

Witness Name: Professor Chris Robertson

Statement No.: 1

Exhibits: CR

Dated: 04 December 2023

UK COVID-19 INQUIRY

WITNESS STATEMENT OF CHRIS ROBERTSON

In relation to the issues raised by the Rule 9 request dated 12 September 2023 in connection with Module 2A, I, Chris Robertson, will say as follows: -

A. Sources of advice: medical and scientific expertise, data and modelling

a) Your roles and responsibilities

1. I am Professor Chris Robertson, of Department of Mathematics and Statistics, Strathclyde University, 26 Richmond Street, Glasgow, G1 1XH, an applied statistician who has worked in public health for many years. I joined the pre-cursor of Public Health Scotland (PHS), Health Protection Scotland (HPS), in 2002 as Professor of Public Health Epidemiology. This was a joint appointment with Strathclyde University. I am wholly employed by the university and Public Health Scotland (PHS) 'buys out' my time through a memo of understanding with the university.
2. My particular areas of expertise are – statistical modelling, design of studies, analyses of linked health data, and surveillance systems for infectious diseases. I also have experience of using and developing disease transmission dynamic models principally in pneumococcal disease, Human papilloma virus (HPV) and measles. I also have considerable experience of vaccine effect studies and vaccine safety studies.
3. In the preparation of this statement, I have referred to records and material provided to me by the Scottish Government. I have also received assistance from the Scottish Government Covid Inquiry Response Directorate. I have also received assistance from the Scottish Government Covid 19 Advisory Group secretariat and the secretariat of the UK Government Scientific Pandemic Infections Group on Modelling (SPI-M) committee.

4. Unless stated otherwise, the facts in this witness statement are within my own knowledge and are true. Where they are not within my knowledge, they are derived from sources to which I refer and are true to the best of my knowledge and belief.
5. References to exhibits in this statement are in the form [CR/XXX - INQ000000].

Background

6. A large number of the questions cover modelling. This covers a very wide variety of mathematical and statistical techniques. In my work as a statistician, I use models all the time. Assessing the real-world effectiveness of a vaccine uses statistical models using individual level data, as do vaccine safety studies, and any type of statistical analysis. I have extensive experience and expertise in using these statistical models. I think that a lot of the questions related to modelling are concerned with epidemiological models of the transmission of Covid-19 and I have largely framed my answers in this respect. These latter models tend to be non-linear models based upon differential equations and often require sophisticated statistical methods to fit the models to the available data which is usually aggregated and not individual level data. My experience in using these models is more limited.
7. At HPS I was effectively the statistical lead and worked alongside a group of 3 statisticians who were employed by Information Services Division (ISD) but who were seconded to HPS. We provided statistical support to all the teams within HPS. I provided statistical advice to the consultants, epidemiologists and healthcare scientists at HPS. In this role, I led on the development of surveillance systems and in the design and analysis of epidemiological studies.
8. I also represented HPS on the Scientific Pandemic Infections Group on Modelling (SPI-M) - committee.
9. When PHS was created in April 2020 my position in the new larger organisation became less clear. I still played the same role in the Clinical and Protecting Health (CPH) division of PHS but was no longer the statistical lead as ISD had its own Head of Statistics, Scott Heald. This did not affect the work I was doing for HPS/PHS and I continued to provide regular information to the consultants and epidemiologists who were managing the pandemic in CPH within PHS.

10. Other than my work on the Scottish Government Covid-19 Advisory Group (SGCAG), I did not provide statistical advice directly to Scottish Government. In the period February 2020 to April 2022, I was in regular contact with the Scottish Government Modelling Team. My contact there was an analytical colleague working in the Covid-19 Analysis Division. Initially, we were discussing the provision of a Covid 19 model for Scotland and the work that the SG modellers were doing in developing an Imperial model for use in Scotland. We also discussed data provision and an SEIR model that I was working on with Adam Kleczkowski at Strathclyde, which was derived from a flu model he has used and published previously. As the pandemic progressed and the EAVE-II project developed I worked with SG Modelling team by providing forecasts of hospitalisation and deaths from Covid-19 in Scotland and also on summary results such as describing the clinical characteristics of those who were testing positive.
11. At HPS I worked alongside Jim McMenamin, David Goldberg and Colin Ramsey in particular and would discuss with them statistical aspects of the surveillance for SARS-CoV2. I also fed back issues discussed at SPI-M in to these consultants. I also provided advice on the data that could be used to monitor the progress of the pandemic. In particular, I worked closely with Jim McMenamin, Mark Woolhouse, and Aziz Sheikh on setting up and obtaining funding for the EAVE-II study.
12. The role I played within HPS/PHS focussed on my strengths as a statistician. I set up statistical systems used to estimate the reproduction number using data from Scotland and set up or adapted surveillance and exception reporting systems for Covid 19. I worked with HPS/PHS analysts to monitor Covid admissions to hospital and estimate length of stay and health care associated infections. I worked with Duncan Lee at Glasgow University to set up a space time surveillance system for NHS 24 Covid calls, and eventually extended this to laboratory testing, once it became widespread. I liaised with SPI-M about the provision of Scottish data for the models developed there. I worked with Adam Kleczkowski and Jonathan Wells at Strathclyde University on the development of an SEIR model for use in Scotland.
13. Everyone in SGCAG knew that I was working more or less full time at HPS from March 2020 onwards and I believe that I was invited to be on SGCAG largely, if not solely, because of my role at HPS/PHS. I do not believe that my role at HPS/PHS had any bearing on me providing different advice to HPS/PHS compared to the advice I gave to Scottish Government. Largely my advice, to both organisations, was restricted to reports of statistical analyses carried out at PHS and this factual advice would be the same.

14. The Chief Nursing Officer's Covid-19 Nosocomial Review Group was not formally a sub-group of SGCAG when it was set up. Jacqui Reilly was the chair of this review group and she was on SGCAG, from April 2020, and gave regular updates on the work of that group as SGCAG. This committee was largely concerned with nosocomial Covid-19 and the management of Covid-19 among patients and staff in hospitals. I frequently presented results from statistical analyses to this group to inform them. These analyses were on the state of the pandemic in Scotland at various times, estimation of the impact of nosocomial Covid-19 of patient mortality and length of stay, estimation of the characteristics of individuals who tested positive after discharge from hospitals.
15. Mark Woolhouse contacted me in January 2020 about the virus in China explaining that he was very concerned and we discussed the availability of data in Scotland for monitoring a novel virus. Previously we had worked together on the H1N1 pandemic in 2009-2011. I started developing simple SEIR models to help understand the potential consequences of a pandemic on the health care system in Scotland. More complex models were being developed by others on SPI-M at the same time. Mark Woolhouse, together with his colleagues in Edinburgh also began looking at these models.
16. Mark is a very experienced epidemiologist with considerable expertise in developing models for the transmission of infectious diseases. I discussed with him the provision of modelling for Scotland in early 2020, the provision of data to calibrate and fit these models and the possibility of setting up similar studies in 2020 as we had worked on in the H1N1 pandemic.

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

17. I don't think I had any understanding of the overarching principles at the beginning of the pandemic. Within my role at PHS I had no direct contact with Scottish Government about the management of the pandemic until I joined SGCAG when it was set up at the end of March 2020. I believe that medical and scientific advice was handled by the Incident Management Team at PHS, which met regularly with representatives from SG and I was not part of this.

18. Scottish Government civil servants and chief and deputy medical officers were present at SGCAG and this group prepared summaries of the scientific evidence at various stages. I was aware from this time onwards that SG was taking into account scientific and medical advice through SGCAG, and SAGE but do not really know what the over-arching principles were. If SGCAG were told what they were, I have forgotten.
19. I was aware of statements about 'following the science' but cannot remember if the First Minister uttered them in the period. It was certainly stated a number of different times to SGCAG that the group existed to provide scientific advice to the Scottish Government. As far as I was concerned this advice was given and this advice was acted on in various decisions that were made. I do not recall if there were instances where the decisions of SG were completely contrary to scientific advice. Equally, I do not recall there being comment among members of SGCAG that its advice was not being considered. In general, I think that there was public confidence in the management of the pandemic in Scotland, as far as Scottish issues were concerned.
20. The period January 2020 to April 2022 was exceptionally frenetic for me with a huge volume of work at PHS. I cannot really remember the key policies of Scottish Government nor did I have any part in setting out the key policies. I was only tangentially involved in the management of the pandemic. Early on, I believe that the main policies were to keep the health service functioning, issues about the provision of suitable protective clothing for health care staff and patients, issues about care homes and making sure they were as safe as possible, issues about protecting the vulnerable and protecting the population as a whole.

c) Informal Decision Making and communication

21. There was a Slack channel for the SGCAG. This was well used but not hugely in the early period January to April 2020. The channel was used by SG civil servants to post questions that it wanted scientific advice on and the members of SGCAG used the channel to raise issues, to share analyses, to share reports and to provide comments of papers brought to it by SG civil servants. At no time did I use WhatsApp for scientific advice or to communicate with other members of the SGCAG. I believe that most of the advice was given in formal meetings or in working groups which reported to the formal meetings. Initially there was a huge amount of email communications within the members of SGCAG before things got started with SLACK. I do not think that advice to

SG was provided directly via the Slack channel; rather the channel was used by the committee members to post their views and then the secretariat assimilated these into a document which was then formally submitted to SG as evidence.

22. I don't recall taking part in any informal meetings to discuss specific scientific advice for Scottish Government. I had phone calls with Mark Woolhouse to discuss modelling issues, I also had discussions with consultants at PHS as part of my role at PHS. I did not take any notes of these meetings.
23. I used Slack for SGCAG work as requested by the group. In this channel I provided my views on issues, as did other members of the group. Advice was not provided directly to SG from the Slack channel but was collated by the SGCAG secretariat into documents which were then formally submitted to SG. I did not use WhatsApp or texts. Other than speaking and phone calls all my communications outside formal meetings was by email – either my university one or my PHS one. I have no idea what other people used or how frequent.
24. The Slack channel for SGCAG was under the jurisdiction of SG and I do not hold the records. I am informed by the secretariat for the group, that the content was deleted from this SLACK channel once formal advice had been submitted.
25. I am afraid I cannot recall the process of minute taking. I do not think that the SGCAG meetings were recorded but have no issues if they were. As far as I am concerned, I am happy with the minutes but to be honest would not have paid them very much attention at the time as I was so busy. I have no reason to doubt the veracity of the publicly available minutes.
26. The following is a list of the meetings I had in my diary over the period February to April 2020. I don't think that there was anything significant in these meetings in terms of advice to Scottish Government and the policies that they adopted. The meetings were largely technical about modelling and data provision and what PHS were going to do about modelling and what SG was going to do. I do not have notes of these meetings.
- On 17 Feb I had a conference call with Scottish Government Health Resilience Unit about Covid 19 system readiness for Modelling.
 - 16 March follow up call with an analytical colleague working in the Covid-19 Analysis Division at the Scottish Government about modelling and data provision

- 20 March follow up call with an analytical colleague working in the Covid-19 Analysis Division at the Scottish Government about modelling and data provision
- 26 March follow up call with an analytical colleague working in the Covid-19 Analysis Division at the Scottish Government about modelling and data provision and SEIR modelling
- 09 April follow up call with an analytical colleague working in the Covid-19 Analysis Division at the Scottish Government about modelling and data provision and SEIR modelling
- 15 April Simulation and Modelling Call – with an analytical colleague working in the Covid-19 Analysis Division at the Scottish Government

27. After that period I continued to have periodic meetings with the SG Modelling team about data provision and results from EAVE-II. I also had meetings with civil servants from SG about care homes and also about risk stratification and identifying vulnerable individuals.

28. I was not aware of any WhatsApp, Slack groups or any other forms of group chats about decision-making or advice relating to the pandemic response in Scotland. I did not participate in any such groups other than the SGCAG Slack channel. I assume that the enquiry has access to this Slack channel, though have been informed by the secretariat for the group, that the content was deleted from this SLACK channel once formal advice had been submitted.

29. As I was not aware of any such groups. I have no communications.

30. On SGCAG we were encouraged to use Slack for discussions as that would provide a record. Many discussions took place and I assumed that all of this would be recorded. At various times there were small subgroups – some early ones were about testing when there will have been emailed documents among the participants. I was involved in this but not when this ad-hoc group became a full sub-group of SGCAG. I recall that there was some early email exchanges among those in the small group. However, the results of these early discussions were papers brought to SGCAG which could then be discussed among the full group. When the subgroups became formalised – and I think that this was after April 2020 – there were regular reports from the subgroups to SGCAG.

31. I did not participate in any informal communications.

d) Scottish Government Covid-19 Advisory group (“SGCAG”) and SAGE

Constitution, membership and role of the SGCAG

32. I believe that the SGCAG was set up by the Chief Medical Officer (CMO) of Scotland. It was referred to as the CMO Scientific Advisory Group. The initial members were largely working in public health. The remit in the invitation letter was to support Scottish Ministers and clinical advisors. Also the sub-points in the remit covered health and data flow issues. There were no business experts or economists, though I think that economic experts joined later meetings. At the time this committee was set up the membership was sufficient to cover the remit.
33. Obviously there were other well qualified people in Scotland, with similar skills who could equally well have been invited. Other individuals joined the committee over the course of the pandemic to increase the expertise required.
34. You can easily see the skills and backgrounds of those who were involved in the SGCAG. The following is my view:
- Health Economics – limited expertise
 - Clinical including respiratory – sufficient
 - Virology – sufficient
 - Immunology – sufficient
 - The Economy – limited
 - Ethics – research ethics – sufficient
 - Education – higher education sufficient – school/nursery and further education limited at the beginning but an education subgroup was set up
 - At risk and vulnerable groups – there was no direct representation of these groups on the SGCAG – though some members may have been in an at risk group.
35. In my view, we restricted our advice to scientific evidence. As a group, we were acutely aware of the consequences of decisions, taken by politicians, which were based upon our scientific advice. Politicians making the decisions had to balance out other aspects not just scientific advice. Within SGCAG meetings there was much discussion about the impact of, for example, closing schools on the wellbeing and education of children, particularly as children did not appear, in general, to be seriously affected by Covid-19.

By the time SGCAG met for the first time the decision to close schools for the first time had already been made.

36. It is easy to conclude after the event that a forum where experts could have their respective areas of expertise brought together would have been useful.
37. Again, it is easy to conclude after the event that an earlier formation of SGCAG would have been beneficial. In terms of the development of the pandemic it would have been fairly difficult to set the committee up much earlier than the end of March 2020.
38. There will be those who say that SGCAG did not need to be formed as SAGE already existed. However, by mid-March 2020 it was clear that there were public health decisions being taken in Scotland before these decision were taken by the UK government – banning mass gatherings and closing schools.

