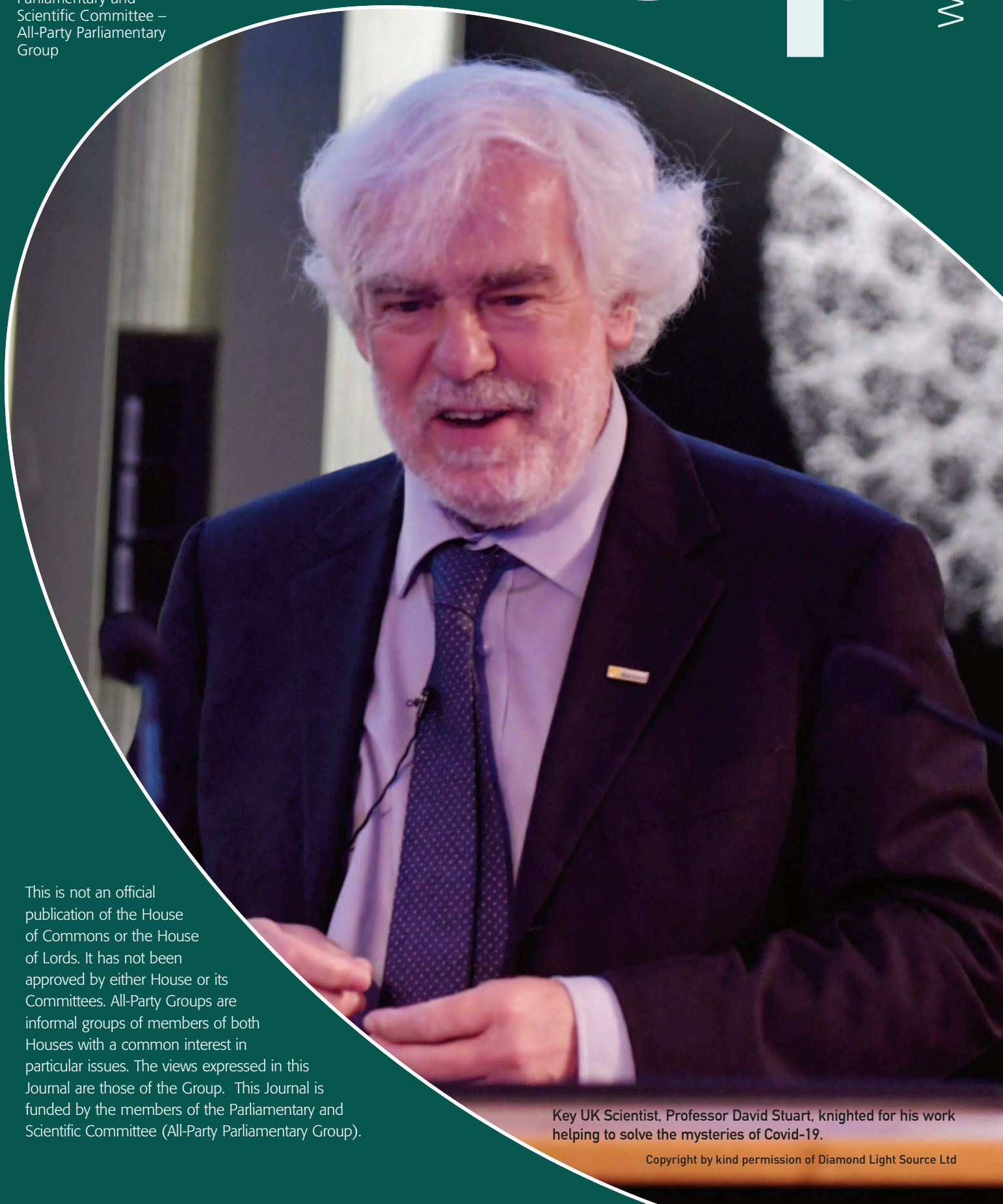
The Journal of the Parliamentary and Scientific Committee – All-Party Parliamentary Group

SCIENCE IN PARLIAMENT sip

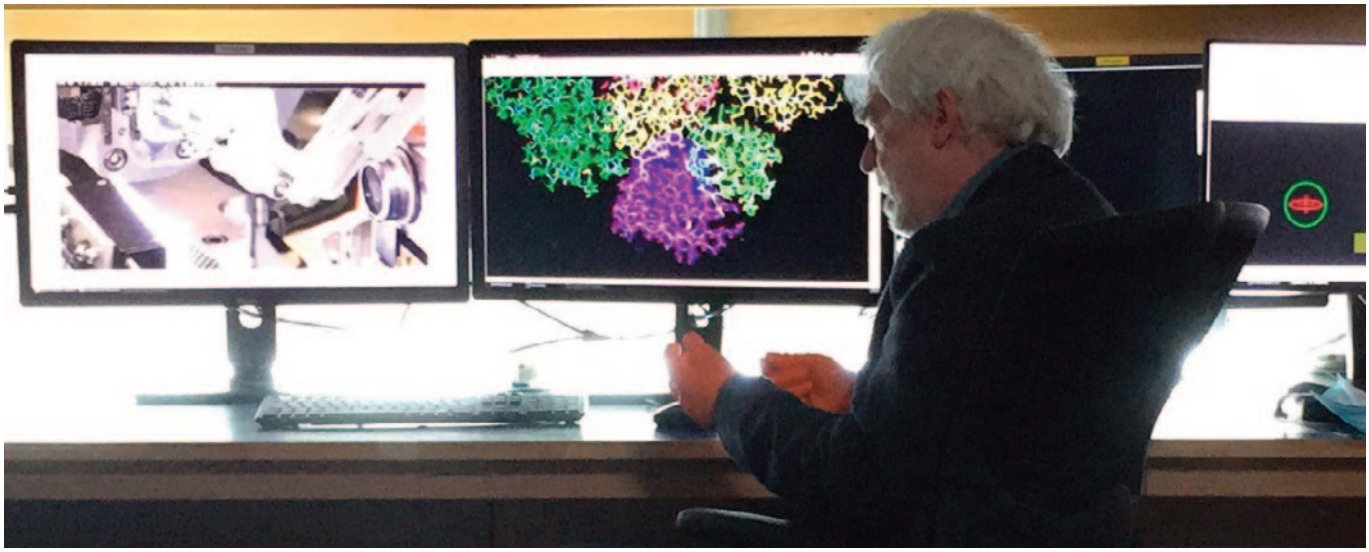
WINTER 2020



Key UK Scientist, Professor David Stuart, knighted for his work helping to solve the mysteries of Covid-19.

KNIGHTHOOD FOR DIAMOND LIGHT SOURCE'S PROFESSOR DAVID STUART IN THE 2021 NEW YEAR'S HONOURS

The Award acknowledges David Stuart's work as one of the key responders to Covid-19 and his pivotal role is helping to map its inner workings.



Prof Sir David Stuart analysing Covid-19 structures on Diamond Light Source's 103 Beamline

Professor David Stuart FRS is MRC Professor of Structural Biology at the University of Oxford, and Head of the Division of Structural Biology at the Department of Clinical Medicine. He has also been Director of Life Sciences at Diamond since 2008.

He is a world leader in structural biology, distinguished by contributions to viral crystallography. Since his 1989 Foot-and-Mouth Disease Virus structure he has extended the complexity of known structures with several milestone determinations; notably of bluetongue virus core and PRD1 (the first structure of an enveloped virus), providing the bedrock for advances in understanding viral assembly, replication and infection. He is also an active research scientist at Oxford University (Joint head of Structural Biology) and he and his team were behind a lot of the breakthrough Ebola work and the FMDV and polio work. Professor. Stuart's group have studied the structure of the Ebola virus and the effect of two drugs, toremifene and ibruprofen on the virus. The study was the first to solve the unligated structure of the Ebola virus glycoprotein and the results were published in Nature.

He has received many accolades and awards for his work over the years – until his Knighthood, the most recent was the prestigious Royal Society Gabor Medal in August 2020. This was awarded for his seminal contributions to understanding viruses (FMDV, Polio and Covid), their structure and application to vaccine design, driving the application of engineering and physical science to the life sciences, and driving interdisciplinary science.

His principal research interests are particularly focused on virus-receptor interactions, basic puzzles of virus assembly and studying virus evolution. His team are studying several viral proteins and enzymes which are potential drug targets and/or illuminate how viruses modulate host responses. For example, the immune modulators of pox viruses. Currently, Dave has been leading the scientific efforts and collaborative relationship between Diamond Light Source and the University of Oxford to develop methods for the production of viral proteins for drug screening and structural analysis, which can provide an atomic level of detail in understanding how anti-viral drugs can work against the SARS-CoV-2. This research helps to realise the potential to identify existing drugs that could be repurposed in the fight against COVID-19. Through Professor Stuart's leadership, Diamond has fostered a joint initiative with Exscientia, a leading AI driven drug discovery company, to accelerate the search for therapies.

On being awarded his knighthood, Sir David said *"I am deeply honoured by this recognition. I have worked to understand the structure and function of pathogenic viruses for many years. This past year has been challenging for many all over the world, and I am amongst the large number of scientists who are trying to apply their knowledge and expertise to help fight this pandemic. I am grateful to all those around me, especially in Oxford University and Diamond Light Source, who have worked together tirelessly to understand, in particular, our antibody responses to SARS-CoV-2 ".*

Stephen Metcalfe MP
Chairman, Parliamentary & Scientific Committee (All-Party Parliamentary Group)

Welcome to Winter 2020/21 edition of Science in Parliament

A very warm welcome to our first journal of 2021.

May I wish you a Happy New Year and one that turns out to be much healthier than 2021, particularly with the rolling-out of the Oxford University/Astra Zeneca Covid-19 vaccine – a wonderful achievement by UK scientists.

In this issue we have, in addition to our usual features a great range of contributions including, inevitably, aspects of Covid-19, the importance of R&D activity across the UK, new sources of sustainable protein, myeloma research, racial inequality in the science community, research outside Universities, lithium in Cornwall and resilience through physical activity.

Since the publication of the Autumn journal I have had the pleasure of chairing five excellent online discussion meetings on the following topics: *"Racial Inequality in the UK Scientific Community"; "Sources, health benefits and global challenges of protein"* in partnership with *the Nutrition Society; "Preparing for the long-term impacts of COVID-19 on older people"*, held in cooperation with The Physiological Society; *"Global perspectives: How UK and international researchers are working together to tackle COVID-19 across developing countries"* in which we were partnered by UKRI; and *"Autonomous Transport"*.

Each discussion has been well attended, with our meeting on racial inequality attracting a record audience of over 100.

It is satisfying that we are drawing the interest of members from across the United Kingdom as well as a number of overseas guests. My sincere thanks to each of the excellent speakers who delivered presentations during our Autumn programme and took questions.

All our virtual meetings have been recorded for viewing on YouTube.

We will continue with our discussions by Zoom at least until the State Opening of Parliament at the end of May 2021.

There has been a further increase in our membership, and I am delighted to welcome the following organisations to P&SC:

Scientific and Technical Organisations: Alan Turing Institute; Diamond Light Source Ltd; Rosalind Franklin Institute; and Fraunhofer UK Research Ltd.

Universities: Cardiff University; Lancaster University; University of Bradford; University of South Wales; Teeside University; London Metropolitan University; and the University of the West of Scotland.

Commercial Organisations: Alcis Holdings Ltd.

I am also very pleased to welcome, as individual members: Professor Izzet Kale, College Institute & Research Director, College of Design, Creative & Digital Industries, University of Westminster, and Professor John Allen, who was recently appointed Professor of Biosensors and Bioinstrumentation at the new Research Centre for Intelligent Healthcare (CIH), Coventry University.

Finally, we have received an excellent response from early-career researchers applying for STEM for BRITAIN 2021. The finalists, selected by the respective judging panels, will have the opportunity to present their posters in a series of virtual meetings during the first week of March.

All P&SC members, and Members of Parliament whose constituents are finalists, will be invited to 'attend' the announcement of the winning candidates and the Westminster Medal on Monday 8th March, receiving joining details in due course.

With many thanks for your continuing support.

With best wishes.

SCIENCE IN PARLIAMENT
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The Journal of the Parliamentary and Scientific Committee (All-Party Parliamentary Group).

Science in Parliament has two main objectives:

1. to inform the scientific and industrial communities of activities within Parliament of a scientific nature and of the progress of relevant legislation;
2. to keep Members of Parliament abreast of scientific affairs.

CONTENTS

The Journal of the Parliamentary and Scientific Committee (All-Party Parliamentary Group).

UK'S RECOVERY TRIAL LEADS THE WAY TO FIND EFFECTIVE COVID-19 TREATMENTS

Throughout the COVID-19 pandemic, the UK has led the way in making life-saving new discoveries about the disease. Caroline Wood describes how a multidisciplinary team at Oxford University rose to the challenge of conducting the world's largest clinical trial to investigate effective treatments, and how this success may revolutionise clinical trials in the future.

Professor Richard Haynes
Professor of Renal Medicine and Clinical Trials, Nuffield Department of Population and Health, University of Oxford.

Evelyne Kestelyn
Head of the Clinical Trials Unit, University of Oxford Clinical Research Unit (OUCRU).

Professor Peter Horby
Professor of Emerging Infectious Diseases and Global Health, University of Oxford and Chair of the UK Government's New and Emerging Respiratory Virus Threats Advisory Group.

Dr Marion Mafham – Clinical Research Fellow, Nuffield Department of Population and Health, University of Oxford.

'When the pandemic first erupted, there were no known effective treatments and we knew vaccines would take many months, if not years, to develop. There was an urgent need to find out whether any existing, widely-available drugs were effective against COVID-19' says Professor Peter Horby (Nuffield Department of Medicine, NDM, Oxford University), co-Chief Investigator of the trial. In order to gather robust evidence to determine if any of the candidate treatments worked, Peter proposed the Randomised Evaluation of COVid-19 thERapY (RECOVERY) trial. As a clinical academic specialising in epidemic infectious diseases, Peter has over 15 years of conducting clinical studies during outbreaks, although the speed and scale of RECOVERY has been unprecedented.

A RECIPE FOR SUCCESS:

Normally, a large clinical trial would take months to set up and possibly years to complete. In contrast, RECOVERY was launched within nine days since its conception, with over 10,000 patients recruited in just two months. By the end of November, the total surpassed 19,000. 'We knew it was vital to get all the processes set up before the first wave really hit and hospitals became very busy' says Professor Richard Haynes (Nuffield Department of Population Health, NDPH, Oxford University), Clinical Coordinator for RECOVERY. 'Surfing is a good analogy – you need to prepare as you see the wave coming in if you want to be ready to ride it. If we had launched a week later, it would have been a very different story.' The trial is open to all patients hospitalised with COVID-19. All recruited patients receive the usual standard of hospital care; those in the treatment group additionally receive at least one of the therapies under investigation. Crucially, the trial was designed to be adaptive, so that new treatments could be added as they became available.

'RECOVERY's success has really been driven by several key factors' says Dr Marion Mafham (NDPH, Oxford University), who leads the trial's data linkage team. 'First, the unified structure of the NHS allowed us to rapidly roll out the trial across the UK. Secondly, the trial was designed to be easy to take part in for the staff in the local hospitals. The paperwork is short and simple to follow. And thirdly, having access to routine patient data stored in the NHS's central databases means we can collect high-quality data without imposing additional burdens on the healthcare system.' To minimise the work required from frontline hospital staff, the recruitment process has been kept as simple as possible. 'My team then links each recruited patient with their record in the databases held by the central NHS data custodian; NHS Digital for England; the SAIL Databank for Wales and Public Health Scotland and the National Records of Scotland. This allows us to track the patient's progress over time, including whether they required ventilation or

dialysis treatment, and ultimately if they made a recovery or not. Since patient data is continually added to their record, we can also analyse the effects of the treatments on health outcomes over the long term, such as later lung problems or kidney disease.'

DELIVERING RESULTS

'The speed that RECOVERY is operating at is incredible' says Richard. 'The independent data monitoring committee, who decide when the data is significant enough to halt the trial, is meeting every fortnight rather than every six months, which would be more usual for a trial.' This regular review led to the discovery in June that the cheap steroid dexamethasone reduced death by up to a third in patients hospitalised with severe COVID-19. It was the first effective treatment discovered for COVID-19, and may already have saved thousands of lives. 'When the dexamethasone result was discovered, it was one of the most exciting moments of my career – you don't often get results like that from clinical trials with such clear implications' says Richard. 'We were very quick to share this result with the rest of the world, so that it could be immediately translated into routine clinical practice.' So far, the trial has also discovered that two promising treatments, hydroxychloroquine (a treatment for malaria) and lopinavir-ritonavir (used to treat HIV) are not effective against COVID-19. Although this is disappointing, the trial can now focus on other candidate drugs. From the very start, the RECOVERY team have been careful to maintain complete transparency, making all information – from protocols to the results- available on their website. This has proved particularly important for hydroxychloroquine, since various agencies have promoted its use as a COVID-19 therapy despite the lack of evidence that it is effective.

'It's been a real team effort, with everyone involved working long days and showing such dedication to the task. You don't mind working very hard when everyone else is and you can see that you are part of something so impactful' says Richard. He also credits the Research Ethics Committee for prioritising the trial and accelerating the approval procedure. 'If each hospital involved had to sign a contract with a wet signature, for instance, we could never have launched RECOVERY in time. The Department of Health and Social Care were also very supportive, buying in a stockpile of the drugs we wanted to test and redeploying nurses from the Clinical Research Network to work on RECOVERY.'

GOING FORWARD

There is particularly high anticipation about two of the treatments currently being investigated by the trial. One of these is convalescent blood plasma, collected from donors who have recovered from COVID-19 and containing antibodies against the SARS-CoV-2 virus. The other is REGEN-COV2, a cocktail of cloned antibodies produced by Regeneron Pharmaceuticals engineered to recognise and neutralise the coronavirus.

Funding has been secured from Wellcome, via the COVID-19 Therapeutics Accelerator, to expand RECOVERY internationally, particularly in countries where Oxford University already has strong links with research institutes. It is likely that Vietnam, Indonesia and Nepal will be the first to join. 'Extending RECOVERY to include other countries will increase the recruitment pool, giving us more information about whether these treatments are effective' says Evelyne Kestelyn, Head of the Clinical Trials Unit at the Oxford University Clinical Research Unit in Vietnam. 'But it is very important to ensure that the treatments we test in these countries can be made widely available there. Convalescent plasma, for instance, wouldn't be possible in countries without a robust blood banking system. It will also be a challenge to adapt the trial design to healthcare systems that don't follow the centralised NHS model.' Nevertheless, these studies will increase our understanding of whether these treatments are effective across all populations.

LESSONS TO BE LEARNT

RECOVERY has effectively rewritten the rulebook by demonstrating that it is possible to deliver high-quality critical data within vastly accelerated timescales. 'It has really shown what can be achieved when there is a national will, and processes are made as efficient as possible. I hope the lessons from RECOVERY will help streamline the approval process for all types of clinical trial in the future' says Richard. Marion, meanwhile, hopes RECOVERY's success will promote greater use of routinely collected patient data in clinical trials. 'There is an immense amount of data held in the nation's trust that could be put to use towards helping discover better, safer treatments, while maintaining patient confidentiality.' This is the goal of NHS DigiTrials Health Data Research hub,[1] which was developed to enable more and better trials through effective use of routine health care data, while maintaining patient privacy. The hub has played a key role in supporting RECOVERY by providing the comprehensive data held by NHS Digital to allow full evaluation of the treatment's effects, and is working to make this service available to other researchers across the UK.

'Ultimately, we need a vaccine for life to return towards normal, but we will still need these treatments' says Richard. 'No vaccine programme is 100% effective and there will likely be overlap between those who don't respond as well to the vaccine and those most at risk of COVID-19, such as the elderly.'

'RECOVERY's success has been due to the hard work of an enormous range of people including epidemiologists, data analysts, computer scientists, trial managers, clinicians, frontline healthcare staff and the goodwill of thousands of patients. It's the type of interdisciplinary work that the UK really excels at' Richard concludes.

For further information about the RECOVERY trial, please see https://www.recoverytrial.net/.[2]

Caroline Wood is a Communications Officer for the Nuffield Department of Population Health, Oxford University.

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1 https://www.hdruk.ac.uk/help-with-your-data/our-hubs-across-the-uk/nhs-digitrial/

2 https://www.recoverytrial.net

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RECOVERY
Randomised Evaluation of COVID-19 Therapy

LOCAL INVESTMENT AND GLOBAL PERFORMANCE

Professor Graeme Reid
Chair of Science and Research Policy, University College London

Grace Gottlieb
Research and Strategy Policy Officer
Office of the UCL Vice-Provost (Research)

Sarah Chaytor
Director of Research Strategy & Policy, and Joint Chief of Staff
Office of the UCL Vice-Provost (Research)

R&D investment should be spread more widely across the UK while continuing to support major research clusters.

Government is rightly committed to tackling unacceptable differences in wealth and opportunities across the UK. New regional initiatives featured prominently in the November 2020 Spending Review. [1]

R&D investment is an important part of the picture. The UK delivers an extraordinary level of scientific performance, despite modest levels of public spending on R&D. This great national strength already supports local and regional economies across the country. High quality research and innovation create jobs and enable improvements in areas such as transport, healthcare, food safety, business competitiveness and the quality of the natural environment.

The focus on regional inequalities highlights concerns about the geographic distribution of R&D investment. In absolute terms, research funding is concentrated in the greater South East of England and, to a lesser extent, in the central belt of Scotland, the North West of England and the Swansea-Cardiff-Bristol axis. A report from NESTA [2], prepared by Tom Forth and Richard Jones, included the observation:

"The current situation is the result of a combination of deliberate policy decisions and a natural dynamic in which these small preferences combined with initial advantages are reinforced with time".

That statement referred to the distribution of R&D within the UK but it also applies to our position relative to cities, regions and nations in other countries.

There is a curious paradox in the behaviour of scientific researchers. On the one hand, knowledge and ideas flow freely between researchers internationally. Meanwhile, many scientists from around the world build careers in large geographic clusters. This allows them to form social and professional networks and:

- move jobs without moving home;
- share expensive scientific infrastructure;
- attract R&D investment from global corporations; and
- present venture capitalists with a large portfolio of opportunities in one place.

The origins of these clusters vary. Some, such as Silicon Valley or Singapore, can be traced to specific decisions or events. Others – in Edinburgh, Oxford or Cambridge, for example – are the products of long histories. Analysis by the Royal Society [3] shows that these clusters combine specific research strengths, highly qualified researchers, access to public and private funding, a skilled workforce, business capabilities, and appropriate infrastructure.

Maybe the pervasive use of video-conferencing during the Covid-19 pandemic will create additional types of cluster. In Wales, for example, universities are exploring new approaches to collaborations. [4]

In the UK, these clusters are magnets for business investment in R&D, not least from companies headquartered overseas, choosing the UK as the place to do R&D. Around half of business R&D investment in this country now comes from firms headquartered overseas. [5] The USA is the largest source of foreign R&D investment while companies from India, China and the Asia Pacific are growing their UK R&D at the fastest rates.

It is difficult to imagine how the Government's plan to raise overall R&D investment to 2.4% of GDP could be delivered without attracting more investment from overseas. If the UK does not maintain research clusters that compete with the largest and best in the world, then over time this country will struggle to hold its place against global competitors. Indeed, a recent report [6] from the National Centre for Universities and Business said:

"The UK must start behaving as a competitor in the global market for R&D investment to retain existing business investment and attract higher levels of globally mobile business research".

In its March 2020 Budget, [7] Government promised to

"…examine how R&D funding as a whole can best be distributed across the country to help level up every region and nation of the country".

The "best" distribution will of course be a matter of political judgement rather than calculation. That judgement may reflect the benefits of large research clusters as well as the benefits of widely dispersed R&D.

Discussions on regional R&D investment often use the cluster of research in London and the South East of England as a reference point. Large research universities in Oxford, Cambridge and London – spanning three regions of the UK – are described collectively as a 'golden triangle'. R&D investment in other regions does not match the scale of that super-region.

