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UK COVID-19 INQUIRY

WITNESS STATEMENT OF

SIR PATRICK VALLANCE

Opening remarks

1. The Covid-19 pandemic caused immeasurable grief, suffering and loss in the UK and around the world and I welcome the chance to contribute to the Inquiry to help ensure that we learn the lessons for the future. It is important to recognise that the burden of the pandemic did not fall equally. Some groups were more affected than others, and inequality was a major determinant of outcome. I should like to express my gratitude for the remarkable contributions made by healthcare professionals throughout the pandemic, and the dedicated expert work of thousands of scientists from many different disciplines who helped the domestic and global response to a new infectious agent. Building on their work will be important to prepare for future threats. Unfortunately the nature of pandemics means that the next one will likely be different from the last one and so preparation needs to be broad enough to cope with many different possible threats whilst the response itself needs to be specific to the new threat.

Introduction

2. The role of the Government Chief Scientific Adviser (GCSA) is to provide scientific advice to the Prime Minister and Cabinet. It is a civil service role that reports directly to the Cabinet Secretary and is described in more detail below. Following an open competition and public appointments process I was appointed as GCSA and started on 4 April 2018. My last day in the post was 31 March 2023.

3. I trained as a medical doctor and qualified with distinction from St George's Hospital Medical School in the University of London in 1984. I practiced as a general physician in the NHS in various hospitals in London and undertook research in cardiovascular disease, first at St George's and later at University College London (UCL). I was appointed Senior Lecturer in Clinical Pharmacology and Consultant Physician in 1990 and became Professor of Clinical Pharmacology and Medicine at UCL in 1995. I led the Division of Medicine at UCL from 2002 until 2006. During my time at UCL I was a consultant physician at UCL Hospitals. From 2006 until 2018 I worked for GlaxoSmithKline (GSK), initially as global head of drug discovery and from 2012 as global head of research and development. My personal research covered a range of topics including work on blood vessels, cell signalling, infections, inflammation and asthma. It spanned from laboratory studies in biology and chemistry through to clinical trials and the use of large electronic clinical databases. At GSK I oversaw the discovery and development of many medicines including antibiotics, anti-HIV drugs, cancer

treatments and drugs for asthma. I am an elected Fellow of the Royal College of Physicians, the Academy of Medical Sciences and the Royal Society and an Honorary Fellow of the Royal Academy of Engineering.

4. This statement is in response to the Inquiry's Rule 9 request of 8 February 2023. Much of the context and background relevant to the issues addressed in this statement are set out in the witness statements of Dr Stuart Wainwright OBE, Director of the Government Office for Science (GO Science), and his third and fourth witness statements in particular. To avoid lengthening this statement by repetition of evidence the Inquiry has already received I have referred to and adopted the relevant sections of Dr Wainwright's evidence where they relate to the matters I have been asked to address. I would also refer the Inquiry to the Technical Report on the Covid-19 Pandemic in the UK produced together with the Chief Medical Officers (CMOs) and published on 1 December 2022.

The role of the Government's Chief Scientific Adviser (GCSA)

5. I have read that part of the third witness statement of Dr Wainwright [PV/1 - INQ000148407 – paragraph 14], which provides an overview of the role of the GCSA. I agree with his description of the role, which is as follows:

> "The GCSA is responsible for providing scientific advice to the Prime Minister and members of the Cabinet, advising the Government on aspects of science for policy and improving the quality and use of scientific evidence and advice in Government. The GCSA is a permanent secretary level post and reports to the Cabinet Secretary. The GCSA is supported by GO Science, an office of [the Department for Business, Energy and Industrial Strategy (BEIS)]. The GCSA is the head of the [Government Science and Engineering (GSE)] profession and co-chair of the Council for Science and Technology (CST), an independent expert committee which provides advice to the Prime Minister."

With the dissolution of BEIS and the formation of the Department of Innovation, Science and Technology (DSIT) earlier this year GO Science is now an office of DSIT.

6. The role of the GCSA is to bring science, engineering and technology know-how into policy. It is primarily about providing science advice to policy makers, rather than advising on science policy itself.

7. One of my aims as GCSA has been to embed science into and throughout government. Prior to my appointment I spoke with a former Cabinet Secretary who gave his view on how the role of economists and economic expertise within government had changed over time, moving from a situation in which economists were lone and sometimes peripheral figures within departments to one in which economic advice permeates all aspects of policy making. In his view, science advice within government needed to make the same transition. Whilst there were very good science advisers who would respond to questions asked of them or would work on matters within their personal knowledge or interest, there was insufficient systemisation to the process. I saw an opportunity to develop science advice so that it informed decisions and policy throughout government.

8. I had spent much of my life working in biomedical fields and on assuming the role of GCSA I was keen to broaden into other important areas of science for government including for example, climate science, data science and technologies, engineering, social and behavioural science, and the interface with policy development.

Departmental Chief Scientific Advisers

9. Soon after starting as GCSA, I set out to improve the system across government by which relevant scientific advice from appropriately qualified people could be quickly and effectively accessed as and when it was needed.

10. Central to this objective were the departmental Chief Scientific Advisers (CSAs). The role of the CSAs is set out in Dr Wainwright's third statement [PV/1 - INQ000148407 – paragraphs 23-32], and I agree with that description. In short, the CSAs are employed and line managed by the government department or agency in which they work, usually at Director General or Director level. Their role is to provide scientific evidence and advice to inform decision making within their departments and across government. They also help provide a bridge to the wider academic and scientific community, including through departmental Scientific Advisory Councils. CSAs also collate their departments' key research interests through Areas of Research Interest (ARI) documents. There is now a CSA representative on each of the UK Research and Innovation (UKRI) research council boards, to provide a link between government science and research funding approaches.

11. Most CSAs are not career civil servants. They are usually recruited from academia, industry or other scientific or engineering posts for a fixed period. Often they will continue to retain an academic position while CSAs, for example spending a day per week at their home institution. This enhances their ability to bring an external perspective, and where necessary independent challenge, to their work within the department and government. The former Cabinet Secretary, Sir Mark Sedwill, once described the role of a CSA as being "licensed dissidents" within the civil service.

12. I have encouraged all departments to appoint a CSA and I provide support for those that are in post. The CSAs, including those from the Devolved Administrations, come together regularly through the CSA network. As described in Dr Wainwright's third statement [PV/1 - INQ000148407 – paragraphs 33-35] the network usually meets on a weekly basis. CSAs discuss their own work and priorities or we discuss cross-governmental issues, including for example the methodology of the National Security Risk Assessment (NSRA), as described further below. External speakers from academia or industry are invited to present their latest work; for example, we recently had presentations on topics ranging from European science funding through to generative artificial intelligence and large language models. The chair of the meeting rotates on a weekly basis. The network has become a highly collegiate environment and is an effective forum for discussion and sharing of best practice. It is a good example of an effective cross-governmental network and it has regular requests from policy groups to present at the meetings.

The Science Capability Review

13. Shortly after my appointment, I worked closely with the then Cabinet Secretary Sir Jeremy Heywood, to identify opportunities to strengthen science within government. Work commenced in 2018 on what would become the Science Capability Review, carried out jointly by GO Science and HM Treasury. Some parts of the work built on existing systems while other elements had not been looked at for some time. For example, the capabilities of public sector research establishments (PSREs) had not been assessed across the whole of government for many years.

14. The Science Capability Review was published on 5 November 2019 and was titled "Realising our Ambition Through Science" [PV/2 - INQ000061614]. It made 15 recommendations, under three broad themes – (i) strengthen science structures and

funding within departments, (ii) improve the use and capability of the PSREs, (iii) work better with industry and academia. The work done through and as a result of the review helped during the response to the pandemic in a number of ways. The departmental science systems and CSA teams were improved and enabled, with the review becoming a handbook for departmental CSAs to strengthen the science mechanisms within their own departments. This proved important during Covid as it helped to bring expert SAGE advice into departments to inform policy and operational responses, for example on risk reduction in school buildings or managing the prison population. The better linked PSREs were important to help with Covid testing and provided direct surge support to GO Science. The business focus and the recommendations in Annex D of the Science Capability Review on "how to run a mission" informed the model for the establishment of the Vaccine Taskforce. A further important part of the review, and my wider work as GCSA, has been to increase diversity in those appointed as CSAs. An evaluation of progress against the recommendations will shortly be completed.

