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UK COVID-19 INQUIRY

WITNESS STATEMENT OF
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This statement follows a process of some initial communications under Rule 9 with the UK Covid Inquiry and initial discussions with them, and it is focussed on a large number of questions raised by the Inquiry, which I have addressed below. It follows on from my Witness Statements for Modules 1 and 2 of the Inquiry [MW/131 - INQ000182616, MW/132 - INQ000250231] and – at the Inquiry's request – covers some of the same topics.

My roles and responsibilities

1) I am Professor of Infectious Disease Epidemiology at the University of Edinburgh. I studied biological sciences at the University of Oxford, University of York and Queen's University (Canada) and then held research fellowships at the University of Zimbabwe, Imperial College London and the University of Oxford, before moving to Edinburgh.
2) I have worked as an academic researcher on infectious diseases and global health since 1985 and have published more than 400 scientific papers.
3) I have acted as an advisor to DEFRA, the Food Standards Agency and the World Health Organization. I advised on previous infectious disease epidemics including foot-and-mouth disease, swine flu and bovine tuberculosis.
4) I was awarded an OBE in 2002 for services to the control of infectious diseases and I am a Fellow of the Royal Society of Edinburgh, the Academy of Medical Sciences and the African Academy of Sciences.
5) I was appointed to SPI-M-O in January 2020 and served until early 2022. I was appointed to SGCAG when it was set up in March 2020. I agreed with the SGCAG Chair to take a 2-month absence from SGCAG meetings in February and March 2021. I was not a

member of SAGE and I was never invited to any SAGE meetings, even when briefings I had written were on the agenda. I am currently a member of the Scottish Government's Standing Committee for Pandemic Preparedness (SCOPP).

6) Throughout the pandemic, I engaged extensively with my professional networks built up over the previous 30 years. In the early stages, key contacts included colleagues such as Jeremy Farrar, Neil Ferguson and Chris Robertson. Our discussions concerned the state of the pandemic nationally and internationally, the need for an effective response, and how to help UK and Scottish Governments deliver that response.

7) I also directed the work of the Epidemiology Research Group on the pandemic response in Scotland, the UK and Africa. This team of about 30 individuals worked flat out under extraordinary pressure for many months and I would like to express my grateful thanks to them for all their efforts during an extraordinarily challenging time.

Principles/policy behind the use of medical/ scientific advice in the Scottish Covid-19 pandemic response

8) I expect policy decisions to be informed by scientific advice but not dictated by it. My impression is that this is exactly how scientific advice was used by Scottish Government during the pandemic. I feel that I have done my job as an advisor if I am heard and understood by policy makers, nothing more.

9) I understand the First Minister to have stated that Scottish Government's response was "informed" by the science. Similarly, the Scottish Government document 'Framework for Decision Making' published in April 2020 [MW/001 – INQ000351869] said "we will use the best available evidence and analysis" (NB "use" not "follow"). As far as I can tell, this was an accurate description of the reality.

10) To all appearances, the Scottish public had – at least initially – confidence in the way the pandemic was being handled in Scotland. I note that levels of trust in scientists remained high throughout the pandemic and I infer that it was helpful for politicians to be able to say that they were engaging with scientific advisors.

11) The Scottish Government's approach to the management of the pandemic was set out in April 2020 [MW/001 – INQ000351869]. The statement therein that "our entire strategy is focused on preventing every avoidable death" gave the strong impression that Scottish Government's approach was to reduce Covid deaths to zero. This would have had to involve eliminating the virus from Scotland and maintaining a Covid-free status indefinitely thereafter. This may well have been reassuring for the public to hear but it was never, in my view, a rational basis for making health policy, not least because it was bound to fail.

12) The only practical way to deliver a zero deaths objective in early 2020 would have been to go into immediate lockdown and stay there until a solution – such as a fully effective vaccine or treatment – became available and had been rolled out. In practice, that would have meant hugely damaging restrictions in Scotland for more than a year. The Scottish Government did not take this route, and nor did any other government worldwide.

13) As of now (the autumn of 2023), little attention is being paid to the continuing death toll from Covid in Scotland. This is hard to square with the Scottish Government's assertion April 2020 that "there is no such thing as a level of 'acceptable' loss". The question arises whether Scottish Government should have been quicker to acknowledge that Scotland – like the rest of the world – would end up living with the virus and prepared the public for that outcome.

14) There was no indication in the early months of the pandemic that ministers or officials understood the long-term nature of the challenge and the inevitability that Scotland and the world would end up 'living with the virus' (despite the fact that this exact phrase is used in the April 2020 document). In contrast, there seemed to be an expectation that the pandemic would be over in weeks or months.

15) I am not convinced the Scottish Government ever fully grasped the equivalence between reducing numbers of contacts and making contacts safe. Halving the number of contacts and making every contact only half as risky are similarly effective in suppressing transmission. This was illustrated repeatedly by people engaging in activities that were permitted at various stages – professional sports are a good example. Yet, for most of the population for long peiods, the emphasis was on reducing contacts not making them safer. This was never a sustainable strategy and was very damaging to education, the economy and the day-to-day functioning of society.

16) The clearest part of Scottish Government strategy was the gradual relaxation of restrictions following the lockdowns of March 2020 and January 2021. Ministers appeared to have the impression that gradual relaxation would somehow prevent any subsequent wave. Otherwise, it is hard to understand why the slow relaxation of restrictions was seen as desirable given the indirect harms that were being suffered. Unfortunately, the idea that gradual relaxation would deliver any long-term benefit indicated a profound failure to understand the underlying epidemiology. The virus has no memory and it does not reward us for being patient.

17) A good analogy is attempting to walk from one end of a seesaw to the other. The seesaw will tip once the walker crosses the fulcrum. It makes no difference whether progress towards the fulcrum is faster or slower, the seesaw will tip when and only when the walker advances beyond the fulcrum. In this analogy, the tipping point corresponds to the R

number equalling one. It illustrates that the threat to public health comes from relaxing too far not from relaxing too fast.

18) The confusion was only increased by the idea that Scotland could eliminate the virus – an idea proffered by the First Minister in the summer of 2020. Firstly, any attempt at elimination would have to involve the prolonged imposition of very severe restrictions, yet restrictions were being relaxed at that time (albeit slowly) – this was contradictory. Secondly, elimination was not remotely realistic anyway, for Scotland or any other country – as subsequent events around the world have unambiguously demonstrated.

19) Even if the objective was to keep the prevalence low rather than zero, it should still have been possible to remove the least effective restrictions sooner. These include stay-at-home orders, restrictions on outdoor activities and school closures.

Informal Decision Making and Communication

20) Outside SGCAG meetings the main vehicles for discussion by SGCAG members were e-mail and the SGCAG Slack channel. Both were used extensively – often daily – by myself and other SGCAG members/officials to discuss evidence and advice. I have records of e-mail conversations but I no longer have access to the Slack channel.

21) I did not take part in any informal meetings either in person or on-line. However, I had frequent informal one-to-one conversations with fellow scientists and scientific advisors, and sometimes with officials. Some of these conversations predated the formation of SGCAG. A small number of such conversations were by phone, but the great majority were by e-mail and so a record is available. I do not know if the other individuals involved kept their own records.

22) I do not know how SGCAG meetings were recorded. The publicly available meeting minutes are quite brief and I believe them to be accurate. As I recall, attendees were not routinely given the opportunity to comment on draft minutes prior to publication. There was considerable use of Zoom 'chat' conversations during SGCAG meetings and I understand that the contents of chats were sometimes captured in the minutes.

23) I consider that the use of informal communications was extremely helpful for assessing evidence and informing advice, particularly during fast-moving phases of the pandemic when the situation was changing almost daily. My personal view is that records should have been kept of all relevant communications, formal and informal. I do not recall receiving guidance on this issue.

24) I have provided all my communications relating to key decisions, both formal and informal, as requested by the Inquiry.

Scottish Government Covid-19 Advisory group ("SGCAG") and SAGE

25) Both SAGE and SGCAG were well qualified to advise on the clinical, public health and health system impacts of Covid and the pandemic response. Neither was well qualified to assess harms done to the economy, education and child development, mental health or societal well-being. I strongly believe that there was a need for some form of scientific advisory group or groups that did consider the wider set of harms caused by the pandemic response.

26) I note that these wider harms were clearly recognised by Scottish Government and were expressed as the Four Harms. The Four Harms comprised the public health burden of Covid, the impact of the pandemic on health care provision, social harms and economic harms. Four Harms was a potentially valuable concept, but I recall very little quantitative assessment of the second, third and fourth harms for Scotland. The overwhelming focus was on the direct public health threat from Covid.

27) Discussions at SGCAG meetings tended to focus on public health but the group did have some expertise – or access to it – on clinical care, clinical risk and virology. SGCAG discussed extensively, and reviewed available data on, issues including vulnerabilities, at risk groups, inequalities, ethnicity and non-Covid health care. However, those discussions were mainly about the effects of these considerations on health outcomes rather than wider harms.

28) SGCAG made no claim to competence in economics, ethics or child development and the implicit assumption was that these aspects of the pandemic were being considered elsewhere. I do not recall that we were ever asked to advise on these areas.

29) One difference with SAGE was that SGCAG had an independent chair who (though very well qualified for the role) was not a paid government advisor nor a subject expert. I think this gave SGCAG more distance from government actions and encouraged more dispassionate and better rounded advice.

30) Actions taken in the early stages of a pandemic are crucial. In January and February 2020 Scotland could have done the groundwork to prepare for the expected emergency. Based on lessons learned from previous epidemics, that work would have included, but not have been confined to: building capacity in diagnostics, testing and sequencing; designing and deploying prevalence surveys; designing and deploying behavioural studies; enabling data sharing and linkage protocols necessary for initiatives such as EAVE; and ensuring access to epidemic modelling specific to Scotland.

31) If SGCAG had been in place in January 2020 then it could (and, I believe, would) have advised Scottish Government accordingly. In the event, most of those actions were delayed by weeks or months and were carried out even then only thanks to the

interventions of concerned parties, many outside the advisory system as it existed at the time.

32) By the time SGCAG was formed in late March 2020, Covid was already entrenched in Scotland and the public health response had already taken us down a path of lockdown. Any possibility of avoiding both the worst impact of the first wave and the harms of lockdown had already been missed.

33) For these reasons, in my view, there is no question that Scottish Government should have set up SGCAG earlier. My hope is that this deficiency has been addressed by the formation of SCOPP in late 2021.

34) I was a member of the SGCAG subgroup on Testing, chaired by David Crossman. Sub-groups had several advantages. First, they allowed more in-depth discussion of specialist topics than was possible at SGCAG. Second, they expanded the specialist expertise feeding into the advisory system, increasing confidence in the robustness of SGCAG advice. Third, they helped manage the workload. Sub-group reports were often an important part of SGCAG meetings and I believe the sub-group structure worked well.

35) SGCAG and its subgroups were primarily concerned with evidence synthesis and evaluation rather than evidence generation. In my view, that was appropriate for fulfilling SGCAG's remit. Gaps in evidence were frequently identified, but the great majority could not be addressed by small-scale bespoke research projects, and most were not specific to Scotland.

36) The commissioning of research during an emergency is an important but challenging task. I suggest that research commissioning and co-ordination are carried out at a higher level than a SGCAG subgroup and, given the work involved, perhaps by a committee dedicated to that task, liaising with both Scottish Government and SGCAG or equivalent.

37) Sub-groups' advice was fed into SGCAG and communicated via SGCAG minutes or through SGCAG briefings to ministers. I am not aware that sub-groups had an influence on decision-making via any other routes.

38) I cannot speak to any issues arising from the creation of Public Health Scotland as I engaged with them mainly through SGCAG. I had minimal interaction with the Scottish territorial health boards, Scottish local authorities, Primary Care services, independent sector care providers or other major public authorities or public bodies myself. I note that representatives of various public bodies did attend SGCAG meetings on occasion. I understand that details of meeting attendance and formal interactions between SGCAG and other public bodies has been provided by Scottish Government.

39) As a member of SGCAG, I had only a distant relationship with Scottish Government ministers and senior decision-makers. My engagement with ministers was entirely

through formal ministerial briefing sessions ("Deep Dives"). I had no direct input into Cabinet meetings, nor SGoRR, nor the Four Harms group.

40) I understand that Scottish Government has provided the requested overview of the key advice provided by SGCAG relating to the management of the pandemic. Here I shall report only my personal contribution to that advice.

41) With the help of my research team and/or other members of SGCAG, I produced a series of more than 30 briefings for the CMO Scotland or SGCAG. These have all been submitted to the Inquiry – some are referenced in the relevant sections below.

42) These briefings included explainers of technical matters and analyses of the state of the epidemic in Scotland and its control. Some were commissioned, others were conceived independently. Through 2020, I also – again with the help of my research team – produced a series of status reports on doubling times and weekly ratios (a metric related to the R number) that were circulated more widely, including to the First Minister's office. I also produced occasional, more personal reflections on the state of the epidemic, shared with the SGCAG Chair and/or CMO Scotland. These are described below.

43) I believe that SGCAG was effective in communicating advice to Scottish Government in its management of the pandemic. However, its effectiveness was greatly limited by its response mode way of operating. We were regularly asked for input on policy questions (sometimes questions about detailed elements of the response, many of which might have been better asked of the public health agencies). We were not routinely asked to advise on strategic questions. Indeed, it is not clear whether strategic questions such as 'how can we avoid lockdowns in Scotland in the future?' were ever asked by anyone – they were certainly not asked of SGCAG. Nevertheless, the SGCAG chair did sometimes invite general observations on the state of the pandemic. I am not aware that these were ever translated into 'advice', nor that there was a route to do so.

44) I understand that a description of the roles of the CSA, CMO, NCD and DCMO has been provided to the Inquiry by Scottish Government. As an advisor, I am unable to say if those key decision-makers suffered from information overload. I do think it was extraordinarily difficult for everyone to keep on top of the huge flow of information. I suggest that in future there needs to be an explicit role of evidence synthesis, perhaps along the lines of the UNCOVER initiative at the University of Edinburgh.

45) I have no direct knowledge of the process by which SGCAG advice was communicated to Ministers but I understand that this question has been addressed by Scottish Government. The SGCAG Chair regularly reported that the Group's input had been well received by ministers or by Scottish Government more widely.

46) I was aware that SGCAG advice reflected the consensus view. One advantage of this is that it gives policy makers and officials greater clarity. One disadvantage is that consensus can be slow to form (which matters, for example, when policy decisions have to made quickly) and, once formed, can be even slower to shift. Another weakness is that on many issues there was not full agreement. If those disagreements are not communicated to decision-makers there is a risk of policy-making being based on a restricted set of options.

47) Most of the advice sought from SGCAG was short term and often operational. I believe the underlying problem was that Scottish Government did not understand, or accept, that Covid was destined to become an endemic infection, i.e. that 'living with the virus' was not a choice but an inevitability, so it was essential to consider the long term too.

48) Any advice on pandemic response is strongly influenced by the expected time-line: more drastic responses might be appropriate for a short-lived emergency but for a long-term problem it is vital that the response is both proportionate and sustainable. For periods in 2020 and 2021, the Scottish response was neither of these. Yet SGCAG was never asked to advise on ways of keeping Scotland out of lockdown.

49) Members of SGCAG (selected by the chair) sometimes met (virtually) with the First Minister and other members of the Cabinet. These were referred to as Deep Dives. I attended six Deep Dive meetings between May 15th 2020 and December 16th 2020, and another in March 2022. I understand that agendas and papers for all Deep Dive meetings have been provided to the Inquiry by Scottish Government. I have provided copies of my own briefings in the relevant sections of this statement, but I do not have any personal records of those meetings.

50) Dashboards were a key tool for evaluating the state and trajectory of the pandemic in Scotland. There were multiple dashboards provided both by government and non-government groups. My own team circulated a dashboard based on our estimates of 'weekly ratios' once or twice per week from April 2020 onwards. As data on cases, hospitalisations and deaths were being updated at least weekly, it was possible to do this with a delay of only a few days. I judge this to have been sufficient to inform real-time decision making.

51) As a member of SGCAG I had a good understanding of policy options under consideration and was able to advise accordingly. My greater concern was about policy options not under consideration; for example, the potential of mass testing to accelerate the exit from lockdown and prevent future lockdowns. That issue was discussed at great length within SGCAG and its subgroups from mid-2020, but mass testing was not rolled out until late 2021.

52) In an early SGCAG meeting (perhaps the second) I commented that I thought one of the innovations needed was mass testing on an unprecedented whole-population scale. This invoked a response from an official that the Group's advice had to be "realistic". For me, this set the tone that there was some advice that policy makers were not ready to listen to. Self-testing on a whole-population scale was (belatedly) rolled out in late 2021, so the idea did turn out to be realistic. It was also highly effective and I regret that its adoption took so long.

53) SGCAG minutes and briefing documents were generally written by the Chair and secretariat. I do not have full knowledge of who received those documents, nor whether the recipients considered them transparent, clear and comprehensible. A continual challenge in making advice comprehensible was the lack of scientific knowledge and training among ministers and officials.

54) I have no direct knowledge of what mechanisms existed for the First Minister and other core decision-makers to challenge medical/scientific advice provided to them by SGCAG. I understand that this question has been addressed by Scottish Government.

55) For the most part, the agenda for SGCAG meetings was handed down by the secretariat. I do not know by what process agendas were set. It was possible to suggest agenda items to the Chair and I did this on several occasions. I have been told by Scottish Government that information made available to SGCAG members in meeting papers has been shared with the Inquiry.

56) The expertise of SGCAG covered public health, epidemiology, modelling, clinical medicine and behavioural science. This made it competent to advise on the public health threat of Covid and to comment on proposed interventions. It was not competent to consider the wider harms caused by the response to the pandemic.

57) The expertise in epidemiology and modelling on SGCAG was, in my view (noting that these are my own disciplines), vital. Those disciplines were central to understanding how the epidemic was developing and how it was likely to develop in the future. The majority of group members were not expert in those disciplines and many of the briefings I provided to the group were essentially undergraduate-level explainers of basic epidemiological concepts (e.g. the R number or herd immunity).

58) Our understanding of the epidemic was discussed in great depth at SGCAG meetings and those discussions fed into the published minutes and formal advice. The chair consistently emphasised the desire to build consensus but the need to acknowledge where consensus did not exist. There was often disagreement and lively debate with SGCAG – I regarded this as healthy and necessary.

59) I formally dissented from the advice provided by SGCAG on one occasion in early May 2020 regarding the re-opening of schools. I held a minority view that it was safe to re-open schools and asked for this to be included in our advice [MW/002 – INQ000352292, MW/003 – INQ000352291]. I understand that a watered down version of my view was included.

60) I was not aware that SGCAG advice was subject to external review, and I do not see how that could have been implemented in practice given the speed of events and the volume of work. I cannot claim that SGCAG was immune from groupthink. However, contributions from all group members were continually subject to challenge and debate, which was healthy, though sometimes wearying. That said, I worry that the emphasis on delivering advice based on consensus could give the impression of groupthink, and could also have resulted in policy makers being presented with too narrow a range of options.

61) In my experience, Scottish Government was more likely to accept some kinds of advice than others. I was anxious that Scottish Government needed to ramp up its response on two occasions during the lifetime of SGCAG: in December 2020 at the start of the alpha wave; and in December 2021 at the start of the omicron wave. Advice to that effect was generated through SGCAG, though outside the regular meeting cycle due to the urgency. On both occasions the advice was quickly followed.

62) Conversely, at other times – May-July 2020 and February-May 2021 – I was concerned that Scottish Government was much too slow to relax restrictions, including school closures. That advice was not quickly followed.

63) Scottish Government's policy of gradually lifting restrictions was, in my view, not well thought out. The idea that once cases began to rise subsequent increases in deaths and hospitalisations were 'baked in' was well understood and justified intervening early. Exactly the same argument applied when cases began to fall: subsequent decreases in deaths and hospitalisations were baked in then too. This could have been taken by Scottish Government as a reason to lift restrictions earlier, but it was not. Instead, there appeared to be a belief that gradually releasing restrictions would somehow prevent a subsequent wave. This was, predictably, entirely incorrect. The public health threat came from relaxing too far not too fast.