Sub-groups

39. I was involved in preliminary discussion on the testing sub-group but did not play an active part in this for most of the pandemic. I was heavily involved in the Chief Nursing Officer's Covid-19 Nosocomial Review Group. I attended virtually all of the meetings of that group and contributed papers to a number of them. This group was set up in May 2020 and was to feed into SGCAG.
40. In my view, the sub-groups of SGCAG were essential and made a huge impact on the scientific advice given to Scottish Government by SGCAG. The principal ones were the testing subgroup and the education subgroup. Both of these made big contributions to the evidence on which the Scottish Government made it decisions.
41. In the timescale that reports were required and prepared it would have been almost impossible to undertake original research or commission research. There was effective literature based research to investigate specific issues – such as ventilation and face masks.
42. I don't think I can provide an effective answer to what account was taken of the advice of these sub-groups as only Scottish Government will know what account they took of the evidence presented to them in core decision making. Over the reference period, I was not aware of any major discord between the decisions made by Scottish Government and the reports of the sub groups.

Operation of advisory structures

43. I worked very closely with PHS in providing statistical analyses related to the surveillance of Covid-19. I was not formally part of the incident management team at PHS but had regular meetings with members of the team during the reference period, particularly in the period January to September 2020, when I was still able to physically go into work in PHS. I was also part of the PHS Research team and made contributions through that group. I played a leading role in the EAVE-II collaboration within PHS and was the main conduit between PHS and the academic community. The PHS Research team and EAVE-II made large contributions in informing PHS and SG about issues related to the covid 19 pandemic.
44. I was a member of a PHS Modelling group who had weekly meetings with representatives of the health boards. I contributed, in conjunction with Adam Kleczkowski, Jonathan Wells, both Strathclyde and colleagues at PHS, forecasts over rolling 2 week periods of the Covid-19 hospitalisations and ICU use in the health boards. This work was done over the period April to December 2020 as the model became redundant once vaccination had been rolled out.
45. I was also part of the team that set up the EAVE-II programme of work and, in conjunction with the respiratory consultant and one of the GP advisers at PHS worked closely with GP representatives to ensure the flow of GP data into PHS for monitoring the Covid-19 pandemic in Scotland. This took place over the period April to June 2020.
46. I did not have any connections with local authorities, care providers or other major public authorities or sectors.
47. I was a member of SPI-M during the whole period and as I had experience in vaccine effect and vaccine safety analyses was invited to be part of the Medicines & Healthcare products Regulatory Agency (MHRA) Commission for Human Medicines Expert Working Group on Covid-19 vaccine safety from May 2020.
48. There was a great representation of PHS senior staff on SGCAG though Jim McMenamin was the principal person involved for the whole pandemic. I am not sure that SGCAG had any advisory role with PHS or any other public body in Scotland. SGCAG reported to CMO and hence to Scottish Government.
49. Did delays occur as a result of the formation of PHS and what issues arose? This is a tricky one. Almost certainly, the formation of PHS in April 2020 initially had a major

negative impact on the management of the pandemic in Scotland, as there was a whole new layer of senior management who the senior consultants had to report to. The management structure of PHS was more complex than HPS and the whole organisation much larger. In addition, many of the senior leaders on the PHS board did not appear to have extensive experience in managing a pandemic response and were new and external appointments. HPS was already managing the pandemic in Scotland and largely became the Clinical and Protecting Health part of PHS, though the Anti-microbial Resistance and Health care Associated Infections (ARHAI) team remained within National Services Scotland (NSS) and was not part of HPS/PHS anymore. HPS, although a much smaller organisation, had many experienced staff who had worked through the H1N1 pandemic. I think that these staff and the PHS consultants ensured that the day to day management of the pandemic by HPS staff was largely unaffected by the creation of PHS in April 2020 as this work was carried out at levels below the PHS senior management.

50. I am not sure that there were any delays because of the formation of PHS. However, the recruitment of senior staff has an impact on ways of working and also on decision making as new senior appointments generally bring their own ways of working.
51. In retrospect, it was probably as well PHS was created in April 2020 as delays to the creation would likely have led to issues later on in the pandemic. If new senior staff who had a role in the management of the pandemic had been appointed earlier and not from April 2020 then that might have helped but this is only from looking backwards in time.
52. Many papers at SGCAG were prepared by the secretariat, many were prepared by the sub-groups. Some papers were just tabled at the meeting – I had a few of these as they were up to the minute analyses. Other than the ones tabled at the meeting there was generally sufficient time to look at them before the meeting. Generally the papers I tabled at the meeting were largely for information on the state of the pandemic at the time.
53. I thought that the group (SGCAG) worked very well. I knew about 5-7 members very well as I had worked with them on previous projects. I also knew a number of other members through work contacts. I thought that the group worked in a very professional fashion throughout the period. Occasionally, there were differences of opinion – some ‘nippy sweetie’ moments – but no breakdowns of communication or walkouts.

54. I did not have any direct role in providing advice to Cabinet meetings, SgoRR (Scottish Government Resilience Room) and the Four Harms group. I do not know if SGCAG provided direct advice other than through the deep dives, which ministers attended, the minutes and reports. If it happened it would likely have been handled by the chairperson or deputy chair of SGCAG or CMO.
55. I did not provide any advice to SG other than through SGCAG.
56. In my view, SGCAG acted in an effective way. There was general discussion of important issues in meetings. Briefing notes were circulated. The civil servants attached to the committee generally drafted these notes. Members of SGCAG had opportunities to respond to the points raised in the notes. There were also occasions when Slack was used to solicit advice from the members.
57. My recollection is that Chief Scientific Advisor (CSA), CMO, National Clinical Director (NCD) and Deputy Chief Medical Officer (DCMO) were relatively passive in the discussion of SGCAG in that they were more intent on listening to the discussions among the other members rather than putting forward their own views. There were certainly briefings from CSA, CMO, NCD and DCMO to SGCAG about meetings that they had attended. They would also highlight areas that they specifically wanted advice on. I am not sure how differences in opinion were communicated to CSA, CMO, NCD and DCMO. As at least one was generally in attendance they would have been aware of major differences in opinion.
58. There was certainly a great deal of information and in January to April 2020, we were operating in a time when much was unknown about the virus and its effects, how to treat people with the virus and how to protect others from catching it. I think that there was no real alternative to considering all possible avenues of information to help. I doubt that there was any mitigation of the risk of information overload – I certainly was not aware of any strategies that were suggested or adopted.
59. I don't really know how the advice from SGCAG was provided to Scottish Ministers. I had assumed it would be through the meeting notes, through the senior civil servants who attended SGCAG or direct briefings from the chair/deputy chair of SGCAG. There were occasions when Ministers attended the meetings (deep dives) to listen to the discussions. Also, when the group was asked for advice on specific issues a draft was prepared by the secretariat and the chair, based on comments on Slack and in meetings

and papers provided by members – the drafts were then shared with members for comments before being finalised and circulated to CMO, Ministers and senior officials.

60. I think that there was a reasonable amount of feedback to the group on how its advice had been assimilated into decisions. I recall Andrew Morris, Daniel Kleinberg, CMO and DCMO, frequently saying how valuable the advice and information had been in formulating specific policies. I do not have any particular examples but we were aware of SGCAG of the importance of our advice on the Road Map developed over the summer of 2020. [CR/001 - INQ000217684]

61. I can't recall if I was aware of the statement, "the centre ground where there was most confidence and agreement" or not. I do not think that I was aware of this. I do not think that there was any injunction to SGCAG about this approach.

62. I had no issues with the way that advice was sought from SGCAG. The requests were understandable. I do not think that we were aware of the strategy and objectives at the time of the request. It probably would not have been helpful to have known in advance the decisions the Scottish Ministers wanted to make as this may have led to unconscious bias in our advice.

63. I thought that the 'deep dive' meetings were focussed on a single issue and were attended by some ministers so that they could hear directly from the SGCAG. They were there to inform ministers and to give them a deeper understanding of specific topics. I don't think that there were any that I attended in the March to April 2020 period.

64. I attended deep dives or meetings with SGoRR on:

- 01 May 2020 on Reproduction Number and other epidemiological parameters.
- 08 May 2020 on TTIS
- 16 December 2020 on Scenario Planning with Sir Jeremy Farrar
- 04 February 2021 on Scenario Planning

There may be others that I have not tracked down in my diary yet.

65. To be honest, I hardly ever looked at the UK and Scottish Covid-19 dashboards. With my role at PHS I was developing reporting systems which fed data into these dashboards and so did not really have any need to consult the dashboards. The dashboards largely provided data without much context. Also, they tended not to focus very much on the imprecision in the data.

66. In the reference period my advice was given through membership of SGCAG and contributions to discussions and papers from the committee, membership of SPI-M though in the period January to April 2020 I did not make a great deal of contribution. I also provided advice via PHS consultants. This would involving sending the PHS consultants information about the state of the pandemic, certainly Jim McMenamin but also others, and discussing the results of my analyses in person with them if requested and if possible.
67. I do not think that there was an issue with confining advice to be more palatable for policy makers. Our role was to advise government on the areas that they required advice on. I also think the members of SGCAG were able to raise issues that were of concern to them.
68. I think that the papers to SGCAG were made publicly available which ensured advice was transparent, clear and comprehensible. The reports from the committee were referenced and the sources of the information referenced. While working on the committee I was always aware that there would be a review of the work and scrutiny after the pandemic. I am happy with the transparency of the work of the committee.
69. I am not sure what mechanisms existed to challenge the advice provided to core decision makers by SGCAG. I believe that the First Minister and other core decision makers such as Scottish Ministers could, and did, attend SGCAG. So, they could attend and question advice. I think they could also send in written questions / queries for SGCAG to respond to. I recollect getting some questions to answer on the Slack channel but these may not have been challenges to the advice already given. Also, the First Minister and other core decision makers were not obliged to follow the advice when making decisions as they would be having advice from other quarters.
70. I am not aware that there was a set process for identifying the matters for discussion or decision. There was an agenda for each of the meetings. It appeared to me that, generally, the work of the committee was set by the chair and the civil servants. There were also suggestions from the members of the group about items to discuss and these most likely would have been brought to the next meeting.
71. Notes were taken of the general discussion by the secretariat and for major papers on advice the chair of SGCAG, Andrew Morris, or the deputy, David Crossman, worked with the secretariat to do a first draft of the paper. This was then circulated to the group. In the early months this would have been by email but latterly on Slack. Group members

would then comment on the paper and a final version prepared by the chair, and secretariat, and then submitted.

72. Epidemiology and modelling were always going to play a major role as there were many epidemiologists and epidemic modellers on the committee, as well as representation from the Scottish Government Modelling Group. This is a correct approach for advice on a pandemic. However I do not think that the advice to SGCAG was dominated by modelling as there were many non-modelling epidemiologists. Most of the modelling advice came via SPI-M through SAGE and this was UK national. In the reference period and especially in the March to December 2020 period there were certainly reports to SGCAG (verbal usually) by Mark Woolhouse and myself on issues that were discussed at SPI-M, as both of us were on SPI-M, as were representatives of the Scottish Government Modelling team.
73. It is easy to look back and think that there may have been too many health related individuals on SGCAG. We had expected SG to be getting advice on other aspects from different groups. As set up SGCAG was not competent to advise on economic issues and I do not think that we did. Obviously some of the health/pandemic related advice would have had an economic aspect and I was of the view that this balancing act was for SG.
74. I do not recall that there were all that many instances of conflicting advice. Senior members of the SG secretariat were present at the meetings and would be able to relay instances where different advisers were giving conflicting advice. I would have expected that this would have been in the minutes, though appreciate that these may have taken some time to get ready. For reports prepared by SGCAG, different view points would have been noted in the report, where there was not a consensus.
75. I do not think SGCAG was subject to external assessment or peer review.
76. I do not recall any major instances of medical or scientific advice or data modelling being provided by SGCAG but not followed.
77. One of the issues I recall was closure of schools, principally primary schools, but I do not think that this referred to the period January to April 2020. What evidence there was during the period March to September 2020 suggested that school age children were not all that severely affected, in the main, though some would have been. The main issues about schools, from the modelling, was that closing them reduced overall transmission

which would have an impact on deaths and hospitalisations among the adult population. Schools were closed in Scotland before SGCAG met for the first time.

78. Schools were open in Scotland in the autumn of 2020 and although they were closed in January/February 2021 were among the first institutions to reopen.
79. I do not think there were any decisions where medical or scientific advice or data modelling ought to have been sought and was not. If issues arose, which were not previously asked for by SG, then members of SGCAG were at liberty to bring them up and they would then be reported to SG.
80. There were certainly discussions about other considerations such as the economy and non-Covid related illnesses but possibly not all that many in the initial March to April 2020 period. There was more discussion about these topics from the summer of 2020 onwards. I think that SGCAG were well qualified to give public health, clinical, scientific and epidemiological advice but not on the economy. There was some expertise on education, inequalities, vulnerabilities, mental health and societal issues among members. I believe that SGCAG generally took the view that it was to give advice on the areas under its remit and leave the economy to others.
81. Tom Evans, who was on SGCAG and the CNO Advisory group was a clinician who was able to give information and views from the front line. The CNO group had many more clinicians, nursing and other care providers who were able to give their views and hence feed into SGCAG through the chair – Jacqui Reilly. The CMO and DCMO were also on SGCAG and they would also have been in receipt of front line information as were the PHS public health consultants on SGCAG.
82. In the initial period March to April 2020, we did not have access to information on patient groups or other representative groups about the patient experience within the healthcare system. Later on we also did not have much access to patient groups, though I think we did have some meetings where patient groups were present. However I may be getting confused with other committees I was on at this time.
83. I cannot really answer why we did not have patient groups on the committee. One reason is that it was a scientific advisory committee another is that we did not ask for patient representatives. Other committees I was on had lay representatives from patient groups.

84. A variety of methods were used to formulate advice. In some cases there was a general discussion in the meeting and the advice recorded by the secretariat. In this discussion everyone had the opportunity to speak. In other cases a paper was prepared by one, or a group of members, and this was circulated for comment. A revised version would be provided and the group would sign off. Another method was posting a paper or discussion topic on Slack and comments were left by members.
85. CMO and/or DCMO were present at the meetings and were also privy to the email and Slack discussions. In this way they would have been able to take note of dissent. If the committee was unable to agree on the advice then the conflicting positions would be reported.
86. The various individuals played a full role, generally commenting on their own areas of expertise. I don't think that there were any formal systems in place within the committee to ensure that the committee has the right expertise. There were times when the committee was expanded to include expertise that was thought to be lacking. Sometimes this was as a result of discussion within the committee at others it may have been the chair of SGCAG who wanted to broaden the expertise.
87. In my view the discussions within the group were balanced and the chair ensured that all members had the opportunity to contribute to the discussions.

