Witness Name: PROF MARK WOOLHOUSE

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UK COVID-19 INQUIRY

WITNESS STATEMENT OF PROFESSOR MARK WOOLHOUSE

This statement follows a process of some initial communications under Rule 9 with the UK Covid Inquiry. It addresses questions raised by the Inquiry. It follows on from my Witness Statements for Modules 1, 2 and 2A of the Inquiry (Exhibit MW-7/01 [INQ000182616], Exhibit MW-7/02 [INQ000250231], Exhibit MW-7/03 [INQ000369765]) and – at the Inquiry's request – covers some of the same topics.

Introduction

1. I am Professor of Infectious Disease Epidemiology at the University of Edinburgh. I studied biological sciences at the University of Oxford, University of York and Queen's University (Canada) and then held research fellowships at the University of Zimbabwe, Imperial College London and the University of Oxford, before moving to Edinburgh.

2. I have worked as an academic researcher on infectious diseases and global health since 1985 and have published more than 400 scientific papers.

3. I have previously acted as an advisor to DEFRA, the Food Standards Agency and the World Health Organization. I advised UK government departments on previous infectious disease epidemics including foot-and-mouth disease, swine flu and bovine tuberculosis.

4. I was awarded an OBE in 2002 for services to the control of infectious diseases. I am a Fellow of the Royal Society of Edinburgh, the Academy of Medical Sciences and the African Academy of Sciences.

5. My publications relating to diagnostic testing of infectious diseases have mainly concerned the design of surveillance systems. I was also co-lead author of a 2006 UK Government Foresight study on the detection and monitoring of infectious diseases, a substantial body of work commissioned by the then Chief Scientific Advisor, David King. The study was motivated by a perceived need to strengthen testing systems to meet future risks from infectious disease outbreaks.

6. I was not involved in the development and comparison of diagnostics assays during the pandemic.

7. I did not have hands-on involvement with designing, operating or maintaining testing systems and strategies during the pandemic.

8. My team was not involved with scientific modelling of the development, implementation and evaluation of TTI systems, though I engaged closely with the modelling work that was being done in this area.

9. I have not been involved in any discussions of testing systems and strategies for future pandemics with any of the agencies responsible.

10. Between January 2020 and June 2022 I was a member of the following relevant groups: SPI-M-O; Scottish Government Covid-19 Advisory Group (SGCAG); Scottish Scientific Advisory Board on Testing (SABoT).

11. I joined SPI-M-O on January 24th 2020 at the invitation of the Co-Chair, Professor Graham Medley. During the period of interest, there were over 100 meetings, and I missed few of these. Attendance is recorded in the minutes. Testing and TTI were frequently discussed at these meetings, as the minutes indicate. I contributed to these discussions, but my team was not directly involved with modelling the impact of TTI.

12. I was a member of SGCAG from when it was set up on March 25th 2020, appointed by the then CMO Scotland, Dr Catherine Calderwood. During the period of interest, meetings were held twice weekly or weekly until mid-2021 when the frequency decreased. I understand that a complete record of these has been provided by Scottish Government. I attended the great majority of meetings, missing those held in February and March 2021, but very few others. Attendance is recorded in the minutes. Testing and Test & Protect (T&P, the equivalent of TTI in Scotland) were frequently discussed at these meetings, as the minutes indicate. I contributed to these discussions and was sometimes asked to speak to briefing notes that I had written or co-written. I was sometimes asked to speak to publications or reports on topics relating to testing or T&P. I was often asked to interpret the results of surveillance studies (e.g. REACT or ONS surveys).

13. I was a member of the Scottish Scientific Advisory Board on Testing (SABoT) from mid-April 2020, at the invitation of the Chair, Prof. David Crossman. Meetings were held frequently but irregularly up to the end of 2021. I do not have access to a complete record of these meetings but I believe I attended the majority of SABoT meetings during the period of interest, though not all. Testing and T&P were the main topics discussed at these meetings. I was sometimes asked to speak to briefing notes that I had written or co-written, or to comment on other briefings, reports or publications.

Briefings

14. I wrote or co-wrote four briefings relating to testing and T&P for SGCAG or SABoT. These have all previously been submitted to the Inquiry (details below). They covered how testing contributes to suppressing transmission and other elements of the Covid response, and the role of mass testing. These were technical briefings intended for scientific advisors rather than policy makers or operations teams.

