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UK COVID-19 INQUIRY
MODULE 1

THIRD WITNESS STATEMENT OF PROFESSOR SIR CHRISTOPHER WHITTY

Contents

I, PROFESSOR SIR CHRISTOPHER JOHN MACRAE WHITTY, will say as follows:

Section 1: Introduction

1.1. This Module covers the period from 11 June 2009, which is when the World Health Organization ("WHO") announced that the scientific criteria for an influenza pandemic had been met for what became known as the 2009-2010 H1N1 'swine flu' pandemic, and 21 January 2020, which is the date on which the WHO published its 'Novel Coronavirus (2019-nCoV) Situation Report - 1'.

1.2. This is my third witness statement. It responds to a Rule 9 request from the Inquiry directed at me in person. I have already made corporate witness statements for Module 1 and Module 2 of this Inquiry on behalf of the Office of the Chief Medical Officer (OCMO), which cover several points likely to be of importance to this Module. I have also contributed to corporate witness statements from the Department of Health and Social Care (DHSC). I have not repeated points previously made unless necessary for the flow of logic or requested specifically by the Inquiry in the Rule 9 request.

1.3. The Inquiry has asked me to draw on my experience as the Chief Medical Officer (CMO) for England, the UK Government's Chief Medical Adviser (CMA) and professional head of the public health profession. This statement seeks to address the questions the Inquiry have put to me.

1.4. In this statement I refer to a number of acronyms for committees, groups, government departments and diseases. These are explained in the text, however the Inquiry may also benefit from reference to the glossary of such terms included at page 5 of the OCMO's corporate witness statement for Module 1.

Section 2: Background and relevant experience

2.1. Since this is my first personal (rather than a corporate) statement, I will briefly lay out my experience and expertise relevant to this Inquiry. I am currently Chief Medical Officer (Permanent Secretary level) for England and Chief Medical Adviser to HM Government, a post I took up in October 2019. During the period covered by this Module I was also Chief Scientific Adviser for the Department of Health and Social Care (DHSC) and head of the National Institute for Health Research (NIHR) (2016-

2021) (Director General level), interim Government Chief Scientific Adviser (2017-2018, Permanent Secretary) and Chief Scientific Adviser at the Department for International Development (DFID) (2009-2015, Director level). I am on the Executive Board of the WHO representing the UK to May 2023 and on the Board and Executive Committee (ExCo) of the Department of Health and Social Care (DHSC). I have been a member of the ExCo of DHSC from 2016 to the present.

2.2. My qualifications include a medical degree (BMBCh), a doctorate of science (DSc) in infectious diseases and BA (MA) in physiological sciences all from the University of Oxford. I hold a masters in epidemiology (MSc) from the University of London. Other relevant qualifications include an MBA, LLM in medical law, and diplomas in economics and tropical medicine in addition to honorary doctorates in science or medicine. I am a Fellow of the Royal Society, the Academy of Medical Sciences, the Royal College of Physicians and the Faculty of Public Health. I am an honorary Fellow of the Royal College of Paediatrics and Child Health, the Royal College of General Practitioners, the Royal College of Pathologists, the Royal College of Physicians and Surgeons of Glasgow, the Faculty of Pharmaceutical Medicine, the Royal Society for Public Health and the Royal Society of Tropical Medicine and Hygiene, among other learned bodies.

2.3. By training I am an infectious disease epidemiologist and infectious diseases and acute medicine clinician. I was senior lecturer in clinical epidemiology from 2001, then professor of public and international health from 2005-2019 at the London School of Hygiene & Tropical Medicine (LSHTM) and, from 2001, was and remain a NHS consultant physician at University College London Hospitals (UCLH) and the Hospital for Tropical Diseases (HTD) and am on the Specialist Register for the GMC for infectious and tropical diseases. I undertook acute medicine duties from 2001 until becoming CMO in 2019 and remain clinically active on a ward rota in infectious diseases. I was an honorary consultant epidemiologist for Public Health England (PHE). I am emeritus Gresham Professor of Physic at Gresham College and remain visiting professor of public health at Gresham and honorary professor at LSHTM.

2.4. While undertaking different roles, I have been involved in the response to many medical and wider emergencies in the UK and globally. In addition to the infectious emergencies discussed below (including HIV, influenza, Ebola, Zika and COVID-19) these include responses to Novichok in the UK (when I chaired the Scientific Advisory Group for Emergencies – SAGE), the Nepal earthquake of 2015 and other international emergencies.

2.5. Having international experience brings perspectives on UK strengths and weaknesses. My own research and clinical practice has been carried out in several countries including the UK, Tanzania, Malawi, Uganda, Ghana, Afghanistan, Pakistan, Yemen and Thailand. This includes epidemiological, public health, clinical, pathophysiological, economic and anthropological research on infections of poverty including malaria, HIV and TB. When not in Government I have been a member of several expert infectious disease committees both within the UK and as part of the WHO. These have included chairing the UK Vaccines Network (UKVN), the Advisory Committee on Dangerous Pathogens (ACDP) and the National Expert Panel on New and Emerging Infections (NEPNEI). I have been a board member or trustee for, among other international medical charities, Medical Emergency Relief International (MERLIN), the Royal Society of Tropical Medicine and Hygiene and Sightsavers (The Royal Commonwealth Society for the Blind).

2.6. Finally, I would like to draw attention to the *Technical Report on the Covid-19 Pandemic in the UK* (published on 1 December 2022) by the UK CMOs (England, Scotland, Wales and Northern Ireland), the Government Chief Scientific Adviser (GCSA), the NHS National Medical Director and the relevant Deputy Chief Medical Officers (DCMOs), with contributions from many distinguished scientists. I was the lead senior author/editor of that report and, although aimed principally at our successors for a future pandemic, it contains significant technical information that is likely to be of assistance to the Inquiry and informative to the wider public. I consider that this and other witness statements produced on behalf of the OCMO should be read in conjunction with that technical report. That report has considerably more detail on many of the key issues considered in this statement.

Section 3: My involvement over the period covered by this Module

3.1. I have at various points been a participant in SAGE as chair, co-chair, member and attending observer depending on the issue. I have also been the independent chair of NEPNEI and the independent chair of the ACDP. I have had close involvement with the Human Animal Infections and Risk Surveillance (HAIRS) group, which at the time I chaired NEPNEI reported into it, and the New and Emerging Respiratory Virus

Threats Advisory Group (NERVTAG) which reports to the CMO, via the DCMO for health protection.

3.2. The dates for my involvement are set out below:

SAGE

3.3. When attending SAGE meetings as an observer I was not always recorded in the minutes (but participated in the discussions when medical advice was useful).

3.4. During the H1N1 'swine flu' pandemic (5 May 2009 to 11 January 2010), I was an observer as DFID CSA and immediate past chair of NEPNEI and gave medical advice.