64) As far as I am aware, Scottish Government never sought advice on how to avoid further lockdowns. Had avoiding lockdown been part of Scottish Government's strategy – or, better, have become policy – then this is an area where scientific knowledge and data modelling could have been extremely helpful. But the question was never asked.

65) SGCAG was very much aware of the likely impact of decisions on the economy, non-Covid related illness and on its treatment, education, inequalities, vulnerabilities, mental

health and societal issues. But, at best, these were only notionally factored into our advice. As far as we knew, little or no work was being done on these topics at the time and so we had no evidential basis – nor the necessary expertise – to incorporate them formally.

66) At least one SGCAG member was a 'front-line' clinician. It is also relevant that many SGCAG members – including myself – had links with clinicians, so I believe that we had a good understanding of the clinical environment. I note that hospital case fatality rates in Scotland fell markedly during the early months of the pandemic. Not only was this a demonstration of improving clinical care but it also had policy implications because it implied a significantly lower infection fatality rate, thus changing expectations of the scale of the public health threat going forward.

67) I do not recall SGCAG engaging directly with patient groups. However, the performance of the healthcare system for both Covid and non-Covid patients was frequently discussed. Formal analysis of healthcare metrics was carried out by EAVE and the outputs communicated to SGCAG.

68) It was clear from the outset that as scientific understanding of Covid changed so the scientific advice to policy-makers could change. I was told by one minister that this could be a problem for government as they might be accused of flip-flopping.

69) In practice, I think that inertia within the science advisory system turned out to be a bigger problem. The consequence was that there could be very long intervals between new scientific evidence being produced and it being reflected in policy. For example, it was clear from the first half of 2020 that SARS-CoV-2 transmits very poorly, if at all, in outdoor settings. This was discussed on more than one occasion at SGCAG but not, as far as I can tell, ever communicated as advice to minsters. More outdoor activities were permitted during the lockdown in January 2021 than in March 2020.

70) As a second example, we knew from early in the pandemic that Covid was not a serious threat to the vast majority of children, and nor was there any evidence that closing schools would have a substantive impact on the course of the epidemic in Scotland or anywhere else. In my view, the evidence that it was safe to re-open schools was conclusive by May 2020. However, it took much longer for other scientists – including other members of SGCAG – to be convinced. SGCAG did then advise ministers accordingly and schools were re-opened in August 2020 (though only to be closed again in January 2021).

71) Pre-prints are scientific papers published prior to peer review. Peer review is the standard mechanism for quality control of academic outputs but it is slow. In a fast

moving emergency, it was helpful to publish work as soon as possible and the release of pre-prints or self-published reports became the norm.

72) Within SGCAG, it was always made clear when we were considering evidence that had not yet been subject to peer review. That put an additional burden on group members who had to judge the merits of the work, particularly in topics outside their expertise. I recall two instances (one to do with genomic diversity and another to do with testing of travellers) where substantive flaws in reports of interest to SGCAG were detected and discussed, so the danger of being misled was real.

73) The obvious remedy is that, if a pre-print or report is felt to be important for formulating advice but there is not the time or expertise available to evaluate it within SGCAG, then a rapid review by a suitable expert is commissioned. Such a service was available during the Covid pandemic, e.g. through the Royal Society of London.

74) SGCAG – supported by its subgroups – had an appropriate breadth of expertise for most tasks allocated to it. The main exceptions were when Scottish Government asked for advice on operational issues. In my view, questions such as how many people should be allowed to meet outdoors were best left to the public agencies. There was occasional discussion about whether SGCAG needed additional expertise – e.g. on genomics – for specific issues, and we did sometimes bring in appropriate experts.

75) I do not have access to a complete record of all advice SGCAG provided on non-pharmaceutical interventions (NPIs) (but it would be an extensive list). Topics discussed at various times during the pandemic included lockdowns, school closures, measures around care homes, shielding, face coverings and physical distancing.

76) I do not know why SGCAG was not involved in policy or decision impact assessments. I do not believe this was in the Group's remit and – given that many of the impacts went beyond public health – I do not consider SGCAG would have been qualified to make such assessments. That said, it would have been useful for the Group to have had sight of any impact assessments that were done by Scottish Government. I do not recall that this happened, and I do not know what impact assessments were done, if any.

77) I find it extraordinary that no formal assessment of the expected impact of lockdown was done before it was implemented in March 2020 (or before Scotland was locked down for a second time in January 2021). This was despite it being obvious that lockdown was likely to cause severe harms to the economy, education, mental health, health care access and societal well-being, and that those harms were likely to affect some sectors of society more than others, exacerbating inequalities.

Data and Modelling

78) A large number of data sources were used by SGCAG to inform advice to Scottish Government. These included: Scottish Government, National Records Office, NHS Scotland, Public Health Scotland and the Office for National Statistics. In addition, non-government sources were sometimes shared, including CoMix, REACT and ZOE. This will not be a complete list. Modelling inputs were mainly provided by SPI-M-O and Scottish Government.

79) Information on the behaviour of the virus – including transmission rates, infection and re-infection rates, hospitalisation and death rates, and variants – came from a wide variety of sources. These included: SAGE and its subgroups; analyses of Scottish data by (among others) Scottish Government, PHS, EAVE, and SGCAG members' research teams; other academic initiatives such as DELVE and UNCOVER; scientific publications and preprints; and reports from a wide range of organisations including PHE (later UKHSA) and WHO. This will not be a complete list.

80) I am not aware of any instances of SGCAG being unable to access data, once data streams had been set up and permissions obtained so that the data were available at all. Data streams and information flows were far better by late 2020 than they had been in the early stages of the pandemic. But in the early months I was aware of issues of data accessibility and quality from conversations with my colleagues Aziz Sheikh and Chris Robertson. Both expressed their concerns at SGCAG meetings.

81) I had raised the issue of accessibility of health data in Scotland with the then CMO Scotland in 2017-18 [MW/133 - INQ000149112, MW/134 - INQ000149111]. This was based on my own experience with trying to access health data for a study of antibiotic resistance in Scottish hospitals. The process was extremely onerous, time-consuming, protracted and expensive. Many colleagues have experienced the same problems. At that time, I decided not to carry out any further research projects that required access to Scottish health data. The situation had not improved by 2020; if anything, it was worse.

82) I am not involved in health data management in Scotland. I suggest that Andrew Morris – SGCAG Chair and Director of Health Research UK – is best placed to explain where responsibility for this state of affairs lies. I do believe, however, that the problem has its roots both in (sometimes consciously) exaggerated concerns about data security and in a misplaced sense of personal ownership of data by (some) within the public health agencies.

83) In my view (expressed in my evidence to Module 1 [MW/131 - INQ000182616]) the non-availability of key data in early 2020 reflected a failure of pandemic preparedness planning, specifically a failure to anticipate what data would be needed and to make sure

it was available and accessible from the outset (i.e. from the time that WHO declared a PHEIC).

84) I note that a large number of highly informative data/information sources – including EAVE, CoMix, ZOE and COG-UK – were not part of Scottish or UK government planning and had to be set up more or less from scratch. This took time and meant that valuable information that would have informed the pandemic response was not available in the period leading up to the March 2020 lockdown.

85) The EAVE project delivered invaluable outputs; for example, rapid assessments of vaccine effectiveness and the severity of omicron, both in 2021. EAVE was conceived in early 2020 and activated in mid-March 2020. However, as I stated in my evidence to Module 1 [MW/131 - INQ000182616], EAVE was unable to carry out large-scale analysis of linked databases until the requisite permissions for data access and linkages had been obtained and implemented, which took until June 2020.

86) In my opinion, had the administrative requirements been less onerous then EAVE could have started generating invaluable data – for example on risk factors for severe disease – much earlier, thus making a better evidence base available to advisors and officials during those critical early months. I wrote to the SGCAG Chair, copied to the CMO and DCMO Scotland about these issues on June 11th 2020 [MW/135 - INQ000103476] and it was finally resolved that same month. I agree with Aziz Sheikh, the EAVE Director, who has stated that those delays cost lives.

87) SGCAG was not an evidence-generating group; it synthesized, assessed and interpreted data and information from multiple sources and delivered advice accordingly. With regard to the impacts and effectiveness of NPIs, I believe that the group had timely access to whatever data/information was available when formulating its advice to Scottish Government.

88) That said, particularly in the early months, there was often limited data available. A particular concern was the limited behavioural data. Even when this did improve – e.g. through CoMix and the Scottish contact survey – it was not sufficiently fine-grained. As a result, we did not have information on questions such as how many contacts people were making outdoors rather than indoors (the risks are far lower outdoors), how well people were complying with requirements to self-isolate, how they were using face coverings, or on patterns of travel.

89) The need for such detailed, real-time behavioural data had not been foreseen before the pandemic and so there were no systems in place for collecting it. This was a significant deficiency because all NPIs involve asking/requiring people to change their behaviour in some way, so a critical first step to assessing the impact of NPIs is to monitor how

behaviour changed in practice. There were regular surveys of people's attitudes; those were somewhat helpful, but attitudes and practices are not the same thing. This needs to be addressed in planning for future pandemics.

90) I do not recall that access to routine data was ever severely delayed or limited, beyond occasional minor technical glitches and sometimes short delays due to bank holidays.

91) The much bigger problem was data/information that was simply lacking at the time, which is bound to happen when dealing with a new infectious agent or variant but was exacerbated by a collective failure to plug gaps in the data needed to inform a pandemic response. I note that data needs had been discussed in depth in a Royal Society of Edinburgh report published in 2011 in the wake of the swine flu pandemic [MW/004 – INQ000351915]. It appears that this report was not acted upon.

92) An example of where timely data analysis provided policy-relevant information came at the start of the omicron wave. In the early stages of that wave, it was clear that transmission rates were very high and that a "tsunami" of cases would hit Scotland. But it was not known – because there was only anecdotal data available for Scotland or anywhere else – how severe those cases would be. In the event, omicron turned out to be significantly less severe in well-vaccinated populations such as Scotland's; this was first demonstrated by the EAVE project. This finding had important policy implications because it lessened to need to consider lockdown as this no longer looked to be a proportionate response.

93) Another problem was policy-makers failing to act on data/information that was already known. This includes data on the very low levels of outdoor transmission and the limited benefits of closing schools. The data were clear on both these aspects of the pandemic months before that was reflected in policy.

94) I do not feel qualified to comment on specific changes to data protection legislation that would improve the accessibility of heath data in Scotland. I am not certain that the problem lies with existing legislation rather than its interpretation by data managers. Everyone involved needs to recognise that data sharing for research purposes – both during and between pandemics – enables potentially life-saving research to be done. That philosophy needs to be embedded in data management systems and protocols.

95) In my view, a comprehensive re-think of protocols for accessing and linking health data in Scotland is required, with an emphasis on the timely and efficient delivery of analyses that will help protect the public at any time, but particularly in times of emergency. I suggest that this is the subject of a commission put together solely for that purpose.

96) The main sources of epidemiological modelling for Scotland were SPI-M-O, the Scottish Government modelling team and the Scottish government analysis hub. I consider that

the modelling resources available to Scottish Government were adequate for the purposes they were used.

97) It is, however, important that there is not over-reliance on a single model, which would be contrary to best practice. This is because epidemiological models are complex and different models may represent epidemiological processes in different ways, make different assumptions and use different inputs. Having access to multiple models increases confidence in the outputs where they agree and highlights areas of uncertainty where they disagree.

98) There was a concern early in the pandemic that many of the SPI-M-O models did not cover Scotland, though this was dealt with reasonably quickly and modelling for Scotland was being done from mid February [MW/005 – INQ000352423]. I understand that at times there were also issues with data transfers for use by SPI-M-O modellers – this is mentioned in other evidence given to the inquiry by other witnesses [MW/136 - INQ000056510].

99) The challenge of doing 'joined up' modelling for the whole of the UK was entirely foreseeable given that health is a devolved matter and that different UK nations use different data platforms. Arguably, Scotland's health data system was an advantage in some respects – e.g. by enabling studies such as EAVE – but it would have been helpful if there had been pre-arranged protocols for sharing data for analysis and modelling.

100) I regard it as vitally important that Scotland had access to SPI-M-O modelling simply because the resources available to SPI-M-O were far greater than those available within Scotland, allowing it to address more questions, more quickly and with greater confidence. Equally, I think it important that Scottish modelling groups remain part of SPI-M between pandemics to establish two-way communication and joint working.

101) SGCAG had access to model outputs from Scottish modellers and from SPI-M-O. I do not recall instances where SGCAG wished to commission modelling for any particular purpose but was unable to do so.

102) I have stated publicly, speaking as an epidemiological modeller, that I think that the UK-wide response was overly influenced by modelling. I regard models as especially helpful tools for understanding the way an epidemic has developed and for exploring ways in which it might develop in the future, but I regard them as no more than indicative and have always argued that they should never be the only evidence considered.

103) I do not know the extent to which Scottish Government policy was informed by models (though modelling was often referred to in public government statements), so I cannot say whether evidence from models was or was not appropriately weighted in decision-making.

104) If models are to be used to inform policy then it is important that the way the modelling is done is consistent with best practice. This should both maximise the quality of the modelling and reassure decision-makers that the ensuing advice is as well-founded and robust as possible. In practice during the pandemic, quality control was delivered in a relatively informal and unstructured way.

105) In my view, expressed in my witness statement to Module 1 [MW/131 - INQ000182616], a specific issue was that insufficient attention was paid to how the reasonable worst case was modelled and communicated. This matters because the worst case scenario is often of greatest interest to policy makers (and to the media).

106) There is always some degree of uncertainty around even the central model outputs; there is usually even greater uncertainty around the extremes of those outputs, i.e. the best and worst case scenarios. Moreover, the best and worst case scenarios are, by definition, unlikely – we cannot completely rule them out but we would be surprised if either happened.

107) Since worst case scenarios developed by SPI-M-O were not accompanied by statements of likelihood it was impossible for policy-makers to evaluate just how likely or unlikely they were. I cannot say whether this issue affected the quality of decision-making in Scotland. I can say, however, that it did influence the quality of evidence provided by SGCAG.

108) For example, in summer 2021 I was regularly updating SGCAG on outputs from SPI-M-O. The models were indicating that there would be a substantial surge in the public health burden of Covid should all social distancing measures be relaxed, which was the UK government's intention. The worst case scenarios were sufficiently alarming as to discourage any further relaxation of restrictions. I duly reported these outputs, despite not being at all convinced (on the basis of my own team's analysis) that such an outcome was likely for Scotland, or the rest of the UK. In the event, the SPI-M-O models – including those developed by the Scottish Government Analysis Hub – did turn out to be unduly pessimistic. The obvious risk here is that policy makers (in Scotland and the UK more widely) might delay relaxing restrictions unnecessarily on the basis of unreliable models.

109) I note that a very similar story played out in December 2021 at the beginning of the omicron wave. Here, the risk was that governments would impose unnecessarily harsh restrictions – lockdown was being considered – to prevent a huge wave of hospitalisations and deaths that were seen in all the modelled scenarios but never materialised. Even the best case scenarios from the omicron modelling anticipated that this would turn out to be the worst wave of the epidemic so far; the worst case scenarios

were catastrophic. Again, my own team's models indicated that the omicron wave could be quite modest, but our findings were not communicated to SAGE. As I recall, Scottish Government modelling did not deviate greatly from SPI-M-O/SAGE at the time.

110) In both those instances, even the best case scenarios communicated to the UK and Scottish governments turned out to be too pessimistic. The models – and the way the modelling was communicated – clearly exaggerated the risks at those points in the pandemic. So it was that, on the two occasions when UK Government policy essentially disregarded model-based advice emanating from SAGE, the Government was proved right and SAGE was proved wrong. I expect that this will naturally raise doubts among policy-makers as to whether they should have been so strongly influenced by model-based advice from SAGE earlier on in the epidemic, i.e. March 2020, October 2020 and at the start of the alpha wave.

111) Further, I am concerned that, as a result of these incidents, confidence in epidemiological modelling more generally within government has been undermined. I think that the epidemiological modelling community needs to face up to these issues, energetically seek to understand what went wrong and why it went wrong, and introduce visible improvements to practice with the express aim of restoring trust in the discipline. I acknowledge that there have already been some small but welcome steps down this path [MW/006 – INQ000351962].

112) Models can – and did during the pandemic – provide helpful short-term forecasts but over the long term they can be no more than indicative. This is because models always involve simplifications and assumptions and often because the inputs – e.g. estimates of transmission rates or infection fatality rates – are uncertain, especially in the early stages of an epidemic. As a result, models generate a range of plausible outputs, with the extent of that range reflecting the degree of uncertainty. I do not believe that the degree of uncertainty was effectively communicated to policy makers. On some occasions, there appeared to be little or no attempt to do so, which is not good practice. Moreover, there was a focus (sometimes explicitly) on worst cases scenarios, without adequate communication of just how likely or unlikely those scenarios were.

113) It is a moot point how failures to communicate uncertainty affected the appropriateness of Scottish Government's responses. It certainly had the potential to do. I think it obvious that overstatement of the public health risks – whether coming from modelling or any other source – would tend to drive policy towards first imposing unnecessarily harsh restrictions and then being slow to relax them.

114) I do not believe that lack of the transparency of the models was the problem. Key assumptions and the sensitivity of outputs to those assumptions were extensively

discussed at SPI-M-O meetings. However, I am concerned that full extent of uncertainty was not made sufficiently clear to SAGE when modelling outputs were reported, as illustrated by the over-pessimistic scenarios presented in the summer of 2021 and again at the end of that year. When reporting modelling outputs to SGCAG I always attempted to communicate the limitations of the exercise.

115) I see no reason why models should not have been shared as widely as possible throughout. Many models – including those of my team – were fully disclosed; for example, by publishing code on open-access platforms such as GitHub. I am, however, sceptical of the short-term impact of doing this; who would then scrutinise the models – a huge and highly technical task given the large number of models and their complexity – and how would any concerns be communicated? In a fast-moving emergency, there is no option but to use the tools available at the time, models included.

116) The key is for adequate quality control to be built into the generation of all kinds of evidence used to inform policy, models included. With hindsight, quality control of model outputs was inadequate during the pandemic. One way to address this in future would be to avoid a situation where the modellers are effectively marking their own homework. The modellers on SAGE and on SGCAG were mostly members of SPI-M-O so there was no opportunity for independent expert evaluation of the modelling work at those levels.

117) A large number of different scenarios were modelled at every stage of the pandemic. That said, many scenarios were extremely difficult to model. Even as the vaccination programme was rolled out there were huge uncertainties about the effectiveness of the vaccines. Nor could the properties of new variants be anticipated.

118) I do not know how differences between models and their outputs were explained to Scottish Government. My general impression is that SGCAG (sensibly) put less weight on models than SAGE and that our advice to Scottish Government reflected this. I believe that this was one reason why SGCAG was less inclined to suggest lockdowns as a first rather than last resort.

119) SPI-M-O was set up to model an influenza pandemic. As such, the models were designed to consider interventions appropriate to influenza, especially moderate social distancing including school closures. They were not designed to consider many of the interventions used in the response to Covid: shielding, protecting care homes, test and trace, isolation of cases and contacts. The models could provide useful evidence on the impact of social distancing but not on those other interventions that may have been both more effective and less harmful. In my view, this disparity steered scientific advice towards social distancing and lockdown.

120) A related problem was a pervasive assumption by the modellers that the only driver of changes in behaviour (in turn, the main driver of changes in transmission rates) was government intervention. No account was taken of people changing their behaviour independently of government in response to the current state of the epidemic around them, though they clearly did so. This incorrect assumption exaggerated the need for additional restrictions, particularly lockdown, and exaggerated the need for keeping restrictions in place. I very much doubt that decision-makers in Scotland were aware of this limitation. There was no Deep Dive on models.

