Witness Name: Professor Harry Rutter

Statement No.: 1

Exhibits: HR/1-HR/69

Dated: **16 August 2023**

Ref: M2/SAGE/02/HR

UK COVID-19 INQUIRY

WITNESS STATEMENT OF PROFESSOR HARRY RUTTER

I, **PROFESSOR HARRY RUTTER**, of the University of Bath, Claverton Down, Bath, BA2 7AY, will say as follows: -

1. Introduction:

1.1. I make this statement pursuant to the Covid-19 Inquiry's Rule 9 request of 24 March 2023.

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

Background

1.3. I joined the SAGE sub-group, Environment and Modelling Group ("**EMG**") on 28 April 2020 and remained a participant through to the last meeting on 25 January 2022.

1.4. I was invited to join the EMG by Professor Catherine Noakes, the chair, having been proposed by my colleague Professor Theresa Marteau as someone who could bring public health expertise to the group in addition to her own.

1.5. I volunteered to take on the EMG co-chair role in November 2020 to provide support to Professor Catherine Noakes and Professor Andrew Curran.

1.6. I became the co-chair of EMG from the 24 November 2020 meeting. As co-chair I then also attended main SAGE meetings from that point on.

1.7. I attended main SAGE group meetings from meeting 67 on 12 November 2020, to meeting 105 on 10 February 2022.

1.8. During the time I was involved in EMG I participated in a number of EMG sub-groups including the Transmission Group, working groups on 'Risk assessment and transmission' and 'Design and behaviour', as well as leading a task and finish group on 'Systems thinking and visualisation'.

1.9. My role was that of a public health generalist, bringing expertise and understanding of broad approaches to disease and risk factor prevention. Addressing health and social inequalities is a core tenet of public health. I have been trained to consider the distributional impacts both of public health harms and actions taken to remedy them. This perspective informed my scientific advice throughout.

2. EMG

3.1

3.2

2.1. EMG included a diverse range of expertise. There was a mix of senior academics, government scientists, and chief scientific advisers from a broad range of disciplines and wide topic expertise.

2.2. The majority of members of the group were men, and there was limited diversity in terms of ethnicity and age.

2.3. Our role was to provide scientific advice based on the best available evidence. EMG incorporated a good breadth of scientific diversity, appropriate to the task in hand. In any such group it is always possible to include an even greater range of scientific perspectives, but any such breadth involves trade-offs in terms of the practicalities of the effective functioning of a larger group. EMG achieved a good compromise between disciplinary breadth and effectiveness.

2.4. EMG was one of a number of SAGE subgroups, each of which brought its own set of disciplinary perspectives, and diversity in terms of gender and ethnicity. Many EMG papers were co-authored with other SAGE subgroups, so much of the advice

provided by EMG incorporated a wider range of perspectives than was represented solely within EMG.

2.5. Nevertheless, in a similar situation in the future it would be important to ensure broad diversity in the composition of all the groups providing advice to government. It would also be beneficial in future to involve a broader mix of ages, including a number of younger scientists in the process. I expand on this further below, at paragraph [6.2.6].

2.6. Diversity is extremely important for bringing different perspectives, and the EMG membership could have been more diverse in terms of vulnerable, marginalised and minority groups. However, our advice was largely focused on scientific evidence of the mechanisms of transmission and associated mitigation measures. Strong input on the social aspects of Covid-19 was provided by other groups, especially the Scientific Pandemic Insights Group on Behaviour ("**SPI-B**") and the SAGE Ethnicity subgroup.

2.7. I have been asked to comment on how issues of diversity and equality can be addressed in order to maximise adherence within certain groups of society. I would defer both to experts in behavioural science and, importantly, people from more diverse backgrounds than my own to answer this. My answer is therefore to engage with people with topic expertise, and those with lived experience – and ideally people with both – to provide such advice.

2.8. EMG was a SAGE subgroup, receiving commissions from SAGE and reporting back. We worked effectively with main SAGE and with other sub-groups, and many of our papers were written jointly with others, e.g. SPI-B. The work of the sub-groups was incorporated into SAGE's advice.

2.9. I have been asked to describe the relationship between EMG and the No. 10 Behavioural Insights Team, Government Communication Service, DHSC communications team, PHE / UKHSA communications team, the behavioural science team in PHE / UKHSA's Emergency Response Department, and various NHS Test and Trace advisory and working groups that focused on large events, self-isolation and testing uptake. I don't recall EMG as a committee working with any of these groups. Individual members of EMG may have discussed communications with some of these teams, and members of these teams may have attended SAGE meetings, but there was no direct link from EMG itself. The

role of EMG was to provide scientific advice through SAGE to support decisions by policymakers, so I would not have expected us to work directly with these teams.

