Witness Name: Sir Mark Walport
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UK COVID-19 INQUIRY

WITNESS STATEMENT OF SIR MARK WALPORT FRS

Contents

Section 0: Introduction

I, Sir Mark Walport, will say as follows: -

1. I am currently retired from executive appointments and have a portfolio of non-executive directorships, trusteeships, and advisory roles. These include Honorary Distinguished Professor of Medicine, Imperial College; Director, Board of NHS England; Trustee, British Museum; Trustee and Chair, Kennedy Memorial Trust; Trustee and Council Member, Royal Society; Trustee, HDR-UK; Chair, Imperial College Health Partners; Chair Partnership Board Imperial College Academic Health Sciences Centre.

2. I have the degrees of MA MB BChir PhD from the University of Cambridge. I am a Fellow of the Royal College of Physicians, retired Fellow of the Royal College of Pathologists and Honorary Fellow of the Royal College of Paediatrics and Child Health. I am a Fellow of the Academy of Medical Sciences, a Fellow, Council member and Trustee of the Royal Society, and an Honorary Fellow of the Royal Society of Edinburgh.

3. I have extensive experience of strategy and policy development, the provision of science advice, the funding and catalysis of research, crisis management and organisational leadership.

4. I make this statement pursuant to a Rule 9 request from the Inquiry dated 8 February 2023. The facts of this statement come from my personal knowledge or the records of the Government Office for Science (GO-Science) or UK Research and Innovation (UKRI).

5. Prior to 2003, I practised clinical medicine and research as a general physician and rheumatologist mainly at Hammersmith Hospital, the Royal Postgraduate Medical School (RPMS). The RPMS merged with Imperial College in 1997, when I became Head of the Division of Medicine at Imperial College.

6. Of direct relevance to this Inquiry, I was Director of the Wellcome Trust from 2003 – 2013. From April 2013 to September 2017, I was Government Chief Scientific Adviser (GCSA). From April 2017 to June 2020, I was the founding Chief Executive Officer of UKRI. I overlapped between the roles of GCSA and CEO of UKRI for a few months, with additional support from Professor Chris Whitty, who was Deputy GCSA, then acting GCSA until the substantive appointment of Professor Patrick Vallance as GCSA.

7. I was a member of the Prime Minister's Council for Science and Technology (CST) (and co-chair during my time as GCSA) from 2004 to 2017 and continued to attend CST in my role as the CEO of UKRI until 2020.

8. As the GCSA, I was responsible for running GO-Science, ensuring the Prime Minister and Cabinet received the science advice they needed and driving systemic improvements across His Majesty's Government (HMG) in how science is used.

9. During my time as GCSA, I chaired the Scientific Advice Group for Emergencies (SAGE), and I attended 54 meetings of SAGE from April 2020 to July 2021 in my role as CEO of UKRI (including continuing to represent UKRI after my retirement as CEO).

10. My statement covers the period for Module 1 between the dates of 11 June 2009 and 21 January 2020. The large majority of my evidence will be confined to the dates from April 2013, which is when I became the GCSA, to 21 January 2020. I will refer to events outside this period in order to cover some of the Inquiry's specific questions.

Statement structure

11. I have structured this statement as follows: -

- The first section (paragraphs 12-28) describes my involvement and roles in the SAGEs convened for the Ebola outbreak (2014) and the Zika outbreak (2016). I put this involvement in the context of the other governmental scientific advisory committees and groups across the UK in which I participated over the course of the date range for Module 1 and specify the relevant time periods of my involvement.
- The second section (paragraphs 29-67) sets out the experience that I gained from my involvement in these groups put in the context of my other relevant experiences as GCSA. I set out my views on the effectiveness of the work and operations of these groups. I also consider the extent to which this work contributed effectively to the UK's pandemic planning, preparedness and resilience up until the time of the pandemic.
- The third section (paragraphs 68-82) sets out my views as to what were the key policies in scientific, technical and research capacity that had a material effect on the UK's pandemic readiness and set out what had been done correctly in relation to pandemic planning preparedness and resilience during my tenure in office.

- The fourth section (paragraphs 83-94) sets out my views, on the basis of my experience, as to what changes could have been made to the specialist scientific institutions, systems and process of the UK Government to better prepare it for a pandemic, considering in particular the operations of SAGE. I also look at the lessons learned from past simulation exercises and potential pandemic events which contributed to the preparedness for the Covid-19 pandemic and what lessons had not been learned.
- The fifth section (paragraphs 95-105) contains my answers to the Inquiry's questions about the principal areas of scientific research into infectious diseases that should be prioritised by the UK Government and what reforms, including to science and technology funding, structures and institutions, could be implemented to make the UK pandemic ready.
- In the sixth section (paragraphs 106-148) I address the questions that the Inquiry asks arising from the evidence that I provided to the Science and Technology Committee and the Health and Social Care Committee in December 2020.

Section 1: Participation in SAGE and other government scientific groups and committees.

12. I first set out the details of the role of the GCSA in order to frame my participation in SAGE and other science advisory structures and committees. I will not repeat here the contents of the third witness statement by Dr Stuart Wainwright OBE [MW/1 – INQ000148407], which sets out in detail GO-Science's roles and functions in provision of science in UK Government and science across Government in general. I agree with Dr Wainwright's comprehensive description of these matters.

13. 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) in my time (now DSIT, Department for Science, Innovation and Technology). The GCSA is the head of the Government Science and Engineering (GSE) profession and co-chair of the CST, an independent expert committee which provides advice to the Prime Minister.

14. I would like to contextualise my role as GCSA in relation to this Inquiry in three areas. The first is the role of the GCSA, GO-Science and Departmental Chief Scientific Advisers (CSAs) working with the Civil Contingencies Secretariat (CCS) in support of the development and updating of the National Risk Assessment (NRA) and its publicly available counterpart the National Risk Register (NRR). The second is the role of GCSA, GO-Science and departmental CSAs in preparedness exercises designed to rehearse the responses to selected Risks. This involvement was two-fold, either in support of departmental or cross-governmental civil contingency exercises or preparedness rehearsals involving 'mock' SAGE committees in cases of risks where scientific input was paramount. The third role of the GCSA, GO-Science and departmental CSAs is as a part of the response to actual emergencies.

15. During my time as GCSA, the CCS had overall responsibility for the development of the NRA and for working with individual departments and across government as appropriate to formulate and conduct civil contingency exercises. The CCS also provided the support and logistics for COBR in response to national emergencies. It is also important to note that each risk in the NRA is 'owned' by the most appropriate government department, which is responsible for managing the risk, working across government as appropriate. This responsibility includes policy and operational preparedness to prevent, mitigate, manage and 'clear up' in the event of an emergency.

16. Shortly before I started as GCSA, I had the opportunity to observe a civil contingency exercise and sat in on several COBR meetings. I had been briefed by my colleagues on the importance of scientific input to the NRA. I wrote a letter to the Director of the Civil Contingencies Secretariat on 30 April 2013 to arrange an introductory meeting with him and in my letter [MW/2 - INQ000142150] noted, "I would therefore find it very helpful to meet with you soon to discuss how we could further strengthen the current use of scientific evidence in all our risks."

17. During my time as GCSA, I was involved in the development of two updates of the NRA, in 2013 and 2016. I made a presentation to the Cabinet in 2013, after which I wrote a letter [MW/3 - INQ000142113] on 16 October 2013 to the Prime Minister, in which I set out four actions which I thought could further strengthen the NRA.

18. The three salient points relevant to this Inquiry in the letter were that:

    a. *"a good risk register should drive thinking about how risks can be prevented, mitigated, handled if they transpire and to clear up afterwards. The NRA is used*

fairly effectively for the handling and clear-up, but variably to drive decisions about prevention and mitigation."

b. *"I think that the NRA could also be used more effectively to prepare for handling of emergencies as they arise. Indeed, I have been working closely with the Cabinet Office to ensure scientific scrutiny of key risks. As part of this work I have requested that scientific briefing papers are created for each of the very high priority risks"*; and

c. "*It would be helpful for future iterations to have a behavioural science viewpoint; for example, how people react in the event of an evacuation, or how first responders react in an emergency situation.*"

19. During the preparation of the update of the NRA for 2015 I sent an email [MW/4 - INQ000142145] on 10 June 2014 to the Cabinet Office about the National Security Risk Assessment in which I wrote: "*I remain of the opinion, however, that response and recovery is only a part of the benefit of a successful risk management. It is surely as important to be pro-active in taking steps to prevent events from happening in the first place, or if that isn't possible, to take steps to mitigate against their effects. As such, I am keen for us to explore how Government could use the NSRA (and indeed the NRA) more effectively to avoid and mitigate against specific risks.*"

20. I followed this up with a letter [MW/5 - INQ000142120] to the Civil Contingencies Secretariat in October 2014. In this letter I made three suggestions for strengthening the NRA:

a. "*Firstly, in order for the NRA to be useful it needs to be accessible. The current NRA is held at a high security classification and I think this is a factor in making it less well known across Government. We should be aiming to produce a document that is largely accessible, with more highly classified annexes. This will better inform those who should be aware of the UK's key risks, while keeping the more sensitive information properly protected".*

b. "*Secondly, I think there are four reasons to have a risk assessment; to prevent the risk; to mitigate the risk, to respond to it and to recover. The response and recovery have been addressed in your work to date. However, I think we need to actively look at what the Government can do to avoid and mitigate against the risks. This remains an outstanding issue and I would like to see this tackled more effectively in the coming months.*"

c. "*As we saw during the winter flooding and again in the Canvey Island flooding, one risk can cascade into another. We need to model the interaction of risks and their consequences.*"

21. One impact of this letter and related work was that the 2016 NRA [MW/6 - INQ000000] was released across government at Official Sensitive level, which, for the first time, made it widely available inside government. The 2016 NRA contained a foreword written by Cabinet Office Minister, Mr Ben Gummer, and me. Relevant paragraphs from that foreword are:

a. "*The 2016 National Risk Assessment brings together within a single framework an assessment of the key risks that have the potential to cause a significant disruption in the UK. As such, it is an essential part of our risk management toolkit, providing Government and local responders with the means to prioritise and proportionately prepare for a range of eventualities*" and

b. "*In line with a programme of continuous improvement, this iteration of the National Risk Assessment is more robust, informative, and accessible than previous iterations. To reflect the UK's integrated approach to emergency management, information about national risks and their common consequences is now held in one comprehensive and concise document. We have made this document available at Official Sensitive in order to ensure that those with the responsibility to prevent, mitigate, respond to and recover from any emergency, whether locally or nationally, have improved access to the evidence base on which to take informed action.*"

