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

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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.

A professor 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 and his team were behind a lot of the breakthrough Ebola work and the FMDV and polio work. 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 tirelessly to understand, in particular, our antibody responses to SARS-CoV-2.”

Professor David Stuart’s group have studied the structure of the Ebola virus and the effect of two drugs, toremifene and ibuprofen 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.

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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; Teesside 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.

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

‘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.

‘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 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.

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.’

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

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.

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

Dr Marion Mafham – Clinical Research Fellow, Nuffield Department of Population and Health, University of Oxford.
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. Ritonavir (used to treat HIV) and lopinavir (used to treat malaria) and hydroxychloroquine (a treatment for malaria) were two promising treatments, the trial has also discovered that these treatments 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.

Fund 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.

References
2 https://www.recoverytrial.net
LOCAL INVESTMENT AND GLOBAL PERFORMANCE

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.

A recent study by consultants SQW for Research England 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: “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

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**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

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**Figure 2: Distribution of total R&D spend across regions of the US, EU, Germany, China and the UK**

Source: UCL analysis of several sources of data.

Notes:
- a. EU and Germany data: Eurostat. German data reflect 16 German Länder plus one Extra-Region (NUTS 1 region).
- b. USA data: National Science Foundation and STATSAERICA
- c. UK data: ONS
- d. China data: China National Bureau of Statistics

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**Table:**

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<thead>
<tr>
<th>Region type</th>
<th>R&amp;D spend of region as % of total spend across nation (or EU)</th>
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<tbody>
<tr>
<td>US states</td>
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<tr>
<td>EU member states</td>
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<tr>
<td>German Länder</td>
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<td>UK regions</td>
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<td>Chinese provinces</td>
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investment in R&D globally. Chinese investment in R&D is growing at over 10% per annum 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, 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 and the Royal Society have noted the challenge of creating new clusters of research excellence – as suggested by the 2070 Commission. 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.

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.

Data Sources


Figure 3: The World’s top ten countries by gross expenditure on R&D


GERD (billion PPP$), 2018 or latest year available

<table>
<thead>
<tr>
<th>Country</th>
<th>GERD (billion PPP$)</th>
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<tbody>
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<td>UNITED STATES</td>
<td>581.6</td>
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<td>CHINA</td>
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<td>JAPAN</td>
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<td>RUSSIAN FEDERATION</td>
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MANAGEMENT OF PRECURSOR STATE (NON-MALIGNANT) HOLDS PROMISE IN IMPROVING EARLY DIAGNOSIS RATES IN MYELOMA

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)
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 heterogeneous 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 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](image)

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

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 29% of those in work 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 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.
- Nearly one in five people 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.

**Impact on food insecurity**

- Large mental health differences across generations are emerging, with young people – especially women aged 19 to 30 – being shown consistently across UK longitudinal population studies, which can compare mental health prior to and during the pandemic.

**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...
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

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).  

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 animals². 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. Others have called for even more dramatic changes in global diets, with the Eat Lancet Commission perhaps producing some of the most radical proposals. 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 ‘Westernized’ diets spread, our current food systems on the health of both the planet and its population.

References
CONSIDERATIONS IN DIETARY PROTEIN RECOMMENDATIONS

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 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.

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). 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%.

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.

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. 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%.

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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. When evaluated against this age-adjusted protein recommendation, protein intake in older adults is suboptimal (Figure 1). This is concerning, as

![Figure 1. Protein intake and protein recommendations per age category (in years). White bars (means + SE) represent actual protein intake; data from Berryman et al. Blue bars represent the Recommended Daily Allowance (RDA) for protein as determined by the World Health Organization (WHO). 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.

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Dietary protein requirements are also dependent 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. 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 diets to populations such as older adults who are already at risk of protein inadequacy.

Physical activity is an important factor that improves the sensitivity to the anabolic effect of protein ingestion. 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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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

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 that privilege ‘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.

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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 for maintaining power and privilege. Imperial science has played a role in racialised constructions of power, and that data collected using categories such as ‘Black, Asian and Minority Ethnic (BAME)’ homogenise across different cultural backgrounds. 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, class, disability and/ or LGBTQI+. Specifically, we focus here on data released by the Engineering and Physical Sciences Research Council (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 three. Proposal writing generally takes six months, and equates to...
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. Likewise at the most senior decision-making levels, ‘ethnic minority’ scientists are severely under-represented. 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 or remaining precariously employed on short term contracts. 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, 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 barriers and carry out more equitable and inclusive research that benefits society.