15. The current picture for science embedded in government now looks different to that which led me to undertake the Science Capability Review. That is not to say there is not still a lot to be done, but considerable progress has been made. For example, the 2018 analysis of Fast Stream entrants – graduate recruits entering the civil service leadership development programme – showed that only 10% had degrees in a STEM (science, technology, engineering, and mathematics) subject; the agreed target is now 50%. Departmental science budgets have increased, CSAs have structures within their departments to support their activities, and there is a broader range of scientific, engineering and social science expertise amongst the CSAs.

16. Whilst the Covid-19 response has enhanced interest in and pull for science in government, change was already evident before the pandemic. The Cabinet Secretary, Prime Minister, and his special advisers were supportive of efforts to strengthen science and science advice across government. Support from No.10 is important for a GCSA as it enables cross-government working.

The Breadth of the Role of GCSA

17. Beyond the structural issue of embedding science advice across government, my role as GCSA has touched upon a very wide range of policy areas. On my appointment, I

expected three of my principal areas of work to be climate science, national security and resilience, and the challenges of taking discovery science through into innovation and industrialisation. The latter reflected a concern that the historic strength of the UK in fundamental scientific research was not matched by utilising that work in industry and the wider economy. These areas were and remain important but there are many other matters on which I have been asked to comment and advise.

18. The breadth of the role of the GCSA is illustrated by the topics that were raised with me by the House of Commons Science and Technology Committee when I attended its evidence session on 11 December 2018 [PV/3 - INQ000142162]. At that point I had been in post for eight months. Among the topics covered were: reports produced by GO Science on obesity, future transport modalities and the "Future of the Sea" [Q6], genomics beyond health [Q8], the role of science and research and development spending in UK industrial strategy [Q8], the future of the European Horizon programme [Q9], UK relations with the European Medicines Agency [Q12], planning for a "no-deal" Brexit [Q19], the role of GO Science and the provision of science advice across government [Q20], foresight projects and reports [Q38], the Government Science and Engineering profession [Q41], the appointment, retention and role of CSAs [Q44], departmental research and development budgets [Q69], the relationship between the GCSA and the UKRI [Q75], links between the GCSA and charitable funding of scientific research [Q76], the role of GO Science in encouraging the "commercialisation of research" [Q78], the Galileo Project [Q80], the Cost of Energy Review conducted by Professor Sir Dieter Helm [Q84], the production and effect of ARIs [Q86], research integrity [Q92], quantum technologies [Q97], the Energy Innovation Board [Q101], communicating science to the public and the Science Media Centre [Q107], and the use of bodies equivalent to the Energy Innovation Board in other areas of industrial strategy [Q113]. This is not, of course, a complete list of areas in which the GCSA is involved.

19. Similarly, there is a wide range of potential emergencies on which the GCSA may be called to give advice. As is set out in Dr Wainwright's third statement [PV/1 - INQ000148407 – paragraph 62, table 2], between 2009 and 2020 SAGE or precautionary SAGE meetings were convened as a result of incidents connected with Swine Flu, a volcanic ash cloud, the Fukushima nuclear accident, winter flooding, Ebola, the Nepal earthquake, Zika, the Salisbury and Amesbury incidents, and the risk of a breach of the Toddbrook reservoir. While GCSA I have been involved in discussions on a still wider variety of potential emergencies, including those caused by nuclear plumes,

a national power outage, space weather, drones at Gatwick, extreme weather and zoonotic diseases.

20. As these examples demonstrate, it is not the role of the GCSA, nor indeed is it possible, to be an expert in all of the matters on which he or she may be asked to give advice. Instead, the GCSA identifies the relevant expertise required, brings together those who possess it, interrogates and tests the evidence, and formulates science advice for the relevant decision maker. Similarly, it is not the role of GO Science – a relatively small department that numbered 74 people on 31 March 2018, immediately before my appointment – to *undertake* the research that government requires, but it is to know what work has been done and to assist government in identifying where there are gaps.

21. The role of the GCSA and GO Science takes on particular importance where issues cut across departmental boundaries. We draw together science evidence and advice from different fields and areas of responsibility to create advice for policy makers. The GCSA and GO Science are seldom the only sources of advice to ministers, but the intention is to provide a wider perspective than would be achieved in individual departments.

22. In my opinion there are four questions that the GCSA needs to consider when providing science advice to decision makers. First, is the evidence that is available sufficient to address the issue, and if not, what should be done to develop more evidence or reduce uncertainty? Second, has the advice been expressed clearly so that it has been understood by the policy makers involved, bearing in mind that they may have no science background? And have you assured yourself that the evidence has been understood, including the uncertainties? Third, has the advice been presented in a way to make it relevant and useful for formulating policy? This might include the use of scenarios and options. Fourth, has the decision maker and the relevant department understood the ways in which science can be used to update the advice and monitor the impact and effect of the relevant policy, once the policy has been formulated?

23. The GCSA's role is to provide science advice to inform policy decisions. For all policies there will be other sources of advice and evidence that a decision maker will need to take into account, including economic advice, legal advice, advice from departmental policy teams and political advisers, ethical advice and on occasion national security advice. The way in which the policy is put into operation, and the monitoring of the operational consequences, are for the relevant parts of government. The GCSA and GO Science remit does not include operational matters.

The National Security Risk Assessment and the National Risk Register

24. The role of the GCSA and GO Science in the NSRA and the National Risk Register is set out in Dr Wainwright's third statement [PV/1 - INQ000148407 - paragraphs 88-96]. The Cabinet Office is the lead government department for the NSRA and the National Risk Register, and the work until recently was co-ordinated by the Civil Contingencies Secretariat (CCS) in Cabinet Office. As described in Dr Wainwright's statement, the principal role for the GCSA and GO Science is to comment on the methodology used when compiling the NSRA. There are a number of ways in which this has been done.

25. In 2018 Dr Corinna Elsenbroich from the University of Surrey was asked by GO Science to look at aspects of the methodology that was then being used.

26. Following discussions amongst CSAs after the last iteration of the NSRA in 2019 we proposed a more comprehensive review of methodology, which contributed to CCS commissioning a report from the Royal Academy of Engineering (RAEng) in January 2021. That report, "External Review of the National Security Risk Assessment Methodology: Recommendations for Greater Resilience" was provided in September 2021 [PV/4 - INQ000068403]. GO Science staff were regularly consulted during the report and identified experts who could assist RAEng in review and quality assurance. The report made important, sensible and practical recommendations on many aspects of methodology, including on the construction of reasonable worst-case scenarios (RWCSs), the separation of acute and chronic risks, and the need to focus on potential impact rather than simply likelihood when preparing for risks. I agree with their recommendations on these points.

27. Within government, the GCSA plays a role in supporting CSAs to provide scientific input into departmental areas of the NSRA and National Risk Register. The CSA network is a useful body for promoting this and for identifying areas of inconsistency in approach to the methodology across government (for example, by discussing how concepts such as impact should be evaluated and scored across different types of risks).

28. The methodology in the current NSRA has improved but I think there is more work to do to implement the recommendations of the RAEng report, particularly in relation to

assessment of impact rather than likelihood, separation of acute and chronic risks, compound risks, and construction of RWCSs.

29. The Inquiry has asked specifically about the use of the "reasonable worst-case scenario", and about alternatives to its use. These are matters that are addressed in some detail in the RAEng report, in particular in section 7 and at §4.2.5. I agree with the analysis presented by the RAEng, including the use of multiple scenarios. I would add this from my experience during the pandemic. The RWCS was (and is) a well-established tool that was used by CCS for emergency planning. RWCSs were generated by SAGE at the request of CCS. However as the pandemic progressed, monitoring real data rather than using assumptions to form a RWCS became progressively more important (this was particularly important as policy choices themselves affected subsequent disease prevalence and made RWCSs less relevant). Data trumps modelling, which is why effective data systems and processes are so important for emergency management (a matter I return to below).

