", including a clear appreciation of "risk" instead of hazard, as assessed under dedicated regulatory regimes, needs to be considered.

This is confirmed by the science brief on Target 7 of the Global Biodiversity Framework commissioned by the CBD, stating that "The headline indicator of total pesticide use per hectare, should be replaced with environmental risk-

based indicators. Risk-based indicators can be calculated using currently available data – more precise risk-based indicators will require efforts to collect better data on pesticide use, exposure per active ingredient and toxicity."⁽⁴⁾

In practice, this indicator should also enable effective management, practical implementation and monitoring and could be further refined by referring to percentage of parties that have established programs to reduce pollution, i.e., off-target contamination, excessive use and agricultural practices non-compliant with Good Agricultural Practices."

In support of implementation and monitoring by countries, the following effective risk mitigation measures are suggested:

- Percentage of parties that have scientifically assessed risk management options to mitigate run-off and spray drift to edge-of-field waterbodies and to terrestrial habitats.
- Percentage of parties that implement risk management/mitigation measures that mitigate run-off and spray drift to edge-of-field waterbodies and terrestrial habitat.
- Adoption rate of precision agriculture to reduce the footprint of pesticide applications.

- Reduction in the frequency of exceedance of regulatory acceptable concentrations for aquatic ecosystems when baseline is available.

Reducing the risk of pesticides on biodiversity

To effectively reduce the risk of pesticides on biodiversity, we call upon all policymakers to cooperate with the key stakeholders to clearly define a qualitative risk-based approach and provide a meaningful indicator to ensure an effective, a workable and a coherent implementation of Target 7.

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SECTION

AGRICULTURE





USDA combats trafficking of illegally taken plants

From the USDA's Animal and Plant Health Inspection Service: Plant Protection Today – Lacey Act Phase VII Is Coming – USDA combats trafficking of illegally taken plants

In the fall, the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) will announce the schedule of the next phase of Lacey Act declaration implementation: Phase VII. But now is the time to get the word out to U.S. importers so they can get ready! Phase VII will include a wide variety of materials and plant products that have not yet required a declaration. APHIS launched an outreach campaign in October 2022 to provide information about the upcoming declaration implementation phase.

In Phase VII, Lacey Act declarations will be required for all remaining plant product Harmonized Tariff Schedule (HTS) codes that are not 100-percent composite materials. That means a wide array of imported products – such as furniture, additional essential oils, and cork – that have never before needed Lacey Act declarations will now need them.

Our message to importers: If you import items that contain plant products, and you do not currently file a Lacey Act declaration, you will likely need to file one once we implement Phase VII. Now is the time for you to prepare by becoming familiar with your supply chain and reviewing what information is necessary to [file a declaration](#). APHIS' Lacey Act [web page](#) provides this guidance:

- Know your supply chain for each piece of plant material in the product.
- Learn how to file a declaration.
- Read the frequently asked questions.
- Stay connected.

Why is the Lacey Act important?

Historically, the Lacey Act was created to combat bird poaching. It was first enacted in 1900, but the 2008 Farm Bill heavily amended the Lacey Act and extended protections to a broader range of plants and plant products, making it unlawful to import certain products without an import declaration. The amendments focus on illegal logging and harvesting of wild plants, practices often linked to terrorist funding, political instability, deforestation, and unlawful trade.

What should importers know?

You can help stop illegal timber trade and protect endangered animals. Under Federal law, you must submit a Lacey Act declaration to import certain plants and plant products into the United States. Your declaration helps our country prevent illegal trade in



Image: © ozgurdonmaz | iStock

timber and timber products – so we can protect forests, people, and wildlife worldwide.

“When you import plant products or items that contain plant products, you must ensure that those plant products were legally harvested,” said Erin Otto, Lacey Act National Policy Manager. “The import declaration must contain the scientific name of the plant, the value of the importation, quantity of the plant, and the name of the country where the plant came from.” Since 2009, APHIS has been phasing in the declaration requirement.

While many plants and plant products will require a Lacey Act declaration, the following do not:

- Common cultivars, except trees
- Common food crops
- A scientific specimen of plant genetic material used only for laboratory or field research
- Any plant that is to remain planted or will be replanted
- Packaging material such as wood crating, wood pallets, cardboard boxes, and packing paper used as cushioning

or support unless the packaging material itself is the item being imported

- The plant material in a product represents no more than 5 percent of the total weight of the individual product unit, provided the total weight of the plant material in an entry of products in the same 10-digit tariff provision does not exceed 2.9 kilograms

Learn more about the Lacey Act and how it relates to plants and plant products by visiting the [APHIS website](#). For further questions, please contact APHIS Lacey Act program staff at lacey.act.declaration@usda.gov.

To find out which plants and plant products require a declaration, go to www.aphis.usda.gov/planthealth/laceyact and select Implementation Schedule.

Originally published online at <https://www.aphis.usda.gov/aphis/ourfocus/planthealth/ppq-program-overview/plant-protection-today/articles/lacey-act-phase-coming>, and used here with the kind permission of the Animal and Plant Health Inspection Service, United States Department of Agriculture. Accessed 8th May 2023.

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<https://www.aphis.usda.gov/aphis/home/>



ORGANIC SOIL AMENDMENTS: ENHANCING VEGETABLE PRODUCTION & SOIL HEALTH IN PUERTO RICO

Ermita Hernandez Heredia, Associate Professor from the University of Puerto Rico, details enhancing vegetable production and soil health in Puerto Rico in this organic soil amendments particular focus

Puerto Rico is an island with a population of over 3 million people, but it produces less than 15% of the food it consumes. The Puerto Rican food system is particularly vulnerable because of adverse climate change effects, such as the increase of extreme weather events and the dependence on importation.

Agricultural economists and food security experts recommend priority in the production and accessibility of short terms crops such as vegetables. This should be aligned with sustainable farming practices to be accessible to future generations.

Agriculture production in Puerto Rico is unsustainable due to rapid industrialization in production regions. Also, this sector relies heavily on agrochemical products. At a state level, there is no mitigation plan to help with adverse impacts caused by contamination or climate change effects, thus raising food security issues.

Impacts on soil & crop health

Soil health is well related to the quantity and quality of organic matter it contains. Therefore, using organic soil amendments such as cover crops, manure, biochar, or compost provides lasting benefits for development and proper plant growth.

Healthy soils are more resilient to changes and are essential since it helps sustainably increase food security. In addition, sources of organic materials in the soil provide many physical, chemical, and biological benefits. All these advantages prevent erosion caused by wind or excess rain and protect the soil against atmospheric events and climate change.

Using many organic amendments in the soil has been shown to improve crop production by improving soil structure, water holding capacity and suppressing pests and disease.

Exploring the uses of compost

Compost is a product of the decomposition of organic waste by macro and microorganisms. The quality or nutrient composition depends on the organic matter that is added at the beginning of its process.

Many researchers have demonstrated the benefits of increased nutrients, soil microbiota, carbon sequestration and soil organic matter. In addition, improvements in soil structure and nutrition, reduction of pests and diseases in crops, environmental impact in farming and crop yield have all been recorded.

The benefits of biochar

Biochar is black carbon produced from biomass waste products converted into a stable form. It is one of the most affordable negative emission technologies for future large-scale carbon dioxide sequestration.

The results of biochar studies often differ due to biochar's properties being significantly influenced by its starting material and pyrolysis temperatures.

The overall benefit of biochar is that it provides the soil with greater retention of nutrients and moisture and transport of heavy metals from the soil, thus reducing contaminants.

Many studies have shown how different biochar types applied at low rates can be stimulatory by promoting seed germination or acting as plant growth regulators and increasing resistance to biotic and abiotic plant stress.

Ongoing University of Puerto Rico research

To address the issue, Dr Ermita Hernández and her team at the University of Puerto Rico have investigated the use and rates of organic soil amendments to increase vegetable production while improving soil health in a different region of the island.

Various compost & rates in vegetable crops

A project directed by Dr Hernandez looked specifically at the rates of coffee pulp or composted chicken manure in different regions where vegetables are grown on the island. Rates were calculated based on the nutrient nitrogen needs of tomatoes, squash and cabbage.

The study showed that in the semi-arid region, when applying organic amendments to vegetable crops based on 50% of crop N inorganic needs, the yield was similar to applying compost based on 100% crop N needs, but the opposite was observed in the wet

region; crops needed to use 100% of crop N needs to ensure a competitive yield.

In addition, the study shows that using a higher amount of compost, either coffee or chicken manure, reduced up to 78% of plants expressing silverleaf, a physiological disorder in squash which can reduce photosynthetic rates due to the presence of high whiteflies population.

The use of coffee pulp compost showed an increase of 400% in the mean change of soil organic matter compared to the use of organic commercial fertilizer in six months in the semi-arid region in tomato crops.

Biochar & spent mushrooms compost in tomatoes

A recent project, co-directed by Dr Hernandez, examined the combined effect of biochar, and spent mushroom compost and its impact on tomato quality, yield and soil health.

The team created plots and amended the soil with six different treatments; pine wood biochar, spent mushrooms compost, organic commercial fertilizer, and combinations of these. These treatments were applied and incorporated the same day, six weeks before transplanting tomato, the leading vegetable crop produced on the island, and have drastically decreased in recent years.

Dr Hernandez's team faced the challenge of monitoring pre and post-soil chemical composition, soil moisture, tomato growth development, nutrient plant uptake, tomato fruit quality parameters and yield.

The first trial was run in 2023, which will provide the team insight into the

potential to improve production and assess soil health, looking into the benefits of soil structure changes caused by traditional farming practices that usually cause soil degradation infiltration and water retention problems.

Preliminary yield results show that spent mushroom compost had a similar total yield to the organic commercial fertilizer. Still, compared to using biochar, it increased the total yield of tomatoes by 31%.

Dr Hernandez and her colleagues will evaluate soil health and tomato quality differences. They have hypothesized that using biochar will increase nutrient retention and water-holding capacity. At the same time, the fruit's chemical composition will vary due to the changes in nutrient uptake by treatments.

Awarded by USDA NIFA Hatch 7004182 Title "Effect of organic soil amendments on soil quality and production of tomato *Solanum lycopersicum*"



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GENETIC MECHANISMS OF PIGMENT ACCUMULATION IN CARROT COLORS

We hear from Philipp Simon, from the USDA, Agricultural Research Service & University of Wisconsin, Madison, about how a kaleidoscope of colors reveals new genetic mechanisms of pigment accumulation in carrot colors

Most consumers in the Western world today are only familiar with orange carrots, and while orange is the color of most carrots grown globally today, red carrots are widely grown in Asia. Furthermore, the predominant color of carrots was not always orange. In fact, yellow and purple were the original colors of carrots in Central Asia (especially Afghanistan) over 1,000 years ago, where carrots were likely first widely grown as a root crop.

Domestication of carrots generated a vibrant range of colors

But since cultivated carrots were domesticated from wild carrots, let's start with the history of carrot colors with wild carrots, often called Queen Anne's Lace. Wild carrots occur widely around the world today as a weed growing along roadsides and in vacant lots, and they have white roots, which are edible and taste like carrots, albeit often with a strong carrot flavor. There is no written history documenting the development of the first yellow and purple cultivated carrots, but we deduce that the first domesticators of carrots likely first foraged local wild carrots growing in the countryside of Central Asia, went back to gather seed from more palatable wild populations, and started cultivating that seed where they eventually found that some of those early cultivated carrots were yellow and purple.

Beyond the unrecorded very early domestication history of carrot, written

(albeit scant) historical records document yellow and purple carrots in Afghanistan, then Iran and northern Arabia in the 10th century. Carrots were then reported in Syria and Anatolia in the 11th century, north Africa and Spain in the 12th century, Italy in the 13th century, and northern Europe in the 14th century. Early carrots were also carried by traders east of Central Asia to China by the 13th century. With their introduction to Asia, red carrots were developed, becoming a prominent color of Asian carrots.

In addition to written records, works of art have been a valuable resource in documenting the historical record of carrot colors. Early botanical treatises of the Roman Empire, before the common era, depict what may be orange carrots. But it was not until the 14th century that orange carrots are first seen in still life artworks in southern Europe, and by the 1500's, orange carrots became widely developed in northern Europe. With the expansion of global trade in that era, orange became the primary color of carrots grown globally.

Carrot colors deliver diverse nutrients

Jumping forward to the 19th century, organic chemists began characterizing the naturally occurring pigments found in carrots and many other vegetables and fruits. The carotenoid pigments play a very prominent role in carrot colors, with lutein accounting for the color of yellow carrots, alpha- and beta-

carotene for orange carrots, and lycopene for red carrots. Anthocyanins account for the color of purple carrots. Modern nutritional scientists have demonstrated that all the carrot pigments are bioavailable. And studies with diverse vegetables and fruits have shown their health benefits, with lutein protecting against age-related macular disease, lycopene protecting against some forms of cancer, and alpha- and beta-carotenes conferring the most significant health benefit as sources of vitamin A, which is an essential nutrient. The anthocyanins and carotenoids also have antioxidant properties, reducing the effects of damaging oxidizing chemicals found in the environment.

Why would carrot roots be so colorful?

Carotenoids play a critical role in photosynthesis by assisting chlorophyll in harvesting the energy of sunlight to convert carbon dioxide and water to glucose and oxygen. They also protect the photosynthetic pigment-protein complexes in leaves from harmful oxidizing by-products of photosynthesis. Both carotenoids and anthocyanins attract animals that pollinate flowers and disperse the fruit of many plants. So why are there carotenoids and anthocyanins in carrot roots, where no photosynthesis is underway and no reliance on animals to disperse roots?

Apparently, early domesticators of carrots discovered naturally occurring

genetic variation in white wild or early cultivated carrots, where lutein and anthocyanins accumulated in carrot roots, and they selected these novel colors over the generations that they grew the crop. So the colors familiar to us in cultivated carrots today are pigments out of place – occurring in roots, rather than their usual occurrence in leaves and fruits.

Recent research reveals novel genetics of pigment accumulation & boosts nutritional value

These pigments of carrots have also drawn the attention of geneticists in the last 75 years. Early studies demonstrated that one gene, referred to as the Y gene, accounts for the shift from the white color of wild carrots to the yellow color found in early cultivated carrots, and the P genes account for a similar shift of root color to purple. Interestingly, while green leaves in all plants accumulate carotenoids, in most plants, roots do not. But in carrots the Y gene upregulates genes of the photosystem to accumulate carotenoids in carrot roots. Similarly, while some wild carrots have purple color in their leaves, but not their roots, the P genes are transcription factors that activate genes for anthocyanin accumulation not only in carrot leaves, but also in carrots with purple roots. Recent extensive genetic studies of carrots have also led to the discovery of the Or gene, which stimulates the biogenesis of chromoplasts, the organelles in plant cells that accumulate carotenoid pigments in green leaves and in orange-fleshed fruits like melons, as well as in orange carrots. Additional research is underway to study additional genes that alter the amount and type of pigments in carrot roots.

In parallel with the more fundamental research studying mechanisms of pigment accumulation, plant breeding has been underway to develop new breeding stocks to improve the nutritional value of the crop available to consumers. This effort has resulted in an increase in the average grocery store carrot in the U.S. by ~45% in the last 40 years. Since carrot is a crop with a broad base of genetic diversity, the prospects for continued improvement of nutritional value are promising.

Laboratories collaborating in carrot color investigations:

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Acknowledgements

This material is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2022-51181-38321; under award number 2021-51300-34900.



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OPTIMISING SUBSURFACE DRIP IRRIGATION FOR EFFECTIVE DROUGHT DEFENCE

Professor Pete W. Jacoby from Washington State University describes how the innovative use of drip irrigation can enhance vineyard resilience to drought

Global warming threatens agricultural crop production and is a genuine concern to many worldwide, especially in regions dependent on sufficient precipitation during the growing season. The lack of rainfall necessary to produce a given crop within a rain-fed production area is defined as “drought”.

Drought may vary in severity according to the period of dryness or the timing of its occurrence during critical crop development. The Palmer Drought Severity Index measures the severity of drought for specific regions.

If deficiency occurs during sequential years, crop production may be threatened by the lack of natural rainfall or by public policies regulating the release of impounded surface water or pumping from aquifers below ground. Increased global warming may increase both drought severity and frequency of occurrence.

Use of irrigation in vineyards

Vineyard owners in drought-prone regions have employed irrigation to offset water shortages created by lack of rainfall. Wine grapevines generally use lower amounts of water than many other perennial crops, such as almonds.

The grapevine is also unique among woody plants by possessing the ability to employ a process known as

hydraulic redistribution. This feature allows the vine to obtain water from a source within the soil via its roots, replenish its needs, and even release water within the upper soil profile to sustain shallow lateral roots.

This feature may not always be well developed in vineyards subjected to frequent irrigation. Descriptive studies have revealed that vines subjected to frequent irrigations of short duration may develop and maintain the bulk of their root biomass within the top 45cm of the soil profile.

Because of their formative development under a dependable source of water availability, these vines may not develop an extensive system of deep roots. A vineyard comprised of vines with shallow root systems would likely be more vulnerable during severe or prolonged drought conditions.

Advantages and disadvantages of surface drip irrigation

The concept of drip or “trickle” irrigation was conceived in Israel by Simcha Blass after the end of World War II and later developed during the advent of extruded plastics during the 1950s.

Drip irrigation uses pressurised water delivered through extruded plastic water lines typically suspended from the bottom trellis wire supporting the grape vines. Water is applied through a

pressure-compensated emitter that drips water onto the soil surface beneath each row of vines.

This pressurised system allows water to be distributed uniformly across undulating land surfaces versus the flat topography required for non-pressurised irrigation. Pressurised surface drip irrigation is currently the most efficient system used for global vineyard irrigation.

While the advantages far outweigh the disadvantages of surface irrigation, it is essential to mention that applying water through the small orifice of the emitter allows the accumulation of mineral deposits that can reduce the flow rate over time. Periodic treatments of diluted acids through the system can extend the useful life, depending upon water quality.

Filtration systems are recommended to reduce clogging by water-borne soil particles and biological algae commonly associated with surface water distribution through canals.

Water applied to the soil surface is subject to evaporative loss. The primary losses occur from water use by broadleaf weeds and annual grasses that compete with the vines unless reduced by chemical or mechanical methods, which are sources of expense for the grower.



The advent of subsurface drip irrigation

Applying drip irrigation through buried lines with internal emitters can greatly improve crop water productivity (amount of product per unit of water applied).

Systems are best installed before planting the vineyard and have been reported to remain effective for 20 years or more. Efficiencies are gained from reducing water loss to weeds or evaporation from the soil surface.

Disadvantages involve the intrusion of fine roots through the emitter orifice and soil clogging of emitters owing to direct contact with fine-textured soils. Using copper in the emitter has been one attempt to combat root intrusion.

In addition, chewing damage to buried lines by burrowing rodents is a problem in certain regions. Such damage to buried lines is difficult to detect and repair, which has frustrated growers and slowed or eliminated the use of buried lines in some regions.

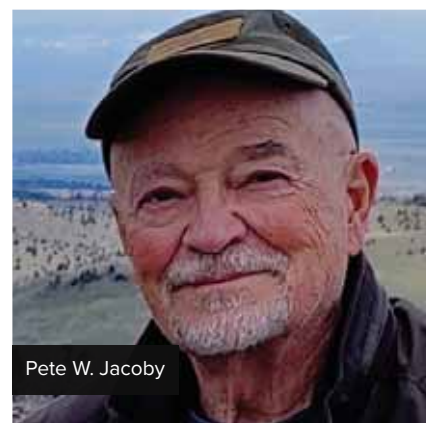
Innovation in delivering subsurface drip irrigation

A method for delivering subsurface drip irrigation without the use of buried lines has led to the development of a technique known as "Direct Root Zone" or "DRZ", which uses rigid plastic tubes to deliver drip irrigation to a desired depth below the soil surface.

Applied research conducted in commercial vineyards and guided by input from growers has been published in international peer-reviewed journal articles. DRZ has been found to alter the vine root architecture by reducing the root biomass in the top 60cm of the soil and increasing root number and total root length deeper within the soil profile.

This alteration enhanced overall physiological activity during periods of high summer temperatures compared to vines receiving surface drip at the same irrigation rate. DRZ achieved desired rates of grape yield while reducing water use by 25-34% of that needed for vines watered by surface drip delivery.

DRZ also enhanced deficit irrigation to improve grape quality for premium wine production, as will be discussed in an upcoming E-book.



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A U.S. perspective on the EU's Farm to Fork strategy

David Green, Executive Director of the U.S. Sustainability Alliance, discusses sustainable food systems, mirror clauses and their meaning



Image: © fotokostic | iStock

Through summer and autumn, U.S. farmers will harvest their crops, many of which they will have produced using innovative technologies. At the same time, the European Commission is expected to propose its far-reaching sustainable food systems (SFS) regulation to legislate minimum sustainability requirements for products placed on the European Union (EU) market.

The SFS is one of many legislative initiatives resulting from the EU's Green Deal and Farm to Fork (F2F) strategies. F2F's objectives for 2030 are to reduce the use of chemical pesticides by 50%, fertilisers by 20%, and antibiotics by 50% while increasing organic production to 25% of total agricultural production. The green strategies

might call for a science-based approach and new production technologies. Still, experience in the EU shows that such technologies can run into political and societal challenges leading to non-scientific delays and even outright rejection.⁽¹⁾

For EU farmers, the cuts in inputs without alternative production technologies mean facing an expected drop⁽²⁾ of up to 20% in overall productivity and a corresponding reduction in quality.⁽³⁾ This, in turn, would lead to increased imports from third countries,⁽⁴⁾ including the U.S., to make up for the shortfall. Little wonder that U.S. farmers and others globally might relish the potential for increased exports while sympathising with their European counterparts. They might even scratch their

AN OVERVIEW OF THE EU'S FARM TO FORK STRATEGY AT A GLANCE

The [EU's Farm to Fork Strategy](#) forms a key part of the European Green Deal and aims to make food systems fairer, more sustainable, and healthier for people and the planet. It plans to accelerate this transformation by harnessing new technologies and scientific discoveries, working collaboratively with key stakeholders, and improving public awareness of food systems.

Key objectives include:

- a neutral or positive environmental impact;
- helping to mitigate climate change and adapt to its impacts;
- reversing the loss of biodiversity;
- ensuring food security, nutrition, and public health, making sure that everyone has access to sufficient, safe, nutritious, sustainable food; and
- preserving affordability of food while generating fairer economic returns, fostering competitiveness of the EU supply sector and promoting fair trade.

[Speaking to Open Access Government in 2021](#), Claire Bury, Directorate-General for Health and Food Safety, said the Farm to Fork strategy alongside the Biodiversity strategy “set concrete and measurable targets, which include reducing the risk and use of pesticides and antimicrobials by 50%, reducing nutrient losses and increasing the share of organic agriculture to 25%, all by the year 2030. The EU is working to do this hand-in-hand with stakeholders, ensuring that all the necessary support to achieve these ambitious targets is given.

“As well as these targets, the Farm to Fork Strategy puts forward a list of 27 EU-level actions to spearhead our progress towards sustainable food systems. These range from food labelling, food waste, animal welfare and promoting the global transition.”⁽⁸⁾

Ambitious legislative framework on sustainable food systems to be introduced in late 2023

To ensure a more robust reformation of the EU's food system and integrate sustainability in food-related policies, the Commission announced an ambitious legislative framework comprising the sustainability labelling framework, which they initially planned to introduce in late 2023. However, this has been met with backlash from some EU officials, politicians, and farmers, who feel other matters, such as food security, should be central to future legislation.

With European-wide elections due to take place in spring of next year, advocates are eager for proposed programmes from the Strategy to be codified into legislation. However, the EU's progress towards meeting its green targets will likely be at risk due to the huge resistance from farmers.

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heads and ask, “what exactly does Europe want and expect from its farmers?”

Profitability and sustainability

From a U.S. perspective, the EU's regulatory approach to drive sustainable production comes across as prescriptive, heavily influenced by environmental and social pressures, with less attention given to the third leg of the 'sustainability stool' – economics. Yet, for farmers everywhere, being profitable goes hand in hand with the

basic tenets of sustainability. The U.S. approach to agricultural sustainability is more focused on voluntary initiatives and market-based approaches, such as incentivising farmers to adopt sustainable practices through conservation programmes.