3.5. During the Japan nuclear incident (13 March 2011 to 13 April 2011), I was an observer as DFID CSA and gave medical advice.

3.6. During the Iceland volcanic ash crisis (21 April 2010 to 24 June 2010), I was an observer as DFID CSA because of its implications for international travel.

3.7. During the 2014 Ebola crisis, I chaired several informal scientific groups prior to SAGE being activated. These groups were incorporated into SAGE once it was activated. I was a participant as DFID CSA and as a subject expert in tropical diseases. I deployed to Sierra Leone as part of this emergency. Formal SAGE meetings were held on:

- 16 October 2014
- 29 October 2014
- 8 December 2014

3.8. During the 2015 Nepal Earthquake (27 April 2015), I was a participant as DFID CSA and deployed to Nepal.

3.9. During the 2016 Zika crisis, I co-chaired with the GCSA (Professor Sir Mark Walport) as Department of Health CSA on behalf of the then CMO, as vector-borne diseases were a speciality area of mine. The meetings were as follows:

- 3 February 2016 (co-chaired)
- 23 February 2016
- 7 March 2016 (co-chaired)
- 8 June 2016 (co-chaired)
- 2 August 2016 (co-chaired)

3.10. Following the Novichok - Salisbury poisonings in 2018, I chaired all meetings about the initial poisonings as interim GCSA; these were held at various classified levels so had a restricted list of participants and minutes. For the subsequent Amesbury poisonings, Sir Patrick Vallance was GCSA and chaired.

NEPNEI

3.11. NEPNEI brought together the chairs of all the other infectious disease expert groups, as well as some additional independent experts. It aimed to identify predictable novel risks and consider wider issues of infectious diseases in the UK. I was its independent chair while full time Professor at the London School of Hygiene & Tropical Medicine. I demitted on being seconded into Government part time as CSA at DFID in 2009.

3.12. The first full meeting I chaired was held on 27 April 2007 and the last meeting was held on 27 November 2008. My role ceased in 2009. NEPNEI was later dissolved and its functions absorbed into other committees, including NERVTAG and ACDP.

3.13. I also attended the HAIRS group as part of this role as at that time HAIRS reported to me as Chair of NEPNEI.

ACDP

3.14. The ACDP gives advice on dangerous pathogens (bacteria, viruses, fungi, parasites, prions) in particular in terms of their special handling in laboratories and clinical settings to protect other patients, staff and the public.

3.15. I was the independent chair between demitting as DFID CSA, and re-joining Government as CSA at the then Department for Health (DH). I chaired meetings from October 2015 to January 2016.

UKVN

3.16. The UKVN was established in the wake of the West African Ebola outbreak in 2014-2016 which illustrated a failure in the development of vaccines against emerging pathogens that cause epidemics in low and middle income countries (LMICs). The UKVN's aim is to support the development of vaccines and vaccine technologies for diseases with epidemic potential in low and lower-middle income countries (ODA eligible LMICs), with investments guided by a multi-disciplinary advisory group. The UKVN advisory group brings together experts in the fields of vaccinology, immunology, epidemiology and bioengineering/biochemistry. This group has provided technical

advice to guide DHSC investment and has produced vaccine analyses and tools for the wider research and policy communities.

3.17. I have chaired all meetings in a personal capacity since its inception in June 2015.

3.18. My views on the strengths and weaknesses of elements of the science and medical advisory systems are outlined later in the statement.

Section 4: Framework for considering planning and preparedness.

4.1. To give a logical framework to my views on planning and preparedness, it is necessary to make some general comments on pandemics and major epidemics. I cover both pandemics and major epidemics because for practical purposes they usually have very similar medical and social effects and countermeasures. The main difference is that a pandemic will involve many, and potentially all, countries in the world, whilst a major epidemic may be just as severe but is usually more localised to a locality, country or region. An epidemic is however for the countries affected potentially as devastating as a pandemic- recent examples would include Ebola in West Africa and Zika in Brazil.

4.2. I have been involved in three pandemics: HIV from the late 1980s mainly as a clinician and researcher in the UK, Africa and Asia; H1N1 'swine flu' in 2009 as CSA in DFID and a clinician; COVID-19 as CMO and clinician. I studied the history of previous pandemics, including the 1918/19 H1N1 influenza pandemic, the cholera epidemics of the 19th century and plague as an epidemiologist. I have also been involved in the response in various capacities to other major epidemics over the period considered by this module which did not become pandemics but were important internationally and, had they occurred in the UK, would have presented serious challenges. These include the West African Ebola epidemic of 2014-16, the Zika epidemic in Brazil of 2015 and in a minor way the MERS epidemic in South Korea of 2015. There were also major cholera epidemics in Haiti and Yemen following disaster and war over this time-period. Additionally, I have conducted research on diseases which are often epidemic in nature, especially malaria (for example I was Director of the LSHTM Malaria Centre prior to joining government).

4.3. The most striking thing about these pandemics and major epidemics is how dissimilar they are. The two great pandemics of my generation's professional lifetime to date, HIV and COVID-19, were completely different.

4.3.1. HIV was, once acquired, a lifelong sexually and intravenously spread infection of mainly young adults with some newborns infected at birth, with initially 100% mortality, no vaccine to date but eventually highly effective drugs.

4.3.2. COVID-19 was a respiratory virus which has infected all ages but the great majority of mortality was in older adults, with short duration of infection, and a vaccine developed in record time but only moderately effective drugs to date.

4.3.3. Ebola was a disease passed on by touch, initially with around 70% mortality, with most of the initial risk arising in healthcare settings and at funerals.

4.3.4. Zika was transmitted almost entirely by the bite of Aedes mosquitoes and caused generally trivial infections in adults but serious neurological damage to babies exposed to infection in the first trimester of pregnancy.

4.3.5. The H1N1 'swine flu' influenza pandemic had a very low mortality, requiring minimal societal response, as compared to the H1N1 pandemic of 1918 where estimates of global mortality are between 17 million and 100 million (at a time when the global population was much smaller than now; probably about 1.8 billion compared to the current population of 7.8 billion).

4.3.6. MERS and SARS, both novel respiratory coronaviruses, had much lower infectivity but significantly higher mortality in infected people than COVID-19.

4.3.7. Cholera, combatting which indirectly gave birth both to the science of infectious epidemiology and the office of Chief Medical Officer, is faeco-oral, spread by water, and with particular impacts on children for which sewers and clean water were the main countermeasures.

4.4. If the societal countermeasures (also known and non-pharmaceutical interventions-NPIs) which were used for the respiratory-transmitted COVID-19 had been used for HIV, cholera or Zika they would have been wholly ineffective (and vice versa) as they have their effect on different routes of transmission.