2.10. The work of EMG focused on the environmental aspects of SARS-CoV-2 transmission, and actions to mitigate it. In the first few months of the pandemic we produced a number of papers describing existing empirical and mechanistic evidence relating to transmission of similar infections, and emerging evidence on transmission of SARS-CoV-2 [HR/1 - INQ000211997, HR/2 - INQ000212008, HR/3 - INQ000212019, HR/4 - INQ000223277, HR/5 - INQ000212027, HR/6 - INQ000223282, HR/7 - INQ000212029]. This included papers on specific settings, such as public transport [HR/8 - INQ000223278, HR/9 - INQ000223272], hospitals [HR/10 - INQ000223281], and concert halls, as well as a number of papers on mitigations including disinfection technologies and hand hygiene [HR/11 - INQ000223276, HR/12 - INQ000223271]. As time passed more evidence emerged on transmission and how to mitigate it so our outputs reflected this, with increasing emphasis on the importance of ventilation and less emphasis on the surface contact route [HR/13 - INQ000223279, HR/14 - INQ000212002, HR/15 - INQ000223280, HR/16 - INQ000223273].

2.11. From autumn 2020 onwards we also started to produce more outputs that considered behaviour, in combination with SPI-B and other SAGE subgroups, and provided guidance to the public on how to reduce their risks of infection [HR/17- INQ000223274, HR/18 - INQ000212006, HR/19 – INQ000223275, HR/20 - INQ000212009, HR/21 - INQ000212010, HR/22 - INQ000212011, HR/23 - INQ000212012, HR/24 - INQ000212013, HR/25 - **INQ000212014** HR/26 - INQ000223270].

2.12. In addition, EMG participants published a number of academic papers. I was involved in two of these which synthesised expert opinion on transmission routes and used these data to underpin an interactive graphic which shows the relative importance of different transmission routes, and the potential impacts of different mitigation measures on those routes [HR/27 - INQ000212016, HR/28 - INQ000212017. A static early version of the graphic was included in an EMG paper for SAGE on 23 Dec 2020 [HR/19 - INQ000212007].

2.13. As demonstrated in these papers, our main contributions to emerging knowledge about transmission were:

2.14. An emphasis on the importance of mechanistic in addition to empirical evidence

2.15. Describing the importance of considering long-range aerosol transmission from early in the pandemic

2.16. A related focus on the importance of ventilation and face masks as mitigation measures

2.17. The development of guidance and information that could be used by the public; and

2.18. As described elsewhere in this witness statement [Section 4] a continued emphasis on the importance of considering inequalities and how to mitigate them.

Support

2.19. The EMG secretariat was excellent and did an outstanding job throughout the process.

2.20. The work I did as an expert adviser during the pandemic was conducted on top of my day job. My university Vice Chancellor, Dean and Head of Department were all extremely supportive and freed me up from many other duties, but it was not possible to drop all teaching and ongoing research, so I was subject to extremely high pressures on my time.

2.21. The main challenge I faced as Co-Chair of EMG was that the role imposed very significant demands on my time; indeed it was because of their workloads that Professor Noakes and Professor Curran invited me to join as Co-Chair. The workload had knock-on effects which continue to play out. For example, my capacity to work on grant proposals was seriously constrained, with consequences in terms of research funding that have had long term impacts on my academic work. I managed to maintain a reasonable level of publication during the time of my work on EMG and SAGE, but it was lower than it would otherwise have been.

2.22. We were not remunerated for our work on SAGE or its subgroups. This did not compromise its ability to provide timely and high quality advice; I think it is appropriate for emergency advisors to act on a voluntary basis as they should be completely independent. Relying on volunteers is not sustainable in the long term however, so the work of SAGE and its sub-groups should eventually be taken up by UKHSA or a similar organisation. I return to this point at paragraph 6.2.1.

2.23. Some payments were made to our universities to cover a proportion of the costs of backfilling our time. There were no resources for bringing in support from

information scientists, data analysts, or support with writing papers. There was a lack of central support for information technology, with online meetings and document sharing hosted by my fellow co-chair's university IT system.

2.24. There was a very high level of public attention focused on those of us who contributed to the SAGE process, with some of it extremely unpleasant and abusive.

2.25. A number of security briefings were provided by GO-Science in which we were given advice on how to minimise any such threats, and how to seek additional support including from the police.

2.26. These sessions were helpful but, having looked through my records, it seems that the first of them was in April 2021. In any future pandemic or equivalent emergency it would be important to offer support of this kind from the outset. I discuss this further below [6.2.4].

2.27. I have been asked to provide an opinion on the ability of EMG to obtain and share data. EMG did not have data analytical support, but it was not its role to conduct primary analyses of data so it did not require such support.

2.28. The role of EMG was to provide scientific advice. This required a great deal of work to engage with the developing evidence as well as writing papers to tight deadlines to maximise the timeliness of our advice. From my perspective as Co-Chair, the main challenge we faced as a group was conducting this work without wider support. In a similar situation in the future it would be beneficial to be able to call on support from information scientists and others to help with reviewing literature, synthesising evidence, analysis, and drafting. I expand on this further below [6.2.5].

Commissioning

2.29. The overwhelming majority of EMG outputs were commissioned through SAGE in response to requests from government departments, with the SAGE secretariat passing the commission to EMG secretariat. I did not participate in this process, but my understanding is that there was a process of negotiation between the SAGE and EMG secretariats to refine the questions in order to maximise the value of our outputs.

2.30. A small number of EMG commissions came from the Science Co-Ordination Group or arose out of discussions in SAGE meetings.