22. As part of the work of National Security Council Officials' Science and Technology subcommittee (NSC(O)S&T), we developed a UK Biological Security Strategy [MW/7 - INQ000142143], aiming to bring together planning in government for potential malicious and natural infectious outbreaks. I wrote to Sir Kim Darroch, National Security Advisor and Chair of NSC(O), on 31 July 2014 enclosing a high level summary of the Strategy and in my letter [MW/8 - INQ000142118] noted, "*The strategy is significant in that, for the first time, all strands of bio-security science and technology are drawn together, covering both the hazards arising from natural disease outbreaks ('flu pandemics, foot and mouth, etc.) as well as biowarfare and counter-terrorist aspects. This provides HMG with an overview of our skills, abilities and gaps in this area.*" The introduction to this paper sets out the reasons why we developed the strategy:

a. "*Significant outbreaks of disease caused by infectious organisms or toxins are amongst the highest impact risks faced by the UK. At their most extreme, outbreaks of disease could cause thousands of fatalities and/or massive economic impact. This is true whether the disease in question is the result of natural exposure, accidental release from scientific or industrial facilities, or a deliberate attack by state or non-state actors. Large scale disease outbreaks in animals or plants can be equally significant, in terms of economic, environmental and social impact.*"

b. *"Regardless of their origin, national-level policy and planning is needed to mitigate the risks of such outbreaks occurring and/or to coordinate any necessary response. Such a response would be similar, whether the cause was natural, accidental or deliberate. The disease would need to be identified, its spread understood and minimised, appropriate treatment provided, and the causes properly understood and mitigated against for the future. This requires an integrated, cross-government response. Capabilities developed to manage more common outbreaks of naturally occurring disease are key for handling incidents of accidental or deliberate release."*

c. *"Ensuring that the UK can effectively manage the threat of significant disease outbreaks requires a range of Government Departments, Devolved Administrations and other Agencies to work closely together. While much excellent work is already being done here, their efforts should be brigaded under a single strategic approach to ensure that their work is coherent and complementary, properly guided and could cope if the threat of a high-impact disease outbreak suddenly increased."*

d. *"This Bio Security Strategy sets out the framework within which the UK Government (including the Devolved Administrations) will work to manage the threat posed by significant outbreaks of disease. It aims to reduce the risk of high-impact outbreaks of disease and mitigate the impact should they occur."*

23. This work eventually culminated in the publication of the UK Biological Security Strategy [MW/9 - INQ000142130] in July 2018. The ministerial foreword noted *inter alia*

a. *"Significant outbreaks of disease are among the highest impact risks faced by any society – threatening lives and causing disruption to public services and the economy. This is true whether such outbreaks occur naturally, such as pandemic influenza or emerging infectious diseases, or in the less likely event*

of a disease being caused by an accidental release from scientific or industrial facilities, or as the result of a deliberate biological attack. Large scale disease outbreaks in animals or plants can be equally significant in terms of economic, environmental and social impact."

b. *"This strategy brings together, and sets out in one place for the first time, the wide range of activity that is carried out across Government to do this. It also explains how in the future we will co-ordinate our activity more strongly and take a truly comprehensive approach to meet the evolving risks (and opportunities) in this area. This will mean closer work between departments, so that prevention activity, the deployment of response capabilities, research programmes, and our engagement with international partners, industry and academia are aligned and their impact maximised."*

24. The implementation of the strategy was set out as follows:

a. *"Minister responsible – Security Minister*

b. *Governance structure: Governance for much of the activity described in this strategy falls within departments' existing portfolios and governance mechanisms. This strategy brings together that activity to ensure that a cross-Government approach to biological security is maintained, while avoiding duplicating existing mechanisms and activities."*

c. *"Many of the commitments can only be delivered if Government departments work together, in many cases across sectors that have not previously systematically engaged with one another. These commitments (as well as any new work or identified gaps that emerge when work on biological risks is being co-ordinated) will be owned by a cross-Government director-level governance board, made up of representatives from the following departments: • Home Office • DHSC (including PHE representation) • Defra (including APHA representation) • Agri-Food and Biosciences Institute (AFBI) • MOD (including Dstl representation) • FCO (including the Science and Innovation Network) • BEIS • DFID • GO Science • Cabinet Office • HSE • OLS • Department for International Trade • the Devolved Administrations"*

d. *"This governance board will report to the Threats, Hazards, Resilience and Contingencies Subcommittee of the National Security Council, through the Security Minister, to ensure that a forum at the highest level of Government*

holds departments to account. The Government Chief Scientific Adviser will maintain an oversight of developments under the strategy."

25. I now set out my involvement and that of senior colleagues where appropriate in activations of SAGE in rehearsals and during emergencies. Dr Stuart Wainwright set out in his third witness statement a description of the operations of pre-SAGE and SAGE committees and how members are recruited to these committees [MW/1 – INQ000148407]. He correctly noted that "*during an emergency, the SAGE secretariat may seek additional experts to provide advice where previously unanticipated gaps in expertise are identified. This may include inviting participants from overseas as happened during Covid-19. Guidance on participation is available in the 'Enhanced SAGE Guidance' document available on GOV.UK.*" [MW/10 - INQ000101595]

26. I (or a senior colleague where specified) participated in four cross-government exercises involving SAGE between 2013 and 2017. In 2016, I participated in Operation Cygnus, a tier one operation relating to pandemic influenza [MW/11 - INQ000142135]. I also participated in exercises in 2014 and 2017 which related to national security matters and which are not related to the issues covered in this statement.

27. I (or a senior colleague where specified) led six SAGE exercises between 2013 and July 2017. CYGNUS Phase 1 took place in May 2014, in the form of a one-day table-top exercise involving a series of meetings, including a mock SAGE meeting [MW/12 INQ000142136]. Other SAGE exercises between 2013 and 2017 covered various other topics, some of which related to national security matters and none of which are not related to the issues covered in this statement.

28. I (or a senior colleague where specified) chaired or co-chaired the following SAGE activations between 2013 and 2017:

    a. February 2014 – SAGE: UK winter flooding

        i. SAGE convened 3 times.

        ii. SAGE gave advice on around how long flood waters might persist, the integrity of structures affected, and on rainfall outlook.

        iii. The published minutes are publicly available on gov.uk [MW/13 - INQ000142154]

b. October 2014 – SAGE: Ebola Virus outbreak (working closely with CMO Dame Sally Davies)

    i. SAGE convened 3 times between October and December.

    ii. SAGE advice focused on modelling the spread of the outbreak and around local burial practices.

    iii. The published minutes are publicly available on gov.uk [MW/14 - INQ000142152]

    iv. This outbreak led to the establishment of the precautionary SAGE principle, whereby SAGE can be activated by the GCSA and can meet ahead of a formal activation from Cabinet Office, as detailed further at paragraph 31 below.

c. April 2015 – SAGE: Nepal earthquake

    i. SAGE convened once.

    ii. The main purpose of the meeting was to determine the worst-case scenario mortality figure, along with advice on future aftershocks, landslides and water availability.

    iii. The published minutes are publicly available on gov.uk [MW/15 - INQ000142153]

d. June 2015 – Precautionary SAGE: MERS

    i. A single meeting was convened, chaired by Prof John Watson (deputy CMO).

    ii. This meeting drew together the current state of knowledge about MERS and cases in South Korea. It concluded that the UK risk assessment on MERS was appropriate [MW/16 - INQ000142137]

e. February 2016 – Precautionary SAGE: Zika

    i. Five precautionary SAGE meetings convened over February to August 2016.

    ii. These discussed potential medical consequences from catching the virus, mechanisms of transmission, and modelled the trajectory of the outbreak.

iii. The published minutes are publicly available on gov.uk. [MW/17 - INQ000142155]

Section 2: Experience of participating in these advisory structures and views on their effectiveness and my views specifically in relation to pandemic preparedness.

29. I will start this section of my witness statement by describing in detail my involvement in the emergencies and the exercises that occurred during my period as GCSA. There were important international outbreaks of three infectious diseases, Ebola, MERS and Zika, each of which we considered to justify activating SAGE to explore the level of risk to the UK and, in the case of Ebola, additionally to explore the risks to military and civilian first responders from UK supporting the local control of the outbreak in West Africa. I will deal with each of these outbreaks in turn. At the end of this section I will provide my views on the effectiveness of the advisory structures and specifically in relation to pandemic preparedness.

30. **Ebola**

a. In August 2014, the CMO for England convened a Health Advisory Committee (HAC), composed of relevant UK experts, to provide her with clinical advice on the in-country and domestic response. The HAC met four times between August and October during the crisis, covering potential new treatments, public health management and care for EVD patients.

b. The CMO for England, in collaboration with the Wellcome Trust and the Department for International Development (DFID) CSA, assembled a group of experts to form the Ebola Scientific Advisory Response Group (ESARG) in September, which addressed questions around community transmission and isolation.

c. The Advisory Committee on Dangerous Pathogens (ACDP), a standing expert scientific advisory committee and experts from Public Health England (PHE) also provided the CMO for England with advice on public health issues in both Sierra Leone and the UK.

d. Following a request from COBR, SAGE was convened in October, subsuming ESARG. I co-chaired this with the CMO for England, bringing together scientific and technical experts. SAGE's role was to ensure coordinated and consistent scientific advice was provided to COBR so that decision-makers were

presented with rounded, evidence-based advice during the Ebola outbreak, particularly in relation to the in-country response in Sierra Leone. This group met on three occasions between October and December 2014 and was supported by two sub-groups:

i. The Ebola Modelling Group, drawn from the existing, health-related core modelling capability and including world leading experts, coordinated the various streams of modelling-based analysis of the Ebola outbreak supporting Government policy. This group provided a high quality, rapid response to emerging evidence in a highly dynamic situation, which was crucial to support planning and delivery of in-country control measures. The modelling group and SAGE presented to COBR and Ministers a range of scenarios [MW/18 - INQ000142169] for the development of the outbreak, making clear that these were projections (and not predictions) of a wide range of possible outcomes at a time when the data on case numbers were sparse and at an early stage of growth in case numbers. I provide an example [MW/19 - INQ000142171] of such a presentation that was presented in COBR.

ii. The Ebola Anthropology and Social Science Group, a network of social scientists funded by DFID and the Wellcome Trust through the Research for Health in Humanitarian Crises (R2HC) programme, provided advice on behavioural science to inform the in-country response.

31. At the end of the Ebola outbreak, GO-Science conducted a review of the lessons that had been learned [MW/20 - INQ000142141]. The HoC Science and Technology Committee also conducted an enquiry [MW/21 - INQ000142122] and questioned me as a witness, to which there was a government response [MW/22 - INQ000142123]. One very important lesson from the Ebola epidemic was the need for a change in the protocol for activating SAGE. Until Ebola, SAGE only met after a formal commission from the Cabinet Office, typically alongside the activation of COBR. This was felt by me and GO-Science to be much later than ideal (although good activity was being led in Department of Health and Social Care (DHSC) by the CMO). The Ebola epidemic led to the establishment of the precautionary SAGE principle, whereby SAGE can be activated by the GCSA and can meet ahead of a formal activation from Cabinet Office.

