Written Evidence Submitted by the Royal Society

(C190110)

Key points

- The scale and nature of the current pandemic is unprecedented in modern times, and initially overwhelmed the UK Government's abilities to access and deploy the UK's operational science capabilities at sufficient scale and speed. The coordination systems needed were not initially in place, though such a crisis was predicted, and to some extent rehearsed. This lack of preparation is in part due to a level of unfounded complacency among those observing the developing outbreak early in 2020. This was perhaps built on the fact that the UK has not been majorly impacted by previous pandemics such as SARS. It is important that we learn from this experience to inform our preparedness in future.
- However, our rapid progress in understanding, modelling and predicting the nature and spread of the virus is the result of investment in research over many decades and the commitment of an army of scientists collaborating openly and widely across the globe.
- The rapid assembly of evidence has been hampered at all levels by data access and sharing. While there have been impressive new data systems established at pace, there have been major obstacles in terms of comprehensive and connected collection of data; data quality; the ability of researchers to access data from the public and private sectors, and sharing data across the health system. These need to be overcome in order to create resilience to future pandemics and to enable researchers to provide evidence and analysis at pace.
- Evidence-based decision making should be a cornerstone of government, especially in a pandemic for which science is of paramount importance to our response. However, we must recognise both the potential and the limits of science. In an emergency, data for decisions may be uncertain, incomplete, or even missing. Nevertheless, rapid decisions have to be made. Science advice is only one aspect of this. Ministers also need to consider economics, ways of implementation, and broad consequences to society, and they need to be able to take the public with them
- The current crisis has tested the UK public's trust in science and the science community needs to work hard to maintain the trust we enjoy. It is important that we retain our independence and our transparent and open approach to our work. Giving everybody the tools to critically engage with science, including promoting science education, will also support a healthy trust in science and engagement with its findings.
- A viral pandemic was the top risk on the UK's risk register and thus entirely predictable. Yet preparation was inadequate, and the response to it from both governments and the science community not as expeditious as it might have been. It would be extremely short-sighted for the government to tackle this crisis, then go back to business as usual. Building in resilience to this and other wholly predictable crises (such as climate change and losses and damage to the biosphere) is necessary for stable growth and long-term prosperity. This should include:
    - Considering the human reasons for lack of resilience (political short-termism, optimism bias, the perceived financial inefficiency of stockpiles, etc.,) and building in institutional mitigations to counter these (as has been done for example through mandating higher capital rations and central bank stress tests following the financial crisis). This is particularly important for the slow motion cognitively challenging crises of climate change and biodiversity loss.
    - making appropriate preparations for risks on the National Risk Register such as investing greater resources into pandemic preparedness and stockpiles, as informed by scientific advice
    - Recognising that the crucial role that science has played in this crisis, (for example rapid sharing of the viral genome sequence, rapid test development, rapid identification of risk factors, extraordinary efforts on development of treatments and vaccination trials etc.) rests on many decades of public investments in R&D, and widespread international collaboration across public and private sectors. Mitigation of future crises depends on science and innovation, which are also central to economic recovery.
    - In addition to any changes in internal Government advisory bodies that should be made in the light of our recent experiences, consideration should be given to the establishment of mechanisms by which Governments can, in the future, access the best

scientific experts in the UK who are working at the coal face of any national crisis and who are well placed to provide invaluable scientific advice. The academies have played a key role in augmenting Government's abilities to access and utilise large numbers of diverse scientists, economists, and engineers from both public and private sectors to help manage the crisis. This has been an unplanned reactive effort. It is worth considering whether such resources could be more optimally deployed going forward through formalising such reactions to future crises.

- The crisis is by no means over. Even in the best case of rapid and successful vaccine development, it will be many months before successful population level application is sufficient to obviate the need for other measures. These include developing novel drugs to treat the disease, or in the worst case maintaining current levels of non-pharmaceutical interventions. In the meantime, the UK government will need to carefully adapt national and local level interventions in order to optimise economic activity whilst minimising risks and handling new challenges – such as flu – as we head into winter. The messaging and communications needed to maintain public trust and compliance will need to be carefully planned and managed.