Pandemic Preparedness

30. The Cabinet Office has the responsibility for managing national risks. A pandemic is one such risk, and pandemic influenza was top of the risk register. The Department of Health and Social Care (DHSC) is the lead department for pandemic planning. The role of the GCSA and GO Science in relation to pandemics is set out in the third witness statement of Dr Wainwright at [PV/1 - INQ000148407 - paragraphs 97-120].

31. The GO Science resilience team leads on aspects of science advice preparedness for pandemics and other emergencies that fall within the remit of GO Science. The nature of the work of this team is set out in Dr Wainwright's third statement [PV/1 - INQ000148407 - paragraphs 110-116]. In addition to the work on the NSRA methodology, GO Science's wider responsibilities include supporting cross-government work on horizon scanning and undertaking Foresight programmes that result in the publication of reports on issues of potential strategic importance for the future. GO Science works closely with the Cabinet Office on these areas.

32. The resilience team also plan and take part in exercises for emergencies. The detail of this work can be found in Dr Wainwright's third statement (including details of exercises

that took place before my appointment) [PV/1 - INQ000148407 - paragraphs 98-109], and fourth statement [PV/5 – INQ000148406 - paragraphs 10-13]. The last such exercise before Covid SAGE was Exercise Obscure Dawn, which was activated on 16 January 2020 and simulated a national power outage. The exercise involved two mock SAGE meetings and a briefing from me to a member of the Cabinet Office acting as the Prime Minister. The exercise was attended by observers from the United States and New Zealand, who provided positive feedback. Dr Wainwright provides further details of the learning points that were taken from the exercise in his fourth statement (paragraphs 10-13). A summary note of the exercise, including subsequent actions can be found at [PV/6 - INQ000064645].

33. These exercises test procedures within GO Science for arranging and running SAGE meetings and probe where there may be gaps in expert evidence. I believe there are two ways in which the approach to this type of exercise should be improved.

34. The first is that historically I believe that there was more focus on the exercises themselves than on ensuring and tracking that the lessons learned were put into effect. Robust information management systems are required to create institutional memory and action tracking by senior management. This has been addressed through the SAGE Development Programme, which is described in Dr Wainwright's fourth witness statement [PV/5 – INQ000148406 - paragraphs 14-22] and below.

35. The second weakness is that table-top exercises, by their nature, do not test the operational response to the advice that is given and the policy that is decided. They do not reveal how the consequences of a decision will play out in practice and how that can be monitored and used as a basis for subsequent policy decisions. Whilst outside the scope of science advice it is my opinion that emergency planning exercises should include more testing of operational responses. It is possible that military exercises might provide examples of how to do this.

SAGE and Pandemic Planning

36. In terms of pre-planning for a pandemic, the most important elements for which the GCSA and GO Science had responsibility were SAGE and the provision of science evidence and advice.

37. The SAGE process was established shortly before its first activation in the 2009 Swine Flu epidemic. It is my understanding that the need for a SAGE structure arose in response to an incident or incidents in which government ministers had been faced, during an emergency, with a number of different scientists and medical experts offering a variety of opinions and advice during COBR meetings. This, it was felt, had confused rather than assisted decision making. SAGE was developed to identify and interpret relevant scientific evidence and experts to inform science advice in a way that is co-ordinated, independent, comprehensive and comprehensible. It is worth noting that many other countries did not have a science advice system in place before the pandemic and had to stand up processes during the emergency. Several, including those that observed the Obscure Dawn exercise in 2020, are exploring the development of a SAGE-like system. I met regularly with counterparts from a number of other European countries during the Covid-19 pandemic and our discussions concerning the requirements of a science council during a pandemic are reflected in a paper I co-authored and which is shortly due to be published entitled 'The use of Scientific Advisory Councils in the COVID-19 response, a view from Western European Science Advisers' [PV/7 – INQ000142170].

38. The structure and role of SAGE, and GO Science as the secretariat, are set out in detail in Dr Wainwright's third witness statement [PV/1 - INQ000148407 - paragraphs 44-50]. In my view, the fact that SAGE has an infrastructure that means it can be activated quickly, and can call upon a large number of the country's leading scientists, is an important element of pandemic preparedness. Some other key features are described below.

39. During the pandemic SAGE was co-chaired by the GCSA and CMO. Close working between the GCSA and CMO is very important for the integration of science, medicine and public health during a health emergency, and in this instance was helped by a pre-existing close working relationship I had with Sir Chris Whitty.

40. There are a number of elements of planning that support the GCSA and SAGE, some of which were drawn from exercises that had previously taken place. One example is the development of Golden Hour documents based on the NSRA. These consist of pre-written advice intended to be used as a resource in the very initial stages of an acute emergency. These short documents contain key facts and important questions to address, and identify experts (and their contact details). They are most useful for acute emergencies and an example is contained at [PV/8 - INQ000142159].

41. The rapid identification of relevant experts is important during an emergency. As set out in Dr Wainwright's third statement [PV/1 - INQ000148407 - paragraphs 66-69], GO Science maintains a list of experts for emergency advice and has strong links to learned academies, science bodies and professional associations, as well as individual scientists. For a medical emergency the CMO will usually suggest medical and public health experts required. Whilst this system worked quickly and well, there is room for improvement to increase diversity of individuals, scientific disciplines, backgrounds, geography, career stage and experience in the selection process.

42. The unprecedented nature and scale of the pandemic revealed some weaknesses and limitations in the system. SAGE had never met for such a prolonged period or involved so many people in the main group and subgroups. Initially the resilience team within GO Science was not large enough to meet all of the demands and more people had to be brought into the team rapidly. It was also clear that the Covid-19 activation was going to require a far more systematic method of managing papers and information, and coordination of input from multiple subgroups and other sources. A lot of this had to be developed quickly at the start of the activation (January - March 2020) whilst also trying to run the response itself. These systems should be in place in advance of an emergency and the SAGE Development Programme is designed to improve information management systems and processes.

43. GO Science is a small department and a surge capacity was needed. In the event other government departments, agencies and PSREs helped and members of the Government Science and Engineering profession were rapidly transferred to GO Science. Specialist academics were also seconded. The SAGE Development Programme has now put in place a type of reservist system to identify and formalise a surge capacity for future use. This would have been a useful provision to have had in place for the pandemic and will need to be actively maintained.

44. The duration of activation of SAGE created problems for participating academics. In many cases the scientists involved had to stop their own work for many months and in some cases for two years or more. GO Science put in place financial compensation to help institutions ensure that teaching or other obligations could be covered. Generally this worked and I would like to thank the universities and research bodies who supported their staff to assist SAGE.

45. There were also concerns for future funding of research projects being led by participating academics. In many instances the time commitment to SAGE meant that there was insufficient time for scientists to renew research grants or apply for new funding. I would like to thank UKRI and other funding bodies that introduced processes to extend funding of existing grants. For individuals, particularly more junior scientists, there were concerns that work on SAGE might hamper career development. To help allay these concerns I wrote to UKRI and universities to ensure that work for SAGE was given appropriate weight within the Research Evaluation Framework and this correspondence is included [PV/9 - INQ000142133 & PV/10 - INQ000142132].

46. Whilst these examples were dealt with during the pandemic, it would be better to have these and other "rules of the road" established in advance of an emergency. The SAGE Development Programme is designed to establish these processes and "rules". It is also one of the themes of the 100 Days Mission for pandemic preparedness, to which I return below.

47. There was a need to provide personal resilience support for SAGE participants and those working within GO Science. Many individuals worked long hours over many months. Pastoral support was provided during the course of the pandemic and the SAGE Development Programme includes a section on how such support can better be provided in the future.

