Witness Name: John Edmunds
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UK COVID-19 INQUIRY – MODULE 1

Witness Statement of Professor John Edmunds

I, **PROFESSOR JOHN EDMUNDS**, of the Department of Infectious Disease Epidemiology at the London School of Hygiene and Tropical Medicine, Keppel Street, London, WC1E 7HT will say as follows:

1: Introduction

1.1. I make this statement pursuant to the Covid-19 Inquiry's module 1 Rule 9 request of 20 January 2023.

1.2. I previously submitted a response to the Inquiry's Rule 9 Questionnaire of 2 September 2022 on 26 September 2022 (**'The Rule 9 Questionnaire Response'**).

1.3. I do not see any overlap between the questions being posed for modules 1 and 2 of the Inquiry, given the distinct time frames of each module.

1.4. The matters I set out within this statement are within my own knowledge save for where I state otherwise. Where I refer to facts not within my own knowledge, I will provide the source for those facts. The contents of this statement are true to the best of my knowledge and belief.

2: Professional background and expertise

2.1. I am a Professor of Infectious Disease Modelling at the London School of Hygiene and Tropical Medicine (**'LSHTM'**). I have been working in the area of infectious disease modelling for about 30 years, having obtained my PhD in modelling the spread of the

Hepatitis B virus in 1994. I moved to LSHTM in 2008. Before that, I was Head of the Modelling and Economics Unit at the Health Protection Agency (**'HPA'**), which is now the UK Health Security Agency (**'UKHSA'**). I have been involved in pandemic planning (mainly for influenza) since my time at the HPA. I joined LSHTM to head up the newly created Centre for Mathematical Modelling of Infectious Diseases (**'CMMID'**), which now has around 150 members. I stood down from running CMMID in 2011, when I became Head of the Department of Infectious Disease Epidemiology at LSHTM. In 2013 I became the Dean of the Faculty of Epidemiology and Population Health at LSHTM – a role I served in until 2019.

2.2. My area of interest and expertise is the control of infectious diseases. Although my interests are broad, covering everything from tick-borne diseases to human papilloma virus and cervical cancer, I have mostly worked on directly transmitted pathogens. These are often outbreak-prone and/or targets for vaccination programmes. I have tended to work on applied issues, using models and other analytical methods to help improve public health policymaking. I have published over 350 peer-reviewed articles and have an h-index of 115 (Google Scholar), meaning that I have published over 115 articles that have been cited at least 115 times by other authors. It is not feasible to list all of these papers here. Google Scholar provides a list of my publications by order of citations [**JE/01- INQ000147219**].

2.3. I was awarded an OBE in the New Year's Honours list in 2016 for services to infectious disease control, particularly during the West African Ebola crisis, and became a Fellow of the Academy of Medical Sciences in 2018.

3: Experience of advisory groups and perceptions of their effectiveness

3.1. I attended SAGE during the 2014 West African Ebola crisis and pre-SAGE meetings about the Democratic Republic of the Congo Ebola outbreak in 2018, so I had some experience of SAGE before the COVID-19 pandemic. I attended 2 of the 3 SAGE meetings during the 2014 Ebola outbreak and 2 of the 3 pre-SAGE meetings for the 2018 Ebola outbreak. In terms of pandemic planning and preparedness, my main work has been in relation to the Scientific Pandemic Influenza Group on Modelling (**'SPI-M'**) and the New and Emerging Respiratory Virus Threats Advisory Group (**'NERVTAG'**).

3.2. SPI-M was established around 2006 or 2007. I was invited to be a member from the beginning. I was, at the time, the Head of the Modelling and Economics Unit at the HPA and was involved with influenza pandemic planning within the agency. The

Modelling and Economics Unit was one of the bigger modelling groups within the UK at the time and, along with the Heads of the other two major groups - Professor Matt Keeling at Warwick University and Professor Neil Ferguson at Imperial College, we formed the backbone of SPI-M as it was constituted then. The Health Protection Analytical Team (**'HPAT'**) at the Department of Health provided the Secretariat and contributed to the analysis for SPI-M.

3.3. It was chaired by Dr Peter Grove of the HPAT team until he retired in 2018. I continued to serve on SPI-M after I moved to LSHTM. My replacement as Head of the Modelling and Economics Unit of the HPA, Dr Peter White, was also invited onto SPI-M at that time. The membership of SPI-M expanded during and after the 2009 swine flu pandemic. By 2009, meetings were attended by about 20 to 25 individuals, including officials, observers and SPI-M members.