Background: The Royal Society

1. The Society is the National Academy of Science for the UK and the Commonwealth. It is a self-governing Fellowship of many of the world's most distinguished scientists working across a broad range of disciplines in academia and industry. The Society draws on the expertise of its Fellows and Foreign Members to provide independent and authoritative scientific advice to UK, European and international decision makers. Our strategic priorities are to promote excellence in science; to support international collaboration; and to demonstrate the importance of science to everyone.

2. This submission first summarises the Royal Society's work on COVID-19 before going on to address the Committee's specific questions where relevant to the Society's areas of expertise.

Royal Society work on COVID-19

3. Researchers around the world, including Fellows of the Royal Society, have carried out work in the area of global disease outbreaks for many years, and expert Fellows and researchers funded by the Society are contributing to the UK and global effort to tackle Coronavirus COVID-19 through their own cutting edge research. In addition, the Society is leading and convening three complementary activities to inform policy decisions on managing the pandemic, specifically DELVE, RAMP and SET-C.

4. The Royal Society has convened - DELVE (Data Evaluation and Learning for Viral Epidemics), a multidisciplinary group of experts to support a data-driven approach to managing the pandemic. The DELVE initiative has led to the production of expert reports on issues including the use of masks, of nosocomial transmission of the virus (transmission in hospital and care settings) and the risks of reopening of schools. These reports have been shared with SAGE, on which the President of the Royal Society sits as a representative of DELVE, and across government.

5. The Society worked to rapidly convene a large-scale volunteer effort to support modelling activities in response to the pandemic – RAMP (Rapid Assistance in Modelling the Pandemic). Through RAMP, people with modelling skills have been seconded into SPI-M teams to increase their capacity; a Rapid Review Group has been established to provide expert assessment of new modelling research within 24-48 hours to inform SPI-M and teams within government; and new project teams have been established researching issues such as behaviour in small spaces and urban analytics, which will have value beyond the current phase of the pandemic.

6. The Society has also established Science in Emergencies Tasking – COVID (SET-C) to provide rapid synthesis of evidence for government. SET-C comprises world leading experts including in immunology, virology, epidemiology, public health and behavioural science. It has reported to Government, including SAGE, on the immune response, immunity to Covid-19 and its relationship

to vaccination, Vitamin D, on Covid and blood groups, on masks/ face coverings, on the R number and on genomics of Covid-19.

7. As well as DELVE, RAMP and SET-C producing advice and reports to Government on many topics, the Society has also mobilised the science community for exercises such as Red Teaming, sourcing individual experts for SAGE meetings, and additional modellers to add capacity to the Government's teams. All outputs are published on a globally accessible 'github' site, alongside a DELVE developed dataset that consolidates country-level COVID-19 data from 170 countries. RAMP also hosts 300 expert modelling contributors on a web-forum, policy ideas are escalated to an Oxford maths hosted Rapid Review group of 100 expert reviewers for evaluation, and multiple Universities have research teams contributing to RAMP's epidemic modelling work. Those leading the work are also submitting research proposals to develop areas that are promising but not yet ready for operational deployment.

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

8. There are two parts to the role of science in policy advice. First there is the development of the scientific knowledge that reduces uncertainty as our understanding increases, see 9 to 11 below. Second is the effectiveness of the mechanisms by which advice from those most expert in the topic is transmitted to policy makers, see 12 and 13 below.

9. It is very important to recognise that the scientific understanding around a new topic like Covid-19 is initially very limited. Scientific research works by studying the problem and learning about it thus reducing uncertainty. At any given time, scientific knowledge is incomplete but is the best we have and will help to make better policy decisions than intuition or guesswork, but it cannot provide certainty in guiding policy. It can however provide increasing certainty as more research is carried out. Our rapid progress in understanding, modelling and predicting the nature and spread of the virus is the result of investment in research over many decades and the commitment of an army of scientists across the globe. The activities outlined above that are being led and convened by the Society draw on this existing expertise to provide timely advice to policymakers.

10. For example, rapid research led to the discovery of asymptomatic transmission and the extensive prevalence of asymptomatic transmission, which in turn led to an understanding of the need to put in place a high level of testing. Also, the nature of the immune response and the importance of the inflammatory response in treating Covid-19.