This is not to say that there is no regulatory oversight since there are some 20 U.S. federal laws and policies governing conservation, the environment, and the protection of waterways.

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Mirror clauses concern EU trading partners

How the EU develops its approach to sustainable production within its borders is a matter for its legislators, regulators, producers, and consumers. However, the F2F strategy made it clear that it sees its approach as setting the global standard for sustainability. The EU's attempts to impose so-called mirror clauses, which would require agriculture imports to meet EU standards, not only for food safety (already needed) but also for animal welfare and environmental protection, have increased concerns ⁽⁵⁾ among trading partners that Europe is trying to dictate its policy unilaterally.

“The war in Ukraine threw into sharp relief the fragility of global agricultural production and trade, particularly in Europe.”

Achieving agricultural sustainability requires a multi-faceted approach that includes regulations and voluntary standards. Each has strengths and weaknesses, but they are complementary in promoting sustainability.

War exposes vulnerabilities in the global food system

The war in Ukraine threw into sharp relief the fragility of global agricultural production and trade, particularly in Europe, where the aspirations of the Green Deal came up against the hard reality of food security. As a result, implementing the F2F strategy is receiving increasing pushback ⁽⁶⁾ from EU politicians, farm groups, and even regulators. The conflict also showed the interdependency of achieving food security. It highlighted a need for flexibility and understanding in accommodating local ambitions alongside various geo-political contexts and contrasting food production systems.

Sustainable productivity growth coalition

In late 2021, U.S. Agriculture Secretary Tom Vilsack launched the Coalition on Sustainable Growth

Productivity (SPG) ⁽⁷⁾ with the underlying message calling for countries to take a global approach to bolster “sustainable productivity growth” and to “guard against trade barriers that discriminate against particular production practices even when the system is delivering positive outcomes.”

Interestingly, the EU joined the SPG Coalition the following March (2022). Perhaps, having looked in the mirror, the EU appreciates the need for more flexibility to meet the requirements of a global approach to tackling how to produce food sustainably and feed a growing world population.

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SUPPORTING EUROPE'S TRANSITION TO CLIMATE-NEUTRAL FARMING

We hear from ClieNFarms, an Innovation Action project funded by the European Commission to support the European Green Deal and achieve climate-neutral farming across Europe's agricultural industry by 2050



Farmers play a critical role in ensuring food sustainability. They are responsible for producing the food we eat, but farming practices can significantly impact the environment and the long-term availability of resources. Although agriculture contributes 10.3% of the EU's green house gas emissions, it has strong potential for climate mitigation through soil carbon sequestration and storage, albedo effects, and the reduction of greenhouse gases etc. ⁽¹⁾

More real-life experiments, clarification, and support are required for climate neutrality and climate-resilient farming. One recent example is the EU carbon removal certification framework

proposal, which 'aims to scale up carbon removal activities and fight greenwashing by empowering businesses to show their action in this field'.⁽²⁾ As well as being an essential initial step, the proposal further solidified the importance of farming practices and the need for sustainable carbon farming solutions.

What is the ClieNFarms project?

ClieNFarms is a four-year Innovation Action project funded by the European Commission to support the European Green Deal. The general aim of ClieNFarms is to co-develop and upscale systemic, locally relevant solutions to achieve climate-neutral

and climate-resilient sustainable farms across Europe.

Funded under the European Green Deal and supporting the Farm2Fork strategy, the ClieNFarms project wants to demonstrate, evaluate, and improve technical, organisational, and financial solutions at farm level to contribute to achieving climate neutrality in European agriculture by 2050. Coordinated by INRAE, the 33-partner consortia will work in a multi-actor approach, interactively integrating and improving existing solutions to achieve economically viable business models in farming systems, by involving farmers, extension services, agri-food businesses, policymakers, banks, and citizens.

The dissemination of sustainable carbon farming solutions is critical, as indicated in the recent IPCC climate report ⁽³⁾: 'The solution lies in (...) integrating measures to adapt to climate change with actions to reduce or avoid greenhouse gas emissions in ways that provide wider benefits'. Some farmers have begun implementing these solutions, but there is an urgent need to dramatically increase adoption to help meet the EU 2030 targets and achieve net climate neutrality.

How will the ClieNFarms project facilitate climate-neutral farming?

ClieNFarms can boost the adoption of sustainable practices and agricultural knowledge transfer through its demonstrative approach. This case-study structure will empower farmers and support the smooth dissemination and replication of tested innovations. These are called the I3S (Innovative Systemic Solutions Space), a network of twenty case-studies (crops, cattle, dairy, special crop productions, etc) where systemic innovative solutions will be tested and evaluated using up-to-date modelling approaches and multicriteria assessment tools. The selected solutions should avoid yield or product quality reduction. In addition, proposed innovative solutions will be tested on their climate-neutral impact, biodiversity, and water footprint, among others, to support a holistic view of the sustainability concept. The goal is to improve existing solutions, and achieve economically viable business models in farming systems through a multi-actor approach.

To avoid the one-size-fits-all approach, the project will facilitate participation and consider the local specificities run on each I3S. As part of a one-day event, for example, this creative arena will

bring together farmers and other key stakeholders that form part of the farming ecosystem (such as extension services, banks, agrifood chain businesses, and policymakers). Together, the group will have the opportunity to discuss solutions (technical, organisational, financial) and therefore move closer to achieving climate-resilient and climate-neutral farming systems.

To map the changes that might occur by implementing these solutions, ClieNFarms will use remote sensing data (e.g., Sentinel 1 and 2) and derived products (e.g., the Copernicus Land Surface High-Resolution Phenology service) as one of the proposed MRV tools (Monitoring, Reporting, Verification). The project will also develop a prototype of a carbon offset platform to create a better financial link between the actors of the whole food value chain – from farmers to retailers—including the food and the energy economic fields. The different elements of this platform will be transparent and truthful and use different numerical and computing solutions. The involvement of the value chain and other sectors remains the most impactful path for knowledge exchange and innovation development. To help with this, an upscaling toolbox will be developed to help replicate single farm prototypes to an entire region or agri-food chain, with a strong focus on the economic business model.

Change is a question of capacity building. The different solutions will be recorded and shared in a solutions hub. This will create capacity-building tools, integrating farmers' testimonials and practical solutions to reach climate neutrality. As part of the European Green Deal, strong links with sister projects will also enable a unified

approach and more decisive actions for change.

Overall, the targets for climate neutrality within European agriculture reflect farmers' critical role in ensuring food sustainability and the need for climate-smart agricultural practices. By developing innovative tools and promoting the adoption of sustainable farming practices, the ClieNFarms project will be a key player in climate change mitigation, supporting a sustainable European farming sector and helping it reach the targets set by the EU.

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This project has received funding from the European Union's HORIZON 2020 Research and Innovation programme under the Grant Agreement no. 101036822.



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Adopting agriculturally sustainable practices in rice cultivation

Aarthi JanakiRaman from Frost & Sullivan explores sustainability in agriculture, focusing on the extent to which rice cultivation shows the way ahead

Rice is amongst the top three crops cultivated globally and is a staple in the diet of more than half the world's population, making it a crucial commodity in international trade and vital for global food security. At present, more than 75% of rice (paddy) production comes from Asia, with China, India and Southeast Asian countries such as Thailand, Indonesia and Vietnam leading the way. Although paddy cultivation is indigenous to Asian countries, increasingly, this commercial crop is also cultivated in other geographies in the last decade, with Sub-Saharan Africa gaining a foothold as a rice cultivation hub; the previous five years have also seen an increase in the consumption of rice in the region, making it the fastest growing staple crop.

However, rice cultivation is riddled with challenges and is affected by weather adversities, water scarcity and other abiotic stresses. Additionally, research studies highlight that traditional rice cultivation methods can be touted as one of the main causes of both biodiversity loss and climate change.

Rising temperatures adversely impact productivity and yield

Traditional cultivation requires an uninterrupted water supply, which is becoming a challenge, with water scarcity becoming a norm in various geographies. Rising temperatures and changes in weather patterns also adversely impact productivity and yield, placing an economic burden on farmers. While climate change adversely affects rice cultivation, its production contributes to global warming and climate change risk.

Rice cultivation results in the release of methane gas due to the decomposition of organic matter and the microbes present in waterlogged fields that can hasten the decomposition process, releasing more methane gas into the atmosphere. This contributes significantly to environmental adversity as methane as a greenhouse gas is more potent than carbon dioxide.

Excess use of agricultural aids to improve yield affects soil biodiversity. The rising temperature due to the accumulation of greenhouse gases can increase temperature and result in water scarcity, making it a vicious cycle that can worsen if immediate action is not taken.

Sustainable rice cultivation: Need of the hour

To meet the rising global demand, rice production must increase by at least 25 to 30% in the next two decades. With depleting natural resources and climate change effects being felt, sustainable rice production is the need of the hour. Introducing sustainability in current rice cultivation practices warrants a multi-pronged tactic, right from choosing the right type of seed, irrigation management, integrated pest management and post-harvesting practices and so on.

Small changes, such as deploying direct-seeded rice instead of transplanted ones, can save water and reduce the need for agrochemicals; it needs continuous monitoring of various weed biotypes that can affect yield. Another practice is alternate wetting and drying (AWD) water management; it not only can reduce irrigation requirements from 10 to 40%, but it also helps increase soil biodiversity and potentially reduce methane emissions. However, AWD can yield lower in certain conditions, especially when the soil redox chemistry is altered.

To ensure long-term sustainability, public and private stakeholders are investigating various approaches, one of the foremost being developing and testing climate-resistant seed varieties. Various types that resist heat, water logging, salt/alkali concentration and even multi-stress tolerance have been introduced.

China, India, and other Southeast Asian countries are actively commercializing climate change-ready rice varieties. For example, India has introduced more than 10 to 15 rice varieties that are climate change ready in

the last ten years. Advances in synthetic biology and high throughput technologies have helped develop strains with desired characteristics that can withstand abiotic stresses but are also environmentally sustainable.

Organic practices to reduce water requirements

Using organic practices has also reduced water requirements and improved crop resilience and yield. Pilot trials using fragrant rice varieties (Jasmine rice) conducted in Southeast Asia where a combination approach of using organic agricultural aids, AWD, planting fewer seeds per square metre and careful monitoring of soil ecosystem and measuring hydro-biogeochemical reactions have increased yield by 20% at a minimum, while in certain instances, it has even doubled the same.

While multiple success stories prove that changes in current rice cultivation practices can improve the biodiversity and sustainability of rice production, these are still fragmented and small-scale. Therefore, an integrated long-term approach that spans the rice supply chain is needed to achieve large-scale success.

The Sustainable Rice Platform (SRP) introduced in 2011 by the joint efforts of UNEP (United Nations Environmental Programme) ⁽¹⁾ and IRRI (International Rice Research Institute) ⁽²⁾ has served as a platform that brings multiple stakeholders, including public, private, and non-profit organizations together to develop solutions that can benefit farmers and consumers while ensuring sustainable practices.

The KPIs devised in the voluntary Standard for Sustainable Rice Cultivation introduced in 2015 ⁽³⁾ have been effective in improving output, ensuring yield quality, reducing post-harvest losses, aligning to sustainable practices and ensuring biodiversity.

Technology as an enabler for sustainable rice production

For farmers to get maximum benefits and to help reduce the environmental footprint using the SRP standards, continuous traceability and monitoring are needed. Changes from conventional practices such as direct seeding or AWD or altering the standard pest control measures must be monitored to get value and to ensure safe output that meets the nutrient requirement of consumers.

Judicious use of biologically derived crop aids, improving soil biodiversity by encouraging the growth of beneficial microbes, integrated energy, irrigation, and pest management practices all contribute towards improving the sustainability of rice farming operations.

With advances in digital farming solutions, monitoring and managing farming steps is easy so that the produce meets food safety standards. Data management solutions are successfully helping farmers manage their day-to-day operations and provide a means for end-to-end traceability of operations; this results in better nutrient management and irrigation schedule.

Better pest management and monitoring of soil threshold levels make adjustment of agrochemical dosage easier, thereby reducing the possibility of leaching and minimizing potential damage to soil biodiversity.

Scientific advances have given a wide range of technologies that can help in smart and sustainable rice farming practices. However, a strong commitment is needed from policymakers and other stakeholders to realize the full benefits. Conducting regular outreach programs for information dissemination on various technology advances ensures technology availability to farmers.

These policies make it financially attractive to implement sustainable farming practices, joint field, and pilot trials to test and commercialize sustainable solutions, to name a few that can help make rice cultivation more sustainable in the next five years.

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Combating NCDs using Plant-based Proteins and Animal-Waste Products

Professor Apichart Vanavichit, PhD, a Rice Genomic Breeding Expert at the Rice Science Center, walks us through high-quality crop-based and ovo-based protein hydrolysates to combat non-communicable diseases in Thailand, specifically among its ageing population

The increasing incidence of non-communicable diseases in Thailand, specifically among its ageing population, is now a significant public health concern.

This situation may be associated with reducing protein intake among ageing people.

Older adults may find consuming high-protein beans and animal meats challenging to chew, digest and absorb. Low protein diets have been a leading cause of muscle loss and weakness among older people.

In addition, absorption of plant proteins may be blocked by antinutritive factors, such as trypsin inhibitors found in many tropical legumes and herbs. Diets with high caloric carbohydrates but low protein could lead to more obesity and type-2 diabetes. For these reasons, redesigning high-protein diets is sensible for the well-being of an ageing society.

Crop-based high-quality proteins

Protein content in plants ranged from < 2% (tuber crops and vegetables), 6-12 % (Cereals) to > 22% (legumes). Nonetheless, a high-quality protein that judges the content of essential amino acids and absorption called The Protein Digestibility Corrected Amino Acid Score (PDCAAS) was developed by a joint FAO/WHO expert in 1989. The PDCAAS scores > 1.00 can be called high-quality proteins.

Although rice grains have approximately 6-8% protein content, they are low in lysine, methionine, and cysteine, which makes rice low in PDCAAS, unlike soybean.

Furthermore, a high-quality protein may consider its therapeutic properties against non-communicable diseases (NCDs) for ageing populations by delaying metabolic syndrome and enhancing anti-inflammatory, insulin sensitivity and immune competency.

For these reasons, pigmented rice bran and rice leaf may be considered better choices for high-quality protein rich in antioxidants, anti-inflammatory, dietary fibre, and micronutrients.

The protein research group at Kasetsart University Agricultural Product Development Institute, led by Dr Sukantharos Tadakittisan, has isolated nutrient-rich proteins from crops and unfertilised eggs to meet the goal.

They combined protein hydrolysate with enzyme technologies to isolate plant-based proteins with functional properties against metabolic syndrome from pigmented rice, soybean and mung bean.

For example, the enzymatic protein hydrolysates from Riceberry bran (RBPH) contained 19% highly absorbable protein showing anti-inflammatory, anti-diabetics, and antioxidants.

RBPH also showed potently suppressed survival of the liver cancer cell (Huh-7/SNU-449), the breast cell (MCF-7/MDA-MB-231) and the bile duct cell (KKU-100). In addition, RBPH protected cell lines from Lipopolysaccharide (LPS)-induced inflammation by reducing nitric oxide and cytokine IL-1 β accumulation in vitro.

Pre-germination and fermentation induced additional nutraceuticals in rice, soybean and mung bean. Protein isolated from the germinated and fermented soybean and mung bean significantly reduced the size of peptides, enhanced anti-diabetics and phytoestrogen isoflavone aglycone.

Combining these isolated plant-based proteins, we created two nutraceutical products, Purple Protein Noodles and Instant Riceberry Protein Isolate. The 50g of the high-protein noodle contains 11g protein, 3.5g unsaturated fat, 3g dietary fibre, and 28g carbohydrate for only 200 kcal.

Additionally, the 35g serving size of the Instant Riceberry Protein Isolate contains 8g protein, 2g unsaturated fat, and 16g carbohydrate for 116 kcal only. The protein hydrolysate mix showed potent anti-diabetic effects by increasing the activities of alpha-amylase inhibitors and insulin-like proteins.

Still, it was also well perceived by most seniors as having a good taste and neutral smell. No arsenic nor aflatoxins were detected in the products. Therefore, these products are suitable as functional foods for delaying metabolic syndrome among ageing populations.

Turning wasteful eggs into high-quality proteins

Thailand is the third largest poultry exporter in the world. As a result, hatchery industries have created a substantial number of infertile eggs, up to 5-10%. Dead eggs are a good source of high-quality protein.

A speciality recipe, Kai Kao, created from unhatched eggs, has become a popular street food in Northeast Thailand.

However, the supply of unhatched eggs is several folds over their consumption. We have now turned these wasteful eggs into nutraceutical animal-based proteins for ageing societies. The pain point of using unhatched eggs in foods stemmed from the disgusting smell of these eggs.

Applying ultrasonic-assisted extraction and enzymatic digestion using bromelain and papain on unfertilised eggs successfully extracted highly absorbable, nutrient-dense protein (UFAP).

The UFAP contained 69% more protein and amino acids than regular eggs, particularly 81% more Lysine and 75% more Methionine. In addition, UFAP had three times more Retinol than 75µg RAE of 50g hard-boiled egg.

The microbial food safety is parallel to commercial white egg protein powder.

The in vitro analysis of UFAP revealed enhancing anti-diabetes and supporting an immune system against NCDs in vitro.



Figure 1: High-quality Plant-based Protein Instant Drink and Noodles with Nutraceuticals to combat NCDs in ageing societies.

Because animals convert 6kg of plant-based protein to make just 1kg of animal-based protein, it is more beneficial and environmentally friendly to develop high-quality plant-based proteins with nutraceuticals to cope with NCDs among ageing populations.

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Acknowledgement

The National Research Council of Thailand (NRCT) supported this ongoing project financially.

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THE EFFECT OF SOIL DEGRADATION ON HUMAN, ANIMAL AND PLANT HEALTH

Dr. Christine Sprunger, soil scientist and ecologist at W.K. Kellogg Biological Station (KBS) and the Department of Plant, Soil, and Microbial Sciences at Michigan State University, discusses the danger of soil degradation on human and animal life, and what we can do to mitigate it

Soil degradation is the biological, physical, chemical, and biological decline of soil quality or health. This phenomenon is problematic because it reduces the capacity of soils to support plant and animal life. Additionally, it reduces the ability of soils to regulate essential ecosystem services such as water regulation and nutrient cycling.

What factors have led to soil degradation?

Soil degradation has become a global issue and has come about largely due to land conversion from forests and

grasslands to intensive agricultural practices. Land conversion depletes soil organic matter values, releasing large amounts of carbon dioxide into the atmosphere, contributing to global climate change and reducing soil fertility and soil health.

Specific intensive agricultural practices that have led to soil degradation include frequent tillage events, failing to incorporate organic matter into a soil management plan, and monoculture cropping. Tillage is vertically disruptive to soils and can

break down soil aggregates, defined as a cluster of soil particles held together by organic matter, plant roots, polysaccharides from bacteria, and fungal hyphae. These aggregates protect soil carbon from microbial attack and are instrumental for soil carbon accumulation and sequestration. To this end, tillage harms soil's physical, chemical, and biological health.

Other intensive agricultural practices include relying solely on external sources of fertilizer, such as inorganic

nitrogen fertilizer, rather than replenishing the soil with organic matter inputs. Such examples include incorporating cover crops, where both above and belowground biomass increase soil organic matter inputs, applying compost or manure, or planting perennial crops with deep root systems. This also leads to the last point of extending crop rotations beyond just monoculture cropping. This crop diversification will reduce disease outbreaks, break up weed cycles, and increase organic matter and has been shown to increase yield stability over time.

How dangerous is soil degradation?

Soil degradation negatively impacts the environment, can be disastrous for the economy, and can even impact human well-being. Soil degradation is intricately related to the loss of soil carbon, which contributes to climate change. Soil degradation also leads to soil erosion. Historically, the Dust Bowl in the United States provides an example of when soil degradation led to financial ruin for numerous American farmers. Soil degradation can also lead to the inability to grow crops; many countries currently face this. For example, parts of Haiti have experienced vast soil degradation, making it challenging for small-holder farmers to produce enough food to support their families and communities. Earlier in May 2023, a dust storm caused by tillage in nearby farmland led to a major chain-reaction car crash, which tragically led to several casualties. To summarize, soil degradation can be dangerous on numerous scales, which is why soil health management is critical worldwide.

Why is soil health important for human and animal health?

While more research is needed to fully understand the link between soil health and human and animal health, there are some concrete linkages already known. For example, most staple crops that feed either humans or animal agriculture rely on healthy soils to maximize yields. For instance, maize production in the Midwestern part of the United States relies heavily on healthy soils, but most of that feed goes to cattle, which is a significant part of most humans' diet. Soils also consist of nutrients that are essential for human health. Some research also shows that maintaining healthy soils via increasing soil organic matter and fungal activity helps improve nutritional quality of crops, which in turn could benefit both humans and animals.

What is the most important thing that individuals, institutions, and governmental bodies can do to improve soil health?

There are numerous examples of how individuals can help to improve soil health. The general public can call upon their local and national representatives to support initiatives around regenerative agriculture, soil health, and environmental quality and request that national budgets incorporate funding for federal agencies to support research on soil health. In the United States, citizens can encourage lawmakers to include stipulations around soil health and regenerative agriculture in the Farm Bill.

Individual farmers can do a lot to directly impact soil health by adopting soil health-promoting practices that

include minimizing soil disturbance, increasing plant diversification, increasing soil organic matter inputs, ensuring year-round ground cover, and maximizing the presence living roots throughout the crop rotation. In addition, adopting practices like cover crops and/or minimizing tillage could lead to enhanced soil health. It could also lead to soil carbon accumulation and nutrient retention, which contribute to other key ecosystem services.

Governmental bodies can contribute by providing resources for farmers interested in adopting regenerative agricultural practices by providing training, farmer-led grants that could support farmers interested in experimenting with new practices, and incentivizing soil health-promoting practices by paying farmers to adopt more sustainable management practices.



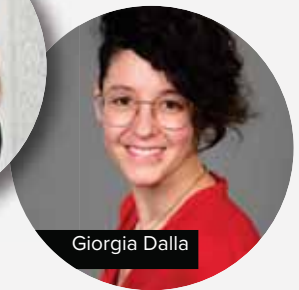
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Public procurement: An opportunity to transform the EU's food system



Dorina Meyer



Giorgia Dalla

Dorina Meyer and Giorgia Dalla Libera Marchiori from ICLEI Europe discuss opportunities for improving food security across the EU, public procurement, and cultivating a more equitable and environmentally conscious food system

With the [fragility of our food system widely exposed](#) and [food insecurity on the rise](#), we need to continue talking about the intersecting dimensions of food security and identify how they can be addressed both in the short and long term. Our current food system promotes products that lack [nutrition](#), adversely impacting our health and reducing biodiversity by not respecting planetary boundaries. Meanwhile, large parts of the world's population do not even have access to adequate food.

To fulfil the United Nations 2030 Agenda for Sustainable Development, specifically, achieve Sustainable Development Goal #2: Zero Hunger, the European Union has to transform its food system. This transformation process must pay equal attention to the different aspects of food security since it can only be realised if 'all people at all times have physical and economic access to sufficient, safe and nutritious food [that] meet[s] their dietary needs and food preferences for an active and healthy life.'⁽¹⁾ Next to the availability of food, food quality and accessibility are equally important when establishing food security and should not get lost in the current geopolitical climate.

Feasible strategies are already being implemented in the EU and beyond. However, there is potential to accelerate the process. [Buy Better Food](#) is a European advocacy campaign that focuses on public food procurement as a driver of transformation towards a sustainable, healthy and fair food system in the European Union, in line with the [SDGs](#) and [EU Farm to Fork Strategy](#). Public procurement, in particular, presents an important opportunity to provide a meaningful framework for reaching shared goals on climate, health, food waste, social equity, and more.