3.4. In 2014 NERVTAG was established and advertised for members in various areas, including mathematical modelling. I applied and was accepted following a recruitment process and interview. I served on NERVTAG until 2022.

3.5. I am also a member of a number of Joint Committee on Vaccines and Immunisation (**'JCVI'**) subgroups, the most pertinent being JCVI's influenza subgroup, which I have been a member of since 2010 (the membership is by invitation). The influenza subgroup is predominantly concerned with seasonal influenza but also considers pandemic influenza vaccine-related issues.

3.6. Each of these groups (SPI-M, NERVTAG and the JCVI Influenza subgroup) met regularly with a frequency of about 2 times per year over the period the Inquiry are interested in. I am not able to recall the number of meetings I attended for these groups, but I would expect the Secretariat at GO-Science would have a record of all the meetings that I attended. Therefore, please revert to GO-Science for this information.

3.7. For the most part, participation on these committees involves providing scientific advice, specifically via reviewing and commenting on papers, discussing matters at meetings etc. First drafts of papers are usually provided by the Secretariat (either DHSC or PHE/UKHSA). Occasionally, members are tasked with bringing a paper to the relevant committee and a working group may be formed for this purpose. The main output from SPI-M was the SPI-M Modelling Summary [**JE/02- INQ000147220**]. This was written before the 2009 swine flu pandemic and was refreshed afterwards. The group met to review it periodically to ensure that it reflected current evidence. This was usually done at the meetings, but occasionally individual members might be tasked

with reviewing and re-drafting a section. SPI-M focussed on the epidemiological and modelling aspects of pandemic influenza. Its remit did not extend beyond this.

3.8. NERVTAG is a multidisciplinary committee with a remit to advise the DHSC on risk assessments and mitigation measures for respiratory viral threats. The group typically met twice a year. It would usually review and approve the current PHE risk assessment (of potentially risky viruses) during every meeting. This mostly concentrated on novel influenza strains but other respiratory infections, such as Middle East Respiratory Syndrome (**'MERS'**), were also assessed. Another key role of NERVTAG was to provide scientific input on the strategic stockpiles (e.g. stockpiles of personal protective equipment, antivirals etc). The committee might also review and comment on other aspects of Government guidance. For instance, guidance on infection prevention control, or management of avian influenza outbreaks.

3.9. The JCVI Influenza subgroup would provide advice to the main JCVI committee on the advisability of different vaccines and vaccine policy (e.g. what sorts of vaccines were preferred, what age/risk groups should be targeted). It typically meets once a year and is mostly concerned with seasonal influenza. However, periodically it is tasked with providing scientific input on pandemic influenza vaccine policy. For example, should a pre-pandemic stockpile be maintained, if so what strain? etc. These issues are discussed every few years. Meetings on pandemic influenza have generally been held jointly between the JCVI influenza subgroup and NERVTAG.

3.10. SPI-M is a modelling group, and as such its membership is almost exclusively modellers and/ or statisticians who work in the field. NERVTAG and the JCVI Influenza subgroup are both multidisciplinary, involving social scientists, epidemiologists, virologists, clinicians, as well as experts in both animal and public health. There is some overlap in the membership between these groups. All three of these groups have members and observers (often representing the public health agencies or departments of health from the different UK nations). In practice, there is little or no distinction between members and observers. Both tend to speak freely and contribute equally. The large modelling groups are represented on SPI-M, including both academic and public health groups, such as those mentioned at paragraph 3.2. It is these larger groups who have had a permanent presence on SPI-M. SPI-M membership has expanded over the years to encompass a wider range of academic modelling research groups. NERVTAG's membership is wider, including public health and animal health

agencies as well as academics. The JCVI does have an international member, but the other committees are made up of UK-based researchers exclusively.

3.11. Membership on these committees is voluntary and unpaid. The committees do not have the ability to commission research and pay for it. This limits the amount of work that can be expected of committee members and their respective research groups. As stated at paragraph 3.7, members generally discuss and comment on papers that have been prepared by the Secretariat or by PHE/UKHSA or DHSC. If specific work is required, then this usually falls to PHE/UKHSA to provide it. That is, specific research work, requested by a committee, is usually commissioned from PHE/UKHSA.