Data and modelling

88. The key sources were the modelling carried out by the SPI-M group which was reported to SAGE and hence to SG and the UK government. Initially this focussed on the estimation of R and the growth and decline of the pandemic. The key data sources were testing data, hospitalisations, ICU admissions and mortality data. Later on vaccination data became crucial. Other important data were the health care associated covid data and covid cases in care homes and schools. The PHS situation report was also a key source of information and there was generally some feedback on this at the SGCAG meetings. Later on there were regular presentations from the EAVE-II collaboration.
89. I was fully aware of the estimates of the dynamics of the pandemic as I was on SPI-M. A member of the SG modelling team also attended SPI-M and SG Modelling team produced a weekly report on modelling aspects of the Covid-19 pandemic. The CMO/DCMO and Andrew Morris, chair of SGCAG were also on SAGE which had the SPI-M outputs. Furthermore, one of the standing items on the agenda of SGCAG was an update of the key points from SAGE, generally given by Andrew Morris.

90. At each meeting, there was epidemiological information from SPI-M, from SAGE and also from the PHS situation report. In my view the SGCAG committee were well informed about the situation with the pandemic.
91. I did not share the concerns of Mark Woolhouse, principally as I have worked closely with PHS for years where the data flows and accessibility are very good. I cannot comment on what Mark refers to as it is linked to a previous email. One issue, which has been discussed, and I have discussed with Mark, is the flow of data from PHS to Public Health England (PHE)/UK Health Security Agency (UKHSA) and the flow of data from PHS to academic researchers. Governance issues control the flow of these data outside PHS and solving these can sometimes be tricky.
92. For example Rowland Kao was developing a spatial model for Scotland and required data at datazone level, possibly by age group and sex within datazone. I was very supportive of Rowland developing this model over the summer of 2020 as there were not that many detailed models for Scotland at that time. Data at this level are considered identifiable and it took some time to get Rowland's team at Edinburgh access to these crucial data for the model.
93. I was on SPI-M and was aware of models that required up to data hospitalisation data. I facilitated the provision of these data through daily uploads to the Department of Health and Social Care (DHSC) data repository site. These were national aggregated data and did not have privacy issues. If I had not been on SPI-M and realised that modellers could have easy and timely access to these data then I doubt that the data flow would have been set up quickly. PHS did publish open data on these topics but sometimes the lag is up to weeks in arrears and this is too long in a pandemic.
94. Among modellers on SPI-M the initial focus was on England and data from the devolved administrations can sometimes be tricky to use as slightly different definitions are used and they are available in different formats and scales.
95. The data flow issue was the main reason that when I helped to set up EAVE-II it was set up with all the data within PHS. Academic researchers had honorary contracts and worked on the analysis within PHS. This ensured very timely data flows with data being updated in the morning and up to date analyses run in the afternoon.

96. In the main yes, SGCAG did have adequate access to data to inform advice. There was a great deal of data during the pandemic but not early on in the pandemic. Adequate testing and good contact tracing data were not available early on in the pandemic and this made it very difficult to accurately assess transmission factors and incidence of infection, without recourse to models which provide information on these transmission parameters through various assumptions. Over the course of the pandemic testing data became much better and there was more information from contact tracing and the ONS survey started and the EAVE-II whole populations surveillance system became available after June 2020.
97. In Scotland we had access to the RAPID data on hospitalisations with Community Health Index (CHI) number. This is extremely valuable data in a pandemic as it is updated daily and is effectively up to date. The major drawback of this unvalidated data is that there is no reason for admission field which is reliably filled in. This means you know that someone is admitted to hospital but not if it is for a respiratory complaint or a fractured leg. Having some idea of the reason for admission would have been very valuable. I understand why this does not happen – resources and admissions staff are more concerned with the patient than filling in additional details.
98. I did some analyses for SGCAG on the impact of movement restrictions in the summer of 2020. This was based upon testing data and was presented to SGCAG around September/October 2020. Google mobility data was available to SPI-M and there were analyses there about the impact of Non-Pharmaceutical Interventions (NPI's) over the summer of 2020. These would go to SAGE and hence to SGCAG. I do not think that there was any work in SGCAG on the evaluation of the impact of NPIs separately from SPI-M. There were at least a couple of studies on the impact of NPIs published from the groups represented at SPI-M.
99. SGCAG had access to the same mobility data that SAGE had access to. I am not sure about data on compliance with restrictions. This may have been in the remit of the Independent Scientific Pandemic Insights Group on Behaviours (SPI-B) and I recall getting verbal reports from Stephen Reicher on SGCAG that compliance was very high. The contact pattern data came from panel surveys of individuals in the UK for Comix and for Scotland for the Scottish version. The former was run through the London School of Medicine and Tropical Hygiene and largely was an extension of the Polymod collaboration for contacts. The Scottish contact survey was commissioned from London School of Hygiene & Tropical Medicine (LSHTM) by the Scottish Government Analytics

team to provide additional details in Scotland. The Scottish data was reported in the Scottish Modelling summary – published weekly or fortnightly – and was available at some SGCAG meetings.

100. I cannot really comment on how effective these data sets were for informing core political decisions. I certainly believe that they should have been useful and they filled a gap in knowledge.
101. Personally I think that SGCAG made effective use of the data that it saw, but I am probably too biased in this respect. There was no shortage of data presented to SGCAG and I presented a lot of up to data analyses, principally coming from PHS surveillance and EAVE-II. There was representation from three groups, who were working with data, on SGCAG – PHS, EAVE-II and SG Modelling group so the advisory group had access to very timely up to date data.
102. I do not think that it was the case in Scotland that access to relevant routine data was delayed or limited as there was great provision of routine linked data within PHS. So testing, hospitalisation, mortality data were available within PHS from the beginning of the pandemic on a daily basis. Additional data on ICU admission became available soon after. Once the EAVE-II platform was working from June 2020 onwards there was much more useful data. The Research Team within PHS led by Professors Helen Colhoun, Sharon Hutchison, Paul McKeigue, David Macallister and myself provided very timely analyses during the first year or so of the pandemic using linked health data.
103. There was some delay in getting access to GP data from all practices in Scotland for EAVE-II, mainly as this had never been done before. Also the GP's were very concerned about researchers having access to detailed information on patients that they placed restrictions on the type of data that could be released – only groups of READ Codes combined together - not individual read codes representing specific conditions. These delays meant that it was well into the summer of 2020 before EAVE-II became fully operational. The restrictions on the data provision from GP data systems meant that EAVE-II was not as flexible as it could have been. There was no major impact of this delay on core decision making.
104. The data protection and governance worked pretty well as far as getting EAVE-II set up within PHS. The appropriate permission were granted within a month or so. It took much longer to get it set up within EDRIS for researchers not associated with PHS to carry out analyses.

105. Dynamic transmission modelling of the pandemic was largely done by SPI-M, and the Scottish Government Modelling Group. The latter often presented modelling updates to SGCAG. I ran a simple model within PHS for use by the health boards in conjunction with Adam Kleczkowski and Jonathan Wells at Strathclyde. There was also a model developed specifically for Scotland by Rowland Kao at Edinburgh. This took some time to get calibrated but eventually became one of the SPI-M models. PHS does not have a disease transmission modelling group and have generally worked closely with Public Health England on this. This meant that PHS did not have much epidemic modelling capacity, other than me and my colleagues at Strathclyde. Had there been a good model for Scotland early on in the pandemic this might have been useful but it is unlikely that this model would have had any different conclusions from the models already in use at SPI-M for the whole UK and for England. Some of the SPI-M models for example the Imperial one was a UK wide model but many of the others started off as England or England and Wales only models and then were latterly extended to UK wide models.
106. It was my understanding the SG had their own modelling group who developed a Covid-19 model for Scotland based upon the Imperial version. I am also aware the SG commissioned modelling work from Warwick and used it as part of their Modelling Report. By the time SGCAG was up and running there were a number of SPI-M models for the whole UK that there was probably no need to commission a Scotland only model at that stage.
107. Individuals who work with mathematical and statistical models know that they are all based upon assumptions, some of which cannot be tested and validated. My previous statement referred to all models. I am not sure that the uncertainty and difficulty validating the assumptions affected the reliability of the models. Uncertainty means that the predictions from models have wide confidence or prediction intervals and one of the ways of reducing this uncertainty is in pooling the results from different models. This method was used effectively at SPI-M to provide a reasonable synthesis of all the models.
108. I cannot recall an instance when uncertainty in model predictions or estimates affected the appropriateness of the response by the Scottish Government. As far as I was aware the CMO/DCMO and the SG modelling team were very well aware of model uncertainty.

109. They were transparent to those who were on SPI-M and who knew about modelling. The details were also available on pre-prints and in eventual publications. I doubt that the models were transparent to the policy makers most of whom would not be very familiar with mathematical modelling. The key assumptions were certainly discussed in SPI-M but that is a very technical group. The key assumptions were not discussed in any detail in SGCAG and for most members such a discussion may not have been all that useful.
110. One important meeting of SGCAG on May 01, 2020 was attended by the First Minister and Cabinet Secretary. The focus on this meeting was a presentation on epidemiological parameters and the reproduction number in particular. I believe that this was organised so that FM and SG colleagues were better informed about the interpretation of the epidemiological parameters. This followed the advice provided by SGCAG to the First Minister on 20th April in response to 4 questions about R [CR/002 - INQ000217537].
111. Many of the models were developed from January 2020 and by April 2020 were still being developed and refined. Virtually all of the models were based upon ones which had been previously published. It is easy to look back and say that everything should have been shared widely early on. Models are complex entities, particularly ones which have a spatial and household dimension, and they require high level of epidemiological, mathematical and statistical skill to fit them. Also it can take some time to get the algorithms working so that the models are stable. I am not sure that releasing the code for the models during the development stage would be all that useful. Many of the modellers have provided code for their models now.
112. There was a lot of modelling of different scenarios. This was especially at the request of UK government to SPI-M for lockdowns and circuit breakers and impacts of vaccinations and vaccine waning. Modellers on SPI-M did a huge amount of work in this area and I think that this was one of the most successful uses of modelling. In this case around September 2020 this was one instance of the advice from a committee (SPI-M) not being taken by UK government though the Scottish Government did implement a form of circuit breaker with a 2 week school closure over the October holiday period.
113. The models were reconciled through a form of meta analysis – a standard technique in statistics for combining the results from a number of studies about the same issue to provide an overall summary, which include a strong focus on uncertainty. I don't think that SGCAG explained the difference/limitations to decision makers in Scottish

government though there was a session of modelling (paragraph 110). I don't think that it was the role of SGCAG to specifically explain the uncertainty though this was certainly communicated in SGCAG whenever models were discussed. SPI-M and then SAGE was where the modelling issues would go.

114. In March 2020 there was an exploding pandemic with hospitals and mortuaries in the UK facing being overwhelmed. Effective treatments for COVID were unknown and there was no information on any prior immunity (it was thought that there was none). I don't think that it is any surprise the lockdowns were considered as the main way of controlling the first wave of the pandemic.

115. The most important model at this time was Neil Ferguson's Imperial model as that was the most sophisticated. This did not just look at total lockdowns but investigated a variety of restrictions but keeping schools open.

116. Other factors such as economic, societal, educational, non-Covid health related and mental health impacts were not modelled. Within a complex epidemiological model it would be incredibly difficult to include all these other factors as outcomes. Also it is not the expertise of epidemic modellers to model the impacts of lockdowns on education and economy. It is difficult enough getting a reasonable epidemic model and validating it with all the assumptions that are made. Adding in economics and other factors would make the modelling much more difficult and have many more untestable assumptions which would mean many more individuals would query the utility of the model.

117. I have recently seen references to recent research publications where there is now an attempt to include health and economic outcomes in the same model. I do not think that this type of model was available in March 2020.

118. Mark Woolhouse and his group did some modelling on shielding and the conclusion of that work was that to protect the vulnerable and at risk who were shielding those individuals who had to be in contact with the shielding vulnerable individuals had themselves to be shielded. I think that this was one of the issues with care homes – that the staff who were working in the homes, sometimes in multiple homes, could not adequately shield themselves when they were outside the care home or in the community.

I also think that there were papers at SPI-M on care homes and vulnerable individuals.

So some attempt was made to model the impacts of the vulnerable.

119. PHS had two groups of academics working within it – one was the EAVE-II collaboration and the other was the Covid Research Team – Professors Helen Colhoun, Paul McKeigue, Sharon Hutchinson, David McAllister and myself. I was in both and this ensured that the groups worked on different topics and that there was not duplication of effort. The Covid Research Team probably got started around April 2020 and EAVE-II began operations around June 2020 with the first GP extracts. These groups had full access to all the data within PHS and also, with permissions, got data into PHS on teachers and NHS staff. Both of these groups worked on individual level data for statistical analyses of epidemiological studies. They were not much involved in dynamic modelling of the course of the pandemic.
120. Researchers who were not fully working within PHS had a more troubled route to obtaining data. There was an Ethnicity study using the national safe haven and eventually permissions were granted and a copy of the EAVE-II data transferred to EDRIS for the researchers to use. I believe that this had many teething problems. Later on I was involved in another study funded by a pharmaceutical company which also used the safe haven. This also took some time to get organised (which was OK as this study was not needed for the management of the pandemic). Once permissions were obtained there was again a teething problem issue of the correct data not getting into the safe haven first time round.
121. I have already remarked on the issues faced by Rowland Kao in getting access to data for his models in paragraph 92.
122. I think that there were also issues with the Scottish branch of COG-UK consortium being able to access data from PHS. They again were using the safe haven and possibly there was a computing issue associated with server capacity required for the sequencing work.
123. I also recollect conversations with modellers within the Scottish Government modelling team who did not have access to the same level of data that was in PHS.

Conclusions on data and modelling

124. I think that largely the data collection in Scotland was excellent for the basic management of the pandemic. There was timely data on testing, hospitalisations, ICU and mortality covering the whole country. These data can easily be linked together using the CHI number. There were issues with the contact tracing data which I don't think was ever fully utilised.