121) Economic, societal, educational, non-Covid health related and mental health impacts were not – to my knowledge – modelled for Scotland or the rest of the UK. If any such exercises were done, I was not made aware of them as an advisor. In my view, such modelling should have been done in order to provide policy makers with the best possible assessment of the harms that were being and would be caused by the pandemic response, especially lockdown. This point was raised on multiple occasions in SGCAG.

122) I worry that lack of such assessments adversely affected the quality of decision-making in Scottish Government. The scope for harms caused both by the virus and by our response to the virus was enormous, making it absolutely critical that we struck the right balance. Without well-reasoned, quantitative assessment of the indirect harms this vital exercise is reduced to a matter of guesswork.

123) Identifying the right balance involves weighing lives lost in the short term (from Covid) against lives lost in the long term (through lower quality health care), lost livelihoods and harms to the economy. Models could have informed this exercise but the way different harms are weighted is a subjective decision for politicians not scientific advisors.

124) To my knowledge, the main vulnerabilities represented in the models were age and sex. These are easiest to model and are also appropriate as age is by far the most important risk factor for vulnerability to Covid, with the greater vulnerability of males having the next biggest impact. I am not aware that the models included other risk factors such as co-morbidities, ethnicities, deprivation or occupation. Nor am I aware that they included high risk settings such as care homes and hospitals.

125) The models were also severely limited in their capacity to explore the benefits of protecting the vulnerable. For example, when segmentation and shielding was explicitly modelled it was done in a crude and potentially misleading manner that did not capture the potential impact of cocooning (protecting vulnerable people by protecting those around them, thereby obviating the need for extreme self-isolation). This is because the models available at the time were not set up to look at cocooning.

126) From as early as January 2020, determined efforts were made – including by myself and Chris Robertson – to ensure that models for Scotland were available. One example is early discussions with Neil Ferguson of Imperial College, London [MW/007 – INQ000352330, MW/008 – INQ000352329]. I was not involved with data flows directly, but I was aware that Chris Robertson was working to ensure that data from Scotland were available to modelling groups in SPI-M-O [MW/136 - INQ000056510].

127) I believe that the lack of scientific training and background in the policy-making community was an issue during the pandemic. I doubt that it is reasonable to expect specific knowledge of epidemiological modelling. However, I do think that education in approaches to risk management more generally – including how to manage risks in the face of uncertainty – would be beneficial. Many risk management courses are available.

128) Surveillance is a key component of any pandemic response. Without it, we are flying blind. This has been well understood by experts in public health since the discipline was formerly recognised over 100 years ago. Routine surveillance for respiratory and other infections is carried out by PHS, and this is valuable. The challenge is to identify ways to ramp up surveillance efforts quickly and dramatically – perhaps by a 100-fold or more – if required in an emergency. This should not be difficult in principle, but it requires the systems to be in place – including the capacity to source or produce and then deploy suitable diagnostics tests rapidly and at scale – in advance. In my view, that should be a key component of future pandemic preparedness planning.

129) It was a tremendous advantage that SPI-M had been set up and had been working for many years prior the Covid pandemic. This must be sustained. In the future, it would be advisable to have thought about model frameworks for threats other than respiratory viruses. This is achievable; there is a substantial modelling community in the UK and internationally that is working on a wide range of types of infection.

SAGE/SPI-M-O

130) I have no major concerns about how SGCAG interacted with SAGE and its subgroups. It was important that SGCAG members were also members or observers on these groups. SGCAG mostly followed SAGE advice, partly because the epidemics in Scotland, England and Wales proceeded in very similar fashions. It was always likely that much the same set of interventions would be needed in Scotland as in the rest of Britain.

131) Nonetheless, in several important instances, Scotland did not take the same steps as England. For example, SAGE members were calling for a lockdown in late 2020 but SGCAG did not follow suit. A full national lockdown was avoided in Scotland at the time

and the second wave in Scotland progressed much as it did in England, consistent with a widely felt concern that SAGE had overreacted.

132) I cannot say to what extent SGCAG helped drive this difference in policy; however, I do believe SGCAG took a less dogmatic approach to the need for the lockdowns and to the roles of children and schools in the pandemic than SAGE. As a result, in September and October 2020 the clamour from advisers for harsher measures heard in England was not echoed in Scotland.

133) I do not know how the memberships of SAGE and SPI-M-O were determined. If it were not for SGCAG then I would be concerned that Scotland was not adequately represented on either. But I feel that SGCAG remedied any deficiency in an appropriate way given that health is a devolved matter.

134) SPI-M was set up several years prior to the pandemic and had a large membership. I did not become a member until January 2020 and I do not know how the membership was decided. I did not understand that my main role on SPI-M-O was to represent Scotland, though I did often do so. Expertise was added to SPI-M-O during the pandemic but at no time did I have concerns that the membership was too limited, given the group's remit. This, however, does not mean that SPI-M-O was immune from groupthink.

135) SPI-M-O models for Scotland required inputs in the form of case data, hospitalisations, deaths and on Scottish demography (geographic locations, age structure etc.), though not all models would have had the same input requirements. Not all SPI-M-O models included Scotland, but a sufficient number did for routine tasks such as estimating the R number and short-term projections.

136) Epidemiological models for Scotland were developed in the early weeks of the pandemic. In principle, any delay could have had implications for policy in Scotland had the strategy been to implement tailored control measures at Scottish national or subnational levels, e.g. local councils or local health boards. Tailored responses were considered but, in the event, the initial responses – including the March 2020 lockdown – were UK-wide. No substantive differences in regional responses were seen until the Tier systems were introduced much later in the year, by which time models for Scotland were well established.

137) I do not know if SGCAG was able to relay information and questions to SAGE. The situation in Scotland was regularly discussed at SPI-M-O meetings, noting that there were three, later four, members from Scotland at the meetings. Two of these – myself and Chris Robertson – were members of SGCAG. On at least one occasion, I presented a report of the Scottish situation to SPI-M-O.

138) In my view, it took too long for SAGE to move away from influenza pandemic assumptions in January and February 2020. This had a profound effect in Scotland because, as far as I can judge, Scottish Government was following the UK-wide lead during that period. If, in Scotland or elsewhere, we had recognised the specific nature of the threat from Covid earlier then we might have responded differently, more urgently, and more effectively.

139) Importantly, we might have realised that we not only had to manage the public health threat of an infection that was considerably more challenging than influenza but also that we needed to put measures in place that would make lockdowns unnecessary. Lockdown was not part of influenza pandemic planning and so did not become a serious policy option for Covid until March. That left minimal time to develop and implement alternatives, or to consider how to mitigate the harms that lockdown would inevitably cause.

140) Also, we were slow to recognise that community-wide social distancing measures – up to and including lockdown – would not be enough and that we needed to invest heavily in targeted interventions to protect the most vulnerable members of society: the elderly, frail and infirm. This would have saved many lives.

141) The influenza focus – not only of the models but of the entire UK pandemic preparedness planning – had several features that were sub-optimal for tackling Covid. One issue was that the models focussed on schools but not care homes. This was appropriate for influenza, where schools are important drivers of transmission and school-aged children are at risk of serious disease; it was not appropriate for Covid, which was not driven by schools and represented a very low risk to children.

142) In contrast, Covid was a serious risk to the elderly and infirm, particularly care home residents, yet care homes were not explicitly represented in the models. Nor were hospitals, another setting with large numbers of vulnerable individuals and high risk of infection (and well known to be susceptible to outbreaks of severe coronaviruses).

143) Also, the influenza planning did not go sufficiently far with regard to measures for protecting vulnerable individuals in the community, including the elderly and infirm who relied on social care or informal carers. These deficiencies were never fully rectified and resulted in a response that was imperfectly attuned to the crisis at hand, in Scotland and elsewhere.

144) With regard to modelling, the inability of the models in the early stages to allow for different dynamics in the community from care homes and hospitals did have policy implications. In the first wave in Scotland, almost half the deaths occurred as a result of transmission in care homes and hospitals, but these were lumped in with the community

when it came to estimating key variables such as the R number, despite differences in the epidemiology between settings. The R number in the community fell faster than it did in care homes and hospitals, but this wasn't visible when all three settings were lumped together. In other words, social distancing was having more effect than we realised at the time. The policy consequence was an over-reluctance to lift restrictions on the wider community based on data that was heavily influenced by what was happening in care homes and hospitals, which needed to be tackled by measures specific for those institutions.

145) Much of SPI-M-O's advice was relevant to all regions of the UK, including Scotland. I cannot recall an instance where a request for advice for Scotland-specific interventions was made. I can see no reason why such a request could not have been made but I cannot say how it would have been received – the situation did not arise. On the other hand, Scotland-specific analyses of the status of the epidemic (e.g. the R number) were routine.

International Perspectives

146) As stated in my response to Module 2 of the Inquiry [MW/132 - INQ000250231], SGCAG did regularly consider actions taken in other countries and their possible relevance for Scotland. In my view (expressed at the time [MW/009 – INQ000352656, MW/010 – INQ000352657, MW/011 – INQ000352658]), this activity was done poorly: the work was not systematic; it gave the appearance of cherry-picking examples to support arguments for or against one policy or another; it relied on overly hasty evaluations of which countries were doing well or badly; and it consistently failed to take into account that different countries had very different pandemics, so that it was naïve to claim that what worked in one setting would work equally well in Scotland. An obvious example was the ill thought out suggestion that Scotland could somehow emulate New Zealand and adopt a Zero Covid strategy.

147) WHO advice was frequently considered by SGCAG (including virtual meetings with the WHO's Covid envoy) and sometimes acted on by Scottish Government, so I consider it to have been very influential in Scotland's response. The endorsement of lockdown by the WHO in February 2020 made lockdown thinkable. However, I do not know what was the immediate driver of the March 2020 lockdown in Scotland as I was not involved in making that decision.

Limitations

148) I do not believe that the advisory structures in Scotland were hampered by a lack of resources. Individual advisors – and sometimes their research teams – were often severely stretched by the unrelenting workload, but that was hardly surprising nor exceptional. In my own case, the biggest problem was the conflict between my advisory work and my job at the University of Edinburgh, but I regarded that as an internal matter. I did take about 2 months leave from SGCAG (but not SPI-M-O) in February and March 2021 in an attempt to manage my workload.

149) The SGCAG officials and secretariat performed exceptionally well throughout the pandemic. They were consistently helpful and supportive and made my job as an advisor considerably easier than it might have been. I also felt supported and valued by the CMO Scotland and Scottish Government.

150) Scotland's Covid pandemic unfolded in very similar ways to most of England's. The biggest difference within the UK concerned London. The epidemic in London was often ahead of the rest of the UK, particularly in the early stages and with the alpha and omicron waves (though the delta wave had early hotspots in the Midlands). This was anticipated given that London is a major international travel hub – the same pattern had been seen previously during the swine flu pandemic.

151) It is very difficult to see much evidence of devolution having any impact on the epidemiology of Covid – Scotland is too strongly connected with England and the differences in both epidemic and response were too small. In terms of its impact on advice, I think that access to UK-wide expertise – for example, in SPI-M-O – was important and was made available.

152) SGCAG did not, as far as I can recall, provide advice directly to local government, and I did not understand this to be in the group's remit.

Conclusions and Lessons Learned

153) In my view, there were two main problems with procedures for preparing and communicating advice to the Scottish Government. First, the advice provided was incomplete, addressing in considerable detail the public health harms from Covid but taking minimal account of the indirect harms caused by social distancing, particularly lockdowns. Second, the advice sought was mainly short term in nature. Strategic questions – such as what was the long-term outlook or how could we avoid further lockdowns – were not asked.

154) More generally, I was surprised that ministers became involved in operational discussions – such as the length of queues permitted outside takeaways or the definition

of a substantial meal. Those matters could surely have been left to the public health agencies, who were far better placed and better qualified to make sensible judgements. My personal view is that politicians could have shown much more faith and confidence in the public health agencies of Scotland and allowed them to decide on operational aspects of the response.

155) As an analogy, during military conflicts I would expect politicians to set the objectives but to leave the conduct of the campaign to their military commanders. I do not see that it should be any different for public health. I hope that in future pandemics Scottish Government will place more faith in the public health agencies. Ideally, those agencies will have been adequately resourced and trained and have better pandemic response planning to draw upon.

156) I am not sure that it would be practical to have real-time scrutiny of SAGE or SGCAG advice. Oversight provided by, for example, parliamentary select committees seems to me to be an appropriate mechanism for scrutiny. Academic societies – for example, the Royal Societies of Edinburgh and London – can also provide independent assessment and guidance.

157) I do, however, think that more internal real-time quality control of SAGE's work and more internal challenge would both be beneficial. For example, formal assessments of the quality of the evidence available to an advisory committee would be useful – there are existing frameworks for tackling this. In particular, clear guidance is needed as to how an advisory committee should make use of what would normally be regarded as low quality evidence, yet is often the only evidence available during an emergency.

158) The SAGE system of grading the confidence it has in its own advice is a useful tool. That said, it would be sensible to explore how that and other grading systems are viewed and used by decision-makers. I initiated some discussion of this issue in the early days of SGCAG [MW/012– INQ000352823, MW/013– INQ000352539] but it was not pursued in the face of so much other business. It would be better to agree on an approach outside times of emergency.

159) A more radical idea is to do away with SAGE altogether. Advice to be given to government would be decided a small core group of the CSA, the CMO, their Deputies and possibly one or two subject experts drawn from the science advisory community. Groups such as SPI-M-O, SPI-B and NERVTAG, plus the health and public health agencies, would feed their specialist advice to the core group. The core group would be supported by evidence synthesis teams whose role would be to collate and summarise neutrally all available evidence relevant to decision making. The core group would thus be able to draw on the expertise of as wide a range of experts as possible and actively

seek as wide a range of opinions as possible. The aim would be to present policy makers with a range of options, each with their advantages, disadvantages and wider implications set out. Where there is genuine consensus this would be reported, but minority opinions would not be ignored (though identified as such).

160) I do not have any concerns about the performance of individual ministers, officials, civil servants or advisors in Scotland or the rest of the UK, though I may have disagreed with some of the decisions made or advice given. I doubt that any advisor would claim to have got everything right during the pandemic but it was plain to see that all them were doing their absolute best.

161) I am much more concerned about the performance of the scientific advisory system as a whole than I am about individuals. When it is working well, scientific advice – like science itself – should be self-correcting, through the established mechanisms of transparency, inspection, challenge and rigorously following the evidence. This cannot happen if the system succumbs to tunnel vision, groupthink and confirmation bias. During the Covid pandemic I think there were times when the UK advisory system as a whole did exhibit these weaknesses.

Initial understanding and responses to Covid-19 in the period from January to March 2020

162) I first became aware of Covid from news reports in early January 2020. My concern increased sharply on January 7th when I was sent a copy of a report written by the Wuhan Municipal Health Committee. The information in the report seemed to me to be consistent with the early stages of a pandemic.

163) At that time, I asked members of my own research team to monitor developments, including in China. I discussed the situation with colleagues – including Jeremy Farrar, Neil Ferguson and Chris Robertson – over the next two weeks. My team did some modelling of a potential epidemic in Scotland during that period. My team also monitored the publication of scientific papers and other reports, including from WHO. I joined SPI-M-O in late January and attended my first meeting on January 27th. Thereafter, I attended meetings at least weekly; SPI-M-O was a highly knowledgeable and well informed committee and its meetings were hugely instructive. My evaluation of the threat to Scotland up to March 23rd 2020 was based on all these sources of information.

164) I quickly formed the view that Covid was likely to become a global pandemic. I expressed those concerns in a series of e-mails to the then Chief Medical Officer of Scotland from January 21st onwards [MW/137 - INQ000103367, MW/138 - INQ000103355, MW/139 - INQ000103354, MW/140 - INQ000103352, MW/141 - **INQ000103216** MW/142 -

INQ000103215, MW/143 - INQ000103492]. My intention at this time was to alert the CMO Scotland to a coming pandemic that would affect Scotland.

165) I copied my January 21st briefing to Anne Glover – then president of the Royal Society of Edinburgh – and did the same with subsequent briefings [MW/014 – INQ000352464, MW/015 – INQ000352461, MW/016 – INQ000352465]. I also copied in Sheila Rowan – then Chief Scientist for Scotland – on January 21st [MW/017– INQ000352455]. I received no reply though I understand that she was also contacted by Anne Glover.

166) In my January 21st e-mails I stressed the need to set up effective surveillance systems as these would be needed to track the spread of the virus. This recommendation was informed by my experience of swine flu in Scotland in 2009 when surveillance had been poor. On that occasion, my team had been asked to advise on a GP surveillance system, to conduct serological surveys and to initiate genome sequencing studies. We were happy to do this but all of it should have been in the purview of the public health agencies at the time.

167) History did partly repeat itself in 2020. Although on this occasion the public health agencies played a leading role, it was still the case that testing systems had to be set up from scratch – as did large-scale genome sequencing and behavioural surveys – all of which took time. This meant that Scotland, along with the rest of the UK, had to make crucial decisions in the early weeks of the pandemic without the quality of information that we would come to rely on later.

168) SAGE first met to discuss Covid on January 22nd. I note that Jim McMenamin of Health Protection Scotland is recorded as attending. I do not know who in Scottish Government received a report of that meeting, nor what actions followed. SGCAG could only have met that early on if it had already existed as a standing committee with a remit covering pandemic threats. That role is now filled in Scotland by SCOPP.

169) The briefings I sent to the CMO Scotland on January 25th and 26th [MW/138 - INQ000103355, MW/139 - INQ000103354] were informed by some simple modelling using basic 'SIR' models. My team used these models to generate initial estimates of the expected attack rate (fraction of the population infected), the number of casualties and the duration of the epidemic. This a standard approach in epidemiology, founded on the Kermack-McKendrick equations dating back to 1927.

170) In their simplest form, these models include only community transmission, assume no countermeasures of any kind and generate a single wave. They are indicative of the potential scale and speed of the wave, but they are not detailed forecasts. The illustrative scenarios that I shared with the CMO Scotland in January 2020 showed an exponential growth trajectory in the early stages of the pandemic. I note that my team's modelling

was consistent with that of Chris Robertson as subsequently communicated to me on January 29th [MW/144 - INQ000103206].

171) I thought that these models would be applicable to Scotland as well as the rest of the UK because I expected any regional differences in the key parameters would be slight (as proved to be the case). The main point of departure was likely to be the number and timings of cases arriving in Scotland, with it being possible that the epidemic in Scottish cities could be delayed up to 3 weeks compared with London (the difference turned out to be just one week).

172) I proceeded to outline possible scenarios for the pandemic, briefly discussed public health measures and suggested some next steps. The CMO Scotland indicated she would discuss my briefing with colleagues. I do not know what resulted from that discussion but my exchange with the CMO Scotland continued regardless. I sent further updates on January 31st and February 10th 2020 [MW/018 – INQ000352450, MW/019 – INQ000352395].

173) I have stated I was not convinced by any of the responses I received to my e-mails in January 2020. This is because I considered the threat to be extremely serious and equally urgent but felt there was little sense of either from the CMO Scotland and CSA Scotland.

174) I first met with Catherine Calderwood on 28th February 2020 (and only then because Sally Davies – ex-CMO England – kindly brokered the meeting [MW/020– INQ000352401, MW/021 – INQ000352400, MW/022 – INQ000352402, MW/023 – INQ000352140, MW/024 – INQ000352396]). I provided an informal briefing by e-mail ahead of that meeting on 27th February 2020 [MW/145 - INQ000103216]. The briefing summarised my views on the Reasonable Worst Case scenario and the pros and cons of social distancing interventions.

175) The main points arising from the February 28th meeting were as follows: social distancing measures might have to be implemented in Scotland "very soon" (by which I meant days not weeks); we needed to understand the harms that would be caused by those measures to inform decision-making; and that we needed an exit strategy from social distancing. I have provided my notes of the meeting to the Inquiry [MW/142 - INQ000103215]. I do not know what actions were taken by Scottish Government as a result of the meeting.