2.31. The commissions that came through to EMG were appropriate. A major factor in this was the work done behind the scenes by EMG secretariat to filter out inappropriate requests and refine the others. I have been asked to comment on the understanding and the 'scientific mindset' of those who formulated the questions, but I was not privy to this filtering and refining process so I am unable to comment on this.

Output

2.32. I have been asked to comment on whether there was a degree of 'groupthink' within EMG. Any organisation is at risk of engaging in groupthink, but we worked very hard both to prevent it and to avoid complacency. Within EMG we deliberately fostered an open culture that invited challenge, considered a wide range of perspectives, made explicit invitations to the group to voice any objections, and explicitly challenged ourselves to ask if we might be mistaken.

2.33. I have been asked to comment on the strengths and weaknesses of the process of SAGE arriving at consensus in order to provide its advice. One of the strengths of operating on the basis of consensus is that, in conjunction with the emphasis on open discussion and challenge that I experienced, it results in thorough and extensive debate leading to high quality scientific advice. The weakness of this approach is that consensus can take time to achieve and requires careful facilitation by the chair. Neither turned out to be a problem because the meetings were expertly chaired by Sir Patrick Vallance, and the small amount of time required did not cause a delay that had a material effect on the timely provision of scientific advice. It is arguably a structural weakness that it is so reliant on the CSA, and this could have been a problem in a counterfactual scenario in which we were not so well chaired. I am not aware of any alternative models, however, that would resolve this structural weakness within the time and pressure constraints inherent in an emergency. The CSA along with the CMO have a very important role as the interlocutors with policy-makers and they are highly qualified to carry out this role.

Airborne transmission

2.34. The NERVTAG meeting of 13 Jan 2020 noted the possibility of aerosol transmission of SARS-CoV-2 (which at that time was still known as the Wuhan Novel Coronavirus). The first paper produced by EMG, which predated my involvement in the group, was an '*Evidence summary on evidence of environmental dispersion for different mechanisms, and the risks and potential*

mitigations/measures of control within different environments from what we know about COVID-19', discussed at SAGE on 14 April 2020 [HR/29 - INQ000212018]. This paper discussed the potential for airborne transmission of SARS-CoV-2 at length and emphasised the importance of factors including ventilation and how densely packed with people a space is, as well as the potential impact of face masks for reducing transmission, and the benefits of outdoor environments.

2.35. These points were explored in more detail in subsequent papers from EMG. The 28 April 2020 EMG paper on '*Environmental Influence on Transmission'*, which considered '*transmission through airborne, droplet and contact routes'*, and noted that '*The risk of short range transmission through aerosol and droplets decreases with distance and there is evidence that 2 metres is a distance where risk drops to an acceptable level for face-to-face interactions.*' [HR/2 - INQ000212008]

2.36. The 14 May 2020 EMG paper on '*Principles of understanding of transmission routes to inform risk assessment and mitigation strategies'* described "*a framework for evaluating the behavioural, viral and environmental factors that control the transmission of SARS-CoV-2*" across the three potential transmission routes of contact, short range droplet, and aerosol [HR/3 - INQ000212019].

2.37. The 4 June 2020 EMG paper on '*Transmission of SARS-CoV-2 and Mitigating Measures'* [HR/5 - INQ000212027] stated that while there was "*weak evidence that aerosol transmission may play a role under some conditions such as in poorly ventilated crowded environments*," the "*risk of aerosol transmission is highest when people share poorly ventilated spaces where the viral aerosols can build up rather than being diluted and removed by the ventilation. Risk increases with time spent in the same shared air. Risk is generally higher closer to the infectious person, but beyond this close proximity the concentration of aerosols that a susceptible person will be exposed to depends on the ventilation in the room. Transmission by aerosol can happen at distances beyond 2m in the same enclosed space especially if the ventilation is poor and duration of exposure is sufficient. It is possible but unlikely that aerosol transmission can happen between people in different rooms (via ventilation systems). Aerosol transmission risk is considered to be very low outdoors due to high dilution of virus carrying aerosols and UV inactivation of the virus*."

2.38. The 4 June 2020 paper noted that "*Given the very recent origin of this novel virus, very few engineering or environmental mitigation measures have strong evidence to support their effectiveness. A number have data from idealised studies to show theoretical efficacy, but there are very few real-world studies. Decisions on selection of engineering controls will inevitably need to be based on incomplete evidence as "do nothing" is not an option*."

2.39. NERVTAG and EMG produced a joint paper on the *Role of aerosol transmission in COVID-19* on 22 July 2020 which summarised the evidence at that time [HR/7 - INQ000212029].

2.40. The SAGE meeting on 14 January 2021 [HR/30 - **INQ000075533**] endorsed the EMG/SPI-B/SPI-M paper on '*Reducing within- and between-household transmission in light of new variant SARS-CoV-2'*. In this paper we noted that "*When someone has tested positive, they should assume that they can transmit the infection through the air*" and that "*in addition to a range of other measures face coverings and other forms of PPE may be beneficial*. [HR/20 - INQ000212009]"

2.41. The UK Government took a number of appropriate measures in response to emerging evidence of the role of airborne transmission. The importance of maintaining a safe distance from others was emphasised in government communication from mid-March 2020 onwards, with explicit mention of 'social distancing' on 22 March 2020 [HR/31 - INQ000212021]. The use of face coverings in enclosed public spaces such as shops, trains and buses was recommended by the Department of Health and Social Care on 11 May 2020 [HR/32 - INQ000212022].