**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 cause harm to minoritised communities. In the COVID-19 pandemic, minoritised communities, specifically, African, Caribbean, Bangladeshi and Pakistani people have died at a much higher rate than ‘white’ people, an issue which was addressed by UKRI in a specific call for overturn this trend, existing inequities often place the burden on resource-stretched community practitioners. An important step is acknowledging that systemic inequity and racism exist, to begin to redress the balance and reap societal benefits.

Increasing the diversity of the workforce is known to improve 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. 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. Crucially, whilst some collaborative initiatives seek to
outcomes in many sectors. 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. The study found that minority scientists are more innovative than their majority counterparts, but 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 ethnicity researchers are largely not judged by their Black and minority ethnicity 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, 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. This demonstrates the effectiveness of this type of approach, which unfortunately the government has recently banned research funders from following. 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” (in which all researchers receive at least some minimum financial support to explore their ideas) or full or hybrid 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

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. This difference is not replicated in findings from research in Africa and the Caribbean, 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.

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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, Emma 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.

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

Whilst the extent to which diagnostic rates reflect levels of morbidity versus psychiatric practice remains contested, 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. 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 and are less likely to receive GP support in accessing specialist mental healthcare. 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 has been admitted to psychiatric care under the Mental Health Act and are less likely to receive GP support in accessing specialist mental healthcare. 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 6, 7. Thus, ‘race’ and theories purporting racial hierarchies have informed explanations of different groups’ location in society. Exploring the 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, the biological basis of ‘race’ and the racial hierarchy resulted from structural inequalities accounted for White people’s ascendancy in a meritocratic system. Leading psychologists, including Professor Hans Eysenck of University College London, publicly endorsed the authors’ views that IQ tests measured true racial differences rather than structural inequalities accounted for White people’s ascendancy in a meritocratic system. Leading psychologists, including Professor Hans Eysenck of University College London, publicly endorsed the authors’ views that IQ tests measured true racial differences rather than structural inequalities accounted for White people’s ascendancy in a meritocratic system. Leading psychologists, including Professor Hans Eysenck of University College London, publicly endorsed the authors’ views that IQ tests measured true racial differences rather than structural inequalities accounted for White people’s ascendancy in a meritocratic system. 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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 comparable 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 cannot 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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Figure 2: IQ Scores and ‘the Bell Curve’
improvements. Findings from the Mental Health Act Review and the Five Year Forward View for Mental Health and the NHS Long Term Plan 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 serves to incentivise and amplify the voices of patients, carers, racialised communities and healthcare practitioners. As indicated by Li and colleagues, 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 published in what are considered high-ranking journals

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.

References


ETHNIC DIVERSITY IN SCIENCE
Why we need ethnic diversity in science

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 UK1. 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 collaborations4 or with ethnically mixed authors5 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”6. 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 profitable6. 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 products7. Ethnic diversity in stock pricing led to stocks being 58% more accurately priced when compared to pricing by ethnically homogenous teams8. Finally, ethnically diverse juries relied more on the evidence when making a decision9.

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 population10. 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 collaborations4. Increasing the diversity in UK science will only enhance this impact.

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>No. of applications</th>
<th>No. of applications awarded</th>
<th>Success rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>1,233</td>
<td>311</td>
<td>83%</td>
</tr>
<tr>
<td>Unknown</td>
<td>86</td>
<td>16</td>
<td>4%</td>
</tr>
<tr>
<td>Other a</td>
<td>218</td>
<td>46</td>
<td>12%</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>% of Applicants applying for EPSRC awards</th>
<th>% of EPSRC awards</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>72.1</td>
<td>80.7</td>
</tr>
<tr>
<td>Mixed</td>
<td>2.3</td>
<td>1.4</td>
</tr>
<tr>
<td>Asian</td>
<td>7.9</td>
<td>5.6</td>
</tr>
<tr>
<td>Black</td>
<td>1.7</td>
<td>0.4</td>
</tr>
<tr>
<td>Chinese</td>
<td>7.1</td>
<td>5.2</td>
</tr>
</tbody>
</table>

Table 2: Engineering and Physical Sciences Research Council (EPSRC) funding rates by ethnicity
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, well in excess of the proportion of ethnic minorities in the general population (13%). 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 and 18% of PhD