176) On 2nd March 2020 I sent the CMO Scotland a technical briefing on how different timings and intensities of social distancing measures influence the epidemic curve [MW/146 - INQ000103516]. This was a slightly modified version of a briefing I had already shared

with SPI-M-O (on 29th February 2020) and with colleagues at Health Protection Scotland (via e-mail to Chris Robertson on 29th February 2020).

177) I met again with Catherine Calderwood on 6th March 2020. My notes of the meeting (sent by e-mail on 6th March 2020) have been provided to the Inquiry [MW/143 - INQ000103492]. The main topics discussed were the likely impacts of different social distancing measures on the course of the pandemic, current uncertainty around the modelling including the effect of spontaneous behaviour change, timings and trigger points for interventions. We discussed the need for self-isolation/quarantining of cases and contacts – this intervention had been used successfully in the 2003 SARS outbreak. We discussed the possibility of cocooning vulnerable individuals, recognising that the elderly were at greatly increased risk, but that other risk factors would also be important that would have to be (and later were) identified by clinical risk studies. I was not convinced at the time that school closures would be effective; knowledge of SARS – and early data from China – indicated that children might not be at high risk and might not contribute much to transmission.

178) I stressed throughout that the models had to be based, at least in part, on a set of assumptions and guesses – because of the continuing lack of definitive estimates of key parameters, including the infection fatality rate – and so should be regarded as indicative but not quantitatively predictive. I pointed out that the epidemic would not be synchronous across the UK and that this was likely to influence the timing of interventions in Scotland and in different parts of Scotland (in the event, the March 23rd lockdown was UK-wide so this became redundant). I stated that I felt decision-makers should consider the indirect harms caused by the response, particularly by social distancing measures. This would allow a formal impact statement and cost-benefit analysis. I am not aware that either were done at any stage of the pandemic.

179) I do not know what, if any, steps were taken within Scottish Government in the wake of the March 6th meeting, but the discussions continued. I understand that Mel Giarchi in Scottish Government began working on epidemic models for Scotland at around that time. She also attended SPI-M-O meetings.

180) Between March 9th and March 20th 2020 I provided Catherine Calderwood and the then Deputy CMO Scotland Gregor Smith with high-level readouts from SPI-M-O meetings [MW/025 – INQ000352775, MW/026 – INQ000352778, MW/027 – INQ000352767, MW/028 – INQ000352784, MW/029 – INQ000352697].

181) As I was not part of its formal advisory system at the time, I have no direct knowledge of how the Scottish Government reacted to news of the epidemic in China in early 2020. But I saw no evidence that the situation was being addressed with the seriousness that

I felt was warranted. Throughout my exchanges with the CMO Scotland, no details were shared with me regarding Scottish Government's response.

182) I do think it was a missed opportunity to delay setting up SGCAG so long that it did not meet until after Scotland, along with the rest of the UK, went into lockdown on March 23rd. This meant that SGCAG had no possibility of discussing ways to avoid such a damaging first wave and ways to avoid such a damaging response. Whether or not Scotland would have indeed taken a better path as a result is a matter of speculation.

183) I had no direct engagement with any of the core decisions taken by the Scottish or UK governments, or by the WHO, in the period preceding lockdown. My contribution was mainly through my involvement with SPI-M-O and my informal briefings to the CMO Scotland. My view at that time was that too little attention was being given to interventions beyond social distancing measures and I was concerned at the prospect of entering lockdown without a clear exit strategy.

184) Scottish Government did take actions on and soon after March 15th when it was decided that Covid was not being contained. At that stage, the most affected location was London, where the epidemic was about a week ahead of the rest of Britain. The idea of locking down London that week was discussed, but not implemented. If it had been implemented, the option of less drastic interventions outside London would have remained on the table, and the UK-wide lockdown on March 23rd perhaps avoided. In practice, decisions made at that time were driven mainly the situation (particularly hospitalisation rates) in London, not in Scotland or other parts of the UK.

185) I note that the emerging retrospective consensus that the March 23rd lockdown came 'about a week too late' does not address the issue of London's epidemic being further advanced. 'About a week too late' for London would imply 'about right' for the rest of the UK, including Scotland.

186) Prior to the first lockdown, we did not yet have available information (from genome sequencing studies) on the extent the epidemic had been seeded in the UK in the second half of February. The sheer volume of imported cases gave the epidemic a head start and brought it forward by several weeks. Since this was not known at the time, most advisors – myself included – thought we had more time than we did. Better surveillance, coupled with genomic studies, would have facilitated better advice and better decision making during this crucial period.

187) Nor did we have access to behavioural data showing the extent to which people had modified their behaviour in the week prior to lockdown. Mobility data obtained retrospectively indicates that lockdown itself appears to have made very little difference.

188) Nor had the work been done to evaluate alternatives to lockdown, such as the likely effectiveness of testing, case detection, contact tracing and self-isolation as interventions that could reduce the need for drastic social distancing measures. These interventions had been highly effective during the 2003 SARS outbreak but would be compromised by asymptomatic and pre-symptomatic transmission, the extent of which was not yet fully quantified. They subsequently turned out to be useful but not sufficient to bring the Covid pandemic under control without also putting other NPIs in place.

189) I cannot recall precisely how my knowledge of transmission routes, person-to-person spread, the reproduction number and doubling time, asymptomatic infection, incubation period, duration of infectivity, infection fatality rate, clinical risk, and risk groups evolved over the pre-lockdown period. The single most important source of that kind of information for me was SPI-M-O meetings – the minutes of those meetings summarize which topics were discussed when.

190) In the earliest stages the key unknowns were the basic reproduction number, the generation time and the infection fatality rate. The reproduction number was discussed at SPI-M-O on January 27th [MW/030 – INQ000351832] – my team contributed our own estimate made some days previously. Initial estimates of the generation time were based on knowledge of SARS. For the infection fatality rate, there was initially a range of possibilities from 0.1% (similar to seasonal influenza) to 10% (similar to SARS). On January 25th, the WHO published an estimate of the infection fatality rate of over 4%. I was very alarmed by this estimate. However, I knew that early estimates of infection fatality rates at the beginning of epidemics can be unreliable, as they were for swine flu in 2009.

191) The true infection fatality rate for Covid in the UK subsequently worked out at close to 1%, though this was not firmly established until well into the first wave. This is higher than seasonal influenza but not as high as the reasonable worst case for pandemic influenza (generally taken at around 2%). The difference from pandemic influenza was the higher expected attack rate (a consequence of a higher basic reproduction number).

192) The infection fatality rate in the UK changed over the course of 2020 and 2021 as a result of several factors: improved clinical care; the appearance of more pathogenic variants; and vaccination. Every time the infection fatality rate changed so did the balance between the costs and benefits of interventions.

193) Hygiene measures have an important place in infection control, but the idea that they alone would be sufficient to control the Covid pandemic was woefully naïve. This was clear from the outset given that the reproduction number was so high.

194) As I explained in my response to Module 2 [MW/132 - INQ000250231], herd immunity refers to the fraction of the population that are immunologically resistant to infection (so they cannot become infected and therefore cannot pass the infection on to others). Immunological resistance may be acquired either through prior infection or through vaccination. The bigger the resistant fraction the more difficult it is for the infection to spread through the population. If the resistant fraction is large enough then an epidemic cannot take off and any outbreaks will ultimately be self-limiting, i.e. they will die out of their own accord.

195) The minimum level of herd immunity to prevent an epidemic from taking off is termed the herd immunity threshold. The value of the herd immunity threshold is set by the basic reproduction number, which is the maximum possible value of the R number for that infection in that population. At the herd immunity threshold the R number itself (the average number of cases generated by a single case) equals one.

196) It is important to understand that herd immunity refers to reductions in the rates of infection and transmission but not in the severity of any infections that arise. However, acquired immunity may have the additional, and very important, benefit of protecting against severe disease if infected.

197) There was no question that acquired immunity would be an important (probably the most important) determinant of the long term course of the UK's (and Scotland's) epidemic. Since I regarded this as inevitable I had difficulty in understanding the term "herd immunity strategy" made in reference to possible approaches to the UK's pandemic response in March 2020. Almost every conceivable long-term strategy for tackling the pandemic would involve herd immunity. The only possible exception would be a Zero Covid strategy but that, in my opinion, had not been a realistic option for the UK since late February 2020.

198) I cannot find reference to herd immunity in my correspondence with the CMO Scotland until March 16th 2020, and then in response to an ongoing debate about herd immunity strategies [MW/031 - INQ000371357]. I advised that herd immunity would not be a major factor during a first wave controlled by NPIs but would be very important in the longer term, with any second and third waves being much larger in the (purely hypothetical) absence of herd immunity [MW/032 – INQ000352010].

199) From the outset, there was the possibility of a vaccine that would provide some level of herd immunity, but we did not know just how effective the vaccine would be nor when it would become available. In the event, the vaccines that were rolled out from December 2020 turned out to be effective at preventing severe disease but less effective at preventing infection and transmission, so they did not get us to the herd immunity

threshold. Subsequent studies showed that a history of vaccination plus natural infection gave stronger protection than vaccination alone. Natural infection continues to contribute to the level of herd immunity – and protection against severe disease – to this day.

200) At no time did I mention behavioural fatigue in my briefings to CMO Scotland and in my team's work we did not directly consider the possibility of behavioural fatigue. However, given the uncertainties about the tolerability of lockdown, we did consider lockdowns of different duration and effectiveness. When the issue of behavioural fatigue arose during SPI-M-O meetings I advised that we were not competent to adjudicate and the matter should be left to SPI-B.

201) I have no direct knowledge of the contribution of events such as conferences and rugby matches to the spread of Covid in Scotland in February and March 2020. My understanding is that such occasions are potential super-spreader events but that they are expected to have only a limited impact on the course of an epidemic. This is because the number of people attending – as a proportion of the whole population – is very small, so the less visible transmission going on throughout the community is far more important for determining the course of a large epidemic.

202) That said, super-spreader events do have the potential to bring forward the timing of a wave, especially in the early stages when numbers of cases in the community is still low. This is because they can generate numbers of cases corresponding to multiple doublings very quickly. The epidemic would still happen without the super-spreader event, but it could be significantly delayed.

203) An earlier ban on mass gatherings might have delayed the epidemic in Scotland, but it is impossible to quantify this due to the lack of testing and of prevalence and contact tracing data at the time. I did not mentioning mass gatherings explicitly in my written briefings to the CMO Scotland until February 27th [MW/141 - **INQ000103216**, though in discussions with colleagues in January I had described them as an element of social distancing measures.

204) The lack of action – in Scotland, the UK and many other countries – in the early stages of the pandemic has led to February 2020 being described as the "lost month" in terms of pandemic response. I can only imagine that national governments were not convinced of the threat at that stage. I have referred to this as 'optimism bias' – the hope that things would not turn out as badly as was being suggested. I also fear that scientists overstating the severity of the swine flu pandemic in 2009 undermined confidence in our advice about Covid in early 2020.

205) The WHO's delay before declaring a public health emergency of international concern (PHEIC) on January 30th and again before declaring a pandemic on March 12th badly

undermined the case being made by me and others for early and effective action within the UK and elsewhere in January and February 2020. I regard it as self-evident that our warnings would have carried more weight had WHO conveyed the same sense of urgency.

206) Although I had briefed the CMO Scotland on the possibility of a second wave before the first wave was fully under way [MW/033 – INQ000352131, MW/034 – INQ000351995], I do not believe that Scottish Government took the prospect seriously at the time. The rhetoric around the March 23rd lockdown suggested to me that there was a widespread belief that lockdown would somehow solve the Covid problem and bring the crisis to an end. If that was the case, then it was a naïve and misplaced belief.

Testing

207) I have not seen an assessment of the performance of Scotland's Test & Protect scheme. I think that a detailed review would be helpful given the large investment in effort and resources. Test & Protect had the potential to make a significant contribution to the pandemic response in Scotland, but I cannot say whether this potential was delivered. I note that wrote a briefing for SGCAG on the possibility of suppressing the epidemic using contact tracing on May 29th 2020 [MW/035 – INQ000351868]. In the event, mass self-testing appears to have been more effective, but this was not rolled out until late 2021.

208) Testing was a frequently discussed topic at SGCAG and there was a subgroup (of which I was a member) devoted to it. I was concerned from early on in the pandemic that the role of testing was imperfectly understood by decision-makers and some advisors, so I co-wrote a briefing on the topic on May 3rd 2020 [MW/036 – INQ000351956].

209) Prior to the creation of SGCAG I had advised on the importance of surveillance, case detection and contact tracing in my briefings to the CMO Scotland from January 21st onwards [MW/137 - INQ000103367], but we did not discuss the mechanics of diagnostics and testing in any great detail.

210) I recognised the need for contact tracing from the outset of the pandemic, reflecting that Covid was in many respects similar to SARS. I included it in my January 26th briefing to CMO Scotland [MW/139 - INQ000103354]. Nonetheless, I did not think that case detection and isolation (as it was conceived in 2020) would be sufficient to bring the epidemic under control by itself. This view was supported by a report from the Royal Society published in May 2020 [MW/037 – INQ000351836]. However, some countries (e.g. South Korea, Taiwan and Japan) did manage to contain Covid in 2020 without resorting to national lockdowns. Contact tracing made a substantial contribution to those outcomes.

211) The realisation that Covid could be transmitted in the absence of symptoms was pivotal. In this respect, Covid was less like SARS and more like influenza, implying that it might not be possible contain an epidemic using case detection and isolation alone because it is too difficult to detect cases in the first place. This is an important reason why social distancing is the intervention of choice for influenza, and the same rationale came to be used to justify social distancing for Covid. This happened despite the knowledge that social distancing would have to be much more severe if we did not implement other measures to reduce transmission at the same time. This is because the R number for Covid was considerably higher than for influenza. With these considerations in mind, I quickly came to advocate mass screening, i.e. the testing of large numbers of people in the absence of clinical symptoms. Mass screening linked to self-isolation would reduce, perhaps even remove, any need for social distancing.

212) I first suggested that we would need to implement mass testing on an unprecedented scale – weekly testing of the bulk of the population – at a SGCAG meeting in March 2020. I was told by the Covid Response Director that the committee's advice to Scottish Government had to be "realistic". I replied that I believed we were going to have to re-think what was realistic. I made the same suggestion to SPI-M-O some weeks later.

213) Mass testing was eventually rolled out in the form of free lateral flow tests made available to the whole population of Scotland in late 2021. I regret that this was not done much sooner when it could have obviated the need for the January 2021 lockdown.

214) I was aware of the importance of community surveillance for infection from experience of and knowledge of previous epidemics including swine flu and Ebola. I believed that this was widely understood; it had been discussed in depth in a Foresight report on infectious diseases I co-authored in 2006 [MW/147 - INQ000149098]. So I was disappointed that so little effort was made to improve diagnostic capacity in early 2020. In my view, the decision to ramp up testing did not need to wait, and should not have waited – in Scotland or anywhere else in the UK – until April.

215) On June 11th 2020 I wrote to SGCAG Andrew Morris and CMO Gregor Smith [MW/135 - INQ000103476]. In that e-mail I argued – in line with my earlier advice – that Scotland needed far more ambitious targets for testing capacity, suggesting that these be scaled up by at least a factor of 10 with the ultimate aim of allowing regular testing of the bulk of the population. The 10-fold increase was not achieved in 2020 but I accept that that was always going to be extremely difficult, and expensive, to do using RT-PCR tests. The lateral flow tests that were trialled in England in November 2020 were a game-changer, and made mass testing a realistic possibility.

216) I do not recall that Scotland set its own targets for testing akin to Matt Hancock's target of 100,000 tests in April 2020, though I presume that testing in Scotland contributed to the count. I had little interest in the 100,000 target as I couldn't see any rationale or scientific basis for it. In my view, the target was entirely arbitrary and wholly inadequate. I had already stated to SGCAG than I thought we needed testing on a scale of millions per day in Scotland alone.

217) Judging by the epidemiological data, the mass self-testing (using LFTs) introduced in late 2021 was far more effective than the top-down approach (using RT-PCR) deployed earlier in the pandemic. I note that uptake of free self-testing was high, with 80% of the Scottish population reporting testing once per week and 50% multiple times per week [MW/038– INQ000369763]. If people acted on their test results – and, if not, why test in the first place? – then this would have had a major impact on the course of the omicron wave.

218) I do not understand why lateral flow tests – an established technology – took so long to be developed and rolled out at a scale. I note that the UK government's 'Moonshot' testing programme was announced in August 2020 and trialled that November, but even then the roll-out of mass testing had to wait another year.

219) I recall a SGCAG testing subgroup where there was opposition to the idea that responsibility for testing could be passed to the public, and concern that there would be substantial numbers of false positives, which could cause disruption to services. In my view expressed at the time (and, as turned out, in practice), those concerns were misplaced. If we had rolled out self-testing in late 2020 when the technology became available then we could well have been able to contain the alpha wave as effectively as we later contained the omicron wave, and not had to go into lockdown in January 2021.

220) I do not recall why the First Minster expressed concerns about testing backlogs in September 2020. Towards the end of 2020, I became concerned about the disparity between reported Covid cases and estimates from ONS surveillance. The latter suggested that roughly half of cases in Scotland were being missed, and it seemed reasonable to doubt that these cases were self-isolating or triggering contact tracing. Given the importance of self-isolation, I likened this to fighting the epidemic with one hand behind our back. Finding these cases and thereby triggering self-isolation would have helped reduce the transmission rate and so saved lives and reduced the need for social distancing.

221) Scottish Government put great weight on a WHO threshold of fewer than 5% positive test results indicating that an epidemic was under control. 5% positivity was used in Scotland as one of the conditions for consequential decisions such as lifting restrictions.

I never saw any scientific justification for the 5% figure – it seemed to be arbitrary – and I did not agree that it should be used to drive policy in Scotland. All else equal, a lower rate is preferable to a higher rate, and an increasing trend is a concern, but the actual figure will depend on a wide range of factors, not least who is being tested and for what reason. I do not know who advised Scottish Government to adopt the 5% threshold and I do not believe that it was endorsed by SGCAG. In my view, the focus on the 5% figure unnecessarily extended the lockdown in Scotland.

222) My understanding of wastewater testing is that it was used to detect the presence of the virus, particularly during periods when there were few positive tests. This is consistent with its use as check on the elimination of infection, e.g. for polio virus. Wastewater testing was not designed to reduce transmission.

Decisions in relation to non-pharmaceutical interventions

223) NPIs in the community fall into three categories. First, there is self-isolation – or quarantine – of cases, suspected cases and contacts. This measure works most efficiently when linked to diagnostic testing. Second, there are Covid safety measures that aim to reduce the risk of infection being passed on when people are in contact. Examples include respiratory hygiene, face coverings, physical distancing, and ventilation or meeting outdoors. Finally, there is social distancing, i.e. reducing the number of people in contact. Work-from-home, school closures and lockdown are all examples of social distancing measures.

224) In addition to NPIs in the community, there are biosecurity and infection control measures implemented in settings such as hospitals and care homes. Biosecurity means preventing infection getting in; usually achieved by symptoms checks or diagnostic testing prior to entry. Infection control is a routine activity in health care settings to tackle outbreaks of both viral and bacterial infections.

225) All these NPIs were used extensively by Scottish Government in their pandemic response. I am, however, concerned about the balance of effort. It is not clear to me why there was so much emphasis on social distancing and not more investment in Covid safety. Covid safety measures were highly effective in a variety of settings, from health care to professional sports. The key was to introduce regular testing – and, where necessary, self-isolation – alongside whatever hygiene, ventilation and physical distancing measures were practicable. In my view that approach could have been extended much more widely, greatly reducing any need for social distancing.

226) I do not think that the Scottish Government's early pandemic response took adequate account of those most at risk from Covid. Nor did it take into account long Covid,

asymptomatic transmission or airborne transmission. However, I accept that scientific understanding of each of these features developed over the course of the pandemic.