4.5. If the same societal countermeasures used for COVID-19 had been used against MERS or H1N1 'swine flu' in the UK they would probably have been effective to some

degree in reducing transmission as these are respiratory pathogens but would have been disproportionate to the risk to society.

4.6. It follows from this that the idea that there can be one well prepared plan for pandemics or major epidemics, which just needs to be followed, is fanciful. It is necessary to have considerable flexibility in skill set, capability and response. This does not however mean it is not possible to have a structured response with some predictable elements. The initial course that a major epidemic or pandemic will take depends, in my view, on 5 major variables: mortality rates including age structure; initial force of transmission (R0); availability of treatments; availability of vaccines; route of transmission. I laid this structure out in greater detail in a lecture at Gresham College in 2018 (i.e. this is not a post-hoc rationalisation) which is available online and I consider remains valid **(CJMW3/01 – INQ000183383)**.

4.7. Of these major variables, we cannot predict in advance the mortality of a novel pathogen. This can be anywhere between less than 0.1% (2009 H1N1 'swine flu') to 100% (HIV, nvCJD). For most infections the elderly and young children are the most affected. HIV and to some extent the 1918 H1N1 influenza pandemic are exceptions to this, with major impacts on young adults. If we consider COVID-19, our societal response would probably have been different if it had similar rates of transmission to this pandemic but a low mortality similar to 'swine flu', or a higher one like MERS (per reporting to the WHO around 35% infected die), or if there had been substantial mortality in children like 1918 H1N1 influenza.

4.8. Non-pharmaceutical countermeasures, treatments and vaccine availability depend on whether it is a known pathogen, a variant of a known pathogen or novel pathogen. If for example there is a major cholera epidemic then we usually know immediately what countermeasures work as cholera is relatively stable as a pathogen (slow evolution). A new variant of a known pathogen will lead to a reasonable first pass understanding - for example we can estimate the likelihood of developing and deploying vaccines and drugs for a new influenza variant, although any drug or vaccine will need to be tested when the pandemic starts and good vaccine efficacy cannot be assumed. For novel viral pathogens such as COVID-19 we have to assume no existing medical countermeasure (drug or vaccine) will work until it has been tested or developed and tested. It is reasonable to assume that a novel bacterial pathogen would be susceptible to at least some current antibiotics. It is less likely that existing antivirals will work against a novel virus.

4.9. The 'R' value indicates the force of transmission of a pathogen. It is the average number of infections each case gives rise to (e.g. if 1 person on average infects 3 others R is 3). R0 is for practical purposes the initial R in a pandemic absent any immunity. R has by definition to be above 1 for an epidemic to expand (one person gives it to more than one person on average); once R is over 1 spread will be exponential. Epidemics are almost always either doubling (R over 1) or halving (R less than 1) - it is rare R is exactly 1. Many major pandemics have R in the range of 1-3 but higher Rs are not uncommon and in COVID-19 R increased as variants became more infectious - so Omicron has a higher natural R than Delta, which was higher than wild-type COVID-19, all other things being equal and excluding immunity. Infections can however have R equivalents of over 100, for example malaria in some parts of Africa. This matters because if R is 2 you have to halve transmission to get R below 1; if R is 10 your countermeasures have to bring it down over 10x which is a much more difficult situation.

4.10. The most predictable, and arguably initially most important, variable for planning is however the route or routes of transmission. To maintain the force of transmission needed for a pandemic or major epidemic there are for practical purposes five routes of transmission, and we need to have the capacity in the UK to identify and then to combat all of them as we do not know what pathogen will be our next major risk. The route of transmission matters because the initial response to a major infectious threat will usually have to be societal/ NPI (reducing the actions which lead to spread) whilst we develop and deploy medical countermeasures like drugs and vaccines, a process which usually takes months to years. These routes of transmission are: respiratory (influenza, COVID-19); sexual/intravenous (HIV); insect or arachnid vector (plague, Zika, malaria); faeco-oral and food (cholera, typhoid, Bovine Spongiform Encephalopathy/new variant Creutzfeldt-Jakob disease (BSE/nvCJD)); touch (Ebola, Lassa). Generally most infections with epidemic potential have a dominant route of transmission, and countermeasures have to reduce transmission to below R=1 via that route. Some have a secondary route - for example Zika has some sexual spread - but generally without the dominant route they cannot achieve R above 1. Plague was a rare example of a disease with two major routes, with important vector (flea) and respiratory routes. An effective societal response (NPIs) to a sexual/intravenous pandemic like HIV (e.g. condoms, needle exchange) is entirely different from a faeco-oral (cholera- sewerage) or respiratory (social distancing) one.

4.11. The UK, as a high income country with a temperate climate and well developed infrastructure, is now relatively hardened against two of these routes which had been important historically here and remain so in some parts of the world: vector-borne and oral. We now have few vectors capable of sustaining a major epidemic, although some can sporadically transmit diseases (such as ticks with Lyme disease); previously fleas and lice were a major risk for plague and typhus respectively in crowded areas and malaria (Anopheles mosquito borne) was endemic in the UK until 1922. We do not yet have a climate capable of sustaining the most effective mosquito vectors present in more tropical climates, although a midge-borne disease could cause problems as they have in some animals (e.g. Bluetongue in sheep). Climate change may over time increase this risk. The UK therefore has to retain capacity in vector-borne diseases.

4.12. Tap water in the UK is safe to drink, and the development of sewers from the nineteenth century onwards should prevent human faeces getting into water people might drink or be exposed to, and so are a major protection from a faeco-oral epidemic (when operating as intended). Human faeces discharged where people might be exposed (e.g. children play or people swim) is a known public health risk.

4.13. Food inspection and hygiene regulations, cooling for storage and cooking reduce the risk from foodborne disease epidemics at scale (although limited outbreaks inevitably occur). This is however not a complete protection. BSE in cattle led to nvCJD in humans in the UK, and this epidemic, whilst very serious for those infected, could have been significantly worse than it was in terms of numbers symptomatic. An ability to respond to oral diseases therefore needs to be maintained.

4.14. This leaves sexual, touch and respiratory. By definition touch and sexual transmission require the infectious person, and the person to whom they transmit, to get very close. Touch diseases may also be spread indirectly via a fomite (a physical object the infected person touches, which is then touched by an uninfected person). Contact tracing capacity remains essential to breaking chains of transmission by these routes. We need to retain this capacity.

4.15. Respiratory infections by contrast can be transmitted at a (short) distance via droplets or aerosols and between people who do not know one another but happen to be in the same space, usually crowded or enclosed. They may additionally have fomite spread. This route is therefore generally the most difficult to provide effective societal countermeasures to in the UK.