48. The pressures of participating in SAGE were made worse by some of the media coverage and by abuse on social media, and in some cases it was necessary to provide security advice and support to SAGE participants. The media had a legitimate interest and important role in reporting on the work of SAGE and the science journalists generally did so responsibly and well. There was also a legitimate interest in reporting on whether or not SAGE participants were following the rules and laws that were put in place during the course of the pandemic. Individual SAGE and subgroup participants also chose to engage actively with the media in a personal capacity. However, in my opinion some media coverage went beyond reasonable interest and became intrusive, unfair and personal and this was detrimental to some SAGE participants. In some cases details were published that allowed identification of a home address. There were examples of photographers stationed outside houses and some SAGE participants received malicious communication or death threats. A hostile and abusive atmosphere on social media, fuelled by some of the mainstream media reporting, often collapsed the distinction between science advice and policy decisions. The effectiveness of the UK's

response to future pandemics and other emergencies will depend on the willingness of scientists to give their time to SAGE voluntarily. These are not public figures and while some may be willing to step into the media spotlight, many will not. We should all be concerned that intrusive and unfair media coverage, and social media abuse, may dissuade people from participating in SAGE or contributing to the provision of science advice to government.

49. In terms of wider transparency, the established practice prior to the pandemic was that SAGE minutes would be published after the emergency had concluded. It was my view, from February 2020 that SAGE minutes and papers should be published. There were several reasons for this. First, it allowed external scrutiny and challenge from the scientific community and public, both nationally and internationally. In the event the SAGE minutes were studied worldwide and became influential in the scientific discussion about the pandemic. Second, it helped to distinguish between science evidence, science advice and policy decisions; the SAGE minutes and papers showed the evidence on which the science advice was based rather than advocating for a particular policy. Third, it helped to inform public understanding of the science.

50. There were also potential downsides. Whilst SAGE minutes and papers were published, other advice, including economic advice, was not, and this may have created the false impression that science advice was the only element in the decision making process. There were also concerns that the publication of minutes would create external pressures on those who attended the meeting, including the risk of lobbying of SAGE participants. I do not believe that this was a problem and SAGE maintained, regularly updated and published a register of participants' interests. More worrying was the possibility that publication would increase social media abuse and raise security risks. Notwithstanding these points I remain firmly of the view that the decision to publish minutes and papers was correct and should be the norm for future SAGE meetings unless there is a national security reason not to do so.

51. It took several weeks at the very beginning of the pandemic to obtain agreement that minutes and papers should be published as soon as possible after the meetings. There were concerns about security and the need for confidentiality as ministers considered options. Once the decision was taken to publish the papers, it still took a few weeks to get administrative arrangements in place as GO Science was not set up to publish minutes during an emergency.

52. Once the process was established SAGE minutes could be published more quickly than SAGE papers and usually within 24 hours of the meeting. Papers took longer because many were not completely finished when they came to SAGE. There was a risk that if all papers were released immediately after the SAGE meeting authors would delay bringing them to SAGE until they were in a final "publishable" form. Furthermore, the scientific discussion at SAGE sometimes led to changes to the draft papers which became formally SAGE endorsed once published. Permission of the authors was required before publication. Effective processes for publication of searchable minutes and papers are now in place and should be maintained.

The SAGE Development Programme

53. As set out in Dr Wainwright's fourth statement from [PV/5 – INQ000148406 - paragraphs 11-33] the effectiveness of SAGE before and during the pandemic was studied by various individuals and groups. These include a review by Sir Adrian Smith conducted in the spring/summer of 2020 (to which I refer to later in this statement), an internal review undertaken in late 2020 (the Covid-19 Science Advice Legacy project), an internal review of the administration and outputs of the SPI-B subgroup, a wider SAGE subgroup review, and reports produced by various Parliamentary Select Committee inquiries. There was also a SAGE participant away day in September 2021 that identified areas of success and ones where improvements could be made. The paper is provided [PV/11 - INQ000064199] but I would pull out here two specific points identified as areas for improvement:

- "Having roadmap-like policymaking processes that can be used to understand the general direction of travel and frame questions clearly – it is very difficult to identify the relevant scientific questions and provide advice when the overall objectives and risk appetite are not clear."
- "Building the measurement of impacts on disadvantaged groups into the system fully from the start."

54. In September 2021 I set out seven thematic areas that I considered needed improvement. These were:

1. Clear construction of attendee list to meet the objectives
2. Rules of engagement for attendees
3. Better information management
4. Clarity on accountability for each action

5. Clarity on scope (what is for SAGE, what is not, and who owns the other bits)
6. A simple consistent docking point for SAGE into government
7. Media handling for SAGE participants

55. The learnings from these various reports, and my own seven themes, have been or are being addressed by the SAGE Development Programme. The origins and purpose of the programme are explained in Dr Wainwright's fourth statement [PV/5 – INQ000148406 - paragraphs 14-21]. In short, it is intended to continuously improve the operation of SAGE by reviewing and implementing the recommendations made as a result of the 2020 to 2022 activation, and any further recommendations that may emerge in the future.

56. From spring 2022, the programme developed five work-streams intended to address the issues identified. This work is summarised in the "SAGE Development Programme Report – Internal Working Document", which I exhibit with this statement [PV/12 - INQ000142161].

57. The five work-streams are:

1. GO Science as a Response Ready Organisation at Scale:
    - This covers a prolonged activation of SAGE at the scale that was required in the pandemic. Work has been done to improve processes for "surge capacity" within GO Science so that there are sufficient and well-trained staff to work on the SAGE secretariat. Information management, and systems for capturing institutional memory, have been strengthened. A wellbeing office role has been created for staff working in response roles. I expect this work to improve the long-term resilience of SAGE and ensure that a robust and resilient structure will be in place to support any future large scale prolonged activation of SAGE. It will also be important for any activation of SAGE for multiple concurrent emergencies.

2. SAGE Transparency
    - A guide on SAGE transparency [PV/13 – INQ000142165] has been produced which outlines what information is in scope for publication, when information will not be released or may be delayed for national security reasons, and the publication process.

3. SAGE Secretariat and Subgroup Ways of Working
    - The unprecedented scale and complexity of the SAGE pandemic response required new ways of working and processes for SAGE and its subgroups. Standing documents setting out guidance for the SAGE secretariat and others have been reviewed, updated and produced. This has included revision of the Cabinet Office owned Enhanced SAGE Guidance [PV/14 – INQ000142166], and it has been recommended that this document should now be reviewed annually and updated as needed.

4. SAGE Experts
    - At the beginning of the SAGE Covid activation there was no systematic process for ensuring that the experts invited to participate reflected diversity across disciplines, backgrounds, career stage and experience. I describe below (paragraph 64) the steps I took to increase diversity within SAGE during the pandemic but we recognised the need to put these arrangements on a more formal and established footing. A review of learned and professional societies has been conducted and 200 such bodies identified; a project to develop an engagement strategy for sourcing experts is due to begin shortly. A SAGE Experts Selection Log [PV/15 – INQ000142167] has been created for audit and transparency. Work is continuing on options for embedding diversity monitoring of SAGE participants.
    - The SAGE Participation Guidance and Expectations Packs [PV/16 – INQ000142168] have also been updated to provide a clearer overview of SAGE ways of working, the role of participants, the expectations of them, and the support available to them. These packs are sent to SAGE participants before they attend their first SAGE meeting. They include information about interacting with the media.

5. Continuous Improvement and Audit Trail
    - Previously there was no consistent, comprehensive, auditable record of lessons learnt from previous SAGE activations and exercises (although this had been introduced following the Obscure Dawn exercise in January 2020). The SAGE Recommendation Tracker was created to provide such a record. This is part of a continuous improvement process and allows for both triage and audit of suggestions for improvements in the way that SAGE operates.

58. One further area on which work is ongoing is on how SAGE should operate in the event of concurrent or compound emergencies, for example a national power outage during a pandemic. During the pandemic we assessed the possibility of setting up a separate team should a second emergency occur. It is likely that specific surge capacity would be required for concurrent emergencies and that SAGE would be the integrating body for the science evidence and that informs the science advice. Future exercises should test the ability to respond to concurrent emergencies.

SAGE and Wider Government

59. Part of the work of the SAGE Development Programme has been to explore how SAGE works with and across government. Inevitably this involves considering matters that are outside the responsibility of GO Science and liaising with the relevant departments to provide our perspective on them. There are three areas that I believe are of particular importance.