227) There were policy implications of shifts in understanding of Covid as the pandemic progressed. For example, the realisation that that the elderly, frail and infirm were at hugely greater risk than the young and healthy should have meant that more resource and effort was directed at protecting them.

228) I was not closely involved in advising on the use of face coverings. The impact of using basic face masks is still disputed, so it is possible to argue both that they were unnecessary and that they should have been used sooner and more widely. There is less controversy about the use of medical grade masks – these are considered effective. In my view, medical grade masks could have been more widely used in specific settings, including protecting the most vulnerable individuals in the community and in care homes.

229) Scottish Government did make some effort to build health care infrastructure, notably the Louisa Jordan hospital in Glasgow. I did not advise directly on this initiative. I do not know how much effort was put into increased staffing, though that – rather than beds – turned to be the critical bottleneck. In my view, planning to increase staff capacity should have begun in early February 2020; I first advised on the likelihood of the Scottish health system being overwhelmed in an e-mail to the then CMO Scotland on January 25th 2020 [MW/039 – INQ000352454].

230) My team did do some preliminary work on the benefits of increasing ICU capacity in March 2020 [MW/040 – INQ000351994. However, I felt that other modelling groups were better placed to tackle this question and, perhaps more importantly, I felt that this issue would be better resolved by reducing demand than increasing supply.

231) The poor underlying health of the Scottish population is likely to have increased both hospitalisation and mortality rates due to Covid. This became apparent as soon as formal risk analyses were published in mid-2020, though arguably it could have been anticipated. In my view, this only increased the importance of finding ways to protect those most vulnerable throughout the pandemic in Scotland, and worsened the consequences of failing to do so.

232) As I stated in my evidence to Module 2 [MW/132 - INQ000250231], when we entered lockdown in March 2020 there was no evidence that schools were making a significant contribution to transmission. There was also no evidence that school-aged children were at significant risk from Covid. It took slightly longer to establish that teachers were not at elevated risk compared with other people-facing professions (such as supermarket workers) but, thanks to ONS surveys, the evidence was there by June 2020. I repeatedly

advised on these points at SGCAG meetings. SGCAG received a report on this topic on May 6th 2020 from the UNCOVER team [MW/041 – INQ000352006].

233) I disagree with the designation of children as a "vulnerable" group with regard to Covid. As was apparent from early in the pandemic, healthy children are at very low risk from Covid. By far the most important risk factor is age; the sharp increase in risk with age dwarfs the magnitude of any other risk factor (with the single exception of Down syndrome). The second most consequential risk – in terms of contribution to total numbers of severe cases – is the increased risk to males.

234) The importance of age as a risk factor for severe Covid was one topic discussed in an e-mail exchange I had with Gregor Smith in early March 2020 [MW/042 – INQ000352830]. Despite this, none of the measures taken in Scotland prior to lockdown were specifically targeted at the elderly. The lockdown introduced on March 23rd targeted the entire population, but lockdown turned out to be least effective at protecting the elderly [MW/148 - INQ000220365].

235) As far as I can ascertain, shielding of vulnerable groups was not introduced in Scotland until March 26th [MW/043 – INQ000351885]. This sequence of events indicates a pattern that persisted throughout the pandemic: protecting the vulnerable was treated as an afterthought when, in my view, it should have been at the forefront of Scotland's pandemic response.

236) I understand that early shielding advice was targeted using clinical judgement. More formal risk analyses followed. SGCAG was given access to the QCOVID algorithm on July 1st 2020. QCOVID was an important, large-scale study of risk factors for Covid mortality and provided the most accurate classification of risk groups available at the time.

237) I do not know whether Scottish Government adapted its list of vulnerable categories in line with QCOVID. A key question is what level of risk triggers advice to take special precautions. Roughly half the Scottish population had at least one Covid risk factor (obesity being a common one). About 20% were advised to take precautions.

238) I do not recall exactly when I first heard the term 'long Covid' – I believe the term came into use around May 2020. The existence of the condition was no surprise to me: post viral syndrome has long been associated with acute viral infections and there was no reason to suppose it would be otherwise for Covid.

Decisions relating to the first lockdown

239) Lockdown was not part of the UK's or Scotland's pandemic preparedness planning. The rationale for the first lockdown in Wuhan, China was an attempt to eliminate the virus

locally (which apparently succeeded) and globally (which did not). Lockdown was never intended as an intervention for dealing with a long-term, pandemic-scale health crisis, and it was not appropriate for that task. Indeed, once it is accepted that we would be living with Covid it becomes clear that any countermeasures must not only be effective, but also proportionate and sustainable. Lockdown is neither proportionate nor sustainable.

240) I do not know what Scottish Government's understanding of the Covid threat was at the time Scotland went into lockdown, but I don't believe that they truly accepted that the virus was here to stay. I am concerned that this short-term view of the crisis influenced both the politicians' willingness to impose lockdown and the public's willingness to accept it. The politicians were mistaken or misinformed and the public were misled.

241) On July 15th 2020 a report by DHSC, ONS and others explored the impacts of the first wave of Covid on mortality and morbidity in the UK [MW/044 – INQ000351961]. The report used a standard public health metric – quality-adjusted life years (QALYs) – to quantify both direct (of Covid) and indirect (due to reduced access to health care, economic damage etc.) impacts for plausible scenarios. The report showed that the long-term damage due to lockdown could be greater than that due to Covid. That was not an argument for a minimal response (in that scenario the impact of Covid would rise dramatically), but it did suggest that we might have got the balance wrong, that the cure would ultimately prove worse than the disease.

242) Though this report – and a subsequent update conveying the same message – was considered by SAGE, I have been unable to find evidence (and cannot recall) that it was discussed at SGCAG. I do not know whether the report and its implications were ever communicated to policy-makers (though surely they should have been). I do not believe that the report influenced policy in Scotland or the UK (though surely it should have).

243) Lockdowns were imposed in Italy, France and Spain before there was a lockdown in Scotland. However, many countries managed to control Covid without resorting to enforced national lockdowns at all. Taiwan and South Korea demonstrated the 'early intervention can be less drastic intervention' approach. Sweden and Japan relied much more on voluntary behavioural change.

244) Sweden did make some of the same mistakes as Scotland during the first wave – it was slow to implement countermeasures and failed to protect the most vulnerable, especially in care homes. However, Sweden did not impose a full lockdown – implementing a lighter package of restrictions and relying more on voluntary behaviour change – and still managed to bring its epidemic under control at much the same time as did Scotland. I observe that public health officials in Sweden were quicker to recognise that this would

not be a short-lived emergency and we needed to control the virus in ways that were sustainable, which lockdown clearly was not.

245) It was often argued at the time that Sweden was not a fair comparator because its population is more rural and has smaller household sizes (both features make Covid less transmissible). But Scotland's population is quite similar on both counts. Moreover, the early rates of spread of infection in Scotland and Sweden were very similar. In my view, it's a valid comparison and indicates that Scotland could, at least in principle, have controlled Covid without resorting to full lockdowns (though it would have been very difficult to avoid social distancing entirely).

246) In my own (informal) advice to the CMO Scotland on February 27th 2020 [MW/045 – INQ000352260], I had referred to the lockdown (though not using that word) in Wuhan. I pointed out that the intervention appeared to have been successful but I was concerned that lockdown could not be a long-term solution and advised that there were risks both from under-reacting and over-reacting.

247) I believe earlier intervention could have made a national lockdown in Scotland less likely. A good maxim for any pandemic response is that earlier intervention can be less drastic intervention. The rationale is straightforward: restrictions severe enough to quickly drive down the numbers of cases will not be needed if cases are not allowed to rise up in the first place. I had provided a briefing on this topic to SPI-M-O on March 4th 2020 [MW/152 - INQ000103518] – this raised the possibility of acting "immediately". For some reason, I do not seem to have shared that briefing with the CMO and DCMO Scotland, though it was seen by SAGE. However, I did advise the CMO Scotland at a meeting on February 28th that social distancing measures might have to be introduced in Scotland "very soon" [MW/142 - INQ000103215].

248) Measures implemented in Scotland in early March – including working from home and school closures – were designed to slow or stop the rise in cases. However, there was not sufficient time to establish how well these were working before the move to full lockdown was made. I stress, however, that I do not believe it would have been possible to avoid social distancing entirely.

249) It is important to be clear about what 'less drastic' means in practice. This is best explained by reference to the R number. By the end of March 2020, government interventions – including the March 23rd lockdown – had reduced the R number from 2.8 to 0.7. It needed to be well below 1 to reduce case numbers quickly. If case numbers had not been allowed to rise up in the first place – early action – then the target would have been to reduce R from 2.8 to 1. So 'less drastic' equates to 85% of the reduction in transmission. This is still a substantial reduction and, at that time, could not have been

achieved without social distancing. The 15% difference is nonetheless big enough to have negated the need for stay-at-home orders, to allow outdoor mixing and to keep schools open. In other words, if we had acted on the principle that early intervention can be less drastic intervention then many activities could have continued and schools could have remained open throughout 2020 (and much the same argument applies to 2021).

250) The more that we can reduce the 'baseline' R number through better Covid-safety measures then the less we need social distancing at all. In that respect, the situation was very different in the autumn of 2020 than the spring because there was a far greater general understanding of how to reduce the risk of transmitting infection at the R number remained much lower than 2.8 at around 1.4. So at that stage, the case for earlier but less drastic intervention was even more compelling.

251) Better protection of the vulnerable in the early stages of the pandemic would have reduced the burden on NHS Scotland, and allowed non-Covid health care to resume more quickly. However, this would have to be done in conjunction with other measures to reduce transmission rates in the community.

252) I am not aware that Scottish Government had any exit strategy from the March 2020 lockdown at the time it was introduced. I am concerned that there was a widespread misperception that lockdown was a temporary measure that would somehow end the pandemic. I do not believe that decision-makers understood that lockdown would delay but not prevent a wave of infection and that we would be living with the virus for the foreseeable future.

253) This matters because the perception that lockdown would be a one-off, short-lived intervention makes it appear a much more proportionate response than the reality that, if lockdown was our preferred mode of response, we would endure multiple waves and multiple lockdowns. I note that I had briefed the then CMO Scotland on this exact point prior to the March 2020 lockdown [MW/046 INQ000371361, MW/047– INQ000352013], advising on the possibility of at least three waves of infection.

254) I am not aware of any models of lockdown specifically for Scotland being available in March 2020 but I do not have access to all the work done by Mel Giarchi and others in Scottish Government. I doubt that it would have been possible to reach a different conclusion from the modelling being done in England – the epidemic was not highly visible in Scotland in early March 2020 and there was very little data.

255) I am unable to comment on whether Imperial College's Report 9 was instrumental in the UK government's decision to impose a national lockdown on March 23rd 2020 as I was not party to any discussion with ministers or officials. Nor do I know to what extent advice given to Scottish ministers at that time drew on Report 9.

256) I note that Report 9 considered all of England, Scotland and Wales as a single (apparently homogenous) population. However, the headline figure of 510,000 deaths is unlikely to apply pro rata to Scotland in practice. This is because the epidemic was disproportionately seeded in London, resulting in a larger early epidemic there.

257) My team began modelling interventions equivalent to lockdown in the last week of February (our work prior to that was mainly concerned with estimating the scale of the imminent pandemic in Scotland). I sent a briefing on the impact of time-limited, population-wide social distancing measures to the CMO and Deputy CMO Scotland on March 2nd 2020 [MW/034 – INQ000351995].

258) I note that at this time many modelling groups were having to undertake intensive research to answer questions about the timing, severity and impact of lockdown-type interventions. This is because lockdown had not previously been considered as a possible intervention during a pandemic, so these questions had not previously been addressed. I see this as one reason why there was so much uncertainty about how lockdowns should best be deployed just as it was becoming increasing obvious that we might need them.

259) Other than media reports, I have no knowledge of the circumstances of nor the impact of Catherine Calderwood's resignation in early April 2020. By then SGCAG had been formed and it continued working with the then Acting CMO Scotland Gregor Smith.

260) In early 2020 I worked on the basis that a vaccine for Covid would not become available for 12 months. This was a common planning assumption at the time. In the event, roll-out began 2 months earlier than that. I was very much aware that additional time would be needed for the vaccine to be rolled out and that this would be important for assessing the duration of the crisis. I did not have any indication of how long roll out would take beyond 'a few months'. Nor, of course, was it possible to anticipate how effective any vaccine would be at reducing rates of infection, the severity of disease, or infectiousness. I note that more people died of Covid in Scotland in the year after vaccine roll-out began than the year before. So it is, and always was, quite wrong to equate the beginning of the vaccination programme with the end of the emergency.

261) I did not anticipate effective treatments becoming available over a similar time scale but I was too pessimistic; dexamethasone was successfully trialled and deployed from June 2020. Dexamethasone saved many lives but was not effective enough – by itself – to greatly alter the overall pandemic response strategy. In addition, there were wider improvements in clinical care that collectively reduced the hospital case fatality rate during the first wave [MW/048 – INQ000369760], indicating significantly improved patient outcomes. This saved many lives.

262) There was at least one attempt to model the impact of an earlier lockdown in Scotland [MW/049 –INQ000351855], though I cannot find it published in a scientific journal. However, similar exercises for England have been published [MW/050 – INQ000351966].

263) There are multiple challenges for this kind of analysis. First, they must take into account behavioural changes that occurred in advance of lockdown. For the UK as a whole, including Scotland, Google mobility data indicate major changes in behaviour in the week prior to the March 23rd 2020 lockdown, and little change thereafter, implying that lockdown itself will have had little effect. Statistical analysis of case data has reached the same conclusion [MW/051 – INQ000369761]. Second, the first wave included a large number of deaths in hospitals and in care homes (roughly 40% of the total for Scotland). Lockdown – at whatever time – had less impact in those settings. Thirdly, the impact of earlier lockdown would have been less in Scotland than for the UK because the epidemic was further advanced in other parts of the UK, London particularly.

264) For these reasons, I am highly sceptical of the claim that locking down a week earlier in March 2020 would have prevented 2000 deaths in Scotland [MW/049 – INQ000351855]. It would have had some impact, but so would less drastic interventions introduced earlier. That said, given that these are retrospective analyses involving debatable counterfactuals, I do not think there can ever be a definitive answer to this question.

265) The issue of the timing of lockdown – in Scotland or anywhere else – is easily oversimplified. Many people seem to think it self-evident that an early lockdown has a public health benefit. As was recognised (e.g. in SPI-M-O) from the outset, that would be true if and only if the strategic objective was to minimise the number of Covid-related deaths (consistent with 'no death is acceptable') without any other consideration. Taking that position, it follows that the rational public health response is to go into lockdown immediately and stay there indefinitely until some other solution (e.g. a fully effective vaccine) presents itself.

266) In practice, no country in the world took that route through the pandemic – the disruption to society caused by an indefinite lockdown would have been catastrophic. As soon as you accept that a lockdown must be time-limited then you are, explicitly or implicitly, accepting that it is possible to lock down too soon. However, there are nuances around this argument: for example, if a longer lockdown is considered supportable then it can be implemented earlier.

267) For me, the more important question is why more proportionate and sustainable interventions than full lockdown were not introduced earlier than they were and then

given time to work. A partial answer to that question is that, as far as I know, the question 'what could we do to avoid going into lockdown?' was never asked and never answered.

268) In March and April 2020 my team developed a proposal for a strategy referred to as "segmentation and shielding" (also referred to as "super-shielding" or "enhanced shielding") as a means of both reducing the public health burden of Covid and accelerating the exit from lockdown. These were all poor choices of names; the term 'shielding' linked the strategy to shielding by self-isolation, a deeply unpopular and often impractical approach that we were actually proposing to make redundant. The term 'segmentation' subsequently allowed the strategy to be seen as similar to the Great Barrington declaration, even though we clearly stated the need for a reduction in transmission as well as better protection for the vulnerable.

269) A key element of the strategy was a focus on the contacts of vulnerable individuals – such as health and social care workers and informal carers – allowing a switch from shielding through self-isolation to safe contacts achieved by a combination of testing, Covid safety measures and biosecurity. This is known as 'cocooning'.

270) I shared a briefing on segmentation and shielding with the Covid-19 Director and the CMO Scotland on April 10th 2020 [MW/052– INQ000352748]. I also briefed the First Minister on the strategy at a SGCAG Deep Dive meeting on May 15th 2020. The briefing made it very clear that, in our view, protecting the vulnerable was best achieved by making contacts safe rather than stopping contacts altogether [MW/053 – INQ000351927]. Stopping contacts altogether was a recipe for isolation and loneliness.

271) Between early April and late May I had an extended series of positive discussions – both verbal and via e-mail – about segmentation and shielding strategies with other members of SGCAG, with clinical colleagues, and with Scottish Government's shielding unit. Ultimately, despite the considerable interest, the strategy was not adopted in Scotland. I believe that this was at least partly because it was never endorsed by SAGE. I was not invited to the SAGE meeting where proposal was discussed.

272) In marked contrast, the idea of cocooning had already informed the measures taken to protect care homes, specifically the testing of care home staff. Yet it was not adopted in the community until vaccines became available, when social care workers and home carers were designated priority groups.

273) One major advantage of cocooning is that it does away with shielding by self-isolation. Extreme self-isolation was hugely undesirable, unsustainable and often impractical. It was therefore deeply unpopular and – rightly in my view – was criticised by SGCAG. Cocooning was a much more preferable alternative that (anecdotally at least) was spontaneously adopted by the public. Nonetheless, critics of segmentation and shielding

continued to link it to extreme self-isolation, and I evidently did a poor job of countering that narrative.

274) One possible objection to the 'cocooning' strategy is that it might not be effective during periods of high prevalence. The objection is right in one sense: cocooning is unlikely to be sufficiently effective during periods of high prevalence by itself; measures to reduce R will also be needed, a point addressed comprehensively in my team's work on segmentation and shielding. I note that our recognition of this need was to become a critical point of departure from the Great Barrington Declaration when that was published in October.

275) However, the high prevalence objection is also fundamentally wrong. Even though cocooning alone will not be enough in this situation, it becomes much more important to implement it, not less. This is because the risk to vulnerable people is higher; prevalence varied by more than 100-fold during 2020 and so the risk varied by roughly the same amount. It should surely be obvious to everyone that, during times of high prevalence, vulnerable people needed more protection not less, so I do not understand how this came to be an argument against cocooning.

276) The debate quickly became ideological, as evidenced by repeated claims that protecting the vulnerable was "unethical", a patently absurd proposition. I had a discussion of this issue with the COVID public health Directorate on September 24th 2020 [MW/054 – INQ000352383, MW/055 – INQ000352094, MW/056 – INQ000352381, MW/057– INQ000352382].

277) I cannot recall whether SGCAG was asked to endorse Scottish Government's extensions of the March 23rd lockdown into the summer of 2020. My expressed preference at the time was to accelerate the exit from lockdown by the wider use of Covid safety measures and testing to suppress transmission [MW/036 – INQ000351956], coupled with better protection of the vulnerable to reduce the burden on the NHS [MW/052 – INQ000352748].

278) I was greatly concerned that there was little or no evidence to support the requirement to stay indoors or closing schools and felt that unnecessary restrictions such as these should be lifted quickly. I also argued that by concentrating so hard on reducing the R number – what I came to call Scotland's 'obsession with suppression' – we were restricting our options for managing the epidemic in less damaging ways than severe social distancing [MW/058 – INQ000351951].

279) As stated in my response to Module 2 [MW/132 - INQ000250231], on October 2nd 2020 I co-authored a report with Chris Robertson making the case that – based on our retrospective analysis of data from the first Covid wave in Scotland – a new lockdown, if

implemented, would not adequately protect the most vulnerable. Our analysis indicated that up to 73% of fatalities during the first wave in Scotland had been the result of infections acquired after lockdown was implemented. The proportion was even higher for the oldest age groups. Clearly, lockdown alone was not providing adequate protection for the most vulnerable individuals. I have provided this report to the Inquiry [MW/148 - INQ000220365].