125. There were gaps at the beginning of the pandemic as denominator data was not readily available for the whole population. This was rectified with the creation of EAVE-II, which enable population based surveillance to be undertaken accounting for the risk profile of individuals in the country.
126. Full access to GP data is important. There are improvements to the prescribing data in hospitals but at present this only covers about half of the health boards. Whole population testing data – or if this is not feasible a good sized representative sample from the population. Having representative sequencing data is also very important. The key epidemiological issue is that those tested as a biased sample as testing tends to be focussed among the easy to reach samples – those seeking health care or those in hospitals. This is unlikely to be representative of the whole population.
127. Within Scotland careful consideration should be given to the creation of a national cohort which forms the basis of all routine surveillance in non-pandemic times. This would mean that the country was well prepared in the event of a future pandemic. This is effectively the EAVE-II platform. Mirroring this into the national safe haven on a regular basis would facilitate work by academic researchers not associated with PHS.
128. To be honest I don't really know how permissions for access to data required should work in the future but the things to consider are:
- (1) Making it easier for groups to refresh the data sets and update the variables required. At the minute you have to specify and justify all the data sets and data variables that you required. Sometimes you have to specify the definitions for a derived variable. Early on in the pandemic the appropriate definitions are not always known and flexibility is required.
 - (2) There should be ready access to non-identifiable aggregated data through portals that all researchers can access. I think that during the pandemic different research groups accessed more or less the same hospitalisation data through different routes and with different definitions. Even better would be if this portal had the raw individual level data behind it and the researchers were able to run scripts on the individual level data to generate their aggregated data. Virtually all of the transmission models are fitted to aggregated data.
 - (3) Staffing the governance teams at an appropriate level – or having a pool of trained individuals who could move into this group during a pandemic.

129. Attendance at some of the SPI-M/SGCAG/SAGE meetings by decision makers would certainly have helped as there was much discussion about uncertainty in these meetings. Training course for policy makers in making decisions under uncertainty would also be useful. I am aware that the Royal Statistical Society has initiatives in this area.

130. The best sources of population information during the pandemic was the ONS survey in UK and the REACT survey in England. Both of these were random/representative samples of the population. Both were very expensive and probably too small for studying subgroups and rare severe outcomes. The EAVE-II study was a very cost effective population surveillance system and it cost £0.5m to set up and run for a couple of years. Maintaining it would probably cost less than £100K per year in analyst time at PHS, as it uses data which is being collected for clinical reasons. A similar system could be built up in England using the Royal College of General Practitioners (RCGP) network provided it got very timely links into the national data in England on hospitalisations, deaths, vaccinations and testing. The rationale for developing and maintaining the EAVE-II platform in Scotland is discussed in this commentary in Lancet Infectious Diseases, from October 2023, [CR/003 - **INQ000361994**]

131. There is nothing else I consider may be of substantial interest to the Inquiry in relation to modelling.

132. What worked well in relation to modelling. I thought SPI-M worked really well. It did show how much of the UK pandemic modelling was based in academic institutes and PHE capacity for modelling at that time was not huge and PHS/PHW and PH NI virtually non-existent. This situation had existed since the H1N1 pandemic and SPI-M was dominated by the big modelling groups in a number of UK universities.

133. There were certainly missed opportunities in terms of data sharing early on in the pandemic and in preparation for a future pandemic based upon experiences following the H1N1 pandemic. The devolved administrations have many advantages in the provision of health services but for a UK picture of the pandemic having different data from different parts of the UK was an issue. This issue could easily have been sorted out beforehand by ensuring that all 4 nations agree on the minimal data that they can all share using agreed definitions.

SAGE/SPI-M

134. In my view SGCAG derived information from SAGE, SPI-M and SPI-B. This certainly took place via verbal reports of the main issues from SGCAG members who served on these other committees. SAGE minutes were provided. Generally, if any of these committees had given advice SGCAG was not going to cover the same ground. I think the remit was only as far as SG. I recollect that some of the papers worked on by SGCAG were also shared with SAGE, nothing went from SGCAG to SPI-M other than information that Mark Woolhouse and I shared with both committees. Usually Mark gave a verbal report from SPI-M, sometimes I did this. I don't know about SPI-B but Stephen Reicher was on both SPI-B and SGCAG and gave regular updates.

135. As far as I was concerned the interaction of these committees was efficient and effective. I am less sure about information from SGCAG going to SAGE. There was a reciprocity agreement but I have no information on how this worked. I don't think there was any instance where SGCAG modified advice to SG which it was already getting from SPI-M, SPI-B and SAGE.

136. I did not think that a similar approach was problematic in any way. Epidemic modelling in the UK is world leading and the UK government had access to excellent advice. Variants of a basic Susceptible, Exposed, Infectious, Recovered model are the standard way to model the transmission of an infectious disease and virtually all models started from this. Within this framework the different groups had different ways of looking at heterogeneity in transmission through ages, regions, households and were fitting to different data sets – death, hospitalisations, serology, positive tests. The results were then synthesised and any differences discussed. Differences and working out the reasons for these led to improvements in the models. In this way the advice given was very robust.

137. Initially, there was only the one UK model which was able to provide modelling data for Scotland, though I do not think it had a separate Scottish output. From listening to colleagues on SPI-M it was apparent to me that some of them could run models for Scotland but they did not have access to data that was available in Scotland. I arranged for PHS to provide hospital admission data to SPI-M to rectify this. Early on – March/April 2020 there was a lack of Scottish specific models but this was not the case later on in the pandemic. It probably did not have a great impact on the advice fed through to SG as the patterns from England were clear and there is no reason to expect a different situation in Scotland.

138. Modellers in SPI-M had access to data from Scotland on tests (positive and negative ones), admission to hospital and ICU, deaths, hospital and ICU occupancy. They also had access to spatial and mobility data.
139. The SPI-M models were very relevant for the management of the pandemic in Scotland. Without these models SG would not have been very well informed about the likely trajectories of the pandemic in Scotland and would have been reliant on the SG modelling team model, available from mid-2020 onwards and any models developed by others in Scotland.
140. The issues are essentially that SPI-M is a UK committee relying on UK academics. The four big epidemic modelling groups represented – Imperial, Warwick, LSHTM and Cambridge/PHE all had complex dynamic models for England – they are all universities in England and the remit of PHE is England. I believe that the Imperial model was for all UK. There are big epidemic modelling groups at Edinburgh and Glasgow universities and some at Strathclyde but none had suitable models for modelling a human virus – this was not part of their research interests at the time. So England dominated the modelling advice to all devolved administrations from the beginning, by summer of 2020 Scotland specific models were available. I doubt that this had very much impact other than it was not really necessary.
141. I don't really know the role of SGCAG in relaying issues from SG to SAGE. As far as I was aware I thought that CMO Scotland was on SAGE and could bring issues from SG to SAGE.
142. Once the SG modelling group got their model working then I think that they were the primary route of modelling advice to SG, together with the weekly reports from SPI-M. The SG model was part of the SPI-M suite of models. The SG Modelling group provided a weekly presentation pack on modelling for SG and this was often relayed to SGCAG.
143. I did not play any role in the development of the SG model nor in any of the SPI-M disease models. I developed a prediction model for Covid-19 hospitalisations and deaths within EAVE-II at PHS over the spring/summer of 2020. [CR/004 - INQ000361995]
144. This model was presented to SPI-M and was used in the SG weekly modelling report. The forecasts were also made available to PHS, and I think SGCAG. I also used forecasts of infections from the SG disease model in conjunction with the individual level risk model to provide forecasts of deaths and hospitalisations. Within PHS I developed a

simple statistical model for hospitalisations and deaths and this was used by PHS management and CMO.

145. All of the advice on the disease models relied on advice from SPI-M. SGCAG did not provide any additional disease modelling advice in the reference period. Further into the pandemic I presented statistical analyses using models to demonstrate vaccine effect and the relative severity of the different covid variants to SGCAG.
146. I think that SG got very timely and up to date modelling advice from SPI-M and subsequently up to date statistical analyses, specific to Scotland, through SGCAG.
147. Statistical analyses generally require computer codes to clean up the data, to transform the data, to merge the data and then fit the models and make predictions. Good practice is to make these codes publicly available so that anyone can check your work and know exactly what has been done. This increases confidence on the accuracy of the analysis and permits reproducible analysis. Published outputs from EAVE-II had the analysis codes made available [CR/005 [INQ000361996](#)]
148. In my previous response I was stating that I retained all of the code that I used to carry out the analyses that I did at PHS, some of which were presented to SPI-M, SGCAG, Joint Committee on Vaccination and Immunisation (JCVI), MHRA. This is in case they were required.

International Perspectives

149. Devi Sridhar was on SGCAG and she is a professor of global public health at Edinburgh University. Almost always, she gave a perspective on international evidence at the SGCAG meetings. Other members, Mark Woolhouse and Tom Evans, in particular, also reported on international perspectives. I don't know if this was planned but it was very useful for the committee. I think latterly there was a standing item on the agenda about international perspectives.
150. I suppose a more formal arrangement might have been better rather than relying on Devi's good offices. This may have involved a dedicated researcher associated with SGCAG whose remit was to provide a weekly report on international perspectives.
151. The PHS weekly report which was available at SGCAG also included an international summary.

Limitations

152. Speaking for myself, from March 2020 onwards, I was working full time on pandemic work. PHS pays Strathclyde for 2 days per week of my time. All of the advisory work I did was on top of the statistical work I do at PHS so effectively Strathclyde was paying for this work. I was working many more than the usual 40 hours a week and my university colleagues were doing the university work that I would have been expected to have done. I think my position was not as extreme as of my colleagues on the advisory committees or at PHS.

153. I don't think that these issues had any impact on my advice as I was able to prioritise my pandemic work with the support of my colleagues at university who effectively covered for me.

154. Additional funding was made available to the EAVE-II program by SG to PHS and the university was paid an additional 2 days per week for my time from September 2020 to October 2021.

155. I really have no idea about issues faced due to limitations imposed on SG due to the devolution settlement.

Local Government

156. I provided advice to SGCAG and hence SG on the impact of the local restrictions in Glasgow in the autumn of 2020, demonstrating that the restrictions had some impact on the slowing down in the rate of increase of the cases compared to surrounding local authorities not affected by the restrictions in Glasgow. I also provided short term forecasts of hospitalisations, ICU use and mortality in all the Health Boards in Scotland through a PHS modelling group.

157. I did not provide advice on the restrictions themselves but on the impact of the restrictions.

158. I do not know how SG communicated with the local authorities.

Conclusions and lessons learned

159. The question of procedures being fit for purpose is surely is for the Covid-19 Inquiry. I have nothing to say on this.

160. It is easy to look back and think that alternative arrangements may have been better. One thing is that everyone on these committees was phenomenally busy and many

individuals were on multiple committees. I doubt that many individuals would have had the energy for away days for internal reflection and better working practices.

161. Full access to the papers and minutes of the meetings would give external scrutiny but many of the papers presented were working documents in the interests of providing up to date information. If these working documents were publicly released the authoring groups would have delayed reporting to make sure that the whole paper was in a form ready for publication and this could have introduced delays of weeks and may also have then been superseded by events.

162. I had no concerns whatsoever regarding the performance of the First Minister, any Cabinet Secretary, Minister, senior civil servants or special advisor. Personally, I thought that the performance of the First Minister was a model for how a leader should act in a global emergency.

163. I had no concerns at all regarding the performance of any of my counterparts. In my view, everyone I worked with performed at a very high level over a long period of time.

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

a) Initial understanding of the nature and extent of the threat

164. My first notice of Covid 19 was news reports and conversations with Jim McMenamin at PHS probably in the second week of January 2020. I then had an email from Mark Woolhouse on 20 January 2020 followed by some phone calls with Mark discussing the surveillance systems in place in Scotland. A SPI-M meeting on 24 January was called and following that I was very aware of the potential severity of the situation should the virus circulate in UK. I discuss this meeting with Jim McMenamin at PHS.

165. I evaluated the threat by taking the information coming out of SPI-M and developing a simple SIER model for Scotland to quantify the likely impact in Scotland. This model would be described as a 'toy model' or tutorial type model in that it was not nearly as sophisticated as the age and region stratified models presented at SPI-M at this time but it allowed me to see how an uncontrolled pandemic would play out in Scotland.

166. I discussed the results of this and the information coming out of SPI-M in meetings with Jim McMenamin, David Goldberg and Colin Ramsey – the three principal consultants at PHS. My principal contact was with Jim McMenamin.

167. I formed the view that there would be a very severe wave of infections leading to overwhelmed hospitals and many deaths.
168. I did not make those views known publicly. I discussed them with Jim McMenamin, David Goldberg and Colin Ramsey – the three principal consultants at PHS. At that time, and for the whole pandemic, I had a contract with PHS and saw my route of passing on information as through PHS, who were in contact with SG and CMO Scotland and also other groups in the UK.
169. I knew it was a virus early on in February 2020 and that the main routes of transmission would be respiratory possibly with virus going onto hands and then to mouths. I did not fully appreciate the contributions of close range and longer distance spread until the summer of 2020. By the time of the first lockdown I was not concerned about talking to people outside provided there was a 1-2 metre distance.
170. Person to person transmission was known early. Asymptomatic transmission was discussed in early SPI-M meetings and the significance well understood. It meant that isolation of just infected people would not be sufficient to control an outbreak and the close contacts of the infected person would have to isolate for a period as well. I don't think any quantitative information on this came until summer of 2020, but am not sure about this.
171. I assume you mean the fact in the UK of community transmission. As soon as the results of the first community surveillance using RGCP were reported to SPI-M – late February 2020 or early March 2020, I think – as one person tested positive who had not been abroad and who had not been in contact with anyone known to have had Covid-19 at that time. This meant that Covid-19 was circulating in UK, and probably had been for some weeks. It meant that border controls were not going to be effective at stopping Covid-19 getting into the UK – they may stop further imported cases or reduce the number of imported cases.
172. As I have studied and worked with epidemic models for a while I have been aware of the significance of exponential growth in transmission and its impact.
173. As I have studied and worked with epidemic models for a while I have been aware of the significance of R and that if $R > 1$ the epidemic will grow and if $R < 1$ it will eventually die out – this may take a long time.

174. Details of the assumed incubation period were shared in SPI-M meetings in February 2020. These were largely based upon the New England Journal of Medicine (NEJM) paper, [CR/006 INQ000361997] which was published online at the end of January.
175. I was aware that there was much uncertainty about these estimates but the initial estimates of around 5-6 days were used for much of the pandemic.
176. Reports of the duration of infectivity probably came around the same time - February 2020. This was not so easy to have good data on. I think that over the course of the pandemic the estimated distribution got more dispersed as there were reports from contact tracing and repeated testing of individuals being positive, and hence likely to be infectious, for longer than 14 days.
177. There were early reports in [CR/006 INQ000361997] of doubling every 10 days. When NPI's are in place and $R < 1$ the doubling time estimates became halving times and these were not available until May 2020.
178. There were early estimates from Wuhan that I recall – around February 2020 – once the pandemic hit northern Italy the estimates of infection fatality got a lot higher, probably as the case data, though not perfect, were a lot better than those from China. This would have been in early to mid-March 2020. These data suggested that the impact of Covid-19 in Europe was going to be much more severe than the early estimates from China might have suggested.
179. That Covid-19 was a very severe infection was known from the first reports from China, where the hospitals in Wuhan were overwhelmed. I was aware of more robust quantitative information once the data from northern Italy was reported. Then it became clearer that the elderly and infirm, ethnic minorities in UK were most at risk of severe disease.
180. Probably by late February 2020 it was clear that the elderly and infirm were at much more risk as were non white ethnic minorities. It was difficult to be sure as there was little information on who was actually infected. Analyses in Scotland began around May 2020 and these showed similar patterns. These results were shown to SGCAG, and I think SPI-M. The final paper is [CR/007 – INQ000361998]
181. I had no direct role in advice/briefings to SG/CMO in January/February 2020. I had contact with Mark Woolhouse who, I believe, was in contact with CMO. I also had

regular contact with Jim McMenamin who was the PHS lead and in direct liaison with CMO and SG.