60. First, SAGE needs a simple and consistent "docking point". As explained in Dr Wainwright's third statement, SAGE is activated by and accountable to COBR, which is where ministers integrate science advice with other inputs including economic, social, operational and policy considerations when making decisions. The resilience team within GO Science has worked with Cabinet Office to agree that this system will remain in place and will be reinforced. The Enhanced SAGE Guidance is part of that process. During the Covid-19 response the C19 Taskforce in Cabinet Office and ministerial meetings developed as the docking point in the place of COBR.

61. Second, in my view there is a need for greater clarity and accountability on each action point identified by SAGE. We found during the pandemic that the sheer weight of work was such that there were occasions when action points were identified in SAGE meetings (usually directed to work that was needed to develop or inform the evidence base) but were not actioned by the relevant government department or agency. While subsequent meetings did identify these, a more robust system of action tracking would allow for more timely action and a clearer understanding of which organisation is responsible. An example from the pandemic is the community infection survey. The need for this was identified in February 2020 and repeated in SAGE minutes. Operational and capacity constraints meant that Public Health England (PHE) was unable to run the study and so the Office for National Statistics (ONS) ultimately took it

on. SAGE does not and cannot monitor how the science advice translates into operational work, but it is important that there are structures in place to do so.

62. Third, there is a need for greater clarity on the scope of SAGE, setting out what it does, what it does not do, and which department or agency owns those things that are not within SAGE's remit. SAGE needs to focus on the complex, cross-cutting science questions and is not and should not be the only source of science evidence and advice within government. COBR is the committee that should integrate science advice with other inputs.

SAGE, Groupthink and Optimism Bias

63. From an early stage in the pandemic it was clear that there was a risk of groupthink and optimism bias and that we needed to defend against that. A significant step to achieving this was publishing the SAGE minutes and papers and encouraging external scrutiny and challenge. This is normal scientific practice.

64. Challenge and diversity of views was sought within the meetings and by setting up specialist subgroups. Participation was invited from a wide variety of academics from different disciplines, and occasional visitors were invited for specific topics. Over 350 scientists, including many in the Devolved Administrations, participated in or contributed to SAGE and its subgroups across the pandemic and the composition of groups was regularly refreshed. When a paper came to SAGE those who did the work often spoke to that work. This meant that more junior researchers, as well as professors and heads of laboratories, presented at SAGE and subgroups. Presentations from overseas scientists were also included. As Chair of SAGE I sought to include more junior or reticent participants and tried to create a culture in which everyone was listened to and encouraged and constructive challenge was welcomed. Work is now being done to ensure that systems are in place to embed and monitor diversity in future SAGE activations.

65. Although the diversity of participants provided some protection against groupthink further steps were taken to guard against complacency. From April 2020 Professor Sir Ian Boyd, former CSA at the Department for Environment, Food and Rural Affairs and Professor in Biology at the University of St Andrews, was invited to attend SAGE meetings with the job of observing meetings and providing the chairs with feedback on

groupthink, optimism bias and other matters. Sir Ian attended every SAGE meeting between SAGE 25 and SAGE 95 [INQ000061533 & INQ000061603], besides five (SAGE meetings 32 [INQ000061540], 44 [INQ000061552], 51 [INQ000061559], 54 [INQ000061562] and 58 [INQ000061566]). An email thread containing his reflections to the SAGE co-chairs, the GCSA and CMO, can be found in [PV/17 - INQ000064643].

66. As set out in the fourth statement of Dr Wainwright [PV/5 – INQ000148406 - paragraphs 23-24], in May 2020 I asked Sir Adrian Smith, the then incoming President of the Royal Society, to undertake a short, targeted review of how SAGE had operated over the first few months of the pandemic. Sir Adrian held discussions with SAGE participants and Cabinet Office colleagues. This review looked at what could be improved as GO Science moved into the next phase of the response. The review is found at [PV/18 - INQ000062443]. An overview of the advice and agreed recommendations is at [PV/19 - INQ000064436], alongside the GO Science response. The recommendations included extending the pool of participants, expanding the use of early and mid-career researchers, reviewing the structures for subgroups, increasing the use of task and finish groups, ensuring better central commissioning of questions for SAGE, and enhanced mechanisms for dissemination of SAGE minutes and papers across government. The recommendations directly informed the SAGE Development Programme and a programme team in GO Science led the implementation in 2020. An example was the introduction of teach-ins for departments covering specific SAGE papers and summary positions.

67. Throughout the pandemic informal small-group "brainstorming" science meetings were held. These sessions usually involved 8-12 people, different mixes of SAGE participants and other scientists who were not involved in SAGE. We would pick a topic for the meeting – for example "what science is needed for exit from lockdown" or the nature of evolution of the virus, or mechanisms by which the virus spread, or just simply "what are we missing" – and discuss what we would need by way of research and input from the subgroups and others in order to inform our thinking. The first of these meetings took place on 10 April 2020 (although we had organised meetings of science funders from January 2020). These were important moments, giving a chance to step back and think about some of the wider issues and emerging science that SAGE might need to consider. The time was sacrosanct. I would encourage any future GCSA to ensure that time was made for these kinds of sessions.

68. International perspectives were important throughout the pandemic. The CMO and I had regular discussions with colleagues around the world, including those in China, Japan, South Korea and Singapore during the early stages (January - March 2020). I had regular meetings with my counterparts in India, New Zealand, Canada and the United States from 16 January 2020 onwards and spoke to each chief scientist individually. This group expanded, from March 2020, into a larger regular meeting, organised by the United States, of science advisers and officials from over 15 countries, though the size of the meeting then limited its effectiveness. Individual bilateral meetings took place with several countries during the pandemic. Most useful were the regular, informal meetings that I initiated with advisers from eight other European countries. These had no formal agendas but were an opportunity to share information and discuss science advice. I attended them with the CMO and we usually met every two weeks, sometimes more frequently sometimes a little less. These meetings stopped in spring 2022 and culminated in a face-to-face meeting in June 2022 in Paris. At that meeting a short paper on lessons learned was developed, as I have described at paragraph 37 above.

69. International colleagues also attended SAGE on occasions. For example, a South African contingent attended SAGE 97 on 29 November 2021 to discuss the emerging Omicron variant. There was also a small group of international experts who provided advice on the National Core Studies programme. The group comprised Margaret Hamburg (then Chair, American Association for the Advancement of Science), Gabriel Leung (then Dean of Medicine at the University of Hong Kong) and Gagandeep Kang (Christian Medical College, Vellore, India).

70. International connections were in part facilitated by the Science and Innovation Network (jointly run by the Foreign, Commonwealth and Development Office (FCDO) and the Department for Science, Innovation and Technology (was FCDO and BEIS during the pandemic)). This network allowed rapid identification of key individuals advising foreign governments: for example, if we wanted to know how a particular scientific issue was playing out in Denmark, it would quickly identify the right person to speak to in that country. I return later in this statement to the importance to pandemic planning of ensuring that the UK remains active in the international scientific community. In 2020 an International Comparison Joint Unit (ICJU) was established in Cabinet Office to provide comparative country data.

71. These, and the other steps described in Dr Wainwright's fourth statement, were intended to help SAGE, GO Science and me remain open to external influence and challenge.

We were not, however, the only sources of science evidence and advice to the government and nor did we wish to be. We commissioned external cross-disciplinary research and the Royal Society established two bodies that provided pandemic advice, interacting with me or directly to the Cabinet Office (DELVE – data evaluation and learning for viral epidemics, and RAMP – rapid assistance in modelling the pandemic).

72. During summer and early autumn 2020 there was much public debate about strategies to deliberately let the virus infect the population, and some scientists advocated looser or no application of non-pharmaceutical interventions. Such scientists, and those who reported on them, would often (wrongly) point to Sweden as an example of the type of approach that they advocated. CMO and I were aware that the Prime Minister and others within government were increasingly interested in these views and were considering whether further restrictions should be avoided. In order to provide scientific input to the policy views that were being explored we suggested a briefing session with some of these scientists, together with the scientists advising the government in Sweden and proponents of stronger measures, so that they could hear directly the competing arguments. Each was asked to provide a one-page paper on the evidence base for their views and a meeting took place on 20 September 2020 in No.10 with Professor Carl Heneghan (the Centre for Evidence-Based Medicine, Oxford University) and Professor Sunetra Gupta (Professor of Theoretical Epidemiology, Department of Zoology, University of Oxford). Also present were Anders Tegnell, the chief epidemiologist advising the Swedish Government, Professor John Edmunds (Professor in the Faculty of Epidemiology and Population Health at the London School of Hygiene and Tropical Medicine), and Professor Dame Angela McLean (then CSA at the Ministry of Defence, and now my successor as GCSA). Both Professor Edmunds and Professor McLean were regular participants at SAGE. The Prime Minister, Dominic Cummings, Cabinet Secretary, CMO and I were amongst the attendees at the meeting. The substance of this meeting will presumably be discussed in Module 2; I mention it here as a specific example of how we sought to ensure that policy makers were provided with competing views on the science.