3.12. They are often expected to fund this work from within their existing budget. Academic groups are seldom asked to undertake work, due to the delays and expense associated with commissioning such work (and the lack of a funding mechanism). The academic groups may be working on similar issues and might be able to re-prioritise their planned work, and/or adjust it somewhat so that it helps answer a question from the Committee. However, this is rare. Over the 11 years that the Inquiry is interested in (2009-2020) I received no renumeration for my time nor did I receive any research grants to conduct work related to any of these committees. We give our advice freely. However, it is not feasible to engage much further than that.

3.13. The groups were not established to enable long-term emergency working and did not work in such a way for most of the period under question (2009 to 2020). The exception was SPI-M, which during the 2009 swine flu pandemic, sat regularly over the course of the epidemic. As with the COVID-19 pandemic, this was both an opportunity for groups to work on a novel pathogen of high academic and public health interest, but it was also a drain on academic resources and a major challenge to sustain. The bigger research groups and/or those with longer-term, flexible funding were able to sustain this effort for longer (in practice this was mostly Imperial College in 2009). As with the COVID-19 pandemic, original research work was undertaken during the pandemic (funded from elsewhere) which was used to inform the work of SPI-M and its umbrella committee, SPI.

3.14. I did not attend SAGE during the 2009 swine flu pandemic. SPI-B (the Behavioural subgroup of SPI) was also established before the 2009 swine flu pandemic and I was seconded to it from SPI-M during the swine flu pandemic to act as a link between the two committees. This arrangement had some success, though it was limited. Mathematical modellers generally require quantitative information (e.g. what fraction

will uptake the vaccine), but behavioural scientists can rarely provide such quantifications. Nevertheless, the qualitative insight provided by SPI-B was still helpful to guide some aspects of the modelling. SPI-B was shut down after the 2009 pandemic and so further liaison was not required. It then re-activated for the COVID-19 pandemic. Indeed, with the setting up of NERVTAG in 2014 there was a forum for behavioural scientists and others to interact given the multidisciplinary nature of this committee. As I have also indicated NERVTAG also interacted with (and shared many members with) the JCVI Influenza subgroup.

3.15. The standing membership of NERVTAG, SPI-M and the JCVI subgroups is both a strength and a weakness. These committees help form a network of senior colleagues (often from very different backgrounds) who know each other well. The relatively stable membership ensures that members are rapidly up to speed during meetings and a level of competence can be confidently assumed in colleagues who are not directly in one's area of expertise (i.e. all experts on the committee have some cross-field competence, due to previous exposure). This is very important during a crisis. The network itself is also important during a crisis, as it can help facilitate rapid research focussed on key public health issues. However, there is also a drawback to this stable membership. It can lead to a lack of challenge. Committees need to re-examine their recommendations periodically, as the science base or the context within which the advice may have been given changes over time. This might be better achieved with refreshed membership.

3.16. It is difficult to judge the quality of the advice that was made over that period. It seems obvious that we were not in a high state of readiness for a severe pandemic, as the UK's poor performance in 2020 demonstrates. However, was that because the advice was in some way wrong? That is difficult to answer, as it depends on what the Government were trying to achieve – something that was not clear during the planning phase or, indeed, during the pandemic. In addition, the scientific advice offered from the UK was not at odds with other agencies. For instance, comparing the pandemic influenza Modelling Summary (first published in 2013) on the effectiveness of non-pharmaceutical measures with the World Health Organization's ('**WHO**') assessment (published in 2019), it is clear that the WHO's evidence summary is more comprehensive and systematic. However, the recommendations for the effectiveness of the different policies are broadly similar.

3.17. It is not possible to know to what extent the advice from these committees was followed or influenced policy. My perception is that advice was generally followed, but I have no way to test this assertion. Draft papers were usually prepared by the Secretariat, public health agency or Department of Health, which should have ensured that they addressed issues of direct importance to these agencies. However, as an ordinary academic member of these committees, I would not be aware of the extent that they were implemented. For instance, if we recommended the stockpiling of a particular type of face-mask, we would not be routinely informed about whether this had actually occurred. Finally, I should stress that the issues that we were tasked with reviewing were operational in nature. Broader, strategic issues (such as mitigation versus suppression) were not discussed. Whether there was any advice or planning at this strategic level from other sources is difficult to ascertain.