32. **MERS**

a. GO-Science convened a group of government and external experts on 9 June 2015 to consider the MERS outbreak in South Korea and the risk to the UK. This was the first instance of a Precautionary SAGE activation by GO-Science. The meeting was chaired by Dr John Watson, Deputy CMO.

b. The expert group confirmed that:

    i. Initial limited analysis of genetic data from two samples in the South Korea outbreak suggests that it is not genetically different from the viruses that are or have circulated in the Arabian Peninsula.

    ii. PHE's assessment that the risk of widespread infection with MERS-CoV in the UK remains very low is correct. This will be kept under review.

c. The outcome of the meeting is to be found in [MW/23 - INQ000142140]: "*It was agreed that the current UK risk assessment and response was proportionate. PHE and DH will continue to monitor the status of the disease with input from two advisory groups: the New and Emerging Respiratory Virus Threats Advisory Group (NERVTAG), and the Advisory Committee on Dangerous Pathogens (ACDP).*"

d. Actions from the meeting of the group were:

    i. Department of Health (DH; renamed DHSC in January 2018) to work with DFID and other funders, such as the Medical Research Council (MRC), to consider the immediate key research questions.

    ii. All attendees to push international collaborative groups working with affected countries to release new and older data relating to the virus genome.

    iii. GO Science to circulate summary note of the pre-SAGE meeting quoted above [MW/16 - INQ000142137] to attendees to make sure technical information is correct.

33. **Zika**

a. The Government Chief Scientific Adviser and the Department of Health's CSA convened and co-chaired a meeting of government and external experts on 3 February 2016 to consider the Zika outbreak in the Americas, the link with

microcephaly and the risk to the UK. The advice [MW/24 - INQ000142144] from the meeting focused on the UK domestic response to Zika.

b. The expert group confirmed that:

   i. *"The risk of acquiring Zika depends on whether an individual is in an area of active transmission.*

   ii. *The risk of severe illness is low for those who are not pregnant.*

   iii. *There is a substantially increased risk to pregnant women if they acquire Zika and this should be taken into account when considering travel to the region. The risk is not to the mother, but to the fetus.*

   iv. *The risk of contracting Zika during air travel when returning from an area of active transmission is exceptionally small and will be reduced further through disinfection.*

   v. *The risk of an outbreak of Zika in the UK is close to zero."*

c. I should explain why there was a high level of confidence that the risk of an outbreak of Zika was close to zero. This is because Zika is a mosquito-borne infection caused by the Zika virus. Two species of *Aedes* mosquito are important. *Aedes aegypti* (currently the main vector) and *Aedes albopictus*. Neither were established in the UK at the time of the Zika outbreak, so the chances of an imported human case of Zika giving rise to an **outbreak** in the UK via mosquitoes was considered in 2016 for practical purposes to be zero.

d. Five pre-SAGE meetings (which I co-chaired with CSA, DH) were held between February and August 2016, with an update of the scientific advice to government after each meeting. I attach the final update [MW/25 - INQ000142160] after the meeting of 2 August 2016 to illustrate how the scientific advice had evolved during the period of the Zika outbreak.

34. **Influenza**

a. Turning to influenza, an influenza pandemic has been consistently assessed as the most serious non-malicious risk facing the UK since the first iteration of an NRA in 2005. This risk was and is 'owned' strategically and operationally by the DH (now DHSC), which, during my time as GCSA, held the budgets for PHE and NHS England. The key senior medical and scientific advisory figures in DH (now DHSC) are the CSA and the Chief Medical Officer. These two roles

were initially one during my time as Chief Scientific Adviser and were held by Dame Sally Davies. They were separated with the appointment of Professor Chris Whitty as CSA to DH and Head of the National Institute for Health and Care Research (NIHR) in January 2016.

b. The DH/DHSC also has an extensive set of expert advisory committees with relevance to pandemic influenza and other infectious diseases.

35. **Exercise Cygnus**

a. During my time as GCSA, the only specific exercise for the handling of an influenza pandemic, with which I and GO-Science were involved was Exercise Cygnus. This was a Tier 1 (national level) multiphase exercise, conducted in three phases:

i. An Exercise Cygnus one day table top exercise, including a mock-SAGE meeting, 14 May 2014

ii. Exercise Cygnet – a discussion-based exercise held 2 August 2016 as part of the build-up to the Tier 1 phase

iii. Tier 1 Exercise Cygnus – 18-20 October 2016

36. The overarching aim of the exercise was to assess the UK's preparedness and response to a pandemic influenza that was close to the UK's worst-case planning scenarios.

37. The purpose of the Tier 1 component of Exercise Cygnus was to enhance the UK's ability to manage the effects of an influenza pandemic by practising and validating response policies and C3 mechanisms (command, control and coordination) at national, regional and local levels.

38. The main input of GO-Science was to provide input during the preparation phase of the exercise in 2014. The main activity was the conduct of a mock-SAGE meeting, which I co-chaired with the CMO, Dame Sally Davies [MW/26 - INQ000142119]. I have reviewed the agenda, briefing notes and record of that meeting to help me in the preparation of my witness statement.

39. The commission to this mock-SAGE meeting was a commission from COBR: *"The Prime Minister has asked SAGE to analyse the forecasting and provide an agreed view on how bad this outbreak could be, to provide commentary on the knock-on effects of that forecast and to provide a scientific view on various mitigations".*

40. The assumptions set to conduct the exercise were that the virus was an H2N2 influenza virus, a variant of the virus responsible for the 1957-58 ("Asian flu") pandemic, but that genetic analysis showed that this virus was significantly distinct from the 1957-58 strain and that therefore there was no expectation of significant population immunity. The final clinical attack rate was set at a range of 30-40% of the population with a 'reasonable worst case" planning assumption figure of 50%. Case fatality rates were estimated to be closer to 1918 than the pandemics of 1957 and 1968/69 and in the range of 1 to 2.5%. Both estimated case fatality ratios and estimated attack rates were likely to undergo major adjustment as more information became available.

41. I include the note of this meeting here [MW/12 - INQ000142136] as in my view, the contents are all salient to my witness statement:

"a. Situation Report

i. The group considered the tabled paper on the surveillance mechanisms currently activated and agreed that these represent a robust and extensive approach to surveillance. It was agreed that the adequacy of these mechanisms should be kept under review.

b. Forecasting

i. It was agreed that the data on mortality should be presented more simply with the population in numbers and the projected numbers of deaths. On the mortality figures it was agreed that in 4-5 weeks we would be able to provide more certainty on the projected number of deaths.

ii. Members agreed that half-term effects should be modelled, advice on how quickly this can happen will be provided to COBR

c. Review of Countermeasure Policies

i. It was agreed that the current strategy of treating all symptomatic cases with antivirals should remain but be kept under review. The group noted that further work is being undertaken by PHE to inform the decision on the use of the reserve zanamivir stockpile and any eventual rationing of antivirals to target groups.

ii. *The group suggested that pressure on the national antiviral stockpile could be greater than modelling suggests given potential for significant 'gaming' of the National Pandemic Flu Service by a fearful public.*

iii. *The advance purchase agreement for vaccines was discussed and the group felt it would be useful to access how this would be upheld if the factories were located in another country.*

iv. *Social distancing measures were considered, and a number of issues were discussed. Firstly, it is not clear how effective any school closures would be due to children mixing outside of schools. Any school closures would also result in greater levels of work absences. Social distancing is to be discussed in detail at next week's SAGE and further work would be required to understand the potential impact of school and university closures on the economy and critical national infrastructure, as well as impact on child mortality and absence levels in the health and care workforce.*

d. *Sickness absenteeism and its impact on national infrastructure*

i. *Sickness absenteeism was discussed, and it was noted that forecasts presented to SAGE included all current pandemic absenteeism. The group agreed that consideration would need to be given to understanding the level of absence within this due to people staying away from work as a preventative measure.*

ii. *It was agreed that each government department should take the absenteeism forecasts presented to SAGE and consider the business continuity impacts of these on their respective areas in advance of discussion at COBR.*

e. *Excess deaths*

i. *It was agreed that further work would be required to confirm advice on the minimum safe temperature for body storage.*

ii. *It was agreed that CCS would provide advice on the specific departmental responsibilities for managing excess deaths, recognising that the issue is an operational one that SAGE would not need to consider specifically."*

42. The output of this mock-SAGE meeting, combined with additional health input, was presented in a paper entitled "Consolidated scientific and health advice for Phase One – Exercise Cygnus" to participants as part of the papers for the Tier 1 National exercise in October 2016 [MW/27 - INQ000142117]. It is stated in the introduction to this report that it "reflects the consolidated scientific and health advice from advisory groups including SAGE. SAGE met on 10 Sep to assess the current understanding of the epidemiology of the influenza A (H2N2) outbreak both internationally and domestically." GO-Science played a very limited role in the actual exercise. There were no mock-SAGE meetings as part of this. Dr Rupert Lewis, Director, GO-Science attended a Ministerial briefing meeting on day 2 of the exercise on 19 October 2016 on my behalf.

43. Exercise Cygnus was an exercise delivered by PHE on behalf of the Department of Health. In July 2017 they prepared a report of the exercise and of the lessons learned. This was released publicly on 20 October 2020, [MW/11 - INQ000142135], with some redactions. It contained one (unredacted) section of six paragraphs on the provision of scientific advice, including SAGE, as follows:

"a. *The SAGE element of Exercise Cygnus was exercised as part of the exercise preparations in 2014 and a mock SAGE was held. The outputs from that meeting were used to develop the 2017 exercise scenario. A record of the 2014 mock SAGE meeting is held by DH.*

b. *"There was limited feedback about the provision of scientific advice during the exercise. At the national level participants used the scientific advice contained in the scenario documents. LRFs received scientific advice during the exercise from their local PHE colleagues. There were no reports of LRFs experiencing difficulty in accessing this information. During the planning phase and Exercise Cygnet it was noted that there was a lack of clarity about where modelling data could be accessed from for planning purposes. There were also questions about how the various teams providing data would work together in a response, in what form data would be provided to responders and how it could be used.*

c. ***"LESSON IDENTIED** (sic) **17: The process and timelines for providing and best presenting data on which responders will make strategic decisions during an influenza pandemic should be clarified.***

d. *"In Exercise Cygnet participants reported that they were unclear about how epidemiological information would be produced and disseminated to*

responding organisations. Timelines for the production of this data should also be reviewed to ascertain if they can be shortened.