SAGE and the Commissioning of Cross-Disciplinary Research

73. The fourth statement of Dr Wainwright sets out in some detail the cross-disciplinary research that was commissioned by me and GO Science during the pandemic [PV/5 – INQ000148406 - paragraphs 38-54]. I do not repeat that detail here. The work drew on

the Royal Society, the RAEng, the British Academy and the Academy of Medical Sciences. In response to the specific question posed by the Inquiry as to the types of multidisciplinary research teams that I consider should be funded and maintained, I think there are a number of examples of effective multidisciplinary working, developed during the course of the pandemic, which illustrate how work of this nature can be most effectively undertaken.

74. In the summer of 2020, I established the National Core Studies (NCS) programme to ensure relevant inter-disciplinary research was being carried out with sufficient priority and scale. Again, more details can be found in Dr Wainwright's fourth statement [PV/5 – INQ000148406 - paragraphs 28-29]. Those involved in NCS work found it effective in bringing together relevant disciplines and creating funding mechanisms that avoided the problems of peer review being undertaken within scientific disciplines rather than across them. While the origin of the NCS was the need for urgent research to inform the response to the pandemic, the teams involved are now trying to preserve ways of working on a longer-term basis.

75. It was important that funding could be put in place quickly to support research work during the pandemic. As well as drawing together funding agencies (UKRI, National Institute for Health and Care Research, Wellcome Trust, PHE) to identify research needs in January 2020, CMO and I also sought a drawdown facility from HM Treasury to allow projects to be commenced as quickly as possible and outside of normal funding mechanisms. This was used to initiate COG-UK, the Covid-19 Genomics UK Consortium. I understand that the work of COG-UK will be considered in later modules, but it is worth noting that the early investment helped to establish a programme that led to the UK at one stage conducting up to 50% of the world's sequencing of SARS-CoV-2 variants. This process of a rapid drawdown fund for the GCSA and CMO should be instituted as a mechanism for future pandemics or other emergencies requiring rapid research.

76. SAGE was also informed by research from its own subgroups, which generally comprised experts from different disciplines. In general the research was commissioned by Cabinet Office or SAGE but subgroups could also self-direct their work. For example much of the SPI-M analysis on modelling was done in this self-directed way [PV/20 - INQ000142164], and SPI-B (behavioural science) also commissioned work [PV/21 - INQ000142138]. But both groups also received direct commissions from Cabinet Office or from within DHSC. The findings from the Covid-19 Clinical Information Network (CO-

CIN) were brought to SAGE when evidence emerged rather than being formally commissioned [PV/22 - INQ000142134]. There was a balance to be struck. The subgroups comprised experts in their fields who would naturally have their own thoughts on which research would be useful to undertake. However, the subgroups were formed to provide SAGE with the inputs required to address urgent questions about the pandemic so that accurate and relevant science evidence and advice could be provided to government decision makers in a timely manner. For that reason, there was a need for a degree of direct commissioning.

Communicating Science Advice

77. SAGE presents a consensus output from the meeting, including an explanation of levels of confidence in the summary positions. This is intended to provide policy makers with a comprehensible summary of the evidence on which the science advice was based and to identify uncertainties. SAGE was established to try to avoid a situation in an emergency where policy makers with no or little scientific background were being presented with conflicting views on complex scientific issues from a range of experts. It aims to reduce the risk of policy being based on a cherry-picking of science advice to suit a particular policy preference. But the consensus view should indicate levels of confidence among the scientists and where uncertainties remain. During the pandemic, SAGE did this in a number of ways. The most common were either to use a phrase such as: "It is probably A but B is also possible / cannot be ruled out on current evidence"; or to use confidence limits, such as stating that the proposition was offered with lower confidence if evidence or data were scarce. On some occasions specific wording was used with the intention of making the position clear, for example:

- SAGE 27: "On balance, there is evidence to recommend the use of cloth masks in certain higher-risk settings as a precautionary measure where masks could be at least partially effective." [PV/23 - INQ000061535]
- SAGE 65: "There is no current direct evidence that transmission within schools plays a significant contributory role in driving increased rates of infection among children, but neither is there direct evidence to suggest otherwise (low confidence)." [PV/24 - INQ000061573]

On other occasions multiple scenarios were developed. This is evident in some of the mathematical modelling papers contributing to RWCS assessments.

78. There is no single, standard way to express scientific uncertainty when presenting evidence or advice to policy makers and the public. The recent report of the Independent Expert Assessment of Unusual Crustacean Mortality in the North-East of England in 2021 and 2022 adopted the definitions of likelihood used by the Intergovernmental Panel on Climate Change: [PV/25 - INQ000142142]

Terminology	**Likelihood of occurrence/outcome**
Virtually certain	>99% probability of outcome
Very likely	>90% probability
Likely	>66% probability
About as likely as not	33 to 66% probability
Unlikely	<33% probability
Very unlikely	<10% probability
Exceptionally unlikely	<1% probability

79. A similar approach was taken during Covid, with a simple graphic presented in most SAGE papers. However this is an area that will benefit from further work, with the intention of having a settled approach in place ahead of any future emergency. The SAGE Development Programme is scoping research work to understand how well SAGE minutes were understood both by policy makers and by the public. I am grateful for assistance during the pandemic provided by discussions on the topic of presentation of data and risk with Professor Sir David Spiegelhalter, former Winton Professor of the Public Understanding of Risk at the University of Cambridge and Professor Sir John Aston, Harding Professor of Statistics in Public Life also at the University of Cambridge.

80. The approach taken meant that policy makers were usually not presented with a single view but a consensus that often articulated a range of possibilities and described uncertainties. The meeting in September 2020 is an example where scientists outside SAGE were brought in to ensure that the Prime Minister heard from other voices as needed so that he could put SAGE advice into context. Other examples include mathematical modelling papers that explore different scenarios.

81. SAGE participants were free to speak publicly about their own research and area of expertise, but they were asked not to comment on the details of discussions that took place within SAGE meetings or seek to draw policy conclusions from the SAGE minutes. Specific comments from SAGE meetings were not attributed to individuals.

82. The relationship with the media and the public was assisted by the work of the Science Media Centre (SMC), an organisation that pre-dates the pandemic. The SMC connects the media, and in particular science journalists, with experts in the relevant field. It allows for direct communication between journalist and scientist, without any political or departmental input. The SMC worked closely with GO Science to improve access to scientists. I also gave regular background briefings on SAGE minutes to science journalists throughout the pandemic.

83. Due to limited resources it was not possible to offer media training to all SAGE participants in the early stages of the pandemic. We relied then, and are likely to rely in the future, on individual academic institutions seeking to help their faculty members with media support and training. However, with the help of the Wellcome Trust, GO Science offered a media training session for SAGE participants on 10 December 2020. How best to support SAGE participants with media interactions is being considered in the SAGE Development Programme, particularly through the SAGE Participants Guidance Pack.

Key Policies Affecting UK's Pandemic Readiness

84. I am asked by the Inquiry which key policies – in the scientific, technology and research contexts – had a material effect on the UK's pandemic readiness.

85. As a general point, the science elements that worked well during the pandemic were those in which the UK was already strong. Examples of strength include the science base in the country both generally and in respect of clinical trials, mathematical modelling and vaccine research. An example of relative weakness was in the industrialisation of diagnostic tests. Prior to the pandemic the UK did not have a major infectious disease diagnostics industry and the NHS does not routinely use rapid point of care testing for infections. This meant that while the UK (through what was then PHE, and is now UKHSA) was able to identify quickly a laboratory test for SARS-CoV-2 there was no domestic infrastructure to scale testing (from laboratory through to clinical records) in a systematic way. The importance of having, and retaining, capacity before a pandemic is a point to which I will return in the section of this statement dealing with lessons learnt.