182. I am sorry but I did not pay much attention to the SG response at that time. I don't think SG could have any role in trying to slow down the arrival of the virus in Scotland as that was a UK issue and there was no/very little evidence that the UK government was considering border closures. I was aware of activity in Scotland around the provision of beds and increasing the ICU capacity in the acute hospitals.

183. This was a very basic SEIR model that is taught and used in masters course in epidemic modelling. It is the same model as in Chapters 2 and 3 of An Introduction to Infectious Disease Modelling by E Vynnycky and R White. To this model I added transfers of infected individuals to hospital, ICU and Death. The parameter estimates I used were based upon information that was available from SPI-M following the meeting on 24 January. Further details of the basic model are in [CR/008 INQ000361999] though the model I was using in January 2020 did not estimate any parameters.

184. I was engaged in trying to modify an SEIR model for flu, first developed by A Kleczkowski and V Marmara, for use in Scotland. [CR/009 INQ000362000] This model could be fitted to Scottish data and used to forecast cases, hospitalisations, ICU and deaths. At that time there were no cases in Scotland so the model could not be used. It was used from March 2020 onwards and used by PHS to give forecasts to health boards as the SG model for Scotland was not available nor were sub national estimates provided.

185. I shared SPI-M projections with senior colleagues in PHS, though they were already known to them from other routes. I used estimates of case fatality rates, hospitalisation rates, serial interval distributions, incubation distribution estimates generated by SPI-M and others in the simple SIER models I was using.

186. I do not think that SG acted in an inappropriate fashion to the news of the pandemic and its spread. I think the main issue was that there was very little evidence that the UK government was on top of pandemic related matters at this time. SG is limited in what it can do as its remit is limited to the devolved powers.

187. In my opinion, in a global pandemic SG should not have needed to have an independent SGCAG. It was obvious to me that the UK needed to have a united response and strong leadership in the UK government, which worked with the devolved

administrations should have seen that SAGE was sufficient for the whole UK without the need for separate ones in the devolved administrations. England, Wales and Scotland are one island and similar agreed strategies should have been the most effective way to manage the pandemic on this island. This did not happen.

188. Given the timelines, I think it would have been difficult for SG to set up the advisory group much earlier than March 2020 but now that it has one then it is probably necessary to keep the group, or one similar to it, live in the event of a future pandemic. The early decisions by SG such as provision of hospital beds, closing schools stopping large gatherings, were not informed by SGCAG.

189. I don't think the infection mortality rate was properly understood by late January 2020. I don't think that it was ever clear that the data from China was totally reliable. Once data from Europe, and Italy in particular became available the doubling time shortened, the case fatality rate became better understood and ICU use increased.

b) Pre-lockdown response

190. I did not provide any direct advice to SG in the pre lockdown period. My advice was limited to discussions with senior clinicians at PHS and in setting up the EAVE-II surveillance system and other systems at PHS. As I was a member of SPI-M I have responsibility for the decisions of the committee at that time as I did not dissent from any recommendations by SPI-M.

191. Most of my information in the period January to March 2020 came from SPI-M meetings which were twice weekly. I think that by the time the UK plan was published on March 3 that things had already got out of hand and there was sustained transmission within the UK and that containment was no longer possible. The testing capacity at that time was not large enough. The guidance advice to self-isolate was fine for those not working or those with sufficient resources to stay at home or for those who were in jobs who could easily work from home. However millions were in jobs where they only got paid when they worked and advice to people to stay at home with mild symptoms without support made it very difficult to halt the spread of the pandemic. Even then contacts would have had to isolate, and I am not sure if there was strong evidence about asymptomatic transmission that early on.

192. By mid-March the case numbers were rising so fast and hospital admissions also that it was clear that urgent measures were needed to reduce contacts and limit the spread of

the disease. I doubt that imposing these restrictions on schools and public gatherings alone would have done all that much to limit the spread.

193. In retrospect the precautionary measures taken by SG may not have been adequate. However this guidance is always good hygiene and infection control. Probably stronger guidance on masks would have helped but the evidence about the use of masks, unless they were high grade clinical masks was limited in spring 2020.
194. It was entirely appropriate to prepare for a second wave of the pandemic.
195. Herd immunity is the concept that if a sufficiently large number of the population have already been exposed to an infection and have lifelong immunity to further infections then reintroduction of new infections will have $R < 1$ and so future outbreaks of the infection will be of limited size and the subsequent outbreaks will eventually die out. Future outbreaks could still be large but they will be time and size limited.
196. The concept of herd immunity is often used with vaccination campaigns to establish how much of the susceptible population needs to be vaccinated to ensure that should the disease be introduced subsequent outbreaks are size and time limited as the pool of totally susceptible individuals is too low to sustain an epidemic. There could still be large outbreaks but they will eventually die out.
197. I am not aware that herd immunity played any part in the SG initial strategy, nor do I recall it being discussed as a strategy for subsequent waves.
198. I do not believe that herd immunity was encouraged due to the belief that the population would not tolerate strict NPIs - though I was not advising SG in the period Jan to mid-March 2020. I don't think this topic was discussed at SGCAG. I am aware that there were other scientists who advocated lesser restrictions but I am not sure how influential they were in Scotland.
199. Looking back at the sporting events from 2020 it is surprising that these large sports gatherings were not stopped sooner. They are large population mixing events and indoor social mixing in small groups over long periods of time are ideal for transmission of Covid-19.
200. The Scotland France game would likely have brought some infections from France to Scotland with others going in the opposite direction. The age distribution of individuals attending these matches would likely mean that while they might have been sick the risk

of a severe outcome was not all that high. However a number of secondary infections would have arisen and some of these could have been in older individuals at much higher risk.

201. The Scotland Wales game in Cardiff was called off late and some groups may have travelled before the announcement. It would have been better had this been called off earlier as it would have prevented travel, however it has been reported that there was conflicting advice from Cabinet Office Briefing Rooms (COBRA) in the days prior to 14 March 2020 where stopping large gatherings was not being advocated.

202. The Nike Conference was an outbreak which was tracked and monitored by PHS. A big effort was made to contact and test those who were contacts of the infected. Many individuals had left the conference and left the country before the cases were reported. I was not directly part of this outbreak investigation but did discuss it with colleagues.

Subsequent genetic sequencing of the cases in a pre-print posted on June 09 2020 [CR/010 - INQ000362001] suggested that, while there was some local onward transmission, the outbreak in Scotland associated with this event was curtailed through the public health activities of PHS and other bodies within Scotland. This event was not responsible for the first wave of Covid-19 in Scotland.

203. I do not think that there was any firm travel advice from UK central government associated with these events or others around this time. Football matches were suspended/postponed by the football associations not by government.

204. Largely I agree with Mark that there was a “troubling lack of urgency”. There were discussion in SPI-M about the impact of mass gatherings and about travel restrictions and about the need for mass testing.

205. I do not know why there was such a lack of urgency in the UK. I could speculate that the UK government was focussed on Brexit. Also many of the recommendations of the Inquiry into the pandemic preparedness report of 2016 were not acted upon – operation cygnus.

206. The UK is a very well connected country and so in the time of a pandemic needs to take decisions about travel restrictions very fast. To have had a major impact on transmission within the UK I suspect that a total ban on travel, and quarantine of all individuals returning to the UK, would need to have been taken by mid/late January.

Other countries are not so well connected and so had a longer lead time for these decisions.

207. Had WHO declared a pandemic sooner UK government would have had to act sooner. WHO declared global risk very high on 28 February 2020 and had this been weeks earlier the UK response would likely have been accelerated.

208. Within SPI-M I do not think that there was any optimism bias. This is from the very early meetings. If the information from these early SPI-M meetings was accurately transmitted to UK government there should not have been any optimism bias. I have no idea if UK government had optimism bias in its decisions.

c) Testing

209. Testing capacity was limited at the outset. Community surveillance programmes and testing a representative sample of the population, are essential to find out the prevalence of the virus in the community; repeat testing on the same individual give estimates of incidence of new infections. At the beginning of the pandemic the community surveillance program for Influenza at PHS, which could have been modified for Covid-19, was not large enough – though it had been in previous seasons.

210. Once lockdown was announced and GP appointments moved to telephone there was no possibility of carrying out community surveillance in Scotland and the decision was made to test all on admission to hospital. This is the best that could be done with the limited resources in March 2020.

211. In the early stages of the pandemic a test and trace strategy is appropriate – early in February with few cases the strategy was working but is quickly became overwhelmed with volume of cases. By the time Test and Protect was underway we were not in the early stages. Contact tracing is a very difficult thing to do and it is doubtful if there were sufficient trained interviewers. It is almost certain that the interviewers were not experienced enough.

212. I was working as one of the senior statisticians at PHS at a time when the Test and Protect data were becoming available. They were not particularly easy to use to try and estimate epidemiological parameters about transmission and I did not make use of these data.

213. SGCAG was a strong advocate of high quality and massive testing capacity in Scotland. There was a testing sub-committee and it made many recommendations about the testing and genetic sequencing strategy. There were certainly aspects of this advice acted on. The lighthouse lab was set up and there were many testing sites throughout Scotland. Access to a test was relatively easy and as one lab was used consistent results were returned for the whole of Scotland for community testing. NHS testing was carried out at different labs using different assays which meant there was inconsistent data from community and NHS testing. Latterly in the pandemic a high percentage of positive cases were sequenced in Scotland and this gave high quality information on variants and also on the dynamics and transmissions within hospital outbreaks of Covid-19.

214. I think that the implementation of contact tracing was not quite as robust as the testing though I had very little to do with this aspect of management of the pandemic.

215. I agree that testing was vital. I believe that I was aware of the importance of testing and tracing from the early SPI-M meetings. The difficulty faced was in the implementation of the test and trace strategy. From an epidemiological perspective it is probably more important knowing about the fact of a contact, the setting and the identity of the contact, rather than filling in a detailed questionnaire about each contact.

d) Decisions in relation to non-pharmaceutical interventions (“NPIs”)

216. Given the state of the pandemic and the likely impact on hospitals and mortality the lockdown from March 2020 was necessary to control the pandemic. The 2021 lockdown was not as severe and did not include as many restrictions but in the face of the alpha variant was also needed to allow time for the vaccinations to be rolled out to a sufficiently large proportion of the population. It is possible that if different decisions about easing restrictions had been made over the autumn of 2020 the January 2021 lockdowns may not have had to be so extensive.

217. I believe the SG could not make its decisions about full lockdowns in isolation from the UK government as fiscal support is needed for people who are prevented from working and business which cannot function. Without strong fiscal support lockdowns imposed by government could not be implemented.

218. Within advisory groups up to March 2020 it was understood that lockdowns would have an impact on health, society, mental health and the economy. It was not clear how the differing effects could be balanced.

219. Compliance was discussed and it was understood that if compliance was not high the impact of the lockdowns would be much less.
220. A group of individuals was identified in Scotland from public health records of those who from their medical records were considered to be most at risk – the shielding and immunosuppressed list. SG were aware of these individuals. SG was also aware of care home residents, though getting a list of residents was not easy. I believe the SG issued guidelines for both groups and care homes were managed in such a way to minimise risk – but not eliminate it completely.
221. I am not sure it was necessary to take into account the effects of long covid on using NPI's. The planned impact of NPI's is to reduce transmission and that will have the effect of reducing infections and so long covid. Long covid became an increasing factor over the summer of 2020 once the initial wave had been dampened. Recommendations of face coverings – particularly the personal use of high quality medical ones – would provide some protection to vulnerable groups and also have an impact on long covid.
222. Asymptomatic transmission was addressed by the use of masks and quarantine if you were a close contact of an infected person. Again this became more of an issue in the summer of 2020. The development of the tracking app was based upon the premise of asymptomatic spread and had it been adopted by a very high proportion of the population would have been more successful.
223. Over the course of the early part of the pandemic information became available about the 'super-spreader' events in indoor locations. One I recall was a bar in an Austrian ski-resort. This suggested that Covid-19 was in the air rather than just contact transmission. This did not rule out picking up Covid-19 from hand touch sites so advice about handwashing was still good practice. There were also only a few documented cases of transmission taking place between individuals who met outside. So the advice to meet people outside with a 1-2 m distance was reasonable.
224. In my view SG's actions on NPI's was proportionate and designed to restrict the transmission of COVID-19 and protect the vulnerable without imposing too many restrictions on individual liberties.
225. Mandated face covering advice was probably too late and should have been given sooner. However I admit that I was not totally convinced about using face masks early on in the pandemic but became convinced as more and more evidence was presented at

SGCAG. It was appropriate and proportionate to use face masks in indoor settings during the pandemic and, in retrospect, it would probably have been better to do this right from the start.

226. I believe that NHS capacity was crucial for the timing of decisions around March 2020 when there was a risk that capacity for ICU beds would be exceeded. This never occurred as SG/NHS Scotland managed to increase ICU capacity to surge levels. I do not know if the advice I passed on the PHS consultants about when ICU capacity would likely be exceeded was ever passed on to SG, but SG has good statisticians who would have been able to model this.

227. After the first wave I do not think that NHS capacity was ever close to being breached, certainly not ICU capacity, but partly this is due to decisions SG took as regards additional NPI restrictions, the timing of them and the vaccination campaign. Also by the second wave there had been improvements in the management and treatment of severe Covid-19 infections in hospitals which had a huge impact on Covid-19 mortality.

228. School closures is a thorny issue and one which was debated a lot in SGCAG. In my view they were needed in the first lockdown as the pandemic would not have been damped so quickly had schools remained open. It is questionable if parents would have sent their children to school had schools remained open and everything else was shut.

229. By the time of the second lockdown there was increasing evidence that children were not all that seriously affected by Covid-19 though they could pass it on to their parents and teachers though it was likely that transmission was in the other direction.