### Table 3: Key Stage 1 Achievements by ethnicity in England 2012 – 2019

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>89 ± 1.7</td>
<td>75 ± 1</td>
<td>91 ± 0.8</td>
<td>83 ± 0</td>
<td>92 ± 0.8</td>
<td>75 ± 1.5</td>
<td>86 ± 2.1</td>
<td>67 ± 2.1</td>
</tr>
<tr>
<td>Mixed</td>
<td>90 ± 1.4</td>
<td>77 ± 1</td>
<td>91 ± 0.8</td>
<td>84 ± 0.6</td>
<td>92 ± 0.8</td>
<td>76 ± 1.5</td>
<td>86 ± 1.7</td>
<td>70 ± 2</td>
</tr>
<tr>
<td>Asian</td>
<td>90 ± 1.4</td>
<td>77 ± 1</td>
<td>88 ± 1.7</td>
<td>81 ± 1</td>
<td>92 ± 1.3</td>
<td>77 ± 1.5</td>
<td>87 ± 2.2</td>
<td>72 ± 2.5</td>
</tr>
<tr>
<td>Black</td>
<td>89 ± 1.7</td>
<td>77 ± 0.6</td>
<td>88 ± 1.6</td>
<td>80 ± 0.6</td>
<td>90 ± 1.7</td>
<td>73 ± 1.5</td>
<td>86 ± 2.7</td>
<td>71 ± 1.6</td>
</tr>
<tr>
<td>Chinese</td>
<td>91 ± 1.2</td>
<td>83 ± 2.3</td>
<td>91 ± 0.5</td>
<td>88 ± 1.5</td>
<td>96 ± 0.5</td>
<td>90 ± 1.7</td>
<td>89 ± 1.7</td>
<td>81 ± 3.2</td>
</tr>
</tbody>
</table>

**b** assessments changed in 2016

### Table 4: Key Stage 2 Achievements by ethnicity in England

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>75 ± 5.1</td>
<td>61 ± 5.2</td>
</tr>
<tr>
<td>Mixed</td>
<td>76 ± 5.1</td>
<td>63 ± 4.8</td>
</tr>
<tr>
<td>Asian</td>
<td>76 ± 5.1</td>
<td>64 ± 6.4</td>
</tr>
<tr>
<td>Black</td>
<td>72 ± 6.4</td>
<td>60 ± 6.0</td>
</tr>
<tr>
<td>Chinese</td>
<td>85 ± 3.3</td>
<td>77 ± 4.5</td>
</tr>
</tbody>
</table>

**a** assessments changed in 2016

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

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>% Achieving at least 3 A grades at A level (2017 - 2018)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>11</td>
</tr>
<tr>
<td>Mixed</td>
<td>11.2</td>
</tr>
<tr>
<td>Asian</td>
<td>11</td>
</tr>
<tr>
<td>Black</td>
<td>5.5</td>
</tr>
<tr>
<td>Chinese</td>
<td>25.7</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>First class/second upper</th>
<th>White</th>
<th>Mixed</th>
<th>Asian</th>
<th>Black</th>
<th>Chinese</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>81.4</td>
<td>76.6</td>
<td>70.0</td>
<td>58.8</td>
<td>76.9</td>
</tr>
</tbody>
</table>
students were from ethnic minority backgrounds in 2018/2019\textsuperscript{17}. However only 9\% of recipients of UKRI studentships were ethnic minorities in 2018/2019\textsuperscript{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 exceed White award rates)\textsuperscript{19}. 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)\textsuperscript{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 panelists or crucially as panel chairs (Table 7), despite being well represented in the peer review college\textsuperscript{19}. Panel chairs serve an important role, especially when moderating panel discussions in order to arrive at a collective decision.

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\%\textsuperscript{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 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\textsuperscript{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

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**Table 7: EPSRC grant reviewers by ethnicity in 2018/2019**\textsuperscript{19}

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Reviewer pool – EPSRC peer review college</th>
<th>Reviewers submitting useable reviews</th>
<th>Grant prioritisation panel</th>
<th>Grant prioritisation panel chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>77</td>
<td>75</td>
<td>74</td>
<td>80</td>
</tr>
<tr>
<td>Black, Asian or minority ethnic</td>
<td>15</td>
<td>18</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Not disclosed</td>
<td>8</td>
<td>7</td>
<td>18</td>
<td>15</td>
</tr>
</tbody>
</table>

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**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.
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 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.

References

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

PHYSICAL ACTIVITY: MOVING TOWARDS RESILIENCE
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).

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.² 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 Society³ 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.

**Table:**

<table>
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<tr>
<th>Levels of physical activity by age group, England, 2018/19</th>
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<td>Active (≥180 mins or more per week)</td>
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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.

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

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 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...
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

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.

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
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.

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

• 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.

Drill rock core samples from United Downs

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

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 Wadoo 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...
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.

