UK Science, Research and Technology Capability and Influence in Global Disease Outbreaks

For more information about the inquiry, please visit https://committees.parliament.uk/work/91/uk-science-research-and-technology-capability-and-influence-in-global-disease-outbreaks/

Executive summary:

In summary, physiology has made an important and positive contribution to many aspect of the covid-19 outbreak, including:

- Supporting frontline clinicians with their evolving understanding of the nature of the disease and best treatment protocols
- Assessing claims and correcting misunderstandings about the best way to treat the virus
- Identifying those at most risk
- Assisting in the development and assessment on new equipment for the treatment of patients with covid-19
- Helping determine policies for the return to work in specialist facilities as well as other more public areas.

About The Physiological Society:

The Physiological Society has a 140 year tradition at the forefront of life sciences. When physiologists collaborate around the world, their research contributes to a better understanding of the complex functions of living organisms. Expanding physiological knowledge helps us to understand how the body works. It also helps us to determine what goes wrong in disease, facilitating the discovery for new diagnostics, treatments and preventative measures. For example, the 2019 Nobel Prize in Physiology or Medicine was awarded to three researchers who discovered how cells sense and respond to changing oxygen levels by switching genes on and off. This discovery has been key in understanding human diseases such as cancer and anaemia because scientists are now able to target this 'switching on and off' mechanism to treat disease.

The Society's activities benefit the public in a variety of charitable ways. Our publications, meetings and educational resources directly benefit people actively involved in physiology such as researchers, teachers, and students. This investment then has a trickle-down effect by improving human health and broadening the public's understanding of how physiology relates to everyday life.

Consultation response:

1. The contribution of research and development in understanding, modelling and predicting the nature and spread of the virus;

Physiological research has been at the heart of the science community's response to COVID-19. The novel nature of COVID-19 has been one of the major challenges of finding vaccines or treatment that can mitigate the different ways that the virus affects the body. Physiology helps to not only better understand the virus but also how it impacts on the different systems of the body such as sensory loss as a symptom, through to 'insidious hypoxia' and 'COVID toe'.

In response to the COVID-19 crisis, The Physiological Society has mobilised physiologists around the world to provide operational support to frontline healthcare workers in the fight against COVID-19. In collaboration with

the Intensive Care Society, it has established a website called 'Questions from the Front Line' (https://www.physoc.org/covid19/questions/). This has allowed an expert advisory panel to offer the most up-to-date physiological insight to answer questions and observations posed by medics treating people who are currently infected with the COVID-19 virus, as well as offering links to the most relevant physiological research. The Society has also worked to explain and dispel rumours about how the public can respond to the coronavirus to protect their health from erroneous or unproven approaches (such as the use of ibruprofen and Vitamin C)

Advice sought from frontline healthcare professionals has been in areas such as shielding during pregnancy, gastrointestinal symptoms, intubation and hypoxaemia and co-morbidities such as diabetes. In addition, physiologists' advice has been sought for PPE research and development. As such, the advice has been applied and practical, not just mechanistic and theoretical. This support demonstrates the crucial role that physiology has in underpinning how healthcare professionals treat disease and support people to live better, for longer in both health and disease.

2. The capacity and capability of the UK research base in providing a response to the outbreak, in terms of:
    - advice to government, public bodies and others on managing the outbreak;

In our experience, there have been a number of ways in which learned societies such as The Physiological Society have been able to contribute advice to government and public bodies on managing the outbreak in collaboration with the rest of the UK R&D base's rapid response to present research information in an applicable and digestible way for medics. As a first step, The Physiological Society put together a section on our website called 'Questions from the frontline'. This was designed for healthcare professionals working on COVID-19 wards to be able to ask physiologists for advice on treating COVID-19 in the absence of any previous medical experience of this unique condition. Successes of this approach include mechanisms to understanding how vitamin D deficiency could greatly increase risk for COVID-19 severity and mortality and understanding why placing patients on their front improves oxygenation both for those able to breath unaided and those on ventilators.