4.16. Several things follow logically from this. The first is that there has to be considerable flexibility in capacity to respond. The exact combination of mortality, R0, medical countermeasures and route of transmission will be different, and potentially radically different, between successive pandemics and major epidemics.

4.17. Planning prior to COVID-19 was, rightly in my opinion, most advanced for influenza because we had had three major pandemics (1918, 1957, 1968) and one minor one (2009) in the last century. Influenza remains a major threat and may emerge from a known animal or bird influenza (e.g. H5N1 avian influenza currently) or an unknown source. Even for this single pathogen influenza there is however considerable variation in the possible mortality with widely different potential impact on society, and therefore response. The 1918 H1N1 influenza pandemic had a mortality of possibly 2-3% compared to less than 0.1% in 2009 for H1N1. Some avian influenzas have mortality significantly in excess of that- current H5N1 influenza has a case fatality in humans estimated at around 50% but it is currently difficult to catch. Transmissibility of influenza variants between humans varies widely. Vaccines are variably effective against different influenza strains, even once developed, and in some years vaccines have vaccine efficacy close to zero for seasonal influenza whilst other years this is around 60%.

4.18. Second, predicting what will cause the next major pandemic or epidemic is somewhere between exceptionally difficult and impossible. Basing our response capacity on the assumption that we can, even with considerable investment in risk prediction, predict our next risk and plan only for that is therefore highly unlikely to be a safe strategy. Before 2020, WHO rightly predicted that the next pandemic would most likely be 'Disease X' (i.e. a new pathogen currently unknown to cause human disease). This was not considered a controversial statement. Neither of the last major pandemics of HIV or COVID-19, both new-to-human infections arising from animal antecedents, were predicted anywhere in the world. Nor were the impacts of Zika in Brazil or Ebola in West Africa predicted, although both had been known pathogens for many decades (1976 and 1947 respectively, both in Africa). In 2019, the UKVN (which I still chair) published a paper explaining the process by which a UK pathogen priority list was developed, the intent behind that process being to inform priorities in vaccine research and development at national and international level **(CJMW3/02 - INQ000183378)**. The study identified and ranked 13 pathogens with disease X as the most likely. The coronavirus MERS however was identified as a top priority for vaccine development; this was a fortunate ranking as the Oxford/AZ COVID-19 vaccine developed from

research supported by this route. We could however equally have faced a pandemic or major epidemic not related to any on this list at all. When HIV emerged from chimpanzee retroviruses and spread in humans it was so different from previous human epidemic viruses that it required a complete rethink of our understanding of infections and immunology.

4.19. By way of illustration, it is probably worth highlighting why in SAGE and with public health colleagues we thought the risk to the UK from the last two pathogens for which SAGE was activated, Zika and Ebola, did not pose a high threat to the UK. It is as important we can identify a low risk as a low risk, as that we can identify a high risk as a high risk, or we would be constantly setting off false alarms with significant social and economic consequence. It also illustrates some of the different skill-sets needed if the UK is to retain this capacity for measured risk-assessment and response.

4.20. For Zika where I co-chaired SAGE there was no doubt this was a dangerous virus for pregnant women, and specifically their unborn child, in early pregnancy with major neurological disability if the fetus (foetus) was exposed in the early weeks of pregnancy. In Brazil the epidemic was fast in onset and in the affected pregnant populations devastating. UK travellers were likely to go to Brazil including in large numbers for the 2016 Rio Olympics that year. Virtually all the transmission was however via two species of Aedes mosquito, *Aedes aegypti* and *Aedes albopictus.* There was some sexual transmission but it was not capable of sustaining an epidemic or outbreak. We had and currently have good vector surveillance and were confident that whilst Aedes quite frequently has been introduced into the UK, it has not to date become established in large numbers for prolonged periods of time. Whilst it was likely there would be imported cases of Zika (as occurred) there was therefore no mechanism of onward transmission at scale from these cases. Equally an infected Aedes mosquito that arrived in the UK on an aeroplane was unlikely to survive for long enough to infect more than a few people at worst (although measures to reduce this risk further by spraying aeroplanes with insecticide were considered and put in place). This balanced risk assessment depended on the current capacity in entomology (study of insects and their interaction with humans). It is also not a static risk assessment- for example *Aedes albopictus* is moving north through Europe in part due to climate change as unlike other Aedes species it can overwinter. Medical entomology is an example of an apparently niche skillset we would be unwise to lose.

4.21. For Ebola, where I was on SAGE and also very heavily involved in the planning and execution of the UK Government's assistance to the Government of Sierra Leone, our risk assessment was in brief that we thought a small number of infected cases could arrive in the UK ('a handful' was how it was communicated). We were however fairly confident both of our ability to manage these cases clinically to minimise onward transmission when detected, and our ability to contact-trace and isolate at the scale that was likely. For this touch disease, where infectious people were almost always symptomatic, contact tracing and isolation is a very effective tool, as it proved in West Africa where it formed a major part of the response which ended the epidemic. We thought it was possible that a few cases could be transmitted on in the UK from an imported case before the first (index) case was identified but that the UK had the contact-tracing capacity for the relatively modest numbers involved then to stop this turning into a significant outbreak. In the event this did not occur. Here the UK NHS capacity to treat highly infected high consequence infectious diseases (HCIDs), and by PHE to contract trace and isolate at least at a modest scale, was the basis for our risk assessment; were either of these capacities to be lost the potential risk to society would have been much higher.

Section 5: Points that follow from this framework.

5.1. It is repeatedly the case, in every society, that at the start of a pandemic or epidemic there is a perception that we have underinvested in maintaining capability to respond rapidly to the epidemic or pandemic, a public health capacity collectively referred to as health protection.

5.2. As soon as the danger is perceived to have passed the process of dismantling that capacity begins again as other calls on public funds become perceived as more urgent. This is simply an observation of what happens (and I predict will happen as concern about COVID-19 fades across the world). The judgement as to what is the appropriate investment in health protection capacity between emergencies is a political, not a principally technical one, as competing demands have to be balanced by elected leaders through the political process. The risk of new infections and other health emergencies (e.g. nuclear, chemical) is however enduring, and as illustrated above if we are to respond in a measured way to predictable challenges we need as a minimum to retain several basic capacities. If the decision is to disinvest from public health

capacity in favour of other priorities, then we cannot expect the public health system to be as strong in its technical response to an infectious or other public health emergency as it would have been had investment been maintained or increased.

5.3. There are some capabilities without which it is impossible to mount an effective response to a large scale epidemic or pandemic. The UK had some, but not all, of these prior to 2020. The UK had, and has, major scientific capacity in the area of infectious diseases. This has enabled the UK to have acknowledged international experts in infectious diseases on advisory groups, and to undertake the basic and applied research needed in an emergency.