11. However, despite the increasing recognition of asymptomatic transmission, the implications took time to impact on the approach to testing and tracing, yet the implications are profound. There is limited merit in a TTI system that relies on symptoms to trigger TTI when there is significant asymptomatic transmission. Similarly taking temperature to determine if someone is infectious has little value, yet we still see this being used as a means of controlling the spread of the disease in some quarters.

12. Regarding the effectiveness of the mechanisms for accessing scientific advice and transmitting it to policy makers. The scale and nature of this crisis is unprecedented, and initially overwhelmed the Government's abilities to access and deploy the UK's operational science capabilities at sufficient scale and speed. For example, the UK government's Scientific Advisory Group for Emergencies (SAGE) is designed to provide scientific and technical advice to support government decision makers during emergencies - its focus is on providing timely and coordinated scientific advice to decision makers to support UK cross-government decisions. As such, it is not necessarily ideal for responding to a long-term problem – as the coronavirus emergency has now become. For this, a standing group with a specific mix of expertise chosen in light of the nature of the ongoing problem may be more appropriate.

13. It will be important to establish mechanisms now by which Government can access rapidly the best scientific advice from the wider research community when future crises occur. The National Academies are well placed to help in his endeavour as they contain many of the experts needed and have a network into others.

The capacity and capability of the UK research base in providing a response to the outbreak

14. Science has played a crucial role in this crisis, (for example rapid sharing of the viral genome sequence, rapid test development, rapid identification of risk factors, extraordinary efforts on

development of treatments and vaccination trials etc.). Its ability to do this rests on many decades of public investments in R&D, and widespread international collaboration across public and private sectors.

15. However there are areas where greater investment into UK resilience would have ensured that the UK research base could provide a more rapid and comprehensive response. For example the UK did not have sufficient testing capacity, nor the ability to scale up testing or any other kind of diagnostics quickly, as may be required when new viruses emerge.

16. Fellows of the National Academies have been involved in many strands of work, including research on the biology of the virus and therapies to combat it; longer term goals such as the development of vaccines; and reviewing evidence to inform policy making. Tackling such pandemics will require both basic and clinical research at every stage, and the scientific community is doing all it can to help fight this terrible disease and reduce its toll.

17. As outlined in section 2, the Royal Society and partners in other National Academies have supported the response to the outbreak by using our convening power to bring together several multi-disciplinary groups working on rapid synthesis of evidence, modelling and data analytics for government. This has played a key role in quickly reacting to multiply the UK government's abilities to rapidly access and utilise large numbers of diverse scientists, economists, and engineers from both public and private sectors to help manage the crisis. This was an unplanned and somewhat delayed reactive effort. It is worth considering whether such resources could be deployed in a more optimal and timely manner going forward through formalising such reactions to future crises. The Comprehensive Spending Review provides an opportunity to address this.

The flexibility and agility of institutions, Government departments and public bodies, and processes to respond appropriately during the crisis

18. There have been a number of examples of institutions showing flexibility and agility. While access to data has been a challenge, there have been rapid efforts to put new systems and institutions in place, with the leadership of the Office for National Statistics and Health Data Research UK. There is great potential benefit in enabling these new systems to be in place and develop beyond the pandemic.

19. UKRI has acted swiftly to put in place new funding programmes to support new research in response to COVID.

20. Once the scale of the pandemic was grasped, the Royal Society as an organisation has been able to respond. This is not only through the COVID-response initiatives outlined above but also by establishing rapid peer review for research relating to the pandemic published in Society journals and by making this research open.The major area where the UK's overall maturity is low, and which has significantly hindered flexibility and agility, is on data access and sharing in both public and private sectors. It has not been uncommon for the Society to have received promising assurances of data at a senior level, most of which have never materialised. Problems occur at every level, from data collection, curation, storage in accessible sharable formats, incentives for sharing, and a lack of competence in well-established ways of handling and sharing data that are compliant with regulations and address privacy concerns. This has been the case across public and private sectors. Much of this could be addressed by a major push on competence, governance and incentives across the health system. There is much data in the private sector that could be of enormous benefit – such as real time locational and transactional data from telecoms and banking sectors that could give a granular picture of how the economy and movements of people are actually taking place. This would greatly improve the sophistication and sensitivity of available policies. The question arises – what would it take to actually mobilise this data, for public benefit during a national crisis?