15. One motivation for these briefings was the confusion generated by the exhortation of the WHO Director General on March 16th 2020 to "test, test, test". This statement was made in the context of advocating a TTI-type strategy, but testing also had other important roles to play. I came to realise that the distinctions

between the different roles of testing and their contributions to the pandemic response was not widely understood, including by some scientific advisors.

16. The briefing 'How rapid virus testing contributes to suppressing the transmission of COVID-19' for SGCAG was written by me on April 24th 2020 and updated by me and Jill Pell on May 3rd 2020. The latter version has previously been submitted to the inquiry (Exhibit MW-7/04 [INQ000351956]). The briefings attempted to explain the full range of contributions that testing could make to the Covid response in Scotland and the UK.

17. The briefings pointed out that testing was a useful, sometimes essential, element of some strategies for suppressing transmission, and had several other functions, but it should not be described as a strategy of itself. It is the actions that follow from testing that can protect health.

18. We explained that a headline count of number of tests per day is uninformative of itself. This was an indirect reference to the recently achieved UK government target of 100,000 tests per day. The contribution of, say, clinical diagnosis and testing key workers to pandemic management are very different, and neither is related to TTI. Some important activities, e.g. surveillance, require only hundreds of tests per day; others, e.g. testing carers of vulnerable people, could require millions.

19. In an accompanying table, we summarised key features of testing for the purposes of surveillance, clinical diagnosis, return to work, contact tracing, shielding and self-isolation. We also discussed the necessary scale of testing required for these purposes (in Scotland alone), up to mass testing on a scale of millions per day.

20. We pointed out that, when the purpose of testing was to initiate contact tracing, speed was as important as scale. This is because the value of contact tracing is tightly linked to the length of the delay before an infected contact is told that they need to self-isolate to protect others.

21. The briefing 'Contact tracing and time to target' was written by me and my research team for SGCAG on May 29th 2020. It has previously been submitted to the inquiry (Exhibit MW-7/05 [INQ000351868]). The briefing used modelling to illustrate that

it was going to be difficult to drive down incidence of new cases in Scotland to near-elimination levels purely by ramping up T&P, and then only if there were no further relaxations of social distancing restrictions.

22. A report by the Royal Society of London published on May 27th (Exhibit MW-7/06 [INQ000351836]) had likewise concluded that TTI (in England) could play a significant role in reducing transmission, but was unlikely to be able to bring the R number below one by itself. Similar conclusions were reached by modelling groups in SPI-M-O and elsewhere.

23. I note the caveat that how well the public would comply with requirements to self-report as cases, to identify contacts and to self-isolate were unknowns for much of the pandemic. This made estimates of how effective TTI was, and of how effective it could be, uncertain.

24. That said, even using more optimistic assumptions, this body of evidence suggested there were limits to what could be expected of TTI in managing the Covid pandemic in the UK going forward. Nonetheless, there was pushback from advocates of a 'South Korea-like' response who maintained that TTI was our way out of the pandemic. In my view, stated at the time, this was never realistic.

25. I note that, right across Europe, testing capacity and TTI capabilities were considerably greater – thanks to huge investment in them – in early 2021 than they had been during the first wave, but this did not spare any of those countries from large waves of the alpha variant.

26. In that vein, our May 29th briefing (Exhibit MW-7/05 [INQ000351868]) and the other evidence available in the summer of 2020 were early indications of the impracticality of an elimination strategy for Scotland – and particularly one relying predominantly on T&P – given that Covid-19 was firmly established in the country by then.

27. The briefing 'Covid-19 in Scotland: what next?' was written by me for SABoT on July 14th 2020. It has previously been submitted to the inquiry (Exhibit MW-7/07 [INQ000103391]). The aim of the briefing was to highlight the need to: i) make Test

& Protect as effective as possible; ii) continue with other NPIs at the same time; iii) extend testing to screen for pre-symptomatic infections.

28. There had been discussion within SGCAG and SABoT about the possibility of using the growing testing capacity to screen (i.e. test in the absence of symptoms) for infection in target groups. My July 14th briefing (Exhibit MW-7/07 [INQ000103391]) set out possible priority groups for screening in the community. Suggested top priorities were care-in-the-home workers and informal carers. Purely as a stand-alone intervention this would save lives, but it was also a crucial component of a wider cocooning strategy designed to protect those at greatest risk from Covid – i.e. the elderly, frail and infirm.