2.42. The main concerns I have about policy on airborne transmission relate to the way it was addressed in healthcare settings. Official guidance placed lower emphasis on the role of airborne transmission as a risk to healthcare workers than we made in our papers from EMG. For example, the '*New government recommendations for England NHS hospital trusts and private hospital providers*' [HR/33 - INQ000224391] recommended the use of '*Type I or Type II facemask worn to prevent the spread of infection from the wearer*' in addition to other measures including hand hygiene and ventilation, by 15 June 2020. As described in paragraph 2.40 above, EMG pointed out in June 2020 that aerosol transmission was possible in enclosed spaces, but the measures advised for clinical settings in

which there was a high likelihood of people infected with SARS-CoV-2 were stated as being designed '*to prevent the spread of infection from the wearer*', not to protect the wearer from infection. The 15 June 2020 guidance was withdrawn on 27 May 2022.

2.43. The development of the 'two metre rule' predated my involvement in EMG. The EMG paper on [HR/5 – INQ000212027] on 4 June 2020 described a non-linear relation between the risk of transmission and distance of separation for face-to-face contact, and stated that best current evidence suggested that 1m carries between 2 and 10 times the risk of 2m of separation.

2.44. It is normal practice across many risk factors in health to apply a threshold to define a condition or recommend a behaviour, even though the risk factor varies across a range in a way that does not demonstrate a clear, dichotomous cut-off. This application of a threshold to a continuous variable unavoidably involves the application of a definition that is to some extent, arbitrary. This should not be seen as contentious – it is necessary to be able to diagnose anaemia, or high blood pressure, or any number of other conditions, and a line has to be drawn somewhere. The two-metre rule is no exception as there is not a sudden alteration in risk from 1.99m to 2.00m, but there is good evidence to support the adoption of 2m as an appropriate distance for separation on the basis of the known behaviour of respiratory droplets and particles. Risk of transmission decreases with distance from the source, and is also a function of duration of exposure, ventilation, configuration of the space and other factors. The risk is appreciably lower at 2m than at shorter distances, but it does not fall to zero, as EMG made clear in its papers [HR/1 – INQ000211997, HR/2 – INQ000212008, HR/3 – INQ000212019, HR/5 – INQ000212027].

2.45. I was not party to discussions with policy makers so I do not know if our advice on these issues was communicated effectively to them. I did not participate in any of the 'teach-in' presentations, but I gather that they were effective and well received.

2.46. To the best of my knowledge I do not recall SAGE or EMG being consulted on the Eat out to Help Out scheme before it was implemented. If we had been I am sure that we would have advised against designing a programme that attracted people into indoor environments to engage in activities that would require them not to wear face coverings, as this was likely to increase transmission of SARS-CoV-2.

2.47. EMG was a SAGE subgroup, receiving commissions from SAGE and reporting back. We worked effectively with main SAGE and with other sub-groups, and many of our papers were written jointly with others, e.g. SPI-B. The work of the sub-groups was incorporated into SAGE's advice.

3. Functioning of government

3.1. I have been asked to comment on the Institute for Government finding that "*decision-making at the centre of government was too often chaotic and ministers failed to clearly communicate their priorities to science advisers*." My role was to support SAGE through the provision of scientific advice. As an adviser I was not party to the decision-making process, or to the priorities of ministers. We received our Commissions via SAGE and EMG secretariat by which time they had been significantly filtered, so I am unable to comment on whether or not ministers had communicated their priorities clearly.

3.2. I have been asked to comment on the level of understanding of the role of EMG by decision makers. Our role was that of a sub-group feeding in to SAGE, with advice from SAGE then being mediated through the GCSA, CMO and others; I do not know the extent to which ministers understood this role.

3.3. I have been asked to comment on whether or not ministers put too much weight on SAGE in the initial months of the pandemic. I did not attend SAGE until November 2020 and had no involvement in SAGE in the initial months of the pandemic. Furthermore, I was not party to ministerial decision-making processes at any time, so I cannot comment on the weightings they placed on different sources of information.

3.4. My role as co-chair of EMG and as a participant in SAGE was as an adviser. The 'SAGE guide for experts' [HR/34 - INQ000224392] I was sent before attending SAGE for the first time explicitly stated that '*SAGE is an advisory group and not a decision-making group'* and that I would be *'expected to provide expert scientific advice to the Government Chief Scientific Adviser (GCSA), based on the information available at the time*.' It was very clear in my mind throughout my involvement with SAGE that my role, and that of my fellow expert advisers, was purely to provide scientific advice, and that the decisions were made by ministers.

3.5. EMG and SAGE gave independent academic and expert advice to assist policy decisions. In neither my initial capacity as a participant, nor later as Co-Chair, was

I directed on what was and was not acceptable for us to say in terms of scope, messages, languages or reference to policy.