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

21. There have been significant limitations in data systems, as highlighted by Sir Patrick Vallance in his evidence to the Committee. While there have been efforts to rapidly scale-up data collection across the NHS, there are gaps in the data system that have caused delay in data-led responses. All three of the RS Covid activities, DELVE, RAMP and SET-C have been limited by the lack of data and have highlighted the severe problems of data deficiency.

22. For example, the DELVE report on *Hospital and Health Care Acquisition of COVID-19 and its Control* concluded that systematic data collection over the course of the epidemic thus far has been insufficient to identify the extent, sources and risks for hospital acquired transmission and to allow effective targeted outbreak response and infection control. Substantial recent investments have, however, been made to improve surveillance and control, but comprehensive, accessible national data are currently limited. For example, the absolute number of healthcare workers affected is unknown, as is the time and place of acquisition of infection. This lack of information is of particular importance in the case of Black, Asian and minority ethnic (BAME) healthcare workers amid widespread concerns that their mortality from COVID-19 exceeds their representation in the work force. Similarly, there has been only limited exploration of the extent to which hospital acquired transmission amplifies wider community spread, including to and from institutional settings such as care homes, especially when there was a lack of testing capacity within the NHS and social care.

23. DELVE work on *Test, Trace, Isolate (TTI)* also pointed out the need for shared data standards to connect data. Existing data collection efforts - including those from TTI, from other ad-hoc systems (e.g., self-reported symptoms or calls to health actors) and from systematic population-based testing work such as the ONS COVID-19 Infection survey – need to be coordinated to ensure standardized data collection that will allow triangulation of information and localization of responses. This requires increased granularity of data in terms of person, time and place for new transmission chains, outbreaks and each individual case and contact.

24. RAMP as a modelling activity is, like DELVE, limited by the inadequacy of the data. For example, the work on transmission in small spaces, on co-morbidities and transmission on surfaces have and continue to be constrained by lack of data.

25. Access to data is important more broadly to ensure that there is diversity in the sources of data-led science that have informed the response to the pandemic.

26. There was a difficulty in modelling in the early stages of a completely new virus. While the parameters are uncertain - such as the incubation period and the rapidity of transmission - relying on estimations for any sort of prediction or policy at an early stage, such as when deciding when or whether or not to go into lockdown, is an issue.

27. However a lot of information has been learned in a very short amount of time, given that this was a new virus about which we knew nothing just a few short months ago. In record time, SARS-Cov-2, the specific coronavirus that caused COVID-19, was identified and sequenced, paving the way for a sensitive test for infections. It is now possible to identify who has been infected as well as begin to understand the biology of the virus, its infectivity and routes for development for vaccines and therapeutics. This rapid progress is the result of investment over many decades and the commitment of an army of scientists across the globe.

28. But for many other aspects of the virus, it will take time to establish the facts, such as how many people have been infected, whether one becomes immune once infected, and if so, for how long. Other important questions exist around why different groups of people are affected in different ways. Much of this reflects the uncertainty inherent at the frontiers of all science.

29. It is always right to take an evidence-based approach whenever possible, but given the uncertainties and the realities in this fast-moving pandemic scenario, there will inevitably be mistakes. Science can only be informed by the data available at the time, and new data may later reveal that earlier advice contributed to policy that was sub-optimal, or indeed that previous advice was incorrect. The best and only option at any time is to make the best decision possible on the best information available, which will always be imperfect. It is always a possibility that new data will change and improve this, and that is the nature of science.

The mechanisms for communication of scientific evidence internationally, within national governments and with the public

30. Evidence-based decision making should be a cornerstone of government, especially in a pandemic for which science is of paramount importance to our response. However, we must recognise both the potential and the limits of science. In an emergency, data for decisions may be uncertain, incomplete, or even missing. Nevertheless, rapid decisions have to be made. Science advice is only one aspect of this. Ministers also need to consider economics, ways of implementation, and broad consequences to society, and they need to be able to take the public with them.