e. *"During Exercise Cygnus, participants at the SCG were using at least three sets of figures as a basis for planning. All the figures for the exercise were generated from the same dataset. The scenario development for Exercise Cygnus relied heavily on input from modelling teams in PHE and NHS England. The PHE data for the scenario was provided by the Emergency Response Department's Bioterrorism and Emerging Disease Analysis Team. This provided national level data which the LRF planners then had to adapt to reflect the local picture. The Analytical Services Team from NHS England's Operation and Information Directorate used the PHE data to provide an NHS National SitRep for the scenario and a local breakdown of hospital occupation. SCGs were also provided with epidemiological modelling data provided through PHE's Field Epidemiology Service based in the National Infection Service."*

44. I note that the evidence behind the mock-SAGE advice paper was derived from a series of Science Evidence Base Reviews that followed the 2009 H1N1 flu pandemic and supported the UK Pandemic Preparedness Strategy of DH. I illustrate these with one example, "The Use of Facemasks and Respirators during an Influenza Pandemic". [MW/28 - INQ000142156] This was written originally in 2010 and updated with evidence up to the end of November 2012. Before its completion in March 2013, it was peer reviewed by the SPI-M committee. It was published externally in May 2014. The conclusions of this evidence review were:

"Despite a further review of all the available evidence up to 30 November 2012 there is still limited evidence to suggest that use of face masks and/or respirators in health care setting can provide significant protection against infection with influenza when in close contact with infected patients. Some evidence suggests that mask use is best undertaken as part of a package or 'bundle' of personal protection especially including hand hygiene, the new evidence provides some support to this argument particularly within the community or household setting. Early initiation and regular wearing of masks/respirators may improve their effectiveness in healthcare and household settings, again an argument marginally strengthened by the updated evidence. The effectiveness of masks and respirators is likely to be linked to consistent, correct usage and compliance; this remains a major challenge –

both in the context of a formal study and in everyday practice. Given the potential loss of effectiveness with incorrect usage, general advice should be to only use masks/ respirators under very particular, specified circumstances, and in combination with other personal protective practices."

45. **The Effectiveness of the Advisory Structures during my time as GCSA**

46. Having set out in paras 29–44 above my experience of participating in these advisory structures I will give my personal views on their effectiveness, and comment specifically in relation to pandemic preparedness.

47. I will start with a few general comments and lessons learned from the wide variety of exercises and emergency responses with activation of COBR in which I participated (set out in paras 48–51), and then focus specifically on the international Ebola and Zika emergencies and the flu exercise CYGNUS.

48. I arrived as GCSA in 2013 without any experience of the management of national emergencies. I was aware of the SAGE and COBR committees and, just before taking up my appointment, sat as an observer at a mock COBR meeting [MW/29 - INQ000142112], thanks to an invitation from my predecessor, Sir John Beddington. My first observation is that it is of enormous benefit to the UK to have a 'hard-wired' mechanism for scientific (including the social sciences) input to national emergencies that can be rapidly tailored to provide deep expertise for particular emergencies.

49. One early lesson was that there were no specific guides for each of the hazards and threats underlying the NRA, so we set out to provide guide documents that would set out the 'bare bones' of the scientific issues and uncertainties needing clarification, initially predominantly focused on natural hazards, but aiming to include over time both hazards and the consequences of human threats, particularly those involving release of toxic biological, chemical or nuclear materials, i.e. the risks in the NRA where SAGE input might be useful. These science guidance documents, including one on Emerging Infections [MW/30 - INQ000142139] were developed in close collaboration with the lead government department that 'owned' the risk. I understand that these science guidance documents 'morphed' into the current set of "golden hour" documents used by GO-Science.

50. A further valuable lesson was that great added value could be provided in emergencies by seconding experts into GO-Science to help with emergencies

which lasted for weeks or more. During the prolonged episode of flooding in SW England in 2014, we recruited, to augment the GO-Science team, an academic hydrologist from the University of Reading, Dr Hannah Cloke, who worked full time in GO-Science for approximately six months.

51. During that same period of flooding, we recruited two international experts in hydrology, flooding and engineering from the Netherlands and the USA to "peer review" the Government response during the emergency. They provided independent assurance of the national response.

52. Turning now to infections – during my period as GCSA there were important international outbreaks of three infectious diseases, Ebola, MERS and Zika, each of which we considered to justify activating SAGE to explore the level of risk to the UK and, in the case of Ebola, specifically to explore the risks to military and civilian contributors to the UK supporting the response to the epidemic in West Africa. I will deal with each of these outbreaks in turn.

53. There were two extremely important outcomes of the Ebola epidemic in west Africa and the emergence of MERS as a significant respiratory hazard. The first was the creation of the UK Vaccine Network (UKVN), a group of experts from academia, industry, government and philanthropic organisations, chaired by the DHSC CSA, who at the time of its formation and implementation was Professor Chris Whitty. This was established in response to the Ebola outbreak and met six times across 2015 and 2016. It prioritised 12 pathogens as priorities for vaccine development. These were: Chikungunya, Crimean-Congo Haemorrhagic Fever, Ebola, Hantavirus, Lassa, Marburg, Middle East Respiratory Syndrome, Nipah, Plague, Q Fever, Rift Valley Fever, Zika. Prioritisation criteria included: likelihood of an outbreak; possible severity of an outbreak; and current availability of treatment or vaccine products. The UKVN [MW/31 - INQ000142158] advised that investment should be centred on:

    a. Late-stage preclinical development and early-stage clinical development of vaccine candidates for the priority pathogens

    b. Development of novel vaccine platforms and manufacturing techniques to:

        i. Enable vaccines against unknown pathogens to be developed faster

        ii. Improve accessibility and delivery of vaccines in LMICs (low- and middle-income countries)

54. In the 2015 spending review the Global Health Security (GHS) team in DH was provided with £477m of UK Official Development Assistance (ODA) funding to develop projects in and for low- and middle-income countries (LMICs), with the aim of contributing to a 'world safe and secure from infectious disease threats and promotion of Global Health as an international security priority.' [MW/32 - INQ000142128] Of this £110 million was allocated in support of projects and programmes aiming to develop vaccines against the 12 priority pathogens identified by the UKVN.

55. This programme was delivered through a series of grants and contracts by the UK Research Councils, Innovate UK and NIHR and the most recent summary and collection of the key documents describing and analysing it is at UK – Department of Health and Social Care (DHSC): UK Vaccine Network. [MW/33 - INQ000142147] Amongst the portfolio of 78 projects (listed in UK Vaccine Network Project Annual Review – 2018/19) was an award of £1.87million for a project entitled "Phase I studies of a novel chimpanzee adenovirus MERS vaccine", conducted by the MRC Centre for Human Immunology, University of Oxford, with Jenner Institute, University of Oxford.

56. The second important development following the Ebola outbreak and emergence of MERS was the creation of the New and Emerging Respiratory Virus Threats Advisory Group (NERVTAG). This was established in 2014 and replaced the UK Scientific Pandemic Influenza (SPI) Advisory Committee. The role of this new advisory group was extended to cover not only pandemic influenza but any new, emerging respiratory virus threat to the UK. It was chaired by Sir Jonathan Nguyen-Van-Tam and first met in December 2014. In his foreword to the first annual report of NERVTAG, [MW/34 - INQ000142125] Sir Jonathan noted: *"In the post-pandemic period we have seen further emerging respiratory virus threats with potential consequences for humans; Influenza A(H7N9), A(H5N8) and A(H5N6), and the Middle East Respiratory Syndrome coronavirus (MERS Co-V). We are reminded that we cannot predict the future, beyond saying that another pandemic is inevitable at some point, but it seems quite clear that the range of major respiratory virus threats to public health may well extend beyond influenza. Likewise, a great many scientific lessons have been learned from the 2009 pandemic and UK preparedness plans updated in line with new scientific evidence."*

57. A process lesson that was learnt from Ebola was that the model for activation of SAGE needed some modification. Up until 2015 a SAGE meeting could only be

convened in response to a CCS request for scientific advice, typically in association with COBR being activated. In the case of Ebola, the outbreak started in March 2014 with reports of small numbers of cases in Guinea and Liberia. Case numbers rose significantly in July and rose steeply thereafter. The CMO convened a Health Advisory Committee in August (as described in more detail above in para 30(a)) and assembled a group of experts to form the Ebola Scientific Advisory Committee in September. It was not until October 2014, three months after the outbreak had expanded substantially in Guinea, Liberia and Sierra Leone, that COBR requested advice from SAGE, to ensure that it received rounded, evidence-based advice during the Ebola outbreak, particularly in relation to the in-country response in Sierra Leone.

58. After this experience, there was an agreement reached between the GO-Science and CCS to allow GO-Science, on its own initiative, to assemble a "pre-SAGE" advisory group to allow it to pro-actively develop and present to government the scientific evidence that could be important for policy makers. This mechanism was used at the start of the MERS outbreak in 2015.

59. I give this detailed account of the Ebola SAGE and MERS pre-SAGE activations to illustrate that there was widespread awareness in the science advisory structures of GO-Science and DH of the risks from emerging viral infections and their potential to become pandemic. This awareness of the dangers of emerging novel infections led directly to funding to enhance vaccine development for emerging infections. The funding of work on developing a vaccine against MERS coronavirus was instrumental in the preparedness of Professor Sarah Gilbert and her Oxford colleagues, as soon as the viral sequence of SARS CoV-2 became available, to pivot their vaccine development with huge success from MERS to SARS CoV-2.

60. It has been very interesting looking back at the Cygnus exercise, especially with the power of hindsight. From a mock-SAGE exercise perspective it was in many respects unusual because there was so much rigorous evidential input, that had been augmented following the 2009 (H1N1) flu pandemic. However, the actual Tier 1 National Exercise was an operational exercise focused specifically on how the NHS would manage and cope with a pandemic causing very large numbers of deaths and even more people with very severe morbidity. The exercise was conducted over just two days. SAGE played a significant role in providing the scenario but was an extremely minor player in the exercise itself.

61. The difficult questions that came back to challenge scientific advisers and policy makers during the Covid-19 pandemic, about the wearing of masks, social distancing, and school closures were considered in 2014 and 2016, in the context of the best evidence or lack of it. The obvious challenge now is: given the uncertainties in the evidence identified at the time of the exercise, could the evidence gaps have been reduced by research between the 2009 pandemic and 2020, when the Covid-19 pandemic started?

62. As I described above, many of the scientific issues were raised and tackled, with the evolution of SPI to NERVTAG – and a large amount of dedicated funding, aimed at vaccine development for known emerging infections. But establishing an evidence base on which to take more informed decisions on the wearing of masks at a population level, or the effects of social distancing measures or school closures is a much tougher proposition. Establishing in rigorous laboratory conditions the efficacy of masks against inhalation of particles of defined sizes is a very different question to understanding their effectiveness in large populations in the real world.

63. From my experiences during my time as GCSA, it is my opinion that in the area of natural hazards, health was amongst the best prepared areas in relation to access to strong scientific evidence and an exceptional array of scientific advisory groups in DH. Other government departments also play important roles.