4: How well were we prepared for the COVID-19 pandemic?

4.1. We were not adequately prepared for a pandemic of COVID-19. Detailed planning concentrated on influenza. SPI-M was a pandemic influenza committee. It did not consider other pathogens. NERVTAG had a wider focus (respiratory viruses) but did not engage in detailed planning. The Advisory Committee on Dangerous Pathogens' remit is wider still, but I am not aware that it engages in detailed pandemic planning and preparedness work (I have never been a member of this committee, so do not know). There are plans for bioterrorism threats, such as smallpox or anthrax, but I am not aware of how detailed these are, nor their relevance for a novel coronavirus threat. Our detailed pandemic planning was focussed on influenza.

4.2. The UK had put significant effort into updating its influenza plans in the years after the SARS outbreak (mid 2000s). These plans were then put into practice during the 2009 swine flu influenza pandemic. The epidemic mostly affected children and was mild. Antivirals had been stockpiled and a means to deliver them quickly, without necessitating a visit to a GP's surgery, had been developed (this became known as the National Pandemic Flu Service, 'NPFS'). As pressure built on GP practices, the NPFS was launched which helped relieve this pressure. The Government had also entered into several advance purchase agreements for pandemic specific vaccines and so the UK was one of the first countries to receive vaccines (indeed, as vaccine rollout was concentrated on children and those at high risk, rather than everyone, we ended up being oversupplied with vaccines). We did not impose widespread non-pharmaceutical measures, nor did we implement travel restrictions. Public health

messaging was simple and consistent (e.g. "Catch it, bin it, kill it"). The overall response was generally regarded as balanced with respect to the risk and was widely praised, including in Dame Dierdre Hine's independent review into the response to the swine flu pandemic [**Exhibit JE/03- INQ000147221**].

4.3. In the light of this experience, pandemic influenza plans were updated after 2009. Stockpiles of antivirals and personal protective equipment were reviewed and refreshed if necessary. See for example the NERVTAG minutes of 14 June 2017 [**JE/04- INQ000147222**] . On paper, at least, we seemed relatively well prepared for an influenza pandemic.

4.4. Subsequent events from the COVID-19 pandemic showed that it is unlikely that these plans would have adequately controlled a severe pandemic of influenza, for a number of reasons. I outline these below:

(a) The surveillance system was poor. This resulted in poor situational awareness during the first few months of the COVID-19 pandemic (until April 2020). There needs to be far better routine surveillance of respiratory infections in the community and in hospitals. Self-reporting illness via an app (such as the ZOE App, or something equivalent), with testing of a sample of those with symptoms, would provide a reasonably inexpensive and scalable method of surveying respiratory infections in the community, though difficulties with understanding the denominator population with such systems complicates interpretation. Other community surveillance systems would also be necessary, including a more comprehensive GP-based system with routine testing as well as serological surveillance (that is, testing of blood samples to see what fraction of the population have antibodies to the virus- i.e. have evidence of infection). In addition, something akin to the ONS Coronavirus Infection Survey or the REACT study would be extremely helpful, as they were during the COVID-19 pandemic, as they provide an estimate of the prevalence of infection in the community. However, early in a pandemic, such surveys would have to be very large to be able to pick up a reliable signal. Other systems are therefore important, including routine testing of hospitalised cases. Environmental (wastewater) surveillance can also be useful to confirm if a new strain is circulating in an area. Improved, routine testing in high-risk settings, particularly hospitals and care homes, is also critical.

(b) The testing infrastructure was inadequate. Testing was limited at the outset of the epidemic and there were significant delays to obtaining results. This impeded the accurate tracking of the early stages of the pandemic and attempts to slow transmission. The difficulties experienced with COVID-19 would be magnified with influenza, as its speed of spread means that delays to testing results can be even more problematic. It also took many months for lateral flow tests to become widely available. Earlier use of these tests could have helped protect vulnerable groups and slow epidemic spread. Evaluation of the performance of rapid tests (including comparison with virus culture, not just PCR) should be undertaken early during a pandemic. These measures should be part of a plan to enable a flexible and scalable testing infrastructure for use during a pandemic that builds on an improved public health testing and surveillance system for routine infections.