Is this scale of the golden triangle and other UK clusters particularly large by international standards? How does the intensity of geographic concentration in UK cities and regions compare internationally?

Let's consider individual cities. London has nearly 50 universities and higher education colleges. [8] It has major research centres such as the Crick, Dementia Research, and Alan Turing Institutes. It has growing communities of research and innovation in White City, King's Cross and elsewhere. Surely, London must be one of the largest centres of research and innovation in the world.

A recent study by consultants SQW for Research England [9] presents the sobering picture shown in Figure 1. The combined R&D expenditure in London's universities falls behind each of the US top ten cities. Even after adding together university R&D spend in Cambridge, Edinburgh, London, Manchester and Oxford, the total is about the same as in Houston, Texas. These five great UK cities include some of the world's most famous and highly respected universities whose combined research spending is around half that in either Los Angeles or Boston.

Not all US cities or states have abundant R&D. Like this country, research in the USA is concentrated into a relatively small number of clusters that compete on a world stage. California, home of Silicon Valley, has total R&D investment that is greater than that in the lowest-spending 39 US states combined. [10]

Turning to regions, Figure 2 shows the geographic distribution of R&D spending across administrative regions in several major research nations and the EU. Of course international comparisons are complicated but the degree of concentration in the UK and China appears less than elsewhere. This contrasts with the popular rhetoric that research in the UK is highly concentrated.

Research concentration is not only visible in public spending. According to the EU Industrial R&D Investment Scoreboard: [11]

"Industrial R&D is highly concentrated. A small subset of companies, industries and countries account for a large share of the total R&D investment."

According to that scoreboard, companies from three countries – USA, Japan and Germany – account for 62% of business

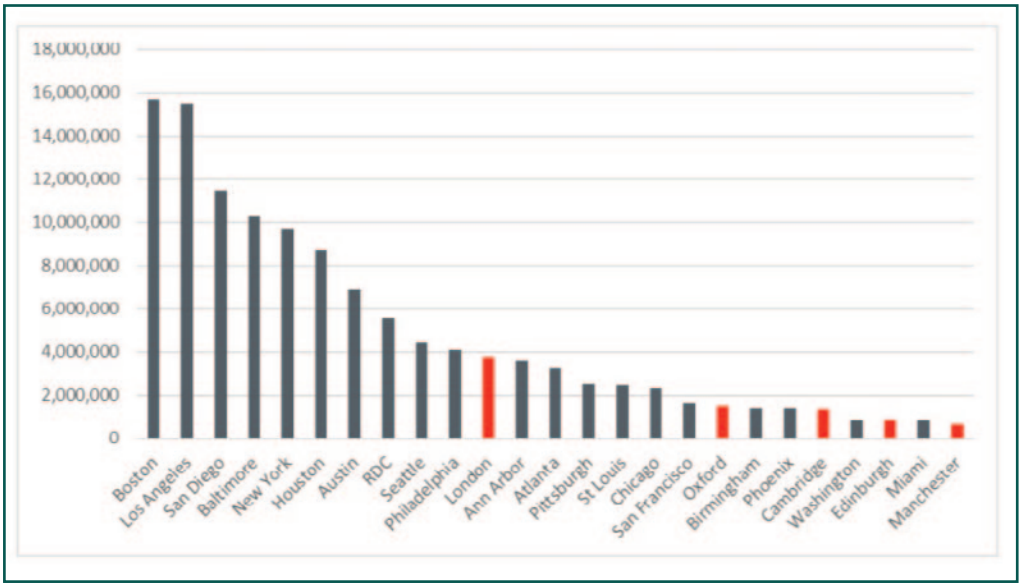

Figure 1 University R&D Expenditure in US and UK cities (£000s, total of 2016-2018)
Source: SQW analysis of data from AUTM and HESA

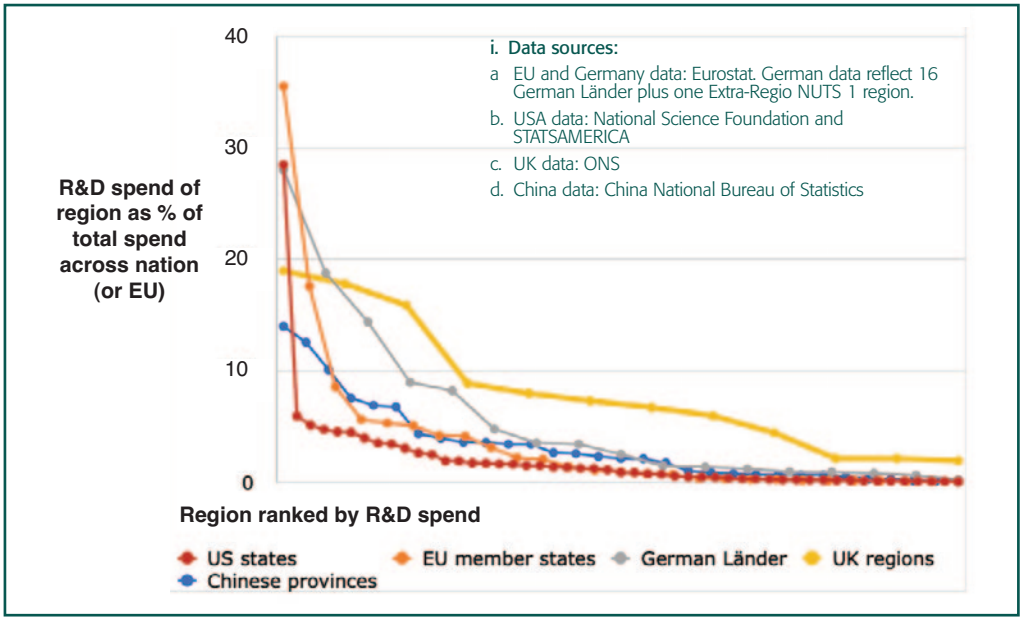

Figure 2: Distribution of total R&D spend across regions of the US [b], EU [a], Germany [a], China [d] and the UK [c]
Source: UCL analysis of several sources of data [i] .Note: Self-evidently, this analysis reflects the number of administrative regions in different countries or territories as well as the distribution between these regions. For example, the USA has more administrative regions than Germany so the proportion of R&D in each German region is correspondingly higher than that in most US states.

investment in R&D globally. Chinese investment in R&D is growing at over 10% per annum [12] so we can expect some jostling for seats at that top table. Indeed, if we look at overall national expenditure on R&D, as shown in Figure 3, China and the USA stand shoulder to shoulder as the largest investors. The UK remains in the top ten but may well need the additional investment promised by Government to retain that position.

What does this mean for the future of research funding in this country? Will the UK be forced to trade the advantages of large research clusters against the strong arguments for a more even geographic distribution of research?

If, as promised,[7] the Government raises public spending on R&D to £22bn per annum by 2024-25, then the next few years provide unprecedented opportunities. In principle, the UK could expand research capacity in more parts of the UK while simultaneously enhancing the major research clusters that already exist.

Recent reports from both CaSE [13] and the Royal Society [3] have noted the challenge of creating new clusters of research excellence – as suggested by the 2070 Commission.[14] Sustaining and enhancing research excellence across the UK in the future is likely to require consideration of, amongst other things:

- the longer-term investment in factors necessary to support emerging clusters, from education and skills to physical and digital infrastructure;
- the empowerment of local actors and leaders in decisions on research investment in order to ensure that it addresses local need; and
- investment in existing centres of excellence to increase research performance across the UK, including through strengthening networks to amplify impact.

In any case, surely universities, businesses and government should aim to bring the benefits of research findings to a wide population – wherever they live – rather than duplicating scarce research capabilities across the UK. That means we should find ways to spread the impact of research across more parts of the UK. [15]

Modifying the geographic distribution of research funding may be part of that agenda but it will not be the only lever of change. Investment in the capacity of businesses and local authorities to take advantage of research might have just as great an effect and show results more quickly. Supporting both major clusters and local investment could bring the biggest rewards of all.

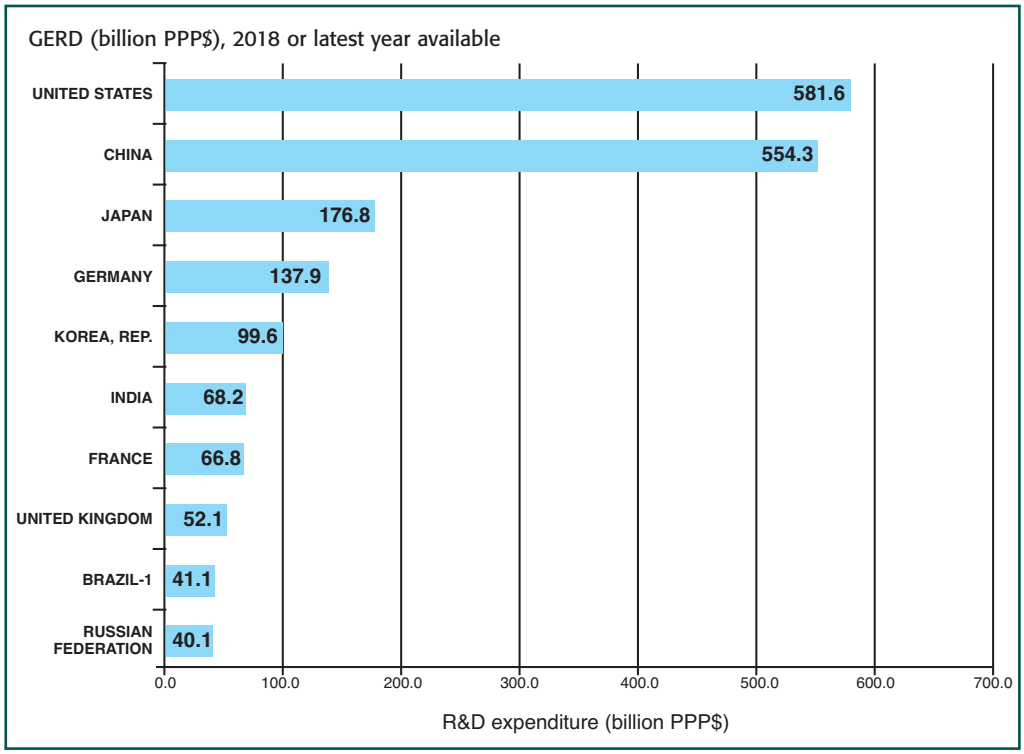

Figure 3: The World's top ten countries by gross expenditure on R&D
Notes: -1 = 2017. Source: UNESCO Institute for Statistics, June 2020.

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MANAGEMENT OF PRECURSOR STATE (NON-MALIGNANT) HOLDS PROMISE IN IMPROVING EARLY DIAGNOSIS RATES IN MYELOMA

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Myeloma affects on average 5800 people/year in the UK and is the advanced stage of a clonal plasma cell disorder with a distinct precursor state, termed monoclonal gammopathy of undetermined significance (MGUS).

Findings from the 2014 National Cancer patient experience survey in England show almost half of myeloma patients visit their general practitioner at least three times prior to hospital referral to confirm a diagnosis. The survival statistics are stark, myeloma patients diagnosed through a standard two week wait cancer pathway initiated by a GP referral have a one year survival of 88% in comparison with myeloma diagnosis being made as an emergency, where only 62% of patients survive a year from diagnosis. Earlier detection is a high priority for patients and improves survival: 84% of people with myeloma survive for >5 years if diagnosed at the earliest stage, compared with only 26% if diagnosed at advanced stage. Despite the widespread availability of diagnostic serological techniques, myeloma is most frequently diagnosed late (>3-6 months post symptom

Figure 1: Myeloma UK approaches to tackle delayed diagnosis in myeloma

presentation the median diagnosis interval (time from first symptom to diagnosis) for myeloma patients is 163 days) and has the longest diagnostic delay of any cancer, with emergency presentations in >30% of newly diagnosed myeloma patients who have shortened survival. There are a number of ways one can tackle this problem.

Myeloma UK has developed a multifaceted approach to deal with delayed diagnosis. A number of efforts have been directed against improving GP education on the diagnosis of myeloma. Educational topics are focused on 10 top tips to diagnose myeloma, myeloma diagnosis pathway and a GP myeloma diagnostic tool that can be used in surgeries. These educational pieces have been showcased in GP education events, RCGP online educational module, medical defence union article and PULSE/ BMJ Journal . In parallel to this, healthcare professional educational events have been developed for allied health professionals and impact case studies to educate hospital staff and through medical grand rounds. A number of other active projects are currently being pursued in this domain, such as building laboratory best practise in flagging myeloma from blood tests that can be disseminated across the NHS hospitals to improve early diagnosis. Early exploratory work of using health economics modelling of the diagnostic pathway, and use of artificial intelligence and blood markers to improve early diagnosis rates are being tested in individual projects to build the case for early diagnosis.

Myeloma care costs are substantial relative to the overall cancer chemotherapy spend worldwide. Most avoidable delays occur in primary care, including inconsistent MGUS testing and follow-up, highlighting the need for improved connectivity between primary care (screening), immunology (initial investigations) and haematology (ongoing management) for effective diagnosis and management of myeloma and precursor states. The term monoclonal gammopathy refers to the aberrant amounts of monoclonal immunoglobulin produced by the dysregulated plasma cell clone. MGUS is heterogenous in its clinical presentation, with varying levels of both aberrant and suppression of normal immunoglobulins. Myeloma is the only clinical state currently offered therapy, although a minority of MGUS patients experience complications such as amyloidosis, kidney disorders, osteoporosis, and skin and nervous system manifestations. MGUS patients with these clinical complications are referred to as having monoclonal gammopathy of clinical significance (MGCS). Because MGUS precedes all myelomas, an early diagnosis strategy is to regularly monitor people with MGUS for progression to myeloma. Progression risk is ~1%/year with a general MGUS population prevalence of 3.2% in individuals >50 years. Unfortunately, MGUS is often diagnosed incidentally and 80–90% of myelomas are diagnosed without first receiving an MGUS diagnosis (**Figure 2; problem 1**).

Given that population-level MGUS screening would be impractical and expensive, research is required to understand clinical symptoms. However, the need to regularly monitor a higher number of patients with MGUS would place a huge burden on GPs (**Figure 2**; **problem 2**). There is a lack of well-defined prediction models for the MGUS-MGCS/ myeloma transition that can be applied in clinical care. Although the size of the aberrant monoclonal protein and subtype (non-IgG) does broadly prognosticate progression to myeloma, only 20-30% of MGUS patients belong to this group. Further, risk factors for MGUS-MGCS/myeloma progression have been difficult to define, leading to largely non-standardised approaches to detection, risk stratification and ongoing monitoring, contributing to the diagnostic delay. Patients presenting with myeloma report pain as the most common symptom at diagnosis and >80% have bone lesions on imaging at diagnosis. Patients diagnosed with MGUS show significantly higher incidence of death due to co-morbidities such as fractures (including all hospital-related morbidities from long-term hospital admission such as hospital-acquired infection), thrombi formation, organ failure and infection, compared with non-MGUS controls. Furthermore, >18% of MGUS patients incidentally diagnosed and with no prior history of osteoporosis will suffer from a vertebral fracture.

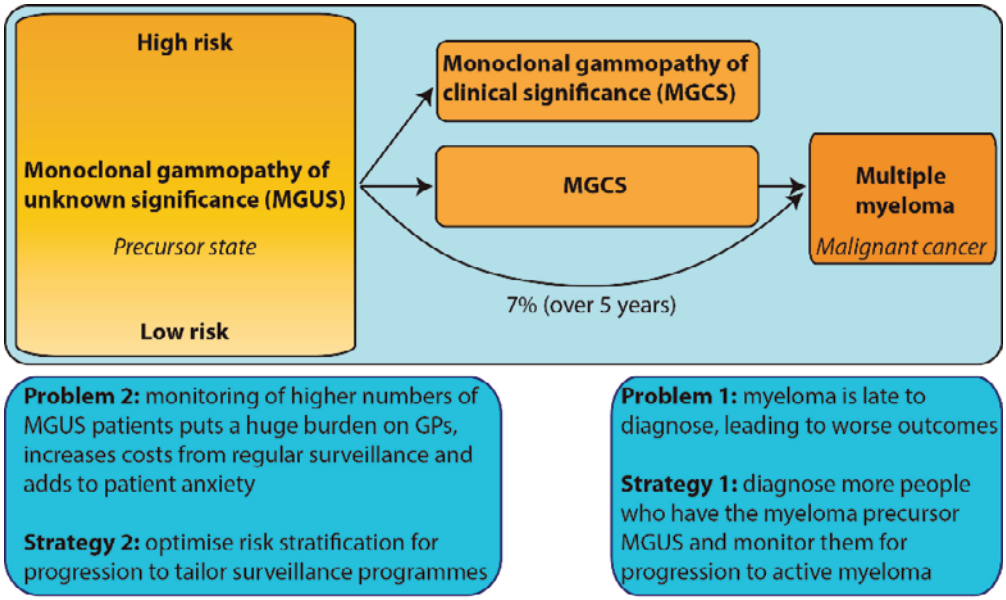

Figure 2: MGUS progression to MGCS and/or myeloma, problems and potential strategies

Therefore a systematic approach is required to both understand MGUS and true disease associations, as well as optimised monitoring with blood-based tools to improve early myeloma diagnosis rates. To deliver this, a number of key specific initiatives have to be developed. They are

1) Primary care data prediction modelling
2) Structured monitoring in secondary care
3) Developing pragmatic observational studies
4) Testing early blood-based biomarkers.

Primary care electronic healthcare databases, such as UK clinical practise research data link and Q research databases, are a phenomenal source of information that can be used to flag up patients with MGUS and map out disease progression trajectories in both progressors to myeloma and nonprogressors. There may be key clinical and/or objective blood-based parameters that differentiate these two cohorts of patients which could be used to both monitor and identify early transition from MGUS to myeloma.

There are no agreed structured methods of monitoring MGUS patients in the community. Some hospitals use lab-based systems for monitoring, others provide telephone or email advice to general practitioners and some other hospitals follow up MGUS patients through telephone clinics run by haematology nurses or doctors. Due to these varied practices, we have been unable to develop a large secondary care data set that could be a very useful resource to validate findings that can be generated from the primary care databases described above. There is increasing push from primary care practitioners to take specialist monitoring of patient cohorts into secondary care. This may be a useful way to both optimise MGUS monitoring as well as develop a resource for research analysis. Although the focus is to diagnose myeloma early, a vast proportion of MGUS patients will not go on to get myeloma. It's equally important that this group is clearly defined through this approach to ensure secondary care MGUS monitoring is both sustainable and cost effective.

Pragmatic observation studies have to be developed to prospectively validate both clinical parameters as well as biomarkers that are being developed and could be used to intervene early to arrest the transition of MGUS to myeloma. In the UK, we are well placed to develop these studies, as we have a seamless healthcare model of laboratories reporting new MGUS diagnosis to general practitioners, who subsequently refer patients to haematologists in secondary care. The NIHR clinical research network also supports development and delivery of similar early diagnosis studies in other cancers.

Use of blood-based biomarkers as an early diagnosis tool for cancer is being tested in solid tumours. In the case of MGUS transforming to myeloma, increasing size of the measurable abnormal protein in the blood has provided a clue to transformation of MGUS to myeloma. But early data using mass spectrometry studies suggest abnormal chemical changes to this protein, circulating in the blood, occurs before any increasing size of the protein. This test has potential to identify MGUS patients who will transform to myeloma earlier. But this biomarker should be prospectively tested in clinical studies.

In summary, myeloma suffers from the penalty of most delayed cancer diagnosis leading to poor clinical outcomes. There's a clear case of improving early diagnosis rates by developing a robust MGUS monitoring service when identified, underpinned by high quality research in the UK, as a platform for early diagnosis of myeloma.

□

COVID-19: UNDERSTANDING THE IMPACTS OF THE PANDEMIC ON THE UK POPULATION

Rob Davies, Head of the CLOSER COVID-19 Taskforce (UCL Social Research Institute)

In April, as the UK began to lock down in response to the COVID-19 pandemic, the UK's longitudinal population studies saw the urgent need to capture the experience of their study participants and how the pandemic was affecting their lives. Launching bespoke questionnaires to their participants, many of whom have been followed throughout their lives, these studies began to collect vital data from hundreds of thousands of people from across the UK.

CLOSER, the home of longitudinal research, brings together these national scientific assets to maximise their use, value and impact. Our 19 world-class longitudinal population studies comprise of both national and regional studies from across the UK. They include national studies like the British Birth Cohort Studies, ONS Longitudinal Study, English Longitudinal Study of Ageing, and Understanding Society – the UK Household Longitudinal Study, and regional studies such as Born in Bradford, Southampton Women's Survey, the Avon Longitudinal Study of Parents and Children, and Generation Scotland.

The evidence from these studies are providing insights into the health, social, economic, and behavioural impacts of the pandemic at both a national and regional level, and across all generations and ages. They are exploring how people at different

life stages are being affected and how prior life experiences shape resilience or vulnerability to its effects. The UK's longitudinal population studies are especially valuable as they have pre-pandemic measures of health and behaviours on the same people, allowing us to look at change from pre-COVID-19 to living with and through the pandemic.

Study participants are asked a range of questions to help understand the changes in response to the pandemic and the subsequent lockdowns in relation to physical and mental health, family and relationships, finance and employment, education and home schooling.

Data from these surveys help researchers explore the effects of social isolation brought about by the pandemic, the impacts on those living in more disadvantaged areas, women, ethnic-minorities, and those with chronic illnesses:

COVID-19 risk factors

- Using pre-pandemic data from longitudinal population studies on health behaviours, body size and blood samples, research has shown that physical inactivity, smoking, and obesity are risk factors for COVID-19 hospital admission.

Impact on women

- The pandemic has had a disproportionate impact on women - particularly mothers - as they have been undertaking the major share of housework and childcare.
- With schools closed, mothers were more likely than fathers to stop working to help educate their children. During the first lockdown, mothers spent around double the time on home schooling compared with fathers.

Impact on mental health

- Mental health problems - in particular anxiety, loneliness, and reduced wellbeing - have risen substantially during the COVID-19 pandemic. This is being shown consistently across UK longitudinal population studies, which can compare mental health prior to and during the pandemic.
- Large mental health differences across generations are emerging, with young people – especially women aged 19 to 30 – at the greatest risk of depression, anxiety, loneliness, and low life satisfaction.
- Young adults have experienced poorer mental health compared to older adults - the youngest age groups (aged 16-34 years old) also report higher levels of loneliness than the oldest study participants (aged 70+ years old).

Impact on employment and finances

- At the height of the first lockdown there was a 40% reduction in working hours across four generations aged 19, 30, 50 and 62. The biggest drop was among the youngest workers.
- Nearly one in five people aged 52 and over reported that their overall financial situation was worse in June–July 2020 than before the outbreak. Older workers have been more negatively affected than retirees: 29% of those in work immediately before the pandemic reported that their financial situation was now worse, compared with 13% of retirees.

Impact on education

- Children from low income and single-parent families and those who previously received free school meals have been most negatively affected when compared to their peers. Areas of particular concern are lack of access to equipment (computer, tablet, laptop) and free school meals for the most disadvantaged children.

Impact on food insecurity

- There was an alarming increase in food insecurity during the early stages of the pandemic: the prevalence of reporting at least one form of food insecurity (having used a food bank in the last 4 weeks, being hungry but not eating in the last week, or not able to eat healthy and nutritious food in the last week) rose from 7% in April to 20% by July 2020. Some of the largest increases were seen among Asian respondents, the self-employed, and 35-44-year-olds.

Impact on alcohol and tobacco use

- Binge and more frequent drinking increased during the lockdown, particularly in those aged 25 and older, women, white ethnic groups, and those with degree-level education. In contrast cigarette smoking decreased during the lockdown, particularly in younger age groups and men. Vaping also decreased. This seems to have been driven by a decline in lighter smokers.

These findings are important as they help to identify those people who are suffering the most as a result of the pandemic and need more help: these include young single mothers, the significant proportion of people who are now suffering from depression and anxiety, and the most vulnerable in our society.