31. Public communications must be clear, consistent and transparent without inconsistent, premature, alarmist information or simultaneously raising scepticism without good reason, all of which lower compliance.

32. The public can feel misled if ministers use “the science” as a prop to create a false sense of security and certainty only to change tack later. It can lead to an erosion of public trust precisely at a time when long-term trust is needed to allow the hard choices ahead. Ultimately, as has been pointed out, advisers advise, ministers decide. In these decisions, science advice is often only one of the things they need to consider. Considering science advice is not the same as simply “following the science.”

33. Moreover, there is often no such thing as following “the” science. Reasonable scientists can disagree on important points, and the science can only go on the data that we have at the time, but the government still has to make decisions.

34. **Example: Face Masks** The gold standard of scientific evidence is the Randomised Control Trial (RCT) – where different groups of similar people are treated differently and the end result is measured. There is hardly any useful RCT evidence on whether face masks are effective in reducing the spread of this or the influenza virus.

35. However, many practices that we now consider essential for good hygiene, such as washing hands to reduce viral transmissions, or the wearing of masks by surgeons, were not based on RCT evidence. Rather they were based on our understanding of how infections spread. In the case of COVID-19, we know that you can be infectious even when you do not have any symptoms. We know that coughing, sneezing, and even talking or breathing release droplets from the mouth that are a key means by which the virus spreads. We also know that cloth-based face masks reduce the spread of those droplets.

36. So given the stakes, even in the absence of RCT evidence, it was this understanding of modes of transmission and the need for precautionary common sense that convinced over 50 governments, including the UK, to make the use of face masks mandatory in situations where physical distancing is not possible or predictable such as busy public transport, shopping and other potentially crowded public or workspaces.

37. Clear communication is vital to ensure the successful uptake of this intervention, with consistent and effective public messaging, which acknowledges that interventions are interrelated. In the case of face coverings to make clear that it is an additional measure for those settings when physical distancing is not possible, and not a substitute for hand hygiene, sanitizers, and physical distancing whenever possible. The messaging needs to make clear that no measure is sufficient by itself, but together a series of measures can have a significant effect.

38. **Case study: Successes overseas**. In countries that have done well, there has been a much greater reliance on local authorities and local agencies for identifying cases through testing or otherwise and following up on them, and then feeding the information back to a more central authority so that a more regional picture can be obtained. India has been highly diverse in its response to the pandemic, for example the state of Kerala in south-west India, a region with one-tenth of the per capita GDP of that in Britain, has done extraordinarily well by issuing strong directives from the state but then devolving all the actions to local authorities[1]. This combination is very useful.

Public trust in Science

39. The current crisis has tested public in trust in science internationally, including in the UK. Science and scientists have been under the spotlight and at the heart of political decision-taking like never before.

40. The science community needs to work hard to maintain the trust we enjoy. It is important that we retain our independence and our transparent and open approach to our work. Giving everybody the tools to critically engage with science, including promoting science education, will also support a healthy trust in science and engagement with its findings.

41. Policy makers should encourage and scientists should commit to[2]:

[1] https://www.who.int/india/news/feature-stories/detail/responding-to-covid-19---learnings-from-kerala [accessed 17 August 2020]

- Promote science education and an understanding of how research is conducted from elementary school onwards, to ensure that all students, both girls and boys, acquire a sufficient background to understand the world around them and the benefits of science.
- Cultivate dialogue, mutual trust and confidence between public, politicians and scientists to ensure that scientific input is considered in decision-making especially on topics of high scientific content.
- Ensure that the fundamental principles of ethics, integrity and responsibility are a major component of science education, to increase awareness of scientific responsibility and of the structures and policies that support it […] Breaches of ethics and research integrity should be treated with full transparency and rigor to ensure that the misconduct of a few does not discredit the whole scientific endeavour.