230. I worked on a paper published in BMJ showing that school teachers were not at increased risk of severe outcomes of Covid-19 but this was published in the summer of 2021. [CR/011 - **INQ000362002**]

231. School closures in the second lockdown were not as necessary as in the first.

232. I do not think I provided any direct advice to SG on the impact of the virus and measures taken to control its spread on vulnerable and at risk groups. I only provided advice through membership of SGCAG. I do not think that SG had any special strategy with regard to the imposition of NPIs with respect to ethnic minorities, asylum seekers and refugees, people of different religions or beliefs, sex and sexual orientation.

Consideration was given to older people, children and young people and disabled people.

233. There was certainly discussion within SGCAG on the impact of NPIs on the elderly, the young and those with disabilities, especially around isolation and not getting help. I have no reason to believe that the strategy taken by SG was inappropriate with respect to these groups. Shielding groups were certainly advised to stay isolated for longer and to be careful when going out. To me this was appropriate at the time and proportionate.

234. As far as I recall they were defined from GP records and from hospitalisation, prescribing and chemotherapy records. This was done within PHS and also by Albasoft. I do not know how the specific conditions were identified.

235. Other than those specifically identified as shielding or immune suppressed no special account was taken of those who had a pre-existing health condition. Over the summer of 2020 the QCovid risk calculator was developed in England and within EAVE-II we were tasked with validating it for use in Scotland. There was some discussion between myself and other EAVE-II researchers and civil servants from SG about the feasibility of using it in Scotland. It was decided by SG not to use this. Also within the Research cell at PHS Paul McKeigue and collaborators developed a risk predictor for people with diabetes [CR/012 - INQ000362003] and the whole population [CR/007 - INQ000361998]. I think I presented these papers to SGCAG.

236. In my view it would not have been all that helpful to use these risk models to differentially treat individuals with pre-existing health conditions. They were relatively complicated and would not have been all that simple to explain. You could easily have a situation where one person with one condition was advised to shield while another the three conditions did not need to shield.

E. Decisions relating to the first lockdown

a) The imposition of the national lockdown in March 2020

237. In March 2020, the number of new infections per day was increasing dramatically, as were hospitalisations and deaths. I do not think that there was any other way to control the pandemic in Scotland at that time. So the lockdown was necessary and proportionate. I think that it was effective as reported new infections peaked shortly after and the reproduction number, R, eventually dropped below 1 and the pandemic declined. There were still huge numbers of hospitalisations and deaths after the lockdown was

announced and part of this is due to the lag between infection data and serious outcome. Part is also due to there still being some transmission after lockdown as there must be some contact between individuals. Having an earlier lockdown would have resulted in fewer serious Covid-19 event over the course of the first wave. Judging by the earlier closing of schools in Scotland and stopping public gatherings, compared to England, I judge the SG would have liked to impose a lockdown earlier. I do not think that this is something that could have been unilaterally decided in Scotland and support would have been required from UK Treasury.

238. I do not know the advice given to SG with respect to lockdowns. They had the modelling advice from SPI-M. The comparison of the timing of the lockdowns between countries based upon date is problematic as the key issue is how far into the first wave of the pandemic are they. One would have expected earlier lockdowns in Italy as the first wave started earlier and there was severe pressure on hospitals in the regions that were closed down in February. In early March 2020 it seemed to me that the UK was trying to follow a cohesive pattern in the four nations but that decisions were slow in England and thus the devolved nations took their own decisions.
239. I think the only realistic way a national lockdown could have been avoided would have been to close UK borders to all travellers and have quarantine from mid-January 2020. This was almost before any cases were recorded in the UK and almost an impossible decision to take. Also the test and trace mechanism for tracing the contacts of cases was not fully functional at that time so there is no guarantee that this strategy would have prevented an epidemic. As there was continued movement into UK in February and March there was no option but to have a national lockdown covering the whole UK. From following the modelling studies I concluded that lesser NPI's such as just closing offices and schools, for example but keeping shops and factories open would not have been sufficient to bring R below 1. Also the initial values of R of 2.2 from China were increased to over 3 when the data from Italy were available. This was in late February and changed the whole profile of the pandemic.
240. Consideration was given to the strategy of protecting the vulnerable. I don't know if SG considered it but it was raised at SPI-M with papers on individual and household isolation on 9th March 2020 and the first papers on shielding on 9th April 2020. In March 2020, it was not known absolutely that the frail and elderly were most vulnerable. This group would be expected to be vulnerable but there could be other groups with special conditions making them vulnerable also. There were reports of severe illness in young

children though few children had been hospitalised but there was no good information on how many had been infected. A lot of this information became available over the summer of 2020.

241. While shielding only the vulnerable and those looking after them is a good theoretical approach, there are severe practical difficulties associated with making sure that the carers are always free of disease. In March 2020 testing was not sufficiently developed to make this a viable proposition.

242. I don't know if SG had a lockdown exit strategy in March 2020 and I don't remember if one had been discussed. Elimination of the virus in Scotland is one possible exit strategy but that was not realistic unless borders were closed.

243. Vaccines were discussed but it was not thought that they would be available until much later. There was also debate as to the feasibility of making such a vaccine as none had previously been developed. Early on - January to May I did not think that a vaccine was likely in 2020. Reports of the ChAdOx vaccine started circulating in meetings I was attending in July 2020 which suggested that a vaccine was likely but it was not until late autumn 2020 that I was sure that vaccination was a strong possibility.

244. Over the autumn of 2020 it became clearer that vaccinations would be available in the UK and that there were 2 vaccines. Even then we did not know if vaccination was going to be effective in the whole population and it was only when we were doing vaccine effect studies in PHS/PHE and within EAVE that I was sure that vaccination was going to be the way out of the pandemic. Even then there was variants to be considered. They were only a theoretical discussion point in March 2020 but reality by September 2020.

245. Many treatments for Covid-19 were discussed but I did not have much contact with any of the trials. The big UK RECOVERY trial was outstanding and by summer/autumn 2020 the clinical management of Covid 19 had improved dramatically. Personally, in March 2020 I was more optimistic that better methods of treating severe covid disease would be discovered than a vaccine developed. COVID 19 was a novel virus and investigations of the way patients in the early months were treated would almost certainly lead to improvements for later patients.

246. I think that both statements, by Professor Neil Ferguson and Professor John Edmunds are reasonable and fairly accurate. Had lockdown started earlier there would

have been fewer deaths in the first wave. Some of those infected in the early weeks may instead have been infected later on in the pandemic when better treatments were available or may not have been infected as vaccine gave them protection. I am not sure about the magnitude of the reduction in deaths but it could certainly have been substantial. John Edmunds' point is also valid as at that time there was no severe pressure on hospitals in the UK. It was likely that there would be enormous pressure in the future. One of the things we learned about the management of the pandemic was that decisions about NPI's had to be taken almost as soon as you thought that they would be necessary as the doubling time was so fast.

b) Continuation of the first lockdown

247. I did not consider Zero COVID to be a realistic possibility. There was discussion of this in SGCAG when case numbers in Scotland got very low and there were days without any deaths. However at this time the strategies in Scotland and England were diverging with a greater reluctance to relax the NPI's in Scotland than in England. Also foreign travel was permitted to certain countries with similar levels of infections.

248. Testing was still not so widespread in the summer of 2020 that you could not be sure that there was not some low level circulation. The genomic data on the cases from summer 2020 suggested that a large proportion of the infections after the summer were as a result of importation of cases into Scotland, though there was some lineages which persisted in the UK throughout the summer.

249. It might have been feasible to have Zero COVID in Scotland but only if the borders – including those with England – were closed. This border could not be closed so Zero COVID in Scotland was not feasible as there would always be Scotland – England travel.

250. Again, I had no direct contact with Scottish Ministers and Government other than when I attended SGCAG, including any deep dives. All of my advice was through SGCAG and the minutes of these meetings and documents from these meetings have been provided to the Inquiry. I think that I attended all of the SGCAG meetings at this time and supported the recommendations.

251. I supported the decision to extend the lockdown from 16 April 2020 for three weeks following a meeting of SGCAG on 14th April. There was not an effective treatment for Covid-19 at this point.

252. I supported the decision to extend the lockdown from 7 May 2020 for three weeks. While the epidemic was declining at that time R was not all that far below 1 and relaxation of the restrictions would lead to an increase in cases. There was not an effective treatment for Covid-19 at this point either.
253. The 11th May 2020 statement by the First Minister was a reasonable position. By this time SG was asking for advice on restrictions that could be raised and the potential impact on case numbers. If the country could get to a position where the cases were as low as possible then there would be more breathing space in hospitals for the next anticipated wave after the summer.
254. I fully supported the SG Framework for Decision-Making as it set out in advance the criteria that would have to be met for various restrictions to be lifted. These were based upon advice from SGCAG and I took part in these discussions. Over the summer 2020 the estimates of R for Scotland were generally below 1 but by the end of the summer holiday in mid-August 2020 it had risen to more than 1. It was certainly an aim of SG to keep the virus under control but with moving to phase 4 of the framework this was not possible. It was correct to warn that some restrictions would need to be in place right up to 2021. Again in April 2020 there was no prospect of a vaccine and no major breakthroughs on treatment, which was not until June 2020.
255. I think the main lesson was that it was very difficult to protect the vulnerable. There were many outbreaks and deaths in care homes despite care homes adopting strong isolation policies. Another thing was that there were many cases of Covid 19 detected among individuals who had recently been discharged from hospital. Many vulnerable individuals, partly due to the nature of their vulnerability are continually in and out of hospital and this exposes them to infections. Finally, vulnerable individuals who successfully shield are extremely isolated which may have had a huge impact on mental health.
256. One thing was that the virus could be controlled with very heavy restrictions on movement and contact. It was a very heavy price to pay to control the virus. The doubling time was about 5 days at the time the first lockdown was announced and this showed that decisions about the control of the virus had to be made very quickly. Also it meant that when restrictions were lifted the epidemic could bounce back very quickly.
257. I thought that in the main compliance was very good. The lockdown did not mean that you could not leave your house and a daily walk was permitted – even

recommended. This was a much better lockdown than that in other European countries where you needed to fill in forms to leave your house.

258. There was a paper by Simon Wood [CR/013 INQ000362004] estimating the numbers of deaths in England and I tried to follow his method using an extended methodology using data from Scotland but simplifying the back calculation aspects. On much later reflection, this simplification introduced a bias. However the main point is unchanged. If there was absolutely no contact among individuals post lockdown there would still be deaths and hospitalisations and new cases post lockdown arising from infections in the 2-4 weeks prior to lockdown. At lockdown R does not go down to zero right away and there is a slow decline. This means that there are new infections occurring after lockdown and some of these will lead to hospitalisations and deaths. Our preliminary estimates were that about 50% of the deaths in the first wave were as a result of infections which were detected post lockdown. In view of the limitations of the preliminary work I did not seek to publish this work in an academic journal and did not have time to revisit it in the intervening period.

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

a) General

259. I think that SG took a very balanced view of how to open up following lockdown and easing restrictions. Advice was given to SG throughout the summer period by SGCAG and I participated in this advice. I did not give any advice directly outside SGCAG. At this stage in the pandemic there was a working partnership between SGCAG and SG with SG putting forward proposed policies and SGCAG providing scientific advice on these. On other occasions SGCAG would be asked for scientific advice on specific topics such as face masks and social distancing, testing and contact tracing.

260. As far as I am concerned the key advice was:

- (1) that testing, tracing, isolation, and support are essential in order to contain transmission;
- (2) children, on the whole did not appear to be getting very symptomatic Covid-19 nor suffering from severe effects of the infection;
- (3) detailed advice on shielding and how it might be managed;

- (4) advice on testing and using rapid and frequent testing to protect vulnerable individuals and those in care homes and hospitals;
- (5) advice on physical distance at social interactions indoors and outdoors and super-spreading;
- (6) advice on relaxing visiting in care homes and day care centres;
- (7) advice on ventilation when meeting in indoor settings.

261. Publication on 21 May 2020 was a very good strategy in the management of the pandemic. SG CAG had a lot of input into this document.
262. Moving to stay safe was appropriate at that time in the pandemic.
263. Over the summer stronger evidence had become available on the use of face masks and this advice was reasonable as all shops started to open up again.
264. Opening schools was one of the goals of the management of the pandemic and was a great step in living with the virus at the end of the summer. It was to be expected that with all the meetings going on around that time and less stringent adherence to meeting indoors that case numbers would begin to rise and not necessarily just among children.
265. I do not think that the EAT out scheme was a SG scheme and I do not think that it was discussed at SG CAG before it was announced. Hotels, restaurants and bars had had a very difficult time during lockdown and opening them up with restrictions on numbers and ventilation was probably necessary. To me, using government money to subsidise eating out by large numbers of the population would likely encourage individuals to go out as the message from UK government was that it was safe to go to eat out. At this time the recommendations of SG were to stay safe which conflicts with the EAT out scheme. While support for the restaurants/bar industry was needed subsidising groups to eat out was not the best way of doing this in my view.
266. As part of my work at PHS, I was running programs to estimate R in Scotland to share with PHS consultants. I was using a similar method to that used by colleagues on SPI-M who were doing the same thing for data from England. I shared these results with Mark Woolhouse and Roger Halliday as we were due to give a presentation on R to journalists at the request of SG. I did not present these data at the press briefing. My recollection of the briefing is that the main presentation was by Roger and Mark and I were there to help answer any questions.

267. At that time the main issues were the community epidemic, which was being controlled by the lockdown, and the epidemic in hospitals and one in care homes. In the two latter settings there was, of necessity, movement of vulnerable individuals within and between hospitals and care homes. With the data available at PHS in March-May 2020 I was reasonably confident about knowing who was in hospital but had less confidence in knowing if someone was in a care home. This information was coming from the test location in the testing data and also from a field in the RAPID data set about where the person was admitted from. Neither of these fields was completely filled in nor validated.
268. In May 2020, SG had the ambition of keeping R below 1 and also having few new cases per day. I think that it was mainly infections which were guiding policy decisions at that time. Deaths in care homes, while catastrophic, did not play much role in the trajectory of the pandemic in care homes – it would be driven by infections among residents and staff.
269. In the summer of 2020 new cases per day were low. This was at a time of relatively limited testing capacity so it is unlikely that all symptomatic individuals got tested. At no time over the summer did I think that Scotland was Covid free, or virtually Covid free. It was very possible for there to be low levels of cases among relatively healthy young people who may have been going abroad on holiday or been in contact with people returning from abroad. These cases would have been unlikely to develop into severe cases requiring medical help, and hence testing.
270. Lessons learnt by me as a result of the experience of this period are that a strong spatial surveillance system was needed within PHS to try and detect local increases in cases very quickly so that local control measures could be introduced.
271. That it was only a matter of time before there was a big wave in the autumn as R had jumped to well above 1 after schools went back. I don't mean to imply that it was schools going back that caused the increase as R had been increasing as restrictions were relaxed over the summer.
272. That adherence to lockdown measures was reasonably good most of the time.
273. That masks were necessary indoors but that there was little risk of transmission outside.
274. That shielding vulnerable was very difficult to achieve.