As we move into a new stage of the UK's response to COVID-19, enabled by the welcome mental health, changes in participants' financial situation, their ability to buy food, access to healthcare and medications, and health behaviours, including smoking, drinking alcohol, physical activity, eating behaviour, sedentary behaviour, and sleep.

Initial findings from the data collected are worrying - they highlight that socioeconomic inequalities in health and life chances are widening. COVID-19 has had a greater impact on

announcement of a viable and effective vaccine, it is vital that we do not lose sight of the potential long-term impacts of the pandemic on the UK population.

In this era of dramatic political, technological, societal and economic change only longitudinal data can provide insights about the dynamics of individual behaviour and the influence of earlier events and circumstances on later life outcomes. With appropriate funding, our world-class longitudinal population studies will continue to follow the lives of their participants for many years to come to ensure we gain a greater understanding of the impacts of this pandemic on individuals, families, and our society and how we might address these. □

"Initial findings from longitudinal population studies suggest socioeconomic inequalities in health and life chances are widening as a result of COVID-19.

Evidence from these national scientific assets will be vital in understanding and addressing the long-term impacts of the pandemic on the UK population."

Rob Davies,
Head of the CLOSER COVID-19 Taskforce

COVID-19 LONGITUDINAL RESEARCH HUB

CLOSER has developed the COVID-19 Longitudinal Research Hub to act as a one-stop resource for researchers, parliamentarians and policy makers, now and in the future. This contains the new surveys, data releases, scientific evidence and insights, all in one place. Access the COVID-19 Longitudinal Research Hub: https://www.closer.ac.uk/covid19-longitudinal-research-hub/

NEW SOURCES OF SUSTAINABLE PROTEIN FOR A HEATHIER FUTURE

Professor Andrew Salter

Professor of Nutritional Biochemistry, based in the Division of Food, Nutrition & Dietetics, School of Biosciences, University of Nottingham. He currently leads the Future Protein Platform, a £1 million investment from the Future Foods Beacon, University of Nottingham. The aim of this project is to evaluate novel systems for production of plant and non-plant protein sources, to assess their nutritional value, and to develop their use as human foods and animal feeds. He is a Registered Nutritionist, has served as Elected Honorary Scientific Officer and Trustee of the Nutrition Society (2012-2018) and is currently a Trustee of the Academy of Nutrition Science.

The proteins of our body are made up of a range of amino acids which can be classified as essential, which must be supplied in our diet, and non-essential, which we can make. The quality of dietary protein is a function of its essential amino acid (EAA) content and, also, its digestibility, which can be influenced by a range of other components in the food. In general, the highest quality proteins tend to be those of animal origin (meat, fish, milk, and eggs) whose amino acid composition closely matches that of human tissues, and is highly digestible. However, much of the world's population obtain the major proportion of their protein from cereal crops, which are often deficient in EAAs (Figure 1)[1].

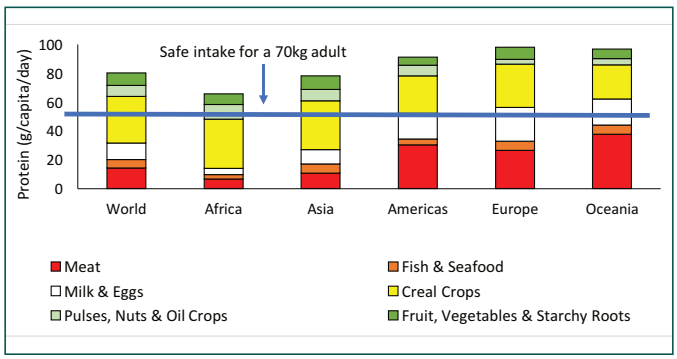

Figure 1. Global protein availabilty
(Data for 2017, based on FAO Food Balance Sheets [1])

While animal-derived foods represent rich sources of high-quality protein, there is increasing concern about their impact on both human health and the environment. Diets rich in such foods are also often energy dense, rich in saturated fatty acids, and as such, contribute to obesity and related chronic diseases including type 2 diabetes and cardiovascular disease (CVD). Animal agriculture is often viewed as an unsustainable use of natural resources. While ruminants (cows, sheep and goats) can be fed on pasture, not suitable for human consumption, monogastric animals (poultry and pigs) are largely fed on human-edible crops. It has been estimated that of all the crops grown, approximately half of the associated protein is fed to farm animals [2]. Hence much

land is taken up for production of animal feed that could be directly used for human food production. Farm animals also make a significant contribution to pollution, of both land and waterways, and are responsible for production of a significant volume of greenhouse gases (particularly methane from ruminants).

The impact of animal production on both human health and the environment has led for urgent calls for us to fundamentally change our food systems, particularly within high-income countries. In the United Kingdom it is suggested that if we were to all adhere to the current dietary guidelines (which would involve a significant reduction in meat consumption) this would have major advantages in terms of both human health and the environment [3]. Others have called for even more dramatic changes in global diets, with the Eat Lancet Commission perhaps producing some of the most radical proposals [4]. This report suggests replacing a large proportion of the animal products we currently consume with protein-rich legumes, seeds, and nuts. This would require a fundamental change in agricultural practices and land-use across the world and would need to be carefully managed to protect the most economically and nutritionally vulnerable populations. However, it is becoming increasingly clear that current food systems are neither sustainable or healthy and, as 'Westernized' diets spread increasingly into the growing populations of Africa and Asia, concerted efforts are required to 'rewire' our food systems. Novel sources of protein may make a vital contribution, both in terms of human food and animal feed, to aid a transition toward a more sustainable global food system.

Recent years have seen increasing consumption of meat 'analogues', designed to provide similar taste and sensory properties to meat. Traditionally, these have often been produced using soya protein, a rich source of protein and EAAs, though there has been increasing concern over the environmental impacts of soya production [5]. Other plant proteins, particular pea, are also gaining popularity as a component of such meat analogues. However, there is growing interest in more novel, currently underutilized, protein-rich crops, which have the potential for production in more severe environments [6]. Two such leguminous crops are Bambara Ground Nut and Wing Beans. While these have represented traditional components of the diets of many indigenous populations, particularly within Africa and Asia, problems associated with yield and the presence of anti-nutritional factors, which reduce protein digestibility, have restricted more widespread consumption. However, research is now actively looking at how to reduce these problems and produce alternatives to soyabean, that can be grown in tropical environments.

Insects are a traditional part of the diet of many global communities with an estimated 2 billion people regularly consuming them. They are a rich source of high-quality protein, have low land and water requirements, a low carbon footprint and can often be fed on substrates of poor nutritional value. While there has been growing interest in consuming insect-containing products in 'Western' countries, perhaps their most valuable use will be as alternative protein sources in animal feed. There is increasing evidence that insect larvae, a natural food of many animals, can effectively replace soya meal in the diets of chickens and pigs, and, indeed, for fish meal (derived from wild-caught fish) used in aquaculture [7]. With further research, it appears likely that economically and environmentally viable systems will be developed for the large-scale production of insects for such purposes.

One of the most rapidly developing areas is the production of single-cell organisms for food and feed. Of course, fungi, such as mushrooms have long been part of the human diet, and yeast and bacteria have been used in fermenting foods to improve nutritional value and longevity of foods. More recently, the filamentous fungus, *fusarium venenatum,* has been used as the major protein source in the range of meat analogues produced by 'Quorn', which has become increasingly popular in many countries around the word. Micro and macro-algae also show promise as protein-rich foods and feed and there is increasing interest in the production of bacterial species as a protein-rich ingredients. Bacteria have high protein content, are a good source of essential amino acids and have a low environmental footprint. There is growing evidence that bacterial protein can replace conventional ingredients in animal and fish feed, and an emerging industry is currently addressing the requirements to make such industry economically viable and safe. Finally, there has been much recent interest in the concept of cultured meat [8]. Stem cells, taken from animals can be differentiated into the various tissues associated with meat and 'built' into structures resembling a whole range of popular foods. While still in its infancy, there has been considerable investment in trying to develop this as a sustainable and affordable contribution to our food chain.

The impact of current protein production systems on our environment, and on our health, requires urgent attention. For those of us in higher income countries this may simply mean consuming less and swapping animal protein for plant protein. However, it seems likely that animal, and fish production will remain part of global food systems for the foreseeable future and, importantly, protect the most vulnerable populations from malnutrition. However, with continued research and investment, novel protein sources, for both human consumption, and as replacements for human-edible crops in animal feed, have the potential to reduce the impact of our current food systems on the health of both the planet and its population.

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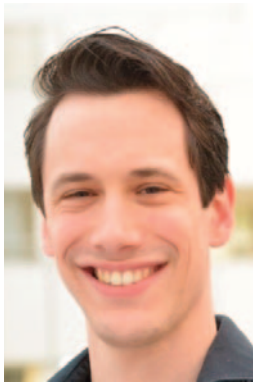
CONSIDERATIONS IN DIETARY PROTEIN RECOMMENDATIONS



Dr Jorn Trommelen

Assistant Professor at the department of Human Biology at Maastricht University Medical Centre+, the Netherlands. Our research group focuses on the regulation of human protein metabolism, with special attention to dietary protein interventions to support healthy muscle mass and function across the lifespan. For a full overview of our research projects and funders, please see our website: https://www.m3-research.nl/

KEY POINTS:

- Most children and adults in the Western world have an adequate protein intake, but older adults are at risk of protein inadequacy
- A move towards (more) plant-based protein diets may result in a lower total protein intake and protein quality, and may therefore not be suitable for populations at risk of protein inadequacy
- Physical activity enhances the anabolic effect of protein ingestion and a small increase in physical activity can have a substantial impact on the regulation of muscle mass and function

All living tissues are constantly renewed in a process called protein turnover, which allows a a high tissue quality to be maintained. For example, muscle tissue has a protein turnover rate of 1-2 % per day, which translates to muscle tissue being completely renewed every 2-3 months. Protein turnover is regulated by two opposing processes: protein breakdown in which body proteins are broken down to amino acids, and protein synthesis in which amino acids are incorporated into body proteins. An imbalance between protein synthesis and breakdown results in a net gain (synthesis > breakdown) or net loss (breakdown > synthesis) in body protein. In a fasted state, there is a negative protein balance. However, protein ingestion is a potent stimulus for protein synthesis that allows protein balance to become positive to offset protein losses that occur during fasting [1].

Therefore, adequate protein ingestion is essential to maintain a healthy organ mass and function.

The World Health Organization (WHO) has set the Recommended Daily Allowance (RDA) for adults at 0.8 gram of protein per kilogram of body mass per day (g protein·kg^{-1}·d^{-1})[2]. Most individuals in Western countries meet and often substantially exceed such protein requirement (Figure 1). Despite protein intake relative to bodyweight decreasing over the life span, protein intake in adults aged ≥70 years old still exceeds the RDA by about 20% [3]. However, it should be noted that there are methodological concerns that the RDA underestimates actual protein requirements. In addition, the RDA is criticized for being a "one size fits all" recommendation that should be tailored more to specific populations and/or conditions.

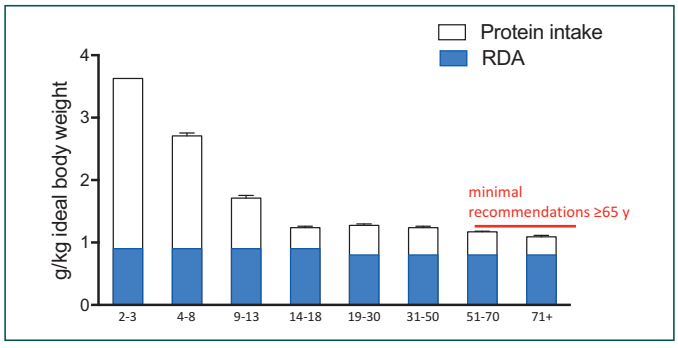


Figure 1. Protein intake and protein recommendations per age category (in years). White bars (means + SE) represent actual protein intake; data from from Berryman et al [2]. Blue bars represent the Recommended Daily Allowance (RDA) for protein as determined by the World Health Organization (WHO) [3]. However, there are concerns that the RDA is inadequate for older adults. The red line represents the minimal protein recommendations for older adults (≥65 year) as proposed by Traylor et al.[4]

Aging is associated with a loss of muscle mass and function called sarcopenia. Sarcopenia results in a loss of functional independence and increased health-care burden. In the fasted state, muscle protein synthesis rates are not lower in older adults when compared to younger adults. In contrast, the increase in muscle protein synthesis following protein ingestion is attenuated in older adults when compared to younger adults. This concept is termed "anabolic resistance" and is considered a main factor responsible for age-related muscle loss. However, it appears such anabolic resistance can be partly compensated for by the consumption of greater amounts of protein. Therefore, it is now generally believed that the RDA is inadequate for older adults, with 1.2 g protein·kg^{-1}·d^{-1} being considered the minimum recommendation [4]. When evaluated against this age-adjusted protein recommendation, protein intake in older adults is suboptimal (Figure 1). This is concerning, as suboptimal protein intake in older adults may facilitate the development of sarcopenia and frailty.

Dietary protein requirements are also depended on the quality of the ingested protein(s). In general, plant-based protein sources are of a lower quality when compared to animal-based protein sources. This is attributed to 1) a lower absorbability: the proportion of the protein that can be digested and absorbed, 2) a lower total essential amino acid content per gram of protein, and/or 3) an unbalanced amino acid profile in which one or more specific essential amino acids is deficient and limits the utilization of the other amino acids. The latter can potentially be circumvented by strategically combing different plant-based protein sources with complementary amino acid profiles. However, to compensate for a lower absorbability and total essential amino acid content, greater amounts of plant-based protein should be consumed. Therefore, dietary protein requirements are higher when a (largely) plant-based protein diet is consumed [5]. In addition to a lower protein quality, protein intake also tends to be lower on a (more) plant-based diet when compared to a standard diet. Such issues are of increasing relevance due to the current "protein transition" towards more plant-based diets, which may have various ethical, sustainability, and health benefits. However, we should be cautious to recommend such diet to populations such as older adults who are already at risk of protein inadequacy [6].

Physical activity is an important factor that improves the sensitivity to the anabolic effect of protein ingestion [1]. The combination of resistance training and adequate protein intake can result in muscle mass gains in young and older adults. Conversely, muscle disuse such as prolonged bed rest can result in a dramatic loss of muscle mass in a short period of time which cannot be prevented by increasing protein intake. However, even small changes in physical activity can substantially improve protein metabolism. For example, a change in the number of daily steps already impacts muscle protein synthesis rates. Such insight may be especially important during the current pandemic where physical activity tends to be limited. While intense resistance-type exercise would be the most effective, any increase in physical activity can substantially help to maintain or improve healthy muscle mass and function.

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WE NEED MORE RESEARCH DONE OUTSIDE UNIVERSITIES

Dr Thomas Fink, Director, London Institute for Mathematical Sciences

There's a bizarre inefficiency in the way we organise scientific research. It's this: we identify the best scientists, then impose fierce limits on how much science they can do.

The explanation for this strange state of affairs is that the overwhelming majority of science is done at universities, where scientists are expected to devote a significant proportion of their energies to teaching. Add to this the escalating demands of university bureaucracy, and what you're left with is legions of talented researchers, who feel lucky if they get to spend a day a week on research. If this sounds crazy, that's because it is.

It is also the reason why we founded the London Institute for Mathematical Sciences in 2011. We wanted it to be a place where, unlike at universities, scientists had the freedom to dedicate themselves full-time to research. The viability of our approach was confirmed in 2019, when the London Institute was recognised as an Independent Research Organisation.

In the UK, the vast proportion of state funding for research is lavished on universities. The rest is given to a select number of Independent Research Organisations, of which only a handful are scientific. As well as the London Institute, these include the Armagh Observatory, the European Bioinformatics Institute and the Wellcome

Sanger Institute for genomics.

Our accreditation was an endorsement of the quality of our research and the amount of funding we had brought in from research agencies ranging from DARPA to the EU's Horizon 2020. On the one hand, this proves that non-university research centres in science are feasible. On the other hand, the fact that there aren't more suggests something isn't working. For a sense of just how thin the current ecosystem of research organisations is, look at the last £5.2bn given by the Engineering and Physical Sciences Research Council. 97.4% of it went to universities or joint ventures between universities. Another 2.4% went to the Faraday Institution for battery research and the national Culham Centre for Fusion Energy. Less than 0.2% of the total budget went to Independent Research Organisations. Clearly, for aspiring researchers, a university job is practically the only game in town.

To understand why this is so, you need to go back to the early 19th century. That was when a German educational theorist, Wilhelm von Humboldt, popularised the idea that research should be shackled to teaching. His argument was that this would benefit education, since students could learn from those at the forefront of knowledge discovery.

However, this way of thinking is out of date. In Humboldt's heyday, the science that undergraduates needed to learn included that being discovered by the professors themselves. Since then, the core curriculum has vastly expanded, and today none of it is 21st century science. In other words, the science that professors are experts in is no longer the science that they are required to teach to undergraduates.

It is not obvious how dividing scientists' energies between research and teaching could be of benefit to research. Supporters of the Humboldtian model point out that, through teaching, academics get to spot the most talented students and recruit them for future research positions. This is beneficial, but it doesn't justify the monopoly universities hold over research.

Nevertheless, having embraced the Humboldtian model two centuries ago, the Western world still clings to it doggedly. In the UK, in particular, the union of research and teaching has become a fact of life. It's one we are so familiar with that it's hard to perceive its strangeness. Yet many university scientists admit to feeling deeply frustrated by these structural inefficiencies, and hungry for an alternative.

The current government, which is the most science-friendly in a generation, has repeatedly declared its commitment to developing a rich and diverse scientific research ecosystem—spelled out, for example, in the R&D roadmap it published in July last year. If it means what it says, it needs to reform how it supports the small number of Independent Research Organisations that are dedicated to research. Crucially, it must offer them the same funding advantages it extends to universities.

Universities currently receive two kinds of funding, the core and the specific. The £3 billion of annual specific funding, which is given by the Research Councils, is allocated for projects and programmes. It mainly goes to researchers who win it in competitive schemes to do research in their field of expertise. The £2.2 billion of core funding, which comes from Research England, is high-trust, long-term support, which goes to universities with little restriction on how it is spent. It is allotted based on performance, which is regularly assessed through the Research Excellence Framework.

As former science minister David Willetts has pointed out in his report "The Road to 2.4%", the UK is right to be proud of its two-track funding system. Yet its pride can obscure what he calls "a significant omission", namely that there is minimal core funding for non-university institutions. At the London Institute, we have gone from qualifying for zero state funding to qualifying for one kind: the specific. But we are still denied the core, high-trust funding. In other words, we have gone from zero to one. Now we need to progress from one to two. There is currently no standard mechanism by which we, or any other non-university research centre, can achieve this.

We propose a structured, precedent-based application process. The organisation applying should be based in the UK and be primarily dedicated to research. That research should be of potential national importance. The organisation should meet the conditions of an Independent Research Organisation, which stipulate, for instance, that it should be a charity that has brought in a certain amount of research funding. It should be willing to work with universities and government, and to engage with the public and industry. It should have a five-year business plan, which spells out its finances and research areas, and also be committed to continue seeking specific funding. If all these criteria have been met, the application would be signed off by BEIS, and core funding granted for a five-year term.

With proper high-trust support, non-university institutes will deliver more bang for the government's buck. Scientists with the freedom to devote themselves full-time to research can do more science, take bigger risks and tackle more transformative projects. Competition from thriving institutes will also inspire universities to cut bureaucracy, reduce demands on scientists' time and use government funding more efficiently. The result will be more ambitious discoveries, for less money, at a time when the UK economy is at full stretch. □

RACISM, EQUITY AND INCLUSION IN RESEARCH FUNDING

Photo credit: Dr Agnese Abrusc

Dr Ying Lia Li

A physicist working on quantum sensing at University College London. Between 2017-19 she ran the UCL Women in Physics Group & is currently a member of the UCL Race Equality Steering Group. She is also the Founder of Zero Point Motion, an early stage start-up developing chipscale optical inertial sensors for navigation.

Hope Bretscher

A condensed matter physicist and activist. She is currently finishing her PhD at the University of Cambridge and moving to the Max Planck Institute for the Structure and Dynamics of Matter.

Photo credit: Dr Agnese Abrusc

Professor Rachel Oliver

A materials scientist at Cambridge University studying materials for photonic and electronic devices. In 2020, she was named as one of the Top 50 Women in Engineering by the Women in Engineering Society. She is an Equality and Diversity Champion of Cambridge's School of Physical Sciences and a founding member of The Inclusion Group for Equity in Research in STEMM (TIGERS).

Dr Erinma Ochu, MBE

Interim Director of Engaging Environments, a NERC climate solutions initiative to build capacity for inclusive research. They are a JUST AI Visiting Fellow at The Ada Lovelace Institute, decolonising AI in service to racial justice. A neuroscientist and filmmaker, Erinma is Senior Lecturer in Digital Media and Communications in the iSchool at Manchester Metropolitan University.

SCIENCE DEPENDS ON RESEARCH FUNDING

Government funded research grants from United Kingdom Research and Innovation (UKRI) are the lifeblood of our research ecosystem in science, engineering, technology, mathematics and medicine (STEMM). These grants pay the salaries of researchers, support staff and technicians, allow academics to buy consumables and equipment, and cement partnerships, including access to world class facilities. This pre-determines what knowledge is produced. Winning grants is vital to career progression from being a PhD student, to developing independence as an early career researcher, to running your own lab and hiring a research team. Whilst this article recognises the systemic barriers in progression in higher education and STEMM careers[1] that privilege[2] 'white' people, we focus on evidence within the grant funding system to consider discrepancies in who is given the opportunity to do research and why this matters.

Funding data recently released by UKRI [3] highlight the different success rates, grant amounts and experiences of 'Black' and 'ethnic' minority applicants and awardees over the past 5 years, compared to 'white' researchers. When discussing these data, we are mindful that race and ethnicity are long proven to be social constructs [4] for maintaining power and privilege. We acknowledge that imperial science has played a role in racialised constructions of power, [5] and that data collected using categories such as 'Black, Asian and Minority Ethnic (BAME)' homogenise across different cultural backgrounds.[6] Since, data collection by funders adopts these terms, we employ them to highlight racialised inequity in funding allocation, which damages the economy and society. A weakness of this dataset is that focusing on BAME versus white categories alone, hides anti-Black racism and ignores the experience of those with intersectional identities, across race, gender [1,7,] class, disability [8] and/ or LGBTQI+ [9]. Specifically, we focus here on data released by the Engineering and Physical Sciences Research Council [10] (EPSRC), one of the UKRI's 11 constituent research councils. Many of the trends we present are seen more broadly across UKRI's STEMM-oriented councils. One key observation from the EPSRC data is that for every year of the last five years, lead applicants who identify in funding applications as an 'ethnic minority' have been less successful in their grant applications than those who identify as 'white'. The average success rate is 25±1%, for 'ethnic minority' researchers as compared to 33±2% for 'white' researchers. But what difference do these numbers imply for researchers, in everyday terms?

These data imply (Figure 1) that an 'ethnic minority' researcher needs to write four proposals on average in order to win one grant, compared to a 'white' researcher who writes three. Proposal writing generally takes six months, and equates to

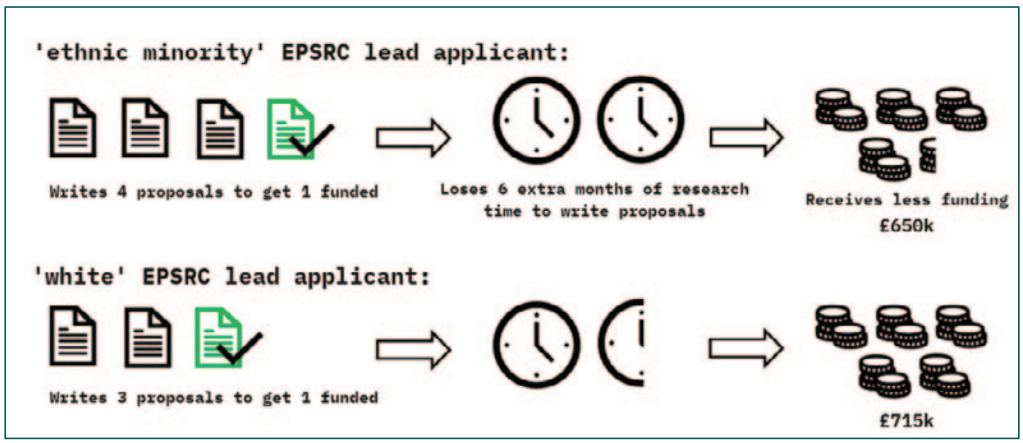

Figure 1

lost research time. When 'ethnic minority' researchers do win grants, the average grant award over the past 5 years is approximately £65,000 lower than for 'white' awardees. This is the equivalent cost of an experienced researcher working in your lab for one year. The resulting underfunding may mean that the 'ethnic minority' researcher achieves fewer published papers, and less impact for their labour. It should be noted that these data on grant value probably *underestimate* the true scale of the problem since the EPSRC data omit some very large awards, for example for the founding or continuation of research institutes, and we observe that these are won overwhelmingly by older, white men.