5.4. The UK maintained technical capacity for a wide-spectrum response at a modest scale in PHE and the NHS; this was recognised by international peers. In 2019, the Global Health Security index ranked the UK second in the world after the USA for preparedness **(CJMW3/03 - INQ000183379)**. Any predictable small outbreak should have been managed effectively in the UK by international standards irrespective of the route of transmission with this PHE capacity.

5.5. What was arguably not in place was an ability rapidly to expand that capacity to a large scale. This was most obvious in diagnostics and case-finding (identifying all early cases, then their contacts, and isolating them) in COVID-19. I consider this ability to scale at speed in response to a rapidly moving pandemic, epidemic or other sudden health emergency was, and still is, the greatest potential vulnerability in the UK.

5.6. To explore this further I would divide the response to any pandemic or major epidemic into five phases. In the first phase there is a global threat and the key ability is to analyse that threat and identify and contain the first few, spillover, cases. In the second phase there is a major expansion of the epidemic or pandemic in the UK before the Government has time to mobilise new capacity. In the third phase the full resources of the State deploy to meet the new threat. In the fourth phase the first scientifically derived medical countermeasures are developed and deployed. The fifth stage is a rational and measured standing down of emergency response to business as usual as the threat recedes due to widespread deployment of medical countermeasures, or the natural evolution of the epidemic or pandemic.

5.7. In my opinion the UK was by realistic international standards relatively well prepared for phase 1- a highly technical response at a small scale, including assessing international risk and developing small-scale countermeasures (see paragraph 5.4 above). A combination of strong academic centres in infectious diseases, a technically

competent and internationally connected group of health protection experts in what was then PHE (now UKHSA), and systems in the NHS to manage small numbers of cases in specialist infectious disease centres underpinned this.

5.8. The UK is objectively an international leader in phase 4, science-led development and deployment of countermeasures, due to its strong science and centralised NHS structures with proven capacity to deliver basic science, clinical trials and deploy countermeasures rapidly. This was demonstrated in COVID-19. This does not mean it could not be stronger still, but in so far as England and the wider UK is an outlier it is on its capacity, rather than lack of capacity, in this area.

5.9. Phase 3 - full resource of the State available, and Phase 5, the stand-down, will have to be designed around a specific threat and have to be political decisions, informed by technical experts in various disciplines. We do however have a lot of expertise to provide the scientific underpinnings for policy decisions.

5.10. Where the UK was, and arguably is, less strong is in the second phase between the first few cases emerging and the full mobilisation of State resources once a crisis has developed. The capacity to scale up rapidly from the initial relatively limited (but technically demanding) response to a large scale one over a short period of time can be achieved by a number of routes. These include the State holding significant capacity in reserve for emergencies; having dual-use resources which can rapidly be switched from one use in normal times to another during emergencies; and using existing private sector manufacturing or technical capacity. The UK did not have private sector capacity in some critical areas including personal protective equipment (PPE) manufacture and several elements of diagnostics manufacturing. Normally, where an epidemic is localised to a country or region these can be bought in on the global market, but in a pandemic everyone wants them simultaneously and countries with domestic capacity are at an advantage. The UK could have invested in significant scale-up capacity for things which are almost always needed in infectious emergencies, especially diagnostic tests and PPE, and the ability to contact-trace at scale, but had not done so. This is not a criticism of political decisions to invest in other areas, but simply an observation that the scale-up capacity was not there. From this many of the problems the UK faced, in particular in diagnostic tests capable of identifying infected people for case management, isolation and planning, in the first 4-6 months of the COVID-19 pandemic flowed.

Section 6: The advisory committees and other advisory structures in Government.

Departmental CSA System

6.1. The UK science advisory system is complex and not perfect but is considered to be one of the stronger ones internationally.

6.2. The departmental CSA system where each major department has (or should have) in place a senior scientist to provide advice, with coordination at a cross-Government level by the GCSA, has at least three strengths in emergencies. The first is that relatively few emergencies involve a single department only. The network across Government therefore allows for the rapid transmission of technical information to the departments that need it between technical experts, which can be disseminated within that department by a senior technical person who will understand both the issues and the department.

6.3. Secondly, it provides a network of Chief Scientific Advisers with overlapping skills to support and challenge internal thinking which are personal to the person appointed at that time. For example, during early COVID-19 the Chief Scientific Adviser in DFID/FCDO (Professor Charlotte Watts) had expertise in many social aspects of medicine; the CSA in the Ministry of Defence (Professor Dame Angela MacLean, now GCSA) is a leading epidemiological modeller; the then GCSA (Sir Patrick Vallance) is a leading pharmacologist with deep knowledge of the pharma industry. CSAs are in post, understand Government, are used to working together, recognise the importance of confidentiality and most are security cleared to a high level.

6.4. Third, each scientific adviser can call on capabilities from within their own department, be it for analysis or research. For example, DHSC, the Ministry of Defence (MOD) and DFID/FCDO had and have significant research programmes. Several departments like MOD and the Department for Environment, Food and Rural Affairs have scientific institutes. The then Department for Business, Energy and Industrial Strategy (BEIS) (now the Department for Science, Innovation and Technology (DSIT)) sponsors the Research Councils in UK Research and Investment (UKRI). Some departments like the Department for Work and Pensions (DWP) have a more limited ability to commission external research but significant internal analytical capacity.

SAGE

6.5. While I have already referred to SAGE earlier in this statement, a little more detail of its role is useful here. The role of SAGE evolved over the period covered by Module 1, but in all cases its main aim is to provide a single scientific view to political leaders and other senior policymakers. This does not need to be a consensus, and the range of and technical strength of the opinion and degree of uncertainty should be reflected in the data and scientific opinions presented, but it is very unhelpful for policymakers to be confronted with several, competing, scientific views from within Government which they are expected to choose between in the heat of an emergency.

6.6. Initially SAGE considered only domestic emergencies. It then expanded to major international emergencies in which the UK had a strong interest and where these have a major scientific component. SAGE used only to convene when COBR was called but following the West African Ebola crisis the concept of pre-SAGE (precautionary SAGE) was introduced which can be called by the GCSA, or in some cases the CMO or the lead CSA for an emergency in consultation with the GCSA.

6.7. SAGE is however only reactive. It is stood up in an emergency where this is deemed useful, and then stands down. It has no standing attendees other than the GCSA, relevant CSAs, and in medical emergencies the CMO; other experts from inside or outside Government are brought in as participants depending on the emergency itself. For obvious reasons, the scientific expertise needed for responding to an earthquake, a volcano, an infectious disease, a chemical attack or a major flood will be completely different. There may be a need for technical sub-groups of SAGE, as there was in Ebola and COVID-19, in which case these can be established and will report into SAGE itself.