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

275. I think that all my engagements with these decisions and announcements were through SGCAG. The group discussed these issues but I do not think that any advice was provided specific to the announcements themselves. There was considerable discussion on a paper of proposed measures circulated on 5th October 2020.
276. At the beginning of August 2020 new cases were around 50 per day while by the end of August this had risen to over 100 and by the first week in September they were at 150 per day. It was entirely reasonable that the FM should warn that the planned easing of restrictions would have to be curtailed. By the end of September new cases were at 600 per day and over 1000 per day by the end of October 2020. Much of this was driven by outbreaks in university halls of residence. The increased restrictions were as a result of this big increase in cases, which would lead to an increase in hospitalisations and deaths. To prevent a subsequent increase in hospitalisations and deaths it was necessary to try and curb new infections. At this time NPIs were the only route to achieving this. By this time, summer/ autumn 2020 it was known that indoor areas where individuals socialize were very high risk areas for transmission events, hence the reasons for the curbs and curfews on pubs and restaurants. Asking students not to visit is an attempt to prevent the university hall outbreaks from spilling over into the wider community through asymptomatic transmission. The five tier system was a way of trying to keep the growth in the epidemic under some control by putting restrictions in place in areas with high/cases or high growth, but at the same time letting individuals living in areas not badly affected to have more freedom.
277. I first heard about alpha from SPI-M meetings where increases in cases in south east England were occurring at a time there were partial restrictions. There was a subsequent paper from Neil Ferguson showing that alpha had a transmission advantage over the wild type virus and that it was also more severe in that hospitalisation rate was greater than with wild type. This would have been in late 2020 – At the SPI-M meeting of 22 December there were 4 papers on this issue.
278. I do not recall hearing too much about delta until it came to the UK in Spring 2021. There was a presentation to SPI-M about the delta wave in India in early 2021.

279. Once there were sufficient cases in Scotland and as the lighthouse lab used a test which was based upon the S gene it was possible to estimate severity differences on alpha compared to wild type and alpha compared to delta in Scotland.
280. I do not disagree with Mark. He does not really give reasons for the differences but only suggestions for what might be happening and pointing out the difficulties of making any comparisons. Comparisons of the case fatality rates are fraught as they are influenced by different testing strategies. The per capita covid 19 mortality rates, even adjusting for age group, are also difficult to compare as the overall mortality, in the absence of a pandemic, is different.
281. To be honest, I cannot remember what view I had at that time in relation to a “circuit breaker” or further lockdown in Scotland. While cases were increasing as were hospital admissions the pressure on the health service was not as great in September 2020 as it was in late March 2020 – admissions per day were about half. Cases were rising and the increased restrictions at that time were not having any noticeable effect. There were modelling investigations from a number of groups at SPI-M showing the benefits of a short term lockdown, but I do not recall thinking that this was imperative in September 2020. Also in Scotland there would be school holidays of one week (two weeks in some areas) and this would have an impact in reducing contacts. Also in September much of central Scotland was living under semi-lockdown restrictions in that you could not go to restaurants – except outside – nor leave the local authority area nor meet more than 6 people.
282. Cases and hospitalisations reduced in October and November 2020 so there was no need for a national lockdown based upon the information available at the time. This was just before the effects of the alpha variant were felt.
283. Lessons learnt by me as a result of this period are that it was virtually impossible to keep R below 1 in the autumn and that there would need to be restrictions over the winter.
284. By this time we knew that vaccinations were going to be available and this started much earlier than I had anticipated. Within the EAVE-II programme and within PHS I had not been expected to work on vaccine effect studies until well in to the spring of 2021 but the alpha wave coupled with vaccine uptake meant that these analyses could be carried out much quicker.

285. We knew that variants of Covid-19 were not just a theoretical possibility and that we would have to be wary of new variants in the future.

286. That there were now effective treatments and this meant that an admission to hospital for covid 19 had a very good chance of leading to a successful treatment and recovery. Most of these treatments were not related to ICU so there was reduced pressure on ICU beds.

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

287. Again all my advice to SG was through the SGCAG

288. To my mind, at that time, there was no scientific rationale for permitting freer travel and indoor meeting on Christmas day. This was purely social and an acknowledgement that so many people were likely to 'break the rules' that it was better to just suspend them for the day. I know that a 5 day window around Christmas had been planned and it was going to be disappointing to have to curtail this to 1 day.

289. Level 4 lockdown from the 26th December was absolutely essential at that time as was reducing the 'free window' around Christmas to 1 day. Even though the vaccination campaign was well under way the alpha wave was causing so many infections that a huge burden on hospitals and deaths was likely if action was delayed by a week. The doubling time for the cases at that time about 3-5 days so decisions had to be made very quickly.

290. In retrospect the timing was not ideal and it would have been much better if the promise of a 5 day restriction holiday was not made. Plans for this were drawn up a lot earlier in November when wild type infection was anticipated. Modelling work at SPI-M in late November suggested that a shorter window at Christmas was preferable to a longer period.

291. I have no comment on how the decisions were communicated as I am not competent to provide any advice on this aspect.

292. I do not know when SG decided to impose a lockdown from 4th January 2021. There was a SGCAG meeting on 30th December 2020 when more information about the alpha variant became available. This strongly suggested increased transmissibility and the increased severity relative to the wild type. I had begun preliminary work on the analysis

of the alpha variant within the EAVE-II study in Scotland and have results from 15th January 2021 suggesting increased risk of hospitalisation with the alpha variant.

293. This lockdown decision was entirely correct in my view. Covid 19 hospitalisation had increased steadily from early December 2020 and by the end of December were at a similar level to the peak in April 2020. It was certainly effective and contributed, along with the vaccination of the elderly and NHS staff to the reduction in daily hospitalisations from the 3rd week of January 2021.
294. I do not doubt that there were severe effects from lockdown. There were also severe effects from Covid 19 and increasing evidence that some unfortunate individuals were taking a very long time to recover from their initial infection (long covid). The herd immunity aspect in October 2020 could only have been achieved by immunity from infection and this would undoubtedly have brought hospitalisations and deaths. Also just because the herd immunity threshold has been reached, if it ever was, this does not mean that there will never be anymore outbreaks among the susceptible. There was also the unanswered question, at that time, of reinfection and long term immunity.
295. I think that the decisions to have the second lockdown were not taken lightly and that the preferred route was to manage the infections and the vaccination campaign so that no lockdown was necessary. This may have been achievable with the wild type infection and it looked over the period October/November 2020 that different levels of restrictions might have been successful in keeping R around 1 so that growth of the epidemic was not too fast. SG certainly had its road map for the easing of restrictions and criteria that would help to decide on the level of restrictions in different areas.
296. Managing the pandemic got much trickier with the emergence of the alpha variant with its increased transmissibility and severity that the anticipated benefits of the vaccination campaign were dampened.
297. I think that one of the lessons learned from the first lockdown was that decisions need to be made very quickly and that doing nothing and delaying a decision was effectively making a decision. Another lesson learned was the importance of opening schools as quickly as possible.
298. Again my advice was relayed through SGCAG. During the period January to April I presented papers to SGCAG from the EAVE-II group on the effectiveness of one dose of the vaccine in preventing hospitalisations for severe Covid-19 infection, in preventing

infection but subject to waning, and on the severity of the alpha variant. I also made presentations to SPI-M on the same topics.

299. Completely relaxing the lockdown restrictions at the end of January 2021 would have been a bit rash. Although daily cases had come down from a peak of over 2000 at the beginning of January to just over 1000 at the end of February, vaccine uptake in the 65-79 age group was just over 10% and lower in the under 65 population. This suggested that relaxation of restrictions would likely have been associated with an increase in cases and severe covid infections as occurred in December 2020. So I think that the decision to extend was justified. Though the results from the vaccine studies were very encouraging.
300. Opening schools as soon as possible was a key aim of SG and SGCAG and I was pleased to see them opening up again at the end of February 2021, albeit only for the youngest and oldest. This phased return was part of the SG planning giving a couple of weeks to investigate the impacts of any easing of restrictions. By this time, April 2021, there was strong evidence that the vaccine was providing protection against hospitalisations and deaths. Hospital admissions were falling steadily, as were reported infections in the community. Consequently it was appropriate to lift the stay at home direction and replace it with stay safe and allow all secondary school children back after Easter 2021
301. In my view the purpose of the second lockdown was to save lives and to protect the running of the NHS. In the first lockdown all non-essential admissions were cancelled and ICU beds almost reached capacity. In the second the NHS was not under the same pressure (but would have been had there not been a lockdown) and non-covid critical care was able to proceed, though not at the same levels as in February 2020.
302. The second lockdown achieved this purpose and we emerged from it in April 2021 with a population where those most at risk were largely vaccinated, where cases continued to reduce until the summer and hospitalisations reduced also.
303. The modelling analysis referred to is in the Lancet paper on the interim results from the assessment of the effect of vaccination in Scotland over the Dec 2020 - Feb 2021 period, [CR/014 INQ000362005] This showed that the temporal reduction in hospitalisation was faster in the age groups that had more vaccination. Thus, vaccination was breaking the association between age and severe covid effects. I do not think that I did any further projections but the continuation of the lockdown would drive

cases down to a low level and coupled with increased vaccination would ensure maximum protection of the population at the time of released from lockdown and low case numbers. This would ensure a relatively easy time over the summer assuming nothing else changed. In fact, we got the delta variant.

304. The main lesson learnt for me was that the vaccines were working with the alpha variant. The second was that the hospitalisation marker of an admission within 14 days of a positive test as denoting a severe covid infection was beginning to be out of date. Testing on admission to hospital was universal in some specialities and many incidental infections were picked up where covid was not the main reason for admission. This became a greater problem with omicron.

I. Decisions relating to the period between April 2021 and April 2022

305. Again my advice was given through SGCAG and SPI-M. I presented work on the delta variant in Scotland to SPI-M on 12th May and 2nd June 2021 and also to SGCAG.

306. The relaxation of restriction over the period was consistent with the evidence from the impact of vaccinations which had great and longer lasting protection against severe disease than against infection. With the lifting of restrictions, the case numbers increased but even allowing for the increased severity of delta compared to alpha the peak of hospital admission in July 2021 and August/September 2021 were lower than January 2021 and March/April 2020. A booster campaign was instigated in Autumn 2021 and case numbers and hospitalisations decreased until December 2021 when omicron appeared.

307. It seemed to me that the decisions to relax restrictions and focus on testing and quarantine was appropriate at the time

308. I heard about omicron first at SPI-M meetings in late November 2021 and certainly at a meeting on December 01, 2021. I carried out an analysis of the preliminary Scottish data on Omicron compared to delta and presented this work to SPI-M SGCAG and CMO Scotland at various times in December (8th, 15th, 22nd December). This showed that omicron was about 60% less severe than delta and that booster doses of vaccination covered protection against severe disease caused by omicron.

309. It was clear that omicron was going to lead to a huge number of cases as it is extremely transmissible. The protection from vaccines against infection wanes and even among those who had the autumn 2021 booster. However, vaccination gives very good

protection against severe disease as does immunity conferred by previous infections. Consequently while there was a huge increase in the number of daily cases this did not translate into a huge number of hospitalisations.

310. I think that the strategy not to have substantial restrictions in the face of omicron was based on the analyses from Scotland, England and South Africa showing the omicron did not have the same severity as delta and that vaccines were still effective against omicron infection.

311. There was no need to have a further lockdown. The very preliminary results I presented on 8th December 2021 showed that the severity of omicron was less than delta. This analysis was not based on all that many cases so was not very robust. Later analyses around the 23rd December were robust.

312. The key advice is detailed in paragraphs 305 to 307 above. And is also in [CR/015 – INQ000362006 This was published on 22 December 2022.

313. All of the decisions made by SG up to 22 December 2021 were made before it was absolutely apparent that omicron was not as severe as delta. As far as I can see the scientific rationale for these decisions is that they are measures which have been used in the past to try and curb the spread of covid 19 and they would likely have some impact.

314. Also just because omicron is less severe does not mean that it is without risk and a huge increase in the number of cases would also be associated with an increase in hospitalisations and deaths – just not as many as there would have been with the same increase in delta cases.

315. The scientific rationale for cancelling large events is that they are known to be situations in which infections can be transmitted. This was clear from the football matches in June 2020 and the associated travel to and from them. Also COP26 in Glasgow had an increase in cases following the event, though they may not be directly related. This is the same reason for the nightclubs; by this time it was well known that the virus can be transmitted easily in poorly ventilated indoor areas where many people congregate. I think that all of the late December restrictions were an attempt to limit the numbers of new omicron cases, which although not as severe as previous variants could still have a big effect if very large numbers of individuals were infected.

316. Lessons learnt by me in this period are vaccination was still the most successful way of protecting the vulnerable individuals in the population.

317. Reinfection was now very common even among the vaccinated.
318. In general, the population were learning to live with a new virus.

J. Care homes and social care

319. In the early part of the pandemic from January to March 2020 I was not really aware of the SG strategy with regard to care homes. Once SGCAG was set up I was more informed. I think that the strategy that SG tried to adopt was to ensure that the residents and staff were as well protected as possible. I think that it was recognised very early on that frail individuals living in communal housing would be at much greater risk from the infection and from the effects of an infection than healthy individuals of the same age living in their own homes. I think isolation of care homes was probably the only strategy early on. Unfortunately, this did not work as there was movement of staff from the community to care homes and testing was not adequate nor fast enough. Also, there was of necessity movement of patients from care homes to hospitals and back again when residents required emergency treatment in hospitals.
320. Over the summer of 2020 easing of restrictions with regard to care homes was considered and a balanced view was recommended by SGCAG. There were still dangers associated with relaxation of restrictions but there were also likely harms associated with, for example, not allowing visitors. Once vaccination became available those in care homes were targeted for the first wave of vaccinations. In my view this was a correct decision as it enable less restrictions on care homes in the following period.
321. Apart from the first wave of the pandemic I believe that SG attempted to keep care homes safe. The methods they chose to use were proportionate, based upon scientific principles and reasonable but not 100% effective. During the first wave there were a lot of infections and deaths in care homes. I think that the magnitude of the impact of moving patients out of hospital into community or care homes on the spread of infections was not fully understood at the time. Certainly one focus was on ensuring that there would be sufficient beds and ICU beds in hospital in Scotland for the anticipated large numbers of hospitalisations in the April to May period. Possibly a consequence of this decisions was a much larger epidemic wave in care homes than might have occurred. This is not certain as many care home epidemics were seeded from community (presumably via staff) infections.