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
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
• 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: 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

• Technological Innovations and Climate Change: Offshore Wind – Opened 6 April 2020.
• Technological Innovations and Climate Change: Hydrogen – Opened 7 May 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

• 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.
• 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.

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

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Carol Monaghan MP, Scottish National Party
Graham Stringer MP, Labour
Zarah Sultana MP, Labour
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.

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

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

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- 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
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**Head of POST**

- Dr Grant Hill-Cawthorne: 020 7219 2952

**PARLIAMENTARY OFFICE OF SCIENCE AND TECHNOLOGY**

Houses of Parliament
Westminster, London SW1A 0AA
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 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.
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.

Website: www.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.

Website: www.ahrc.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.

Website: www.bbsrc.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.

Website: www.esrc.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.

Website: www.epsrc.ukri.org

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.

Website: www.innovate-uk.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.

Website: www.mrc.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.

Website: www.nerc.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.

Website: www.re.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.

Website: www.stfc.ukri.org
Contact: Audrey Yvernault
Head of Policy and Public Affairs
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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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AWE plays a crucial role in our nation’s defence by providing and maintaining warheads for the UK’s nuclear deterrent. It 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 biochemical 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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AIRT0, the Association of Innovation, Research and Technology Organisations, comprises approximately sixty principal organisations operating in the UK’s Innovation, Research and Technology (I RT) sector. The I RT sector has a combined turnover of £6.9 billion, employs over 57,000 people and contributes £38bn 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.

Contact: Tony Harding
07895 162 896 for all queries whether for membership or assistance.
Branch Office Address: Merchant Quay, Salford Quays, Salford M50 3SG.
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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www.bivda.co.uk

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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tgus@bsac.org.uk
www.bsac.org.uk

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 outstanding parental antimicrobial therapy (ORAT) 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.

Cavendish Laboratory
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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 worldwide collaborations with other universities and industry

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Website: www.ctpa.org.uk & www.thefactsabout.co.uk

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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Website: www.soils.org.uk

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 use 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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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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Website: www.cms.ac.uk

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.
The Institute of Materials Finishing

Contact: Dr Trevor Crichton, FIMF; MinstCorr; MRSC, CChem.
Email: exeterhouse@materialsfinishing.org
Tel: 0121 622 7387

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 (IMFinformation), as well as holding regular regional and international technical meetings, symposia and conferences.

Institute of Measurement and Control

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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. 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.

Institute of Marine Engineering, Science and Technology (IMarEST)

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Website: www.imarest.org

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.

IOP Institute of Physics

Contact: Patrick Cusworth
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Website: www.iop.org

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.

Institute of Food Science and Technology

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Website: www.ifst.org

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.

Institute of Chemical Engineers (IChemE)

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Web: www.theiet.org

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.

IPEM Institute of Physics and Engineering in Medicine

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Website: www.ipem.ac.uk

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.
We deliver our charitable objective by:

- Tackling global challenges across Agrifood, Energy, Environment, Health and Materials
- 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 Chemical Industry

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Website: www.soci.org

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

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Secretary General
Society of Cosmetic Scientists
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Website: www.scs.org.uk

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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 for Underwater Technology

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Lisa@SFAM.org.uk
+44 (0)207 685 2596

SFAM 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, SFAM publishes five internationally acclaimed journals.

Society of Maritime Industries

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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.
Contact: Chris Magee
Head of Policy and Media
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direct tel: 020 3875 1234
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http://www.understandinganimalresearch.org.uk/

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.

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E-mail: Andrew.muir@midven.co.uk
Website: https://ukinnovationscience
seefund.co.uk/

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.

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.

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Chief Executive and Scientific Director
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Email: ufaw@ufaw.org.uk
Website: www.ufaw.org.uk
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.

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direct tel: 020 3875 1234
e-mail: cmagee@UAR.ORG.UK
http://www.understandinganimalresearch.org.uk/

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.

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**SCIENCE DIARY**

**PARLIAMENTARY AND SCIENTIFIC COMMITTEE – ALL-PARTY PARLIAMENTARY GROUP**

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

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

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**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

**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

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**ROYAL SOCIETY**
Details of all events can be found on the events calendar at events@royalsociety.org

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**ROYAL SOCIETY FOR BIOLOGY**
For further details please contact Karen Patel or Dr Stephen Benn at events@rsb.org

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**ROYAL SOCIETY OF CHEMISTRY**
For further details please contact Events@rsc.org

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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.

Download the report at physoc.org/policy/covid19resilience