In addition, The Physiological Society has also supported sector and industry wide efforts to respond to the UK Government's stated priorities around increasing the availability of ventilators, testing and staffing new diagnostic laboratories. Working as part of cross-disciplinary teams, a number of The Physiological Society's members have been involved with projects to increase the number of ventilators available including Federico Formenti's work as part of OxVent, a rapidly deployable ventilator for COVID-19 patients that build on existing readily available, off-the-shelf components that can be easily manufactured at scale once approved within 3 months[1]. Similarly, Mike Tipton and his team have been involved in an international project to 3D print facemasks and develop a new CPAP device for UCH Whittington hospitals These opportunities have been piecemeal however and it was left to trade associations such as the BIA, to promote these opportunities to hear directly from the Secretary of State for Health as to how the science community could best support the Government's ambitions and priorities.

Finally, more opportunity could be made available for the scientific community to feed research and experience into the Government's thinking on easing lockdown restrictions, particularly in specialist environments such as laboratories and universities. For example, The Physiological Society worked with one of its journal Editor's, Mike

[1] https://www.cbsnews.com/news/oxvent-ventilator-coronavirus-covid-19-death-rate/

Tipton from the University of Portsmouth, to organise a webinar to tease out concerns and challenges related to returning to human-based trials in laboratories while maintaining an evidence-based approach to minimising the risk of transmission of COVID-19. As a result of this, we were joined by over 650 scientists from over 30 countries. While the Government's initial approach of full lockdown to dramatically halt the initial spread of COVID-19 was entirely warranted, in the absence of treatment options or a vaccine, these measures to return scientists to work in close contact with human triallists will serve as vital demonstrations of the measures that are likely to be required at a general public health level.

- the development of testing, diagnostic methods and technologies;

Physiology and patho-physiology are at the heart of understanding and responding to the COVID-19 crisis. In clinical settings, physiologists are working alongside front-line staff to conduct and analyse tests to monitor and detect effects of the disease on cardio-respiratory function and support healthcare professionals in the delivery of respiratory support where there is clinical need.

For example, research teams at the University of Portsmouth are using their knowledge of thermal physiology to try and improve the non-invasive identification of those with infection. As the number of businesses such as offices, factories and the hospitality sector using non-invasive temperature checks to check an individual's COVID status prior to entry increases, there is concern that current temperature screening measures are insufficient[2].

- the development and testing of vaccines

Physiologists are working to understand the mechanisms of how COVID-19 enters, replicates and damages people with the virus. This understanding supports both the development of new treatments and can help better repurpose drugs already approved for use in humans, thereby cutting the length of time it takes for drugs to be available for use in COVID-19 patients.

- the development and testing of therapeutics;

Over a less immediate timeframe, patients that recover from severe symptoms of COVID-19 are likely to have some lung or heart impairment, muscle deconditioning and functional impairment and physiologists from a variety of its sub-disciplines will be involved in supporting the rehabilitation of people that have recovered from COVID-19 in a variety of the body's systems.

In addition, the development and testing of therapeutics will depend heavily on physiology to gain an understanding both of the mechanisms that treatments can target and the consequences of treatment on other body systems to prevent or minimise side effects.

3. The flexibility and agility of institutions, Government departments and public bodies, and processes to respond appropriately during the crisis including:
   - the availability and responsiveness of funding; and
   - the optimal functioning of regulatory and ethical processes;

[2] https://www.gov.uk/government/news/dont-rely-on-temperature-screening-products-for-detection-of-coronavirus-covid-19-says-mhra

    - the availability and influence of scientific advice in all Government departments and public bodies—including by departmental Chief Scientific Advisers; and
    - the extent to which decisions taken drew on that advice;
4. The capacity to manufacture and distribute testing, diagnostics, therapeutics and vaccines:
    - both standing capacity and capacity able to be mobilised;
5. The capturing during the crisis of data of the quantity and quality needed to inform:
    - decisions made during the crisis; and to maximise the learnings afterwards

While epidemiological data are important to recognise who is at highest risk and to reduce the risk of transmission when little is known about the disease beyond similarities with other coronaviruses, understanding the mechanisms of the virus and how it affects human physiology is crucial both for decision-making during the initial phases of the pandemic and to maximise learnings afterwards. For example, the Government's stockpiling of tests could have been undermined by an incomplete knowledge of the immunology of COVID-19 which has made the evaluation of serologic tests more difficult.