(c) The PPE stockpile was insufficient to cope with a major epidemic, resulting in widespread infection of health and care staff. This, in turn, facilitated widespread infection in our most vulnerable groups (hospital patients and care home residents).

(d) Data access was slow during the COVID-19 pandemic. SPI-M did not have widespread access to data until late March, though some groups (including my own) did have access before this time.

(e) It seems apparent that senior decision-makers had not adequately rehearsed to what extent they would be willing to implement widespread non-pharmaceutical interventions to slow or stop the epidemic. This can be seen from the delay in implementing lockdown in the UK and the inconsistent strategic approach applied throughout the pandemic (as evidenced by the first lockdown being replaced by "Eat Out to Help Out"). Taken together it does appear that politicians were inadequately prepared to take these decisions. Data on the effectiveness of non-pharmaceutical measures from before the pandemic were very sparse as these measures had not been widely implemented since 1918. See for example a report from the WHO titled 'non-pharmaceutical public health measures for mitigating the risk and impact of epidemic and pandemic influenza' [**JE/05-INQ000147223**]. However, the evidence did suggest that they could be

effective but would be disruptive to society and the economy. The SPI-M Modelling Summary [**JE/02- INQ000147220**] suggested that "The combined effects of various social distancing measures (including closing schools, cancelling large public events, closing places of entertainment, and home isolation) if started very early on in a locality affected by influenza may have a significant impact on reducing transmission… however such measures would need to be maintained until sufficient quantities of pandemic specific vaccine became available". It goes on to say that "While there is a role for the less disruptive social distance measures such as voluntary home isolation in any pandemic, school closures and the cancelling of public events are generally only justified in very severe pandemics because of their severe social impact over an extended period of time". Although Exercise Cygnus concentrated on a severe pandemic scenario, it was not designed "to identify what action could be taken to prevent widespread transmission" [**JE/06- INQ000147224**]. This seems to be avoiding the key question that politicians needed to address – to what extent are they willing to trade wealth and civil liberties for health? Better rehearsal and stress-testing of these decisions during the planning phase may have sped-up decision-making during the pandemic and enabled the Government to develop an overall and consistent strategic aim.

(f) This latter point (that Government had not adequately rehearsed pandemic policy) points to a wider failure of planning. Pandemic influenza was always at the top of the UK's National Risk Register [**JE/07- INQ000147225**], partly because it was expected to have a major impact on virtually all aspects of society and therefore Government. If pandemics are expected to affect all areas of society, then there is a need to plan adequately for their impact on every aspect of society, not just health. It is not clear that this was the case. Was there, for instance, an equivalent of the SPI-M Modelling Summary that examined the economic impact of different mitigation measures? This could have allowed Government to make a more informed strategic choice.

(g) Wider structural issues affect our vulnerability to pandemics and our ability to respond effectively. The UK has a very high rate of arrival of airline passengers and so is likely to import cases very quickly (as happened during both the COVID-19 and swine flu pandemics). In addition, the UK population has one of the highest levels of obesity across the WHO

European Region [**JE/08- INQ000147226**] as well as high rates of other chronic conditions, such as diabetes. At 2.3 beds per 1000 inhabitants, the UK has one of the lowest provisions of hospital beds within the whole of the OECD - less than half that of France (5.7) and less than a third that of Germany (7.8) [**JE/09- INQ000147227**]. Each winter the NHS struggles to cope with demand. It is therefore unsurprising that COVID-related pressures were felt so acutely within the UK.

4.5. In mitigation, a number of structural issues facilitated the UK's response to the pandemic. For instance, it has a strong science base and nationalised health system. The combination allowed large scale clinical trials and observational studies to be conducted, facilitated by the ability to link data across many different health care providers and surveillance systems. This meant that the UK was well placed to undertake ground-breaking research to help improve the response to the pandemic. The UK also had a system whereby scientific evidence could help inform UK policy (via SAGE and JCVI). The nationalised health system meant that medical interventions could be implemented at scale in a fair and equitable manner. The roll-out of the vaccination programme was an excellent example combining these different facets of excellent science, a direct route to policy-making and national equitable implementation. The roll-out built on the existing system to plan, deliver and evaluate vaccination programmes. This enabled a rapid, rational and ordered roll-out of COVID-19 vaccines as well as a rapid assessment of the benefits and health costs.