6.8. Between emergencies there is a SAGE secretariat in GO-Science that is involved in horizon-scanning, and in an emergency services SAGE. The role of SAGE and its importance was different in each emergency I have seen in Government. Generally, and unsurprisingly, it has a strong role when the principal issues are scientific, and a lesser one when the principal issues are operational or political. Prior to COVID-19, the most effective work of SAGE and equivalents was in my view probably in support of the UK response to the West African Ebola crisis, but it has provided important technical inputs to many other emergencies.

Independent scientific advisory committees

6.9. Scientific Advisory Committees (SACs) are chaired by an independent scientist; generally most or all members are academics independent of Government, although Government will provide the secretariat. Occasionally, a Government-employed scientist might be a member in their own right because of their particular expertise. Important SACs over the period of this Module and for the events leading up to COVID-19 were NERVTAG (chaired by Sir Peter Horby), JCVI (chaired by Sir Andy Pollard) and ACDP (chaired by Professor Tom Evans). Detail on these committees is set out in my previous corporate statements. For reasons I have laid out above, these cannot be expected to, and did not, predict the arrival of COVID-19. I do not consider this a scientific failing but rather a reflection of biological reality.

6.10. More information on my views as to how formal and informal scientific advice is provided to Government and others during an emergency is found in an article I co-authored for a Royal Society journal, published on 12 October 2021 **(CJMW3/04 - INQ000183380)**.

6.11. The various scientific bodies which operate between emergencies did the job they were set up to do. ACDP is particularly involved in laboratory safety and identifying HCIDs and there is no indication this proved a weakness in COVID-19 or prior emergencies. NERVTAG provided, in my view, rapid and sensible analyses once COVID-19 was identified based on the scientific information then available. It is not obvious that had they operated differently over the time period covered by this Module, within their remits, the outcomes of the COVID-19 pandemic in the UK would have been substantially different. I have indicated above why I consider prediction one of the least exact sciences for pandemics, and it is not evident the UK was any worse than any other country or competent multilateral organisation such as WHO on this.

6.12. It is not obvious that changing structures would in itself lead to an improvement in my view. Specifically, there is no obviously better structural system internationally for the UK to emulate. Not having interlocking expert scientific committee structures like this runs the risk either that advice is not received, or that particular individuals known to policymakers become too influential - sometimes well outside their area of competence. This can happen even in the UK system but having no structure makes it more likely.

6.13. Potential weaknesses stem from whether the best people are on scientific committees, whether the spread of expertise is appropriate for the problem in hand (including

sensible outlier opinions), and how they are used by Government rather than the structure itself. They also require technically competent and responsive secretariats, or else the questions put to the committee are the wrong ones, and the advice to policymakers through minutes becomes distorted. Advice based on an expert committee structure is inevitably slower than an individual giving advice but also more rounded and considered. Therefore this should not be seen as a perfect system by any means, but it is a reasonable one.

6.14. In attracting the best people to serve on these committees, which are generally unpaid and often quite onerous, the UK starts with some major advantages, of which the most important is the depth of technical talent in the academic sector, and a strong life sciences industry. There is also a strong tradition of volunteering to advise Government especially in an emergency. There are however some significant risks to this model; one is the increasing tendency for time to be managed by higher education institutions expecting full economic costings to be recouped. A second, of which COVID-19 was a particular exemplar, is where expert scientists, giving their time as volunteers, individually or collectively become targets of abuse and unjustified criticism whether from social media, the mainstream media, or even occasionally the political process. This is not something for which scientific training equips many of the best scientists which the nation needs in advisory roles in an emergency. This was more apparent in COVID-19 than any emergency I have previously witnessed in the UK, and in some cases the level of abuse, criticism and threat was extreme.

6.15. Another major question is whether the Government uses the expertise at their disposal effectively. This includes posing sensible, prioritised and answerable questions, and then incorporating the scientific advice given into policy advice. Here the experience is, in my view, more mixed. Generally, in my experience of Government, scientific advice is taken very seriously, and engaged with systematically, during emergencies. This is less universally the case between emergencies. The best scientific advice is only practically useful if those to whom it is given are genuinely interested in the question, and in its answer.

Section 7: Initial observations for future pandemics and epidemics from the COVID-19 pandemic.

7.1. In the technical scientific, as opposed to the clinical, operational or wider societal response to COVID-19, the most important prior policy was to have a strong research base. This provided both the technical experts to advise Government in an emergency, and the ability to respond to clear gaps in understanding by undertaking research at speed. We lay out some of the main ways this was important in the *Technical Report* including:

1. a strong and established clinical, public health and biomedical research sector;
2. broadly based but reasonably centralised processes to fund and manage publicly funded research;
3. a relatively large and highly skilled research-focused workforce and research infrastructure; and
4. expertise across a range of relevant disciplines – particularly in clinical sciences.

7.2. The speed of the UK research response to COVID-19, for instance a jointly funded NIHR, UKRI and Medical Research Council (MRC) rapid call for research into vaccines and therapeutics launched on 4 February 2020, 4 days after the first UK case, was only possible due to strong existing research infrastructure (especially NIHR, MRC and UKRI), and continued funding for this research infrastructure over many years. More detail on this is also set out in the Module 1 corporate statement.

7.3. Following from what I have said above, the greatest area of vulnerability for future pandemics and emergencies, in my view, was and remains the issue of rapid operational scale-up between a small technical response to a moderate-sized outbreak as it becomes a major epidemic/pandemic and before the whole-of-Government response can take effect. None of the current scientific bodies have that as their main area of work. The practical issues are operational, but the need for the ability to scale up is often missed. In particular, many non-specialists may unconsciously act on the assumption that it will be possible to identify a threat sufficiently far out in time that a scale-up can be planned; this is not a good basis for emergency planning as for infectious threats this is unlikely to be correct. Some infectious threats build up sufficiently slowly that a scale up can be planned for (HIV, despite being a major pandemic, was quite slow in onset with the pandemic peaking over years). Most however are very rapid in their onset (weeks to months), and if we do not have the

ability to scale up before they emerge it will usually not be possible to develop it in two months when they do.

7.4. Most major human pandemics and epidemics are either terminated (e.g. Ebola), or de-risked (HIV, COVID-19), by science-based interventions. Maintaining a scientific capacity rapidly to undertake observational, basic and clinical science once an infectious emergency unfolds is in my view essential. Science is global. The capacity of UK science in this area remains formidable however, and many of the key interventions that de-risked COVID-19 globally including understanding the epidemiology, major trials of 'old' therapeutics like dexamethasone, and development of vaccines (Oxford/AZ) came from the UK. Whilst science is always international it is very unsafe to rely on other nations to do this for us and to reduce our capacity on the basis they will; COVID-19 demonstrated this.