86. In terms of specific science policies affecting the UK's pandemic readiness, I have identified four that I think are of particular importance. I do not discuss the issues of capacity and capability in the healthcare or social care systems.

1. The decisions taken over a number of years to reduce the science budget of PHE must have had an effect on its ability to perform at scale during the pandemic. The outsourcing of research to universities left PHE with restricted internal science and operational capability. These decisions are of course difficult ones for any administration but in my opinion it is important to view public health science funding as a resource that is required for the future, much in the same way as the army is required to be ready for action even when there is no war.

2. The establishment of UKRI brought together different research councils and meant that funding for cross-disciplinary research could be considered rapidly. It will now be important to assess what funding would be required to create multidisciplinary centres of excellence together with UKHSA, building from the National Core Studies model. Continued funding of a strong science base is essential. COG-UK could only do what it did because of pre-existing strengths in genomics.

3. The establishment of the National Institute of Health Research created clinical research structures in hospitals. Because clinical trials are conducted routinely within the NHS, it was possible to undertake the most important therapeutics study that took place during the pandemic – the RECOVERY study (which I describe at paragraph 106 below).

4. The Science Capability Review [PV/2 - INQ000061614], which I have discussed in paragraph 14 above helped in a number of ways including (i) improving science support within departments that was available for policy and operational responses during Covid, (ii) PSRE join up and support including for Covid testing and surge capacity for GO Science, (iii) by providing a model on which the Vaccine Taskforce was established.

Lessons Learned and Future Planning

Data

87. One of the principal lessons from the UK response to the pandemic is the importance of data collection, data flows and data systems, and analytics. As I said in my evidence to

the House of Commons Science and Technology Committee on 16 July 2020 [Q1043 to Q1045], data are needed in order to be able to make informed decisions. Therefore, for any emergency situation it is important to understand (i) which data are required to provide the information that will be needed, (ii) who owns those data and how are they collected, (iii) where will the data be needed, how do they get there, and are they interoperable with other important datasets, (iv) how will data be analysed to create information and knowledge. These areas should be considered and resolved in advance of an emergency.

88. The lack of large scale diagnostic testing capacity in the UK at the start of the pandemic was an important factor that limited data that we had at that time, but it was not the only one. For the first months of the pandemic, even quite basic data about how many people were in hospital, or how many people were in intensive care with Covid-like disease were difficult to obtain and in some cases unreliable. We did not know the distribution of the disease around the UK and poor data systems hampered our ability to understand the spread of Covid-19 or evaluate which individuals might be most at risk. As a consequence we were, to a degree, flying blind early on.

89. There was uncertainty among those holding the data about what they could and could not share, and with whom, in part because of well-intentioned concerns about confidentiality. In some cases, data collection practices were poor and lacked priority. Even when data was entered there would often be a delay, for example certain types of data only being recorded when a patient was discharged, sometimes weeks or even months after admission. There were also technical difficulties in sharing data between different information management systems.

90. The UK did build data systems that were of great value both nationally and internationally, but this had to be done during the pandemic and sometimes from scratch. NHS Scotland was an important source of information due to the well-developed electronic health data system. The ONS Coronavirus (COVID-19) Infection Survey came to be admired around the world as a population level survey that allowed us to understand disease patterns across the UK. The Joint Biosecurity Centre (JBC) was established in Cabinet Office in May 2020 and became a command and control centre for the data received from the NHS, the ONS and technology companies. An effective data visualisation dashboard was created in No.10, replacing large packs of slides and oral descriptions. A Situation Centre for data (SitCen) was created to allow effective presentation of data to decisions makers. These are good developments that should be

maintained. Many of the data visualisation tools were very effective and in my opinion could be made more widely available. Rules on making data visualisation outputs and dashboards publicly available should be defined in advance.

91. The JBC now sits within UKHSA and SitCen exists within Cabinet Office. The ONS survey continued, but at a reduced scale as the situation changed. It has recently been paused. Data resources for research purposes including Health Data Research UK and Open Safely were useful sources of information.

92. A national conversation about which data people are willing to share in the event of an emergency situation may be helpful and could be part of establishing the "Rules of the Road" before a pandemic. This concept is discussed below in relation to the 100 Days Mission.

93. Embedding and making it easy to collect data as part of routine work in the NHS or elsewhere would help. Systems should allow for data to be entered promptly and shared automatically when required. Such systems should be interoperable by design so that they do not need to be retrofitted. There should be clarity about the repository to which the data flows (or how it is accessed at source) and which groups are going to access and analyse it and for which purposes.

94. While my answers about data are given in the context of a statement about pandemic planning, they apply with equal force to preparations and planning for other national emergencies.

Operational Implementation

95. A second important lesson from this pandemic, and one that I have mentioned at various points in this statement, is the need to focus on how science advice and policy decisions are going to be implemented operationally.

96. To give one example, as a result of decisions taken during the pandemic to increase testing capacity, the UK now has many automated diagnostic testing facilities, including in the form of the Lighthouse Laboratories. How these facilities are used for routine healthcare will determine how effectively they can be used for emergencies. Maintaining the use of facilities for valuable services outside a pandemic is essential if they are to be useable and can be scaled in the event of a pandemic or epidemic.

97. I am conscious that there will always be pressures on budgets. A public conversation may cover how much the UK is willing to spend in order to maintain its preparedness for pandemics and other national emergencies, and the risk associated with not spending in those areas that could be accepted.

The 100 Days Mission

98. As part of the UK's presidency of the G7, I was tasked with leading work on reducing the time taken to develop and make available safe, effective and affordable diagnostics, therapeutics and vaccines (DTVs) in a future health crisis. This led to the 100 Days Mission: a global public-private effort to harness scientific innovation for DTVs to be ready to be deployed within the first 100 days of a future pandemic threat being identified. I currently chair the International Pandemic Preparedness Secretariat for the 100 Days Mission. Further details of the work done on the 100 Days Mission are contained in Dr Wainwright's fourth statement [PV/5 – INQ000148406 - paragraphs 62-65].

99. The 100 Days Mission report [PV/26 - INQ000064650] is a document that deals with international preparedness, but it is of course relevant to the UK. The following have particular relevance to the UK:

1. Investing in research and development to fill gaps in the DTV arsenal
    - As is argued in the report [§14], "We can, and should, prepare prototype DTVs to treat pathogens of greatest pandemic potential and progress them to a stage that can be adapted quickly to respond to a specific pathogen threat. We must also be prepared for the unexpected, and should develop vaccines and therapeutic technologies that can be readily adapted to respond to an unknown 'Disease X', including simplified and easily transferable manufacturing processes." It was the existence of such prototypes that allowed for such rapid progress to be made with vaccines for Covid-19. The presence of a significant industrial presence and expertise for vaccines and medicines in the UK was a critical feature of our ability to respond.
    - The report also argues that we should create a market by using diagnostics as part of business-as-usual healthcare and surveillance. This will stimulate research and development and boost manufacturing capacity. This is similar to

the point I have made above in respect of the Lighthouse Laboratories. The general point also applies to vaccine manufacturing capacity, something that was lacking in the UK [§11].

2. Making the exceptional routine by embedding best practice and preparation in business-as-usual activity
    - The report argues [§14(b)] that this should include regionally and internationally networked randomised controlled trial platforms, better harmonised regulation and simplified transferable manufacturing processes, particularly for vaccines, as the norm.
    - I have given several examples in this statement of where there is a need for best practice to be embedded to guard against a future pandemic – in the recording and sharing of data, routine surveillance, the use of point of care diagnostics, or clinical trials.

3. Agreeing different rules of the road in advance
    - The examples given in the 100 Days Missions report include guidance on supply chains, identification and data sharing as well as a system to share data and biological samples and utilise standardised assays. These are all important areas, particularly for international co-operation.
    - There are also lessons to be learned domestically. In particular, there is a need to establish which data will be shared, how and by whom. It is also important to ensure that funding streams are in place to allow for rapid research. GO Science is working to ensure that the SAGE rules of the road are clear and communicated to all that are involved in the process.