The language of 'winning' and 'losing' funding assumes there is a level playing field in the STEMM funding 'game'. This assumption ignores the historical impacts of racism in academia, and in broader society. This is also evidenced by funding data, which indicates that 'ethnic minority' students are less likely to be UKRI-funded than 'white' students. [11,12]. Likewise at the most senior decision-making levels, 'ethnic minority' scientists are severely under-represented.[13] This means that senior researchers devising calls for research proposals and judging the resulting applications are not representative of the UK tax paying population, who fund research.

This under-representation creates additional barriers to the success of 'ethnic minority' researchers within their own institutions: racial microaggressions; lack of support for proposal development; and the privileging of 'white' researchers in both job promotions and the institutional sifting processes that determine who is *allowed* to apply for grants. Together, this can lead to many minoritised researchers leaving academia [14] or remaining precariously employed on short term contracts. [15] For those who stay, failure to 'win' on the skewed playing field of the funding game, leads to a cycle of reduced opportunities for research career progression, as shown in Figure 2. While some scientists have found ways of circumnavigating or flipping these barriers,[16] to drive innovation alongside community or industrial partners, the 'make it or break it' role of funders and their funding cycles remains a recurring theme. There is a lack of recognition of the ways in which minoritised researchers, carve out alternative career pathways, take on unacknowledged Equality, Diversity and Inclusion work to reduce institutional barriers11 and carry out more equitable and inclusive research that benefits society.[17]

FUNDING EQUITY BENEFITS SCIENCE & INNOVATION

Promoting equity via institutional and funder policy leads to better outcomes. How research is funded and who gets funded to carry out research has drastic impacts on society. The voices and ideas that are excluded and the science that is underfunded [17,18] cause harm to minoritised communities. In the COVID-19 pandemic, minoritised communities, specifically, African, Carribbean, Bangladeshi and Pakistani people have died at a much higher rate than 'white' people,[19] an issue which was addressed by UKRI in a specific call for research proposals. A Black women's collective, orchestrated by Dr Addy Adelaine, who specialises in 'inclusive accountability', investigated who was funded as an outcome of this call, which failed to award funding to Black researchers, in spite of many applying. [20] As a result, the funded projects were highly slanted towards genetic and biological factors, an approach which is scientifically contested and fails to account for the systemic and social factors which Black researchers had proposed to investigate. These abuses of power and privilege not only prevent Black communities from generating effective solutions but also risk further reducing trust in science. Similar issues are prevalent within environmental science and climate change research[21,22]. Crucially, whilst some collaborative initiatives seek to overturn this trend, existing inequities often place the burden on resource-stretched community practitioners.[23] An important step is acknowledging that systemic inequity and racism exist, to begin to redress the balance and reap societal benefits.

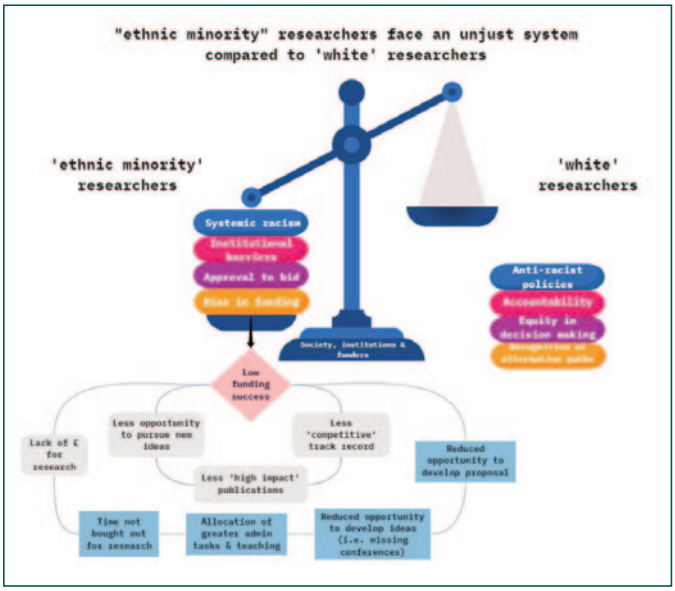

Figure 2

Increasing the diversity of the workforce is known to improve

outcomes in many sectors[24, 25, 26, 27]. One recent study used automated text-based analysis to look for markers of innovation across *1.2 million* PhD theses published in the USA between 1977 and 2015.[28] The study found that minority scientists are more innovative than their majority counterparts, but that they receive less reward for their new ideas and inventions. This suggests that ethnic minority researchers may well be more innovative than their white peers – but they are being held back from success by the funding system. This suppresses innovations which could create a stronger and more inclusive economy.

WHAT CAN WE DO?

It is vital to consider and report on the diversity of those framing and judging research proposals. The Haldane principle states that decisions about what to spend research funds on should be made by researchers rather than politicians. This principle, coupled with the concept of peer review (where researchers' proposals and outputs are judged by their peers) notionally underpin our entire research funding system. However, Black and minority ethnic researchers are largely not judged by their Black and minority ethnic peers. EPSRC, for example, convenes expert panels to make decisions on which proposals should be funded, but only 8% of EPSRC panel members and 5% of EPSRC panel chairs identify as an ethnic minority, whilst ethnic minority researchers make up 20% of the EPSRC researcher cohort.[29] Funders have a responsibility to ensure panels are culturally diverse, that panel members are adequately trained, and funding decisions or feedback are not racially prejudiced.

In order to ensure that research proposals from Black and minority ethnic scientists actually *reach* this vital peer review stage, funders could mandate that institutions meet minimum requirements for removing the barriers experienced by Black and ethnic minority researchers, which could be evidenced by Race Equality Charter accreditation. Accredited institutions should demonstrably monitor and boost the number of minoritised researchers applying for funding and improve the support they are offered.

When the National Institute for Health Research (NIHR) introduced incentives to encourage institutions to achieve Athena Swan accreditation for dismantling barriers to women's progress, the number of women in mid-level leadership positions and the proportion of funding going to women increased.[30] This demonstrates the effectiveness of this type of approach, which unfortunately the government has recently banned research funders from following.[31] Nonetheless, it is vital that meaningful incentives are established by UKRI and other research funders to increase the diversity of both those who receive funding and those who make funding decisions. This must be achieved within a culture of increased transparency and accountability. Some funders, such as Wellcome, have appointed an anti-racism expert group.

More radically, since the Haldane principle nominally encourages researchers to decide on the direction of scientific research and training, we can consider measures which empower every researcher to influence funding decisions, rather than just a privileged few. This would require a substantial overhaul of our funding processes. Novel approaches such as the "Universal Basic Research Grant"[32] (in which all researchers receive at least some minimum financial support to explore their ideas) or full [33] or hybrid [34] lottery systems, could potentially reduce the impact of racism on our scientific systems, as long as pitfalls such as Institutional gatekeeping of access to such schemes are avoided.

Given the growing need for research and innovation to address societies' biggest challenges, from pandemics to the climate crisis to systemic abuses of power, change is urgently needed. Individual researchers, institutions, funders and the government can all play a role by committing to change, addressing inequity and taking action together.

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'SCIENTIFIC RACISM' AND STRUCTURAL INEQUALITIES: IMPLICATIONS FOR RESEARCHING BLACK MENTAL HEALTH

Dawn Edge is Professor of Mental Health & Inclusivity within the Faculty of Biology, Medicine and Health at The University of Manchester. Her research focuses on addressing inequalities in mental healthcare experienced by racialised and marginalised communities. Dawn currently leads a multi-disciplinary team undertaking research to develop, implement and evaluate culturally-informed mental healthcare. She is also University Academic Lead for Equality Diversity & Inclusion with a particular focus on 'race' and students informed by intersectionality.

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Dr Erinma Ochu, MBE is interim director of Engaging Environments, a NERC climate solutions initiative. They are an AHRC Just AI/ Ada LoveLace fellow decolonising AI in service to racial justice. A neuroscientist and filmmaker, Erinma is Senior Lecturer in Digital Media and Communications in the iSchool at Manchester Metropolitan University. Undertaking co-inquiry with minoritised artists and communities, funded by Wellcome, they study new forms of information expression to extend human perception and collective consciousness to address climate justice.

BLACK MENTAL HEALTH IN THE UK

Ethnic inequalities in mental healthcare is one of the most consistent findings in UK research. Perhaps the most stubborn, is substantially elevated risk of diagnosis with schizophrenia and related psychoses among people of African and Caribbean descent (Black) compared with White British peers [1]. This difference is not replicated in findings from research in Africa [2] and the Caribbean [3], generating several theories to explain the racialised inequities in the UK. Hypotheses underpinned by biological (e.g. genetics), social (e.g. urbanicity or economic disadvantage), and psychological theories have been proposed yet none are conclusive. Intriguingly, Black people in England are significantly less likely to be diagnosed with neurotic disorders such as depression

and anxiety, suggesting more nuanced approaches to understanding and addressing these disparities are needed [4].

Whilst the extent to which diagnostic rates reflect levels of morbidity versus psychiatric practice remains contested [5], what is unequivocal is that Black people experience inequalities at every level of the mental health system. Firstly, Black access to services is characterised by delayed diagnosis and negative care pathways [6, 7]. Compared with White British counterparts, Black people are four times as likely (306.8 per 100,000 versus 72.9 per 100,000) to be compulsorily admitted to psychiatric care under the Mental Health Act [8] and are less likely to receive GP support in accessing specialist mental healthcare [9]. As psychiatric inpatients, Black people experience more coercive care. For example, higher levels of treatment in seclusion, forcible injection with psychotropic medication, and being subject to control and restraint techniques [10, 11].

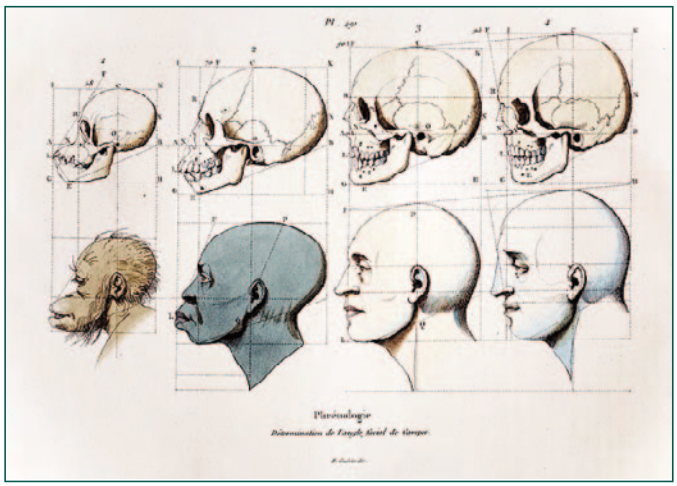
Disproportionate use of force with Black patients is associated with elevated death rates in psychiatric care. The 2004 Blofeld Report[12] into the death of David 'Rocky' Bennett six years earlier found that, the way in which he was restrained by nursing staff, resulted from his treatment as a "lesser being". The then Secretary of State for Health, John Reid, asserted that there was "no place for discrimination in the NHS", but did not commit to enacting any of Blofeld's 22 recommendations to tackle the kind of racism that David Bennett experienced at the hands of both patients and staff. Subsequently, the Department of Health responded with a 5-year 'Delivering Race Equality (DRE) in Mental Health' policy guidance and action plan [13]. CQC's findings [14] that DRE had improved little in Black patients' psychiatric care is evidenced by the passing of Sani's Law [15] in 2018 after Olaseni 'Seni' Lewis' death due to being forcibly restrained by 11 police officers in psychiatric hospital. Alongside greater exposure to coercive care, Black people are also less likely to be offered evidence-based psychological care. This begs the question of why ethnic inequalities persist despite policies and legislation to eradicate them within a system designed and commissioned to deliver care equitably - a principle enshrined in the Public Sector Equality Duty under the Equality Act 2010 [16].

SCIENTIFIC RACISM AND CONTEMPORARY MENTAL HEALTHCARE

Exploring the historical relationship between psychiatry, psychology, and 'race science' might provide a lens through which to view Black people's sub-optimal access, experiences and outcomes in contemporary mental health care. Although now generally agreed to be a social construct [17, 18], the biological basis of 'race' and theories purporting racial hierarchies have informed explanations of different groups' location in society. In his treatise, '*Crania Americana*', 19th century American anthropologist and physician, Samuel George Morton, concluded that the Caucasian's place at the top of the racial hierarchy resulted from superior mental capacity to other 'races' as evidenced by having larger skulls to accommodate larger brains. Superior intelligence coupled with advanced planning skills, self-control and longevity were said to distinguish Caucasians, and indeed all other 'races', from Africans [19]. Impulsive, superstitious and prone to violence by nature, 'Negroes' (the "lowest grade of humanity" and ranked just above primates) were deemed incapable of creativity; merely able to imitate others and manage routine work under supervision [20]. Thus, 'race science' was used to justify the enslavement of Africans and advance theories about how to manage them. In 1851, Samuel Cartwright proposed a new diagnosis, 'drapetomania', defining slaves' tendency to run away as a form of madness. The 'condition' still appeared in a medical dictionary almost 100 years later [21].

Psychologist Richard Herrnstein and political scientist Charles Murray's controversial book '*The Bell Curve: Intelligence and Class Structure in American Life*' [22] claimed that the inequalities experienced by African Americans was due to having average IQs 15 points lower than that of White Americans. That being the case, they argued that individual differences and genetic predispositions rather than structural inequalities accounted for White people's ascendancy in a meritocratic system [23]. Leading psychologists, including Professor Hans Eysenck of University College London, publicly endorsed the authors' views that IQ tests measured true racial differences rather than access to education and that concerns about the cross-cultural validity of these tests were unfounded [24]. This is significant because, at his death in 1997, Eysenck was the world's most widely-cited and therefore influential academic psychologist. This line of argument has important socio-political implications as it suggests that there is little merit in improving the education of Black people or establishing initiatives designed to create a more level playing field.

Another signatory to the article in support of The Bell Curve's thesis was Professor Richard Lynn whose work was cited in the book. A member of the editorial board of the academic journal '*Personality and Individual Differences*' (PAID) until 2019, Lynn theorised links between race-based differences in intelligence [25] and psychopathic personality disorders [26]. In 2020, a paper published in PAID in 2012 claiming that genetic differences related to darkness of skin colour explained purported racial differences in sexual behaviour and violence, was retracted by publisher Elsiver [27]. Given that much of the 'evidence' on which the paper was based had been previously challenged, the decision to withdraw the paper in the wake of academic and research institutions' public statements on institutional racism is noteworthy.



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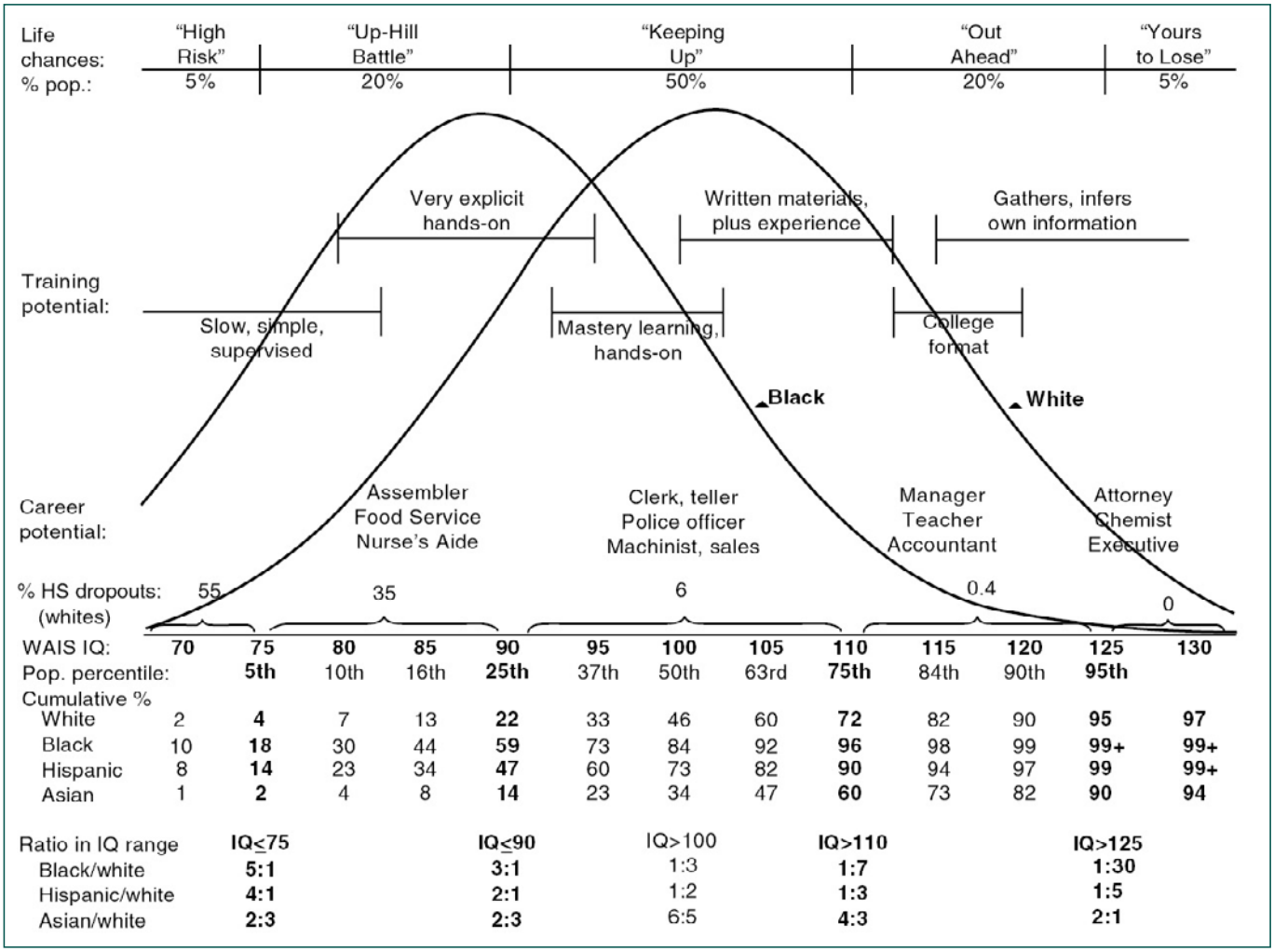
The extent to which such views continue to inform contemporary mental health services, is illustrated by Black patients and Approved Mental Health Professionals' evidence to the 2018 Independent Review of the Mental Health Act [28], which was established in response to what the then Prime Minister, Theresa May, described as the "burning injustice" of exponential rates of 'sectioning' under The Act. Since the Royal College of Psychiatrists acknowledged that psychiatry is institutionally racism in 2018, it has come under increasing pressure from its membership to do more to eradicate race-based disparities. In an open letter [29] to their newly elected President, 175 psychiatrists condemned the profession's history of systematic racism and discrimination – specifically, of: i) ignoring the effects of discrimination on patients' mental health, ii) painting other cultures as 'psychologically primitive', and iii) colluding in silencing civil rights protesters and political dissidents by labelling them 'psychotic'. Jonathan Metzel's '*The Protest Psychosis: How schizophrenia became a Black disease*' [30] highlighted how schizophrenia, regarded as a 'serious and enduring' form of mental illness, became a racialised diagnosis inextricably linked with blackness and dangerousness. It is astonishing that, in 2020, negative perceptions of Black people, such as being labelled insufficiently 'psychologically-minded', continue to impede access to non-pharmacological treatments such as talking therapies [31].

RESEARCH AND PSYCHIATRIC PRACTICE: RECOMMENDATIONS FOR MOVING FORWARD

Health inequalities and strategies to address them have been the focus of much research and policy, as exemplified by the seminal work of Sir Michael Marmot [32, 33] have been the focus of much research and policy. In contrast, the role of 'racism' in the onset of illness and the extent to which racism causes and/or perpetuates disparities in a healthcare system designed to eradicate them, remains relatively under-researched. In 2020, the #BlackLivesMatter protests in the midst of the COVID19 pandemic in which non-White people have disproportionately died, after diagnosis and hospitalisation, compared to White people with comparative health status [34], foregrounded the systemic racial injustice in relation to physical health. Given what is known about the relationship between physical and mental health, greater efforts to understand the relationship between racism, health and wellbeing is long overdue. In the UK [35] and US [36], racism is increasingly regarded as a 'public health crisis' that can no longer be ignored.

Asserting that "there's no quality without equality", the Royal College of Psychiatrists' guidance on Advancing Mental Health Equality (AMHE) advocates radical, system-wide approaches underpinned by research to: i) identify inequalities, ii) design new ways of doing things, iii) evaluate those ideas, and iv) deliver



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improvements [37]. Findings from the Mental Health Act Review [26] and the Five Year Forward View for Mental Health and the NHS Long Term Plan [38] indicate that the views and experiences of patients and their families and a co-production ethos is integral to service redesign and commissioning that is fit for purpose in a multicultural society.

However, research that currently informs 'evidence-based practice' is predominantly quantitative with randomised control trials currently at the top of the 'hierarchy of evidence'. Qualitative research, which seeks to bring insights from the perspectives of those experiencing healthcare, especially those whose health is most adversely affected, does not currently feature within this 'hierarchy of evidence'. Including qualitative research within the hierarchy of evidence could serve to incentivise and foreground vital research that includes and amplifies the voices of patients, carers, racialised communities and healthcare practitioners. As indicated by Li and colleagues [39], those undertaking this kind of research are less likely to receive funding and/or receive smaller awards or have their socially impactful work published in what are considered high-ranking journals. We therefore assert that changes to the funding system, which is vital to research career progression, is urgently needed. More equitable funding and greater transparency in recruitment and appointment processes will increase the likelihood of under-represented groups attaining senior leadership roles and/or membership to influential research funding panels or editorial boards with ability to influence what counts as 'evidence'.

We conclude that it is crucial for government, who invest in both research and healthcare services to recognise that, as with psychiatry and mental health, scientific racism, also underpins the foundations of academia. Research investments aimed at redressing systemic inequalities through co-produced research, holds the promise of broader academic and societal value.

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ETHNIC DIVERSITY IN SCIENCE

Why we need ethnic diversity in science

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Does the UK's structural racism harm UK science? The answer to this question is yes. For example, individuals of Black African and Pakistani heritage are three times more likely to die from COVID-19 in the UK[1]. This has been attributed to longstanding racial inequities which mean that Black, Asian and minority ethnic individuals (ethnic minorities) are more likely to be in occupations with a high risk of contracting COVID-19 and/or live in crowded conditions with a high risk of transmitting COVID-19. It is unfortunate that the risks to certain populations, from the pandemic, were not known prior to these deaths being recorded. However, as funded university researchers in the UK are not diverse, this is not surprising, since researchers follow their interests when developing their ideas. MRC grant success rates were lower in 2017/ 2018 for applicants who ticked the "other" ethnicity box when asked to declare their ethnicity (Table 1)[2] and EPSRC funding rates are lower for ethnic minority applicants (Table 2)[3].