10 municipalities have already endorsed the Sustainable Food Procurement Manifesto



Local and regional governments can endorse the Sustainable Food Procurement Manifesto

Addressing the accessibility of nutritious food via public procurement

One huge opportunity to address the accessibility of nutritious food within a more sustainable food system is

by procuring better school food for kids across the EU. Buy Better Food's current [petition](#) for healthy, sustainable school meals has gathered more than 12,000 signatures, signalling the growing interest in a better food system - especially one that supports the health and wellbeing of young people. This aligns with the European Council's recommendation on the [EU Child Guarantee](#), which implores Member States to consider nutrition and provide at least one healthy school meal per day. The EU school scheme could also bolster access to [healthy, sustainable school meals](#), which is currently under revision and guides the provision of fresh produce and food education in schools. In addition, strong support for the [Global School Meals Coalition](#) from several EU Member States, including France, Finland and Germany, shows that the issue of healthy and sustainable school meals is gaining attention at an international level.

Now is also the right time to show public interest and support on the subject, as this year, the European Commission will submit a proposal for the upcoming [EU Sustainable Food Systems Law](#), which will play - as a key initiative of the Farm to Fork Strategy - a pivotal role in ensuring healthy meals are available in schools and other public canteens.

Addressing food quality: 93% of people agree that food offered in schools and hospitals should be healthy

In light of the upcoming legislative proposal, Buy Better Food recently emphasised its message by conducting a [poll](#) ⁽²⁾ in six European countries (France, Germany, Greece, Italy, Poland and Spain). The poll results reveal that the general public recognises the relevance of healthy (public) food: 92.8% of participants agree that food offered in schools and hospitals should be guaranteed to be healthy - with Italy, Spain and Poland having the highest approval rates. Along the same lines, when asked about government spending, 88% of people agree that guaranteeing healthy and sustainable food in public canteens (like schools and hospitals) is a good investment of public money.

Public procurement as a tool to address food insecurity

Buy Better Food is pressing for minimum sustainable public procurement standards to be included in the EU Sustainable Food Systems' legislative framework to move

towards food security, in addition to highlighting the critical role of local and regional governments in implementing procurement measures.

These standards are clearly outlined in the [Sustainable Food Procurement Manifesto](#), which identifies seven actionable criteria to help public authorities buy better food for the health of the planet, people and future generations: healthy food; organic and other agro-ecological products; support for small-scale farmers; climate action; social economy and labour rights; fair trade; and animal welfare standards.

[Ten regional and municipal authorities and organisations have already endorsed the Manifesto](#), and the numbers are growing. By harnessing public interest in sustainable, healthy school food and outlining broader actions aimed at cultivating a more equitable and environmentally conscious food system, Buy Better Food is taking the first steps toward a better food future and increased food security across Europe.

Local and regional governments are invited to endorse the Sustainable Food Procurement Manifesto advocating minimum standards in public canteens [here](#).

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The devastating water footprint of animal agriculture

Jasmine Clark, Senior Environment Campaigner at Viva! walks us through the devastating water footprint of animal agriculture, including scarcity, pollution and unsustainable demand

Water covers a staggering [70 per cent](#) of Earth's surface. However, access to usable water is extremely limited, with only three per cent of this being freshwater, two-thirds of which is trapped in glaciers and snowfields leaving only one per cent of all the Earth's water actually available for human use.

While we tend to think of water's primary life-sustaining use as drinking water, the single biggest global consumer is agriculture, using [70 per cent of all freshwater reserves](#). This is used to: grow crops (including animal feed crops), general on-farm use, such as cleaning, sanitation, crop spraying; and to rear farmed animals which feed the world's meat, dairy and egg demand.

The proportion of water used to produce animal products is not small. In fact, it's estimated that meat and dairy are responsible for around a [third to 40 per cent](#) of agriculture's water demands. Given that animal products only provide [18 per cent of the world's calories](#) this is an inefficient use of an extremely limited resource. 4

Our food and its water footprint

Everything we consume has a water footprint that reflects how much water is used to produce it. [The FAO](#) predicts that depending on your diet, it takes "2,000 to 5,000 litres of water to produce the food consumed daily by one person". This huge difference comes down to what we choose to eat – notably animal products or vegetable crops. Figure 1 shows the comparison between different food products based on research from Mekonnen and Hoekstra (2010; 2012) (<https://www.waterfootprint.org/resources/interactive-tools/product-gallery/>).

Meat scores significantly higher than most plant-based products, with beef, pork and chicken using nine, four and [three times more](#) water respectively than cereals. While milk looks like it has a relatively low water footprint, when you compare it to the water demand of plant-based alternatives, it is significantly higher, using as

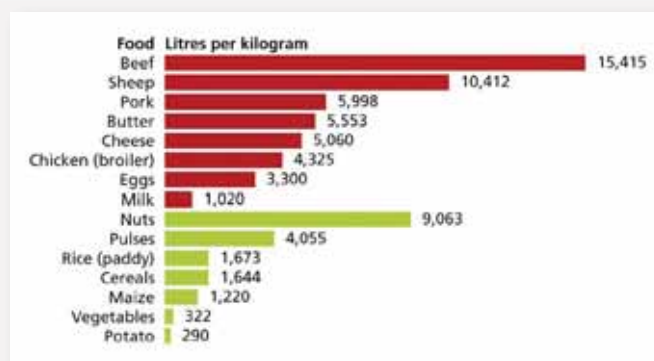


Figure 1: Water use in litres per kilogram of food

much as [two to 20 times](#) as much freshwater, depending on the plant milk.

The problem isn't that cows and sheep are exceptionally thirsty – only a fraction of the water used for farmed animals is drinking water. A study by [Mekonnen and Hoekstra \(2010\)](#) found that the vast majority, around 98 per cent, of this water is used to grow animal feed crops.

Growing crops to feed to animals for meat and dairy production is an unnecessary addition to the food chain, and a waste of limited resources.

This is recognised by experts, such as those at [Chatham House](#), who say: "[A global shift in diets away from livestock products could free significant water resources](#)".

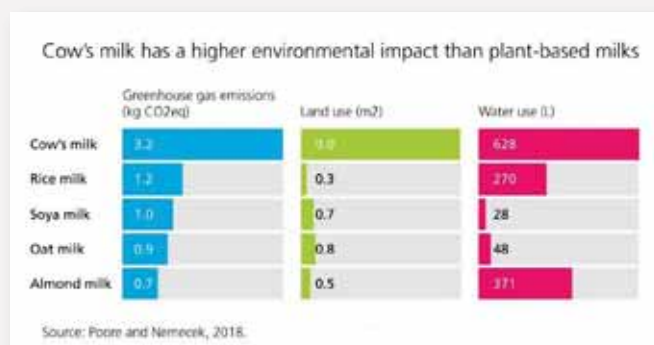


Figure 2: Environmental impact of different milks

Understanding the extent of water pollution in agriculture

Inefficiency isn't the only water-related problem when it comes to animal agriculture, water pollution from farmed animals and feed crops is also a growing problem.

Currently, at least 70 per cent of all farmed animals in the UK are factory farmed. Housing hundreds or even thousands of animals together in a small area, results in huge quantities of manure. In fact, farmed animals produce seven to nine times more sewage than humans, and most of it is left untreated!

The excess nutrients from this animal waste, alongside the fertiliser used on crops to feed them, then runs off into waterways resulting in eutrophication (the excess accumulation of nutrients in water) – leading to dead zones, where little to no aquatic life can live.

This is due to nutrients, such as nitrogen and phosphorous, promoting the growth of harmful algae blooms which remove oxygen from the water, making it unable to support life.

In the EU, [38 per cent of water bodies](#) are significantly under pressure from agricultural pollution. Closer to home, the environmental management of [River Wye](#) has recently come under scrutiny, with the Environmental Agency being taken to High Court over claims it has failed to protect the river from agricultural runoff.

At the centre of this case lies an algal bloom, which in June 2020 stretched for more than 140 miles, posing a significant threat to local biodiversity. Research from Lancaster University found [large quantities of phosphorus present in the River Wye](#) thought to have come from expanding poultry farms nearby, estimated to house around 20 million chickens.

Water security in a continually warming world

Water scarcity is one of the world's most dangerous challenges; currently, over two billion people live in countries with inadequate water supplies.

Richer countries further exacerbate this global problem by importing '[virtual water](#)' in meat or animal feed crops – essentially moving our water footprint abroad. In the UK, it is estimated that we import up to [50 per cent](#) of our food. By switching to a vegan diet, we would play a

key role in preserving crucial water reserves not just in our own country, but across the world as well.

As the world continues to warm, the requirement to reduce water consumption will be even more significant, with the climate crisis altering weather and water patterns around the world, causing shortages and worsening water scarcity.

A recent report by [Christian Aid](#) predicted that by 2050, British rivers could lose more than half of their water. Even sooner, by 2025, two-thirds of the world's population may face water shortages.

Animal agriculture, a leading cause of the climate crisis, contributes to a [fifth of all global greenhouse gas emissions](#). Therefore, if we want to reduce or avoid the impending water shortages, we must address the key drivers – meat, dairy, fish and egg consumption.

The world's finite water resources are already being pushed to their limit, and this will only worsen as the population grows and the impacts of the climate crisis intensify. However, we already have a key solution.

Reducing animal-based foods offers the potential to save enough water to [feed 1.8 billion](#) additional people globally and will significantly reduce global greenhouse gas emissions. It's time we moved away from this inefficient system by switching to a vegan diet.

Viva!'s environmental campaigns raise awareness of how eating meat, dairy, fish and eggs lies at the heart of nearly every environmental issues. Explore our campaigns [Vegan Now](#) and [Eating the Earth](#) to find out more and see how you can help.

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URBAN LIVING LABORATORIES: OPPORTUNITIES FOR MODELLING SUSTAINABILITY TRANSITIONS

Here, a group of academics present Urban Living Laboratories to study sustainable food production systems, using systems dynamic modelling to analyse policy alternatives

Urban Living Laboratories (ULLs) have shown first promising signs of being valuable platforms for understanding transition phenomena.

To address our time's diverse grand societal challenges (like climate change and biodiversity loss), we must transition to truly sustainable systems, possibly the most significant shift facing modern civilisations. Such transitions involve coupled technological, social, economic and environmental shifts and demand transformative approaches with new forms of organisation and management.

Urban Living Laboratories can be used in a mission-oriented experimental setting to observe, investigate, validate and involve diverse actors to co-create inclusive and relevant sustainable alternatives for the systems of interest.

Among these actors to be included in such an experimental arrangement are: citizens, specific industries, market agents, policymakers and government, regulatory agencies, academia and others, depending on the guiding questions of inquiry.

The diversity of groups involved in the decision-making process to achieve sustainability is a crucial factor: it is the fundamental first step on the path to ensure that experiences and knowledge about more socially robust transition pathways are generated.

Exploring the food-energy-water nexus

The [WASTE FEW ULL](#) Project, a Belmont Forum-funded initiative, sought to identify inefficiencies in city-region's food-energy-water (FEW) nexus to investigate and test internationally applicable methods for reducing waste (Fried et al., 2022).

The project was centred around four Urban Living Laboratories – one in Brazil (São Paulo), one in South Africa (the Western Cape) and two from Europe (Bristol and Rotterdam) (Winter et al., 2023; Black et al., 2023). The ULLs experimentally demonstrated the dynamics and investigated pathways for transitions towards sustainability in the FEW nexus.

São Paulo in Natura Lab

The Brazilian Urban Living Laboratory – the São Paulo in Natura Lab – focused on a metropolitan food production area around the city of São Paulo. The sustainability level of several relevant FEW policies was included in a study by Francisco et al., 2023; this article demonstrates the use of a) Ecosystems Service Index (ESI) – Payment for Environmental Service's proxy and b) the Consumer Supported Agriculture Index (CSAI).

Both were assessed using system dynamics modelling (SDM), allowing the modelling of the interactions between technological, environmental, political and social variables and multiple policies.

Also, relevant factors to facilitate an understanding of the complex nexus system's potential to transition to sustainability were used in the overall study, including the Human Development Index focusing on land use and measures, indicating the potential for sustainable food production, including water and energy use.

Modelling of ESI and CSAI allowed a comparison of the impacts different policies to promote sustainability could have on agroecological and conventional food production modes. For example, traditional approaches make use of agrochemicals, such as pesticides and fungicides, to keep fields free of weeds and pests, plus artificial fertilisers to add necessary nutrients to the soil; agroecological principles, on the other hand, do not use artificial methods to support their crops, but rather organic fertilisers and biological pest control are used (Figure 1).

Six predictive scenarios for land areas

To support this investigation, six predictive scenarios were considered, using SDM to model trends for a range of different land areas (from 4 to 10 acres), implementing ESI and CSAI at rates from 1, 5 and 10% per month over the modelled 10-year period.

The six modelled scenarios:

1. No implementation of CSAI or ESI; this represents the benchmark.



Figure 1: A. Agroecological farming methods, “Parelheiros”, to produce greens to be marketed at local co-operatives in Sao Paulo, Brazil. B. A field of wheat grown using conventional farming methods in the UK

2. CSAI and ESI are implemented at a rate of 1% per month.
3. CSAI and ESI are implemented at a rate of 5% per month.
4. CSAI and ESI are implemented at a rate of 10% per month.
5. No CSAI and ESI with the climate crisis is represented by a reduction in rainfall of 30%.
6. CSAI and ESI were implemented at a rate of 10% per month with the climate crisis implemented as under scenario 5.

Results were applied to Land Use Earnings (LUE) to find whether implementing a more sustainable approach to a food production system would attract the producers and encourage its use. Compared to benchmark scenario 1, all these scenarios indicated that LUE increased for agroecological and conventional systems.

The agroecological system had a higher prospect of transitioning to sustainability

However, occasionally, the benefits of the agroecological system appeared to be slightly more significant than that of the conventional system (Francisco et

al., 2023). This comparison suggests that the agroecological system had a higher prospect of transitioning to sustainability.

However, there was no statistically significant difference between scenarios 2-4 as the payment for ESI implementation is low, which has minimal impacts on both production systems.

Overall, the tests and comparisons using this modelling approach revealed that:

- a) The FEW Nexus is a complex system; SDM can support decision-makers by representing the system as a whole while providing an overview of interactions between individual aspects of the system.
- b) SDM enabled a better understanding of the potential for sustainability transition due to implementing FEW policies when applied to agroecological and conventional farming systems.
- c) Urban Living Laboratories can be used to model real-time and real-world experiments representing the relationship between sustainability challenges and public policy. ULLs can guide policy and

management decisions, as in this case, by valuing ESI more and enabling better uptake of FEW-related policies.

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WASTE FEW ULL
Waste: Food – Energy – Water Urban Living Labs

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Phasing out the use of animals in science

Barney Reed, Senior Scientific Manager, Animals in Science Department at the RSPCA, stresses the need for ambitious strategies for phasing out the use of animals in science

In April, new public polling ⁽¹⁾ showed that 77% of EU citizens want to see clear plans for a transition to doing science “without the use of animals”. The European Parliament has also called for this. ⁽²⁾ The sentiment is mirrored in the UK, where 8 in 10 adults agree that more must be done to speed up the development and uptake of alternatives to animal experiments and that the Government should “commit to ‘phasing out’ animal use in scientific research and testing.” ⁽³⁾

Using animals in science continues to be an important issue, with high public interest worldwide. Although the debate on this emotive topic can sometimes become polarised into simplistic ‘for’ or ‘against’ arguments, the issues involved are complex.

Animals are used in experiments for many different purposes, and each raises specific animal welfare, ethical and scientific issues. But, ultimately, we believe everyone should be able to agree on the desirability of reaching a point where science is done without causing pain, suffering, distress or lasting harm to sentient animals.

Challenging the status quo of animals in science

Annually, over 100 million animals are used in research and testing globally. Whilst there are examples of animal use leading to benefits around understanding certain diseases and developing therapies, there is also increasing recognition of the significant scientific limitations of many animal ‘models’ and tests.

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German Coalition Government declared ⁽¹³⁾ it will “present a reduction strategy for animal experiments” and “intensify research on alternatives”. The UK’s Minister for Science, Innovation and Technology has said ⁽¹⁴⁾ “...while I do not believe we are yet at the point where we can completely move away from reliance on animals, I make it very clear that we need to move faster. We need to reiterate to the public that that is our intent”.

And in the U.S., the Environmental Protection Agency has said ⁽¹⁵⁾ that by 2035 it wants to eliminate the use of mammal species in the tests it undertakes and funds.

Actions, not just words, are needed for the end of animal experiments

More organisations are signing up to work towards entirely replacing the use of animals in science. This is not about ‘banning’ or stopping important research; it is about maximising our opportunities to pioneer and adopt the advanced methods and approaches that will help solve the major health and environmental challenges of the 21st century.

The EPAA, a collaboration between the European Commission and industry partners, recognises ⁽⁴⁾ “the translational and predictive value of animal studies is increasingly being debated and questioned in the public, scientific and regulatory community”.

While in the UK, a report by six key organisations associated with government funding for science has highlighted ⁽⁵⁾ that “there is increasing recognition among companies and regulators of the limitations of preclinical models, including animal models, and the need for more predictive approaches”. ⁽⁶⁾

Changing scientific approaches

There is a growing appetite for doing things a different way. In recent years there has been encouraging progress in developing some of the needed non-animal technologies (NATs) and new approach methodologies (NAMs).

New technological advances offer increasing potential for replacing current animal use in specific tests, research stages or areas. For example, advanced *in vitro* models, such as organs-on-chips ⁽⁷⁾ and organoids, are increasingly available in biomedical research. An increasing number of approaches that avoid animal use are being introduced to assess the safety of chemicals. ⁽⁸⁾ This has raised ambitions for what might be possible in the future to help reduce the use of animals, while simultaneously speeding up and increasing the success, and reducing the cost of scientific research. But how do we make faster progress?

A building momentum in the alternative testing market

We now see clear statements of intent in several countries that perceive real benefits in leading the pack on this. And not only for scientific and animal welfare reasons - the global non-animal alternative testing market, which is growing annually, is expected to be worth an estimated \$2.6 billion by 2026. ⁽⁹⁾

The European Commission has emphatically stated that it shares the conviction “that animal testing should be phased out in Europe” ⁽¹⁰⁾, highlighting that EU legislation “sets a final goal of full replacement of all animals used for scientific and educational purposes and is taking concrete action towards that goal”. ⁽¹¹⁾

The Netherlands has set out a ‘Transition Programme for Innovation without the use of animals’ ⁽¹²⁾, and the

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But such ambitions must be matched by [leadership and commitment to achieving this](#), with clear plans, the right investment, and targeted support for people and infrastructure. Whilst this lags behind the rhetoric, the landscape will not change anywhere near fast enough.

In many cases, there are clearly real scientific obstacles to be overcome. For example, alternative methods may not currently be available. But there are also cultural issues around 'the way science is currently done', which means that even when alternatives exist, people may be slow to accept them - sometimes because they don't know about them or how to use or access them.

Transitioning away from using animals in science, and phasing in alternative approaches, will require greater commitment and coordinated action from politicians; companies that produce new medicines or chemicals and the bodies that regulate them; organisations that fund science; and individual scientists. It is a challenge that I and millions of others hope they rise to.



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ANIMAL ETHICS IN RELATION TO DESENSITISATION AND EXTREME COMPARTMENTALISATION

Dr Rebekah Humphreys, a Senior Lecturer in Philosophy at the University of Wales Trinity St David, Lampeter, discusses animal ethics and the morality of our treatment of animals in testing and intensive farming.

Having become interested in the subject since studying it at university as part of a BA Degree in English and Philosophy, I have researched animal ethics (a sub-discipline of philosophy) for the past 25 years. I became conscious of the ways in which animals were being used in animal experimentation and factory farming (partly because of the work of Compassion in World Farming and (what is now known as) Cruelty Free International.

This led me to an MA in Ethics and Social Philosophy before completing a PhD, specialising in animal ethics.

I wanted to examine the justifications given for the suffering of animals used in these practices to understand how such treatment could be possible on such a vast scale (more than 100 million animals are used in research globally every year, with 4 million being used in the UK alone (RSPCA, 2023a); and approximately 50 billion animals are factory-farmed worldwide every year (CIWF, 2023)). My current research includes issues of justice, equality, desensitisation, compartmentalisation, and dignity in relation to animal ethics, ethology, and environmental ethics. My work is influenced by the work of many philosophers, particularly that of Robin Attfield, Peter Singer, Raimond Gaita, Mary Midgley, Richard Ryder, and Stephen R. L. Clark, and by ethologists

such as Frans de Waal and Pamela J. Asquith to name just two.

What do you think the biggest struggle with animal testing is currently?

I believe it is partly public perception and the narrative of our use of animals (Watson and Humphreys, 2019). Animal experimentation is often conceived as a special area of research – a place where miracles and cures are made (Humphreys, 2022, pp.238-46). This (mis) conception exists despite many experiments causing suffering for peripheral purposes, such as the testing of new products or ingredients. Even where suffering is caused for medicinal purposes, it does not follow that causing such suffering on such a vast industrial scale is justifiable. The RSPCA estimates that 10 million animals undergo severe suffering each year across the globe in the practice of animal experimentation (2023b).

Further, the language used in reports on animal tests tend to use highly mechanistic language that distances us from the experiences that the animals endure (for example, distress tends to be depicted as a stress response, rather than a subjective experience felt by the animal). This reinforces unchallenged norms and assumptions about our use of animals in research and distorts our moral compass by

acting as a veil over the reality of the lived experiences of animals in laboratories.

How we present the sufferings of such animals in the media is important because, just as in other contexts, language can serve to hide that which in plain language would be described as brutalities on humans and animals (for more on language in relation to animal experimentation, see Linzey, et al., 2015, pp.45-45).

Additionally, animals in experiments are often viewed as abstractions of what they truly are (sentient individual animals with their own pains, pleasures, and lives); a reality that is separated from what they are in the experiments (when they are used merely as a means to an end). This abstracted view may foster desensitisation to their suffering, which could enable us to do things to animals in certain contexts that we would not be prepared to do to animals outside of these contexts (see Humphreys, 2022, pp.242-44).

We do things to animals in this practice that we would not be prepared to do to animals of the same species outside of the practice

As such, with animal ethics, we should be wary of a certain type of extreme

compartmentalisation of mind that could go along with desensitisation; one that relates to the practicalities of the work.

One might consider that a mild sort of compartmentalisation is permissible (in relation to the different treatment of animals within science) and may have some ground because science is a knowledge-obtaining institution. Such mild compartmentalisation can be seen across all professions – it's often one that varies according to social roles (see MacIntyre, 2006, p.196). However, in contrast to extreme compartmentalisation, mild compartmentalisation need not involve desensitisation, nor involve incoherences in moral judgments (Humphreys, 2022, pp.238-41).

Extreme compartmentalisation and desensitisation may foster a certain unresponsiveness to the sufferings of animals used in experiments; sufferings that would be met with horror were they inflicted outside of the scientific arena (even for great benefits).

This is deeply problematic as exercising compassion towards animals and reflecting on their sufferings can make us sensitive to actions that harm and benefit them, just as it does with human beings.

The cultivation of moral emotions in animal ethics, then, is important for developing safeguards against the unethical treatment of animals, and as such, should not be overlooked as mere sentimentality or as an unwelcome interference in carrying out the practicalities of animal research. Such emotions and reflections can

make us alert to what we should not do to animals, as well as promote respectful treatment (Humphreys, 2022, pp.247-48).

Another important issue with animal ethics concerns the funding and legality of certain experiments, such as the LD50 (lethal-dose 50) Draize test. This is a cruel test that causes considerable suffering and is used in respect of certain toxicological requirements. For chemical products and ingredients, it's a legal requirement that toxicology tests are conducted.

There are now humane alternatives for many experiments, and in relation to the LD50 test, a ground-breaking *in-vitro*, an animal-free alternative has been created by XCell R8 and is now ready to be used. This animal-free alternative was funded by Animal Aid (see Animal Aid, 2022; and XCell R8, 2023). It is wonderful to see such alternatives being funded.

Indeed, part of the struggle with animal testing is making humane alternatives recognised and supported through funding initiatives. It is vital that such alternatives are implemented as part of the aim to reduce, refine, and replace animal experiments (the 3Rs) (see further RSPCA, 2023a).

Do you believe there will ever be an option to end animal testing? If so, how could we do it?

There are already excellent options as alternatives, but ending animal testing involves challenging the drivers that maintain the continuance of the practice. Such drivers are complex and involve economic and political factors, as well as practical and psychological

ones. It also involves a genuine non-anthropocentric recognition that the causing of suffering to animals and the taking of their lives is not necessarily justifiable based on the accrual of human benefits, whether peripheral or not.