4. Inequalities

4.1. The UK already had a high level of health inequalities before the pandemic, many of which have worsened over the last decade. These existing health inequalities were amplified by Covid-19. People living in deprived areas were 3-4 times more likely to die from Covid-19 than people living in the least deprived areas, and people of Bangladeshi and Pakistani origin were 2-3 times more likely to die than white British people (ONS/Health Foundation 2022) [HR/35 - INQ000224393]. There were indications of these inequalities from an early stage of the pandemic, but even if there had been no specific data pertaining to Covid-19 and inequalities it would have been appropriate to assume that there would be differences in impact from the disease in relation to socio-economic status, as this pattern is seen in almost all medical conditions.

4.2. The reasons for these inequalities are complex, and are still not fully understood, but they include differences in pre-existing health status, living and working conditions, exposure to the disease, and vaccine uptake.

4.3. Within EMG we were aware from the early months of the pandemic that it was important to consider the unequal impacts of Covid-19, and the need to consider the equity impacts of responses to the pandemic. For example, in the very first EMG papers to which I contributed, '*Risk Estimation to inform risk assessment'* [HR/36 - INQ000212024] and '*Principles of understanding of transmission routes to inform risk assessment and mitigation strategies'* [HR/3 – INQ000212019] - we highlighted the importance of considering individual level vulnerabilities within a population approach, and the importance of promoting equity:

'*It is important that vulnerable groups as well as equality and accessibility are considered throughout the risk assessment process'*

'*Accessibility and equality: There is already evidence that COVID-19 has disproportionate impacts on certain societal groups. It is important to consider equality and accessibility throughout the process to ensure that mitigation strategies do not further marginalise any groups*.'

'Consideration will need to be given to any potential inequality issues which may arise from the implementation of control measures, and how best to mitigate them.'

'*At-risk groups, accessibility and equality: the process described above provides a "population" based approach to assessing risk. However, there are a number of individual susceptibility issues which would need to be considered at the organisational and national level to ensure that any at risk groups are effectively protected. There is already evidence that COVID-19 has disproportionate impacts across society serving to widen existing inequalities in health and financial resources. It is important to consider equality and accessibility throughout the process to ensure that mitigation strategies do not further marginalise or disadvantage any groups, and that interventions are in keeping with the Equality Act.*'

4.4. In our paper on *Risk Estimation to inform risk assessment* [HR/36 - INQ000212024] we addressed the potential to widen inequalities through approaches to risk reduction that rely on personal agency, emphasising the importance of mitigating the potential impact on inequalities of control measures:
'Risk communication should be a way of empowering individuals to make informed decisions about their own protection as well as well as the protection of others. If they understand the principles by which risk can be controlled then they may be able to support the process through a dynamic individual assessment of their personal risk in any situation. However, there a need for caution with this as there is evidence that the more agentic an intervention is, the greater the risk that it may widen health inequalities.

'Consideration will need to be given to any potential inequality issues which may arise from the implementation of control measures, and how best to mitigate them.'

4.5. Our focus on inequalities was maintained throughout the pandemic. For example, in our January 2021 paper on *Reducing within- and between-household transmission in light of new variant SARS-CoV-2* [HR/20 - INQ000212009] we stated:
'A comprehensive package of information and support would likely improve household implementation of self-isolation and quarantine, especially in disadvantaged households and communities. Maximum effect could be achieved by considering the broad range of barriers to adherence that exist, including financial, practical, informational and emotional factors'
and
'Deprivation and economic constraints are associated with household

overcrowding and reduced availability of space such as a spare room. Overcrowded or dense living conditions increase the risk of droplet and aerosol transmission. There is a triple burden of risk imposed by deprivation and poverty. People living in these situations are more likely to be in public-facing occupations that generate increased exposure to risk of infection, with an increased likelihood that they will be in low-paid, precarious employment which increases the disincentives for them to engage in testing or isolation because of risks to their income over the short and long term. At the same time, they are less likely to be able to isolate from others within the home than more affluent people if there is a lack of space. These problems may be exacerbated in certain ethnic groups that have a higher preponderance of large and/or multigenerational families living in the same home where space is limited'

4.6. Similarly, in the SPI-B, SPI-M and EMG paper on '*Considerations for potential impact of Plan B measures'* of 13 October 2021 [HR/25 - **INQ000212014** we said: *'Reintroduction of working from home guidance, for those who can, may have the largest impact on transmission out of the potential Plan B measures. The impact of reintroducing working from home guidance would likely largely depend on what proportion of workers are attending their workplaces at that time and the behavioural response – that is, adherence by employers and employees [Medium confidence]. There are, however, associated harms and unequal impacts that should be considered prior to implementation [High confidence].'*

4.7. As is apparent from these papers, we repeatedly emphasised the importance of measures to address inequalities, such as providing financial support to people in precarious employment to take time off work if unwell, and considering the particular needs of people from different cultural backgrounds, including those for whom living in multi-generational households is particularly prevalent. The widespread use of furlough was an important factor in allowing people to maintain an income despite being unable to work during Covid-19, and in allowing businesses to stay afloat. However, furlough did not apply to everyone, and as a result there were some groups who were unable to benefit from it, for example the self-employed. This was a problem for all people who fell into these categories, but it posed an even greater problem for people in whom multiple factors affecting Covid-19 risk intersected: those with chronic disease, from low-income backgrounds, and from ethnic minorities. Many people in these categories were in

public-facing jobs such as taxi drivers or delivery drivers, in roles in which if they did not work they would receive no income, creating economic pressure to continue working even if they were unwell.