There is growing evidence that ethnic diversity at all levels of decision making leads to better quality outcomes. Academic papers arising from international collaborations[4] or with ethnically mixed authors[5] are more likely to be cited. After analysing 9 million publications, AlShebli et al concluded that, "*ethnic diversity is the strongest predictor of a field's scientific impact*"[5]. In the private sector, McKinsey's latest edition (2020) of the report, *Diversity Wins – Why Inclusion Matters*, found, after analyses of 1000 companies in 15 countries, that those in the top quartile for ethnic diversity in their executive teams were 35% more likely to be profitable and those in the top quartile for gender diversity in their executive teams were 25% more likely to be profitable[6]. The report concluded that, "*there continues to be a higher likelihood of outperformance difference with ethnicity than with gender*"[6]. Similar conclusions were drawn by Mckinsey in 2014 and 2017 and one of the reasons could be that companies led by ethnically diverse management teams tend to introduce more innovative products[7]. Ethnic diversity in stock pricing led to stocks being 58% more accurately priced when compared to pricing by ethnically homogenous teams[8]. Finally, ethnically diverse juries relied more on the evidence when making a decision[9].

A further driver supporting diversity in scientific research is that the UK is a multicultural society with ethnic minorities making up 13% of the UK population[10]. Additionally, the UK is home to a number of top global universities and as UK research is consumed around the world, there is a real need to reflect the needs of global populations. UK researchers already punch above their weight by forging global collaborations[4]. Increasing the diversity in UK science will only enhance this impact.

Table 1: Medical Research Council grant application success rates by ethnicity in 2017/ 2018[2]

Ethnicity	No. of applications		No. of applications awarded		Success rate (%)
White	1,233	80%	311	83%	25%
Unknown	86	6%	16	4%	19%
Other [a]	218	14%	46	12%	21%

[a] There is an assumption that "other" refers to Black, Asian and ethnic minority

Table 2: Engineering and Physical Sciences Research Council (EPSRC) funding rates by ethnicity

Ethnicity	% of Applicants applying for EPSRC awards	% of EPSRC awards
White	72.1	80.7
Mixed	2.3	1.4
Asian	7.9	5.6
Black	1.7	0.4
Chinese	7.1	5.2

WHY IS UK SCIENCE NOT DIVERSE?

Considering the benefits outlined above, why then is UK science not diverse? There are structural inequalities in the UK that prevent ethnic minorities from achieving scientific careers and these inequalities are evidenced by the impacts outlined below.

An examination of English educational award data reveals that when pupils are first tested at 7 years old in Key Stage 1 assessments, pupils of all ethnicities are performing at a similar level, with Chinese pupils having a slightly better performance in mathematics in some years (Table 3). When pupils are examined at 11 years old in Key Stage 2 assessments, two things are noticeable: Chinese pupils have pulled further ahead in reading, writing and mathematics, but all other pupils are performing at a similar level (Table 4). If any of these pupils wish to achieve a career in science, admission to a research intensive university is a good first step and to secure such a place in the UK, at least 3 A level A grades are usually required. It is by this metric that it becomes clear that the UK education system is spectacularly failing Black pupils (Table 5). At A level, Chinese pupils outperform all other groups and so the lead gained at Key Stage 2 is maintained and strengthened (Table 5). Looking further ahead, by the time our bright young graduates have completed a 3 – 4 year degree the difference in awards among the groups is clear. White students are now performing best and the Chinese students have lost the lead gained at Key Stage 2. Asian students have fallen behind and the Black students are now well and truly behind (Table 6). The data reveals that UK universities are not adding value to ethnic minority students. Furthermore, this low award culture persists against a backdrop of ethnic minority students being over represented in UK universities, as they made up 24% of UK domiciled students in 2018/2019[15], well in excess of the proportion of ethnic minorities in the general population (13%)[10]. One could argue that maintaining a system that results in low awards to the fastest growing group of higher education consumers does not make good business sense.

Despite the adverse degree outcomes (Table 6), ethnic minority students still hope for science careers, as 50% of ethnic minority students participated in undergraduate science degrees compared to 48% of White students in 2018/2019[16] and 18% of PhD

Table 3: Key Stage 1 Achievements [b] by ethnicity in England 2012 – 2019 [11]

	% Achieving the standard in each ethnic group							
Ethnicity	Reading (2012 – 2015)	Reading (2016 - 2019)	Science (2012-2015)	Science (2016 - 2019)	Mathematics (2012 – 2015)	Mathematics (2016 - 2019)	Writing (2012 – 2015)	Writing (2016 – 2019)
White	89 ± 1.7	75 ± 1	91 ± 0.8	83 ± 0	92 ± 0.8	75 ± 1.5	86 ± 2.1	67 ± 2.1
Mixed	90 ± 1.4	77 ± 1	91 ± 0.8	84 ± 0.6	92 ± 0.8	76 ± 1.5	86 ± 1.7	70 ± 2
Asian	90 ± 1.4	77 ± 1	88 ± 1.7	81 ± 1	92 ± 1.3	77 ± 1.5	87 ± 2.2	72 ± 2.5
Black	89 ± 1.7	77 ± 0.6	88 ± 1.6	80 ± 0.6	90 ± 1.7	73 ± 1.5	86 ± 2.7	71 ± 1.6
Chinese	91 ± 1.2	83 ± 2.3	91 ± 0.5	88 ± 1.5	96 ± 0.5	90 ± 1.7	89 ± 1.7	81 ± 3.2

[b] assessments changed in 2016

Table 4: Key Stage 2 Achievements [c] by ethnicity in England [12]

	% Achieving the standard in each ethnic group	
Ethnicity	Reading, Writing and Mathematics (2011 - 2015)	Reading, Writing and Mathematics (2016 - 2019)
White	75 ± 5.1	61 ± 5.2
Mixed	76 ± 5.1	63 ± 4.8
Asian	76 ± 5.1	64 ± 6.4
Black	72 ± 6.4	60 ± 6.0
Chinese	85 ± 3.3	77 ± 4.5

[a] assessments changed in 2016

Table 5: Achieving at least 3 A grades at A Level by ethnicity (2017 – 2018)[13]

Ethnicity	% Achieving at least 3 A grades at A level (2017 - 2018)
White	11
Mixed	11.2
Asian	11
Black	5.5
Chinese	25.7

Table 6: UK domiciled students achieving a first class or second class upper honours degree (2018/2019) in the UK [14]

	First class/second upper
White	81.4
Mixed	76.6
Asian	70
Black	58.8
Chinese	76.9

students were from ethnic minority backgrounds in 2018/2019[17]. However only 9% of recipients of UKRI studentships were ethnic minorities in 2018/2019[18] (note 29% of UKRI studentship holders withheld their ethnicity data). There is clearly an appetite among UK ethnic minority students to contribute to the creation of scientific knowledge, despite having to work within a culture that systematically results in lower degree classification awards and a lower chance of state financial support.

What happens when ethnic minority students do attain a science career and begin to compete for grants in order to create scientific advances? Even though the proportion UKRI applicants that are ethnic minorities has risen over the last 5 years, UKRI ethnic minority applicants are more likely to score lower value awards and achieve lower award rates (apart from in fellowships where ethnic minority award rates exceeded White award rates)[18]. As UKRI data also includes data from the arts, humanities and social sciences, it is important to examine what happens in the sciences. As stated above, ethnic minority applicants to the MRC and EPSRC are less likely to be funded when compared to White applicants (Table 1 and Table 2)[2,3].

The low ethnic minority grant award success rate, when compared to White applicants, is matched by the low level of participation of ethnic minorities in the grant prioritization panels, either as panellists or crucially as panel chairs (Table 7), despite being well represented in the peer review college[19]. Panel chairs serve an important role, especially when moderating panel discussions in order to arrive at a collective decision.

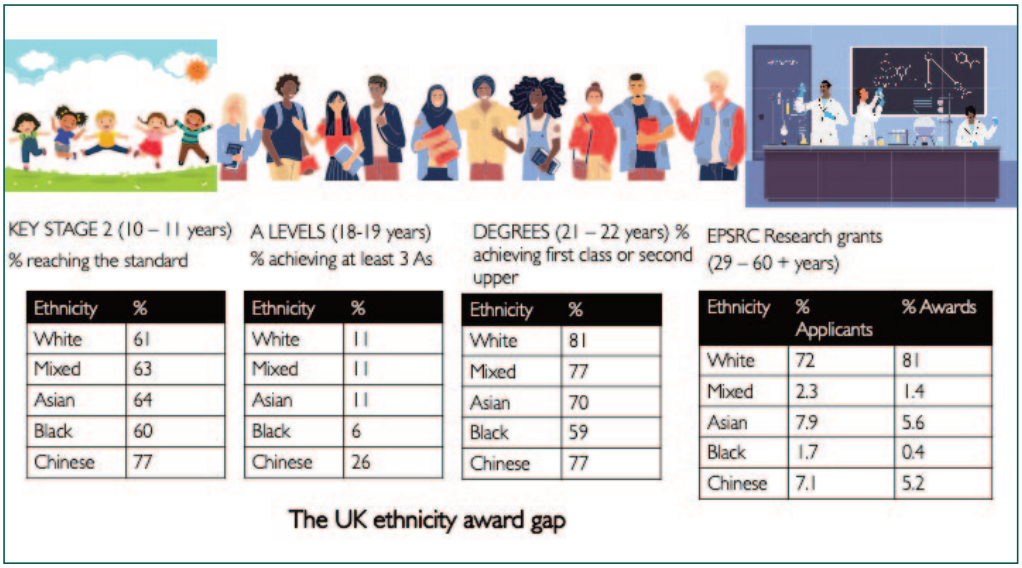

Figure 1: The UK ethnicity award gap. Black students fall behind from the A level assessment period and Chinese students lose their lead at degree level assessments.

Table 7: EPSRC grant reviewers by ethnicity in 2018/2019 [19]

Ethnicity	Reviewer pool – EPSRC peer review college	Reviewers submitting useable reviews	Grant prioritisation panel	Grant prioritisation panel chair
White	77	75	74	80
Black, Asian or minority ethnic	15	18	8	4
Not disclosed	8	7	18	15

It is clear (Figure 1), that being an ethnic minority makes it harder to achieve a successful scientific career and there are differential ethnicity-related outcomes in our education system that contribute to this difficulty. These differential outcomes frustrate ambition and limit the numbers of ethnic minorities that are working at the top of their fields as scientists. In the UK in 2018/2019, 9% of White academics working in science, engineering and technology subjects were professors whereas the comparative number for ethnic minorities is just 3.2%[20].

Where does the problem start? Most children (Black, Mixed, Asian and White) are similar at Key Stage 2 (Figure 1), although Chinese pupils are ahead. For Chinese and Asian students the differential occurs during the undergraduate years, whereas for Black students the differential outcomes occur much earlier, at secondary school.

WHAT CAN BE DONE.

If the UK is to fully benefit from its entire population and produce research which serves UK and global communities, it is important to ensure that more ethnic minorities are able to achieve scientific careers. A race equality strategy is required for all aspects of our education sector and the following recommendations are a good place to start.

1. Schools, colleges and universities should be offered financial incentives to assist with closing the awarding gaps between Black and White pupils.

2. Previously the National Institute for Health Research (NIHR) had stated that being in receipt of the Athena Swan kitemark for gender equality was necessary for the award of certain grants (decision now reversed). The original decision resulted in more women researchers being funded by the NIHR[21]. UKRI should consider making large infrastructure grants only to institutions in England that hold a Race Equality Charter Bronze award.

3. All research funders in the UK should examine their peer review processes to ensure ethnic minority researchers are well represented through all stages of the peer review process, including as grant prioritisation panel chairs and members of their governing bodies.

4. Data on the ethnic award gap in schools, colleges and universities, the ethnic research funding gap and the ethnic pay gap in universities should be

published annually in a rank ordered list to allow prospective pupils, students and grant applicants to easily access this information.

CONCLUSIONS

There is a clear deficit in our entire education system that results in ethnic minority pupils being less likely to graduate with a good degree; even though ethnic minority individuals are more likely to opt for a university education when compared to White pupils. Despite good participation in science and engineering disciplines within our universities by ethnic minorities, it is harder for ethnic minority researchers to obtain research funding. This needs to change if the UK is to produce research that benefits the entire population. A number of recommendations have been put forward.

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PHYSICAL ACTIVITY: MOVING TOWARDS RESILIENCE

Dr Alison Giles, Associate Director for Healthy Ageing, Centre for Ageing Better

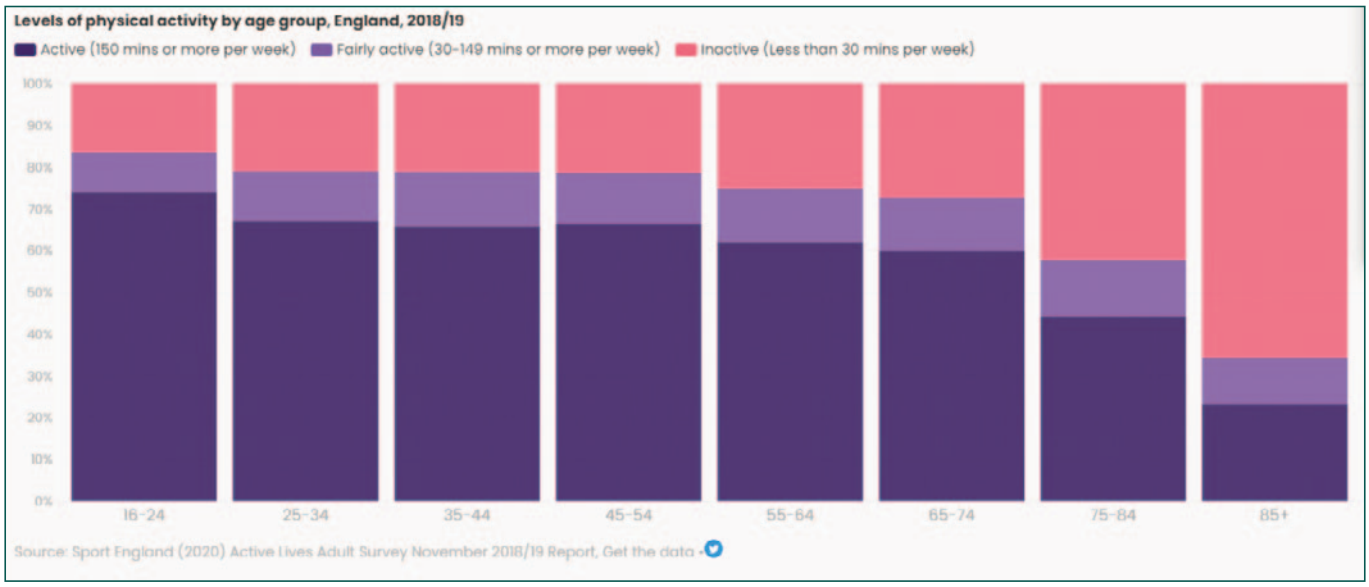
It is a strange feature of our modern society that we dread the idea of frailty and infirmity and yet we shun the very medicine that would prevent that outcome: physical activity. Not only have we engineered movement out of the activities that keep our lives ticking over - housework, commuting, shopping – but we make all sorts of excuses why we don't seek out movement in our leisure time and we've shaped our built environment to make being active more difficult and less attractive.

> "When he had just turned forty, he had gone to the doctor because of vague pains in various parts of his body. After many tests, the doctor had said: "It's age." He had returned home without even wondering if any of that had anything to do with him."
>
> *Gabriel Garcia Marquez, Love in a Time of Cholera*

How many of us blame the number of candles on our birthday cake for the breathlessness we feel climbing the stairs, or for our inability to stand up from a crouching position without using our arms to pull us up? While it is true that our functional capacity does naturally decline with the years, a loss of cardio fitness and muscle strength is not inevitable. But we do have to work at it.

In the UK, we become less active as we age. Among people

aged 65-74, Sport England has found that 28% are inactive (do less than 30 minutes of moderate activity per week) compared with 16% of people aged 16-24.[1] And concerningly, Public Health England estimates that 67% of adults aged 65 and over are not meeting the UK CMOs' guidelines for strength and balance exercise that will enable them to get up onto and stay on their feet (unpublished data).



This lack of movement as we get older has serious implications. Physical inactivity reduces the body's resilience and contributes to the onset of some of the most prevalent and disabling long-term health conditions, including back pain, arthritis, Type 2 diabetes, and cardiovascular disease. And it is a significant risk factor for falls among older adults. Conversely, keeping active builds resilience and can help prevent, delay or manage these same conditions and risks.[2]

SO, WHAT IMPACT HAS THE PANDEMIC HAD ON PHYSICAL ACTIVITY LEVELS AMONGST OLDER ADULTS?

Whilst the reality of who is most vulnerable to Covid-19 is more nuanced, the response to the pandemic has been largely framed in terms of protecting all older adults from infection. But a blanket policy of advising all older adults to stay indoors may have reduced their immediate risk of infection at the expense of their physical and mental health.

A YouGov poll of 2226 adults aged 50+ commissioned by The Physiological Society in October 2020 found that almost one in three people (32%) said they had done less physical activity during the UK's first national Covid-19 lockdown period (23 March – 4 July 2020) than during the period before the lockdown was brought in.[3] Of those, 43% said that this was because they no longer had a reason, or had less reason, to get out of the house and be active; 32% were worried about catching Covid-19; and 29% reported lacking motivation to exercise.

When asked to compare their levels of physical activity since the first national lockdown ended (after 4 July 2020) with their activity levels pre-lockdown, 36% said their physical activity levels were lower. This was most marked in the 75 and older age group, where 42% said they were less active [3].

Research tells us that any significant drop in physical activity levels leads quite quickly to physical deconditioning, with a loss of fitness, muscle mass and bone strength[3]. For any adults whose physical condition was already quite poor at the start of the pandemic, a decrease in their daily activity levels may have tipped them into disability or made them more vulnerable to falls. It may also have decreased their resilience to catching Covid-19, surviving it or recovering from it.

In a study conducted by AgeUK on the impact of COVID-19 on older people's mental and physical health, 26% of respondents said they were unable to walk as far as before, 18% said they felt less steady on their feet, and 34% said they had less energy.[4] The same AgeUK study found that these changes were more pronounced amongst people with long-term health conditions. 43% of people with a long-term health condition said they were unable to walk as far as before, compared to 13% of people without a long-term health condition.

The task now is to rebuild those physical activity levels, recognising that as winter approaches and we face continued restrictions on our lives, it is going to be ever harder for older adults to be physically active outside of their homes.

The Physiological Society and Centre for Ageing Better published a report in November 2020 highlighting the central role of physical activity in boosting resilience. We are calling for a National Covid-19 Resilience Programme to give older adults the tools and the confidence to regain their physical and mental health this winter[3]. A key component of the Resilience Programme will be the delivery of appropriate guidance on how to keep active in the home. Our mission is that by spring, and following the vaccination rollout, older adults will have rebuilt their strength and fitness to venture outdoors again, safe in the knowledge that they will be safe from falls as well as from catching the virus.

The YouGov poll commissioned by The Physiological Society[3] identified that a significant proportion of older adults would like to receive physical activity guidance via the mainstream television broadcasters. We are jointly campaigning for action from the broadcasters on this.

AND WHAT OF LIFE POST-PANDEMIC?

The Government has set the Ageing Society Grand Challenge goal[5] to ensure that people can enjoy at least 5 extra healthy, independent years of life by 2035, while narrowing the gap between the experience of the richest and poorest.

The Centre for Ageing Better shares the Government's goal and believes that increasing physical activity levels will make a vital contribution. We have set ourselves an ambitious target to decrease the proportion of adults aged 55-74 classified as inactive by 5 percentage points by 2030. We are focusing on the role of the fitness and active leisure sector and on active travel.

ukactive, the trade body for the fitness and active leisure sector, has set out its ambition to attract more older adults to engage in physical activity.[6] The sector has been hit hard by the pandemic, having to close its doors for many months. We are working with ukactive to support the sector as it re-opens to identify what it can do to attract older adults to take up physical activity offers. This could include the provision of strength and balance classes for the most frail, as well as more general activities. We are also interested to explore whether an older workforce in the fitness and leisure sector can have a positive impact on the uptake and sustainability of physical activity among older adults.

Active travel - building walking or cycling into daily routines - is an effective way to increase physical activity levels. Switching more journeys to active travel also improves quality of life and the environment by reducing traffic volumes and levels of air pollution, and helps build more connected communities. As a result of the pandemic, the Government has brought forward investment in local walking and cycling plans along with proposals to accelerate planning decisions. We will be working with local authorities and partners to ensure that these initiatives serve the needs of all generations and all abilities and increase the numbers of older adults who participate.

The Covid-19 pandemic will have caused many of us to reduce our activity levels, which could have far-reaching consequences for older adults. 2021 marks the launch of the WHO Decade of Healthy Ageing,[7] intended to stimulate ten years of concerted, catalytic and collaborative action across sectors to improve the lives of older people. We intend to use the Decade to promote the importance of physical activity in healthy ageing. It really is the best medicine.

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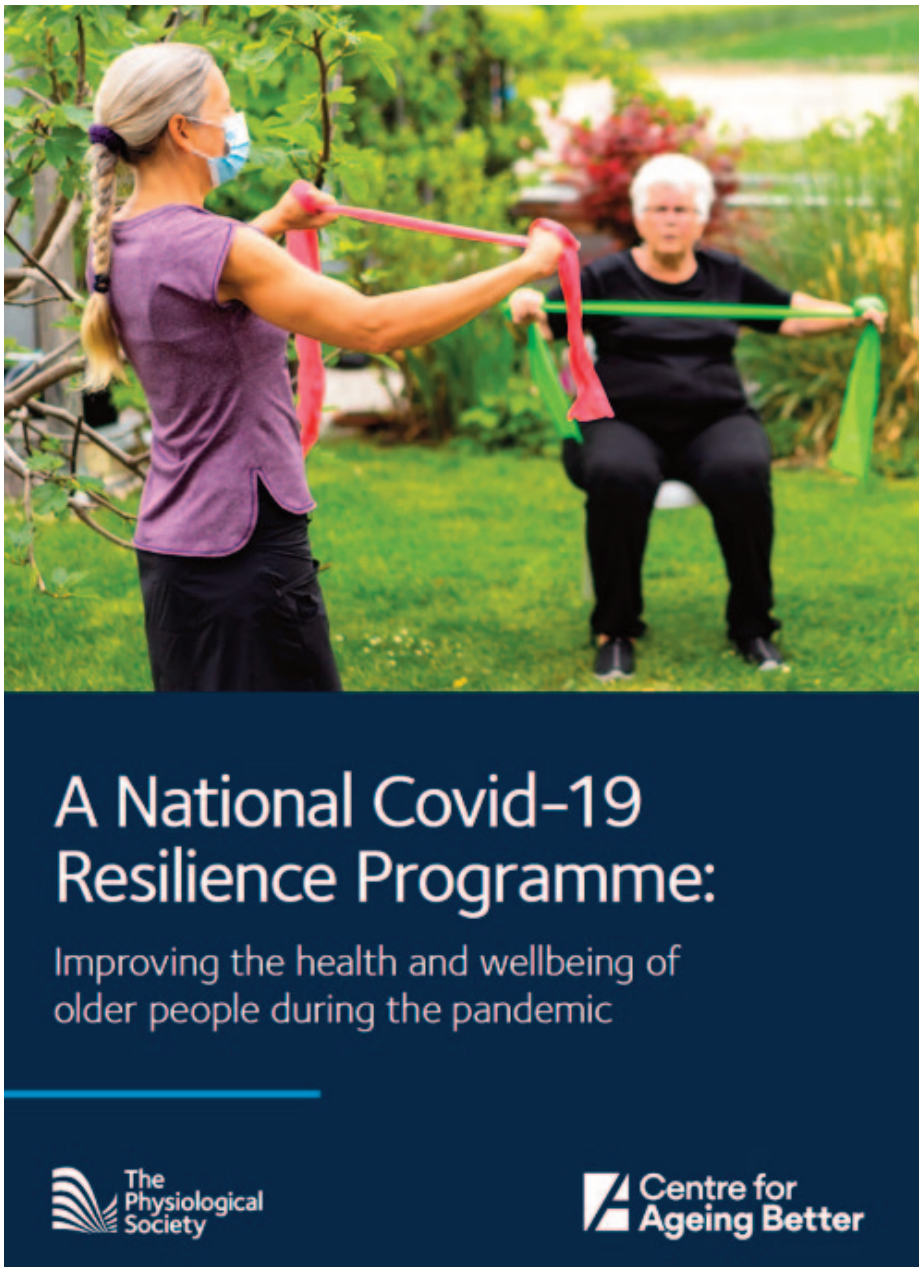
3 The Physiological Society (2020) A National Covid-19 Resilience Programme: Improving the health and wellbeing of older people during the pandemic. Available from: https://www.physoc.org/policy/covid19resilience/

4 Age UK (2020) The impact of COVID-19 to date on older people's mental and physical health. Available from: https://www.ageuk.org.uk/globalassets/age-uk/documents/reports-and-publications/reports-and-briefings/health--wellbeing/the-impact-of-covid-19-on-older-people_age-uk.pdf

5 https://www.gov.uk/government/publications/industrial-strategy-the-grand-challenges/missions#healthy-lives [accessed on 14 December 2020]

6 ukactive (2018) Reimagining ageing. London.