There are parallels here with experimentation on humans, and although some research on humans is undoubtedly justifiable, we should remember that history is littered with cases of unethical experiments on humans (such cases often involved vulnerable people), and we should bear in mind that animals in experiments are some of the most vulnerable creatures on earth whose interests are thwarted from the time that they come into existence for the very purpose of being used in experiments.

Arguments that humans are of greater value than nonhumans do not make for helpful arguments here, because animals' significant interests (at the very least, their interests in not suffering) are often overridden for peripheral reasons, such as the testing of new products or ingredients that are to be put on the market. And besides, as Attfield claims, recognition of the intrinsic value of animals and their flourishing 'does not commit us to respect (or treating) all creatures equally' (Attfield, 2023, p.16).

But we need to consider if we would be prepared to inflict such suffering on animals outside of the laboratory for the same purposes, or whether we would be prepared to inflict that same amount of suffering on humans for the same purposes. If not, then we should question our readiness to use animals in experiments.

Such questioning may involve a profound reevaluation of animals and their lived experiences. Indeed, animal ethics and Critical Animal Studies more generally, have much to contribute here via their challenge to the normalisation of animal experimentation (see Linzey et al, 2015), the commodification of animals and their lives, and the recognition of animals used in experiments as having a value in and of themselves, rather than as a 'free' resource (see further Humphreys, 2023, forthcoming).

Powerful interests are at stake with animal testing

There are huge-vested and powerful interests at stake, particularly within the pharmaceutical industry, made stronger by animals not having a voice. Although they will often dissent from being used (via their body language, for example), properly responding to animals' dissenting behaviour would have massive implications on what we are permitted to do to animals in the name of our own interests.

Sadly, animal discrimination has become part of everything we do and consume, making the movement for change difficult on motivational, habitual, and political levels.

This is one reason why some political theorists have considered the potential of genuine deliberative justice in relation to animals and their interests (see Garner 2019). Robert Garner clearly explains the deficiencies with the current 'strong' anthropocentric approach within political systems – 'which holds that only human preferences regarding animals ought to be promoted' (Garner, 2016, p.464) drawing on the well-established all-

affected principle (see Warren, 2017) to claim that 'animals themselves have a democratic right to have their interests represented in the political process' (Garner, 2016, p.460), irrespective of whether humans desire or would prefer to have better protections afforded to animals (ibid., pp.459-77).

Such representation would be a central step forward in creating a meaningful political platform for change for the animals themselves. Most notably, this claim is made outside of traditional animal ethics theory and thereby avoids the debates regarding the moral status of animals and the conclusions of those debates, including abolitionist ones (see, for example, ibid., pp.461-63, and 471-72). For information on deliberative justice and animals, see the research being carried out by The Centre for Animals and Social Justice (CASJ).

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NUTRITIONAL MANAGEMENT OF CHRONIC KIDNEY DISEASE IN PETS

Renea Creech and Kim Wilson outline the challenges of Chronic Kidney Disease in pets, the irreversible loss of kidney function, and how nutrition can help

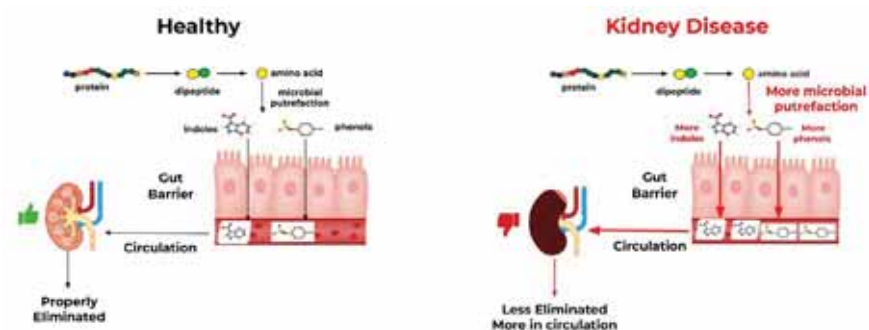
Approximately one in three cats and one in ten dogs are likely to develop kidney disease in their lifetime. ^(1,2) Increased incidence of diagnosis occurs in older pets, particularly in cats. ^(3,4) A longevity study showed renal disorders were a major cause of death in cats over five years ⁽⁵⁾, and upwards of 80% aged over 15 years are affected by Chronic Kidney Disease (CKD) or other renal disorders. ^(3,4)

Clinical signs include vomiting, decreased appetite, increased water intake, and total and lean body mass loss. Veterinarians often analyse urine and blood samples to determine biomarker levels such as serum creatinine and symmetric dimethylarginine (SDMA). The International Renal Interest Society provides veterinarians with guidance for diagnosing and managing kidney disease based on staging, with stage 1 representing early CKD and stage 4 severe CKD. ⁽⁶⁾

Diagnosing CKD in pets is challenging partly because kidneys adapt to the structural and functional loss of nephrons and renal tubules to maintain glomerular filtration rate and eliminate waste such as urea, indoles, phenols, and other nitrogenous waste. ⁽⁷⁾ Significant kidney damage often occurs before clinical signs appear, ⁽⁷⁾ and lifespan is ultimately shortened.

Nutritional management is recommended for pets diagnosed with CKD to slow progression and ensure adequate nutrient intake. Prescribed by

Figure 1



a veterinarian, these foods are formulated to have controlled protein, phosphorus, and sodium to reduce the workload of the kidneys and added omega-3 fatty acids and antioxidants to fight inflammation. These foods can be different for early stage (1 & 2) and late stage (3 & 4) by levels of nutrients provided.

The gut microbiome-renal axis influence on CKD

Like the gut-brain axis, crosstalk between the gut and kidneys impacts CKD. ⁽⁷⁾ People and animals with CKD have less gut microbiome diversity. ⁽⁹⁻¹¹⁾ The gastrointestinal microbiome shows functional differences between healthy and CKD pets (see Figure 1).

In these pets, there is a decrease in protein digestion, causing microbiome activity to shift towards putrefaction, which is the fermentation of undigested protein in the gut. This causes an increase in the production of end-products such as indoxyl-3 sulfate and p-cresyl sulfate. These circulating end products normally enter the kidneys as uremic solutes; however, the build-up is toxic (uremic toxins). ⁽¹²⁾

A healthy kidney with abundant nephrons ⁽⁷⁾ and functional renal tubules can eliminate solutes. However, pets with CKD have a reduced ability to eliminate uremic solutes, which become toxins.

The prolonged inflammation in the kidneys and the gut caused by these putrefactive end-products can disrupt the intestinal barrier and the kidneys' ability to eliminate uremic toxins. Sustained inflammation leads to further damage of the kidneys and increases gut permeability ^(12,13), making it harder for pets with CKD to absorb nutrients, leading to weight loss and lean body mass. ⁽¹⁴⁾ The progression of CKD is thought to result from this self-perpetuating cycle, which can be combated by nutritional interventions, specifically by feeding the gut microbiome.

Feeding the microbiome to slow the progression of CKD in pets

Feeding the microbiome impacts both the pets' nutrient digestion and the microbiome's end-products. ⁽¹⁵⁾ Fiber is an excellent substrate for the microbiome

as multiple meta-analyses have shown fiber intake reduces uremic toxins (p-cresyl sulfate and indoxyl sulfate) in people with CKD. ^(16,17) Selecting appropriate fibers is important to enhance specific microbiome functions. ⁽¹⁸⁾

For pets with CKD, the goal is to reduce the microbiome's putrefaction end-products while promoting beneficial end-product production and limiting the inflammatory response. Fibers in small quantities are required to maintain the strict nutritional formulation for pets with CKD.

Novel nutritional approaches to manage CKD

Fiber

Several fermentable types of fiber have shown promising results in kidney disease. Fructooligosaccharides (FOS, short linear fructose oligomers) and oat beta-glucan (OBG, larger, nonlinear polysaccharides) reach the colon where putrefaction occurs and provide the microbiome substrates to promote beneficial activity and reduce putrefactive end-products.

Providing FOS or OBG has reduced uremic toxins p-cresyl sulfate and trimethylamine N-oxide (TMAO) in people with CKD, respectively. ^(19,20) Mixtures of fibers provided by ingredients such as apple pomace additionally contain antioxidants in the form of polyphenols. ⁽²⁰⁾ Apple pomace can increase intestinal SCFA and lower ammonia production in kidney-injured rats. ⁽²¹⁾

A recent study evaluated feeding cats with CKD foods containing OBG and either apple pomace or FOS. ⁽²²⁾ Both fiber sources increased bacterial abundance of SCFA-producing bacteria relative to cats not provided with treatment fiber. More importantly,

the microbiome activity dramatically changed when comparing fiber sources. Food with OBG-FOS reduced circulating creatinine and several uremic toxins in cats with CKD compared to OBG-apple pomace. ⁽²³⁾ Therefore, a well-selected and more readily fermented fiber source may be better for pets with CKD.

To support an animal with CKD, a new approach is needed to nourish the microbiome properly and support pets' kidneys and gut at the cellular level.

Osmolytes

Osmolytes protect cell structure from damage and death by facilitating water uptake and retention, relieving cells from the additional energy required to maintain homeostasis. Betaine is an osmolyte that is efficiently utilised in the kidneys and gut. Betaine has specific receptors (BGT-1) in the kidneys and gut for uptake.

Unlike other osmolytes, betaine spares choline and methionine nutrients, reducing homocysteine reserves, which is considered a uremic toxin in pets with CKD. Circulating levels of betaine naturally decrease as CKD progresses ⁽²⁵⁾; dietary betaine supports kidney cells and improves intestinal integrity ⁽²⁶⁾ needed in pets with CKD.

Recent publications on cats with CKD tested changes in gut microbiome activity and body composition when fed the fibers FOS, OBG and the osmolyte betaine in a food designed for pets with kidney disease. ⁽²⁷⁾ The betaine-FOS-OBG addition increased total body mass in cats with CKD when compared to the control kidney food without betaine-FOS-OBG addition.

A more extensive CKD cat study saw improved total and lean body mass using the same betaine-FOS-OBG. ⁽²⁸⁾ A similar

study in CKD dogs showed total and lean body mass maintenance after over two months on the same betaine-FOS-OBG. ⁽²⁹⁾

Across these studies, reductions of several uremic toxins were found, including 3-indoxyl sulfate, several carnitine derivatives, a source of TMAO, and homocysteine while increasing omega-3 fatty acids DHA and DPA. ⁽²⁷⁻²⁹⁾

Traditional nutritional solutions for pets with CKD include controlling protein, phosphorus, and sodium to reduce kidney stress. Nutritional approaches that affect the gut microbiome-renal axis can have profound positive effects on pets with CKD. Foods with proper fibers and osmolytes will support the gut-microbiome renal axis as an additional approach to increase the quality of life for pets with CKD.

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Advancing animal rights

With a particular focus on South Korea, Open Access Government explores the changing perceptions around animal welfare and some of the policies introduced to support this

Animal rights is a controversial area for debate. For many of us, it is unimaginable for an animal to suffer pain at the hands of humans. However, in many parts of the world, whether for the purposes of tradition, consumption, economic gain, scientific research, or historical relevance, animals are still exploited for human gain. In recent years, social media has helped to highlight the harsh reality and brutality that animals worldwide have been subjected to; activists and animal welfare organisations have used far-reaching platforms to encourage industry, governments, and the public to acknowledge that animals are not mere commodities void of emotion and that further policy action to prevent animal cruelty is vital to reduce their suffering. The widespread increase in public awareness and publicly available information concerning animal welfare has encouraged many consumers to be mindful of the impact of their purchasing behaviour and for policymakers to introduce measures to mitigate animal cruelty in various settings.

Cosmetic testing, for example, has been an area of increasing public and political concern. In Europe and some other countries, it is now illegal to sell animal-tested cosmetics – though ingredients used in some products may still be tested on animals as per the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulation, the world's most extensive chemical testing programme. Equally, while companies are prohibited from selling animal-tested cosmetics in Europe, they are still allowed to test products on animals outside of Europe and sell them in other parts of the world. ⁽¹⁾

Despite progress in finding [alternative methods to animal testing](#), millions of animals are still used for biological research and to test the efficacy, toxicity and safety of products, including pharmaceuticals, consumer goods, and industrial/agrochemicals. According to Humane Society International (HSI), it is estimated that more than

115 million animals worldwide are used in laboratory experiments every year. ⁽²⁾ HSI also notes that because only a small number of countries actually collect and publish data on animals used in testing and research, the exact number needs to be clarified. For example, up to 90% of the animals used in laboratories in the U.S. are excluded from the official statistics. ⁽²⁾

In South Korea, fundamental changes at policy level have been proposed to reduce animal suffering, including a ban on the slaughtering of dogs for meat - a longstanding custom in the country - and a ban on all bear farming from January 2026. National attitudes towards animal welfare in the country are shifting alongside a rise in the number of South Koreans owning companion animals. However, many, particularly younger generations, feel more robust policy measures are needed.

Changing public perceptions towards animal welfare

It is estimated that up to a million dogs are bred and confined on farms across South Korea to be killed for human consumption. ⁽³⁾ According to opinion polls, 85% of people in South Korea would not consume dog meat, and almost 60% of the population now supports banning it outright. While dog meat consumption is declining, a nationwide ban on the dog meat industry in South Korea is still under consideration.

Equally, according to a survey conducted by Realmeter on behalf of HSI/Korea, 81.6% of Koreans believe that legislative support is necessary to create and promote alternatives to animal testing. ⁽⁴⁾

Ending unnecessary animal testing

Greater policy-level efforts are being made to advance progress in animal-free testing and in 2020, South Korea announced a draft Act that could position it as a world leader in non-animal testing technologies. ⁽⁵⁾ This new development was timely since statistics released in 2019 revealed an alarming increase in the number of animals used for experimentation in South Korea - a 187% increase in testing insecticides on animals and a 115% increase in the number of animals used to test industrial chemicals. ⁽⁶⁾

Ms In-soon Nam, a National Assembly member, said: "As a member of the health and welfare committee, I believe that this bill marks a much-needed initiative in our society to finally move away from relying on old

models that use animals and collectively move forward to provide better research approaches based on human biology, which will advance public health as well as animal welfare." ⁽⁶⁾

The proposed Act on the Promotion of Development, Dissemination and Use of Alternatives to Animal Testing Methods (PAAM) was introduced in December 2020. It would prioritise human-mimetic technologies to improve human health research and product safety testing. A second bill on the topic was proposed in December 2022. In 2023, campaigners submitted a petition with more than 66,000 signatures to members of the National Assembly, requesting the immediate enactment of the PAAM Act.

Although this marks a significant step in the right direction to reduce reliance on animals for experimentation, progress, according to Humane Society International, has been slow 'due to the lack of related laws and cooperative working structures among ministries.' ⁽⁷⁾ However, what made this campaign concerning PAAM particularly poignant was the screening of HSI's award-winning film 'Save Ralph', which follows the story of a rabbit named Ralph used in a cosmetics-testing facility.

The Director of the Korea Center for Validation of Alternative Animal Methods at the Ministry of Food and Drug Safety said, "We are aware of the importance of the bill that replaces animal testing and agree with its initiatives. As a government, we will do our best to provide support for its passage." ⁽⁷⁾

Last year, South Korea's Ministry of Food and Drug Safety amended its Biologicals standard and test method guidelines to cease the need for Abnormal Toxicity tests. The test, introduced in the 1950s to detect contaminants in pharmaceutical and biological products, has been deemed unnecessary and obsolete in many parts of the world following the emergence of modern pharmaceutical production and manufacturing facilities with clear and specific quality control measures.

The World Health Organization has also advocated the removal of the ATT since 2018 in the EU, U.S. and Canada. The test can still be waived for some products in Japan and India.

HSI/Korea's senior policy manager, Borami Seo, said, "We welcome this much-awaited amendment that does

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away with an obsolete animal test. This test was required for regulatory purposes despite evidence showing its lack of scientific value. Korea has a demonstrated capacity to adopt and refine rapidly advancing technologies. With this important step, we hope Korea will move even faster, showing its commitment to developing new technologies and reforming regulatory guidelines with non-animal methods.”⁽⁸⁾

Further policy changes to improve animal welfare

In 2019, South Korea’s Ministry of Food and Drug Safety announced it was drawing up a [five-year plan \(from 2020-2024\) to improve animal welfare](#) and introduce tougher regulations against animal cruelty. Part of the plan would mean research labs must monitor test animals and apply stronger regulations concerning their use for experiments.

South Korea’s animal welfare legislation – the Animal Protection Act – was first brought in 1991. Its significant revision, which came into force in April 2023, outlined substantial efforts to reduce animal cruelty and clarify the definition of what actions constitute cruelty. This included tougher punishments for those who abuse or abandon their pets and screening owners of new and current animal shelters, as well as the shelters themselves, before giving them the authorisation to operate. Despite this critical revision, animal rights activists and welfare groups have expressed concern over the robustness of the act and the need for administrative agencies, investigative agencies, and the courts to fully play their part. They also said that even those punished for abusing a pet could still have their pet back after a certain period.

In a statement released soon after the announcement of the Animal Protection Act, KARA, the ‘Korea Animal Rights Advocates’ group, outlined the worrying distinction between dogs seen as farm animals and bred for consumption and those viewed as companion animals: “All the animal abuse punishment applies to pets and it does not apply to dogs that are bred for consumption.

“Many people are not aware that Korea categorizes dogs into two, as pets and for consumption. Under the current law or even the revised law, we can’t do anything about abusive breeding and slaughtering of dogs categorized for consumption. We can’t punish the owners of dog farms that rear dogs for consumption even if they are feeding dogs food scraps.”⁽⁹⁾

With increased public awareness and [those at policy level continuing to strengthen animal rights](#), it is hoped that changes will continue to be made to promote non-animal alternatives across industries and treat all animals with the respect they so deserve.

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WHY DO WE ALWAYS CARE ABOUT THE WELFARE OF LABORATORY ANIMALS?

Seasoned experts from the Daegu-Gyeongbuk Medical Innovation Foundation (K-MEDI hub) in South Korea share their research perspectives on the welfare of laboratory animals, including the issue of veterinary care

Awareness of animal ethics is changing and rising worldwide, and the concept of animal welfare importance is spreading rapidly. Generally, animal welfare involves not hurting, harassing or recklessly killing animals. In addition, animal welfare involves inducing positive changes in humans and animals, both physically and emotionally. Based on the research and discussion of Ruth Harrison's claim in 1965, Britain began establishing various animal welfare measures. Subsequently, public opinion on animal welfare has spread widely across Europe.

Movement forwards to improve laboratory animal welfare

The Korean Ministry of Agriculture, the Korea Food and Drug Administration (KFDA), and the Ministry of Food and Drug Safety have announced a 5-year plan to address animal welfare. Although the application of animal welfare was initially limited to companion or exhibition animals, the need for animal welfare is emerging for all animals, including those raised in a limited space, such as laboratory animals. Animal experiments must be performed in the non-clinical evaluation process before entering the clinical trial phase. Unfortunately, during this process, laboratory animals inevitably experience pain and stress. Therefore, it is necessary to devise and implement a plan to alleviate this. In Korea, there has been a recent mandate for the inclusion of attending veterinarians in laboratory animal research facility, reflecting efforts



towards enhancing the welfare of research animals.

Animal testing has a 3R principle (replacement, reduction, and refinement). The first part of this principle, "replacement", refers to replacing animal experiments with a possible alternative method to achieve the research purpose without conducting experiments involving animals. Secondly, "reduction" involves using a minimum number of animals with scientific, statistical significance to obtain useful comparable information. Lastly, "refinement" is the concept of improving animals' happiness levels by reducing their pain and stress and eliminating the occurrence of inhumane treatment when animal experiments are unavoidable. The idea of refinement can be retained when improving animal welfare.

To address animal welfare in a laboratory environment, it is vital to

consider animals as living creatures and have some consideration and respect for their natural way of life. To support this, providing appropriate environmental enrichment for these animals is crucial. This will prevent boredom because of receiving a limited food and living in a limited space. Additionally, environmental enrichment may also prevent mental abnormalities due to experimental stress, which can positively affect the stability and reproducibility of research. However, although it is recognized that providing enrichment can improve animal welfare, scientific evaluation to determine what kind of enrichment can reduce animal stress is yet to be conducted.

Efforts for animal welfare at the K-MEDI hub

K-MEDI hub Preclinical Research Center (PRC) received full accreditation from the Association for Assessment and Accreditation of Laboratory Animal Care International (AAALAC-I), and was

Stress Level	← Less Stressful → More Stressful →					
Body weight (g)	1st	2nd	3rd	4th	5th	6th
	IVC cage Group E.E*	IVC cage Single E.E*	IVC cage Single	IVC cage Group	ISO cage Group	ISO cage Single
Stress Level	← Less Stressful → More Stressful →					
Corticosterone concentration one serum (pg/mL)	6th	5th	4th	3rd	2nd	1st
	IVC cage Group E.E*	IVC cage Group	IVC cage Single E.E*	IVC cage Single	ISO cage Single	ISO cage Group
Corticosterone concentration/body weight	6th	5th	4th	3rd	2nd	1st
	IVC cage Group E.E*	IVC cage Group	ISO cage Single	IVC cage Single E.E*	ISO cage Single	ISO cage Group

*E.E: environmental enrichment

certified for laboratory animal welfare at an international level and approved as a Korean excellent laboratory animal facility by the Korea Food and Drug Administration.

To find the least stressful breeding environment, PRC scientifically evaluated the degree of stress caused by the breeding environment of mice and the research results were published (Animals, 2023 Jan 10;13(2):249 / Animals 2023 Mar 19;13(6):1095). The results confirmed that providing a well-ventilated environment and environmental enrichment reduces animal stress. Mice from individually ventilated cages (more ventilated than isolated ventilated cages) and mice from group cages with environmental enrichment had the lowest levels of the stress marker corticosterone. In addition, appropriate companions and environmental enrichment can reduce stress levels in dogs.

In addition, PRC is currently studying environmental care that reduces stress for large laboratory animals, including dogs and pigs. For example, in 2021, K-MEDI hub established a playground intending to improve the welfare of beagle dogs. Regular exercise and gathering in the playground will significantly positively affect the psychological and physical well-being of beagle dogs raised in limited areas like cages. Basic comprehensive animal health checkups for dogs, pigs, and

monkeys are conducted twice a year to promote animal welfare through individual veterinary care management.

According to the guidelines in South Korea, the functions of the Institutional Animal Care and Use Committee (IACUC) with post-approval monitoring (PAM) were strengthened with the mandatory continuation of education to enhance the expertise of IACUC members. It is recommended that PAM activities occur at least twice a year, which is followed at PRC, where activities are conducted by an attending veterinarian in conjunction with IACUC. At K-MEDI hub, PAM activities have enhanced the welfare of laboratory animals and the communication between researchers and IACUC members. Some researchers think of PAM activities as the bothersome task, but the fundamental purpose of PAM is to work in partnership with researchers to conduct successful and ethical animal experiments while paying attention to the welfare of laboratory animals. PRC is trying to find ways to cooperate by strengthening the role of "collaborator" in improving animal welfare.

Why is the welfare of laboratory animals necessary?

We believe that animal welfare is necessary for two reasons. First, "happy animals make good science" in terms of improving the reproducibility and reliability of experiments. Stress

unexpectedly affects several physiological factors, causing substantial variation in the experimental results due to artifact lesions. Improving animal welfare produces reliable experimental results. Second, the suffering of laboratory animals can be a psychological burden and, therefore, influence researchers' professional quality of life. These reasons are why we always care about the welfare of laboratory animals in the field of preclinical research. K-MEDI hub PRC will continue its efforts towards improving animal welfare. We hope this article provides the necessary information to expand global interest in the importance of laboratory animal welfare.



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SECTION

ENERGY





Fighting energy poverty in the EU

Baiba Miltoviča, President of the Section for Transport, Energy, Infrastructure and the Information Society (TEN), European Economic and Social Committee (EESC), argues that the EU must take tangible steps to fight energy poverty in the EU and safeguard vulnerable people's right to access energy

Energy poverty is, unfortunately, still headline news. While energy poverty in the EU runs rampant, the situation is serious across the world.