4.8. In the November 2020 EMG and SPI-B paper on *Mitigating risks of SARS-CoV-2 transmission associated with household social interactions* [HR/18 - INQ000212006] we included a section that specifically addressed the topic of equity:

'Guidance is more likely to be adhered to if it is perceived as fair and just for all groups in society. For the recommendations to be implemented by all groups, additional support may be required to facilitate equitable access and enable the recommended activities. This requires consideration across a number of aspects:

'Digital access. The safest option to celebrate with others requires online meet ups or telephone contact. This may disadvantage low digital literacy groups and exclude them from celebrating with significant others if knowledge or physical capability of using online resources is limited and/or physical resources such as data are not available due to financial restrictions. Mitigations should include support for individuals and households to facilitate online or telephone contact.

'Physical space. Mitigations to make indoor social gatherings safer will be difficult to implement in cramped or crowded households, or where there are limited facilities (such as shared bathrooms and small kitchens). Overcrowded households are linked to socio-economic disadvantage and increased deprivation and are linked to poor housing quality and inadequate ventilation. Limited physical space will make it difficult to maintain adequate physical distance. To ensure groups are not excluded or disadvantaged communities are not further disadvantaged because they do not have the opportunity to implement mitigations within the household, additional support may be required to open up community spaces to allow families and/or friends to meet and celebrate events outside the home. This could include larger indoor spaces such as community centres and unused business spaces or facilitate access to safe outdoor spaces such as temporary pedestrianisation of streets, neighbourhood parks, golf courses, etc. which will create a safer alternative space to a crowded indoor household gathering. In addition to community spaces, places of worship may provide adequate space and should be opened to support communities to participate in significant events, where this can be done in line with guidance.

'Gender equality. The impact of the pandemic has been considered gender regressive as women have experienced increased unpaid care responsibilities due to the heightened need to care for elderly family members and childcare due to school and nursery closures. It is therefore especially important to involve women in decision making about creating safer household environments, and to promote gender equity in communications and policies relating to household social interactions.

'Culturally relevant communication. Communities which prioritise wide kin networks should be supported using culturally relevant communication including language that emphasises protecting the family. This could potentially reduce difficult conversations and decisions particularly for larger households with extended family networks to implement safe measures within the household during social gatherings.

'Houses of multiple occupation. Guidance is required to support HMOs to develop a social script (as outlined in EMG/SPI-B household paper) to negotiate and develop a household plan as it may not be possible for all occupants to invite family and/or friends at the same time due to the number of permitted bubbles that can join together.

'Financial barriers. Implementing the recommendations may be more challenging for some households due to financial constraints. For example, adequate ventilation may be difficult to achieve due to concerns that additional heating costs will be incurred as a result of opening windows or for those in flats without windows that open. Furthermore, purchasing masks and hand gel may not be feasible for households that do not have sufficient finances to cover the additional expense. Supportive measures, including financial support for measures to increase safety, are likely to increase perceptions of fairness and equality which will increase trust and adherence to recommendations.'

5. Public health messaging and communication

5.1. I have been asked to give an opinion on the channels of communication used by the government, and whether ministers adequately communicated changes in approach as scientific understanding evolved. The use of press conferences, broadcast media, social media, and other forms of communication such as posters and written communication seems to me to have been appropriate. As scientific understanding of the pandemic evolved the communication adapted to reflect this.

5.2. The widespread use of the phrase 'following the science' by ministers implied that policy followed automatically from the scientific advice we gave. This would be a mischaracterisation of the policy process at any time, not only during Covid-19, as expert advice relating to a specific scientific question is only ever one of a wide range of factors that need to be considered by politicians, who must take account of the detailed design of any policy and its impacts on different population groups, over different time frames, in the context of multiple interacting social and economic factors, other policies, and political considerations.

5.3. The phrase 'following the science' fails to communicate the unavoidable uncertainty inherent in a pandemic caused by a novel pathogen spreading at a scale none of us had previously experienced. Our advice acknowledged this uncertainty, and we accompanied our conclusions with statements stating the degree of confidence we had in them, taking this into account. The Executive Summary of the EMG and SPI-B paper on *Mitigating risks of SARS-CoV-2 transmission associated with household social interactions* provides a clear example of this, with some statements being noted as 'high confidence' while others were listed as 'medium confidence.' [HR/18 - INQ000212006] I do not know whether uncertainties in the scientific evidence were successfully communicated to the Government, or in turn from the Government to the public. Similarly, I do not know the extent to which ministers were successful at conveying messages such as the risk of gathering in indoor and poorly ventilated spaces.

5.4. I believe that the use of the phrase 'following the science' by ministers underplayed their responsibility to interpret scientific advice in the context of both its inherent uncertainties, and the multiple other factors that it was incumbent upon them to consider in their decision-making.

6. Lessons learned

6.1. The Institute for Government has stated that "*as an ad hoc committee, SAGE was not designed for the semi-permanent role it has had during the Covid crisis.*" In all previous occasions when it has been stood up SAGE has only met a small number of times, and it is true that it was not 'designed' for the role it ended up occupying during the pandemic.