Similarly, COVID-19 has challenged healthcare professionals and academics because of the unique patterns of symptoms presented. Only through continued integrated thinking across specialties and disciplines and applying what we already know about systems physiology will we discover how to successfully treat COVID-19 in intensive care medicine. Examples of this include addressing so called 'insidious hypoxia' where COVID-19 patients are lucid, talking and not in distress, but have oxygen levels in the blood low enough of up to half the levels seen in health, enough to typically cause unconsciousness or even death.

6. The mechanisms for communication of scientific evidence internationally, within national governments and with the public:
    - including the handling of conflicting scientific opinions;

The global nature of the pandemic, combined with different country's timelines and heterogenous circumstances (such as urbanisation, average age of population, climate etc), has made clear communication of scientific evidence more important but harder to achieve. As an example of this, early treatment of those patients most affected by COVID-19 included early transfer onto mechanical ventilation as healthcare professionals treated it like Acute Respiratory Distress Syndrome (ARDS). However, physiological research has demonstrated that COVID-19 is similar but not identical to ARDS and therefore ventilation for those that are able to breathe independently can be damaging and lead to longer-term complications.

As an example of this, a lack of consensus among scientific opinion around whether there is any immunity to COVID-19 and for how long this immunity lasts, has led to often unevidenced discussions around 'immunity passports' and the risk of transmission posed by children and young adults. While this uncertainty and scientific agreement cannot be helped within the context of a new and emerging pandemic such as COVID-19, governments must act responsibly to ensure that the public are aware that the evidence is conflicting and unverified in order to prevent perceptions about immunity from impacting on other public health messaging around returning to work and the use of face masks etc.

7. The UK's readiness for future outbreaks, including a consideration of:
    - the National Risk Register;
    - the UK Pandemic Influenza Strategy; and
    - PHE's Global Health and Infectious Diseases Strategy

COVID-19 has made it clear that physiology is crucial in dealing with novel diseases. In order to be prepared for the future outbreaks we need to learn as much as we can about how this particular coronavirus is structured, replicates and affects the human body. It also shows the important of embedding physiological understanding

into clinical environments, so we need to ensure we have the capacity to connect physiologists, responsible for discovering more about the human body, and healthcare professionals, responsible for treating patients in the future, for the next outbreak.

Beyond the UK's strategic response to future outbreaks, the Government should also give considerable thought to the long-term physical and mental consequences of both the coronavirus and the UK's lockdown response and how it can better prepare the population to respond to future outbreaks and pandemics. Age remains the single best indicator of likely mortality from COVID-19. As the ONS notes; 'The age-specific mortality rate due to the coronavirus (COVID-19) increased significantly in each age group, starting from ages 35 to 39 years in males and ages 40 to 44 years in females.' Mortality in those aged 90+ is twenty-two times higher than the population as a whole[3]. Similarly, the most common pre-existing conditions recorded for those dying of COVID-19 were dementia, frailty, pneumonia, diabetes, hypertension, COPD and urinary tract system diseases, all diseases that are associated with age-related decline. As such, insuring that the whole of the UK is encouraged and empowered to take control of their health to improve their healthy life expectancy will not only help to fight further outbreaks of respiratory infections such as COVID-19, it will have the added benefit of furthering the Government's own Industrial Strategy 'Ageing Society' Grand Challenge.

[3] https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/deathsinvolvingcovid19englandandwales/deathsoccurringinapril2020