According to the latest reports, more than 700 million people worldwide, about 10% of the population, live in extreme poverty and have no access to electricity. Across Europe, between 50 and 125 million people can't afford to heat their homes properly.

Energy poverty is still a worldwide issue

In the past few years, energy poverty has risen, made worse by recent international events such as the energy price crisis and the war in Ukraine.

Despite these appalling and alarming figures, the European Union has no commonly agreed definition of energy poverty. However, it is often called the "inability to keep homes adequately warm".

Many Member States widely recognise the issue's scale and its severe consequences from a personal and social point of view. Energy poverty in the EU affects health and brings about social isolation, and those who are negatively impacted are usually described as energy-poor, fuel-poor or vulnerable energy consumers.

Overarching strategy based on increased coordination at all political levels

The European Union has a big challenge ahead: on the one hand, it needs to make the energy transition happen and reach the climate objectives of a carbon-neutral EU by 2050, but on the other, it needs to protect the weakest households and ensure that nobody is left behind. In short, the EU needs to implement a socially fair and just energy transition.

The right to affordable energy will be one of the critical battles of our century. When the EU strives to implement the energy transition, tackling energy poverty in the EU must be at the heart of the strategy.

The EU can only tackle this significant social problem through an overarching strategy based on close cooperation at all levels – European, national and local – and focusing on three major priorities: social, political and environmental.

Better implementation of the energy transition starts by being genuinely inclusive. The main concern must be actively involving EU citizens and empowering them while at the same time protecting the most vulnerable.

To this end, we need increased financial resources, particularly streamlined procedures for access to EU funding.

We need appropriate local measures, which are the best means to achieve targeted results, especially for energy-poor households, and these must be based on more precise statistics at the local level to be effective.

We also need specific measures to make energy efficiency of buildings possible and lead to a higher building renovation rate, supporting the lowest income groups to avoid a serious risk of rising rents and "green gentrification".

Let's not forget European businesses or overlook young people. They need support because energy poverty is also a reality for millions of micro, small and medium-sized enterprises, with many of them risking bankruptcy, and it also concerns younger generations, who are often the weakest link in the chain and are rarely listened to.



Baiba Miltoviča
President of the Section for Transport, Energy,
Infrastructure and the Information Society (TEN)

Fully & systematically involving civil society organisations

To successfully address the root causes of energy poverty, a vital element is the presence of organised civil society. Civil society organisations can make a clear difference if involved correctly and at the right time.

Despite their strong commitment, they face a difficult situation in their work. They are confronted daily with the absence, or inefficiency, of measures to fight energy poverty.

Civil society organisations should instead play an essential role in defining, implementing and monitoring energy policies. These organisations have the knowledge, expertise and grassroots networks. They are active on the ground and make dialogue possible and easier between a wide range of actors: citizens, businesses, workers, consumers and decision-makers.

The European Economic and Social Committee (EESC) are the home of EU-organised civil society. It is the bridge between EU citizens and the EU's decision-making institutions and is instrumental in connecting them.

Taking stock of energy poverty in the EU

To take stock of energy poverty in the EU Member States and put forward concrete proposals, the Committee has organised a significant event for two years in a row: [Energy poverty at the crossroads of the European Pillar of Social Rights and the European Green Deal](#), and in 2021,

[Tackling energy poverty at the heart of the ecological and energy transition](#) in 2022. This year, the key dates are 18-19 July 2023 for the conference [Tackling energy poverty for a just transition](#), in Brussels and via web streaming.

These events bring together all relevant stakeholders: the representatives of European, national and local institutions, civil society organisations, activists and students because it is precisely by joining forces with all actors on the ground and at the national and European political levels that we can make progress.

We need a strong coalition between all stakeholders at all levels of governance, backing solid political will. A bottom-up or top-down approach alone cannot work.

Now more than ever, the Committee is ready to play an active role and team up to meet this common critical objective: ending energy poverty in the EU.

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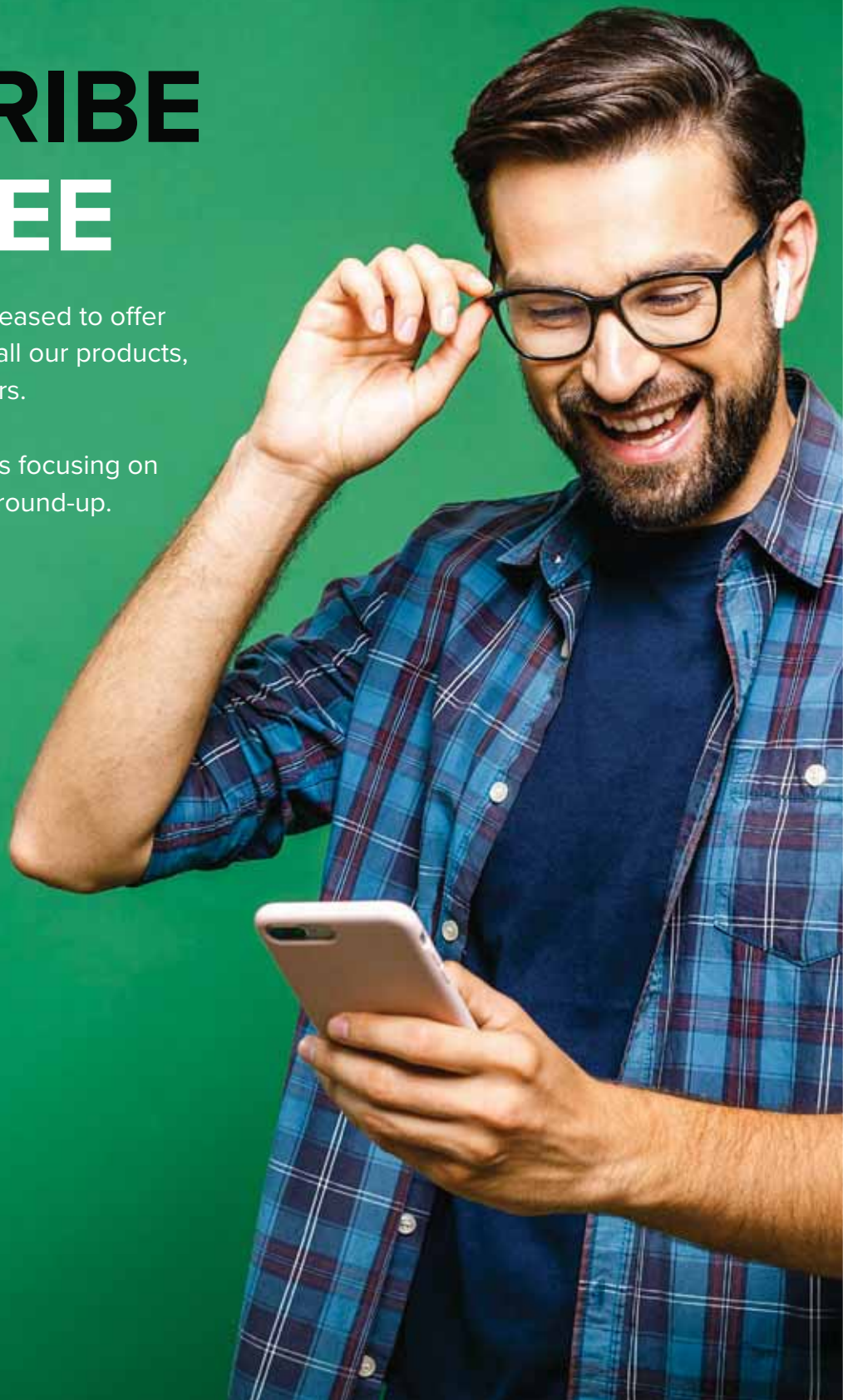


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EUROPEAN COMMISSION ENERGY STORAGE FOCUS

In April this year, Kadri Simson, European Commissioner for Energy, gave a speech at the European Parliament Plenary Debate on energy storage. Getting straight to the point, the Commissioner stressed that energy storage is at the heart of “building a decarbonised, flexible and cost-effective energy system, through electrification and energy system integration” plus essential to achieving “REPowerEU targets, with regards to renewables and hydrogen production”.

Presenting the most recent European Commission suggestions on energy storage, the Commission references the proposal to reform electricity market design, which had at its heart provisions to bolster flexibility technologies and advanced storage.

“The reform of the electricity market design strengthens flexibility services, demand response and energy storage in the electricity system – with measures for Member States and system operators. For Member States, they would be required to assess the flexibility needs in their national energy systems for a period of at least 5 years,” Commissioner Simson added.

To avoid system flexibilities due to fossil fuel gains, Member States must establish “indicative national objectives”, mainly focusing on non-fossil flexibility technologies like storage and demand response. Also, system operators could procure flexibility services during peak hours.

A Commission recommendation on energy storage to the Member States has also been addressed. As such, Staff Working Document has been published with a comprehensive and solid study of electricity storage options and how to promote them in a technology-neutral manner. ⁽¹⁾

In May, the recently revised Renewable Energy Directive, we hear, laid out the framework to guarantee non-discriminatory access for mobile and small storage systems. Plus, it will accelerate and simplify the permit granting procedures and process, which are also applicable for storage assets.

A Net Zero Industry Act proposal was also mentioned to secure Europe’s renewable energy supply chains and boost clean tech manufacturing. “This includes storage technologies supply chains, as the proposal defines storage as a ‘net-zero energy technology’,” the Commissioner detailed. ⁽²⁾

The Commissioner remarked in April that energy storage is at the heart of Europe’s clean energy transition being a success. “We aim to shape a conducive environment for storage and flexibility solutions to develop at the pace and scale we need. ⁽¹⁾ Later, the Commissioner rightly stated at the Energy Storage Coalition: “Energy storage is key to building a future-proof, resilient and decarbonised energy system.” ⁽²⁾

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NET ZERO INDUSTRIES AND CITIES ARE WITHIN REACH

Technological expertise and solutions for climate target response is already here, but to unlock the hidden potential in industries and cities, we need clear priority setting by politics, orchestrated deployment, and significant public funding (CAPEX and OPEX) backed by an eased regulatory framework

The political discussion about necessity and accessibility of decarbonisation is gaining momentum. At least since the Paris climate agreement, it has been clear: in the long term, combustion processes can only occur in exceptional cases. Energy is precious and must be used as efficiently as possible. Many solutions for the decarbonisation of cities and industries already exist – further potential is being explored. The focus of all our activities is to ensure that the Europe-wide climate goal does not remain simple “lip service”.

The entire portfolio of E.ON's Energy Infrastructure Solutions is geared towards supporting customers, companies and cities in their decarbonisation efforts.

The Net Zero industrial competitiveness

On 16 March 2023, the EU Commission published the Net-Zero Industry Act to preserve industrial competitiveness and reduce dependency on third countries.

This proposal defines strategic technologies, but each of these technologies has a different starting point. The way is clear for solar PV, solar thermal and renewable energies – they must be used wherever possible.

A more connected solution is the use of decentralized heat pumps in district heating systems, also in combination with geothermal solutions. These solutions are more of a systemic nature and need much more support. Above all, it is important to speed up municipal heating planning and approval times for the full decarbonisation of cities.

Additional financial support is needed for test drilling. Extremely high importance is attached to the use of hydrogen via electrolyzers and fuel cells, but the additional green energy required is not yet available. In addition, both CAPEX and OPEX costs are extremely high making its economic viability today impossible without public funding.

Consideration of CO₂ in the entire value chain

The draft act considers that the climate targets cannot be achieved with CO₂ savings alone. Therefore, CO₂ storage is increasingly becoming the focus of political discussion.

CCU/S technologies are a very important solution component. For a successful market implementation and scale up, promotion of the complete CCU/S value chains is key. In addition to carbon storage, thermal storage for heating networks and electrical storage offers great potential for increasing efficiency (including applications as a grid booster).

Tightening up the regulatory framework

All these technologies are essential on the journey for the decarbonisation of cities and industries – but not all of them have the same maturity and an existing business case. Hence, the deployment of those solutions needs to be orchestrated and individually

supported via (CAPEX and OPEX) funding and an easy regulatory framework. In the communication of the commission, so-called Net-Zero Strategic Projects are introduced.

For selected projects, all approval procedures are to be bundled in a national body and the entire approval process is completed within a maximum of 12 months. This is very welcome.

A key missing piece in this legislation is a large-scale demonstration of innovation in industry and cities.

Measurable emissions reduction results are directly dependent on the engagement of key stakeholders such as utilities, solution providers and contractors. They work close to production and industry to implement needs-based and sustainable solutions on-site.

Heat is a key element for the energy transition

If we look at the heat transition, process heat alone accounts for 40% of energy consumption in industry and commerce (in Germany).

Around half of the heat used in industry is lost unused as waste heat. Above all, the energy transition is a heat transition. The focus should also lie in the sensible reuse of unused heat.

First, it is important to use energy generation methods that are as carbon-free as possible – efficiency first.

Secondly, it must be checked whether system-related energy, mostly in the form of heat, can be recovered or used in another way. Sustainability,

costs, security of supply and efficiency are all high on the list of requirements to be met.

An example of new coupled solutions in this segment is the use of waste heat from data centers for supplying local district heating networks. In the past, the temperature levels were too different and using the waste heat was inefficient.

With our E.ON ectogrid™ technology, the decarbonisation of cities is possible. E.ON ectogrid™ is a complete energy system for heating and cooling that enables the sharing, balancing and storage of energy for entire neighbourhoods and cities and can help achieve zero emissions.

Funding opportunities in municipalities and industry

At the beginning of every transformation process, it is important to demonstrate the capability of new technologies. The promotion of large lighthouse projects is suitable for this. For broader impact, more medium-sized and smaller projects must now also be funded.

Municipalities and industry closely monitor the various funding opportunities (like horizon framework, Innovation Fund, Life, CEF) offered by the EU. However, it has been repeatedly shown that these calls are extremely oversubscribed (i.e., the probability of funding is low) and require a lot of effort in the preparation of application documents.

The funding should always be focused on the climate impact. It is necessary that service providers and contractors are also included in the general conditions.

We need to move away from the fear of climate change towards understanding that climate change is an opportunity – especially for growth and prosperity. We expressly welcome the EU's activities to achieve the climate goals.

We are convinced that the transformation can only succeed with intelligent solutions that are at the same time decentralised, future-proof, and above all, efficient.

At the Energy Infrastructure Solutions unit of E.ON, we are working to provide industries with tailored energy solutions, and the decarbonisation of cities, that meet these requirements – whether it's heating, cooling, power generation, or energy efficiency.

Strong partnerships can bring ecology and economy together and thus create unimagined joint opportunities – benefit from unconventional ideas, amazing synergies, and lower energy costs.



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BRIDGING THE GAP BETWEEN RESEARCHERS AND ENTREPRENEURS

Dr Venizelos Efthymiou from the FOSS Research Centre at the University of Cyprus discusses the vision of partnership for researchers and entrepreneurs in the EIRIE platform

Europe is taking significant steps towards achieving emissions neutrality by 2050 to combat climate change. The goal is to stay within the scientifically-proven limit of a 1.5°C rise in temperature compared to pre-industrial levels. This objective is at the heart of the European Green Deal ⁽¹⁾ and in line with the EU's commitment to global climate action under the Paris Agreement – which cannot be achieved without the work of researchers and entrepreneurs. ⁽²⁾

In parallel, an important objective that comes through the future-looking Green Deal is the smart objective of “Leave no one behind – Just transition”. According to the “Smart Grids Project Outlook of 2017” ⁽³⁾ report by JRC, it is unfortunate that the EU15 countries spend more than 95% of their annual budget on research and innovation in smart grids, storage, and systems, while the EU13 countries are left behind in this area.

This is further confirmed by the work done through the Horizon 2020 project SUPEERA ⁽⁴⁾ which falls within the work of the EERA AISBL ⁽⁵⁾ association representing 250 European research organisations. The findings of this project confirm the disheartening figures presented in the table.

To help change these unpleasant realities in EU13 widening countries,

Sample	Organisations involved in H2020 projects	Organisations involved in H2020 projects (% of EU total)	H2020 net EU contribution (in million €)	H2020 net EU contribution (% of EU total)
EU total	151.718	100%	€59.590	100%
EU13 total	14.640	9.65%	€3.470	5.82%
EU15 total	137.078	90.35%	€56.120	94.18%

the PANTERA ⁽⁶⁾ coordination and support action project was financed by Horizon 2020 with the promise to act in building processes that will help these low-activity countries to raise the status and bridge the gap between researchers and entrepreneurs in support of the energy transition.

With a vision in mind, the PANTERA consortium has given through its activities the birth of the multifunctional interactive platform “EIRIE”. ⁽⁷⁾

What is EIRIE platform?

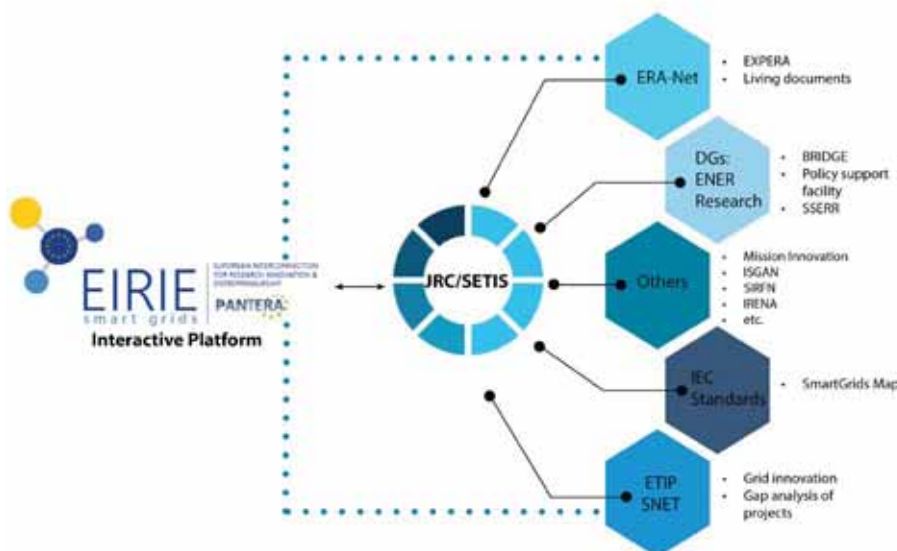
The EIRIE platform – the European Interconnection for Research Innovation & Entrepreneurship – has been developed as a sustainable multifunctional platform and a single point of reference for the EU research and innovation community in smart energy systems and technologies, supporting the energy transition and the low-carbon economy.

It is not aiming to replace all existing platforms or sources of information, data and knowledge, but offer interoperable connectivity that can be by-directional.

Furthermore, EIRIE is complementing the objective of setting up a European forum composed of research and innovation stakeholders, including policymakers, standardisation bodies and experts, representing the EU energy system.

What benefits can EIRIE offer?

- EIRIE will help bridge the gaps between researchers and entrepreneurs in the energy field, and between Member States in Europe, by bringing together and promoting successful national, regional or European partnerships.
- EIRIE serves as the central hub for individuals and organisations involved in the research and development of smart grids, storage, and local energy



A dynamic and versatile platform has been created to unite Europe's smart grid, storage, and local energy systems community. This interactive hub brings together key stakeholders in the sector to collaborate and promote research and innovation.

systems across Europe. It will contribute to the achievement of the envisioned carbon-free system of 2050.

What are EIRIE's key functionalities?

Data area, with search and linking functions:

- Projects data collection (results and outcomes, best practices, use cases, white papers, scientific papers, reports and deliverables, etc.);
- Standards and regulations; and
- Common repository of research infrastructure in Europe in support of the R&I endeavours of stakeholders.

Information area, with search and linking functions:

- Project-related information through integration with JRC, ETIP SNET, BRIDGE, Mission Innovation, CORDIS and many more.
- Knowledge area, with search and linking functions:
- Living documents

Benefits of using the platform – a bridge for knowledge sharing across Europe

- Easy access to information on potential funding and consortium building, useful for all actors of the research and innovation community in Europe, be it researchers, industrial parties, academia or SMEs;
- A central point for collaborating on the issues relevant to the energy sector in general, particularly the decarbonisation of the European energy system; and
- Taking an active role in the community and providing input to European policies to better reflect national needs.

How do representative stakeholders of the EU reflect on these achievements?

“The EIRIE platform is a much-needed crucial step to make the low-carbon sustainable future as envisioned by the European Commission, a reality. What makes EIRIE different from other platforms? EIRIE facilitates connectivity with all sources (platforms, initiatives, etc.) of data/information/knowledge,

making it the single point of reference for the related R&I community, enriching the original content that it generates.”

Mario Dionisio, DG Energy – European Commission.

“The European Commission's Joint Research Centre (JRC), as the science and knowledge service of the European Commission, will support the development, hosting and knowledge management of EIRIE, based on its experience in the analysis of digital energy projects and the regular issue of the Smart Grid Outlook Report.”

Marcelo Masera, Head of Unit, Joint Research Centre – European Commission.

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ENGINEERING A GREENER FUTURE WITH RENEWABLE HEATING TECHNOLOGIES

Here, Andy Farquhar, Senior Product Manager (New Energy) for Groupe Atlantic UK, Republic of Ireland and North America, the parent company of Ideal Heating, discusses the vital role of manufacturers in the shift to renewable heating technologies

To meet the UK's 2050 net zero target and transition to a low-carbon economy, an almost complete decarbonisation of the UK's housing stock is needed.

The race to net zero is heating up. At Ideal Heating, we're engineering a greener future. Here, I discuss the vital role of manufacturers in the shift to renewable heating technologies

The way we heat our homes is changing

The Office for National Statistics reported in August 2022 that over a quarter of UK carbon emissions are produced by the nation's 25 million homes.

That means decarbonising homes and supporting the drive to a net zero economy will require a transition from traditional gas boilers.

In response to this challenge, the Government has set a target of 600,000 heat pumps to be installed in UK homes annually by 2028. That's a very ambitious goal, but we will do all we can to contribute.

At Ideal Heating, we're rapidly transforming our business and the products we manufacture to support the transition to net zero.

Recently we launched Logic Air – our new monobloc heat pump for the domestic market. This flagship new product represents a substantial



Ideal Heating's new Logic Air heat pump was launched at a VIP event at The Gherkin skyscraper in London

investment from Ideal Heating – in our technology, people and operations.

For generations, we've been at the forefront of the UK heating industry, and our market-leading boilers have kept homes warm and dry for over 100 years.

Now it's time to hand the baton over to products such as Logic Air. Designed to deliver efficient, reliable low carbon heating, Logic Air will be a vital piece of the jigsaw as homes are converted from gas to renewable sources of energy.

We know heat pumps aren't the only solution. A combination of technologies and products will be needed to decarbonise UK homes.

But we're confident that Logic Air will become a staple at the heart of

peoples' homes, as our boilers have been for decades.

What lies behind our products

Behind all our products, including Logic Air, is a suite of a wealth of experience and expertise, combined with world-class technology, customer support and training.

Our UK-based customer support team helps customers 364 days a year, providing a rapid, efficient response to their needs.

They're supported by a network of over 150 service engineers, providing a same or next-day response to customers nationwide.

It means if you need any help or support, we'll provide it quickly and get you back up and running.

Training the next generation of low-carbon engineers

To meet the ambitious targets set by the Government, the UK will need a network of skilled, low-carbon engineers.

However, the industry has acknowledged a shortage of installers with the skills and experience to fit heat pumps.

We're playing our part in bridging the skills gap by creating a best-in-class learning environment at our new National Training and Technology Centre in Hessle, East Yorkshire.

Our sector-leading facility will train up to 5,000 engineers annually in green technologies, driving the heating industry forward.

Working together to reach net zero

The heating industry is deeply committed to the net zero agenda and moving at pace to make the required changes.

It means manufacturers such as Ideal Heating must reshape our entire business operations in a very short space of time.

Investment must be made in skills, training, equipment and resources to ramp up heat pump manufacturing and servicing. At Ideal Heating, we're investing £60 million at our site in Hull in new facilities to support the transition to heat pumps.

But our message is clear – the targets which have been set can only be achieved by working with manufacturers.