5: Planning for future pandemics

5.1. A summary of the UK's capabilities in pandemic preparedness and planning has recently been published by the UKHSA [**JE/10- INQ000147228**]. It identifies some of the UK's strengths, including its laboratory network and genomic sequencing capabilities, its national immunisation programme as well as its strength in data analytics and surveillance. It also sets out broad plans for improving the UK's resilience and ability to respond. This document demonstrates that the UKHSA is taking steps to evaluate and improve our preparedness and ability to respond. I have added a few thoughts of my own below.

5.2. Epidemic planning and preparedness should consider a wider range of scenarios. Planning has been focussed on pandemic influenza. However, other infections can result in pandemics – or at least very damaging epidemics. A wider range of pathogens needs to be considered, including those that are not spread through the respiratory

route. The last pandemic of the 20th century was the HIV/AIDS pandemic, which was primarily sexually transmitted. The Mpox epidemic of 2022 was also sexually transmitted and showed how quickly such infections can spread globally through international networks of high-risk individuals. Although less likely to affect the UK in the near future, many vector borne diseases are expanding their range and have caused widespread health and economic damage, including the Zika and Dengue viruses. The expansion of West Nile Virus in the US is a warning sign for other countries, as the vectors of this virus are widespread, including in the UK. There also remains the risk of high consequence (high case-fatality) pathogens such as Ebola, Marburg and Nipah viruses. These are unlikely to cause widespread transmission but could cause major disruption. Clarity is needed, regarding which committees are responsible for scientific input to pandemic planning for these infections (see, for instance, discussion on Nipah virus at the Seventh meeting of NERVTAG on 21 June 2018) [**JE/11- INQ000147229**].

5.3. Flexible plans need to be developed to cover a wide array of epidemic scenarios. The possible effectiveness of basic public health measures (such as contact tracing, or measures at international borders) need to be evaluated against this variety of potential threats. Since the COVID-19 pandemic, DHSC/UKHSA have taken this on board and are developing plans to cover a wider range of scenarios. This is reflected in the report titled 'UKHSA Advisory Board; preparedness for infectious disease threats' [**JE/10-INQ000147228**]. This is a good starting point, but further details are required on mitigation measures (not just a reasonable worst cases scenario) as well as their costs. The operational requirements to control these outbreaks needs to be reviewed and investments made where necessary. Finally, these plans need to be tested in realistic exercises that examine not only operational issues, but also strategic ones.

5.4. As noted, pandemics affect all areas of Government. Although the UKHSA are examining and developing their plans and capabilities in preparation for the next pandemic, it is not clear that other Government departments are doing so to the same level. We risk, once again, having an imbalance in the strength of advice on the medical and public health side, compared with other aspects of pandemic planning.

5.5. From a modelling and epidemiological point of view much of the planning for pandemic influenza centred on the description of a "Reasonable Worst-Case Scenario". This was based on the largely unmitigated 1918 influenza pandemic in the UK. It is possible that overfocussing on this scenario, rather than the mitigation measures available, led to a

defeatist attitude. That is, "this will occur", as opposed to "this could occur, if we don't take measures to stop it". The reasonable worst-case scenario remains helpful – in my opinion – but it should not be treated as an expectation. It is something that we should strive to avoid.

5.6. Plans need to be kept up to date with changes in society and in technical advances. For instance, the COVID-19 pandemic demonstrated that large parts of the workforce can work effectively from home. Indeed, it seems likely that the pandemic has brought about a permanent change in working patterns. Plans did not adequately consider this, possibly as they were written about a decade or more earlier when broadband availability was poorer and online meetings were rare. Similarly, vaccine development (particularly the rapid success of the mRNA vaccine platform) will likely shorten the time from the emergence of a new disease to an effective vaccine being available. Preparedness plans and associated strategic goals need to be re-evaluated periodically to ensure that they remain current.

5.7. Although the strength and value of the UK's science base was repeatedly demonstrated over the course of the COVID-19 pandemic, there were areas where significant improvements could be made, a few of which are listed below.