322. I was aware about the issues with care homes early on. There were presentations at SPI-M about outbreaks in care homes in April 2020. Also information on nosocomial transmission was presented in April 2020. At this time I worked on PHS data trying to identify discharges from hospital and testing positive. I had presentations of this information to SPI-M and also to the Covid Nosocomial Review Group (CNRG). With the data available to me it was difficult to assess if a patient had been transferred directly from hospital to a care home and also if someone had been admitted directly from a care home. These data are available in SMR01 but that takes 6-8 weeks to come through. The RAPID data for hospital admissions did not always have this information in it.
323. I understood that the risks to the residents in care homes were great as many were frail.
324. I do not know the full data provided to PHS on care homes and social care. I was not formally part of the PHS management of the disease but worked in a supporting role analysing data, setting up surveillance systems and providing intelligence on the pandemic. One issue was that there was no live list of who was in a care home and who was not. There was information in GP records and also from the care homes themselves but not available at PHS, to my knowledge.
325. I am aware that the care home data in RAPID and the testing data was not all that reliable at the beginning of the pandemic. Work was done in this area over the course of the pandemic and these data fields became more reliable. I attended a number of meetings with SG civil servants and other academic groups about the care home issue in Scotland.
326. I think that the statement on the 21 April 2020 is based on reasonable infection control principles. They were also based upon what was known about the virus at that time. Once a person was infected it could take up to 14 days for an infection to develop and requiring isolation of new residents for 14 days plus a negative test is based upon this. Discharges from hospital are problematic as the negative test just means no evidence of an infection at that time. Unlikely though it is, there is the possibility of a false negative. So requiring two negative tests, at least one day apart, reduces this risk and makes it more likely that the person discharge from hospital to a care home is free of infection at the time of discharge.

327. To me the guidance is reasonable but for many care homes I imagine that it would have been very difficult to put into practice 100% of the time.
328. Individuals are in care homes as they are unable to look after themselves and are generally much more frail than individuals of the same age living in their own homes. This puts them at more risk from infectious diseases. To some extent these risks can be minimised but not eliminated completely.
329. Seeking to isolate care homes and increasing hygiene and infection control procedures in care homes was a reasonable thing to do.
330. This was not successful and there were devastating outbreaks in care homes. This would have been associated with virus coming in – possibly from staff or from hospital discharges.
331. What went wrong was that the strategy failed. Anything I say about why it went wrong would just be speculation on my part.
332. If we had rapid lateral flow tests available right at the beginning and testing was carried out frequently then this may have alleviated the situation. If care homes all had adequate isolation facilities and if staff only went to one care home then these would reduce the risk. Testing is unlikely to be available in a future pandemic right at the beginning.

K. Borders

333. A combined UK approach to external borders needed to be adopted. It is no good one nation letting people go to Spain, for example, while another asks its citizens not to, as there is free movement within the UK.
334. SG tried to advise people not to travel to England in Christmas 2021 and also at times in 2020. It was unlikely that this was wholly successful.
335. In the summer of 2020 when infection levels were reasonably low plans were made for regional variation in the restrictions likely over the autumn. This was reasonable if the virus was localised and guidelines for the introduction of the different levels of restrictions were available. Also it meant more liberty in rural areas with little infection but did mean that Glasgow was almost wholly under level 3 restrictions for a long period. To some

extent these localised restrictions were successful but eventually all regions moved to level 4 once the alpha variant became dominant.

336. I think that the strategy of restricting movement between regions in Scotland and from Scotland abroad was necessary.

337. Managing borders is very difficult and balancing out the needs of business (travel and holiday companies, hotels and restaurants) with trying to manage the virus was very difficult. Also variations in the decisions made between the different UK administrations was not all that helpful and it would have been much better to have a unified plan.

L. Covid-19 public health communications

338. I have no strong views on SG strategy for public communication and messaging. By and large, I thought that SG communication was balanced and reasonable and tried to be honest.

339. I played no role in providing advice to SG about its strategy for public communication and messaging. I believe that the most important advice by SG CAG to SG was to be honest and build up trust with the population. Essentially to engage with the population as joint partners in managing the pandemic.

340. Yes, I believe the messages SG promulgated about its approach to the pandemic promoted public confidence. It was not helpful that there were different messages coming from SG and UK government but, on balance, I think the messaging from SG was more realistic.

341. I don't know if there was any guidance or rules imposed on medical and scientific advisors. It was certainly discussed at SG CAG and many members did express their opinion in public, making clear that they were speaking personally. I do not believe that it would have been correct for SG to regulate its advisors.

342. I took the view that I would not speak publicly about any aspect of the pandemic as Strathclyde, my employer, had a contract with PHS. I was not going to speak in case anyone thought I was speaking on behalf of PHS, which I could not. I turned down many invitations for interviews. I did 3 Science Media Centre presentations to explain the results of 3 important publications I was involved in during the pandemic.

343. I don't think reports of breaches in other parts of the UK had any impact on the public confidence in the SG management. Both of these events had a huge impact with regard to the trust in the UK management. Fortunately, most of the Partygate material came out at a time that vaccinations had reduced the impact of the Covid 19.
344. This was very unfortunate and a mistake on the part of Catherine Calderwood. It was resolved very quickly. As a result, it probably had minimal impact.
345. I think that the actions of SNP MP Margaret Ferrier was local to the one person and did not impact of SG.
346. I had forgotten about the First Minister removing her face covering at a wake and only remembered one incident about going into a hairdresser. Both were handled well. I would be surprised if there were not many people who had made an inadvertent slip at some time during the pandemic. The important thing is to acknowledge it, admit responsibility and move on. This contrasted with what happened with breaches in other parts of the UK mention, though Nicola Sturgeon's slip was minor by comparison.
347. I did not pay much attention to SG public health communications and the maintenance of public confidence at all. I thought that it was important that the FM took responsibility all the time. I thought that the communication was balanced and transparent.
348. I guess that establishing more of a public government partnership would be something to try and improve. Communication is not my strong point though.

M. Public health and coronavirus legislation and regulations

349. I don't have a view on SG strategy with regard to legislation, recommendations and guidance. I do not think that I, or SG CAG, provided advice on the use of legislation as this is not a scientific aspect of the pandemic.
350. I did not provide any role in providing advice about this strategy.

N. Key challenges and lessons learned

351. The interviews were all associated with important publications I was involved in during the pandemic. I was responsible for the statistical analysis on all three. The main reason for doing these interviews was to ensure that journalists were able to report on these papers after having any questions answered by the authors.

352. The publications were results coming from the EAVE-II group and showed a forecasting method based upon individual risk characteristics, vaccine protection and severity of the delta variants, reduced severity of omicron variant and a spatial surveillance method developed at PHS.
353. The key theme was using linked health data from Scotland to provide insights to assist in the management of the pandemic.
354. I have not provided any evidence to UK parliament select committees, nor to Scottish Parliament Committees, nor any external reviews.
355. The key issues I consider in the decision making process relating to the management of the pandemic have all been covered above.
356. I suppose the key challenge is that initially the pandemic was a public health issue but from early on in the pandemic it appeared to be managed by SG and not PHS. All of the communication was by SG. This may, indeed, be appropriate in view of the lockdown measures which were taken and their impact over all aspects of life in Scotland.
357. I was reasonable happy with the way in which SGCAG interacted with SG. The decisions made by SG were not totally at odds with the advice from SGCAG and SG appeared to ask SGCAG for its opinion prior to most of the decisions. I appreciate that many of the decisions made by SG would have had non-public health aspects while SGCAG was largely concerned with public health.
358. The data available within PHS and EAVE-II during the pandemic was enviable and very few countries had access to similar granular data. This could be improved. It took some time to set up EAVE-II, even though a similar, much smaller, system had been used in the 2009/10 pandemic. This structure could be improved as part of pandemic preparedness in Scotland to ensure that PHS keeps a live cohort of all residents in Scotland and maintains the ability to link their clinical data over a variety of data sources. Having real time access to the most important GP data would be very beneficial. Also tightening up on the diagnostic accuracy of RAPID and where patients are discharged to would have been very important early on in the pandemic.
359. Not to my knowledge that SGCAG members attended lessons learned exercises undertaken. I don't think I attended any. Probably there should have been a lessons

learned but perhaps the Standing Committee on Pandemics (subsequently the Standing Committee on Pandemic Preparedness or SCoPP) did this and I am not on this new committee.

360. It was great to be involved at this level and I was privileged to be involved on SGSAG as well as CNRG, SPI-M and an MHRA committee. I appreciate that my main contributions to these committee were through my role at PHS, leading to the analyses of EAVE-II data and presentation of results on the state of the pandemic to the committees. In 2020, work on the committee was very intense with advice sought on a wide variety of issues over very short time scales. In 2021 things were a bit easier as there was much more knowledge about the virus and how to live with it. Also the vaccination programme was working well.

361. If asked to serve on such a group again I would but I will be retiring soon and so I am unlikely to be asked again.

362. I don't recall being asked for feedback on my involved in SGCAG. I would gladly give feedback but not if it meant filling in a series of open ended questions. Feedback sessions would be better with the opportunity to discuss the working of the committee with colleagues from the committee.

363. I have not given any evidence to parliamentary committees.

364. Around April/May 2020 it became clear that a lot of individuals were testing positive for the first time not long after they had been discharged from hospital. This meant that the decision to clear the hospitals in preparation for huge number of covid admissions may have inadvertently contributed to increased transmission.

365. So many recommendations are going to come out of this review. The main one for me, based upon my experience as a statistician, is to make sure that the data needed to support management of the pandemic is available before the pandemic starts. This means ensuring that these important surveillance systems, which are based upon individual linked health data, run all the time and form the basis of the surveillance for infections in non-pandemic times. I am totally biased in this respect but with EAVE-II Scotland had a unique and enviable resource and it would be a great pity not to develop it.

366. Personally I did not have any issues with the way that the advisory groups worked. In my view a large number of individuals worked extremely hard over a sustained period

of time. Also there were not any great disagreements. I suppose too many of the same people were involved in the groups. I was on a lot but that was a consequence of my role at PHS and PHS did not have an understudy.

367. I don't have any internal or external reviews, lessons learned exercises or other reports.
368. I don't have any initiatives or activities involving, overseen or responded to by me concerning the making of changes to the role and performance of medical officers or expert advisory groups.
369. I don't have any details of the extent of SG's response to any conclusions or the implementation of any recommendations.
370. I was involved in a large number of research projects, principally through EAVE-II and the PHS research group. [CR-016 – INQ000000]
371. The main findings of the PHS research group related to the severity of the infection, who was getting infected, studies about infection and transmission in health workers, teachers and work on vaccine effect and vaccine safety.
372. The main findings from EAVE-II and its co project Covid Infection in Pregnancy Study (COPS) were concerned with Vaccine effect, Vaccine failures Vaccine safety, Severity of different variants. Impact of Covid 19 on pregnant women, demonstrating the vaccine was safe among pregnant women and investigations of pregnancy outcomes as a result of covid infection.
373. The summary is taken from the abstract of the paper. [CR/007 – **INQ000361998**]
374. The objectives of this study were to identify risk factors for severe coronavirus disease (Covid-19) and to lay the basis for risk stratification based on demographic data and health records. The design was a matched case-control study. Severe Covid-19 was defined as either a positive nucleic acid test for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in the national database followed by entry to a critical care unit or death within 28 days or a death certificate with Covid-19 as underlying cause. Up to 10 controls per case matched for sex, age, and primary care practice were selected from the national population register. For this analysis—based on ascertainment of positive test results up to 6 June 2020, entry to critical care up to 14 June 2020, and

deaths registered up to 14 June 2020—there were 36,948 controls and 4,272 cases, of which 1,894 (44%) were care home residents.

375. The study showed that, along with older age and male sex, severe Covid-19 is strongly associated with past medical history across all age groups. Many comorbidities beyond the risk conditions designated by public health agencies contribute to this. A risk classifier that uses all the information available in health records, rather than only a limited set of conditions, will more accurately discriminate between low-risk and high-risk individuals who may require shielding until the pandemic is over.

376. The summary is taken from the abstract of the paper. [CR/004 - **INQ000361995**]

377. We aimed to create a national dataset of patient-level data in Scotland to identify temporal trends and Covid-19 risk factors, and to develop a novel statistical prediction model to forecast Covid-19-related deaths and hospitalisations during the second wave.

378. We established a surveillance platform to monitor Covid-19 temporal trends using person-level primary care data (including age, sex, socioeconomic status, urban or rural residence, care home residence, and clinical risk factors) linked to data on SARS-CoV-2 RT-PCR tests, hospitalisations, and deaths for all individuals resident in Scotland who were registered with a general practice on Feb 23, 2020. A Cox proportional hazards model was used to estimate the association between clinical risk groups and time to hospitalisation and death. A survival prediction model derived from data from March 1 to June 23, 2020, was created to forecast hospital admissions and deaths from October to December, 2020. We fitted a generalised additive spline model to daily SARS-CoV-2 cases over the previous 10 weeks and used this to create a 28-day forecast of the number of daily cases. The age and risk group pattern of cases in the previous 3 weeks was then used to select a stratified sample of individuals from our cohort who had not previously tested positive, with future cases in each group sampled from a multinomial distribution. We then used their patient characteristics (including age, sex, comorbidities, and socioeconomic status) to predict their probability of hospitalisation or death.

379. The estimated incidence of SARS-CoV-2 infection based on positive tests recorded in this unique data resource has provided forecasts of hospitalisation and death rates for the whole of Scotland. These findings were used by the Scottish Government to inform their response to reduce Covid-19-related morbidity and mortality.

380. I have most of the emails I received and you are welcome to look at all the ones I sent. At the minute I can easily find all the emails I sent from September 2021 onwards but will need to approach the university archives for earlier ones . I do not think that I made any comments in emails over and above the ones you already have.

381. I did not use phone texts/WhatsApp to discuss any pandemic issues. You are welcome to look at anything I wrote on the Slack channel for SGCAG. However, I am informed by the secretariat for the group, that the content was deleted from this SLACK channel once formal advice had been submitted.

382. I did not keep a diary or notes.

383. I did not provide any advice briefings or presentations other than those through SGCAG. I am informed by the group's secretariat that you have them.

384. I did not write any articles. I do not think I did any research about the UK or SG response. I wrote a lot of papers about the pandemic and its effect and vaccinations. These were presented to SPI-M, SGCAG and CNRG and may have influenced the response. I am informed that the Scottish Government have passed meeting papers for SGCAG and the CNRG to the Inquiry and assume that SPI-M will have done the same. I can supply copies of the papers I hold, if required.

385. I have not been at any parliamentary committees in the specified period so there are no transcripts.

Statement of Truth

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

Signed:

Personal Data

Dated: 04 December 2023