Andy Farquhar, Senior Product Manager (New Energy) at Groupe Atlantic UK, Republic of Ireland and North America, spoke at the Logic Air launch at The Gherkin

This transition will not be achieved if unrealistic conditions and punitive measures are put in place which deter investment and create additional pressures in an already fiercely-competitive business environment.

The challenges of climate change unite all of us. Only by working together and by the Government and other stakeholders understanding the challenges faced by the heating industry, will we succeed in changing how our homes are heated.

Engineering a low carbon future with renewable heating technologies

At Ideal Heating, we have the expertise and the experience to help customers and partners in the low-carbon transition.

Ideal Heating's parent company, Groupe Atlantic, is a European heat pump market leader. Working closely with our colleagues in France, we're sharing knowledge and know-how in the renewable heating technologies which will heat our homes for generations to come.

Our industry expertise spans world-class training, exceptional customer support, pioneering research and development and decades of experience manufacturing reliable, efficient heating products.

We're the UK leader in both the domestic and commercial heating markets, and now we're playing our part in the next chapter.

The future is greener, and Ideal Heating is right at the heart of it.

ideal
HEATING
COMMERCIAL

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DIVERSIFYING THE TRANSITION TO RENEWABLE ENERGY IN TAIWAN

MMA Global Aqua discuss the transition from the traditional uses of oil and gas to renewable energy in Taiwan, describing the challenges, benefits and skills needed in the transition

What are the challenges and opportunities in transitioning from the oil and gas industry to renewable energy in Taiwan?

The transition from the oil and gas industry to renewable energy in Taiwan presents both challenges and opportunities.

On the challenge side, professionals must adapt to a different industry landscape, including new technologies and practices specific to renewable

energy. They also need to understand the regulations and policies governing the renewables sector in Taiwan, which may differ significantly from those in the oil and gas industry.

Additionally, the language barrier poses a significant obstacle, making effective communication and collaboration more challenging. However, amidst these challenges lie a number of opportunities.

By shifting to renewable energy in

Taiwan and abroad, professionals can actively contribute to environmental sustainability and the reduction of greenhouse gas emissions. They can play a role in diversifying energy sources, moving away from fossil fuels to more sustainable alternatives.

With the renewables sector experiencing rapid growth globally, joining this market in Taiwan provides professionals with the chance to be part of a thriving industry at the forefront of the global energy transition.

Image: © stockinasia | iStock



How does the expertise and experience you gained in the oil and gas sector translate to renewable energy in Taiwan?

The expertise and experience gained in the oil and gas sector can be highly valuable when transitioning to the renewable energy sector in Taiwan. Professionals can leverage their project management skills, risk assessment abilities, and knowledge of offshore operations.

They can apply their understanding of complex regulatory environments and navigate the intricacies of project development and execution.

Geophysical surveying and Geotechnical investigation expertise, which is often utilised in the oil and gas industry, can also be directly applicable to renewable energy projects, particularly in the context of offshore wind farms.

While some upskilling is necessary, the foundational knowledge and experience gained in the oil and gas industry provide a strong basis for success in the renewable energy sector. Professionals can draw upon their existing skill set and transferable expertise to contribute effectively to the development and growth of renewable energy in Taiwan.

How does joining MMA Global Aqua benefit professionals transitioning to Taiwan and connecting with stakeholders in the renewable energy industry?

Recognising that the language barrier poses a significant challenge, joining MMA Global Aqua has provided invaluable assistance to support the transition to Taiwan professionally.

MMA Global Aqua is on the ground with deep local knowledge and connections which can facilitate engagement with the necessary government departments and stakeholders in the renewable energy sector. Other benefits include access to dynamic market research and analysis to inform strategic decision-making in the renewable energy sector as well as assistance in contributing to local networks, facilitating the necessary connections to navigate Taiwan's renewables market successfully.

This support extends to helping with matters like relocation and facilitating accompanying family members with getting settled into life in Taiwan.

How do you see the role of offshore renewable energy, such as wind and wave power, evolving in Taiwan's future?

The role of offshore renewable energy, including wind and wave power, is poised to evolve significantly in

Taiwan's future. The country is actively working towards diversifying its energy sources and reducing its dependence on fossil fuels.

Offshore wind power holds significant potential for Taiwan due to its coastal geography and favourable wind resources. The country has already made significant progress in developing offshore wind farms, with several projects in operation or under construction.

Wave power exploration is also being explored, although it is still in the early stages. The growth of offshore renewable energy projects in Taiwan not only contributes to the country's energy transition goals but also brings about numerous benefits. It leads to environmental sustainability by reducing greenhouse gas emissions and mitigating climate change.

Offshore renewables also contribute to economic growth, job creation, and the establishment of a vibrant renewable energy industry ecosystem.

What are the environmental and sustainability benefits of renewable energy, and how is MMA Global Aqua ensuring these benefits are realised in Taiwan?

Renewable energy offers a host of environmental and sustainability benefits actively contributing to the reduction of greenhouse gas emissions and playing a significant role in combatting climate change. MMA Global Aqua actively contributes to ensuring these benefits are realised in Taiwan, by supporting the development of renewable energy projects.

Renewable energy sources such as wind and wave power produce clean electricity without the emissions

associated with fossil fuels. This leads to improved air quality, reduced pollution, and a healthier environment for the people of Taiwan. Additionally, renewable energy helps conserve natural resources by reducing dependence on finite fossil fuel reserves.

It promotes sustainability by providing a long-term energy solution that can be harnessed indefinitely. MMA Global Aqua actively works for government departments and international wind farm developers to help promote environmental sustainability.

What are the key regulatory and policy considerations that professionals must navigate when transitioning from the oil and gas industry to renewable energy in Taiwan?

When transitioning from the oil and gas industry to renewable energy in Taiwan, professionals need to navigate key regulatory and policy considerations.

Understanding renewable energy targets and incentives is crucial, as Taiwan has set specific goals for renewable energy adoption. Professionals must familiarise themselves with the available incentives such as feed-in tariffs, tax incentives, grants, and other financial mechanisms to support renewable energy projects.

They also need to navigate the permitting and licensing processes specific to renewable energy projects. This involves obtaining the necessary approvals from government agencies, such as the Ministry of Economic Affairs (MOEA) and the Bureau of Energy (BOE). Compliance with environmental impact assessment (EIA) requirements and other regulatory obligations is vital.

Professionals need to adhere to safety standards and regulations to ensure the wellbeing of workers and the general public. Navigating these regulatory and policy considerations requires a comprehensive understanding of the local legal framework, engagement with relevant government agencies, and consultation with industry experts. Staying updated on ongoing policy developments is also important to ensure compliance and a successful transition.

How does MMA Global Aqua collaborate with government entities, research institutions, and industry partners to drive the renewable energy transition in Taiwan?

MMA Global Aqua actively works with various stakeholders to help them drive the transition to renewable energy in Taiwan. MMA Global Aqua's Chairman, Dr. GwoShyh Song, has numerous associations with partners, institutions, universities, and other organisations, which has been forged throughout his 40 plus years in Taiwan. These partnerships facilitate knowledge sharing, resource pooling, and collaborative project development, leading to successful renewable energy projects in Taiwan. Active participation through memberships in industry Marine Associations and forums is another way MMA Global Aqua collaborates with stakeholders. MMA Global Aqua is a local Taiwanese company, employing local Taiwanese people for local and international foreign companies in Taiwan.

With the assistance from our partner MMA Offshore (an international vessel and subsea services provider), we are striving to grow our local capability to service the offshore energy market in Taiwan. Considerable time and effort has been invested to develop MMA

Global Aqua's local capabilities which align with the Taiwanese Government Authorities, such as the Bureau of Energy and their mandate and vision of developing local content. Through these collaborative efforts and alignments, MMA Global Aqua contributes to shape renewable energy in Taiwan and drive sustainable development for a greener future.



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What to consider when getting a heat pump installed

Aoife Foley, Chair in Net Zero at The University of Manchester, assesses the pros and cons of getting a heat pump installed in this special energy focus



Image: © NAPA74 | iStock

Heat pumps have been at the top of the news agenda over the past year or so, cited as an effective solution to combat rising energy bills.

However, it's more complicated than simply saying that everyone should go out and get a heat pump installed straight away.

There are several factors to consider, ranging from the different types of heat pump available, the initial outlay and your current energy consumption.

How do heat pumps work?

Heat pumps may seem like a new phenomenon, but the technology used has been around in some form since the 1800s. It works in the same way as refrigeration and air conditioning, only in reverse.

Heat energy is taken from an outside source, such as the air, the ground or water, and transferred into the pump to heat water in tanks, radiators and underfloor heating systems.

This is referred to as space heating. In essence, it replaces your oil or gas central heating but can also cool your home and heat your water simultaneously.

The heat will then warm a liquid, typically a refrigerant, such as hydrocarbons, ammonia, carbon dioxide or water with a small amount of a refrigerant, which evaporates and move through a compressor, causing a temperature rise.

The heated gas can then be blown into a heating or hot water system – rather than out of it, as is the case in a fridge, thus cooling or heating your home via your radiators whilst heating your hot water.

Heat pumps can be used for individual small flats and houses to heat pools and sports facilities, commercial facilities and large industrial users in heat networks. So, heat pumps come in all shapes and sizes.

Electricity is still the primary source of energy used by a heat pump, but it is far more efficient in terms of its

output. This is the unique selling point of heat pumps.

In the most efficient pumps, you can expect one unit of energy to produce three or four units of heat. This reduces how much energy you need to use, so you should cut bills and be more sustainable too.

On top of that, heat pumps can take unwanted electricity from variable wind and solar, nuclear and fossil fuels during times of the day when demand is low.

This is why we have seen significant growth in heat pumps across Europe and the world over the last decade.

What are the different types of heat pump?

There are three primary types:

- **Ground source** heat pumps extract geothermal heat from the ground, to heat or cool the refrigerant liquid and then drive the heat pump system. They are also called ground-to-water heat pumps.
- **Water source** heat pumps use heat from water in lakes and ponds to heat or cool the refrigerant liquid and then drive the heat pump system.
- **Air source** heat pumps use energy in cold or hot air from outside your home, or through a ventilation system to heat or cool the refrigerant liquid. These are often called air-to-water heat pumps. These behave just like a fridge, and so emit noise from the fan.

There are others, such as air-to-air, solar assisted and hybrid. We don't see many of these in the UK.

Air-to-air is typically found in countries like the U.S. or Spain with significant summer cooling needs. Looking purely at the figures, water source pumps have the best input-to-output coefficient, as water is particularly good at storing energy.

There are two types, a closed and an open loop; the difference between the two is the volume and type of refrigerant liquid used.

But there are different considerations, including the cost of installation, running costs and kind of property.

The open is more efficient, but running costs tend to be higher.

Air source pumps are generally the cheapest and most straightforward to install and are most commonly used in smaller properties.

On the other hand, ground source pumps can be quite complicated to install, and you will need a reasonable amount of outdoor space, like a garden, which can take a pipe loop or a probe.

Are heat pumps cost-efficient?

As mentioned earlier, the heat output per unit of energy input can be as much as three to four times higher.

I don't think we'll likely see energy prices fall to the levels we saw before the war in Ukraine for the foreseeable future, so it is expected to keep paying dividends even when prices eventually fall from their current peak.

It is a long-term investment, so we need to consider the initial outlay of installing the system.

It will vary by the type of pump and the property, but they can be between £3,000 to as much as £30,000. So if you're not planning to stay in your property for a few years, you might not really see the benefit.

You'll also need to factor in maintenance in the same way you would a regular boiler.

It will generally have a lifespan of around 15 years, and there will be wear and tear along the way, but no more so than most gas boilers.

If you consume a significant amount of energy, then the bigger the saving will be proportionate. But if you typically don't consume a considerable amount of energy, your savings might not justify the initial outlay.

Should I get a heat pump installed?

My best advice is to do your homework and work out the best solution for you. If you decide to proceed, it must be installed and serviced by a reputable provider.

You should check their accreditation and, if you're unsure, speak to the local district operator to find out

ENERGY POLICY: PUBLIC SECTOR DECARBONISATION

Lord Callanan, Minister for Energy Efficiency and Green Finance in the UK, is responsible for many policy areas, including industrial decarbonisation, energy efficiency plus demand reduction, and local authority decarbonisation, to name a few. ⁽¹⁾

Over 115,000 homes throughout England will get upgrades to better their energy efficiency and, as such, will enjoy reduced bills thanks to the UK Government's funding announcement of almost £2 billion.

For example, the Home Upgrade Grant and Social Housing Decarbonisation Fund are worth £1.4 billion to fund new windows and loft insulation.

Also, £409 million through the Public Sector Decarbonisation Scheme was granted to assist public sector buildings like hospitals and schools in reducing carbon emissions.

We are told that improved heating systems will lower the use of fossil fuels impacted by volatile global energy prices, saving taxpayers substantial costs and supporting thousands of jobs.

Lord Callanan provided more detail about the UK's ambitions to lower carbon emissions: "The UK is truly a world-leader when it comes to reducing carbon emissions and the progress we've made over the last decade has been remarkable. But we can't rest on our laurels and must continue to drive forward progress, setting a standard for other countries to follow.

"Reaching net zero means considerable action from the public sector as well as private sector. Through the Public Sector Decarbonisation Scheme funding allocation...we are empowering public bodies to save the taxpayer hundreds of millions while packing a punch on our ambitious and necessary climate goals."⁽²⁾

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Professor Aoife Foley

more. If it has not been installed correctly, many issues can arise afterwards.

The installation should be reasonably straightforward for most properties, but there are outliers, and like any heating systems installation, it can be inconvenient.

For instance, you may need planning permission for a listed building. Local authorities should be able to provide guidance. So, checking before you start the journey is critical to ensure a heat pump is right for you.

Ensuring your property is well-insulated will also be vital to getting the most out of your heat pump.

And don't forget to read your system's operations and maintenance instructions to have it running at its optimum and keep your bills manageable. In combination, all of these can significantly impact your energy usage.

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HEAT PUMPS IN HEALTHCARE ARE THE CATALYST FOR A NET-ZERO NHS

Paul Burnett, MD and Co-Founder at Asset+, a Johnson Controls Company, explores how UK healthcare can benefit from the Public Sector Decarbonisation Scheme and the efficiency, sustainability, and financial gains of moving to heat pumps in healthcare

Much of the blame for the UK's carbon emissions is often put on transport, industry, and residential buildings. Although these are some of the biggest culprits for catapulting us towards climate change, the healthcare sector can be overlooked as one of the nation's biggest emitters.

The British Medical Association reports that the NHS produces 4-5% of the UK's total carbon emissions, with NHS England responsible for 40% of public sector emissions.⁽¹⁾ Reducing the healthcare sector's carbon footprint will play a critical role in the country's move towards a greener future, and the NHS' ambition to become the world's first net-zero national health service.

“The best partners will design and install heat pumps based on the business and building needs, providing the highest value in terms of cost and efficiency.”

However, with hospital trusts dealing with strikes, inflation, and overstretched services, it can be difficult to push energy efficiency to the top of the agenda. The NHS must take advantage of government grants, move from gas boilers to heat pumps in healthcare, and work with trusted efficiency partners to achieve their net-zero goals.

About the Public sector Decarbonisation Scheme

The Public Sector Decarbonisation Scheme (PSDS) is a government grant programme to fund heat decarbonisation and energy efficiency measures for public sector bodies.

With an ambitious goal of reducing public sector building emissions by 75% by 2037 compared to 2017 figures, the next phase of PSDS grants is set to open for applications this autumn.

Although there has been some success for healthcare bodies in the first phases of the scheme, with NHS Trusts such as Mid Yorkshire Hospitals, Leeds Teaching Hospitals, and North Bristol winning funding, the main recipients of grants so far sit within education, councils, and government bodies.

As organisations need to apply to the scheme with a proposed decarbonisation project to win funding, success hinges on the knowledge of internal staff or partnerships with external experts.

Heat pumps in healthcare: An efficient solution

Part L of Building Regulations state that non-domestic buildings should be moving to low-carbon heat sources – and heat pumps are the most efficient solution.

The upcoming ban on gas boilers may

not necessarily be enough for healthcare organisations to make the move to heat pumps.

However, government incentives and education on this technology's efficiency, sustainability, and financial benefits will be more likely to drive widespread adoption.

Heat pumps don't burn fuel to create heat like a traditional gas boiler. They can be used as a primary source of generation, with their energy coming from renewable sources.

Now able to work at higher temperatures, heat pumps are a great option for healthcare settings where there is a high demand for hot water at peak times.

Due to the nature of heat pumps transferring heat rather than generating it, they can prove up to four times more efficient than traditional boilers, boasting an efficiency of 300-400%.⁽²⁾

Why use heat pumps? What are the benefits?

Heat pumps offer a wide range of efficiency, sustainability, and financial benefits to healthcare sites. Working smarter by building an optimised and integrated energy infrastructure will boost efficiency and reduce dependence on unsustainable energy sources.

When external temperatures vary so much, 'wasted' energy can be reused by integrating both heat pumps and chiller systems. When there is a simultaneous demand for heating or hot water and cooling, the heat rejected from the cooling process can be extracted and reused for the heating process. This results in efficiency gains and additional energy savings.

For maximum efficiency, artificial intelligence (AI) and machine learning (ML) come into play with model predictive control. Using the building's data, AI and ML can assess the energy conversion rate for each element of the building and recommend new opportunities for optimisation.

As for sustainability, heat pumps in healthcare will help to reduce reliance on fossil fuels and decarbonise heating.

According to the Carbon Trust,⁽³⁾ heat pumps have the potential to deliver CO₂ savings of up to 70% compared to conventional electric heating, and up to 65% compared to an A-rated gas boiler.

These benefits also extend to cost savings, especially important with The BMJ reporting a 200% increase in NHS energy bills last winter.⁽⁴⁾ Although the government implemented a short-term emergency energy price cap, the NHS cannot rely on government support indefinitely.

Heat pumps offer long-term cost and maintenance savings compared with traditional boilers, and make it easier to monitor, track and reduce energy for continued savings.

Trusted energy efficiency partners

Introducing heat pumps in healthcare will allow services to improve

efficiencies, drive down costs, and remain on track for carbon neutrality. However, many trusts simply don't know where to start or how to manage the new complexities of heat pumps.

Working with energy efficiency partners that audit current operations, consult on how sites can decarbonise, and advise on how to capitalise on new energy and cost savings will be vital. By choosing a reputable partner, trusts can implement systems across a whole suite of different buildings with varying needs and set a new standard through people, technology, and processes.

Choosing which heat pump model is right for a building is not a straightforward decision. The overall economic case, operator needs, health, safety and environmental (HSE) requirements and external factors must be considered.

Ultimately, there is no one-size-fits-all solution when it comes to choosing which heat pump is right for a site, and hospitals need to work with a partner that can deliver the most efficient solution based on these factors.

The best partners will design and install heat pumps based on the business and building needs, providing the highest value in terms of cost and efficiency.

For instance, when Hounslow Council partnered with Johnson Controls to decarbonise schools and public buildings as part of the PSDS, carbon emissions and energy costs both dropped by 50%.⁽⁵⁾

A key part of the project was the switch from gas boilers to air-source heat pumps, and to date, the council has saved over 17 million kWh of energy across its corporate and school sites,

equating to over 3,000 tonnes of carbon.

When NHS Trusts access government funding and find the right energy efficiency partner, the efficiency, sustainability, and financial benefits are endless. A move from gas boilers to heat pumps will create a more sustainable healthcare sector and will be the catalyst for a net-zero NHS.

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THE ROLE OF BATTERY ENERGY STORAGE SYSTEMS IN RENEWABLE POWER

Founded in 2010, Harmony Energy is one of the UK's leading developers of utility-scale battery energy storage systems. Here is how they are shaping the future of renewable energy



Harmony Energy is one of the UK's leading developers, owners and operators of utility-scale battery energy storage systems (BESS). We also have experience developing, building, and operating wind and solar projects, both independently and in partnership with others.

Harmony's renewable energy story began with the development of onshore wind in the UK, garnering support from the UK's largest pension fund – Universities Superannuation Scheme (USS).

In 2019 – having shifted our focus to BESS in 2016 – we sold the majority of our 15 wind assets to Blackfinch Investments, recognising the crucial impact of BESS on enabling more renewable power onto the network.

Challenges of wind and solar

In the UK and many other countries, wind and solar are the cheapest

forms of electricity generation. However, they are intermittent, i.e. they do not generate 24/7 and therefore may not be generating when the power is needed most or may oversupply when power is not required. We understood these challenges first-hand.

To overcome these challenges, you can store the power and balance the network when it requires it most creating a more secure and efficient system which is environmentally and financially sustainable.

For example, in the UK, wind farms are paid to switch off when the grid network has insufficient demand to take the power (known as 'constraint payments'). In December 2022, National Grid spent £82m on constraint payments. If sufficient energy storage was available, such payments would be avoided therefore reducing the ultimate cost to the consumer.

Why our focus shifted to BESS

BESS enable the grid to keep renewable energy assets operating by sending the surplus power to charge the BESS to be used later when the grid is under stress or in need of power.

At present, the grid still relies on gas generators to provide power when the network is short. BESS will help displace these gas generators and therefore help reduce emissions and achieve Net Zero.

BESS in the UK essentially plays two roles in providing multiple services to National Grid:

1. Provide 'ancillary services' –

Ancillary services consist of services to National Grid, such as frequency response, which helps ensure the grid remains at a stable frequency (to avoid blackouts) by responding to events within milliseconds. For example, if a power station unexpectedly drops offline, BESS

can stabilise the power network in the area impacted until the power station is back online.

2. Trade the energy (arbitrage) – The BESS can be charged when energy is cheap and pumps it back to the network when it is expensive. To achieve this, we trade on different markets, including wholesale, intraday, day ahead and the Balancing Mechanism.

In June 2020, we completed our first UK BESS site, Holes Bay (located near Poole). This was developed in partnership with Madrid-based renewable development company, FRV. Holes Bay was the first site in Europe to utilise Tesla's Megapack technology and energy trading platform, Autobidder.

The successful development was the catalyst for future BESS projects, including the next site delivered, Contego (Burgess Hill). These sites were the leading performing BESS assets in 2021 and 2022 in the UK. Both sites were the first in the UK to utilise 2-hour duration systems.

Harmony Energy Income Trust launched

In November 2021, we launched the Harmony Energy Income Trust Plc ('HEIT') on the London Stock Exchange following the success of the earlier sites, with a market cap of £210m. HEIT has preferential rights to acquire and build out our future development pipeline. Launching HEIT enabled us to accelerate our developments by deploying capital at speed – with HEIT currently having three live BESS sites, a further three due online before the end of 2023 and an additional two in 2024.

In addition to the equity raised, HEIT also raised £130m of debt through NatWest and Rabobank. The recent appetite from the banks shows the investment creditability of the sector.

A few years prior, bank debt was unavailable as the market was yet to be established, meaning people hadn't built a track record to show how the assets would perform. Since its launch, HEIT's Net Asset Value has increased by over 12% in addition to paying a healthy dividend (HEIT pays an annual dividend of 8p per annum). Looking ahead, we see significant capital growth opportunities with annualised target returns of 10-12%.

November 2022 marked a significant milestone for HEIT when HEIT's Pillswood site – Europe's biggest battery energy storage system (by MWh) – went operational. The Pillswood site, located in Hull, can store enough electricity to power approximately 300,000 British homes for two hours. Pillswood is located next to the substation where the world's largest offshore wind farm, Dogger Bank, will connect to the network later in 2023.

In addition to HEIT, we have joint ventures with FRV and TagEnergy, both global leaders in energy storage. These joint ventures have also secured debt from NatWest, Natixis and Santander.

Delivering renewable energy for the future

Within the Harmony group, we have 220MW / 440MWh of BESS operating across five sites and a further 412MW / 824MWh across seven 'in build' sites. We have a significant pipeline of sites moving closer to 'in build' status (over

2GW) within the UK and a further 2GW in our international pipeline.

We have a strong track record of delivering renewable energy projects in a successful and timely manner, and we work closely with landowners from the outset to ensure financial and environmental benefits are maximised.

Being a key figure in the renewable energy industry, we provide community funding to support incentives and organisations that improve the local environment, such as planting trees or protecting wildlife, as well as increasing biodiversity across all our developments.