7 https://www.who.int/ageing/decade-of-healthy-ageing [accessed 14 December 2020]



CORNISH LITHIUM

Lucy Crane
Senior Geologist

Cornish Lithium is using modern technology to evaluate the potential to responsibly extract vital battery metals in Cornwall, from both geothermal waters and from the rocks which underlie the County. The Company's mission is to establish a strong, sustainable and environmentally responsible extraction industry in the UK for minerals which facilitate the transition to a green economy via renewable energy and battery power storage.

Since the Company's inception in 2016 the team has assembled historic and contemporary data in order to build an extensive understanding of the sub-surface geology and mineral ownership of Cornwall. The Company's proprietary digital models are used to inform ongoing exploration programmes and have already resulted in the identification of project areas which are considered to have commercial potential. The Company therefore continues to secure additional agreements with key mineral owners in Cornwall over areas that it believes hold potential for commercial extraction of lithium and other minerals.

Whilst Cornish Lithium remains focussed on extracting lithium from geothermal waters, the Company is also exploring opportunities to extract lithium and other battery metals from hard rock using modern mineral extraction techniques. Cornish Lithium is based in Penryn in Cornwall.

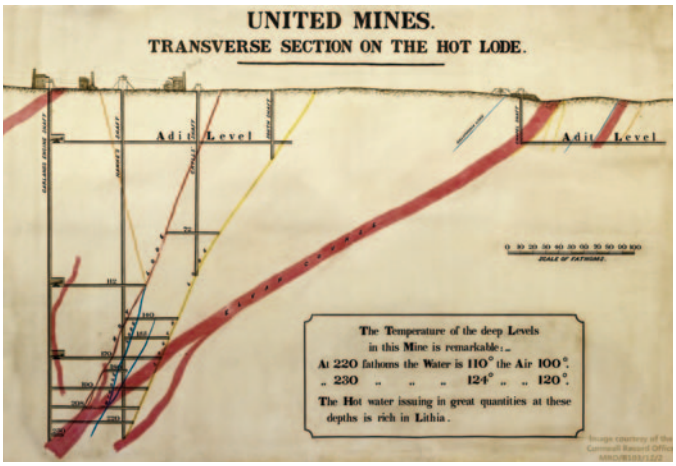
WHAT ARE THE MAIN CHALLENGES?

As the world transitions to a decarbonised economy, a vast amount of low carbon technologies such as wind turbines, solar panels and electric vehicles will need to be built. In particular, batteries will become increasingly important to store renewable energy at a grid scale, and to power electric vehicles.

According to the Volkswagen Group lithium is the "Irreplaceable Element of the Electric Era", making lithium vitally important for the future economy as the world moves towards renewable energy sources and away from a reliance on fossil fuels. The UK aspires to be a leader in the move towards electric vehicles and renewable power in order to realise its net zero carbon ambitions by 2050, and will therefore need significant quantities of lithium in order to build batteries for the domestic car industry.

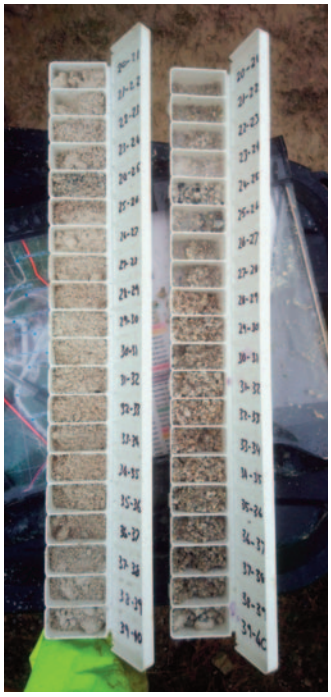
The EU has also recently released a list of "Critical Raw Materials" and made the following associated statement: "The List of Critical Raw Materials has been updated to reflect the changed economic importance and supply challenges based on their industrial application. It contains 30 critical raw materials. Lithium, which is essential for a shift to e-mobility, has been added to the list for the first time."

The Covid-19 crisis has highlighted the fragile state of current global battery supply chains, demonstrating that these are now highly vulnerable to disruption given that Europe and the UK are heavily reliant on imports. The pandemic has also focussed attention on what a world with fewer carbon emissions could look like and has provided an impetus for accelerating the transition towards electric vehicles and renewable energy in order to reverse the process of climate change. Both these factors have highlighted the need for a domestic, sustainable supply of



Miller 1864 – Lithium in hot springs

battery raw materials in the UK and Europe, especially as the region currently produces no battery quality lithium chemicals - making it totally reliant on imported materials. In addition, when battery materials are imported it is rare to have any oversight of the conditions in which these materials are produced. Only by producing battery materials domestically can the provenance and environmental credentials of such materials be assured.



Drill chip samples of lithium rich granite – Trelavour

Metals such as lithium, tin, and cobalt, are vital components of batteries used in electric vehicles and energy storage. The opportunity to extract such metals in Cornwall represents a key strategic advantage for the United Kingdom. In a recent publication, the Faraday Institution estimated the UK would need approximately 59,000 tonnes of LCE ("Lithium Carbonate Equivalent") per annum in order to build sufficient batteries for electric vehicles by 2035. Clearly, if at least some of this demand can be satisfied by domestic sources of lithium this would create additional value for the local economy and enable a vertically integrated electric vehicle battery supply chain within the UK. The Company believes that Cornwall has the potential to be the "Battery Metals Hub" for the UK and aspires to build a new industry for the future in an environmentally responsible and sustainable manner.

Drill rig at United Downs

Cornish Lithium has had a number of recent achievements which are accelerating the Company's path to commercial extraction of lithium from both lithium-enriched geothermal waters which circulate naturally at depth in Cornwall, and from minerals contained within the granite rock itself. Highlights include:

- Identification of some of the world's highest grades of lithium and best overall chemical qualities encountered in published records for geothermal waters anywhere in the world;
- Drilling and evaluation of two "shallow" wells (each approximately 1km deep) into lithium bearing geothermal waters near United Downs in central Cornwall, which have generated encouraging results and provided proof of concept for the potential extraction of lithium from these waters;
- Drilling and evaluation of 41 drill holes (each approximately 40m deep) in a prospective hard rock granite source of lithium in a former china clay pit near St Austell, the success of which has led to management's decision to fast track further exploration and development of this project;
- Metallurgical testwork on material from Trelavour has

Hard rock Li drilling – Trelavour

successfully produced nominal battery-grade lithium hydroxide. Production was achieved using ASX-listed Lepidico's proprietary L-Max® and LOH-Max® process technologies on lithium mica samples obtained during the Company's maiden hard rock lithium drilling programme in early 2020;

- Cornish Lithium has now acquired a 15-year technology license from Lepidico which provides an innovative and environmentally responsible metallurgical processing solution, allowing the Company to proceed immediately towards bulk metallurgical testing and the construction of a pilot plant.

Drill rock core samples from United Downs

- Recent successful crowdfunding round in September 2020, raising over £5m (more than three times the £1.5m target) in less than 3 days via the equity crowdfunding platform Crowdcube: demonstrating strong support from over 3700 investors;
- Ongoing acquisition of mineral rights agreements in the County; and
- Ongoing acquisition and processing of historic and contemporary data enabling the Company to continue to build our proprietary subsurface geological models.

RESEARCH AND DEVELOPMENT

Cornish Lithium is taking a highly innovative approach to mineral exploration and extraction, as it strives to be as environmentally responsible and sustainable as possible. As such, the Company is involved in a number of R&D projects with a variety of industry and academia partners across the UK to develop these approaches. One such project is the 'Li4UK' project which has just concluded, in which Cornish Lithium was a consortium member alongside the Natural History Museum and mining consultants Wardell Armstrong. 'Securing a Domestic Lithium Supply Chain for the UK' ('Li4UK') was funded by Innovate UK as part of the UK Government's Faraday Battery Challenge. The project addressed a critical missing link in the UK's battery material supply chain by identifying the requisite processing technologies and possible sources of raw materials needed to develop a sustainable, domestic lithium supply chain. In light of the Covid-19 crisis, the fragility of some international supply chains has been thrown into the spotlight, and the need to establish secure and responsible supply chains is growing increasingly important.

These achievements have provided a significant boost for the Company's ambitions in Cornwall and puts Cornish Lithium in a position to rapidly accelerate plans toward commercial production and the establishment of a vital new industry for the UK economy.

PLANS FOR THE FUTURE

Cornish Lithium's plan for the future is to move rapidly towards commercial production of lithium in the UK, for use in the UK battery industry. Next steps involve trialling environmentally friendly lithium extraction technologies for geothermal waters and for hard rock at pilot scales at the existing projects in Cornwall. In Cornwall, hot, lithium-enriched geothermal waters circulate naturally beneath the surface in large, permeable geological fault zones. Many synergies seem to exist between the production of lithium from geothermal waters, and generating renewable energy from the same geothermal waters. Cornish Lithium are keen to explore how utilising this renewable energy source to power lithium extraction could result in net zero carbon production of lithium from the same waters. In parallel, the Company is generating further lithium exploration targets and also assessing the opportunity to extract other battery metals from prospective sites across the County – again, embracing new exploration and extraction methods to do so.

For more information about Cornish Lithium please head to www.cornishlithium.com, or email info@cornishlithium.com

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Exploration drilling for geothermal waters – United Downs 2019

THE NEW DEALER ON THE BLOCK

Researching the Rise of Afghan Methamphetamine and its Penetration of International Markets

David Mansfield

Dr David Mansfield is a pre-eminent expert on the drugs economy and Afghan rural livelihoods. His research is an important source of primary data for policy analysts and academics. He has been a technical adviser to the UK government and worked for the World Bank and the European Commission. David is the author of *A State Built on Sand: How Opium Undermined Afghanistan*.

Alison Hall MBE

Alison Hall is the Marketing Manager for Alcis Holdings Ltd, who provide geographic information services that enable better understanding of complex environments in fragile and conflict affected states. She is the Founder of Seeds for Development, a charity working directly with remote farming communities in the post-conflict region of northern Uganda and was awarded an MBE for services to Victims of War in Northern Uganda in the Queen's New Year Honours list 2019.

High up in the mountains of central Afghanistan, you will find ephedra, a plant, which for centuries has been used as firewood by the local people. Until one day, they discovered it was a natural source of Ephedrine, a key ingredient of methamphetamine, or crystal meth.

Traditionally, ephedrine was extracted from medicines such as cough mixture or decongestants, but this was expensive and complicated to do. The traders from Bakwa in south west Afghanistan knew this and in 2016 started setting up stalls in the villages during the harvest season. They bought the fresh crop, dried it and took it back to the Abdul Wadood Bazaar in Bakwa, where it was processed, ready to produce the final meth.

Plant-based Ephedrine introduced a two-tiered meth production system, with tier 1

A man in the mountains of central Afghanistan with Ephedra Plant

Ephedra plant close up.

Satellite image of Ephedrine Factory in Afghanistan

being a lab to extract the ephedrine and tier 2, a lab to make the meth from the extracted ephedrine.

Before long, a thriving cottage industry producing plant-based ephedrine had become established in Bakwa. Larger specialised labs, known as "factories", also emerged, mostly in old and abandoned compounds.

Unlike Ephedrine, Meth production is clean, with little waste, making it difficult to tell an illicit meth factory from a typical household compound. Behind the walls of what appear to be ordinary buildings, cooks were preparing up to 80 kg of crystal meth per week.

It is hard to estimate how much plant-based Ephedrine is produced in all of Afghanistan. We used satellite imagery and details given by ephedrine cooks to study 14,278 compounds, in Bakwa district, and identified 329 possible production sites.

If these 329 sites were working 20 days a month, an estimated 98 tons of ephedrine, using up to 3,000 tons of dried ephedra, could be produced. This could produce around 65.5 metric tons of crystal meth a month.

Abdul Wadood Bazaar is also the regional primary wholesale market for ephedra, with an estimated 2,400 trucks a year bringing the dried crop to be milled and stored.

An indicator of how all this contributes to the development of the local Bakwa economy is the bazaar itself. High-resolution satellite imagery charts this growth from a few stores in 2016 to shops lining both sides of the street in 2020.

If this ephedrine was used to produce meth locally, it could be worth an estimated 240 million US dollars.

The potential scale, value and speed at which this has emerged in this small remote corner of Afghanistan is hard to believe.

But what happens to the ephedrine and meth once it is produced and where does it go?

Recent media reports suggest Iran, where the Iranian authorities have seen a dramatic increase of drug seizures in the Afghan border zone and are growing increasingly concerned about the availability of cheap, "low quality" crystal meth in the border areas and Tehran.

Crystal Meth

There is also growing coverage of large amounts of meth, connected with Afghanistan, being seized further afield and reaching international markets, including Australia.

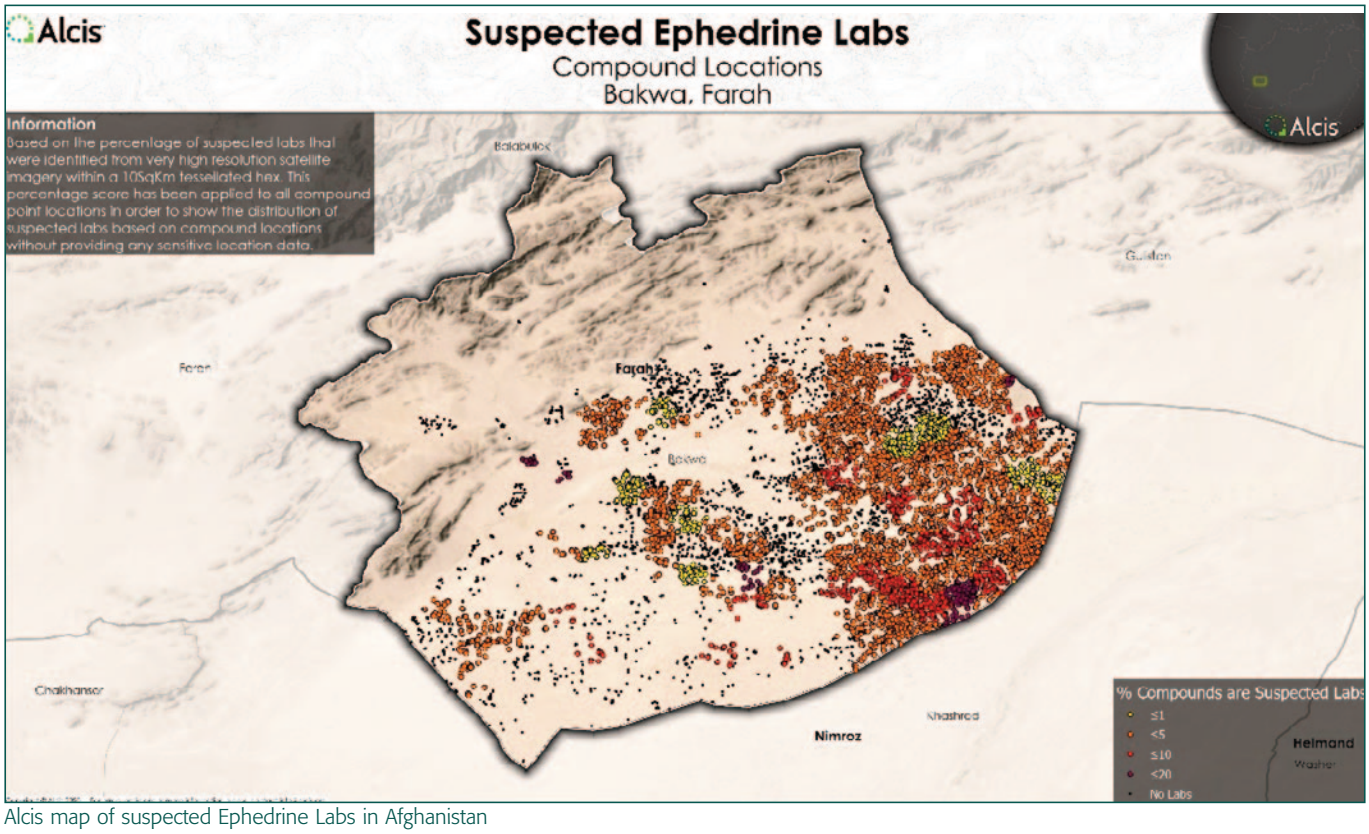
Despite the limited scope of this research, the speed and degree that producers in the Bakwar area have established synthetic drug production is a reminder of how quickly and dramatically drug markets can change.

Given the well-established and regular heroin trafficking between southwest Asia and Europe, there is an urgent need to assess the threat posed by meth produced in Afghanistan.

More Information

For more detailed information on the research: https://www.alcis.org/post/afghan-meth

For more information on the report, a short video and BBC coverage: https://www.alcis.org/our-work



Alcis map of suspected Ephedrine Labs in Afghanistan

HOUSE OF COMMONS SELECT COMMITTEES

BUSINESS, ENERGY AND INDUSTRIAL STRATEGY COMMITTEE

The Business, Energy and Industrial Strategy Committee scrutinises the policy, spending and administration of the Department for Business, Energy and Industrial Strategy and its public bodies, including Ofgem, the Financial Reporting Council and the Committee on Climate Change.

The Committee regularly holds accountability evidence hearings with Government Ministers and with bodies such as the Financial Reporting Council, the Committee on Climate Change and Ofgem. The BEIS Committee also hears from a range of stakeholders in the course of its work, receiving evidence from academics, business groups, NGOs and charities to its inquiries.

Current Inquiries:

- Post Office and Horizon – Opened 4 March 2020
- My BEIS inquiry – Opened 5 March 2020 Published 11th July 2020
- Net zero and UN climate summits – Opened 6 March 2020
- The impact of coronavirus on businesses and workers – Opened 13 March 2020
- Delivering audit reform – Opened 18 March 2020.
- Work of the Department and Government Response to coronavirus – Opened 14 April 2020
- Post-pandemic economic growth – Opened 3 June 2020.
- Post-pandemic economic growth: Industrial Strategy – Opened 23rd July 2020.
- Post-pandemic economic growth: Levelling up local and regional structures and the delivery of economic growth – Opened 24th July 2020.
- ONE WEB – Opened 16th September 2020.
- Freed Labour in UK value chains – Opened 18th September 2020.
- Decarbonising heat in homes – Opened 2nd October. Accepting written evidence until 13th November 2020.
- Business and Brexit preparedness – Opened 17th November 2020.

For further details: Tel: 020 7219 5777
Email: beiscom@parliament.uk

ENVIRONMENTAL AUDIT COMMITTEE

The remit of the Environmental Audit Committee is to consider the extent to which the policies and programmes of government departments and non-departmental public bodies contribute to environmental protection and sustainable development, and to audit their performance against sustainable development and environmental protection targets.

Unlike most select committees, the Committee's remit cuts across government rather than focuses on the work of a particular department.

From its beginning in 1997, in carrying out its environmental 'audit' role the Committee has had extensive support from the National Audit Office, providing seconded staff and research and briefing papers.

Current Inquiries

- Electronic Waste and the Circular Economy – Opened 13 March 2020.
- Technological Innovations and Climate Change: Offshore Wind – Opened 6 April 2020.
- Technological Innovations and Climate Change: Hydrogen – Opened 7 May 2020.
- Greening the post-Covid Recovery – Opened 13 May 2020. Deadline 14 August 2020.
- Energy Efficiency of Existing Homes – Opened 18 May 2020. Deadline 13 July 2020.
- Biodiversity and Ecosystems – Opened 13th July
- Technological Innovations and Climate Change: Tidal Power – Opened 9th November 2020
- Green Jobs – Opened 17th November 2020.
- Water Quality in Rivers – Opened 8th December 2020.

For further details: Tel: 020 7219 5776
Email: eacom@parliament.uk

SCIENCE AND TECHNOLOGY COMMITTEE

For further details: Tel: 020 7219 2793
Email: scitechcom@parliament.uk

The work of many Government departments makes use of — or has implications for — science, engineering, technology and research. The Science and Technology Committee exists to ensure that Government policies and decision-making are based on solid scientific evidence and advice. It is chaired by Greg Clark MP.

The Committee has a similarly broad remit and can examine the

activities of government departments that make use of science, engineering, technology and research (otherwise known as science for policy). In addition, the Committee scrutinises policies that affect the science and technology sectors, such as research funding and skills (often referred to policy for science).

Current Inquiries

- UK Science, Research and Technology Capability and Influence in Global Disease Outbreaks – Opened 20 March 2020. Deadline 31 July 2020.
- Commercial genomics – Opened 9 April 2020.
- UK telecommunications infrastructure and the UK's domestic capability – Opened 9 April 2020.
- A new research funding agency – Opened 9th April 2020.
- The role of technology, research and innovation in the COVID-19 recovery – Opened 24th July 2020.
- Coronavirus – Lessons Learnt – Opened 6th October 2020.
- The Role of Hydrogen in Achieving Zero – Opened 4th December 2020.

HEALTH AND SOCIAL CARE COMMITTEE

The Committee scrutinises government and in particular the work of the Department of Health and Social Care. It is chaired by Jeremy Hunt MP.

The Committee also scrutinises the work of public bodies in the health system in England, such as NHS England and Improvement, Public Health England and the Care Quality Commission, and professional regulators such as the General Medical Council and the Nursing and Midwifery Council. They do so by holding inquiries on specific topics and accountability hearings with the Secretary of State, and Chief Executives of relevant public bodies.

Current Inquiries

- Management of the Coronavirus Outbreak – Opened 3 March 2020
- Pre-appointment hearing for the role of Chair of NICE – Opened 4 March 2020
- Social care: funding and workforce – Opened 10 March 2020.
- Delivering Core NHS and Care Services during the Pandemic and Beyond – Opened 22 April 2020. Published 30th October.
- Safety of maternity services in England – Opened 24th July 2020.
- Workforce burnout and resistance in the NHS and social care – Opened 30th July 2020.
- Coronavirus – Lessons Learnt – Opened 6th October 2020.

For further details: Tel: 020 7219 6182
Email: hsccom@parliament.uk

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HOUSE OF LORDS SELECT COMMITTEES

SCIENCE AND TECHNOLOGY COMMITTEE

The Science and Technology Committee has a broad remit "to consider science and technology". It is chaired by Lord Patel

The Committee scrutinises Government policy by undertaking cross-departmental inquiries into a range of different activities. These include:

- public policy areas which ought to be informed by scientific research (for example, health effects of air travel),
- technological challenges and opportunities (for example, genomic medicine) and
- public policy towards science itself (for example, setting priorities for publicly funded research).

In addition, the Committee undertakes from time to time shorter inquiries, either taking evidence from Ministers and officials on topical issues, or following up previous work.

Current Inquiries

- Ageing: Science, Technology and Healthy Living - Opened 25 July 2019
- The science of COVID-19 Opened 7 May 2020.
- The Contribution of Innovation Catapults to Delivering the R&D Roadmap – Opened 11th November 2020.