5.8. There needs to be far greater attention paid to the economic impact of pandemics and the interventions aimed at controlling them. The economics of outbreaks is a specialised field. Interventions can have major knock-on effects, so that individuals who were not directly reached or targeted by the intervention can still benefit (as they have a reduced risk of infection from others). These knock-on effects need to be incorporated in the analyses, to avoid underestimating the benefits of public health actions. Furthermore, the same intervention (that would therefore cost the same) can have profoundly differing effects if it is implemented early in an epidemic or late (imagine if effective COVID vaccines had been available a year earlier or a year later). Finally, pandemics can have a major impact on the wider economy (macro-economic impacts) but this is seldom taken into account in standard health economic assessments [**JE/12- INQ000147230**]. There is therefore a need for much greater interaction between economists and epidemiologists to improve not just the quantity of economic assessments in this area, but also the quality. Given the cost of pandemics, modest investment in this area to improve decision making and preparedness may well be extremely well placed.

5.9. The behavioural sciences are critical in many areas of public health, as interventions frequently require individuals to change their behaviour to reduce their risk, or the risk to others. Further research to improve our quantitative understanding of the drivers that may affect uptake and compliance with interventions is therefore important.

5.10. We still do not know with any great certainty how effective (and cost-effective) most non-pharmaceutical interventions ('**NPIs**') were. Many were implemented together, so it was difficult to ascertain the effect of each individual measure. Although they were eased more gradually, this was not done in a scientific way and so there was little opportunity to learn from the experience. Ideally, randomised controlled trials should have been conducted to give the highest quality of evidence possible. Suggestions made during the pandemic included a trial of attendance at large sporting events [**JE/13- INQ000147231**] and trials of different testing strategies, which I suggested myself [**JE/14- INQ000147232**]. Although a few trials were undertaken, (two trials evaluated daily testing of contacts instead of quarantine [**JE/15- INQ000147233**] and [**JE/16- INQ000147234**] and one is currently underway to assess testing options in care homes) it is surprising how limited our ambitions were in this regard. This lost opportunity to learn from the pandemic will leave us similarly unprepared for the next one. However, since prevalence has remained relatively high at around 2%, [**JE/17- INQ000147235**] there is an opportunity to implement further studies at reasonable cost. That is, it remains feasible to put in place a programme of research, that will not only help our pandemic preparedness but also improve strategies for controlling the ongoing COVID-related burden of disease. Examples could include trials for appropriate funding of sickness absence payments as well as testing regimes in hospitals and for those at high risk in the community.

5.11. There should be longer-term consortium funding to undertake research in the pre-pandemic phase (planning phase) and to build surge capacity and research networks for use in emergencies. Such funding should encourage joint working between UKHSA and academia. There is currently considerable experience of pandemic-related research within UK academia. Ensuring that this expertise is not lost would greatly help planning and future response. In addition to funding research during the pandemic phase, the UK could consider instituting "sleeping research contracts" as was implemented by the National Institute of Health Research (**NIHR**) after the 2009 swine flu pandemic. Research awards were given in a number of areas to allow set-up of critical studies that would be activated during an emergency. Similar schemes could

facilitate rapid research during an outbreak to help improve the clinical and public health response.

5.12. Finally, as I have already mentioned, the UK has a number of structural factors that affect our vulnerability to pandemics and our ability to respond effectively to epidemic threats, including an aging population, high levels of obesity and other chronic conditions, large differences in life expectancy across the population and a low number of hospital beds. It is likely that these structural factors are beyond the scope of the Inquiry. However, addressing these could well significantly improve our response to the next pandemic as well as bring about lasting improvements in health more generally.

6: Documentation

6.1. The main document that I made a contribution to was the SPI-M Modelling Summary [**JE/02- INQ000147220**]. My contribution was to comment on drafts and make minor edits to it.

6.2. I have not published any papers specifically on pandemic preparedness. The closest that I have published is a piece with Neil Ferguson, Matt Keeling and others from 20 years ago titled 'Planning for Smallpox Outbreaks' [**JE18- INQ000147236**]. However, despite the title, the paper is really about mathematical models and what they should and should not be able to do, rather than any details of how to plan for a smallpox outbreak. I have not written anything for the media or commented in the media about pandemic preparedness.

6.3. I do not hold any other relevant documentation relating to these matters and I do not have any other relevant information to provide to the Inquiry which is relevant to the matters being examined in module 1.

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.

Name: **Professor John Edmunds**

Signed: Personal Data

Dated: **14 April 2023**