In addition to the UK, Harmony has teams in France, Poland, Germany and New Zealand. We recently achieved planning on the largest solar farm in New Zealand in 2022 and are looking to commence construction in 2024.

Harmony aspires to be the market leader in BESS development. Our ability to prove concept early and build at scale has successfully put Harmony Energy at the forefront of the sector whilst laying the foundations for our international expansion.



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DECARBONISING SCHOOL HEATING SYSTEMS

Mounting pressure on already tight budgets has prompted many educational establishments to look for additional savings. One way to cut costs is to upgrade school heating systems, which has added environmental benefits

The UK's education sector faces a severe funding crisis, with spending per pupil in 2024-25 expected to be 3% lower than in 2010, according to research from the Institute for Fiscal Studies (IFS).

The situation in post-16 education is even worse, with the IFS reporting that college funding per pupil in 2024-25 is 10% below 2010-11 levels, while school sixth form funding per pupil will be an alarming 23% below.

There are, of course, a variety of complex reasons for the financial squeeze on education. Still, one of the most pressing is energy prices, with the biggest section of a school's energy bill likely to be accounted for by heating.

School heating systems cost £543m annually

UK schools are estimated to account for more than half of a typical local authority's carbon emissions, so they play a pivotal role in cutting the public sector's costs and slashing carbon emissions.

The Carbon Trust has estimated that UK schools spend £543 million annually on their heating systems. And the average primary school in the UK spends £31,000 each year on energy bills, according to the financial website www.businesselectricityprices.org.uk.

This figure, it says, increases to £90,000 for secondary schools.

One Finance Manager told The Guardian newspaper that a secondary school in her trust had seen its energy bill jump from £75,000 to a staggering £213,000 in a year.

But funding problems are not the only reason for the education sector to take its heating requirements seriously.

Environmental concerns are also critically important as the world faces the often-appalling impact of global heating systems.

Schools are estimated to account for around 2% of UK greenhouse gas emissions, equivalent to a whopping 15% of the country's public sector emissions.

Sustainability & climate change in education

In response to this, the Department for Education has developed a [sustainability and climate change strategy for education](#) that states: "By 2025, all education settings [including early years settings, schools, multi-academy trusts, colleges, and universities] will have nominated a sustainability lead and put in place a climate action plan."

A crucial element of boosting sustainability is managing energy, particularly the heating supply.

Heating can play a central role in helping to solve the twin problems of school funding and the urgent need to decarbonise educational facilities.

Ground & air source heat pump systems

One possible way to reduce costs and help the environment is to install heat pumps.

These tried and tested devices are significantly more efficient than traditional boilers and use cleaner electricity, so they will cut fuel bills and reduce a school's carbon footprint.

Ground and air source heat pumps offer powerful advantages in terms of cost-savings and efficiencies.

[Klima-Therm](#) supports fossil-fuel upgrades and then provides ongoing servicing and maintenance contracts to ensure optimum efficiency and prevent operational downtime.

Recent examples include the installation of hybrid cooling and heating systems at [Kingston College](#) and [Northbrook College](#), cutting-edge projects that use innovative technology.

HOW KLIMA-THERM CAN SUPPORT YOU

Klima-Therm can help consultants advise schools to meet their sustainability goals and reduce their outgoings by upgrading old and inefficient heating and cooling systems with the latest low-carbon solutions.

For existing HVAC systems, regular, planned maintenance ensures essential plant continues to operate at its optimum, preventing disruption, energy wastage, and associated costs.

Optimum temperature and air quality have been shown to be essential for teacher and pupil well-being, helping to facilitate the best learning conditions and enhancing productivity. Indeed, many organisations, including the Environmental Protection Agency, say that [classroom temperatures](#) can affect student performance.

Through its sister company, [LH-plc](#), Klima-Therm can help create ideal conditions using the most efficient and cost-effective HVAC solutions.

Increasingly warm summers are leading many more schools to consider mechanical cooling. LH-plc supplies servicing and maintenance for chillers and other central cooling systems. Many of the latest heat pumps offer both functions for simultaneous heating and cooling.

We recommend that all our clients enter into a planned preventive maintenance (PPM) contract (a scheduled maintenance routine for HVAC assets). This is the best way to ensure operational certainty and cut the costs associated with off-plan callouts and repairs.

With plant checked at regular intervals, a PPM contract can provide schools peace of mind, reducing the risk of expensive repairs, breakdowns and inflated fuel bills caused by inefficient systems. Well-maintained HVAC and associated equipment will also last longer, contributing positively to whole-life costing.

Both examples feature simultaneous chilled and hot water for use in air conditioning, heating, and domestic hot water supplies.

Importance of maintenance in energy-saving technology

However, specifying state-of-the-art energy-saving technology is not the only way to save money.

Maintenance is also important. After all, even the best heating solution is useless if it fails to operate correctly, so effective installation and maintenance are critical.

The best way to ensure both is to work closely with a trustworthy supplier (see the box above).

Maintenance is vital to the smooth running of any business that operates machinery.

Effective preventative maintenance will cut running costs and reduce the likelihood of potentially expensive breakdowns.

It can also extend the lifetime of your equipment and provide peace of mind that you are doing everything you can

to keep your process running and downtime at a minimum.

Our sister business, LH-plc, provides a comprehensive range of services that support chiller maintenance, including fault finding, commissioning & decommissioning, refurbishment & repair, and specialist maintenance.

And the company has a long, distinguished history of helping educational establishments with their maintenance needs.

Indeed, we are proud to be a preferred [heat pump and chiller servicing](#) and maintenance supplier for educational establishments in the Southeast.

It has recently become a member of [Sky Blue Education](#), which connects private and academy schools with businesses to meet all their procurement needs.

Contact [Klima-Therm](#) to discover how the company can help you to support your clients in their missions to become more sustainable.



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REVOLUTIONISING RENEWABLE TECHNOLOGY IN THE UK FOR A GREENER FUTURE

Hannah Jepp from Ares Power, part of Kingdom Energy, explores how we can use renewable technology in the UK to accelerate our clean energy revolution

As the world transitions towards a greener future, businesses are continuously navigating the challenge of reducing greenhouse gas emissions. Sustainable energy sources are one way the UK is making strides in the fight against climate change, with renewable technology like heat pumps, EV chargers and solar power increasing in demand in a bid to reduce carbon footprint.

The UK government has set a target to achieve net-zero greenhouse gas emissions by 2050, this means that the country will need to reduce its emissions to the point where any remaining emissions are offset.

Harnessing the power of heat pumps

Heat pumps are a renewable technology which provide a sustainable



alternative for heating and cooling buildings. They extract renewable energy from the air, ground or water and efficiently convert it into usable heat or cooling.

They are renowned for their exceptional energy efficiency, with a coefficient of performance (COP) of 3 to

4 meaning for every unit of electricity used, three to four units of heat are produced. This high level of efficiency translates into substantial energy savings and reduced heating costs for homeowners and businesses alike.

The gas and oil ban, which was announced in 2019, means that from 2025 there will be no gas or oil boilers installed in newbuild properties. Alongside this, the government is incentivising upgrading existing boilers to air source heat pumps and other renewable technology heating systems. With the UK government wanting 600,000 heat pumps installed per year by 2028, now is the perfect time to begin utilising the power of heat pumps.

Accelerating electric vehicle infrastructure

The UK government has set ambitious plans to ban the sale of petrol and



diesel cars and vans by 2030, and hybrid vehicles by 2035, the adoption of EV infrastructure is critical to support these challenges. By investing in a robust and widely accessible EV charging infrastructure, including fast-charging stations on the UK's highways and urban centres, the UK can encourage the mass adoption of electric vehicles and other renewable technologies in transport which are related.

Promoting electric vehicles (EVs) and expanding charging infrastructure can reduce dependence on fossil fuel-powered vehicles. In addition, supporting public transportation, cycling infrastructure, and walking can help reduce emissions from transport.

Embracing solar power as a renewable technology

With energy prices at an all-time high, and as global temperatures and sunny weather rises the demand for embracing solar PV and battery storage systems is increasing. Through installing solar PV, businesses and individuals can reduce their reliance on the traditional grid and bring numerous benefits, including cost savings, environmental sustainability, and energy independence.



There are several UK incentives and schemes available to encourage the adoption of solar panels for individuals and businesses, and as more homeowners work from home the demand for energy saving solutions is increasing.

As the UK strives to achieve its climate targets and transition into a greener future, sustainable technology plays a vital role in unlocking energy efficiency and reducing carbon emissions.

With increasing performance and lowering costs in renewable technology

we can pave the way for a cleaner, more sustainable future for the generations of tomorrow. However, this can't be done alone. The UK needs to collaborate with other countries, share best practices, and work together to develop global solutions to combat climate change. Engaging in international climate agreements and supporting developing nations in adopting sustainable energy solutions and renewable technology can have a significant impact.

To find out how you can play your part in reducing the UK's carbon emission through supplying renewable technology solutions, visit: www.arespower.co.uk.



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CAPITALISING ON RENEWABLE HEATING AND THE POWER OF HEAT PUMPS

Martin Fahey, Head of Sustainability for Mitsubishi Electric UK & Ireland, explains how we can efficiently enter the renewable heating market with heat pumps to reduce emissions

To solve the climate crisis, even the most strident cynic now realises that we must stop burning fossil fuels and turn to renewables to significantly reduce the emissions generated by keeping our buildings comfortable places for us to work, rest and call home.

In the UK, heating accounts for almost a third of all carbon emissions, so changing how we heat residential and commercial buildings is critical to tackle climate change and reach net zero before 2050.

Our power grid is getting greener and cleaner as we generate more renewable energy and heating our buildings with electric heat pumps becomes the obvious solution.

The UK Government already recognises this and has identified heat pumps as one of the pivotal technologies that can truly be effective in the required timeframe due to their efficiency and suitability for a wide range of applications.

Yet some still see modern, inverter-driven heat pumps as 'new' even though hundreds of thousands are working up and down the country. The Government is also calling for 600,000 residential installations a year by 2028 – just five years away.

Achieving this ambitious target will require a tenfold increase in residential

installations over the next five years. This presents a significant opportunity for growth in renewable businesses geared up to help customers transition to low-carbon heating.

The end of gas in the public sector

Modern heat pumps have been available for over a decade. Yet, the renewable heating market is still in its infancy, and the number of renewable heating installers needs to grow significantly.

There are challenges in training enough installers, and we need to upgrade older buildings, but there is no doubt that the heat pump age is here.

With an urgent need to tackle the climate crisis, the Government and industry must come together to find ways of applying heat pumps as quickly as possible.

For our homes, achieving the Government's ambitious target of 600,000 heat pump installations a year by 2028 will require a tenfold increase in the number of installations over the next five years.

In the commercial sector, there is now a strong economic and ethical case for renewable heating. Businesses know they need to move from gas, with many actively planning this in their annual budgets during the next three to five years.



Martin Fahey, Head of Sustainability for Mitsubishi Electric, UK & Ireland

In the public sector, funding to decarbonise local authority, the NHS, and educational buildings is available, with commercial heat pumps now helping to ensure that the public sector is leading the way to low-carbon buildings.

For community heating schemes, heat pumps can also use fifth-generation, low-temperature heat networks to maximise efficiency and minimise running costs.

Modern heat pumps are now available for anything from a 5kW system for a small apartment or typical family home, right up to Megawatts of heating that will service a school, a leisure centre, a hospital, or an entire university campus.

Commercial opportunities of renewable heating

In addition to helping create thousands of 'green' engineering jobs, the move to decarbonise heating will also allow private and public businesses to reduce carbon in their buildings.

Work has already been happening in the background to help decarbonise the public sector and introduce renewable heating systems.

The next round of the Public Sector Decarbonisation Scheme will open to applications again this coming autumn and will likely be oversubscribed again.

Otherwise known as Salix funding after the body administering the funds, the Scheme supports the intention to reduce "emissions from public sector buildings by 75% by 2037, compared to a 2017 baseline".⁽¹⁾

The publicly funded Scheme provides 100% interest-free loans to the public sector to improve their onsite energy efficiency and reduce their carbon emissions.

Salix supports decarbonisation in various public sector bodies, such as the NHS, local authorities and education. The Scheme has already helped many schools and councils begin the transition to renewable heating forms.

Well on the road to net zero with heat pumps

To achieve growth in the adoption of heat pumps, we need three things to align:

- A sustainable growth in demand, leading to;
- An increase in manufacturing, supported by;
- A considerable increase in the

number of qualified renewable heating engineers

Salix funding is helping to turbocharge the adoption of renewable heat pumps in the public sector. Manufacturers are responding by increasing production to meet expected demand.

In the private sector, building owners realise that they need to move to renewable heating in the immediate future if they want to avoid ending up with a stranded asset that they cannot let.

Businesses with their own properties are also looking at renewable heating and planning on how to transition to heat pumps, with many planning for this in their annual budgets.

This is increasing demand, which manufacturers are gearing up to meet.

At the same time, heat pump manufacturers are significantly increasing the training available to develop the skills necessary to become a heat pump engineer.

In our own case, we have entirely redesigned our training to make it a three-stage process, quadrupling the amount of training available.

The three-stage process of engineers in the renewables industry

Stage One is online learning modules that engineers can complete at a time which suits them.

Stage Two follows the completion of the online learning and involves live webinars with our advanced trainers, which can include as many as 90 engineers simultaneously.

Stage Three involves visiting one of our training suites nationwide, where

the engineers are given specific faults to remedy.

While this is all available right now, it is also worth reminding ourselves that thousands of heating engineers are also looking to their future and deciding to acquire the skills needed to move from gas to heat pumps.

These skilled plumbing and heating professionals already have the majority of skills needed to deliver renewable heating systems.

So, it now seems clear that tackling the heating challenge can help us decarbonise society and create new and sustainable 'green' careers.

For over a decade, Mitsubishi Electric has led the way in the UK heat pump market. We were among the first manufacturers to include embodied carbon data for its products. Our company manufactures heat pumps in Scotland and has developed what, in our view, is the most comprehensive range for almost any building in the country.

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How hydrogen cars can drive us towards the UK government's net zero targets

Steve McEvoy, Vice President of Automotive at [Expleo](#), outlines how hydrogen cars can drive us towards the UK government's net zero targets

This year's Spring Budget focused on the four 'E's: enterprise, employment, education and everywhere. The reaction was mixed – with many pointing out that the budget was missing significant emphasis on a final, important E: the environment.

Although the green revolution was covered to an extent, with the chancellor announcing £20 billion of funding for carbon capture over the next 20 years, it did not put any focus on sustainability in the automotive sector – as many within the industry expected it to do so.

Transport accounts for around [30% of global carbon emissions](#), and 72% of these emissions coming from road transportation such as cars, vans and buses, I believe this should be a priority for any forward-looking government.

The potential of hydrogen for the automotive sector

When it comes to sustainable transformation in the automotive sector, hydrogen has the potential to be the energy carrier of the future.

Some governments have already said it will be a key element in solving environmental and economic challenges. For example, Japan wants to increase the number of hydrogen cars on the road [to more than 800,000 by 2030](#). France is also leading by example, having set the goal of deploying 10,000 hydrogen taxis [on the streets of Paris by 2024](#).

In a traditionally difficult sector to decarbonise, we already see hydrogen fuel cell technology utilised for



Steve McEvoy
Vice President of Automotive

heavy-duty lorries and double-decker buses in the UK. Our research also found that automotive leaders across France, Germany and the UK actively pursue hydrogen-powered cars, with [70% of respondents](#) saying they're currently producing hydrogen vehicles or the components for them.

But despite some investments already happening, we're a way away from hydrogen-powered vehicles becoming a mainstream reality. With its potential to reduce our reliance on ecologically damaging substances such as oil and coal while carrying reliable properties such as storability and transportability, the government needs to explore its use further when considering automotive carbon neutrality goals.

Hydrogen cars are an alternative to electric vehicles

Currently, the UK automotive industry is focused more on electric vehicles (EVs). However, with the rising costs of materials, parts shortages and infrastructure challenges related to EV adoption, the UK needs a secondary solution.

This is where hydrogen has an advantage, although diminishing. In comparison to EVs, hydrogen is currently faster to refuel. Refuelling with hydrogen would set British motorists back five minutes, whereas many EVs need at least an hour, if not significantly longer. However, that advantage is quickly disappearing as EV battery tech improvements close the gap – some EV models now take around 15 minutes to recharge.

At a fundamental level, hydrogen is the cleanest fuel – it's created through the electrolysis of water, which only requires electricity. When a fuel cell converts hydrogen

into electricity, its only emissions are water vapour and warm air. It can, therefore, be created and used without creating any additional carbon, and there is virtually no risk of it ever running out. However, the devil is in detail; specifically, the production method used to extract hydrogen. The most common method of producing hydrogen uses fossil fuels and releases large amounts of CO₂ – called grey hydrogen due to its not-entirely-green credentials. To get to a position where we can produce enough green hydrogen to fuel a means of transportation would require significant investment in the infrastructure needed to create, store, transport and retail it. Not only that, but it would also require substantial political and legislative support to incentivise this investment. We've yet to see a country step forward and put significant efforts behind developing the tech and infrastructure needed to make hydrogen a viable alternative clean fuel source EV.

Look at it this way, there are only 11 hydrogen fuelling stations in the UK, which creates significant challenges for innovators looking to convince manufacturers to commit hard-won R&D budgets in developing hydrogen tech. Overall, we should remember that the hydrogen market is still young, so challenges around cost and production are to be anticipated, and as with battery EVs, take time to overcome. There is also work to be done in convincing the consumer of the safety and benefits of hydrogen vehicles, especially as the cost of hydrogen-powered cars is expensive.

Hydrogen cars on UK roads in the future?

So, how far are we from seeing hydrogen cars on UK roads? Automotive leaders are optimistic – with [half of those we surveyed in Europe believing that hydrogen cars will soon become a common sight on our roads](#). However, the government will need to meet this enthusiasm with significant investment and funding to make it a reality and meet the net zero targets they have set.

Steve McEvoy
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HYDROGEN PRODUCTION IN THE ENERGY TRANSITION: EXPLORING PROTIUM PROJECT PIONEER 1

Protium explores green hydrogen production in a case study of the Protium Project Pioneer 1, exploring carbon storage and net zero possibilities in energy

Hydrogen is widely seen as a critical component of a net zero future and has a key role to play in decarbonising sectors such as heavy transport and industrial processes.

It has seen a recent boom in interest, driven by the urgent need to tackle climate change, technological improvements, and the challenges faced by industries in decarbonising through electrification.

Is hydrogen the future of energy?

Hydrogen is already commonly used in industries, particularly in chemical processes. The dedicated production of hydrogen as an energy carrier is an emerging trend.

The speed by which demand has grown is nothing short of phenomenal, and it is only increasing, but this has led to two important questions – is it a sustainable solution and where does it come from?

While it is very encouraging to see a desire for a greener future, it is

important to consider how hydrogen is produced to ensure that there is a positive difference being made to a net zero future.

Today, most of the hydrogen in the UK and around the world is produced through a process called Steam Methane Reforming.

As the name suggests, methane (made from natural gas) is broken down by steam and heat into hydrogen and carbon dioxide, the latter being released into the atmosphere. Due to the emissions associated with this, it is often labelled “grey hydrogen”. If all hydrogen for future “green projects” was from “grey” sources, this would simply shift emissions from the point of use to the point of production.

The opportunities of carbon storage

Methods to capture and store carbon, commonly termed CCS for short, are being developed. When CCS is added downstream of the steam reforming process, the hydrogen can be labelled “blue”. However, this process is still not

a zero-emission procedure, as not all carbon can be captured.

The best zero-emission method for hydrogen production is called electrolysis, where water is ‘split’ into its constituent parts using electricity. If the power is generated by renewables or nuclear power, there are no carbon emissions, and the hydrogen can be labelled “green” because there are no carbon emissions.

Currently, the availability of green hydrogen is very limited, but this is fast changing with companies like Protium leading the charge.

Pioneering green hydrogen facilities and projects

There is a growing shift taking place towards green hydrogen, with production facilities being planned and developed across the UK.

Protium is one of the companies leading the way, having unveiled its first operational electrolyser earlier this year, and with more projects already in development.



The Protium Pioneer electrolyser unit is the largest installation of Enapter AEM technology in the UK. Pioneer 1 consists of 40 Enapter electrolyser modules that can produce over 40kg of hydrogen per day. This is the equivalent to powering 13 cars for 350 km.

The system is fully integrated into a single shipping container, along with water tanks, filtration, pipework, cables, and sensors. A buffer tank and compressor have been installed alongside the electrolyser to allow the filling of gaseous hydrogen into high-pressure cylinders, bundled together in manifolded cylinder pallets (MCP). These cylinders are mobile and can be distributed by truck to wherever hydrogen is needed.

The electrolyser load can be adjusted to match the fluctuations and intermittence of the renewable power, while the hydrogen produced can be stored as a gas or liquid and consumed as and when the user needs it. Therefore hydrogen will be so important in a net zero future.

However, developing and implementing this kind of infrastructure is not without its pitfalls.

The impact of energy supply chain disruptions

The effects of the pandemic and ongoing war in Ukraine, coupled with a surge in demand for green hydrogen products have put a squeeze on the supply chain in nearly every area involved in the mechanical manufacturing of products.

There is evidence currently of costs increasing over 30% as well as lead times increasing over 100% in the space of a few weeks. From a developer's perspective, this has put pressure on getting orders placed early and managing contracts to prevent cost overruns.

Managing inherent hydrogen safety

A key aspect of any project is ensuring that inherent safety is achieved within the design. By its nature, hydrogen is more flammable than natural gas. However, being a much lighter molecule, it also disperses faster.

Therefore, achieving adequate ventilation for a hydrogen system is a key challenge to prevent hydrogen from reaching its flammability limit (4% v/v in air). To achieve an inherently safe site, many key pieces of equipment should be deployed outside of containers to ensure maximum natural ventilation and to prevent hydrogen build-up.

“Hydrogen has seen a recent boom in interest, driven by the urgent need to tackle climate change, technological improvements, and the challenges faced by industries in decarbonising through electrification.”

Additionally, the hydrogen container for Pioneer 1 fitted with forced ventilation, ensures hydrogen can never reach its flammability limit. Explosion-proof equipment should also be used where needed.

Stakeholder engagement

Green hydrogen is a nascent industry, and many key stakeholders are unfamiliar with hydrogen in contrast to other fuel sources. The key takeaway is that educating stakeholders and the public about the benefits of green hydrogen as well as the setbacks should be encouraged.

This will speed up the acceptance of green hydrogen and ultimately allow

the general populace to appreciate the need for a quicker move towards a net zero emission future.

Extending the development of the UK hydrogen market

Project Pioneer 1 as well as all green hydrogen production projects show the ongoing development of the UK hydrogen market.

Project pioneer 1 demonstrates the importance of scaling up in the market from a smaller project. It also proves that with the required technology and processes a blueprint can be created to aid in planning for larger-scale green hydrogen projects.

This means that outcomes will be delivered more quickly not only for companies like Protium, but, more importantly, for the wider hydrogen market.

Projects Pioneer 1 demonstrate that green hydrogen can be a viable decarbonising solution and it is a major step forward towards a net zero economy.



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Australia's energy policy priorities

Open Access Government investigates some of the energy policy priorities of Australia's Minister for Climate Change and Energy, The Hon Chris Bowen MP, especially clean energy, energy efficiency and electric vehicles

The Hon Chris Bowen MP became Minister for Climate Change and Energy in June 2022 ⁽¹⁾ and is also the Federal Member for McMahon, NSW. Chris joined the Federal Parliament in 2004 and has been responsible for various portfolios, including Minister for Human Services, Treasurer, Minister for Small Business and Minister for Immigration. ⁽²⁾

Australia's clean energy policies and ambitions

To set the scene, Australia has massively increased its clean energy ambitions since the election of the Albanese Government, the International Energy Agency (IEA) say. [The IEA's Australia 2023 Energy Policy Review](#) says, "the Australian Government has stepped up its climate ambition at the federal level" and underlines the legislated 2030 target and net zero by 2050 as vital steps per the Paris Agreement.

Minister Bowen believes the IEA report shows the Australian Government's policies place the country on the correct road to ensure a future of clean energy and is on the right track to enable a clean energy future. "This new report is an endorsement of the strong action the Albanese Government has taken on climate change and energy to achieve 82% renewable electricity by 2030," the Minister commented.