64. **My participation in other government scientific groups and committees**

65. As the GCSA I participated in many other government scientific groups and committees. I have selected a subset of these that I think have the most relevance to this Inquiry. I start by providing a broad 'taxonomy' of the committees and groups with which I was involved. The work of these groups contributed to:

    a. Optimising the mechanisms for providing scientific advice to government and improving the "customer function" of government and individual government departments in demanding and using effectively such advice;

    b. Working to improve national resilience;

    c. Horizon scanning of emerging technologies looking specifically at their importance for government, society and the economy, and at issues to draw to the attention of policy makers in government; and

    d. Foresight work to look through a lens of science and research at potential futures in important areas for society.

66. In the following paragraphs, I will provide examples of committees and groups in which I participated, with examples of outputs and impacts in relation to each of the areas set out above:

a. I joined the Prime Minister's CST as a member in 2004, when I was Director of the Wellcome Trust. In my role as GCSA, I became the co-chair of the Council with Dame Nancy Rothwell as the 'outside government' co-chair. Outputs from CST from 2013 to 2017 included the letters to the PM and other senior ministers on a wide range of issues including STEM education, genetic modification technologies, and driverless vehicles.

b. I chaired or co-chaired several groups aimed firstly at improving the co-ordination and quality of the scientific advice provided to government departments and secondly at improving the "customer pull" for such advice. Some examples include:

    i. Established taskforce by the CSA and chaired by Professor Chris Gilligan to investigate how plant health functions are performed and make recommendations about how GB should protect tree health and strengthen plant biosecurity [MW/35 - INQ000142116].

    ii. Collaborative work that I undertook with Professor Ian Boyd, CSA at DEFRA concerning animal and plant health, touching on the UK's capacity to predict detect, understand and respond to animal disease [MW/36 - INQ000142121].

    iii. Working with relevant departments and agencies across the whole UK wrote "A Vision and high-level strategy for UK animal and plant health research to 2020 and beyond" [MW/37 - INQ000142157].

c. GO-Science has a responsibility for preparing in-depth foresight studies looking at major issues in the medium and long-term future.

    i. One highly relevant report was produced by my immediate predecessor Sir John Beddington in 2012

        1. Reducing risk of future disasters [MW/38 - INQ000142115]

    ii. In my time at GO-Science we published the following foresight projects – in undertaking these we always worked with government departments and ministers to ensure that there was active interest in advance of their

publication. Each report was accompanied by a series of commissioned evidence papers

1. Future of Cities [MW/39 - INQ000142124]
2. Future of an ageing population [MW/40 - INQ000142131]
3. Future of skills and lifelong learning [MW/41 - INQ000142129]
4. Future of the sea [MW/42 - INQ000142127]

d. GO-Science Blackett reviews typically cover emerging technologies and topics relating to security and national resilience.

i. Again, my predecessor Sir John Beddington wrote a review highly relevant to this Inquiry in 2012

1. Blackett Review of High Impact Low Probability Risks [MW/43 - INQ000142114]

ii. A further Blackett review on Satellite-derived time and position [MW/44 - INQ000142126] was undertaken in 2016 (and published in 2018)

iii. During my time as GCSA four other Blackett Reviews were published on subjects including financial technology and computational modelling.

e. During my time as GCSA, I produced four annual reports on a range of issues including 'Innovation: managing risk, not avoiding it' [MW/45 - INQ000142149] and 'Forensic science and beyond: authenticity, provenance and assurance' [MW/46 - INQ000142148].

67. A common theme from my time as GCSA was the challenge to improve the co-ordination and thereby the effectiveness of scientific advice to government, and to strengthen the "customer function" of government departments for expert scientific advice.

Section 3: Views on the key policies in scientific, technical and research capacity that had a material effect on the UKs pandemic readiness and what had been done correctly in relation to pandemic planning preparedness and resilience during my tenure in office.

68. The previous two sections of my statement describe the "nuts and bolts" of the science advisory machinery and how it operated across government and within

government departments. In this section, I will set out what I think are the key policies in relation to scientific, technical and research capacity. I will set out what I think had been done correctly in relation to pandemic planning, preparedness and resilience during my tenure in office. However, I think it is really a matter for others to judge whether they agree with this assessment.

69. First and foremost, I think that policies that recognise and support preparedness against pandemics and the materialization as emergencies of other natural hazards and threats are the most important. In this context I inherited a 'hard-wired' machinery of government that recognised the importance of scientific and other technical expert advice as an intrinsic part of preparedness and management of national emergencies.

70. I was very focused during my time as GCSA on strengthening the NRA and, most importantly, ensuring that the NRA was used properly. However, one of the biggest challenges facing government is that resilience frequently comes at a high cost – and I comment on the challenges that this poses to government departments responsible for the delivery of expensive public services later in this statement in paras 115–117.

71. In relation to pandemic preparedness, government policies for the funding of research are extremely important. Support for two types of research is critical. The first type of research (discovery research) is that which advances our knowledge of the workings of humans, of the other species with which we share our planet, and of our planet and the universe of which Earth is an infinitesimal part. The second is research (applied research) which is directed at increasing understanding and developing possible approaches to assist the handling of issues of importance to government and other policy makers. Such research is also important to professions such as medicine that need to understand the workings of the body and of the microbial 'universe' that inhabits us in health and causes infectious diseases. It is also important for innovators, and for businesses and services that apply knowledge for private and public benefit.

72. The UK government policies that distinguish these two types of research date back to 1918 and the Machinery of Government report from the Ministry of Reconstruction, chaired by Viscount Haldane. This report emphasised the necessity of research for the development of good government policy. It distinguished explicitly between the two types of research set out in the previous paragraph. It laid out the principles for public funding of research that have

continued to the present. The Haldane report located the funding of discovery research in the then nascent Research Councils and gave the responsibility to individual government departments of funding the applied research that was important for their policy development and operational delivery.

73. The UK's national public funding for discovery research remains located in the Research Councils (now collectively parts of UK Research and Innovation (UKRI). Each government department has its own research and development budget, and the two largest of these budgets are held by the DHSC and the Ministry of Defence (MoD). In the case of DHSC, this funding is core to its work on health resilience and also essential in the support of the NHS. I think it is important to be aware that the research and development budgets of government departments suffer from similar pressures to those on budgets that pay for resilience. I comment on this later in this witness statement in paras 115-117. Budgets for research and development, and for resilience, are the easiest to cut when there are funding pressures on delivery services.

74. There are two important outputs from research and development funding. The first is the direct outputs of the work itself and the outcomes and impacts that result.

75. The second, which I think is all too often taken for granted, is the education, training and support of highly skilled researchers and innovators, whose pluripotential skills are critical to a nation's health, wellbeing, resilience and security and also to a nation's wealth. In terms of pandemic preparedness, skilled people in government, in health, in business and industry, and many other walks of life, are critical for the effectiveness of the national response.

76. I will set out below in Section 5 details of the relevant outputs of research and innovation that were so important for the management of the Covid-19 pandemic.

77. It is my opinion that a long period of stable policy means that the UK institutional model for funding the research and development necessary for pandemic preparedness is appropriate. I also think that the UK is fortunate to have a highly skilled workforce, especially in the sciences needed for pandemic management.

78. A key question in relation to pandemic preparedness is whether the UK was too distracted by the risk of an influenza pandemic to properly prepare for a pandemic caused by another microorganism. I do not think that this was the case during my time as GCSA. I think that significant outbreaks of SARS-1, Ebola, MERS and Zika (which posed very low risk to the UK because of its transmission by an insect vector

that was essentially absent in northern Europe) provided a 'red flag' to researchers, advisers and policymakers, including those in the NHS and DHSC. The key points that lead me to this conclusion are set out in the next three paragraphs.

79. First and foremost, the establishment of NERVTAG in 2014, of the UK Vaccine Network in 2015, and the allocation that year of £110 million of ODA funding in support of the development of vaccines against the top 12 priority pathogens identified by the UKVN was critical to the development of the MERS vaccine that provided the prototype for the Oxford-AstraZeneca vaccine against SARS-CoV-2.

80. Second, I think the guides for the use of SAGE in the handling of pandemic flu and emerging infectious diseases were a significant innovation that has developed into the 'golden hour' documents. The Guide on Emerging Infectious Diseases set out that an emerging infectious disease could potentially become pandemic, and the worst-case scenario postulated was of a smallpox-like disease with a mortality of up to 40%.

81. Another example of preparedness for a pandemic was the funding for, through the Industrial Strategy Challenge Fund, the creation of a Vaccine Manufacturing Innovation Centre. The history of the funding of this goes back to an announcement in the Autumn Statement of 2016 of an "industry-led" programme funded by the Treasury from the National Productivity Investment Fund (NPIF). As part of this funding UKRI worked with BEIS ministers to create the Industrial Strategy Challenge Fund. One of the strands of this fund was entitled "Health, ageing and wellbeing" with £188 million in funding, leveraged by additional funding from industry participants. Within this strand were four challenge programmes: i) Medicines Manufacturing; ii) From Data to Early Diagnosis and Precision Medicine; iii) Accelerating Detection of Disease; and iv) Healthy Ageing.

82. As part of the Medicines Manufacturing Programme it was agreed to provide £66 million in support of a partnership between two industrial partners, Janssen and MSD, supported by bioprocessing expertise and training from GE Healthcare, and three academic institutions, the Jenner Institute (a partnership between the University of Oxford and the Pirbright Institute, Imperial College London and London School of Hygiene and Tropical Medicine to create a Vaccines Manufacturing Innovation Centre (VMIC)). In the Janssen Press Release of 3 December 2018, two quotes [MW/47 - INQ000142151] from Dr Paul Stoffels, Vice Chairman of the Executive Committee and Chief Scientific Officer, Johnson & Johnson and from me in my role as CEO of UKRI indicates that that a major reason

for the creation of VMIC was to increase preparedness against infectious diseases with pandemic potential.

Section 4: Views on what changes could have been made to the specialist scientific institutions, systems and process of the UK Government to better prepare it for a pandemic, considering in particular the operations of SAGE and lessons learned from the past.

83. Before setting out my view on what changes could have been made to the specialist scientific institutions, systems and processes of the UK government that could have prepared it better for a pandemic, it is necessary to map out these institutions and to clarify their interrelationships. As was explained in the third witness statement of Dr Stuart Wainwright [MW/1 – INQ000148407] the GCSA, GO-Science, the network of Government CSAs and the SAGE committee are only a small part of the scientific, engineering and technology institutions and advisory mechanisms within government. The DHSC has an extensive and important set of departmental and arm's-length bodies and advisers given the complexity and specialised skills required to provide and run the NHS and public health services that are necessary to support the health, wellbeing and resilience of the population. I note the description of these bodies and advisors in the DHSC statement provided to the Inquiry in Module 1.