7.5. COVID-19 has led to some remarkably rapid advances in science. The evolution of RNA vaccines is the most obvious example of this, but our understanding of respiratory pathogens, coronaviruses and our immune response to them, and advances in modelling are examples of others. These will be optimally useful if our next pandemic threat is a coronavirus transmitted by the respiratory route, and fairly useful for other viruses transmitted by the respiratory route, or infections for which a vaccine needs to be developed rapidly and RNA proves a useful platform. They may however have limited use for the next pandemic. If the sequence of pandemics had reversed, few of the lessons painfully learned during COVID-19 would apply usefully to HIV- indeed there might be an over-confidence in planning that a vaccine would rapidly arrive that changed the dynamic.

7.6. More widely the COVID-19 pandemic has shown the remarkable altruism of the population. Most younger citizens felt, correctly, at minimal (not zero) personal risk of mortality and relatively low risk of major morbidity, yet they were prepared to endure significant social and economic hardship to protect others, most of whom they would never meet, who were more vulnerable than they were, and in particular older citizens. COVID-19 was however a pandemic where a societal response of this kind had a realistic chance of significantly reducing mortality. For many previous major pandemics including HIV and cholera, and major recent epidemics like Zika, such a response would have had little impact.

Section 8: Some issues of specific interest to the Inquiry as laid out in the Rule 9 request.

Data communication, flows and sharing, including international.

8.1. Science is never certain, but the degree of uncertainty varies widely. Where people, whether political leaders, policymakers, clinicians or the general public are making a decision on their own action, understanding the degree of confidence around the central view is ideally an important part of communication. There is however a trade-off between being clear ('this is our central view') and offering necessary caveats when time to communicate is limited. There is no ideal way of doing this. In a short broadcast media clip lasting at most a few minutes and often less than a minute it is almost impossible to give all the caveats whilst giving a helpful central message people can understand and act on. In discussions of policy between a small group of advisers and policymakers lasting hours it is easier to provide all the main caveats, and correct misunderstandings. It is never acceptable deliberately to hide uncertainty with the aim of changing people's opinion. It may however be practically difficult to communicate all the uncertainties within a very compressed timeframe when there is a lot of data to convey to a very varied audience with a range of scientific understanding. The decision in COVID-19 to publish not only the SAGE minutes but the accompanying underlying papers allowed people who were interested to explore all the uncertainties and science underpinning them.

8.2. Science is naturally international. There are practical, mechanistic, legal, political, selfish and commercial reasons data are not shared internationally in emergencies. The most important practical one is that scientific capacity is still very unequal globally. It is far easier for countries with a strong science and research base, generally higher-income countries, to be confident enough of their data to share it. Improving this means capacity strengthening science internationally. The mechanistic barriers are mainly having platforms to share data between and within counties without technical or legal barriers. This is improving the whole time, and in addition to the WHO and other multilateral organisations, websites such as ProMed (epidemics) and GISAID (genomics) provide a neutral platform for sharing data. Legal barriers to sharing data are not my specialist area, but these include significant concerns about breaking the

law by data transfer across borders, and concerns about one country taking commercial advantage of another country's freely shared data including genetic data.

8.3. Political barriers arise where a country has the capacity to share important data, and the information is of international importance, but the government forbids or blocks this for political reasons. Political barriers to sharing data can be some of the most destructive to public health, as exemplified during the SARS international epidemic. They are also the least amenable to technical intervention. The political risks in sharing data about new infections are however not theoretical. China (initially), the UK (when Alpha emerged), India (Delta), Denmark (mink outbreak) and South Africa (Omicron) all suffered from international responses to sharing data about new variants, with travel bans and barriers to trade against the country which chose to share the data.

8.4. The least excusable barrier to sharing data are selfish reasons, where scientists want to publish a paper and withhold data until they have secured that publication. Following bad experiences in Ebola, I have, with others, written about the responsibility of scientists to share data, and encouraged journal editors not to publish papers based on withheld data **(CJMW3/05 - INQ000183381)**. Finally, there may be commercial reasons, ranging from a journal wanting to maintain its pay-wall through people wanting to ensure a submitted patent is not threatened (neither a major problem in COVID-19 in my view).

8.5. Data flows within the UK system early in the pandemic (but after the timespan of this Module) were not optimal, and may be an issue the Inquiry want to explore in detail in later Modules. It improved considerably over the course of the pandemic.

8.6. Especially in the early stages of the pandemic the UK relied on data from other countries. Initially this was China where the virus had emerged where clinical, epidemiolocal and genome sequencing data from Chinese scientists and clinicians were essential. Wider southeast Asia and then other countries such as Italy had significant outbreaks before the UK and we learned from their scientists and doctors. This informal sharing, and sharing through publication in the normal way, operated reasonably well, but did depend on personal relationships in many cases. In return many other counties relied on UK data: specifically on Alpha when it first emerged in the UK, but also because of our very robust epidemiological studies including the ONS and SIREN studies which will no doubt be covered in subsequent modules.

8.7. We were aware of the potential limitations of relying on data from countries with very different demographic, ethnic and health-systems such as China and other nations

affected early on, but the data were very useful for early planning. This guided initial assessments, particularly on issues such as likely mortality by age group, before we had UK data. This is covered in more detail in the Technical Report. Relatively quickly however UK data became some of the strongest internationally and was important in both the clinical response and the scientific and public health advice in Government.

8.8. The use of pre-prints where papers were put online prior to peer review reduced, but did not eliminate, the delays in data-sharing through scientific papers which is the mainstay of most forms of medical science. It came at the cost that not all information was properly peer-reviewed, but in a rapidly moving epidemic delay was in most cases the bigger threat.

Activation of early research and the research response.

8.9. This is covered in much more detail in the *Technical Report*, and will be subject of subsequent Modules, but these are some early observations.

8.10. In response to the COVID-19 pandemic the UK set up or activated multiple research studies with different timelines for reporting. Research was one of the 4 key aims in the 'Contain, delay, research, mitigate' strategy which will be important to examine in Module 2. The UK put more early emphasis on research than most comparable nations.

8.11. For clinical and epidemiological data these included: the First Few Hundred study, a largely descriptive clinical study of early cases which followed a protocol previously used for MERS in 2015 and 'swine flu' in 2009 (started in January 2020); CO-CIN, a study of hospitalised patients with COVID-19 and in particular those in ICU (started March 2020); SIREN, a study of healthcare workers with serial sampling to understand infection rates, reinfection and in due course vaccine efficacy in working-age adults (started June 2020); VIVALDI in care homes (started May 2020); ONS COVID-19 Infection Survey, a study of the proportion of general population with infection (started April 2020); COMIX, a survey of a sample of the UK adult population looking at social contact trends (started March 2020); PITCH, a study to understand T-cell responses in healthcare workers (started March 2020); ONS COVID-19 Schools Infection Survey, a study to understand and assess infection and transmission in schools (started October 2020); Virus Watch, a study of households focusing on transmission, immunity and symptoms (stared June 2020); ATACCC, a cohort study of healthcare workers studying secondary attack rate and time between exposure and infection (started September 2020)

8.12. This area of the UK response was, in my view, relatively strong by international standards, and a significant amount of the global epidemiological data, especially in the first year after March 2020, came from these UK based studies. They were set up through a combination of existing sleeping design/contracts (e.g. First Few Hundred) and swinging existing infrastructure, especially that of the NIHR within the NHS, over to COVID-19 work. It will be essential to maintain this capacity if we are to be able to respond to future pandemics or major epidemics effectively.