280) We now have a good understanding of why this was the case: the most vulnerable people require day-to-day care and cannot fully self-isolate; necessary interactions with health care workers, social care workers and informal carers put these people at risk [MW/059 – INQ000369766]. If we had done more to protect the vulnerable by protecting their contacts – or by any other means – then the death toll could have been reduced.

281) I bitterly regret not winning this argument at the time. Many lives could have been saved if the Scottish and UK governments had been persuaded that, whatever else they did, protecting the minority of very vulnerable individuals should have been their top priority. I was unable to get past Scottish Government's 'obsession with suppression' and SAGE's fixation on lockdown as the primary public health response (something the WHO Covid Envoy – David Nabarro – specifically warned against in October 2020).

Decisions relating to easing the first lockdown in the period from 29 May 2020 to 7 September 2020

282) I understand that Scottish Government has provided the requested overview of the advice provided by SGCAG relating to the easing of the first lockdown. Here I shall report only my personal contribution to that advice.

283) On May 14th 2020 I spoke – alongside two other SGCAG members, Chris Robertson and Roger Halliday – at a press briefing on the R number for Scottish journalists (though I believe others attended too). We discovered at the press briefing that some journalists were under the impression that Scottish Government strategy was to further reduce the R number, which was already well below one at the time. This was not our understanding of the strategy [MW/060 – INQ000352713] and it would be incompatible with the planned easing of restrictions unless other measures to reduce transmission were introduced to compensate. I believe that the misunderstanding illustrated a failure to understand the R number, not only among journalists but also the Scottish public, politicians and decision makers.

284) The day before the press briefing Chris Robertson had shared a technical note of an analysis showing that the R number in Scotland was still below one but had been rising slowly since mid-April [MW/061 – INQ000351949]. A separate estimate of the R number

in care homes showed that R had only fallen below one 2-3 weeks after it did in the wider community, indicating that lockdown had been less successful at protecting people in care homes than in the wider community.

285) On June 11th 2020 I sent an e-mail to the SGCAG Chair and copied in the CMO and DCMO Scotland [MW/062 – INQ000352704]. In that e-mail I raised a number of concerns that I felt strongly at the time. I have no record of any reply to my e-mail and I doubt it had any impact on Scottish Government policy.

286) My first concern was the continuing imposition of restrictions and the stated possibility of lockdown being re-imposed in future (as it was in January 2021). I felt that indirect harms to health care, the economy, education and societal well-being were not being adequately assessed when policy options were being considered. I cited the fact that no evidence regarding these harms had been made available to me as an advisor.

287) A second issue I raised in my June 11th 2020 e-mail was that I felt the policy of keeping schools closed was likely to be causing enormous (but then unquantified) damage and any claims of a public health benefit were not supported by any empirical evidence. Quite the reverse, there was accumulating evidence that there was minimal public health benefit to keeping schools closed and I felt that SGCAG was being slow to accept that evidence. I said that I expected that by August the evidence would become so compelling that we would advise that schools open fully. This came to pass, but I regret that it did not happen in May or June as it did, for example, in Denmark.

288) On June 22nd 2020, I participated in an on-line seminar for the Moray House School of Education at the University of Edinburgh entitled 'International Policy Perspectives on Re-opening Schools' attended by 78 Scottish educators [MW/063 – INQ000352160]. I provided an update on age-related mortality from Covid, transmission by schoolchildren, and risk to teachers. I argued that, based on the available evidence, we should consider re-opening schools. The material was clearly a surprise to the audience. I concluded that even senior educators had a poor understanding of the risks from Covid. To me, that reflected poorly on the communication of those risks – by government, academics and media alike – up to that point. A copy of my presentation has been provided to the Inquiry [MW/064 – INQ000351965].

289) On June 29th 2020, I attended a virtual briefing of the Scottish Cabinet where I spoke to the low risk to children, explaining that the risk of a child dying from a fatal Covid infection acquired at school was – in Scotland at that time – about the same as the risk of that child being struck by lightning in the playground. Again, the material was clearly a surprise to the audience. I concluded that even senior politicians had a poor

understanding of the huge disparities in risks from Covid. A copy of my contribution to the briefing has been provided to the Inquiry [MW/065 – INQ000351954].

290) As I stated in my response to Module 2 [MW/132 - INQ000250231], I was taken aback when in late summer 2020 when serious consideration was given by the First Minster and others to the idea that Scotland should adopt an elimination, or 'Zero Covid' policy. As I had pointed out repeatedly at SGCAG (and as subsequent events around the world made all too clear), elimination was an unrealistic objective. Scotland needed strategies that were consistent with the realisation that we would be living with Covid for the foreseeable future.

291) Any suggestion that Zero Covid was the strategy should have been accompanied by a clear statement that even attempting it would require a much stricter and greatly extended lockdown and completely sealing off the border with England (impracticable in itself). It should have been explained that elimination would require a reversal of the existing Scottish Government policy of gradually relaxing restrictions.

292) I am also concerned that pursuing, even notionally, what I have referred to as the "pipe dream" of elimination meant that Scotland did not plan for and so was inadequately prepared for subsequent waves of infection. I note that I had consistently advised SGCAG that further waves were likely, a view shared and expressed by SPI-M-O.

293) I expressed my views on elimination in a briefing to SGCAG dated July 14th 2020 [MW/066 – INQ000352019]. In that briefing I advised that "an elimination strategy in Scotland at this stage of the pandemic would be highly likely to fail". The fact that the Zero Covid strategy was eventually abandoned by every country in the world who had adopted it shows that this expectation was correct.

294) To be clear, I am not objecting that elimination was discussed in the first place – the science advisory system needed to imagine and debate every conceivable option for navigating the pandemic. Elimination (for the UK) was also discussed – and quickly dismissed – by SPI-M-O. Trying out ideas such as elimination, herd immunity and the 'Moonshot' testing programme was an important part of improving understanding among advisors and decision-makers alike. Personally, I feel it was easier to debate different proposals in Scotland than it was at UK level.

295) As I stated in my response to Module 2 [MW/132 - INQ000250231], the public was not given accurate information about Covid in the early stages of the pandemic, most notably in the much repeated phrases "we are all at risk" and "the virus does not discriminate". This was at a time when we already knew that the risk of dying from Covid was ten thousand times higher in the over 75s than the under 15s. In the media, the BBC television news repeatedly reported rare deaths or illnesses among healthy adults as if

they were the norm, again creating a misleading impression of who was at greater or lesser risk. I consider that this applied to Scotland as it did to England.

296) I suspect this misinformation was allowed to stand throughout 2020 because it provided a justification for locking down the entire population. That view is supported by the SAGE subgroup SPI-B briefing dated March 22nd 2020 that "a substantial number of people still do not feel sufficiently personally threatened; it could be that they are reassured by the low death rate in their demographic group… the perceived level of personal threat needs to be increased among those who are complacent, using hard-hitting emotional messaging" [MW/149 - INQ000119485]. I believe that the general impression that we were all at risk – a misperception likely to be shared by policy makers too – was a barrier to targeting interventions at the vulnerable minority who truly were at high risk from Covid. I fear that Scottish Government's pandemic response was compromised as a result.

297) As I stated in my response to Module 2 [MW/132 - INQ000250231], in my view travel restrictions were a particularly chaotic feature of the UK government's pandemic response in the summer of 2020. The scientific advice throughout the pandemic was that travel restrictions would only have a limited impact once Covid was established in the UK (i.e. from mid to late February 2020).

298) The reactive, targeted restrictions on individual countries that came and went at a high frequency during that summer are unlikely to have delivered any meaningful public health benefit. A comprehensive travel ban might have had more impact, but even that could not have reduced the importation of new cases to zero.

299) I was concerned that discussions in SGCAG about the benefits of travel bans were being driven by extrapolations from countries – such as New Zealand or Taiwan – that had been able to prevent Covid from becoming established in the first place. The benefits of travel bans to those countries would not have been enjoyed by a country like Scotland where Covid was firmly established by the summer of 2020.

300) A draft COG-UK report circulated in the summer of 2020 but not published until January 2021 [MW/067 – INQ000351902] analysed SARS-CoV-2 genome sequences to understand the introduction and persistence of infection in Scotland. The study showed that although there was evidence that virus lineages circulating in England did enter Scotland in the summer, these imported lineages were contributing only 1% of Scottish sequences by the autumn. It subsequently emerged that the dominant virus lineage in Scotland in late 2020 originated in Spain.

301) I concluded that travel from Scotland to Spain had been more problematic than travel into Scotland from England. Yet discussions of travel-associated risks within SGCAG

(and more widely) had been much more focussed on England at the time. I had disagreed with the assumption that English holidaymakers were a significant risk, and they were not.

302) In the summer of 2020 the emphasis was on the gradual easing of restrictions, including the re-opening of schools. For much of that period the public health burden of Covid was relatively low. The R number rose above one in early September, corresponding to increasing numbers of cases. I did not advise on specific prevention measures prior to September 7th but I did warn that I still expected a second wave (anticipated from early March on the basis of my own team's epidemiological modelling).

303) The Eat Out to Help Out scheme in August 2020 was just one element of the relaxation of restrictions over the summer of 2020, alongside many others such as the re-opening of universities and overseas travel during the holiday season. Against that background, there is no suggestion that Eat Out to Help Out, by itself, was responsible for the second wave. Though it has been linked to an 8-17% rise in case numbers, this corresponds to an increase of just a few percent in the R number for a period of a few weeks. This was a small contribution to the 100% increase in R (i.e. doubling) in Scotland that was seen between July and September 2020.

304) This confirms that Eat Out to Help Out was one small component of a much larger trend of increasing contacts. There was no reason to give it particular weight among the many relaxations allowed at the time, and I did not highlight specific concerns about it with Scottish Government.

305) There was some retrospective discussion within SGCAG about the lowest number of cases reached in Scotland during the summer of 2020 [MW/068 – INQ000352490]. This was a period when testing capacity in the general population was still quite limited so many infections would have been missed. The best estimate available at the time (from SPI-M-O) was that cases fell no lower than 500 (though the Scottish Government modelling team's estimate was lower). The SPI-M-O estimates during that period were corroborated when the ONS prevalence survey began in Scotland in the autumn.

306) SPI-M-O was making and reporting estimates of the number of cases in regions of the UK during the summer of 2020. These estimates were always considerably higher (up to ten times higher) than reported numbers of cases because there was little testing of the general population at the time. I believe that the under-reporting of cases was well understood at the time.

307) The more reliable (though still imperfect) metrics were hospitalisations and deaths and more weight was given to these as drivers of policy. In Scotland there was, however, a systematic discrepancy between numbers of deaths reported by Scottish Government

and higher numbers reported by National Records of Scotland. I believe this was due to whether or not a positive test was required to register a Covid death.

308) I do not know why ONS prevalence surveys for Scotland did not commence until October 2020. The surveys provided immensely valuable data. It would have been helpful if they had been put in place months earlier, ideally as early as February.

309) An early sign of the coming second wave in Scotland was the large Covid outbreak in Aberdeen in August. Localised interventions (known as whack-a-mole) were appropriate during that phase, but if the underlying R number grew then such outbreaks would become harder and harder to contain.

310) It seemed to me that policy makers did not understand that once the R number nationally rose above one then a wave was inevitable. The emphasis remained on cautious relaxation, as if by being 'cautious' enough a second wave could somehow be avoided. This was naïve. The threat to public health was not from relaxing too fast, it was from relaxing too far.

311) From that point on, to avoid a second wave, any relaxation would have to be accompanied by strengthening other NPIs (test and trace, Covid safety measures etc.) to compensate. In addition, the public health burden could be reduced directly by better protecting the vulnerable. However, protecting the vulnerable continued to be treated as an afterthought and few resources were devoted to it.

Decisions relating to the period between 7 September 2020 and the end of 2020

312) I understand that Scottish Government has provided the requested overview of the advice provided by SGCAG relating to the last four months of 2020. Here I shall report only my personal contribution to that advice.

313) The CORSAIR study published in September 2020 [MW/069 – INQ000351838] reported poor adherence to the requirements of test, trace and isolate, as well as poor knowledge of key Covid symptoms. This was despite much higher self-reported levels of intent to adhere. Ways of improving adherence were frequently discussed within SGCAG, a recurrent theme being the need to increase support for those willing to adhere in principle but who found it difficult to do so in practice. Scottish Government did provide support grants for low income workers from October 2020, though arguably more could have been done, perhaps in line with the 'Take Care' support package adopted in New York.

314) I do not have data for the uptake of the Protect Scotland app during 2020-21 and I have not seen a formal analysis of the app's impact. One study for England estimated that use of the NHS app there averted several hundred thousand cases in the last 3 months of 2020, despite it being used by just 28% of the population. The impact of contact tracing

apps rises rapidly with increased uptake, doubling uptake should more than double the number of cases prevented.

315) My advice in September 2020 was summarised in a briefing for SGCAG dated September 17th [MW/070 – INQ000351922]. That briefing included: a situational assessment – reiterating that a second wave in the autumn had been anticipated back in March; a summary of the limitations of lockdown; and some comments on risk, especially on the importance of reducing the risk to the most vulnerable. I also advised that a circuit breaker was just another form of lockdown and so would delay any second wave but not prevent it, so was not a sustainable solution [MW/071 – INQ000352740]. I made the same points publicly in an article for The Telegraph published on September 19th [MW/072– INQ000351925] and again on the BBC television's Andrew Marr Show on September 27th.

316) As set out in my response to Module 2 [MW/132 - INQ000250231], I was concerned when, at a briefing on 21st September 2020, the UK CSA showed a projection of an epidemic doubling every seven days, reaching 50,000 cases per day by mid October. The SPI-M-O estimate at the time was that the epidemic was doubling every 10-11 days, a significant difference. I could not see any reason to expect the epidemic growth rate to suddenly accelerate. I therefore expected the CSA's projection to turn out to be too pessimistic. I was acutely aware that a shorter doubling time corresponds to a higher R number and implies more drastic interventions are needed to bring the epidemic under control, so there was a clear risk of over-reacting.

317) I made my concerns public through a comment posted by the Science Media Centre saying I did not think we would get close to the 50,000 figure by mid October [MW/073 – INQ000351904]. In the event, we barely reached half that number. I note that other scientific advisors also had concerns about the projection [MW/150 - INQ000103396].

318) In an e-mail that I sent to the SPI-M-O co-chairs on October 16th 2020 [MW/151 - INQ000103262] I included a graphical comparison of the inaccurate case number projection for England. I also showed a much more accurate projection for Scotland (produced within Scottish Government and based on the longer and more realistic estimate of the doubling time).

319) I note that one post hoc defence of the 7-day doubling time projection was the claim that the 50,000 cases per day figure had been reached in October after all. However, this is only true when the scale is switched from reported cases to ONS estimates of cases (which were running about twice as high at the time). This is not a legitimate argument; whichever scale is used, the doubling time was 10-11 days, not seven.

320) As I explained in my response to Module 2 [MW/132 - INQ000250231], in October 2020, many scientists – myself included – were critical of the Great Barrington Declaration's "focussed protection" strategy. Great Barrington proposed focussing exclusively on protecting the vulnerable and doing nothing to reduce transmission in non-vulnerable groups. This was diametrically opposed to SAGE who were focussing almost exclusively on suppressing the virus, paying limited attention to protecting vulnerable groups outside hospitals and care homes.

321) Both views seemed to me to be unnecessarily extreme. I agreed with Great Barrington that we needed to do much more to protect the vulnerable, and I agreed with SAGE that it remained important to control transmission. But I agreed with neither that we had to choose between one or the other; we could and should do both. This was the essence of the segmentation and shielding proposal I had put forwarded several months earlier. It occupied the abandoned middle ground. Unfortunately, that is not how it appears to have been presented to SAGE, and I regret not being given the opportunity to make the case personally.

322) My impression is that the debate became ideological. This had become apparent to me even earlier at a Deep Dive on May 15th 2020 when it was suggested to the First Minster by one of the participants that a policy of protecting the vulnerable was incompatible with suppressing the virus. This was misleading; it was perfectly possible to do both. I tried to make this clear at the time, as the minutes of the meeting show [MW/074–INQ000352159], but subsequent Scottish Government policy and First Minister's press conferences did not reflect that view.

323) An unhelpful repercussion of this charged debate was a tendency to re-frame the choice as lockdown or nothing. This encouraged proponents of lockdown to exaggerate the risks of Covid (to better justify such a drastic intervention) and the opponents of lockdown to play down those risks (implying that a minimal response would be proportionate). Neither position was tenable.

324) Regrettably, the middle ground – combining protection and suppression in the knowledge that the better you did one the less you would need the other – was effectively abandoned throughout the pandemic, and not only in Scotland. In my view, this resulted both in avoidable deaths and unnecessary and overly prolonged lockdowns.

325) Supporting lockdown in 2020-21 became what has been described as "a test of virtue". This attitude was prevalent within the scientific community as well as in wider society. It made it exceptionally difficult to have a reasoned and objective debate about alternatives to lockdown, even among scientists.

326) Though I did not agree with the strategy described in the Great Barrington Declaration, I was taken aback by the backlash against that proposal. I felt this was indicative of the need for lockdown as a public health intervention becoming scientific dogma. Given the immense harms that lockdown caused, particularly to people not a high risk from Covid, it is hugely regrettable that this happened.

327) I note that while a second national lockdown was imposed in England in November 2020 the same did not happen (and demonstrably did not need to happen) in Scotland. I feel this was an occasion where Scotland benefitted from access to advice from SGCAG and not just SAGE. I have the impression that the membership of SGCAG were more concerned about the Four Harms than their counterparts on SAGE.

328) Scotland introduced a tier system that came into force on November 2nd (by which time cases had already peaked). The R numbers in Scotland and England were similar in October but the second wave in Scotland was brought under control without a full national lockdown. Instead, "Tier 4" restrictions (close to a full lockdown) were implemented in a targeted fashion in 11 out of 32 council areas for approximately 2 weeks. I consider this as confirmation that the national lockdown in England was unnecessary and could have been avoided.

329) That said, if additional interventions – preferably with an emphasis on making contacts safe – had been introduced earlier then the autumn 2020 wave would have been significantly smaller. That was as true for Scotland as it was for the rest of the UK. It is disappointing that, during this phase of the pandemic in particular, there was not more investment of planning and resources in the many interventions available beyond social distancing. There was extensive discussion of, for example, mass testing in SGCAG in the autumn of 2020, but this did not translate into clear advice and subsequent action, at least not at the time.

330) Virus genome sequence data from COG-UK confirmed that the autumn wave was not driven by recently imported viruses. Some advisors had attributed the second wave to the reopening of universities, but the data confirmed that although university students had been caught up in Scotland's second wave – and some large, high-profile outbreaks occurred in university residences – they did not cause it. The second wave was mostly associated with virus lineages that had been present in Scotland before the universities reopened, with some likely to have been imported during the summer holidays from mainland Europe.

331) In November 2020 I became concerned that Scotland appeared to have an unexpectedly high case fatality rate. My briefing on this topic for SGCAG has been provided to the Inquiry [MW/153 - INQ000103445]. This could have resulted either from a genuinely

higher ratio of deaths to infections, or an under-reporting of mild cases. I knew there was under-reporting of cases at the time from comparing Scottish Government case data with ONS Scotland survey data. I saw this as a significant problem. However, I do not know if case reporting in Scotland was worse than elsewhere. This issue was discussed at SGCAG, but was never satisfactorily resolved. The effect did not persist and the analysis was not pursued.

332) I became aware of the Kent (later named alpha) variant on December 14th 2020 from an announcement by Matt Hancock, Secretary of State for Health. I was one of two participants from Scotland at a meeting of NERVTAG to discuss the new variant on December 21st. On reading the papers for that meeting [MW/075 – INQ000351930], I became sufficiently concerned to alert the Scottish Government and CMO Scotland [MW/076 – INQ000352421]. In particular, I was concerned about evidence pointing to increased transmissibility and advised of the prospect of a rapid increase in cases. The expected increase duly happened; reported cases in Scotland reached a new high by the end of December.