6.2. I have a number of suggestions for ways in which the UK's science-policy advisory mechanisms could be improved for future crises.

6.2.1. A very urgent response inevitably requires rapidly pulling together a group of known experts who are already known to government. If it becomes apparent that an acute emergency will become a chronic problem it is important to have processes in place to move rapidly and without disruption from this kind of immediate response structure to a more formally constituted structure with wider membership. This would support the engagement of a broader range of experts, which would help to ensure appropriate disciplinary and social diversity.

6.2.2. It is important to strengthen the links between academia and policy. This is a longstanding challenge with importance that goes far beyond responding to crises. The Institute for Government produced a pair of reports in 2018 and 2019 respectively on 'How government can work with academia' and 'How academia can work with government' which provide a number of recommendations, including the establishment of expert networks by government departments; building partnerships with universities; to fill gaps in expert advice with advisory bodies; establish secondment programmes; establishing standing contracts for rapid evidence reviews with approved researchers; and creating structures to facilitate and incentivise engagement in policy making by researchers.

6.2.3. Establishing mechanisms in advance to be able to second the wide range of people required to provide expert advice into the SAGE (or an equivalent) system in ways that release them from other demands on their time would support the relevant experts to contribute in ways that are sustainable over the medium to long term.

6.2.4. It will be important to provide training and other support to advisors who are likely to find themselves subject to unpleasant public attention at the earliest possible opportunity in future crises. As discussed above [2.25, 2.26], the support provided by GO-Science was welcome but would have been more useful at the outset.

6.2.5. Providing knowledge infrastructure in the form of people including information scientists, systematic reviewers, data analysts, and others who can support topic experts with drafting papers and reports would allow SAGE participants and other advisors to focus on the provision of high-quality advice.

6.2.6. Early and mid-career researchers should be involved in the advisory process to help build the next generation of experts. In our EMG meeting on 5 May 2020 we proposed the establishment of a group of early/mid-career researchers to work within the SAGE system [HR/37 - INQ000224395]. The proposal was not

progressed; I do not know why this was the case but, in my view, it would help equip SAGE for future crises.

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: 16 August 2023

Appendix 1: Outputs from EMG

	EMG, TWEG or TSG lead/co-lead papers:	Exhibit Ref	INQ Number
1	Evidence of environmental dispersion for different mechanisms, and the risks and potential mitigations/measures of control within different environments from what we know about COVID-19, 14th April 2020	HR/1	INQ000211997
2	Environmental Influence on Transmission, 28th April 2020	HR/2	INQ000212008
3	Risk Estimation to inform risk assessment, 7th May 2020 (note paper 4 is updated version of this)	HR/36	INQ000212024
4	Principles of understanding of transmission routes to inform risk assessment and mitigation strategies, 14 May 2020	HR/3	INQ000212019
5	EMG: Survival of SARS-CoV-2 in the environment, 11 May 2020	HR/4	INQ000223277
6	Possible additional interventions to address hospital transmission risks of SARS-CoV-2, 12 May 2020	HR/10	INQ000223281
7	EMG: Transmission and Control of SARS-CoV-2 on Public Transport, 18 May 2020	HR/8	INQ000223278
8	EMG: Evidence for transmission of SARS-CoV-2 on ground public transport and potential effectiveness of mitigation measures, 18 May 2020	HR/9	INQ000223272
9	EMG: Summary of disinfection technologies for microbial control, 18 May 2020	HR/11	INQ000223276
10	EMG: Application of UV disinfection, visible light, local air filtration and	HR/12	INQ000223271

	fumigation technologies to microbial control, 19 May 2020		
11	SARS-CoV-2 in the hospital environment and risk of COVID-19 nosocomial transmission, 31 May 2020	HR/38	INQ000224396
12	Transmission of SARS-CoV-2 and Mitigating Measures - update, 4 June 2020	HR/5	INQ000212027
13	TWEG: Evidence of wider environmental transmission of SARS-CoV-2, 12 June 2020	HR/6	INQ000223282
14	NERVTAG/EMG: Hand hygiene to limit SARS-CoV-2 transmission, 2 July 2020	HR/13	INQ000223279
15	EMG: COVID-19 - Theatres, concert halls and other performance spaces, 12 July 2020	HR/39	INQ000224397
16	EMG: Measurement of effectiveness of risk mitigation measures in reducing transmission, 16 July 2020	HR/40	INQ000224399
17	NERVTAG/EMG: Role of aerosol transmission in COVID-19, 22 July 2020	HR/7	INQ000212029
18	PHE/EMG: Aerosol and droplet generation from singing, wind instruments and performance activities, 13 August 2020	HR/15	INQ000223280
19	SPI-B/EMG: COVID-19 housing impacts, 10 September 2020	HR/41	INQ000224400
20	EMG: Processing methods to facilitate the re-use of personal protective equipment (PPE), 8 September 2020	HR/42	INQ000224401
21	NERVTAG/EMG: Duration of wearing of face coverings, 15 September 2020	HR/43	INQ000224402
22	EMG: Role of Ventilation in Controlling SARS-CoV-2 Transmission SAGE-EMG, 30 September, 2020	HR/16	INQ000223273