84. Other government departments and non-departmental public bodies also have assets that are relevant to pandemic prevention. The major BEIS arm's-length bodies, the UK Research Councils and Innovate UK (now brought together in a single body, UKRI, of which I was the founding Chief Executive) play a key role in funding the research that ultimately supplies the knowledge necessary for pandemic prevention, mitigation and management, although it is important to recognise that most research is a global enterprise and global collaboration is essential, especially in the context of pandemic prevention and hopefully recognition of a novel emerging infection to prevent it becoming pandemic.

85. Another very important government department in respect of a pandemic is DEFRA, since the majority of pandemics in human history almost certainly started as zoonotic infections, caused by a micro-organism gaining the capacity to jump species and transmit within its new host species, in this case *Homo sapiens*. So, the Chief Veterinary Office and advisory committees within DEFRA (such as the Animal & Plant Health Agency (APHA) and Veterinary Products Committee) may

be important partners in work to prevent zoonotic transfers into humans and for surveillance of novel outbreaks of infectious diseases in wildlife or domesticated species. An obvious and immediate example of this is the current global outbreak of avian influenza.

86. Every national emergency has knock on effects on citizens lives beyond the immediate impact of the emergency itself - and there is always the possibility that the 'cure' for the specific emergency in terms of the policies and actions directed at stemming the primary damage causes harmful 'side effects'. In the case of a pandemic, lockdowns and quarantining, closing international borders and other restrictions to travel, closing of institutions such as schools and businesses all have serious adverse consequences. This raises important questions for policy makers about how to balance direct harms from the pandemic infection against the adverse consequences of interventions, singly or in combination.

87. Until now SAGE has been constituted solely of researchers with domain expertise in the direct causes and consequences of the pandemic (or other emergency) and the steps that could be taken to manage and mitigate the direct harms. In spite of this specificity, SAGE typically includes researchers and experts with very broad training and background skills, including scientists and engineers, and also social sciences such as behavioural scientists, psychologists, anthropologists and others. It has been suggested on numerous occasions that SAGE should also contain experts and researchers with expertise in all the other areas that could be affected significantly by the effects of the policies introduced to control, for the purpose of this Inquiry, the pandemic.

88. I think this suggestion crosses the line between the role of providing advice and the role of those who receive the advice and have the extremely onerous responsibility for making the ultimate policy decisions - government ministers, working with their policy officials. So, it is extremely important that the policy makers receive advice on what are the potential adverse consequences of, for example lockdowns, on businesses, the economy, education and indeed, other domains of health, including mental health and people potentially not presenting to the health system with other life-threatening conditions. But it is only the policy makers themselves who can ultimately decide on how to make the exceedingly difficult choices between, as a specific and rather pointed example, preservation of the health and lives of the elderly and vulnerable by measures that are likely to damage the economy and disrupt the education of young people.

89. It is my view that it is essential for policymakers to seek expert advice in all of the potential areas where collateral harm could follow from measures designed to control a pandemic or other emergency, but it should be the responsibility of government to ensure that each relevant government department has the means of either using a standing expert committee or assembling a committee for the purposes of the emergency in order to feed in advice to the government.

90. In my opinion the job of SAGE should be to provide government with advice on what is known about the pandemic and what are the uncertainties, and the best evidence on the measures that might mitigate and end the pandemic. It should not be placed in the position of being asked to balance the consequences of the policies to manage and control the pandemic against all of the collateral effects of those control measures. That is the job of government, who should be able to make the really difficult policy decisions working with their policy advisers, based on their own integration of independent expert advice from different sources.

91. Another important question that has come to the fore is the extent to which the proceedings and minutes of SAGE should be publicly available and on what time scale. This is an area that has moved on since my time as GCSA. When I was appointed in 2013, the custom and practice was that the members of SAGE were not announced publicly but members of SAGE were told that this was not classified information and they were able to publicly say that they were members of SAGE. Furthermore, they were allowed to speak publicly via the media if they wished, as long as they did not disclose information that was not in the public domain that they had received as part of their membership of SAGE. The minutes of SAGE were published but only at the end of the emergency in question.

92. To help me to answer the question as to what the extent of the transparency of SAGE should be, and whether the practice was right or wrong in my time, I need to stray into 2020 and the Covid-19 pandemic. This was like no other emergency that had presented to government since the foundation of SAGE in 2009. The pandemic was clearly here "for the long haul'. Government had decided to involve senior scientific and health advisers in the communication process of the Prime Minister and other senior Ministers via daily Press Conferences in 10 Downing Street – and the acronym SAGE had suddenly become public property. Although there were very many researchers and other expert advisers attending and contributing to SAGE, there were very many who were not. Amongst these were many who had deep expertise and very strong opinions as to what should be done

and many who had little expertise but nevertheless had equally strong opinions. The role of SAGE was not to tell ministers what should be done, it was to advise the GCSA and CMO, whose job it was to present that advice, the underlying evidence and the uncertainties to the Prime Minister and Government, including the possible effects of a series of potential interventions on the transmission of infection. It was almost inevitable there was a clamour from many quarters to see the evidential papers presented to SAGE and to read the minutes describing the conclusions of the SAGE discussions. These formed the basis of the evidence and uncertainties about the progress of the pandemic to enable the GCSA and CMO to provide their advice in private to the Prime Minister and government. The decision was made to publish the minutes of SAGE, subject to some redactions for national security reasons, and the names of all of the SAGE attendees, which included me from 4 May 2020. I have no doubt that this was the correct decision.

93. I think that there was immediate benefit from opening SAGE papers and minutes for public scrutiny. They provided a basis for well-informed professional and public communication and debate. But there were also some adverse consequences. There was undoubtedly personal harm to some of the attendees at SAGE meetings who suffered severe personal abuse through social media and other more direct and unpleasant routes. These attendees had not chosen careers in the public eye and were not equipped by their training and experience to cope with the furnace of modern social media and press intrusion. Secondly SAGE became the target for some who were dissatisfied with the policies developed by government to manage the pandemic. However, SAGE's role is to provide the best advice on evidence and the nature of uncertainty. It is entirely the role of government to make policy decisions.

94. Related to the discussions of SAGE transparency are questions about the role of the GCSA as a commentator on science during an emergency. During my time as GCSA I was frequently asked why I was not more critical of government policies, even when these appeared to be not supported by scientific knowledge. There are two important principles at play here as to why a GCSA cannot be directly critical in public of the government that they serve. The first is the Civil Service Code, which prevents public servants from public criticism of the government that they serve. The second is that the effectiveness of any adviser depends on a relationship of trust with the person or organisation that they are advising. The privilege of being a senior public servant is a high level of direct access to senior politicians and the opportunity to "speak truth to power" by delivering uncomfortable

advice. As soon as an adviser finds it necessary to broadcast their advice via public media, the trusted relationship is likely to evaporate, and the adviser will find their advice ignored. Better in that situation to resign and it then becomes open to them to use the media to make their case, if the media is still interested in broadcasting it.

Section 5: Thoughts on the principal areas of scientific research into infectious diseases that should be prioritised by the UK Government and what reforms, including to science and technology funding, structures and institutions, could be implemented to make the UK pandemic ready.

95. I was asked to provide my thoughts in this witness statement about prioritisation of scientific research and what reforms to science and technology funding, structures and institutions, could be implemented to make the UK pandemic ready.

96. It is my opinion that one of the key lessons from this pandemic and indeed from many other natural disasters is "be prepared". It is salutary to remember that, in 1918, the year of the last pandemic which caused a very high global death toll, it was not known what was the causative agent of influenza. A specific viral cause for influenza was only discovered in the 1930s. More than a century of scientific research motivated primarily by a thirst for knowledge of the molecular and cellular workings of living organisms has transformed our knowledge of biology and medicine. So, in 2020, it was possible within weeks of the global recognition of the new infection to identify the new coronavirus by establishing its full genetic sequence. This knowledge was used to immediately start to develop new vaccines and to develop diagnostic tests.

97. The consistent history of investment in genetics and genomics in the UK, going back to the work at King's College London and the MRC in Cambridge in the early 1950s, leading to the discovery of the structure of DNA, and latterly supported by the Wellcome Trust alongside the MRC and NIHR, has enabled the development and support of an outstanding cohort of researchers. They pivoted their work immediately when the pandemic emerged. It was also the case at the start of the pandemic that the UK has exceptional communities of researchers in virology, immunology and epidemiology.

98. A key part of management of any new infection is to be able to understand the transmission of the disease and project the scale and range of possible outcomes.

The UK is a global leader in mathematical modelling of infectious diseases thanks to long term investments by funders such as the MRC and Wellcome Trust.

99. Medical research preparedness is also crucial "in the clinic and at the bedside". The modern era of clinical trials was invented in the UK with the work of Austin Bradford Hill, supported by the MRC, who developed the "double-blind" trial. With specific respect to respiratory infectious diseases, ISARIC (International Severe Acute Respiratory Infection Consortium) had been established with initial funding from the Wellcome Trust in 2011, as a response to emerging respiratory infections such as SARS and avian influenza. It is now hosted and led by Professor Sir Peter Horby from the Nuffield Department of Medicine at the University of Oxford. As part of its work in the UK the consortium had pre-established protocols for clinical investigation, including draft research ethics committee proposals, so that established groups of national and international researchers could immediately collaborate to characterise new and emerging viral infectious diseases. As a result of their preparedness, they were able to start working on Covid-19 within weeks of its identification.

100. Finally in relation to research, the social and behavioural sciences are critical to helping to understand social responses to pandemic infection and to attitudes to different control mechanisms. Economists and educational researchers are important to understand the broader societal consequences of pandemic infection. As one example, anthropological advice proved extremely important during Ebola in 2014 in helping reduce transmission of the virus as a result of burial practices in West Africa.

101. Industrial preparedness is also critical in response to pandemic preparation and handling. Here there are two issues, industrial R and D preparedness and operational preparedness to develop, trial, scale, regulate and manufacture new products at global scale.

102. Looking at the institutional infrastructure for the support of the research and innovation needed to handle a new pandemic, the UK has been in a good position with strong support for biomedical and infectious diseases research funded by public funders including the Medical Research Council (MRC), Biotechnology and Biological Sciences Research Council (BBSRC) and Economic and Social Research Council (ESRC). Charitable funding relevant to infectious diseases has also been uniquely strong in the UK thanks to input, particularly from the Wellcome Trust. Many UK-based medical research charities focused on specific disease

areas, such as Cancer Research UK (CRUK), the British Heart Foundation (BHF) and Versus Arthritis, are also large contributors to biomedical research, though I am not aware of a charity focused on the full breadth of infectious diseases. These "disease and organ-specific" charities are also important and played an important role in the Covid-19 pandemic in supporting, for example, cardiovascular disease in Covid-19 and the important issue of understanding what happened to cancer care during the pandemic.

103. The presence of industry and funding is critical for the research and innovation that underpins the development, the testing and the manufacture and distribution of the innovative diagnostics and therapies necessary for any new pandemic infection. The UK has a very strong history in this area with large and longstanding investments from both large and small companies.