HOUSE OF LORDS SCIENCE AND TECHNOLOGY COMMITTEE

The Lord Patel KT, Crossbench, Chair
The Baroness Blackwood of North Oxford, Conservative
The Lord Borwick, Conservative
The Rt Hon. the Lord Browne of Ladyton, Labour
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The Lord Hollick, Labour
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The Lord Mair CBE, Crossbench
The Baroness Manningham-Buller LG DCB, Crossbench
The Viscount Ridley DL, Conservative
The Baroness Rock, Conservative
The Baroness Sheehan, Liberal Democrat
The Baroness Walmsley, Liberal Democrat
The Baroness Young of Old Scone, Labour

For further details: Tel: 020 7219 5750
Email: hlscience@parliament.uk □

PARLIAMENTARY OFFICE OF SCIENCE AND TECHNOLOGY (POST)

POST is a bicameral body that bridges research and policy, providing reliable and up-to-date research evidence for the UK Parliament. It is overseen by a Board of MPs, Peers and external experts.

POST briefings are impartial, non-partisan, and peer-reviewed. Timely and forward thinking, they are designed to make scientific research accessible to the UK Parliament

POSTnotes are four-page summaries of public policy issues based on reviews of the research literature and interviews with stakeholders from across academia, industry, government and the third sector. They are peer reviewed by external experts.

POSTnotes are often produced proactively, so that parliamentarians have advance knowledge of key issues before they reach the top of the political agenda.

And those produced in 2019 and 2020 were:

635: Screen use and health in young people
634: Mental health impacts of COVID-19 on NHS staff
633: Interpretable machine learning
632: Heat networks
631: Edge computing
630: Digital sequence information
629: Cloud computing
628: Remote sensing and machine learning
627: Managing land uses for environmental benefits
626: A resilient UK food system
625: Marine renewables
624: Food fraud
623: Natural mitigation of flood risk
622: Online extremism
621: Infrastructure and climate change
620: 3D bioprinting in medicine
619: UK insect decline and extinctions
618: Bioenergy with carbon capture and storage (BECCS)
617: Climate change-biodiversity interactions
616: Low-carbon aviation fuels
615: Climate change and aviation
614: Brain computer interfaces
613: Non-custodial sentences
612: Autism
611: Human Germline Genome Editing
610: Misuse of Civilian Drones
609: Access to Critical Materials
608: Online Safety Education
607: Improving Witness Testimony
606: Compostable Food Packaging
605: Plastic Food Packaging Waste
604: Climate Change and Fisheries
603: Climate Change and UK Wildfire
602: Developments in Wind Power
601: Sustaining the Soil Microbiome
600: Climate Change and Agriculture
599: Early Interventions to Reduce Violent Crime
598: Advances in Cancer Treatment
597: Climate Change & Vector-Borne Disease in Humans in the UK
596: Chemical Weapons
595: Reservoirs of Antimicrobial Resistance
594: Limiting Global Warming to 1.5°C
593: Cyber Security of Consumer Devices

POSTbriefs are responsive policy briefings based on mini-literature reviews and peer reviews. Those produced in 2019 and 2020 were:

40: Proposals to increase UK recycling of plastic food packaging
39: Outward medical tourism
38: Understanding research evidence
37: Key EU space programmes
36: Understanding insect decline: data and drivers
35: Evaluating the integration of health and social care
34: Net Gain
33: Research for Parliament: Preparing for a changing world
32: 5G technology
31: Evaluating UK natural hazards: the national risk assessment

POST has also introduced some rapid response articles that summarise the research around COVID-19:

COVID-19: Current understanding
COVID-19: Behavioural and social interventions
COVID-19: Insights from behavioural science
COVID-19: School closures and mass gatherings
Vaccines for COVID-19
Models of COVID-19: Part 1
Models of COVID-19: Part 2
Vaccines for COVID-19
COVID-19 misinformation
Face masks, face coverings and COVID-19
Models of COVID-19: Part 3
COVID-19 therapies
Mental health and well-being during the COVID-19 outbreak
Light switches and clusters: social distancing strategies for COVID-19
Contact tracing apps for COVID-19
COVID-19 and international approaches to exiting lockdown
COVID-19 in children
Immunity to COVID-19
Antibody tests for COVID-19

COVID-19 and social distancing: the 2 metre advice
COVID-19 Vaccines: July update on research
Effects of COVID-19 on the food supply system
COVID-19 in children – July update
Child and adolescent mental health during COVID-19
COVID-19, children and schools
COVID-19: July update on face masks and face coverings for the general public
Immunity to COVID-19: August update
Influenza immunisation programme, NHS winter pressure and COVID-19
COVID-19 vaccines: Immunisation and prioritisation of eligible groups
COVID-19 and the disadvantage gap
Long-term health effects of COVID-19
Contact tracing apps for COVID-19: September update
Interpreting COVID-19 test accuracy
Mental health impacts of COVID-19 on NHS healthcare staff
The latest in COVID-19 testing: developing new technologies
Impact of COVID-19 on different ethnic minority groups
COVID-19 and occupational risk
Test, trace and isolate programmes for COVID-19
Test, Trace and Isolate: Behavioural aspects
COVID-19 vaccines November update: progress of clinical trials
Technology and domestic abuse
Mass testing for COVID-19 using lateral flow tests

POST has also recently asked its COVID-19 Expert Database of 5500 experts what their main short-, medium- and long-term concerns are related to COVID-19 and what data they want to see the Government release. 17 articles covering different sectors are all available on the POST website here: https://post.parliament.uk/category/horizon-scanning/2020/. The evidence gaps identified through this work and that of parliamentary staff have been published as Parliament's first Areas of Research Interests: https://post.parliament.uk/covid-19-areas-of-research-interest/

Ongoing and future projects approved by the POST Board.

BIOLOGY AND HEALTH

In production

Disorders of consciousness
Researching gambling
Influence of industry on public health policy
Reformulation of food products
Testosterone and sports performance
Mental health impacts of COVID-19
Living organ donation
Developments in vaccine technologies

Scheduled

Childhood obesity
Preventing zoonotic diseases

ENERGY AND ENVIRONMENT

In production

Food waste
Sustainable cooling
Effective biodiversity indicators
Reforestation
Hydrogen
Regulating product sustainability

PHYSICAL AND DIGITAL SCIENCES

In production

Smart cities
AI and healthcare

Scheduled

Digital skills for life

SOCIAL SCIENCES

In production

Distance learning

The POST Board oversees POST's objectives, outputs and future work programme. It meets quarterly.

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House of Commons

- Rt Hon Greg Clark MP
- Alan Whitehead MP

House of Lords

- Lord Oxburgh, KBE, FRS
- Lord Haskel
- Lord Patel KT, FMedSci, FRSE

Non-parliamentary

- Professor Elizabeth Fisher, FMedSci
- Paul Martynenko, FBCS
- Professor Sir Bernard Silverman, FRS, FAcSS
- Professor Dame Sarah Whatmore, FBA

Ex-officio

- Dr Grant Hill-Cawthorne, Head of the Parliamentary Office of Science and Technology
- Penny Young, House of Commons Librarian and Managing Director of Research & Information
- Tom Healy, Principal Clerk, Committee Office, House of Commons
- Edward Potton, Head of Science and Environment Section, House of Commons Library
- Nicolas Besly, Clerk of Select Committees, House of Lords

Head of POST

- Dr Grant Hill-Cawthorne: 020 7219 2952

PARLIAMENTARY OFFICE OF SCIENCE AND TECHNOLOGY
Houses of Parliament
Westminster, London SW1A 0AA

HOUSE OF COMMONS LIBRARY

The House of Commons Library is an impartial research and information service for Members of Parliament of all parties and their staff. This service supports MPs in their work scrutinising Government and legislation, and supporting constituents.

The Library provides confidential, impartial and bespoke briefing to Members of the House of Commons and their offices on a daily basis supporting the full range of parliamentary work, from policy development to constituency issues.

The Commons Library publishes a range of products including research briefings, shorter insight articles and briefings for non-legislative debates, all of which are available online for MPs and the general public. These briefings include in-depth and impartial analysis of all major pieces of legislation. The briefings also cover areas of policy, frequently asked questions and topical issues. You can find the briefings on the Commons Library website (https://commonslibrary.parliament.uk) where you can also sign up for personalised alerts for new or updated briefings in subject areas.

A recent focus of briefing has been Coronavirus and a webpage provides access to all the relevant material published by the Commons Library as well as the Lords Library and POST (see https://commonslibrary.parliament.uk/coronavirus/). This includes:

A series of briefings on Coronavirus restrictions: https://commonslibrary.parliament.uk/coronavirus/coronavirus-restrictions/

A series of briefings on Vaccination: https://commonslibrary.parliament.uk/coronavirus/coronavirus-vaccination/ including:

UK Vaccination Policy
Published 9 December 2020, CBP-9076

Coronavirus: Covid-19 vaccine roll-out - Frequently Asked Questions
Published 10 December 2020, CBP-9081
The Library has also produced many research briefings around the debate on Brexit (see https://commonslibrary.parliament.uk/category/brexit/).

The Science and Environment Section (SES) is one of eight teams in the Research Service in the House of Commons Library. In 2020 they have published, and continue to update, briefings on issues as varied as:

End of transition: Brexit and chemicals regulation (REACH)
Published 17 December 2020, CBP-8403
This paper discusses the EU REACH regulation for chemicals, the impact of Brexit on the chemicals industry and UK Government plans for a separate UK REACH regime after the end of the transition period.

UK Hydrogen Economy
Published 16 December 2020, CDP-2020-0172
A briefing prepared for the Westminster Hall debate on the UK hydrogen economy on 17 December.

Tree planting in the UK
Published 15 December 2020, CBP-9084
A paper covering tree planting policies that aim to increase tree cover in the UK, improve biodiversity, reduce climate emissions and provide income from agroforestry.

Electric vehicles and infrastructure
Published 4 December 2020, CBP-7480
This paper explains what electric vehicles are and how successive governments have planned for infrastructure and provided vehicle grants and incentives to encourage and accommodate their growth. It also sets out how the electricity grid is preparing to accommodate any increased demand from EV charging.

Full-fibre broadband in the UK
Published 2 December 2020, CBP-8392
A briefing on Government policy for building nationwide gigabit-capable broadband.

Telecommunications (Security) Bill 2019-21
Published 27 November 2020, CBP-9063
This briefing provides an overview of the Telecommunications (Security) Bill in advance of its second reading on 30 November 2020.

Climate Assembly UK
Published 24 November 2020, CBP-9059
This paper covers the Climate Assembly UK which was jointly commissioned by six Parliamentary Select Committees in 2019 to answer the question of how the UK should meet its target of net zero greenhouse gas emissions by 2050.

Energy bills and tariff caps
Published 18 November 2020, CBP-8081
This briefing paper provides a summary of the UK energy market, a breakdown of the components of energy bills, and details of concerns and reforms in the market, including the tariff cap.

Plastic Bags – The single use carrier bag charge
Published 19 October 2020, CBP-7241
This briefing paper provides information on the single use carrier bag charge in England, Scotland, Wales and Northern Ireland, examines the legal basis for the charge, the exemptions and what will be done with the proceeds of the charge. It also examines the impact of the charges to date.

Botulinum Toxin and Cosmetic Fillers (Children) Bill 2019-21
Published 14 October 2020, CBP-9032
This briefing covers the Private Member's Bill that had a second reading on 16 October 2020

Forensic Science Regulator and Biometrics Strategy 2019-20
Published 23 September 2020, CBP-8815
This briefing covers the Private Member's Bill that had a second reading on 25 September 2020 □

UK Research and Innovation

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UK Research and Innovation

Arts and Humanities Research Council | Biotechnology and Biological Sciences Research Council | Economic and Social Research Council
Engineering and Physical Sciences Research Council | Innovate UK | Medical Research Council
Natural Environment Research Council | Research England | Science and Technology Facilities Council

Website: www.ukri.org

Big challenges demand big thinkers - those who can unlock the answers and further our understanding of the important issues of our time. Our work encompasses everything from the physical, biological and social sciences, to innovation, engineering, medicine, the environment and the cultural impact of the arts and humanities. In all of these areas, our role is to bring together the people who can innovate and change the world for the better. We work with the government to invest over £7 billion a year in research and innovation by partnering with academia and industry to make the impossible, possible. Through the UK's nine leading academic and industrial funding councils, we create knowledge with impact.

Arts and Humanities Research Council

Website: www.ahrc.ukri.org

AHRC funds outstanding original research across the whole range of the arts and humanities. This research provides economic, social and cultural benefits to the UK, and contributes to the culture and welfare of societies around the globe.

Biotechnology and Biological Sciences Research Council

Website: www.bbsrc.ukri.org

BBSRC invests in world-class bioscience research and training. This research is helping society to meet major challenges, including food security, green energy and healthier, longer lives and underpinning important UK economic sectors, such as farming, food, industrial biotechnology and pharmaceuticals.

Economic and Social Research Council

Website: www.esrc.ukri.org

ESRC is the UK's largest funder of research on the social and economic questions facing us today. This research shapes public policy and contributes to making the economy more competitive, as well as giving people a better understanding of 21st century society.

Engineering and Physical Sciences Research Council

Website: www.epsrc.ukri.org

EPSRC invests in world-leading research and postgraduate training across the engineering and physical sciences. This research builds the knowledge and skills base needed to address scientific and technological challenges and provides a platform for future UK prosperity by contributing to a healthy, connected, resilient, productive nation.

Innovate UK

Website: www.gov.uk/government/organisations/innovate-uk

Innovate UK drives productivity and economic growth by supporting businesses to develop and realise the potential of new ideas, including those from the UK's world-class research base. They connect businesses to the partners, customers and investors that can help them turn these ideas into commercially successful products and services, and business growth.

Medical Research Council

Website: www.mrc.ukri.org

MRC is at the forefront of scientific discovery to improve human health. Its scientists tackle some of the greatest health problems facing humanity in the 21st century, from the rising tide of chronic diseases associated with ageing to the threats posed by rapidly mutating micro-organisms.

Natural Environment Research Council

Website: www.nerc.ukri.org

NERC is the driving force of investment in environmental science. Its leading research, skills and infrastructure help solve major issues and bring benefits to the UK, such as affordable clean energy, air pollution, and resilience of our infrastructure.

Research England

Website: www.re.ukri.org

Research England creates and sustains the conditions for a healthy and dynamic research and knowledge exchange system in English universities. Working to understand their strategies, capabilities and capacity; supporting and challenging universities to create new knowledge, strengthen the economy, and enrich society.

Science and Technology Facilities Council

Website: www.stfc.ukri.org

STFC is a world-leading multi-disciplinary science organisation. Its research seeks to understand the Universe from the largest astronomical scales to the tiniest constituents of matter, and creates impact on a very tangible, human scale.

Association of the British Pharmaceutical Industry

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The Association of the British Pharmaceutical Industry (ABPI) represents innovative research-based biopharmaceutical companies, large, medium and small, leading an exciting new era of biosciences in the UK. Our industry, a major contributor to the economy of the UK, brings life-saving and life-enhancing medicines to patients. Our members are researching and developing over two-thirds of the current medicines pipeline, ensuring that the UK remains at the forefront of helping patients prevent and overcome diseases. Topics we focus on include:

- All aspects of the research and development of medicines including clinical research and licensing
- Stratified medicine
- Vaccines, biosimilars, small and large molecules, cell therapy and regenerative medicine

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AIRTO, the Association of Innovation, Research and Technology Organisations, comprises approximately sixty principal organisations operating in the UK's Innovation, Research and Technology (IRT) sector. The IRT sector has a combined turnover of £6.9Bn, employs over 57,000 people and contributes £34Bn to UK GVA. AIRTO's members work at the interface between academia and industry, for both private and public sector clients. Members include independent Research and Technology Organisations, Catapult Centres, Public Sector Research Establishments, National Laboratories, some university Technology Transfer Offices and some privately held innovation companies.

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Website: www.amps-tradeunion.com

We are a Trades Union for Management and Professional Staff working in the pharmaceutical, chemical and allied industries.

We have produced a training programme funded by the EU on diversity and helping women managers remain in the workplace after a career break. This training programme is aimed at both men and women and is intended to address the shortfall in qualified personnel in the chemical and allied industries.

We are experts in performance based and field related issues and are affiliated to our counterparts in EU Professional Management Unions.

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AWE plays a crucial role in our nation's defence by providing and maintaining warheads for the UK's nuclear deterrent and delivers advice and guidance on a 24/7 basis to UK government in the area of national security.

We are a centre of scientific, engineering and technological excellence, with some of the most advanced research, design and production facilities in the world. AWE is contracted to the Ministry of Defence (MOD) through a Government-owned-contractor-operated (GOCO) arrangement. While our sites and facilities remain in government ownership, their management, day-to-day operations and maintenance of Britain's nuclear stockpile is contracted to a private company: AWE Management Limited (AWE ML). AWE ML is a consortium comprising three partners: Jacobs Engineering Group, the Lockheed Martin Corporation and Serco Group plc.

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The Biochemical Society works to promote the molecular biosciences; facilitating the sharing of expertise, supporting the advancement of biochemistry and molecular biology and raising awareness of their importance in addressing societal grand challenges. We achieve our mission by :

- bringing together molecular bioscientists;
- supporting the next generation of biochemists;
- promoting and sharing knowledge and
- promoting the importance of our discipline.

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British Antarctic Survey (BAS), an institute of NERC, delivers and enables world-leading interdisciplinary research in the Polar Regions. Its skilled science and support staff based in Cambridge, Antarctica and the Arctic, work together to deliver research that uses the Polar Regions to advance our understanding of Earth as a sustainable planet. Through its extensive logistic capability and know-how BAS facilitates access for the British and international science community to the UK polar research operation. Numerous national and international collaborations, combined with an excellent infrastructure help sustain a world leading position for the UK in Antarctic affairs. For more information visit www.bas.ac.uk @basnews

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The British Ecological Society is an independent, authoritative learned society, and the voice of the UK's ecological community. Working with our members we gather and communicate the best available ecological evidence to inform decision making. We offer a source of unbiased, objective ecological knowledge, and promote an evidence-informed approach to finding the right solutions to environmental questions.

British In Vitro Diagnostics Association (BIVDA)

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BIVDA is the UK industry association representing companies who manufacture and/or distribute the diagnostics tests and equipment to diagnose, monitor and manage disease largely through the NHS pathology services. Increasingly diagnostics are used outside the laboratory in community settings and also to identify those patients who would benefit from specific drug treatment particularly for cancer.

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The British Pharmacological Society is a charity with a mission to promote and advance the whole spectrum of pharmacology. It is the primary UK learned society concerned with drugs and the way they work, and leads the way in the research and application of pharmacology around the world.

Founded in 1931, the Society champions pharmacology in all its forms, across academia, industry, regulatory agencies and the health service. With over 3,500 members from over 60 countries worldwide, the Society is a friendly and collaborative community. Enquiries about the discovery, development and application of drugs are welcome.

Tracey Guise, Chief Executive Officer
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BSAC is a learned society whose members are among the world's leading infectious disease physicians, pharmacists, microbiologists, and nurses.

With more than 45 years of leadership in antibiotic research and education, BSAC is dedicated to saving lives by fighting infection. It does this by supporting a global network of experts via workshops, conferences, evidence-based guidelines, e-learning courses, and its own high-impact international journal.

BSAC also provides national surveillance and susceptibility testing programmes, an outpatient parenteral antimicrobial therapy (OPAT) initiative, research and development grants, and the secretariat for the All-Party Parliamentary Group on Antibiotics.

BSAC has members in 40 nations and active learners in more than 135 countries.

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The British Society for Immunology's mission is to promote excellence in immunological research, scholarship and clinical practice in order to improve human and animal health. We are the leading UK membership organisation working with scientists and clinicians from academia and industry to forward immunology research and application around the world. Our friendly, accessible community of over 3,500 immunologists gives us a powerful voice to advocate for immunological science and health for the benefit of society.

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The British Society of Soil Science (BSSS) or "BS cubed" as it is fondly known was founded in 1947 by a number of eminent British soil scientists. It was formed with the aims: to advance the study of soil; to be open to membership from all those with an interest in the study and uses of soil; and to issue an annual publication.

Nowadays BSSS is an established international membership organisation and charity committed to the study of soil in its widest aspects. The Society acts as a forum for the exchange of ideas and provides a framework for representing the views of soil scientists to other organisations and decision making bodies. It promotes research by organising several conferences each year and by the publication of its two scientific journals, the European Journal of Soil Science, and Soil Use and Management.

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Brunel University London is an international research active university with 3 leading research institutes:

Institute of Energy Futures: Led by Professor Savvas Tassou, the main themes of the Institute are *Advanced Engines and Biofuels, Energy Efficient and Sustainable Technologies, Smart Power Networks*, and *Resource Efficient Future Cities*.

Institute of Materials and Manufacturing: The main themes of research are *Design for Sustainable Manufacturing, Liquid Metal Engineering, Materials Characterisation and Processing, Micro-Nano Manufacturing*, and *Structural Integrity*. The Institute is led by Professor Luiz Wrobel.

Institute of Environment, Health and Societies: Professor Susan Jobling leads this pioneering research institute whose themes are *Health and Environment, Healthy Ageing, Health Economics Synthetic Biology, Biomedical Engineering and Healthcare Technologies*, and *Social Sciences and Health*.

Brunel University London offers a wide range of expertise and knowledge, and prides itself on having academic excellence at the core of its offer, and was ranked in the recent REF as 33rd in the UK for Research Power (average quality rating by number of submissions) and described by The Times Higher Education as one of the real winners of the REF 2014.

Cavendish Laboratory

UNIVERSITY OF CAMBRIDGE

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The Cavendish Laboratory houses the Department of Physics of the University of Cambridge.

The research programme covers the breadth of contemporary physics

Extreme Universe: Astrophysics, cosmology and high energy physics

Quantum Universe: Cold atoms, condensed matter theory, scientific computing, quantum matter and semiconductor physics

Materials Universe: Optoelectronics, nanophotonics, detector physics, thin film magnetism, surface physics and the Winton programme for the physics of sustainability

Biological Universe: Physics of medicine, biological systems and soft matter

The Laboratory has world-wide collaborations with other universities and industry

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Our vision is integrated design to improve life, wellbeing and performance through science, engineering, technology and psychology. The Institute is one of the largest in the world representing the discipline and profession of Human Factors and Ergonomics. We have sector groups in most industries from defence to aviation and pharmaceuticals that provide expert advice to industry and government. We accredit university courses and consultancy practices and work closely with allied learned societies.

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CTPA is the UK trade association representing manufacturers of cosmetic products and suppliers to the cosmetic products industry. 'Cosmetic products' are legally defined and subject to stringent EU safety laws. CTPA is the authoritative public voice of a vibrant and responsible UK industry trusted to act for the consumer; ensuring the science behind cosmetics is fully understood.

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Clifton Scientific Trust Ltd is registered charity in England and Wales 1086933

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The Council for the Mathematical Sciences is an authoritative and objective body that works to develop, influence and respond to UK policy issues affecting mathematical sciences in higher education and research, and therefore the UK economy and society by:

- providing expert advice;
- engaging with government, funding agencies and other decision makers;
- raising public awareness; and
- facilitating communication between the mathematical sciences community and other stakeholders

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The Francis Crick Institute is a biomedical discovery institute dedicated to understanding the fundamental biology underlying health and disease. Its work is helping to understand why disease develops and to translate discoveries into new ways to prevent, diagnose and treat illnesses such as cancer, heart disease, stroke, infections, and neurodegenerative diseases.

The Crick was formed in 2015, and in 2016 it moved into a brand new state-of-the-art building in central London which brings together 1500 scientists and support staff working collaboratively across disciplines.

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Founded in 1992 in memory of the UK's first female Professor of Physics, the Trust is the UK's leading charity dedicated to realising the potential of scientists and engineers returning to research after career breaks for family, caring and health reasons. Recently, we have expanded our remit to incorporate the social sciences and arts & humanities. Our Fellowship programme, working in partnership with universities, UKRI, charities, learned societies and industry, enables individuals to undertake part-time research in universities and research institutes. Fellowships comprise a research project alongside an individually tailored retraining programme, with additional mentoring and support, enabling recipients to re-establish their research credentials, update skills and redevelop confidence, in a suitably supportive environment.