Communicating scientific evidence internationally

42. It is important to consider and manage perceptions of blame when ensuring the smooth communication of scientific advice and collaboration with other countries. If countries fear that they will be blamed if a pandemic starts in their region, they may be more circumspect in what they share. We need to ensure that countries or regions are not blamed because something emerged in their locality. Rather, we should look objectively at the conditions that cause these things to emerge

43. Governments should work internationally through a strengthened WHO to ensure that individual countries are not blamed for the origins of pandemics, which could in turn hamper collaboration and data sharing.

The UK's readiness for future outbreaks

No 'business as usual'

44. Science advice should not be heeded only during emergencies. For many years, a pandemic has been the biggest risk on the National Risk Register, and the UK Government even tested its own pandemic reactions in operation Cygnus in 2016. The perceived lack of planning and preparation for what was an important known risk has been criticised.

45. Those countries that had first-hand experience of SARS and MERS were also some of the best prepared for COVID-19. The UK has tended to be much less prepared because its economic system usually rewards efficiency - which often comes without building in spare capacity into our health system. Not spending on resilience to predictable crises is a false economy.

46. The current Covid-19 pandemic has had terrible effects and we cannot yet foresee how it will end. It is completely predictable that an even worse virus will emerge someday, and this has the potential to be exacerbated by the impact of ongoing mega-crises of climate change and biodiversity loss, which unmitigated, will be catastrophic for the future of humanity.

47. It would be extremely short-sighted for the government to tackle this crisis, then go back to business as usual. So instead of prioritising immediate economic efficiency and agility above all others, we must seriously look at how to develop resilience towards known major risks by analysing what mistakes were made this time and finding ways to compensate. Given the shocks to the economy from the 2008 financial crisis and the current pandemic, we can see that it is not a choice between having an efficient flourishing economy and spending on resilience. Instead, the

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[2] Summit of the G7 Science Academies (2019) *Science and Trust* https://royalsociety.org/-/media/about-us/international/g-science-statements/2019-g7-declaration-science-and-trust.pdf?la=en-GB&hash=32D575A44FA381AB16B9ADF762FA99FB [accessed 17 August 2020]

Government should recognise that building in resilience is necessary for stable growth and long-term prosperity.

48. Preparing much better for things we know are going to happen would be one way to respect the sacrifice, loss, heroism, and hard work of so many in the current crisis.

Ongoing investment in research and innovation will be central to ensuring future resilience to new challenges

49. As noted previously, the ability of science to play a crucial role in this crisis rests on decades of public investments in R&D, and widespread international collaboration across public and private sectors.

50. The effects of the COVID-19 pandemic on our economy, health and social wellbeing have been profound. The crisis has created new challenges, as well as exposed and exacerbated existing vulnerabilities. In the short term, there are specific areas of research and innovation that this crisis highlights should receive investment to build resilience, including development of diagnostics, therapeutics and work to identify drug targets. But we must also take the opportunity now to think more broadly; a successful research and innovation system as a whole is vital to our immediate recovery and to realising a prosperous, resilient and sustainable society.

51. This requires people and infrastructure supported by meaningful investment to pursue applied and discovery-led research, creating new knowledge, innovations and jobs, protecting our international position and ability to respond effectively to global challenges.

52. Research and development therefore must remain a priority for government investment, to equip our economy and society for a strong recovery. The increase in public investment in R&D to £22billion per year by 2024/25 announced in the March 2020 budget is very welcome. However it is important to note that this would represent 0.8% of GDP in current figures. To reach the government target for 2.4% of GDP to be invested into UK R&D by 2027, the UK will need to attract greater investment from other sources. The publication of the UK Research and Development (R&D) Roadmap is a positive statement of intent. The Roadmap contains a useful analysis of the current research and innovation landscape and provides a coherent framing for the UK government's research and innovation policy. As it acknowledges, it is 'the start of the conversation.' Further work is required to identify the solutions to the challenges that the Roadmap describes. Specifically, it is important to note that private sector spending makes up the majority investment in R&D in the UK and so greater consideration of how best to support businesses, including those headquartered outside the UK, is necessary.

53. Longer term, a strategy is needed to ensure additional investment is allocated in ways which support green economic growth and skilled jobs across the nation and allow the UK to remain at the cutting edge of innovation as we 'build back better'.

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