8.13. For reasons laid out at the start of this statement, it is difficult to be sure which skillsets will be needed for the next health emergency. It is not obvious therefore that new structures will help in future pandemics and epidemics. What is needed is a broad and deep research base that can rapidly respond, a mindset that it can and should be swung towards an emergency once one arises, and a view in Government that research is a critical part of the response rather than an add-on. There are however dangers to the rapid movement of research infrastructure to the emergency; other forms of important research are inevitably halted in the process, and the scale of the threat has to be sufficient to justify this step to change the normal process by which research is undertaken for important diseases such as cancers or heart disease. It would not, for example, have been appropriate to stop non-'flu research during the 2009 H1N1 'swine flu' pandemic at anywhere near the scale it was for COVID-19. There have, as an illustration, been complaints in the media by some that the UK non-COVID commercial trials research decreased in 2020 and 2021 relative to other countries when this was the inevitable result of the UK deliberately swinging its research capacity over to COVID to a significantly greater level than many other nations (with global benefits).

8.14. It is important to retain flexibility for the duration of studies over time, and to be prepared to initiate new studies, expand them, extend them, or terminate them depending on need, and emerging international evidence. There was to help with rapid response a dual-key 'fighting fund' (£30m to spend on rapid COVID-19 research) held by the GCSA and CMO which proved very useful in being able to take decisions at speed and I would commend this mechanism for future emergencies. Detail on what it funded can be found in my corporate Module 2 statement.

8.15. For clinical interventions there is a tension between a desire to do something fast and the need to test it rigorously. It is absolutely essential clinical interventions with unknown effects are properly tested, even in the face of strong public or political

pressure to deploy at speed. Several drugs and other therapeutic measures that were widely expected to work did not to any meaningful degree (for example convalescent plasma), along with others, like chloroquine and ivermectin which had strong if minority support. On the other hand, dexamethasone was not initially widely expected to work, but the RECOVERY trial showed it significantly reduced mortality. In each case trials were essential. This was about mindset rather than structures. Clinical interventions where there is reasonable doubt on the outcome ('equipoise') should be tested; all drugs and vaccines have side effects and are only justifiable if the benefits outweigh these. This does not however mean all interventions have to be, or can be, tested: it was obvious oxygen was needed; it became obvious anticoagulation was important, and these did not need a trial to be deployed, although optimising dosing (high v low dose) potentially benefitted from trials.

8.16. Funding multidisciplinary teams between emergencies solely in order to be ready for the next one is in my view unlikely to be effective or sustainable, for reasons laid out at the start of this statement; the emergency that we face may well be very different next time and may not occur for many years. Rather a tradition and habit of multidisciplinary teams working together and inter-disciplinary research needs to be fostered. This is necessary for all policy-relevant research; in emergencies the scale and urgency is what is different.

8.17. Having dual-use facilities however is helpful- for example vaccine manufacturing or research laboratories which normally undertake other, useful, activity but can in an emergency relatively easily move to a new threat. It is almost always much easier in a fast-onset crisis to build out from or adapt existing capacity than to create it from scratch.

8.18. There were also some relatively less successful areas. The social science response was arguably less strong than the biomedical and clinical research for COVID-19, and as an example we used anthropology less effectively. This was in contrast to Ebola where it was one of the strongest components of the scientific response.

8.19. There was also a demonstrated inability to undertake interventional research into policy decisions without slowing them down to a dangerous degree, but it was and is not clear this can be improved on. In COVID-19, because of the speed of the pandemic, there was a constant tension between needing to get policy interventions rolled out, and the need to evaluate them rigorously. Generally evaluations need to be

built in from the start, and both the planning and the operational delivery of built-in studies imposes some delay.

8.20. Whilst the ideal would be randomised policy trials in practice during emergencies this is seldom practical in the time available even with forward planning, and it proved very difficult in COVID-19. Policy trials and group-randomised trials are even in non-emergency settings technically and operationally harder to do rigorously than individually-randomised clinical trials for which a very established methodology has existed for decades. We will therefore have to rely on post-hoc analyses of observational data for evaluating the effectiveness of policy interventions during COVID-19 which are significantly more liable to unintended bias than trials.

8.21. It would, in my view, be sensible to have evaluations planned out for likely policy interventions which could be considered in a variety of emergencies such as airport screening, facemasks, and social distancing. These would need to be adapted to the specific emergency, just as happened with clinical and epidemiological studies. Even with planning it may not be possible to undertake these studies, but without pre-planning it will be almost impossible against the speed of an emergency.

8.22. Now that COVID-19 is a much smaller proportion of the burden of disease and pressure on healthcare than it was, we need rapidly to re-establish research on important disease classes including cancers, cardiovascular, inflammatory and surgical diseases. This includes academic, charity (e.g. British Heart Foundation, Cancer Research UK) and private sector research. Our observation was that stopping this kind of research in an emergency and prioritising COVID-19 related research or frontline services proved easier and faster than we anticipated; re-establishing this important research after the event has proved considerably more difficult and slower than we hoped or anticipated. This needs to be anticipated and planned for.

8.23. Finally, I would like to repeat my invitation to those who would like more detail on these or other issues to consult the *Technical Report on the Covid-19 Pandemic in the UK* by the UK CMOs, the GCSA, the NHS National Medical Director and the relevant Deputy Chief Medical Officers (DCMOs) along with many other distinguished authors.

8.24. A draft of this witness statement was provided to the Inquiry on 14 March 2023. Whilst I have not been asked any follow up questions by the Inquiry, I have considered whether there are any further matters that I should address. In light of the fact that I have provided two additional statements (each of which go into further detail in respect of the OCMO's involvement in the pandemic) and having not yet considered the

evidence of other witnesses, there are no immediate matters that I have felt it necessary to add. I am however happy to continue to assist the Inquiry either before the oral hearings or during my oral evidence (or at any other stage) and address any matters pertinent to Module 1 that the Chair or Counsel to the Inquiry considers would be of benefit.

Statement of Truth

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

Signed **Personal Data**

Dated 05/05/2023