333) It took longer to establish that the alpha variant was also more pathogenic, resulting in higher infection fatality and hospitalisation rates. There was some dispute about this finding at the time, but I doubt the dispute had much impact on policy in Scotland or elsewhere. This is because the sheer volume of cases promised a substantial increase in deaths and hospitalisations even if the alpha variant had not been more pathogenic.

334) The possibility of genetic variability of the SARS-CoV-2 virus was always recognised. However, the degree of difference between alpha and its predecessors – especially in transmissibility and pathogenicity – was a surprise. Moreover, the timing of arrival of the alpha variant was unforeseen and unforeseeable.

335) Some commentators have lumped the November wave (which was not caused by alpha) with the much more severe December/January wave (which was caused by alpha). This is misleading; though they arrived in quick succession, they were distinct epidemiological events.

336) In light of the emergence of the alpha variant – which caused a rapid rise in cases in Scotland in December 2020 – Scottish Government pulled back on plans to open up over Christmas and re-imposed Level 4 restrictions on December 26th. Arguably, this could have been done some days earlier given that Matt Hancock had raised concerns on December 14th. However, there was a clear desire among politicians to allow some additional mixing over Christmas.

337) I advised SGCAG that one option over Christmas was to allow mixing but to emphasize the need for Covid safety measures. Contrary views were expressed, but those seemed

to me to reflect an intuitive impression of high mixing rates at Christmas that were not borne out even by pre-Covid contact data. In other words, the risk at Christmas was being exaggerated.

338) That said, it was difficult to predict how people would react to any opportunity for increased mixing at Christmas, so a brief surge in transmission was a possibility. However, in the event, there was so little mixing at Christmas that the situation was described by one advisor as if we had put ourselves back in lockdown. This is another example of the public making their own assessments of the risk and behaving accordingly.

339) The possible need to reintroduce school closures in response to the spread of the alpha variant was discussed at a meeting of NERVTAG that I attended on December 21st 2020 [MW/077 – INQ000351931]. I discussed the question of school closures, among other issues, in communications with the SGCAG Chair and CMO Scotland immediately after the meeting [MW/078 – INQ000352426, MW/079 – INQ000352561, MW/080 – INQ000352560, MW/081 – INQ000352557, MW/082 – INQ000352562].

340) My own view (overly pessimistic) at the time was that the alpha variant might not be controllable at all, but that we needed to act quickly if we were to slow its spread. Thus, I was not surprised at the eventual decision to close schools and go into lockdown in January 2021. However, I stress that if we had made a greater effort to build up capacity in other NPIs, including mass testing, in the preceding months then we might not have had to take such drastic steps for the second time in less than a year.

Decisions relating to the second lockdown (January 2021 to 2 April 2021)

341) I understand that Scottish Government has provided the requested overview of the advice provided by SGCAG relating to the second lockdown in Scotland. Here I shall report only my personal contribution to that advice.

342) Scotland went back into lockdown on January 4th 2021. The lockdown was a response to a new phase of the Covid emergency. I shared the grave concern widely felt by advisors, officials and policy-makers at that time. The public health threat from the alpha variant was all too real; hospitalisations and deaths in Scotland reached higher levels in January 2021 than at any other period of the pandemic. So a major intervention was warranted.

343) My concern at the time was that to achieve a substantial reduction in the transmission rate there were no real alternatives to lockdown. This was extremely disappointing given that Scotland had had almost a year to build up capacity in testing, case finding, contact tracing, Covid safety and targeted measures to protect the vulnerable. Because this had

not been done adequately there was no practical alternative to lockdown in January 2021, just as had been the case back in March 2020.

344) I am concerned that this failure to build capacity in alternatives to lockdown stemmed from Scottish Government's failure to accept that the virus was here to stay and that further waves were expected (my team had circulated a second and third wave scenario as early as March 11th 2020 [MW/047 – INQ000352013]). Instead, Scottish Government had been entertaining the completely unrealistic possibility of elimination just a few months beforehand.

345) I note also that the start of the vaccination campaign in early December 2020 had given some the false impression that the pandemic would soon be over – "over by Easter" was one well-publicised claim. I said publicly at the time that I thought this was unrealistic (and was accused of pessimism as a result). However over-optimistic, such claims made it easier to justify lockdown and promised a swift exit from restrictions. In the event, the pandemic was far from over by Easter; many restrictions would continue well not the summer and restrictions would not be fully removed for well over a year.

346) In my view, the Scottish Government's responses to the second wave in October/November 2020 and the alpha wave in January 2021 were rooted in a failure over the preceding months to accept that measures to reduce the transmission rate would be needed for years. Because they had failed to invest in alternative ways of reducing transmission (e.g. mass testing) they were forced into further restrictions and lockdowns. I believe that this investment would have been made if Scottish Government had made avoiding lockdown an explicit policy objective, and the practical implications of that policy had been discussed in detail. This did not happen.

347) As I expressed at SGCAG at the time, two priority areas were improved case finding and better protection for the vulnerable in the community. There were proportionally fewer deaths in care homes and hospitals in the second wave which suggests that there had been improvements in protecting those high risk settings. January 2021 was more challenging because the alpha wave grew much faster (shorter doubling time). There had been a desire to allow mixing at Christmas resulting in a delay in introducing Level 4 restrictions. In my view, more could have been done to promote Covid safety in the interim, though time was very short.

348) Just as importantly, had mass self-testing technology been rolled out sooner (it was trialled in Liverpool in November 2020) then it could have had as great an impact on the alpha wave as it did on the omicron wave a year later. However, the investment was not made in time.

349) Numbers of cases peaked in Scotland around January 9th and were clearly in decline by the end of the month. This could have encouraged earlier relaxation of some restrictions, but it did not.

350) In my view, the second lockdown in Scotland was in place for far too long and caused unnecessary harms to education and the economy. I believe that Scottish Government held on to the view that another wave could somehow be avoided if they relaxed slowly enough. They still did not understand that any threat to public health came from relaxing too far not too fast.

351) It is important to understand that the public health benefits – i.e. the reduction in illness and death – are greatest at the start of a lockdown period and decay exponentially over time. In Scotland by March 2021, the R number had fallen to around 0.75, so the number of infections was halving roughly every 2 weeks. This means that half the public health benefit accrues in the first two weeks of lockdown, more than that achieved by the following 3 months of restrictions.

352) For this reason, my view is that prolonged lockdowns are much harder to justify than short ones and policy makers should always plan to lift as many restrictions as can be done safely (i.e. without the R number rising above one) as quickly as practicable. This was not the position taken by Scottish Government.

353) Between the start of February and the arrival of the delta variant (in May 2021) the data on both Covid and the vaccine roll out were close to the reasonable best case. I therefore did not understand why relaxation of restrictions was not being accelerated, given that the policy mantra was 'data not dates'.

354) I was particularly concerned that some schools did not re-open at all until mid-March and that schools did not fully re-open until after the Easter holidays. My assessment at the time was that this was unnecessarily cautious and that schools could have re-opened safely in early February, as soon as it was apparent that the alpha wave had been brought under control.

355) The Scottish Government had led the re-opening of schools in the UK the previous August. I do not know why they reverted to excessive caution regarding schools in the first quarter of 2021. There was an argument that opening schools was only safe when the prevalence of infection in the wider community was low, but they were still kept open in October 2020 when prevalence was not only higher but rising. The biggest challenge to schools when the prevalence was high was the disruptive impact of the regulations around Covid, not Covid itself.

356) I understand that Scottish Government was following WHO guidance determining whether or not Covid was under control, but this guidance was inappropriate as it pre-

dated the roll-out of vaccination, which was rapidly weakening the link between cases and severe illness.

357) In early March 2021, I expressed some of these concerns in an e-mail conversation with David Crossman [MW/154 - INQ000103308]. I had also expressed my concerns about the slow re-opening of schools at a Westminster Parliament Select Committee on February 17th 2021 [MW/083 – INQ000351853].

358) All that said, the course of the epidemic in Scotland over the first half of 2021 was very difficult to forecast. I spoke to this – alongside other epidemiological modellers – at a Science Media Centre briefing on January 21st 2021. A copy of my briefing has been provided to the Inquiry [MW/084 – INQ000352009]. There were three main elements to that briefing. First, it reflected the consensus that the epidemic was firmly in decline. Second, it reflected further consensus that, even with a successful vaccine roll out, the wholesale lifting of restrictions in March risked a resurgence, i.e. the epidemic would not be 'over by Easter'. Thirdly, the longer term dynamics were essentially unpredictable, mainly because of uncertainty over vaccine effectiveness and the build-up of herd immunity. In the event, the picture was further complicated by the appearance of another new variant, delta.

359) Scottish Government followed JCVI advice for prioritising vaccination. Specifically, they prioritised protecting the vulnerable (and their carers) rather than prioritising those groups contributing most to transmission (young adults). This contrasted with Scottish Government's unwillingness to prioritise protecting the vulnerable (or their carers) prior to vaccines becoming available. This radical change in approach passed with little comment.

360) Vaccination roll-out went as well as could reasonably be expected, but it took many months even to vaccinate just the most vulnerable groups, and this period was extended once it became apparent that boosters were needed to achieve high protection from the delta variant. I note that more people died of Covid in Scotland after the vaccination programme began than before.

Decisions relating to the period between April 2021 and April 2022

361) I understand that Scottish Government has provided the requested overview of the advice provided by SGCAG relating to the period April 2021 to April 2022. Here I shall report only my personal contribution to that advice.

362) I was aware of the delta variant (then called B.1.617) because of the surge in cases in India in April 2021. It was extensively discussed at SPI-M-O from early May onwards [MW/085 – INQ000352825, MW/086 – **INQ000352032** MW/087 – INQ000352178,

MW/088 – INQ000352181, MW/089 – INQ000351841]. I also consulted a colleague in India [MW/090 – INQ000352209]. I requested and received a report of genome sequencing data from Scotland on May 12th [MW/091 – INQ000352059, MW/092 – INQ000351972] – this clearly indicated a rising proportion of delta cases in Scotland.

363) The information I received from these various sources indicated that the delta variant was yet more transmissible and exhibited partial immune escape. This made it a significant public health threat to Scotland, particularly if it made vaccination less effective, and necessitated a reappraisal of the timetable for relaxing restrictions over the summer of 2021.

364) The possibility of immune escape had already been indicated by two variants – beta (prevalent in southern Africa) and gamma (prevalent in South America) – reported earlier in 2021. Neither of these became fully established in the UK and it was not until the arrival of the delta variant that there were policy implications of immune escape variants.

365) For delta, it was quickly ascertained that a booster vaccination was needed to maintain vaccine effectiveness. The booster vaccination programme was therefore brought forward in the summer of 2021 throughout the UK. Since the booster campaign would take time, there was valid reason to delay the relaxation of restrictions over the summer of 2021.

366) The eventual removal of most (but not all) restrictions in July 2021 did not lead to the surge in cases that SPI-M-O modellers had warned of. Though the public health burden through the autumn was significant, it was considerably lower in Scotland and the rest of the UK than in many other European countries. This was at least partly due to the UK's vaccination programme being more advanced.

367) I first became aware of the omicron variant through media reports on November 29th 2020 and discussed it with colleagues the same day. I asked my team to do some modelling of an omicron wave in Scotland on November 30th – our initial report [MW/093 – INQ000351888] was submitted to SPI-M-O the next day. On that day, I also re-shared with the SGCAG secretariat an earlier briefing I had written on travel bans [MW/094 – INQ000351921].

368) Omicron was the main topic at a SPI-M-O meeting on December 1st. I briefed the CMO Scotland on the SPI-M-O meeting the same day [MW/095 – INQ000352232]. SGCAG met on December 2nd – the meeting documents included some omicron wave modelling by Scottish Government. I recall speaking to the CMO Scotland in person by phone during this period, but I do not have a record of that call.

369) The omicron variant was hugely concerning because it was very different from previous variants (with several dozen changes to its genome) and there was early evidence

(which turned out to be correct) that, even in populations with some immunity due to previous exposure and/or vaccination, omicron was far more transmissible than its predecessors. There was also the possibility (later confirmed) of a shorter generation time too. Together, this information indicated that a wave of infection of an unprecedented size and speed was likely. That is what happened in the following weeks.

370) On the other hand, there was anecdotal clinical evidence from South Africa than omicron was also significantly milder than earlier variants (this too, turned out to be correct). However, SPI-M-O modellers were not willing to assume lower pathogenicity and so their modelled scenarios all generated huge waves of hospitalisations and deaths. These did not materialise.

371) This was frustrating for me personally because in a series of briefings for SPI-M-O and SGCAG in December 2021 [MW/093 – INQ000351888, MW/096 – INQ000351985, MW/097 – INQ000351987, MW/098 – INQ000351988] my team showed that, although we could reproduce the expectation of a huge public health impact when making consistently pessimistic assumptions, it was entirely plausible that the omicron wave would turn out to be much more benign (as it turned out in practice). Nonetheless, I was supportive of Scottish Government introducing additional measures on a precautionary basis as quickly as possible, though hopefully only for a limited period. My team's briefings highlighted that speed was essential; early action can be less drastic action.

372) Accurate advice on the response to omicron required information on the severity of omicron in the Scottish population. This would be determined by: i) the innate severity of omicron (it turned out to be less severe than the delta variant, but still capable of causing a major health burden in unvaccinated populations such as Hong Kong); ii) the impact of prior exposure to Covid (a large fraction of the Scottish population had been infected by this stage, which gave them some protection); and iii) the impact of previous rounds of vaccination (vaccine coverage was well over 90% in the most vulnerable groups).

373) The EAVE project carried out a rapid analysis of omicron severity in Scotland (the first formal analysis globally) that was reported on December 22nd 2021 [MW/099 – INQ000351977]. We estimated that omicron was only one-third as likely to cause hospitalisation as delta, a finding which greatly reduced the expected public health burden.

374) In early December 2021, it was far from clear what the appropriate public health response to omicron should be. Scottish Government did introduce a series of additional social distancing and Covid safety measures between December 10th and 27th. I did not directly advise on these measures (nor the subsequent relaxing of restrictions in April

2022) and I do not know what decided Scottish Government against implementing a full lockdown in response to omicron.

375) In my view, even a March 2020-style full lockdown would not, by itself, have prevented a huge wave – the R number for omicron was too high and could not have been reduced below one by that means.

376) In the event, two other interventions were far more effective. First, the Covid booster programme already under way in late 2021 was accelerated; this helped provide additional protection against severe disease, especially to the most vulnerable. Second, mass self-testing was delivered by providing free lateral flow tests. I do not know the background to that decision but it was a masterstroke. Uptake in Scotland was very high: over 80% of survey populations reporting using the tests once per week, with 50% doing so multiple times [MW/038 – INQ000369763]. This allowed people to manage their own risk effectively by changing their behaviour when testing positive. The lateral flow tests proved so accurate that the need for confirmatory PCR testing was dropped. Booster vaccinations, voluntary behaviour change and self-testing, coupled with the reduced severity of omicron, proved sufficient to keep the omicron wave manageable.

377) The issue of balancing the Four Harms persisted into 2022 despite the vaccine. I am concerned that too little attention was paid to, and too little investment made in, sustainable alternatives to social distancing (such as self-testing) in 2020 because of over-optimistic expectations of time it would take for a vaccination programme to take full effect, which includes the time taken for roll out. In my view, this is one reason why Scotland endured a second lockdown in 2021.

Care homes and social care

378) I did not personally advise Scottish Government on care homes and I do not recall that SGCAG was asked for such advice in the early stages of the pandemic. With hindsight, it is clear that not enough thought had been given to the possible introduction of infection into care homes from hospitals, nor by staff, particularly staff who worked at more than one home.

379) It is a concern that during lockdown – Scottish Government's primary intervention – numbers of cases in care homes fell more slowly than those in the community, reflected in a protracted period of high mortality. This was in part due to the impossibility of many care residents avoiding contacts with their carers, coupled with a failure to protect care homes by introducing biosecurity measures to prevent infection getting in in the first place. It was also because care homes (and hospitals) had their own outbreak dynamics that was partly independent of transmission in the wider community, reducing which was

the aim of lockdown. One way of expressing this is that care homes had their own R number.

380) The first time I can find mention of care homes in my conversations about Covid was in an e-mail from Jeremy Farrar on January 28th 2020 [MW/100 – INQ000352148]. The first time I can find mention of care homes as a particular concern was another e-mail from Jeremy Farrar on March 1st 2020 [MW/101 – INQ000352104].

381) I was aware of a Covid outbreak in early February 2020 among the mainly elderly passengers on the Diamond Princess cruise ship. Evidence that age was an important risk factor accumulated during February 2020. In this respect, Covid was similar to SARS, and we knew from early January that the two viruses were very closely related. For that reason alone, we should have been more alert to the possibility of risk increasing with age.

382) I was not involved in NHS plans to avoid using agency staff to care for suspected patients to curb the risk of the virus spreading across hospitals and care homes in mid-February 2020. I do not know what data were available to Scottish Government relating to infection linked to care homes and social care over that period. Nor do I know the rationale behind Scottish Government's announcement on April 21st 2020 relating to care homes. As I was not involved in decision-making around care homes I cannot judge what went wrong in terms of risk management in care homes.

383) I did not look at statistical data on care homes and social care myself. I understand that information regarding such data has been provided to the Inquiry by Scottish Government.

384) The biosecurity measures introduced to protect Scottish care homes appear to have been at least partially effective: the fraction of those dying who were care home residents was lower in the second wave than the first. Obviously, it would have been helpful if those measures had been introduced earlier. However, I have not seen a formal analysis of how many lives could have been saved.

385) It is difficult to say precisely what measures should be taken to protect care homes in future pandemics; it depends on the exact nature of the threat and the risk profile associated with it. That said, for any infection transmitted by person-to-person contact, a critical component of the response should be to establish the infection status of those in contact with care home residents and other vulnerable individuals, preferably by regular testing but also by symptoms. Planning must allow for the impact this will have on staff availability.

386) I emphasize that lockdown proved least effective at protecting the most vulnerable, precisely because of their need to have contacts with health care and social care workers – self-isolation was not an option. This should have been recognised from the outset.

Borders

387) The UK did not close its borders in the early months of the pandemic. To do so would have contrary to WHO guidance. I did not mention border closures in my advice to CMO Scotland in January and February 2020. My understanding was that borders were not a devolved matter. I suspect that any such suggestion that the UK close its borders in January or early February 2020 would have been regarded as massively disproportionate by decision-makers at that time. I question whether it was even practicable. I note that WHO was not recommending border closures or travel bans at that time.

388) Early UK border closures might have delayed the first wave, though it would be near impossible to prevent the arrival of Covid entirely. Once community transmission was established in the UK – it was first reported in late February but we now know had been happening for some weeks – closing the UK border would have had very little impact.

389) The idea of closing the border between Scotland and England was raised at various times at SGCAG. I was not supportive and I provided a briefing for SGCAG on this topic in January 2021 [MW/094 – INQ000351921].

390) The SGCAG advice on travel and borders on January 28th 2021 [MW/155 - INQ000147323] explained that border closures have limited impact. It might have been helpful to give advice on border controls earlier and I do not know why such advice was not requested. However, I very much doubt that Scottish Government would (or could) have deviated from WHO guidance on this matter in the early stages of the pandemic – WHO did not recommend closing borders or travel bans. By March 2020 it was too late for external or internal border closures to make a material difference to the course of the pandemic in the UK, Scotland included.

391) It has long been understood by epidemiologists that border controls and travel restrictions have to be implemented before infection becomes established in a country/locality. Otherwise, they can have at best a small impact on an epidemic. The need to act early must be fully understood by governments and international agencies, including WHO.

Covid-19 public health communications

392) I am not an expert in communications and I have not seen a formal analysis of the effectiveness of Scottish Government's communications strategy. I therefore cannot say whether Scottish Government messaging promoted public confidence. To all appearances, the Scottish public had – at least initially – confidence in the way the pandemic was being handled in Scotland. SGCAG did discuss the importance of good

communications. I was not deeply involved in those discussions myself and I do not recall what advice was given.