23	EMG: Simple summary of ventilation actions to mitigate the risk of COVID-19, 1 October 2020	HR/17	INQ000223274
24	NERVTAG/EMG SARS-COV-2: Transmission Routes and Environments, 22 October 2020	HR/44	INQ000075016
25	EMG: Potential application of air cleaning devices and personal decontamination to manage transmission of COVID-19, 4 November 2020	HR/45	INQ000224404
26	EMG/SPI-B: Mitigating risks of SARS-CoV-2 transmission associated with household social interactions, 26 November 2020	HR/18	INQ000212006
27	TWEG: Environmental monitoring of viral presence, infectivity and transmission of SARS-CoV-2, 3 December 2020	HR/46	INQ000224405
28	EMG/SPI-B/TWEG: Mitigations to reduce transmission of the new variant SARS-CoV-2 virus, 23 December 2020	HR/19	INQ000223275
29	EMG: Application of physical distancing and fabric face coverings in mitigating the B117 variant SARS-CoV-2 virus in public, workplace and community, 13 January 2021 - GOV.UK (www.gov.uk)	HR/47	INQ000224406
30	EMG/SPI-B/SPI-M: Reducing within- and between-household transmission in light of new variant SARS-CoV-2, 14 January 2021	HR/20	INQ000212009
31	EMG: COVID-19 risk by occupation and workplace, 11 February 2021	HR/48	INQ000224407
32	HOCI and EMG: Masks for healthcare workers to mitigate airborne transmission of SARS-CoV-2, 25 March 2021	HR/49	INQ000224408
33	EMG Transmission Group: COVID-19 transmission in prison settings, 25 March 2021	HR/50	INQ000224410

34	EMG and DCMS: Science framework for opening up group events, 16 March 2021	HR/51	INQ000224411
35	EMG Transmission Group: Insights on transmission of COVID-19 with a focus on the hospitality, retail and leisure sector, 8 April 2021	HR/52	INQ000224412
36	EMG, SPI-M and SPI-B: Considerations in implementing long-term 'baseline' NPIs, 22 April 2021	HR/21	INQ000212010
37	EMG and SPI-B: Application of CO2 monitoring as an approach to managing ventilation to mitigate SARS-CoV-2 transmission, 27 May 2021	HR/22	INQ000212011
38	EMG: Role of screens and barriers in mitigating COVID-19 transmission, 1 July 2021	HR/53	INQ000224413
39	EMG/TG/SPI-B: COVID-19 Transmission in Hotels and MQFs, 9th Sept 2021	HR/23	INQ000212012
40	EMG and NERVTAG: Update on transmission and environmental and behavioural mitigation strategies, including in the context of Delta, 13 October 2021	HR/24	INQ000212013
41	SPI-B, SPI-M and EMG: Considerations for potential impact of Plan B measures, 13 October 2021 (includes EMG consensus on face coverings shared with cabinet office 28th Sept 2021)	HR/25	INQ000212014
42	EMG and SPI-B: Non-Pharmaceutical Interventions (NPIs) in the context of Omicron, 15 December 2021	HR/26	INQ000223270

43	EMG Transmission Subgroup: Consensus statement on SARS-CoV-2 transmission risk at festivals, 23 December 2021	HR/54	INQ000224414
	Papers from other SAGE working groups – with EMG input		
44	SCWG: Care homes analysis, 12 May 2020	HR/55	INQ000224415
45	Managing infection risk in high contact occupations, 15 June 2020	HR/56	INQ000224416
46	TFC: Risks associated with the reopening of education settings in September, 8 July 2020	HR/57	INQ000224417
47	NERVTAG: Assessment of transmission of COVID-19 through musical events, 16 July 2020	HR/58	INQ000224418
48	Principles for managing SARS-CoV-2 transmission associated with higher education, 3 September 2020	HR/59	INQ000224419
49	Principles for managing SARS-CoV-2 transmission associated with further education, 3 September 2020	HR/60	INQ000224421
50	Summary of the effectiveness and harms of different non-pharmaceutical interventions, 21 September 2020	HR/61	INQ000224422
51	NERVTAG: Seasonality and its impact on COVID-19, 22 October 2020	HR/62	INQ000224423
52	Key evidence and advice on celebrations and observances during COVID-19, 5 November 2020	HR/63	INQ000224424
53	PHE: Factors contributing to risk of SARS-CoV2 transmission in various settings, 26 November 2020	HR/64	INQ000224425

54	TFC: COVID-19 in higher education settings, 10 February 2021	HR/65	INQ000224426
55	Cross organisation study: Risk factors associated with places of enduring prevalence and potential approaches to monitor changes in this local prevalence, 22 April 2021	HR/66	INQ000224427
56	SPI-B: Sustaining behaviours to reduce SARS-CoV-2 transmission, 30 April 2021	HR/67	INQ000224428
57	SCWG: What are the appropriate mitigations to deploy in care homes in the context of the post vaccination risk landscape? 26 May 2021	HR/68	INQ000224429
58	SPI-B: Social and behavioural impacts for lifting remaining restrictions, 10 February 2022	HR/69	INQ000224430