104. Ultimately it is the excellence, breadth and depth of the researchers and innovators who lead and execute the critically important research and its translation that determine national and global capability to tackle novel infectious diseases. To do their work they need employment, funding and a vibrant infrastructure to succeed. Research is a team effort and a global and collaborative enterprise. Researchers and Innovators are highly mobile and the best research environments attract and support an international mix of staff.

105. My long pre-amble leads to my thoughts about preparedness for future pandemics. First and foremost, I think that we cannot be complacent for the future – a distinguished past does not guarantee a distinguished future. I believe that we must continue to support a breadth of research in science, engineering, social sciences, arts and humanities, and mathematics, if we are to train, develop and retain people with the skills and capability to tackle new variants of known infectious diseases and novel infections. We must provide the necessary infrastructure, including outstanding educational and training environments, laboratories in universities, research institutes and companies. An environment that is conducive to pharma, diagnostic and biotechnology companies is also essential. To achieve all of this, long term policy stability and funding is essential. Reality should match rhetoric.

Section 6: Supplementary answers as requested by the Inquiry to the evidence that I provided to the Science and Technology Committee and the Health and Social Care Committee.

106. I stated, as part of my evidence to this joint meeting between the House of Commons Science and Technology and Health and Social Care Committee, that preparedness against pandemic needed to be examined through three lenses: were the science advice mechanisms in place? was there the necessary science and research preparedness? and third, was there sufficient operational preparedness?

107. In this context it is my opinion that appropriate science advice mechanisms were in place. Pandemic preparedness had been at the top of the national risk assessment through all of its iterations. The response of DH to the 2009 H1N1 pandemic had been independently reviewed by Dame Deirdre Hine. DH had established the SPI family of committees in response to the 2009 H1N1 influenza pandemic. These committees were essentially 'fit for purpose' for providing analysis and advice for other infectious outbreaks as these occurred. For example, SPI-M-O provided modelling advice during the Ebola epidemic in West Africa in 2014.

108. It has been suggested that the focus on influenza had meant that other potential causes of pandemic infection had been neglected. I do not think that this suggestion was correct. The New and Emerging Respiratory Virus Threats Advisory Group (NERVTAG) was set up in 2014 as a successor to the UK Scientific Pandemic Influenza Advisory Committee. The foreword to the first annual report of NERVTAG [MW/34 - INQ000142125] stated "We are reminded that we cannot predict the future, beyond saying that another pandemic is inevitable at some point, but it seems quite clear that the range of major respiratory virus threats to public health may well extend beyond influenza." NERVTAG was created to explicitly extend the role of the committee beyond influenza to cover "not only pandemic influenza, but any new, emerging (or re-emerging) respiratory virus threat to the UK."

109. This takes me to my second lens, which is: was there the necessary science and research preparedness? Here again I take the view that the answer is yes. It is my opinion that one of the key lessons from this pandemic and indeed from many other natural disasters is "be prepared". It is salutary to remember that, in 1918, the year of the last pandemic which caused a very high global death toll, it was not known what was the causative agent of influenza. It has taken a century of discovery science research to put us in the position that it was possible within weeks of the global recognition of the new infection to identify the new virus by establishing its

full genetic sequence; use this information to immediately start to develop new vaccines; and to develop diagnostic tests.

110. The consistent history of investment in genetics and genomics in the UK, going back to the work at King's College London and the MRC in Cambridge in the early 1950s, leading to the discovery of the structure of DNA, and latterly supported by the Wellcome Trust alongside the MRC and NIHR, has enabled the development and support of an outstanding cohort of researchers. These pivoted their work immediately when the pandemic emerged. It was also the case that the UK has exceptional communities of researchers in virology, immunology and epidemiology.

111. A key part of management of any new infection is to be able to understand the transmission of the disease and project the scale and range of possible outcomes. The UK is a global leader in mathematical modelling of infectious diseases thanks to long term investments by funders such as the MRC and Wellcome Trust.

112. Medical research preparedness is also crucial "in the clinic and at the bedside". The modern era of clinical trials was invented in the UK with the work of Austin Bradford Hill, supported by the MRC, who developed the "double-blind" trial. With specific respect to respiratory infectious diseases, ISARIC (International Severe Acute Respiratory Infection Consortium) had been established with funding from the Wellcome Trust in 2011, as a response to emerging respiratory infections such as SARS and avian influenza. As part of its work in the UK the consortium had established protocols for clinical investigation, including draft research ethics committee proposals, so that established groups of national and international researchers could immediately collaborate to characterise new and emerging viral infectious diseases.

113. Finally in relation to research, the social and behavioural sciences are critical to helping to understand social responses to pandemic infection and to attitudes to different control mechanisms. Economists and educational researchers are important to understand the broader societal consequences of pandemic infection. As one example, anthropological advice proved extremely important during Ebola in 2014 in helping reduce transmission of the virus as a result of burial practices in West Africa.

114. Industrial preparedness is also critical in response to pandemic preparation and handling. Here there are two issues, industrial R and D preparedness and

operational preparedness to develop, trial, scale, regulate and manufacture new products at global scale.

115. This takes me to the question as to whether there was sufficient operational preparedness in place. Here my answer is no. In my evidence to the Science and Technology Committee and Health and Social Care Committee, I argued that the challenge for Departments that provide the front-line delivery of services to citizens, e.g., the DHSC, that funds NHS England, is how to balance the daily delivery of services in a financially and operationally "hard-pressed" system, specifically, how to prioritise the "immediate and urgent" against the needs to provide resilience and preparedness for future and uncertain threats. I used the metaphor of "paying for insurance" against natural hazards. But the challenge for Government is that it is the insurer – and there is no pooling of risks when it comes to a pandemic, nor can risks be pooled between the potential for a human pandemic, serious livestock disease, the risks of flooding, drought or other natural hazard, and the consequences of climate change.

116. After the 2009 flu pandemic, there was criticism that large amounts of the anti-influenza drug oseltamivir (Tamiflu) had been purchased. In the event these were not needed. So, the incentives for government departments, responsible for delivery of services and for 'ownership' of the threats and natural hazards assigned to them as part of the development of the NRA, are to fund present needs at the expense of very large funding commitments to potentially huge, but 'uncrystallised' risks. Accountability for the present is always in danger of trumping accountability for the future. And when resilience is put in place that is not needed, blame ensues.

117. I was asked by the Inquiry what the solution to this dilemma might be. This strikes at the heart of governments around the world, struggling to provide health, wellbeing, security and resilience to their citizens. Any solution must come in two parts. The first is that government must decide how much it can afford and wishes to pay to provide resilience against adverse events. Second, it is not straightforward to devolve this funding to Departments or agencies whose first priority is delivering 'stretched' services. So, there is a choice for government – to pass this on to Departments with a clear understanding that the funds are "ring-fenced" for an agreed resilience plan. Alternatively, government could hold the funds for national resilience centrally in a Department or Unit staffed by people with skills and expertise to present a balanced plan to Government on the spread of funding across government as a whole, which would demand a coherent plan for

"whole of government" resilience spend. Regardless of which approach government takes in the future to funding and providing national resilience, I think that there is a good case for government to create a National Resilience Assessment to act as a basis for resilience planning.

118. This takes me to the important question about what the nature of the operational preparedness should be to protect against future pandemics. I suggest that the answer can be divided into four parts which I will consider in turn.

119. The first is the development, in global partnership, of the means to identify emerging infections in humans and other species that could have pandemic potential and the continuing global surveillance of influenza and other existing human pathogens that have the potential to increase their transmissibility and potentially, their pathogenicity.

120. The second is operational preparedness for the generic tools and approaches that have wide applicability to a very wide range of infectious pathogens. These can be categorised in four categories, first, identification of unexplained outbreaks of infection and the characterisation of the causative organism with global open sharing of the information; second, development of specific diagnostic tests, trialling of known potential vaccines, drugs and therapeutics; third, development of new vaccines, drugs and therapeutics depending on the nature of the infectious agent; and fourth, ensuring the availability of the relevant personal protective equipment. One of the predictable outcomes of a global emergency is the 'nationalisation' of locally produced supplies of products for which there is a global requirement. At one end are simple 'low value, low cost' items such as medical grade masks, syringes and needles, and glass vials from which to dispense vaccines. At the other end are sophisticated diagnostic tools, medical devices, such as ventilators and chemicals needed as part of the supply chain for the manufacture of drugs and therapeutics, and the sophisticated manufacturing facilities and equipment (such as bioreactors) needed for the manufacture of diagnostic tests, drugs and biological therapeutics such as antibodies and vaccines. In a global emergency, nations cannot rely on global markets delivering large volumes of advanced and potentially novel products, nor can they necessarily rely on the supply chains needed to manufacture these products. Resilience requires a strong national industrial base, ranging from world class capacity in research and development to high volume advanced manufacturing capabilities.

121. The third is much harder, which is to put in place a resilient supply of specific tools to treat the consequences of pathogens that cause widely variable organ damage. Covid-19 caused mainly lung injury and generated a need for increased numbers of ventilators and of the highly skilled staff capable of operating these. However, other micro-organisms may cause liver or renal failure requiring advanced liver support or renal dialysis respectively. The protean nature of how infections damage the human body makes it almost impossible to anticipate all the potential needs for advanced life support in a pandemic.

122. The fourth means of operational preparedness is to tackle the societal disparities that individually and collectively comprise the social determinants of health. These, first characterised many years ago by Sir Michael Marmot, divide people and communities according to their vulnerability to develop chronic non-infectious conditions such as diabetes and cardiovascular disease and similarly infectious diseases such as tuberculosis and, as we discovered recently, Covid-19. This increased vulnerability is also associated with worse medical outcomes.

123. The Inquiry has asked me to expand on my evidence to the Select Committee that the closure of the laboratories of the Public Health Laboratory System (PHLS) in 2004, when these were merged into the pathology laboratories of NHS hospitals, resulted in the loss of some of our traditional test and trace capacity. In the same hearing I commented on the model of the highly distributed model of the Robert Koch Institute in Germany, coupled with its central epidemic intelligence service, which provides a different and I would argue a more successful means of providing a national test and trace service.

124. It is important to place the closure of the Public Health Laboratory System in the context of a long decline in the UK in the capacity of public health laboratories to conduct mass test and tracing of infectious disease outbreaks, and of local systems for the delivery of public health measures. There has been a similar decline in the USA.

125. Part of this can be attributed to a switch in interests in public health systems during the latter part of the 20th century from infectious diseases to chronic non-communicable diseases such as diabetes, cardiovascular diseases and cancer. This is attributable in part to the enormous successes of the public health measures of the second half of the 19th century to separate the water that we drink from the water that we excrete, and in the development of vaccination. The development of antibiotics provided another huge boost to the control of infectious diseases.