393) I do not know why Scottish Government focussed so hard on the R number. I do think that this focus was ill-advised; the R number is an important piece of technical information for epidemiologists but it has not previously been the public focus of a public health response. In my view, it is not well suited for that purpose, and I agree with the UK's then Deputy CSA who called it the 'R monster'.

394) The R number is most useful as a marker of progress when the objective is elimination. (As such, it was tracked closely – by my own team – during the 2001 foot-and-mouth disease epidemic when elimination was the unambiguous goal). The Scottish Government's stated intention to keep the R number below one implied (to any infectious disease epidemiologist) that the goal was indeed elimination. This was paradoxical given that elimination was not a realistic goal for Scotland from March 2020 onwards. I doubt this was understood by policy makers and officials.

395) I prefer metrics such doubling times or weekly ratios for communicating the trajectory of an epidemic. These metrics – unlike R – are relevant to the key indicators such as hospitalisations and deaths as well as cases. My team estimated both metrics at various stages of the pandemic. We shared these analyses with officials and Scottish Government including the First Minister's Office.

396) Scottish Government did not appear to me to be overly focussed on models. Rather, models were used, appropriately in my view, as one of multiple sources of information to inform decision-making.

397) In general, the models were reasonably accurate at short-term projections but proved unreliable for long term projections. In particular, the models were overly pessimistic about the public health impact of relaxing restrictions and tended to exaggerate the need to impose restrictions in the first place. To the extent that Scottish Government did consider modelling when making decisions, this is likely to have resulted in restrictions on the Scottish population being too severe and being maintained for too long.

398) Some media sources – notably the BBC television news – did repeatedly misrepresent the risk posed by Covid. One example is that they gave the impression that hospitals were being overwhelmed during the first wave. Some (mainly in London) were, but overall hospital bed occupancy was at an all-time low during that period. A second example is that they routinely reported deaths of healthy young adults, thereby giving the impression that these were common. In reality, such deaths were extremely rare; the great majority of Covid deaths occurred in the elderly, frail and infirm.

399) Possibly, this kind of coverage was an attempt to back up government public health messaging; for example, the hugely misleading claim that 'we are all at risk'. I see this as an issue for the media themselves and their oversight bodies, not Scottish Government.

400) I do not know the rationale behind the FACTS message promulgated by the Scottish Government. It is unclear to me why it needed to be different from the UK's "hands, face, space" messaging. The latter was considerably simpler and much more memorable. I do not believe that most people in Scotland knew or could remember what FACTS stood for.

401) SGCAG was not involved in providing guidance to the public. My view is that it would not have been appropriate for it to do so; public communication was not our main area of expertise.

402) Public expressions of opinion by SGCAG members were not forbidden but they were gently discouraged. Personally, I advised the SGCAG secretariat on multiple occasions of forthcoming media appearances or articles and the expected content. At no time did I seek or was given guidance on how to proceed. I did, however, subscribe to the "no surprises" principle – I tried not to say anything to the media that I had not already fed into the scientific advice system.

403) I found it difficult to find the right balance between not wanting to damage public trust in the government response and publicly commenting on – sometimes criticising – the delivery and impact of that response. Nonetheless, as a professional scientist, I am expected by my university and research funders to engage with the media on areas within my expertise and I believe that was a necessary and useful function during the pandemic.

404) There was great public interest in transgressions of Covid rules by authority figures, including the First Minister. I have not seen any systematic analysis of their impact on public confidence, other than one publication on the Dominic Cummings incident [MW/102 – INQ000351940]. It is possible for people to strongly disapprove of such transgressions – which they clearly did – without necessarily changing their own behaviour. In that vein, I believe it was important that these transgressions were – as far as I can tell – treated by the authorities in exactly the same way as they would be for any member of the public.

405) One concern regarding communications is the way in which fear was used to increase compliance with guidance and restrictions. I cannot adjudicate on this but I understand that there is an active debate about whether the use of fear in public health messaging is ethically acceptable.

406) I am also concerned that misleading information – such as "the virus does not discriminate" – was used repeatedly in an attempt to improve compliance by giving a false impression of the risks to low risk groups. As a result, young adults in particular came to massively overestimate their personal risk from Covid. My view is that the public can be trusted with accurate information and will, for the most part, make sensible decisions based on their understanding of the risks.

407) I note that the messaging around vaccine safety was much better than the messaging around Covid itself, including explicit acknowledgement of the (very low) risk of vaccine-related harms. Yet vaccine uptake was extremely high, higher than had been expected. If the public could be trusted with accurate information about the risks of vaccination then I cannot see why they could not have been trusted with accurate information about the risks of the virus.

408) It is difficult to anticipate the kinds of messaging that will be needed in future pandemics because the nature and source of the public health threat may be quite different. I believe that the main purpose of health communication should be to provide the public and patients with accurate information and guidance. This is considerably more difficult during an event such as the Covid pandemic because of the inevitable uncertainties when dealing with a novel threat. Providing information and guidance in the face of uncertainty – not only to the public but to politicians too – remains a challenge. This is a topic requiring further attention by the public health community.

Public health and coronavirus legislation and regulations

409) I did not advise Scottish Government on the appropriateness of its legislation around the pandemic. I do not know how decisions regarding sanctions were arrived at.

410) In my view, the strict enforcement of certain restrictions was an issue. Not all restrictions made a significant contribution to controlling the pandemic. Restrictions on outdoor activities are a case in point; there was good evidence from very early on that the SARS-CoV-2 virus transmits poorly, if at all, in outdoor settings. Issuing hill walkers with penalty notices seemed to me to be grossly disproportionate – that has to be one of the safest activities imaginable.

411) Possibly the fault lies with the legislation not with the enforcement. Either way, there was a danger that we lost of sight of the restrictions that were actually helpful, such as self-isolation of cases. The idea that outdoor activities were safe was not reflected in Scottish or UK government guidance until January 2021, though the evidence had been available for many months.

412) In my view, the introduction of long prison sentences introduced in early 2021 for failing to declare visits to certain countries – such as Portugal – was grossly disproportionate. There are two reasons. First, it is hard to see why the public health risk from visiting Portugal was that much greater than transgressions within the UK that were punished with penalty notices. Second, the risk from other countries fluctuated so rapidly that classifications changed within weeks and travel bans were introduced and removed with bewildering frequency, especially in the second half of 2020.

413) The UK borders policy was incoherent, chaotic and largely ineffective. Prison sentences for those who fell foul of it gave the impression that lawmakers had lost all sense of proportion.

414) My understanding was that Scottish Government did not have jurisdiction over border controls – which are not a devolved matter – so the responsibility lies with the UK government. These matters were discussed within SGCAG. There was vocal support for border closures (even with England) within SGCAG – I did not agree with that view.

415) There was considerable resistance in Scotland, and within SGCAG, to the idea that testing could be used to release people from restrictions. For long periods, there was little appetite for any policies that would make it easier to live with Covid. I believe this reflected a failure to understand that the virus was indeed here to stay.

416) Building on work done in May 2020 [MW/036 – INQ000351956], my argument in January 2021 [MW/103 – INQ000351998] was that testing could be used to allow people to stop self-isolating, return to work, travel, visit care homes, attend social events and so on. This was indeed how self-testing with lateral flow tests was used by the majority of the population in late 2021. But mass testing could have been implemented over a year earlier. I believe that if Scotland had adopted this so-called 'fit-to' testing in early 2021 then the second lockdown could have largely been avoided, and that restrictions could have been lifted earlier.

417) I recall some discussion within SGCAG about the use of carrot and stick to ensure as high as possible compliance with Scottish Government guidance and legislation. One view was that people might not comply with, for example, the requirement to self-isolate if their economic or social circumstances made that difficult. In that case, there was argument for supporting people to self-isolate rather than criminalising them. I largely agreed with this view. I do not know if this was communicated to decision-makers beyond the minutes of SGCAG meetings.

418) The main difficulty, in my opinion, was the absence of hard data on factors that encouraged or discouraged self-isolation. The detailed behavioural studies required were not being done. That said, polls consistently showed – especially in the early

months – that people were mostly supportive of restrictions and willing to make sacrifices for the common good.

Key challenges and lessons learned

419) Precision public health refers to the tailoring of interventions to the populations that are most at risk. It means delivering the right intervention, at the right time, to the right people. Blanket interventions such as lockdown – which affected the whole population regardless of huge differences both in risk and in the nature and magnitude of the indirect harms suffered – are the opposite of precision public health. Such interventions would normally be regarded as inefficient and unnecessarily costly. The key feature of precision public health is that it targets interventions where they deliver the greatest benefit. Examples include pre-exposure prophylaxis for HIV and Mpox information campaigns targeted at 'men who have sex with men'.

420) I am concerned that lockdown is now a familiar public health tool, making it more likely that it will be used again in future pandemics. In my view, this would be a grave mistake. Lockdown should be seen not as a public health response but as a failure of a public health response. Lockdown should always be a last resort and its use reflects a failure to control a pandemic in other ways. There are always alternatives. There are also many pandemic scenarios where Covid-style lockdowns simply would not work.

421) That said, avoiding lockdown requires foresight and considerable effort to plan for, invest in and resource appropriate alternatives. Because none of this had happened prior to the Covid pandemic, Scotland ended up in the first lockdown. Because it did not happen in the second half of 2020 – when the possibility of future lockdowns should have been all too apparent – Scotland ended up in a second lockdown.

422) Future pandemic preparedness – in Scotland and elsewhere – must include planning to take steps that negate the need for drastic and damaging public health interventions such as lockdown. This may require significant and urgent investment of effort and resources in alternative approaches. Government must be made aware of the costs of not making those investments. If instead they ignore the problem or choose to hope for the best then it is far more likely we will be forced into lockdown.

423) One lesson learned is that it is not optimal for politicians to be too closely involved in the minutiae of a public health response. They are not qualified to make operational decisions – that is the purview of the public health agencies. I would not expect this kind of issue to arise for other kinds of crisis. For example, during military conflicts I would expect politicians to set the objectives but to leave the conduct of the campaign to their military commanders.

424) That said, I believe that a greater degree of scientific literacy in government – both among elected representatives and officials – would have been enormously helpful in a crisis of this kind.

425) A summary of my views on lessons learned for the Scottish and UK response to the pandemic was published in The Telegraph on February 20th 2022 [MW/104 – INQ000351873]. I repeat them verbatim here:

- We needed to act much earlier than we did in March 2020; earlier intervention can be less drastic intervention.
- Border controls and international travel bans instigated in February 2020 could have delayed the epidemic, buying time to prepare the NHS and build testing capacity. They were largely ineffective thereafter.
- Much more should have been done, more quickly, to protect the most vulnerable minority (particularly the elderly and those advised to shield) by making their contacts Covid-safe, routine testing of close contacts and helping those contacts protect themselves.
- No full lockdowns – the public health benefits were overestimated and there were much less damaging ways to save lives. We should have recognised immediately that lockdown was not the best way to save lives and treated going into lockdown as a failure of public health policy, never the intervention of choice.
- School closures and banning outdoor activities were not necessary and should have been reversed quickly, or not implemented at all.
- Other social distancing measures in the general population should have been relaxed more quickly and replaced by Covid-safe protocols, while accepting that some measures would need to be retained at least until vaccination roll-out was well under way.
- More should have been done to support those asked to self-isolate, with test-to-release adopted much earlier.
- We were far too slow to accept that the pandemic was never going to be over in a matter of weeks but that we would be living with the virus for the foreseeable future – so our response had to be proportionate and sustainable. We could not ignore wider ramifications for mental health, education, the economy and the well-being of society.

426) I do not know why SGCAG was not more involved in lessons learned exercises. I have not been involved in lessons learned exercises myself, other than being asked to comment on disease surveillance. I note, however, that several SGCAG members – myself included – are now members of SCOPP. I believe that our experiences of working

on SGCAG will be useful in our new roles. I understand that information on lessons learned exercises has been provided to the Inquiry by Scottish Government.

427) I would be prepared to serve again on a group such as SGCAG. The main weakness of SGCAG was that it was much more reactive than proactive; agenda setting was mostly determined elsewhere. That said, it did provide a route to raising concerns swiftly through the SGCAG chair and CMO Scotland; I took this opportunity at the start of the alpha and the omicron waves.

428) I would be prepared to give feedback to Scottish Government on SGCAG, though I feel that events have moved on with the creation of SCOPP. SCOPP responds to two lessons learned from SGCAG. First, SCOPP is a standing committee, so represents a formal mechanism for alerting Scottish Government to a pandemic threat immediately – something that was difficult to achieve using the channels available to me in January 2020. Second, I understand that SCOPP will have a more proactive role in briefing Scottish Government than did SGCAG.

429) EPIC is Scotland's Centre of Expertise on Animal Disease Outbreaks, bringing together mainly Scottish-based expertise under one umbrella to best prepare Scotland's livestock industry and stakeholders for disease outbreaks. EPIC aims to advise the Scottish government and industry stakeholders on the risks and spread of emerging diseases in cattle, sheep and pigs, and on how to prevent or respond. It is funded by the Scottish Government.

430) EPIC was set up in 2008 – I was the inaugural Director – partly in response to the foot-and-mouth disease outbreaks of 2001 and 2007. The model has multiple advantages. One is that is supports collaborative networks across Scotland, and more widely, that are able to respond quickly to animal health emergencies. Another is that it works closely alongside Scottish Government, building effective working relationships between scientists and officials that are vital during an emergency. In my view, it has been obvious since the 2009-10 swine flu pandemic that Scotland needs a similar initiative for human infectious disease outbreaks.

431) There is no robust answer to the question of how many lives might have been saved if the pandemic response in Scotland had been different/better. In a complex, dynamic event such as a pandemic – particularly one driven by how people, businesses, institutions and governments behave in response to a once-in-a-lifetime emergency – there is no reliable (or even agreed) basis for choosing a counterfactual. International comparisons also have to be treated with caution because every country had its own epidemic and attitudes and practices vary greatly from country to country. There have already been numerous attempts to quantify the impact of interventions and their timings

on mortality rates and other key indicators for different countries and a variety of settings. So far, these have given a very wide variety of answers. I doubt it will ever be possible to reach a unified position on questions of this kind.

432) That said, the glaring weakness of the response in Scotland was the failure to provide better protection for the vulnerable in hospitals and care homes and especially in the wider community. Over the short term (such as the first wave) there is a substantial payoff: if we had been able to halve the risk to the most vulnerable 20% then we would have reduced the death toll between March and August 2020 by more than 40% (because more than 80% of deaths occurred in the most vulnerable groups).

433) Halving the risk was an arbitrary target but, in the view of me and my co-authors, a realistic one. However, even smaller levels of protection would have made a difference. I am deeply concerned that we did not try harder to protect the most vulnerable, over and above all other elements of the pandemic response. In any other context the fact that a minority of the population is at hugely greater risk would have demanded to a public health response whose first priority was to protect those people. It is extraordinary that this was not the first priority of the Covid pandemic response in Scotland, but it clearly was not – protecting the vulnerable was always more of an afterthought.

434) I made the following ten recommendations for future pandemic responses in a talk I gave to the Royal College of Physicians of Edinburgh on March 23rd 2023. I have provided a copy of my presentation to the Inquiry [MW/105 – INQ000351945]. The ten recommendations are repeated here verbatim:

- Re-assess "preparedness" and "vulnerability"
- Don't only prepare for the pandemic we've just had
- 100 day mission is optimistic – plan for longer
- Plan to mitigate harms of response
- Lockdown is a failure of public health policy
- Better situational awareness → better decisions
- Act quickly – early action can be less drastic action
- Response must be effective, proportionate, sustainable
- Set up data flows and analysis pipelines now
- Don't dither, DON'T PANIC!

Documents

435) I led the research work done by Epigroup at the University of Edinburgh during the Covid pandemic. I was also a member of the EAVE II team led by my colleague Aziz Sheikh. These activities contributed to a number of scientific publications covering (in order of

publication date): risk factors for disease severity and mortality; efficacy of the first dose of vaccine; optimising the timing of NPIs; segmentation and shielding; vaccine failures; risk due to multimorbidity; epidemic monitoring; vaccine safety; impact of lockdown on health care; severity of omicron. The publications themselves – each of which contains an outline of the main findings as an Abstract or Summary – have been provided to the Inquiry [MW/106 – INQ000351854; MW/107 – INQ000351866; MW/108 – INQ000351876; MW/109 – INQ000351889; MW/110 – INQ000351905; MW/111 – INQ000351914; MW/112 – INQ000351917; MW/113 – INQ000351918; MW/114 – INQ000351937; MW/115 – INQ000351947; MW/116 – INQ000351974; MW/117 – INQ000351976].

436) I have provided the Inquiry with six press articles/commentaries I wrote about the Covid response in Scotland and the UK [MW/118 – INQ000371356; MW/119 – INQ000352003; MW/120 – INQ000352002; MW/121 – INQ000351964; MW/122 – INQ000351973; MW/123 – INQ000351919].

437) I contributed to two evidence sessions at the Scottish Parliament: the Covid-19 Committee on February 25th 2021 and the Covid-19 Recovery Committee on May 19th 2022. The 2021 session was very wide-ranging but included discussions of elimination, protecting the vulnerable and variants. I have provided the Inquiry with a link to a transcript of this session [MW/083 – INQ000351853]. For the 2022 session, I was asked to speak about how epidemiological modelling is used to inform risk assessment and decision-making. I have provided the Inquiry with my briefing for that meeting [MW/124– INQ000351861]. I did not make my own records of either of those meetings.

438) I gave evidence to four parliamentary Select Committees in Westminster, three in the House of Commons and one in the House of Lords. I have provided the Inquiry with links to transcripts of those sessions [MW/083 – INQ000351853]. The sessions were primarily concerned with the UK-wide response. I also participated in a Westminster All-Party Parliamentary Group meeting on March 28th 2022. I did not make my own records of any of those meetings.

439) I contributed to a meeting to discuss the Royal Society of Edinburgh's response to Select Committee working group on July 1st 2020. I have provided the Inquiry with my briefing for the meeting [MW/125 – INQ000351864]. I did not make my own record of that meeting.

440) I have provided the Inquiry with 573 e-mails relating to the issues discussed in my Witness Statement. Many of these had previously been submitted in response to Rule 9 requests from Module 1 and Module 2.

441) I did not communicate directly with Ministers during the pandemic. I occasionally communicated regarding the Covid response with officials and advisors via text (transcripts provided as requested [MW/126 – INQ000352000, MW/127 – INQ000352001]) or phone (no records). I did not use WhatsApp at all for Covid-related matters. I made full use of the SGCAG Slack channel in 2020 and 2021 and would be happy for the Inquiry to have sight of all the content that I posted. However, I cannot now access the channel and do not have a record of its contents or its membership.

442) I did not keep a diary, nor use voice mails, relating to Scottish Government's Covid response. I routinely made notes during meetings as an aide memoire, but discarded them once any follow-on actions were completed. I did not make my own records of any meetings I attended in any form. Earlier drafts of my book – The Year The World Went Mad – were made in note form, including lists of chapter contents. I have provided the Inquiry with a copy of the book as published in February 2022 [MW/156 - INQ000273832].

443) I have provided the Inquiry with my contributions to (through SGCAG and only through SGCAG) four briefings/presentations to the First Minister and/or Cabinet Secretaries [MW/053 – INQ000351927, MW/035 – INQ000351868, MW/128 – INQ000351955, MW/129 – INQ000351916]. The only briefings of this nature that were provided to me came via the SGCAG Secretariat and I believe that these have been shared with the Inquiry by Scottish Government. I attended seven of these 'Deep Dive' meetings in total. I did not make my own records of these meetings.

444) I have provided the Inquiry with 170 other documents that were shared by me or with me and relate to issues discussed in this statement. I have provided one other document that I think would assist the Inquiry relating to the provisional scope of Module 2A [MW/130 –INQ000369762]. This is a supplementary chapter to my book about the pandemic [MW/156 - INQ000273832] that was drafted in January 2023 but never published.

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: PD

Dated: 14/12/2023