The Minister then detailed Australia's energy policy ambition to reach net zero by 2050 and examples of strategies and reforms on that road ahead. "I welcome the IEA's recommendations to strengthen Australia's policies to achieve net zero by 2050 and I'm pleased we are already making significant progress against many of those recommendations.

"Our National Electric Vehicle Strategy, National Energy Productivity Strategy, and National Building Code reforms

will all play a vital role in helping Australia achieve strong climate and energy ambitions." ⁽³⁾

Energy efficiency action in Australia

This year, much is happening around what the Australian Government is doing to tackle energy efficiency. For example, did you hear the news in April that the Albanese Government's Community Batteries for Household Solar Program will provide 400 community batteries to assist with reduced household electricity bills whilst also delivering renewable energy and easing pressure on the power grid?

Renewable energy, we hear, is the cheapest type of energy, and as such, the Albanese Government will help deliver it throughout the country. Minister Bowen went on to say: "One in three households in Australia now has solar panels on their roofs. We have the highest uptake in the world, and we can take advantage of that for our grid and for household energy bills." ⁽⁴⁾

In May, we discovered that a priority for the Albanese Government is to make businesses and homes more energy efficient, to ease the cost of living pressures Australians face. The 2023-24 Budget provides over \$1.6 billion for energy-saving upgrades to benefit social housing, homes and businesses. ⁽⁵⁾

In this spirit, a \$125 million investment will assist Australians in purchasing energy-efficient homes. This endeavour will persuade renovators and home builders to build dwellings that meet high energy efficiency standards, including electrification, heat pump water systems and battery-ready solar panels. Minister Bowen added: "Powering homes with battery-ready solar PV, as well as installing better insulation and windows, will help households cut power bills and emissions." ⁽⁶⁾



Image: © tsvibrav | iStock

Encouraging electric vehicles in Australia

There's much to unpack about electric vehicles in Australia regarding energy policy. For instance, Minister Bowen explained in late April that the Government was working to improve EV infrastructure by setting up a network of fast chargers throughout the country. This comment coincides with the news that the Albanese Government joins the NRMA to build 117 quick EV charging sites across Australia on national highways, ensuring there is a fast charger roughly every 150km.

While EVs are cheaper and cleaner to run, range anxiety has been one of the most significant barriers for Australians when considering whether to buy an EV or not for too long. Minister Bowen provided further detail: "We're making range anxiety a thing of the past. This project will help close the gaps and known black spots in the network and make it possible to drive from Darwin to Perth, Broken Hill to Adelaide, and from Brisbane to Tennant Creek in the NT. This national rollout will help put more Australians in the driver's seat of cheaper and cleaner cars," Minister Bowen remarked. ⁽⁷⁾

Interestingly, the Albanese Government offers \$40 million for discounted loans on the cleanest vehicles to make buying cheaper and cleaner EVs easier. After the Albanese Government's National Electric Vehicle Strategy, this funding is a crucial stride forward to increase the accessibility of EVs for all Australians. Minister Bowen provided comment on this government-backed financing.

"Discounted loans are a great way to help Australians buy an EV and grow the first and second-hand EV markets," Minister Bowen said. "This financing will also help open the way for more manufacturers to supply the cleanest EVs to the local market because the Green Car Loan scheme is available to a wide range of EVs, Minister Bowen added. ⁽⁸⁾

Energy policy in Australia ahead

Australia's first National Electric Vehicle Strategy, already referred to here is a robust roadmap to a better choice of EVs. It encourages increased use of cheaper-to-run, cleaner vehicles for the country's people. As part of this, we hear that a Fuel Efficiency Standard will finalise soon. ⁽⁹⁾

We wish the Government of Australia well as they commit to a clean energy future, combat climate change and energy to reach 82% renewable electricity by 2030, strive to achieve net zero by 2050, tackle energy efficiency and encourage EV use.

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MAXIMISING ENERGY EFFICIENCY WITH ELECTRIC MOTORS

With an increasing number of technologies and applications employing electric motors, Rukmi Dutta from the University of New South Wales discusses the mechanisms and efficiency potential of electric motor systems

Electrical motors are the powerhouse of the industrial world, efficiently converting electrical energy into mechanical power. Many critical sectors use electrical motors, including industrial, commercial, residential, agricultural and transport. Hence, it is unsurprising that electrical motor-driven systems currently consume 50% of the total electrical energy worldwide and 70% of the electrical energy used in industries (6000 trillion watts per hour).⁽¹⁾ Increased industrial activities in developing economies like India, China, and many others will push the use of motors even further. The worldwide growth of electrical motor-driven systems is predicted to double by 2040. The increased market share of electric vehicles in developed countries and the high demand for heating and cooling in the increasing population of developing countries are pushing this growth.

The widespread use of electric motors

An electric motor-driven system (EMDS) typically consists of an electric motor and an end-user device: fan, pump, compressor etc. Increasingly, input power and speed/torque control devices referred to as variable speed drives (VSDs) are also becoming essential parts of EMDS. The output power ranges from a fraction of a kilowatt (kW) to thousands of kW. Chemical, paper, food processing, metal and textile industries extensively use electric motors for pumping, compressing, turning fans, handling, conveying, and processing materials. In addition, various appliances use electric motors in commercial and residential sectors, from household electric toothbrushes to commercial buildings' large air conditioning systems. In the residential sector, the electric motors used in refrigerators,

washing machines, air conditioners and various types of exhaust fans (including the small fan of the computer hard drive) consume most of the household electrical energy. The Irrigation pump, electrified agriculture vehicles and appliances also use electric motors. In the transport sector, electric trains, electric vehicles, drones, emerging electric ships/boats, and aircraft use electric motors.

How electric motors work

Most electric motors are rotary devices; the converted mechanical power is available as torque (turning force) at the motor's shaft to perform the valuable tasks of pumping, turning a fan or driving the wheels of a car. The interaction between the magnetic field and electric current produces torque in an electric motor. A DC (direct current) or AC (alternating current) supply powers an electric motor. If an electric



Rukmi Dutta, Associate Professor

motor converts mechanical energy to electrical power, it becomes a generator, and hence, at the basic design level, a motor and a generator are the same.

Efficiency and losses

Electric motors can be classified based on the construction, power supply, and type of output motion. However, the efficiency of all motors is calculated by dividing the mechanical output power by the electrical input power, and the input power minus the losses gives the output power. The motor losses are classified as copper loss (heat loss of the current carrying windings), iron loss (heat loss of the iron core), mechanical loss (friction in the moving parts), and stray or excess loss (unaccounted losses that occur in a loaded motor). The superior materials, design optimisation and application-oriented design approaches can lead to efficiency as high as 99%.

Why high-efficiency matters

Energy efficiency is one of the most cost-effective ways to reduce energy-related CO₂ emissions and offset energy demand growth via savings from efficiency gains. A 2022 IEA (International Energy Agency) report on energy efficiency found that the accumulated energy-saving measures via efficiency have kept the energy demand of many developed countries steady despite strong economic

activities in the last decades.⁽²⁾ Since the electricity sector emits one-third of the global energy-related CO₂, energy efficiency will play a significant role in achieving net zero.⁽³⁾ The benefits of minimum energy performance standards (MEPS) in electric motors were realised by 2008, which led to the approval of the standard IEC 60034-30 (International Electrotechnical Committee) to harmonise the efficiency classes of electric motors globally.

IEC 60034-30 standard classifies motors according to four International Efficiency (IE) groups – IE1 standard efficiency, IE2 high efficiency, IE3 premium efficiency and IE4 super premium efficiency. IEC standard replaced its predecessor EEF efficiency classes. The key difference between them is that the stray motor losses are measured indirectly in IE classification. In contrast, in EEF, this loss is estimated roughly as 0.5% of the output power resulting in an underestimation. For compliance with IEC, the efficiency must be measured by test methods described in standard IEEE 112. Many countries adopted MEPS for electric motors based on IEC efficiency classes.

Improving overall system efficiency for electric motors

The new type of highly efficient synchronous motors with rare-earth magnets, and some newer designs without any magnet, attain IE4 efficiency class easily. Some of the newer designs even exceed IE4, which has prompted the IE5 ultra-premium efficiency class. The IE5 motors should have 20% fewer losses than the IE4 class. The European Union (EU) has already made IE3 and IE4 classes mandatory for certain categories of motors.⁽⁴⁾ Emphasis on MEPS requirements has ensured that most industrial motors sold worldwide comply with at least one of the IEC efficiency classes.

Since typically electric motors are part of a large system, the focus is slowly shifting towards improving overall system efficiency. For example, controlling the torque and speed of the motor as per the system requirement using a VSD can improve overall system efficiency by up to 35%.⁽⁵⁾ However, the intake of VSD is still slow. Awareness, climate-oriented policies, additional incentives, and investment are required to realise the full extent of the potential benefits of VSD and newer types of permanent magnet synchronous and reluctance motors. UNSW Sydney's Electrical Machines and Drive Systems research team is at the forefront and contributes to developing novel, highly efficient motors and drives suitable for many applications.

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To meet energy demand, creating new battery chemistries is key

Johan Söderbom, Thematic Leader Smart Grid and Energy Storage, [EIT InnoEnergy](#) argues that creating new battery chemistries is key to addressing the rising demand in the battery industry

The battery industry is forecast to treble to [\\$135 billion by 2031](#), but its recent growth has been remarkable. Six years ago, there was very little planned battery capacity in Europe. Still, recognising batteries' vital role in tackling climate change, there are now at least 45 different battery projects in the works, as scientists aim to generate newer, cleaner battery chemistries.

The [European Battery Alliance \(EBA\)](#), led by EIT InnoEnergy, has helped drive this forward. Bringing together stakeholders from across the battery manufacturing value chain, the EBA is working to overcome Europe's battery challenge from every angle – from roadmap development and financing to mining and skills.

Now, the challenge is not so much about capacity, but about chemistry. Twenty years ago, battery chemists hashed out the pros and cons of several major battery chemistries and ultimately opted to pursue lithium, resulting in its superior energy density performance. It is a decision that has served the world well, until recently.

Developed initially for small electronics such as cameras, nobody could have predicted such a considerable uplift in demand due to electric vehicles. This surge in demand poses a challenge in ethically sourcing sufficient quantities of lithium, cobalt and nickel. The IEA suggests that the world may face a potential shortage of lithium as early as 2025.

Capitalising on sodium in battery chemistries

Although current sodium technologies continue to trail lithium in terms of energy density, sodium is an abundant material, making it ideal for stationary storage.

As a result, sodium-ion batteries have the potential to be an attractive alternative for entry-level electric vehicles that will be on par in charge times but have a little shorter range in return for a lower price point.

An 'AB battery solution' that combines lithium and sodium cells into one battery pack could also be an attractive option to harvest the best of the two technologies. Enticed by the vast potential of sodium battery chemistries, industry giant CATL has already begun small-scale production, having expected mass volumes this year. And many smaller innovators are following suit.

Readying the supply chain for a surge in demand is evidenced, for example, by Uppsala-based [Altris](#), who has developed a high energy density cathode material it calls Fennac, which it manufactures from sodium, iron, carbon and nitrogen.

The technology has been developed to plug and play into any industry-standard Li-ion production line. It is so innovative that it has caught the eye of world-leading battery developer Northvolt who took part in Altris' Series A funding round. The €9.6 million raised is being used to open a GWh scale production facility later this year.

Moving to 100% silicon solutions

Silicon as an anode material is also on the rise. Silicon solutions are unique because they can store vast amounts of Li-ions at rapid speeds, enabling charging speeds of under 15 minutes with over 500 miles of range.

However, the industry faces several challenges in taking chemistries from the <10% silicon-graphite mix that we have today, to the potential 100% silicon chemistries that we could benefit from in the future.

These challenges include creating a stable chemistry that will allow silicon's natural propensity to expand and contract as it charges and discharges and makes it scalable at a cost-competitive price point. The industry is pursuing several strategies, some of which will follow a path of gradually increasing silicon content, while others are pushing to introduce full silicon anodes as early as 2027.

Working towards a full silicon solution is a challenge that New York-based battery innovator GDI has spent the best part of the last decade working on to deliver.

Taking inspiration from photovoltaic panels, GDI uses plasma-enhanced chemical vapor deposition to create a unique 100% silicon anode design. In laboratory tests, the chemistry has been proven to offer a 30% energy density increase on advanced Li-ion batteries by 30% and safe and reliable fast charging from 10-75% in 15 minutes over 500 times with a remaining 80% state of health.

Securing the battery supply chain's future

Twenty years ago, the industry made the misstep of pursuing certain battery chemistries without considering what the future might hold. We know better now. In December 2022, the European Parliament announced new circular economy legislation stipulating requirements across a battery's life cycle.

The new legislation drives home the message that we must address our scrap. This includes reducing manufacturing waste, making it easier to understand the remaining health of a battery for potential reuse and easy disassembly for recycling.

Innovators such as [Verkor](#) are tackling scrap by applying data and industrial digitalisation to bring forward a more modern and efficient Gigafactory model to meet future demand.

The next several years are critical for developing a sustainable, indigenous supply of batteries for Europe, and rapidly developing new chemistries will be a crucial part of that. We are fortunate to boast many innovative battery projects in Europe, but it remains vital that the industry has access to sufficient capital and collaboration opportunities to meet growing demands.

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INSIGHTS INTO MAGNESIUM BATTERIES USING CALORIMETRY

Dr Carlos Ziebert, Leader of the Group Batteries – Calorimetry and Safety, KIT, explains how generated heat and self-discharge of magnesium batteries can be studied through calorimetry

In 2019, the KIT, the University of Ulm, the Center for Solar Energy and Hydrogen Research Baden-Württemberg, and the University of Giessen jointly launched the POLiS - Cluster of Excellence for Battery Research Post Lithium Storage, funded by €47 million over seven years.

Such post-lithium batteries use more abundant and environmentally friendly materials, such as Sodium, Magnesium or Calcium, instead of Lithium, Nickel and Cobalt. The work in the group Batteries – Calorimetry and Safety at the Institute for Applied Materials – Applied Materials Physics (IAM-AWP) started with coin cells that were provided by the Helmholtz Institute Ulm (HIU) and the Institute of Nanotechnology (INT).

Electrochemical test

In these cells 14-polyanthra-quinone (14PAQ) cathodes were assembled against Mg-foil as an anode by using 0.3 M magnesium tetrakis (hexafluoroisopropoxy) borate Mg[B(hfip)₄]₂/dimethoxy-ethane (DME), 0.5 M Mg[B(hfip)₄]₂/DME and 0.5 M Mg[B(hfip)₄]₂/tetraglyme (G4) electrolytes.

The MS80 Tian-Calvet calorimeter allows us to determine both the generated heat during cell operation and the self-discharge in the relaxation

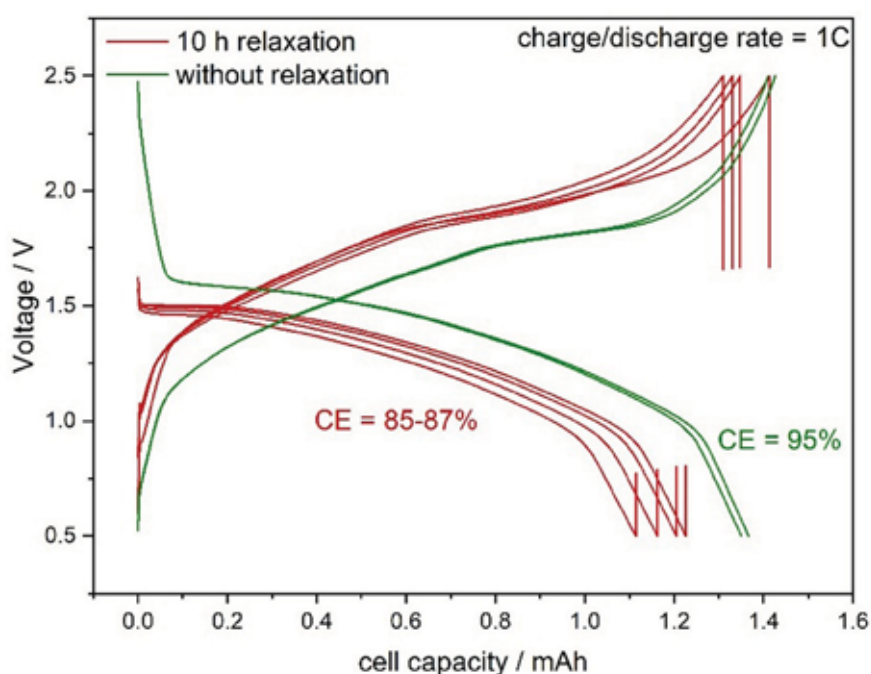


Figure 1: Comparison of voltage vs capacity curves of Mg coin cells at 1.0 C charge/discharge rate with and without 10 h relaxation.

periods of these cells. Fig. 1 compares the voltage vs capacity curves at 1.0 C charge/discharge rate without (green curve) and with 10 h relaxation (red curve). It can be clearly seen that the relaxation leads to a 10% reduction both in capacity and in Coulombic Efficiency (CE). The latter is defined as the ratio between the charge and the discharge capacity. This level of reduction indicates self-discharge.

Self-discharge test

Undesired parasitic chemical reactions lead to a spontaneous and irreversible capacity reduction by self-discharge

without any external electrical connection in the Mg coin cells. This becomes even more pronounced in the 24h self-discharge test shown in Fig. 2.

In this test, the coin cells are charged and discharged in the MS80 calorimeter with 1.0 C for two cycles and then held for 24 h at the fully charged state. Then the cells are discharged with the same C-rate, and finally, they are charged and discharged again for two cycles to determine the change in CE. A high level of self-discharge of 36% was found given in terms of Coulombic efficiency.

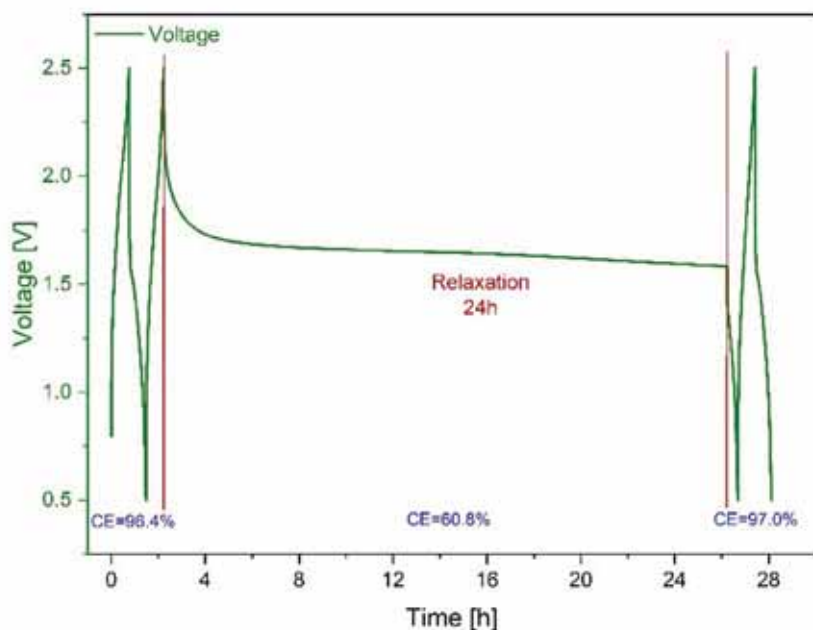


Figure 2: 24 h self-discharge measurement of Mg coin cells during charging and discharging at 1.0 C rate.

Determination of generated heat by calorimetry

The total heat generation can be accurately determined during cycling by the direct heat flow measurement capability of the MS80 calorimeter. Fig. 3 shows the capacity and the generated heat per mass (J/g) that has been determined by integration over the heat flow curves at 25°C for a 0.2 C

rate. The generated heat amounts to 325 J/g during charging and 375 J/g during discharging. For a 1.0 C rate, these values are a little bit higher with 375 J/g and 450 J/g.

Interestingly, the heat-flow in these organic based 14PAQ cells is negative during charging. This indicates that the cell absorbs heat (endothermic

reaction) during the magnesium extraction. This can be attributed to entropy change during de-magnetisation, and entropy changes are responsible for the heat absorption associated with material phase changes in the cell.

Thus, it has been demonstrated that calorimetry gives insights into the underlying reaction mechanisms and heat conduction processes in Mg batteries. The next steps will be material optimization to reduce the self-discharge, followed by safety tests and upscaling to the pouch cell scale.



The work described here contributes to the research undertaken by CELEST (Center for Electrochemical Energy Storage Ulm-Karlsruhe). The German Research Foundation (DFG) under Project ID 390874152 (POLIS Cluster of Excellence) funds this work

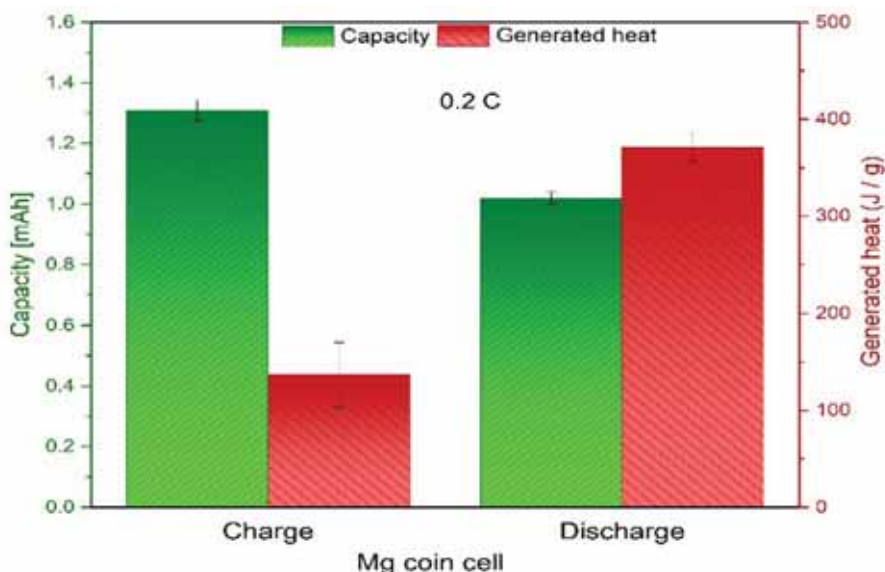


Figure 3: Capacity and generated heat of Mg coin cells at 0.2 C charge/discharge rate.

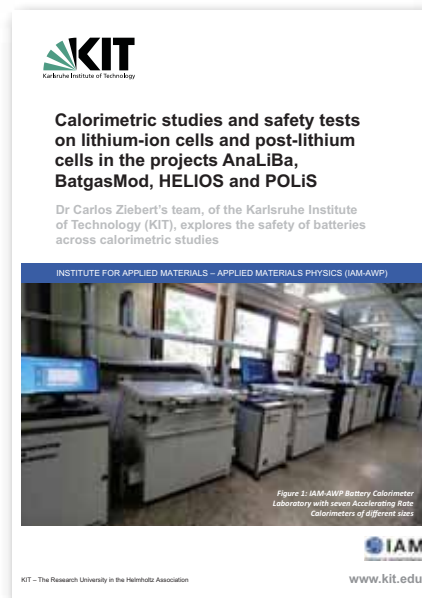


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Calorimetric studies and safety tests on lithium-ion cells and post-lithium cells in the projects AnaLiBa, BatgasMod, HELIOS and POLiS

The group Batteries - Calorimetry and Safety focuses on calorimetric studies and safety tests on lithium-ion cells and post-lithium cells. For this purpose, depending on the cell size and application, different types of calorimeters are used in Europe's largest Battery Calorimeter Laboratory, which was established in 2011.



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Bacteria are often painted as the enemy of humanity. Before the discovery of antibiotics, a wound getting infected was frequently a death sentence.

Even with modern medicine, infections such as *C. difficile* and infectious diseases such as tuberculosis continue to kill many people globally. Crop blights and diseases among livestock cause extensive monetary losses and threaten food security in affected areas.

With all of these reasons to distrust bacteria, it may come as a surprise that certain microbes are immensely beneficial to humanity. Unfortunately, they rarely get to enjoy the limelight.

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