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The Energy Institute (EI) is the chartered professional membership body bringing together expertise for urgent global challenges. Our ambition is that energy, and its critical role in our world, is better understood, managed and valued. We're a unique network with insight spanning the world of energy, from conventional oil and gas to the most innovative renewable and energy efficient technologies. We gather and share essential knowledge about energy, the skills that are helping us all use it more wisely, and the good practice needed to keep it safe and secure. We articulate the voice of energy experts, taking the know-how of around 20,000 members and 200 companies from 120 countries to the heart of the public debate. And we're an independent, not-for-profit, safe space for evidence-based collaboration, an honest broker between industry, academia and policy makers.

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EngineeringUK is an independent organisation that promotes the vital role of engineers, engineering and technology in our society. EngineeringUK partners business and industry, Government and the wider science and technology community: producing evidence on the state of engineering; sharing knowledge within engineering, and inspiring young people to choose a career in engineering, matching employers' demand for skills.

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Fera provides expert analytical and professional services to governments, agrichemical companies, food retailers, manufacturers and farmers to facilitate safety, productivity and quality across the agrifood supply chain in a sustainable and environmentally compatible way.

Fera uses its world leading scientific expertise to provide robust evidence, rigorous analysis and professional advice to governments, international bodies and companies worldwide. Our food integrity, plant health, agri-tech and agri-informatics services ensure that our customers have access to leading edge science, technology and expertise.

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FirstGroup are the leading transport operator in the UK and North America and each day, every one of our 110,000 employees works hard to deliver vitally important services for our passengers. During the last year around 2.2 billion passengers relied on us to get to work, to school or college, to visit family and friends, and much more.

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GAMBICA is the voice of the laboratory technology, instrumentation, control and automation industries, providing influence, knowledge and community. We offer members a common platform for voicing their opinions and representing their common interests to a range of stakeholders. GAMBICA seeks to spread best-practice and be thought leaders in our sectors.

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The Geological Society is the national learned and professional body for Earth sciences, with 12,000 Fellows (members) worldwide. The Fellowship encompasses those working in industry, academia and government, with a wide range of perspectives and views on policy-relevant science, and the Society is a leading communicator of this science to government bodies and other non-technical audiences.

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Advancing knowledge and setting standards in biomedical science

With over 20,000 members in 61 countries, the Institute of Biomedical Science (IBMS) is the leading professional body for scientists, support staff and students in the field of biomedical science.

Since 1912 we have been dedicated to the promotion, development and delivery of excellence in biomedical science within all aspects of healthcare, and to providing the highest standards of service to patients and the public.

By supporting our members in their practice, we set quality standards for the profession through training, education, assessments, examinations and continuous professional development.

Institute of Food Science + Technology

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We are the UK's leading professional body for those involved in all aspects of food science and technology. We are an internationally respected independent membership body, supporting food professionals through knowledge sharing and professional recognition.

Our core aim is the advancement of food science and technology based on impartial science and knowledge sharing.

Our membership comprises individuals from a wide range of backgrounds, from students to experts, working across a wide range of disciplines within the sector.

IKE Institute of Innovation & Knowledge Exchange

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IKE is the UK's professional body for innovators. It accredits and certificates innovation practices. We influence the inter-relationship between education, business, and government through research and collaborative networks. Our Innovation Manifesto highlights our commitment to support the development of innovative people and organisations. IKE runs think-tanks, conducts research, develops new business models and tools and supports organisations to benchmark their innovation capabilities.

Institute of Marine Engineering, Science and Technology (IMarEST)

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Established in London in 1889, the IMarEST is a leading international membership body and learned society for marine professionals, with over 15,000 members worldwide. The IMarEST has an extensive marine network of 50 international branches, affiliations with major marine societies around the world, representation on the key marine technical committees and non-governmental status at the International Maritime Organization (IMO) as well as other intergovernmental organisations.

The Institute of Materials Finishing

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The Institute of Materials Finishing is the premier technical organisation representing industry, academia and individual professionals in both the UK's and global surface engineering and materials finishing sector.

We actively promote continual education and knowledge dissemination by providing both distance learning and tutored training courses, as well as a technical support service. We also provide bespoke courses that are tailored to an employer's specific needs. The Institute also publishes *Transactions of the Institute of Materials Finishing* and a bimonthly newsletter (*IMFormation*), as well as holding regular regional and international technical meetings, symposia and conferences.

Institute of Measurement and Control

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Website: www.instmc.org
Reg Charity number: 269815

The Institute of Measurement and Control is a professional engineering institution and learned society dedicated to the science and application of measurement and control technology for the public benefit. The InstMC has a comprehensive range of membership grades for individuals engaged in both technical and non-technical occupations. Also, it is licensed by the Engineering Council to assess and register individuals as Chartered Engineers (CEng), Incorporated Engineers (IEng) and Engineering Technicians (EngTech).

The InstMC works to develop the knowledge and skills of individual engineers, fostering communication and advancing the science and practices within the industry.

IOP Institute of Physics

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The Institute of Physics (IOP) is the professional body and learned society for physics in the UK and Ireland. The IOP's mission is to raise public awareness and understanding of physics, inspire people to develop their knowledge, understanding and enjoyment of physics and support the development of a diverse and inclusive physics community. As a charity, the IOP seeks to ensure that physics delivers on its exceptional potential to benefit society.

IPEM Institute of Physics and Engineering in Medicine

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IPEM is a registered, incorporated charity for the advancement, in the public interest, of physics and engineering applied to medicine and biology. Its members are medical physicists, clinical and bio-engineers, and clinical technologists. It organises training and CPD for them, and provides opportunities for the dissemination of knowledge through publications and scientific meetings. IPEM is licensed by the Science Council to award CSci, RSci and RSciTech, and by the Engineering Council to award CEng, IEng and EngTech.

IChemE Advancing Chemical Engineering Worldwide

The Institution of Chemical Engineers

The Institution of Chemical Engineers (IChemE) advances chemical engineering's contribution worldwide for the benefit of society. We support the development of chemical engineering professionals and provide connections to a powerful network of around 35,000 members in 100 countries.

We support our members in applying their expertise and experience to make an influential contribution to solving major global challenges, and are the only organisation to award Chartered Chemical Engineer status and Professional Process Safety Engineer registration.

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Kuala Lumpur | London | Melbourne | Rugby | Singapore | Wellington

IET The Institution of Engineering and Technology

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The IET is a world leading professional organisation, sharing and advancing knowledge to promote science, engineering and technology across the world. Dating back to 1871, the IET has over 163,000 members in 127 countries with offices in Europe, North America, and Asia-Pacific.

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LGC is a global leader in the life sciences tools sector, including human healthcare and applied markets (food, agbio and the environment). LGC provides a comprehensive range of measurement tools, proficiency testing schemes, supply chain assurance standards and specialty genomics tools (oligos, PCR tools, NGS reagents), underpinned by leading analytical and measurement science capabilities. Under the Government Chemist function, LGC fulfils specific statutory duties as the referee analyst and provides advice for Government and the wider analytical community on the implications of analytical measurement for matters of policy, standards and regulation. LGC is also the UK's National Measurement Laboratory for chemical and bio-measurement.

With headquarters in Teddington, South West London, LGC has laboratories and sites across Europe, the US, China, Brazil, India, and South Africa.

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L'Oréal employs more than 3,800 researchers world-wide and dedicates over €877 million each year to research and innovation in the field of healthy skin and hair. The company supports women in science research through the L'Oréal UNESCO For Women In Science Programme and engages young people with science through the L'Oréal Young Scientist Centre at the Royal Institution. L'Oréal also collaborates with a vast number of institutions in the UK and globally.

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As the world's oldest active biological society, the Linnean Society is an essential forum and meeting point for those interested in the natural world. The Society holds regular public lectures and events, publishes three peer-reviewed journals, and promotes the study of the natural world with several educational initiatives. The Society is home to a world famous library and collection of natural history specimens. The Society's Fellows have a considerable range of biological expertise that can be harnessed to inform and advise on scientific and public policy issues.

A Forum for Natural History

London School of Hygiene & Tropical Medicine
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www.lshtm.ac.uk

The London School of Hygiene & Tropical Medicine (LSHTM) is a world-leading centre for research and postgraduate education in public and global health with over 4,000 students and more than 1,300 staff working in over 100 countries across the world – including at two MRC Units in The Gambia and Uganda which joined LSHTM in 2018. Our depth and breadth of expertise encompasses many disciplines, and we are one of the highest-rated research institutions in the UK.

Marine Biological Association

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Since 1884 the Marine Biological Association has been delivering its mission *'to promote scientific research into all aspects of life in the sea, including the environment on which it depends, and to disseminate to the public the knowledge gained.'* The MBA represents its members in providing a clear independent voice to government on behalf of the marine biological community. It also has an extensive research programme and a long history as an expert provider of advice for the benefit of policy makers and wider society.

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The Institution provides politicians and civil servants with information, expertise and advice on a diverse range of subjects, focusing on manufacturing, energy, environment, transport and education policy. We regularly publish policy statements and host political briefings and policy events to establish a working relationship between the engineering profession and parliament.

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The Met Office doesn't just forecast the weather on television. Our forecasts and warnings protect UK communities and infrastructure from severe weather and environmental hazards every day – they save lives and money. Our Climate Programme delivers evidence to underpin Government policy through the Met Office Hadley Centre. Our Mobile Meteorological Unit supports the Armed Forces around the world. We build capacity overseas in support of international development. All of this built on world-class environmental science.

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The Microbiology Society is a membership charity for scientists interested in microbes, their effects and their practical uses. It is one of the largest microbiology societies in Europe with a worldwide membership based in universities, industry, hospitals, research institutes and schools.

Our principal goal is to develop, expand and strengthen the networks available to our members so that they can generate new knowledge about microbes and ensure that it is shared with other communities. The impacts from this will drive us towards a world in which the science of microbiology provides maximum benefit to society.

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The National Physical Laboratory (NPL) is the United Kingdom's national measurement institute, an internationally respected and independent centre of excellence in research, development and knowledge transfer in measurement and materials science. For more than a century, NPL has developed and maintained the nation's primary measurement standards - the heart of an infrastructure designed to ensure accuracy, consistency and innovation in physical measurement.

SCIENCE DIRECTORY

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We challenge the way people think about the natural world – its past, present and future

We use our unique collection and unrivalled expertise to tackle the biggest challenges facing the world today.

We are leaders in the scientific understanding of the origin of our planet, life on it and can predict the impact of future change.

We study the diversity of life and the delicate balance of ecosystems to ensure the survival of our planet.

We help enable food security, eradicate disease and manage resource scarcity.

We inspire people to engage with science to solve major societal challenges.

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The University of Northampton is an institution committed to science education through initial teacher training, a STEM Ambassador network which works within the community and teaching and research to doctoral level. We are an Ashoka U 'Changemaker Campus' status university recognising our commitment to social innovation and entrepreneurship.

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With 43,000 students and campuses in Nottingham, China and Malaysia, The University of Nottingham is 'the nearest Britain has to a truly global university'. With more than 97 per cent of research at the University recognised internationally according to the Research Excellence Framework 2014, the University is ranked in the top 1% of the world's universities by the QS World University Rankings.

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The Nutrition Society is a not for profit, membership organisation which is dedicated to delivering its mission of advancing the scientific study of nutrition and its application to the maintenance of human and animal health. Highly regarded by the scientific community, the Society is one of the largest learned societies for nutrition in the world and anyone with a genuine interest in the science of human or animal nutrition can become a member.

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As the largest network of physiologists in Europe, with academic journals of global reach, we continue our 140-year tradition of being at the forefront of the life sciences.

We bring together scientists from over 60 countries, and our Members have included numerous Nobel Prize winners from Ivan Pavlov to John O'Keefe.

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Prospect is an independent, thriving and forward-looking trade union with over 120,000 members across the private and public sectors and a diverse range of occupations. We represent scientists, technologists and other professions in the civil service, research councils and private sector.

Prospect's collective voice champions the interests of the engineering and scientific community to key opinion-formers and policy makers. With negotiating rights with over 300 employers, we seek to secure a better life at work by putting members' pay, conditions and careers first.

QUADRUM INSTITUTE

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Opening fully in mid-2018, the Quadram Institute will be an interdisciplinary research centre capitalising on the academic excellence and clinical expertise of the Norwich Research Park. Its mission is to understand how food and the gut microbiota link to the promotion of health and preventing diet and age related diseases. The Quadram Institute brings together fundamental and translational science with a clinical research facility for human trials and one of Europe's largest gastrointestinal endoscopy units. This will synergise interactions between basic and clinical research, delivering a step change in the understanding of the role of food in health.

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As the UK's national academy for engineering, we bring together the most successful and talented engineers for a shared purpose: to advance and promote excellence in engineering. We have four strategic challenges: drive faster and more balanced economic growth; foster better education and skills; lead the profession; and promote engineering at the heart of society.

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RBG Kew is a centre of global scientific expertise in plant and fungal diversity, conservation, and sustainable use, housed in two world-class gardens. Our scientific vision is to document and understand global plant and fungal diversity and its uses, bringing authoritative expertise to bear on the critical challenges facing humanity today.

Kew's strategic priorities for science are:

1. To document and conduct research into global plant and fungal diversity and its uses for humanity.
2. To curate and provide data-rich evidence from Kew's unrivalled collections as a global asset for scientific research.
3. To disseminate our scientific knowledge of plants and fungi, maximising its impact in science, education, conservation policy and management.

These priorities enable us to curate, use, enhance, explore and share Kew's global resource, providing robust data and a strong evidence base for our UK and global stakeholders. Kew is a non-departmental government body with exempt charitable status, partially funded by Defra.

The Royal Institution
Science Lives Here

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The Royal Institution (Ri) has been at the forefront of public engagement with science for over 200 years and our purpose is to encourage people to think further about the wonders of science. We run public events and the famous CHRISTMAS LECTURES®, a national programme of Masterclasses for young people in mathematics, engineering and computer science, educational activities at the L'Oréal Young Scientist Centre and policy discussions with science students. And through the Ri Channel we share the stories behind cutting-edge science with people around the world.

THE ROYAL SOCIETY

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The Royal Society is the academy of science in the UK and the Commonwealth comprising 1400 outstanding individuals representing the sciences, engineering and medicine. The Society has played a part in some of the most fundamental, significant and life-changing discoveries in scientific history and Royal Society scientists continue to make outstanding contributions to science across the wide breadth of research areas. Through its Fellowship and permanent staff, it seeks to ensure that its contribution to shaping the future of science in the UK and beyond has a deep and enduring impact, supporting excellence in science and encouraging the development and use of science for the benefit of humanity.

Royal Society of Biology

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The Royal Society of Biology is a single unified voice, representing a diverse membership of individuals, learned societies and other organisations. We are committed to ensuring that we provide Government and other policy makers – including funders of biological education and research – with a distinct point of access to authoritative, independent, and evidence-based opinion, representative of the widest range of bioscience disciplines. Our vision is of a world that understands the true value of biology and how it can contribute to improving life for all.

ROYAL SOCIETY OF CHEMISTRY

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The Royal Society of Chemistry is the world's leading chemistry community, advancing excellence in the chemical sciences. With over 50,000 members and a knowledge business that spans the globe, we are the UK's professional body for chemical scientists; a not-for-profit organisation with 170 years of history and an international vision of the future. We promote, support and celebrate chemistry. We work to shape the future of the chemical sciences – for the benefit of science and humanity.

society for applied sfam microbiology

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*Sf*AM utilises the expertise of its international membership to advance, for the benefit of the public, the application of microbiology to the environment, human and animal health, agriculture, and industry. Our values include equality, diversity and inclusivity; collaboration to amplify impact; scientific integrity; evidence-based decision-making and political neutrality. With Wiley-Blackwell, *Sf*AM publishes five internationally acclaimed journals.

Society for Underwater Technology

SUT Society for Underwater Technology

Society for Underwater Technology
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The SUT is a multidisciplinary learned society that brings together individuals and organisations with a common interest in underwater technology, ocean science, and offshore/subsea engineering. The society was founded in 1966 and has members from over 40 countries, including engineers, scientists, other professionals and students working in these areas.

Society of Chemical Industry

SCI: where science meets business

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Established by Royal Charter in 1881, SCI is a unique multi-disciplinary community. Set up by a prominent group of forward thinking scientists, inventors and entrepreneurs, SCI continues to be a multi-science and industry network based around chemistry and related sciences. Our charitable objective is to promote links between science and industry for the benefit of society. Our passion is invention and creation.

We deliver our charitable objective by:

- Supporting the commercial application of science into industry
- Tackling global challenges across Agrifood, Energy, Environment, Health and Materials

Society of Cosmetic Scientists

SCS SOCIETY OF COSMETIC SCIENTISTS

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Advancing the science of cosmetics is the primary objective of the SCS. Cosmetic science covers a wide range of disciplines from organic and physical chemistry to biology and photo-biology, dermatology, microbiology, physical sciences and psychology.

Members are scientists and the SCS helps them progress their careers and the science of cosmetics ethically and responsibly. Services include publications, educational courses and scientific meetings.

Society of Maritime Industries

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The Society of Maritime Industries (SMI) is the voice of the UK's maritime engineering and business sector. Promoting and supporting companies in Commercial Marine, Maritime Defence & Security, Ports & Terminals Infrastructure, Marine Science & Technology, Maritime Autonomous Systems and Digital Technology.

UK INNOVATION & SCIENCE SEED FUND

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The **UK Innovation & Science Seed Fund** is a leading patient capital investor with more than £330 million private investment leveraged to date. The Fund works to build technology companies from the earliest stage by working closely with its partners led by STFC, BBSRC, NERC and Dstl, with the National Research and Innovation Campuses they support, and with entrepreneurial science-led teams. UK Innovation & Science Seed Fund is also closely aligned with the Catapults and InnovateUK, helping to commercialise key technological advances in industrial biotech, agricultural technology, healthcare, medicine, clean energy, materials, artificial intelligence, software and space.

Understanding ANIMAL RESEARCH

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Understanding Animal Research is a not-for-profit organisation that explains why animals are used in medical, veterinary, environmental and other scientific research. We aim to achieve a broad understanding of the humane use of animals in medical, veterinary, scientific and environmental research in the UK. We work closely with policymakers to ensure regulation is effective and are a trusted source of information for the national and international media. We are funded by our members who include universities, professional societies, trade unions, industry and charities.

University of Essex

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Established in 1964, the University of Essex is ranked as one of the Top 20 universities in the Research Excellence Framework and is awarded Gold in the Teaching Excellence Framework. It is home to world-leading expertise in analytics and data science, with research peaks spanning the social sciences, sciences, and humanities. Pioneers of quantitative methods and artificial intelligence techniques, Essex is also in the UK top 10 for Knowledge Transfer Partnerships, and works with businesses to embed innovation into operations, through KTPs, knowledge exchange and contract research.

Universities Federation for Animal Welfare

UFAW Established 1926

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Registered in England Charity No: 207996

UFAW, the international animal welfare science society, is an independent scientific and educational charity. It works to improve animal lives by:

- supporting animal welfare research
- educating and raising awareness of welfare issues in the UK and overseas
- producing the quarterly scientific journal Animal Welfare and other high-quality publications on animal care and welfare
- providing advice to government departments and other concerned bodies.

The Welding Institute

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The Welding Institute is the leading institution providing engineering solutions and knowledge transfer in all aspects of manufacturing, fabrication and whole-life integrity management.

Industrial membership provides access to innovative problem-solving from one of the world's foremost independent research and technology organisations.

Non-Corporate services include membership and registration, education, training and certification for internationally recognised professional development and personnel competence assurance.

TWI provides Members and stakeholders with authoritative and impartial expert advice, knowhow and safety assurance through engineering, materials and joining technologies.

SCIENCE DIARY

PARLIAMENTARY AND SCIENTIFIC COMMITTEE – ALL-PARTY PARLIAMENTARY GROUP

Email: office@scienceinparliament.org.uk
www.scienceinparliament.org.uk
follow us on Twitter @ParlSciCom

Monday 15th February 2021
Discussion Meeting on Sector Deals for SME's
5.30pm – 7.00pm Virtual Meeting

Monday 8th March 2021
STEM for Britain
11.00am – 1.00pm Virtual Event

Monday 15th March 2021
Discussion Meeting Covid 19 update – title tbc.
5.30pm – 7.00pm Virtual Meeting

Tuesday 16th March 2021
Annual General Meeting
12.30pm – 2.00pm Virtual Event

Monday 12th April 2021
Discussion Meeting on the UK National Quantum Programme
5.30pm – 7.00pm Virtual Meeting
In cooperation with Innovate UK

Monday 7th June 2021
Discussion Meeting on Natural Capital Initiative
5.30pm -7.00pm

Tuesday 8th June 2021
Annual Lunch
House of Lords

Monday 5th July 2021
Discussion Meeting on Climate Change
5.30pm – 7.00pm
Sponsored by the Met Office

THE FOUNDATION FOR SCIENCE AND TECHNOLOGY

Wednesday 24th February 2021
Discussion meeting on "Will Hydrogen Technologies get us to Net Zero?"
6.00pm – 7.00pm Virtual Meeting
https://www.foundation.org.uk/Events/2021/Will-Hydrogen-Technologies-get-us-to-Net-Zero-(1)
Speakers:
Nigel Topping, High Level Climate Action Champion for UN climate talks, COP26
Baroness Brown of Cambridge DBE FREng FRS
House of Lords and Deputy Chair, Committee on Climate Change
Jane Toogood
Chief Executive, Efficient Natural Resources, Johnson Matthey

ROYAL SOCIETY

Details of all events can be found on the events calendar at events@royalsociety.org
For scientific meetings queries:
scientificmeetings@royalsociety.org

THE ROYAL INSTITUTION

Details of all events and booking Information can be found at www.rigb.org/whats-on

ROYAL SOCIETY OF BIOLOGY

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ROYAL SOCIETY OF CHEMISTRY

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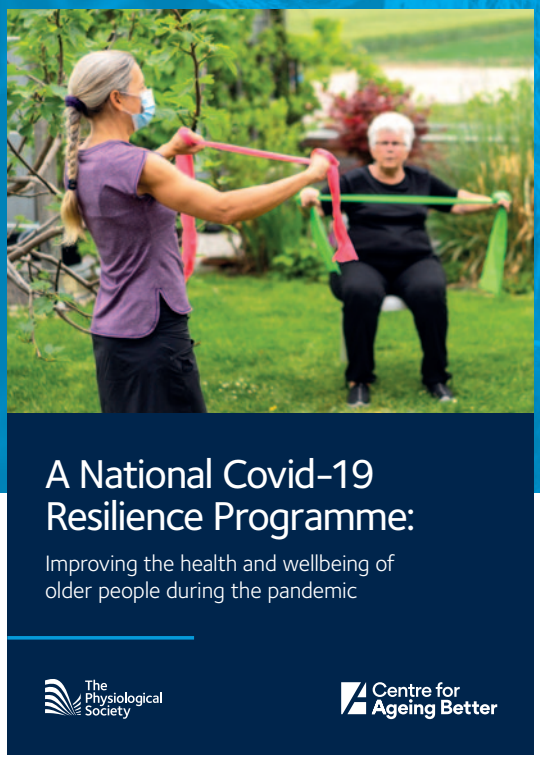
A National Covid-19 Resilience Programme

Improving the health and wellbeing of older people during the pandemic

Physical activity, with tailored exercise goals, is one of the most impactful ways in which older people can reduce the risk of developing severe Covid-19, improve recovery and keep healthy and resilient during winter's public health restrictions.



A National Covid-19 Resilience Programme should:

- Include a tailored exercise programme, focused on older people with key Covid-19 risk factors such as obesity, Type 2 diabetes and cardiovascular disease
- Include clear guidance about the importance of a healthy, balanced diet containing sufficient levels of protein and appropriate energy content
- Enhance mental health through the creation of virtual communities to counter social isolation
- Reinforce messages by relatives, friends, care workers and volunteers to successfully rebuild older people's confidence to stay active

Sign Early Day Motion 1144

Download the report at physoc.org/policy/covid19resilience

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