100. The focus of the 100 Days Mission is on diagnostics, therapeutics and vaccines, but it is predicated upon there being an effective international surveillance mechanism. Sir Jeremy Farrar led the work on this during the UK's G7 Presidency, producing the Pathogen Surveillance Report [PV/27 - INQ000142163]. It is very important that a global effective disease surveillance system (animal and human) is supported by governments.

101. The work of the 100 Days Mission also underlines the point that pandemics are, by definition, international. As with so many other areas, international collaboration will be more resilient in a pandemic if it is embedded as normal practice. I have described earlier in this statement how the UK response was improved by drawing on pre-existing

networks or contacts to allow for an international perspective. More widely, SAGE participants were able to contribute data and insights from other parts of the world through academic contacts with colleagues in other countries. Those contacts were the result of past collaborations and discussions. Science and science systems need to be engaged and international, and scientific links within Europe are particularly important for many emergencies.

Future Research and Pandemic Institutions

102. The Inquiry has asked me to comment on the principal areas of scientific research into infectious diseases that should be prioritised by the UK Government, and about what reforms could be implemented in the field of science and technology to make the UK pandemic ready.

103. In the 100 Days Mission report [PV/26 - INQ000064650], industry and academia are urged to prioritise research and development into DTVs against the WHO list of priority pathogens [§16]. I agree with that proposal, and with the other recommendations of the report set out on preparing prototype DTVs and flexible technologies against known and unknown diseases.

104. We must be careful not to prepare to meet the last pandemic rather than the next one. For example, the HIV virus that caused the AIDS pandemic acts in a quite different way from SARS-CoV-2 and necessitated an entirely different response. With this in mind, it is important to focus on research structures and institutions rather than individual specific research projects.

105. I am aware that interest has been expressed by certain universities in the UK in establishing pandemic preparedness centres, where pandemic preparedness would be developed as an academic discipline. These centres would draw on a range of academic expertise, including many scientific disciplines, engineering, social science, mathematical modelling, economics etc. They would also link to industry, both small and large. This is a welcome initiative, particularly if these centres developed a hub-and-spoke model to bring in the broader university science base: the university housing the centre would act as the hub, with experts from other institutions, industry and government departments and agencies contributing as the spokes. A centre could join with UKHSA to provide ongoing monitoring of national and international developments

and suggest the research and reforms that are required to meet the ever-changing risks posed by emerging viruses and diseases. Any proposed centre would, of course, need a sustainable funding model.

Testing Clinical and Non-Clinical Interventions

106. The UK has a strong and long-standing track record in clinical trials. It is an example of where a pre-existing strength allowed for resilience in the face of the pandemic. The tradition of evidence-based medicine in the UK, the single healthcare provider in the form of the NHS, and the willingness of so many patients to volunteer for trials, allowed for properly powered large scale trials to be undertaken, in contrast to many other countries. In particular, the RECOVERY trial identified the effectiveness of dexamethasone, an inexpensive and widely available steroid drug, in treating Covid-19, and did so within 138 days of the WHO declaring the pandemic. It is estimated that this saved a million lives worldwide [100 Days Mission report, §10]. RECOVERY also demonstrated what didn't work and prevented the use of medicines that had no benefit or which caused harm.

107. While this traditional strength of UK medicine is welcome, it should not be taken for granted. Running large scale clinical trials routinely in the NHS will maintain and improve the capacity to do this in a pandemic. It will also ensure that the NHS continues to practice evidence-based medicine.

108. In any pandemic there will inevitably be pressure to introduce interventions that are not supported by proper clinical evidence (for example proposals to introduce Vitamin D for the whole population in the hope that this would increase protection against Covid-19, or to use hydroxychloroquine or ivermectin for treatment). It is vitally important that such pressure is resisted and that proposed pharmaceutical interventions are tested in well-designed clinical trials. History tells us that many interventions that appear useful in small trials or anecdotes turn out not to be effective or even to be harmful when tested in larger scale trials.

109. As pandemics move around the world, ideally there would be a common trial protocol in place internationally. This is extremely difficult to achieve. Trying to set up a single large international trial risks being slow and unworkable. The approach suggested in the 100 Days Mission report [PV/26 - INQ000064650], which I endorse, is to try to link trials

within individual healthcare systems by ensuring that they are sufficiently similar to allow for data to be shared and combined.

110. There are two areas in which the UK pandemic exposed limitations in the UK's capacity to run trials. The first is the difficulty in obtaining good quality data about the effects of non-pharmaceutical interventions. This is an inherently difficult area as there are so many variables, so much "noise", that it is difficult to reliably isolate the effect of any given measure. Whilst it is clear that various degrees of "lockdown" reduced viral spreading more work is required to establish better methodologies for research in this area. This is likely to involve better use of everyday data collection to enable "real world" evaluation rather than always relying on clinical trial methodology. The development and effective implementation of social science evaluation methodologies will be particularly important.

111. Second, the UK's success at large scale trials contrasted with its more modest record in testing novel treatments in the earlier stages of drug development (phase 1 and 2 studies), when more intense studies on small groups are required. It may be that the two things are linked, and that in the understandable and justified effort to arrange the large scale trials that this area took second place, but it may well turn out to be very important in future infectious outbreaks. It would also be important to evaluate to the place of human challenge studies (i.e. the experimental use of the infectious agent) for early assessment of treatments and vaccines.

112. The decision taken by the National Institute of Health Research to suspend all trials other than those approved for Covid-19 was important. This undoubtedly helped focus resources on the large clinical trials that were subsequently undertaken, with great success, within the NHS, but of course it came at the cost of trials into other diseases which were suspended.

113. I have not discussed vaccines in this statement as I am aware that there will be a separate module dealing with vaccines. I will briefly mention that the structure and setup of the Vaccine Taskforce was an important component of the successful vaccine programme. I have commented elsewhere on the key features of the Vaccine Taskforce and the importance of being able to access experts from industry [PV/28 – INQ000101626]. The role of the regulator was important to achieve early regulatory approval. I would be happy to provide more detail on this in a future statement if required.

Concluding Observations

114. In this statement I have commented on science advice mechanisms and processes and suggested how I believe they could be improved. Overall I think that the SAGE system and UK science advice more widely operated effectively during the pandemic and drew on the very strong science base in the UK. That is not to say that every decision or piece of advice was correct but pre-existing structures and processes within GO Science and across government meant that SAGE activation was rapid, the breadth of areas covered was appropriate, and the direct links into policy and operational parts of government largely worked. The challenge and input provided by academic institutions, learned academies and others were a helpful feature of the UK system. The close working relationship between the CMO office and GO Science was important.

115. There are also areas I identify in this report which the pandemic exposed as requiring further development. The scale of challenge meant that rapid scaling of SAGE and its subgroups created both capacity and capability challenges in the first few weeks and new systems had to be developed for surge capacity, resilience support for SAGE team and participants, information management and publication of minutes and scientific evidence. The established system of SAGE reporting into COBR did not continue beyond the first few months and new "docking points" for SAGE were required both in Cabinet Office and across departments. On occasions the advice from SAGE did not find a clear operational owner. These and other areas are addressed in the SAGE Development Programme. Data systems were poor at the beginning of the pandemic but improved. Continued focus on data systems will be important for all emergencies.

116. In places I have gone beyond the remit of science advice and commented on matters of operational preparedness. The 100 Days Mission identified an ambitious plan to be able to respond with medical countermeasures faster than was possible during this pandemic. Whilst this is a global mission, the implementation of the recommendations domestically should also be prioritised. Finally I suggest that exercises to test emergency preparedness should focus more on operational readiness and effectiveness and not just process assessment. Preparedness requires continued funding of key activities and using them in usual practice outside a pandemic environment.

Statement of Truth

I believe that the facts stated in this witness statement are true. I understand that proceedings may be brought against anyone who makes, or causes to be made, a false statement in a document verified by a statement of truth without an honest belief of its truth.

Signed: Personal Data

Dated: 11/04/23