However, any idea that modern medicine was 'on top' of infectious diseases was dispelled by increasing microbial resistance to antibiotics and by the emergence of new viral diseases, particularly HIV, the H1N1 flu pandemic in 2009, and the SARS-1 and MERS coronaviruses.

126. The history of the capacity and capability of the UK public health system to respond to infectious diseases has been recently documented in a scholarly article by Dr Claas Kirchhelle, Lecturer in the History of Medicine at University College Dublin, previously Fellow of the Oxford Martin School [Giants on Clay Feet-COVID-19, infection control and public health laboratory networks in England, the USA and (West-)Germany (1945-2020). Social history of medicine: the journal of the Society for the Social History of Medicine (2022) 35:703-748]. [MW/48 - INQ000142146] The author analysed and compared the history of public health laboratory systems in (West-)Germany, the UK and the USA between 1900 and 2020. Paragraphs 127 to 136 below are a highly condensed precis of Dr Kirchhelle's detailed and extremely well documented description and analysis of the relevant parts of this history. Where possible, I have sought to confirm the accuracy of Dr Kirchhelle's chronology, and to the extent that I have been able to do so, it would appear to be accurate. I emphasise however that paragraphs 127 to 136 are my summary of the salient aspects of his chronology and not my evidence. I set it out in this statement because in my opinion it contains many important lessons for current policymakers in public health.

127. The origin of public health laboratories in England and Wales was a distributed system of public health laboratories that were created in the 1930s as an emergency response to the threat of bacteriological warfare, the Emergency Public Health Laboratory Service. These became an important peacetime national network for the local testing and characterisation of infectious disease outbreaks and in 1946 were renamed the Public Health Laboratory Service (PHLS). These worked closely with local authority Medical Officers of Health to provide local infection control and management. Over time central laboratories providing specialised testing and reference services developed alongside and in support of the PHLS system of laboratories. From 1947 to 1969 the number of PHLS laboratories expanded from 28 to 63. Many of these laboratories were co-located with District Hospitals and worked with their NHS counterparts in microbiology to provide local NHS microbiology services.

128. In the 1970s this all "went into reverse gear". The delivery of public health was transformed in the 1974 NHS reforms. These reforms were intended to improve the management, quality and integration of social and health services. The system of Medical Officers of Health, working in local authorities was abolished. The responsibilities of local authorities for personal health services outside hospitals were transferred to new NHS regional and area health authorities.

129. During the next 10 years 13 of the 69 PHLS laboratories were closed. A central laboratory, the PHLS Communicable Disease Surveillance Centre, was created at the PHLS centre at Colindale, which led to a decline in the perceived importance of the locally based surveillance laboratories. In 1985, a Department of Health and Social Services review recommended a transfer of the remaining 52 PHLS labs to NHS Health Authorities, leaving Colindale in an analogous position to the USA's Centers for Disease Control and Prevention (CDC), as a centre for epidemic intelligence.

130. This proposed change was resisted and a resurgence in interest in infectious diseases stimulated by the development of HIV, and outbreaks of salmonellosis and legionella led to a review by the then CMO, Sir Donald Acheson. His report in 1988 emphasised the importance of epidemiological oversight and criticised the 1974 NHS reorganisation for the fragmentation of public health at a local level. He recommended recreating local expertise by the appointment of local Consultants for Communicable Disease Control and Directors of Public Health at a District level, who would submit local public health annual reports, harking back to practices developed in the 19th century, when the UK was a world leader in public health.

131. However, austerity in the 1990's saw budget cuts to the PHLS and between 2003 and 2013 there were a series of major health reforms. The creation of over 300 NHS Primary Care Trusts led to yet another rearrangement of community-level public health. In 2003, the PHLS was disbanded and merged into a new Health Protection Agency, following a report by the CMO Sir Liam Donaldson, which provided a common 'home' for management of infectious diseases, and chemical and radiation hazards.

132. The PHLS laboratories were merged with NHS local microbiology laboratory services. Lord Turnberg, the chair of the PHLS, resigned in protest against these changes and a House of Lords debate on the Public Health Laboratory Service surfaced a series of criticisms and warnings about potential adverse outcomes from the proposed changes [HL Deb 09 January 2003 vol 642 cc1176-93].

However, the final outcome was essentially the implementation of the proposals of 1985, which had been rejected at the time.

133. Subsequent history is of sustained financial cuts to the HPA and its successor bodies. Between 2009 and 2013 HPA staffing fell by 9.7% and its core budget by 26%. In 2013 the HPA and its eight regional laboratories were merged into PHE.

134. The 2012 Health and Social Care Act provided the vehicle for a further major NHS reorganisation with the abolition of the Primary Care Trusts and a return of the responsibility for public health from the NHS to local authorities. Directors of Public Health were appointed with the responsibility to deliver public health and social services at a local level. However, there were subsequently cuts to public health budgets for local authorities, with an in-year cut of £200 million in 2015 and a further 9.6% over the next five years. PHE had a 30% cut in its budget between 2013 and 2017.

135. This history of public health policy and its implementation in the UK and parallel changes in the USA can be contrasted with the robust system of decentralised public health provision in Germany, working alongside epidemic intelligence at a federal level. The Robert Koch Institute became the primary German hub for communicable disease control and created a federal network of reference and consultant microbiology laboratories in 1995, which by 2015 comprised 59 laboratories. These provided a comprehensive service, ranging from the development and delivery of diagnostics to disease outbreak detection and integration of data from the laboratory and the clinic. These laboratories were independent, in keeping with the extremely strong German political principle of decentralisation but were funded and audited by the Robert Koch Institute.

136. In contrast to the cuts in public health funding in the UK, in Germany a new infectious disease law in 2001 maintained responsibility for the delivery of public health in state and communal authorities. It strengthened their ability to manage outbreaks of infectious diseases with improved vaccination, surveillance and police powers. Spending rose between 2000 and 2015, amounting to between 3.27 and 3.52% of rising total health expenditure.

137. It is my opinion that there are several important lessons from this historical analysis and especially from the comparison with Germany. The UK (and the USA) has chopped and changed our policies towards the organisation and delivery of public health and, alongside these changing policies, consistently disinvested in public health funding and its delivery over more than fifty years. In contrast Germany has

maintained a consistent policy to public health delivery for more than fifty years and has increased its investment.

138. In the modern era the UK was undoubtedly one of the world leaders in public health research and delivery – and the role of chief medical officer and a network of local medical officers of health date back to the middle of the 19th century. The 1974 NHS reforms, including the abolition of the MoH role was arguably the start of the accelerated decline in local public health provision.

139. Although the 2014 reforms in public health delivery restored the responsibility for public health to local authorities, the funding stream in support of this function has inexorably declined and there are currently no funding 'levers' to support an integrated interface between NHS England and public health functions in local authorities. With recent abolition of PHE, the newly created Health Security Agency on its website appear to have abandoned the use of the terminology of public health. There are now 16 Health Protection Teams covering England and it is not clear what is their relationship with local authority public health teams.

140. It is my opinion that the government should carefully review the nature of the delivery mechanisms for public health following the experience and outcome of the Covid-19 pandemic and consider whether the scale of investment is sufficient for the health, wellbeing and resilience of the population. As part of this it should examine and learn from how other countries organise their system of and investment in public health. Although I would be extremely cautious about another wholesale reorganisation since policy stability is a very important to the maintenance of public health. It should be possible to reshape existing structures and organisations to tackle the problems in public health delivery. However, public health delivery and its contribution to national resilience come at a price.

141. It is also noteworthy that South Korea, following the lessons learnt from an outbreak of the MERS coronavirus in 2015 that resulted in 186 cases including 38 deaths, strengthened their infectious disease surveillance and testing capabilities by the formal creation of an epidemic intelligence service.

142. There has been considerable focus on the fact that the central case for a future pandemic in the NRA since its inception was an influenza pandemic and that the UK was not sufficiently prepared for a pandemic caused by another infectious organism. However, a second risk was for an emerging infectious disease – and here the central case was for a SARS-type infection. However, the guidance

document for internal use that was prepared for management of an emerging infectious disease [MW/30 - INQ000142139] made clear that an emerging infectious disease could potentially become pandemic, and the 'reasonable worst case' scenario postulated was of a smallpox-like disease with a mortality of up to 40%.

143. Almost any natural hazard can strike with enormous variability, from a small volcanic eruption to a massive volcanic effusive eruption, from floods to tsunamis, and infections are the most variable of all given the enormous range of potential pathogens, known and unknown. So, the challenge for a risk register is to encompass all of these possibilities and the range of possible exercises and contingency plans is similarly potentially huge. For the future, one approach to manage this complexity is to set out, as part of the NRA, a range of possible scenarios for risks as appropriate.

144. In the case of preparing for the next pandemic, the central risk case would be likely to remain influenza, which because of the way it can shuffle its fragmented genome between human, porcine and avian influenza viruses, is able to make step changes in its composition that can evade immunity to previous influenza infections (so called antigenic shift). I think that it would also be prudent to include coronaviruses, although these do not have the same genomic plasticity as influenza viruses, nevertheless in the case of a co-infection by two different coronaviruses (e.g., MERS and SARS-Covid-2) there could be the possibility of 'shuffling' of the genes between viruses, and the emergence of a new coronavirus with enhanced pandemic potential.

145. However, my substantive point is that future NRAs should present emerging and pandemic infectious disease on a complete spectrum. And those responsible for this risk should consider the possibilities for prevention, mitigation, and management of this spectrum of natural hazards by rehearsing and preparing by setting out and exploring a range of scenarios.

146. I also think that it is extremely important that the lessons from the handling of the Covid-19 pandemic are learnt and taken into account by all those responsible for the development of future NRAs and, most importantly, by those responsible across government for planning and response to prevent, mitigate, handle and return to normality after national emergencies.

147. Straying forward to the Covid-19 pandemic, in my opinion, one positive issue that has been insufficiently appreciated is that our national infrastructure, power, water,

transport, food distribution, telecommunications and internet, all continued to work very effectively throughout the pandemic, thanks to the dedicated efforts of many key workers. Global supply lines in general were effectively maintained, though they were disrupted in respect of the goods, such as PPE equipment, vaccine manufacturing hardware extending from bioreactors to essential glassware, and chemical and other goods needed for vaccine manufacturing. We should not take the resilience of our critical national infrastructure for granted for the future. If the pandemic mortality had been significantly greater, it is my opinion that it might have proved difficult to maintain the infrastructure that we depend upon for our security, health and wellbeing. That would have had disastrous consequences for the nation.

148. But sadly, it is hubris to believe that humans can always have the upper hand against nature and infectious diseases and the other forces of nature will continue to surprise and subjugate us. The "retrospectoscope" is an infinitely powerful observational tool – and the danger for governments is that they are usually much better prepared for the last emergency than for the next one.

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.

Personal Data

Signed: _____

Dated: 08/04/2023