29. My July 14th briefing made the point that the great majority of testing that had been done in Scotland to date would have had little effect on reducing transmission. That is because it was targeted at people who should already be self-isolating. The briefing set out the challenges of using the RT-PCR test to bring down the R number.

30. Both those points raised the concern that Scottish Government policy intention of using testing to bring down the R number was not being realised. I believe the underlying problem was that policy-makers (and some advisors) were following the "test, test, test" mantra as a 'way out' of the pandemic without fully understanding what the testing being done was and was not actually achieving.

31. The briefing 'Test on ~~demand~~ [sic] request: citizen engagement and testing system reform' was written by me for SABoT on January 12th 2021. It has previously been submitted to the inquiry (Exhibit MW-7/08 [INQ000220378]). The aim of the briefing was to advise on: i) the need for better case detection; ii) 'test on request'; iii) 'test to release'; and iv) mass testing. I explain each of these further in paragraphs 32-37, 38-43, 50-53 and 623-67 respectively.

32. Covid-19 case detection rates – the ratio of reported cases to (estimates of) the true number – were around 10% during the first wave in the UK. That was far too low for the 'tracing' aspect of TTI to have a significant impact on transmission if only confirmed cases triggered the tracing and isolation of contacts.

33. During the early stages of the pandemic, the public were (sensibly) asked to self-isolate on the basis of symptoms, and their household contacts too. This will have had an effect on transmission, as was indicated by modelling. I note that it is a public-led response, not reliant on any action by the public health agencies other than effective messaging (and, ideally, support for those asked to self-isolate).

34. There has been extensive discussion in the health research literature as to which symptoms or combinations of symptoms are most reliably predictive of having Covid-19. The underlying problem is that there are many other potential causes of symptoms such as a cough or fever, so the false positivity rate is high. The optimal choice of symptoms to use depends very much on whether the aim is to minimise false negatives (the risk-averse approach – "anything that could possibly be Covid" – that inevitably catches many people who do not have Covid but minimises the risk of missing cases) or false positives (the light touch approach – "not if it is more likely to be something else" – that minimises the disruption due to unnecessary self-isolation but increases the risk of missing true cases).

35. The ZOE app allowed members of the public to self-report symptoms. It proved unexpectedly reliable (given the different ways that Covid cases could present) and was fast, often providing the earliest indication of changes in the trajectory of the pandemic. However, this app was only used for disease surveillance purposes.

36. SPI-M-O made and reported estimates of the number of cases in regions of the UK throughout the pandemic. During the summer of 2020, these estimates were always considerably higher (up to ten times higher) than reported numbers of cases because there was little testing of the general population. I believe that the under-reporting of cases was well understood at the time, but I felt that the issue warranted much more attention that it received.

37. In my January 2021 briefing (Exhibit MW-7/08 [INQ000220378]), I reported that, even at that stage of the pandemic, we were (in Scotland) still only detecting roughly 50% of cases. This meant that T&P was still performing well short of its potential.

38. Test-on-request (referred to as test-on-demand in earlier briefings) is a strategy for testing individuals to establish that they are Covid-free prior to undertaking

activities where there is a risk of transmitting infection, especially (but not solely) to vulnerable individuals at high risk from Covid-19, i.e. the elderly, frail and infirm. They are also referred to as 'fit-to' tests.

39. Examples of fit-to tests include:
    a. fit to fly (which became mandatory in 2020, thereby establishing the principle);
    b. fit to visit a care home or to stay with grandparents;
    c. fit to go to work.

40. There was a legitimate concern about potential false positive test results leading to workers – especially key workers – being unable to work when they were, in fact, fit to do so. Indeed, when the prevalence of infection is low it is entirely possible for the great majority of positive test results to be false positives (technically referred to as low positive predictive value). In practice, the specificity (the likelihood of a false positive result from an uninfected individual) of RT-PCR was estimated at between 0.8% and 4% in the UK – a figure high enough to cause some disruption. It is a moot point whether this disruption would be greater than the consequences of missing genuine Covid cases and then having to deal with the consequence of a subsequent outbreak. An obvious solution is to treat the initial test result as provisional and do a confirmatory test 2-3 days later, thus minimising any disruption.

41. There is also a legitimate concern about potential false negatives encouraging people to carry out activities as if they were safe to do so when in fact they were not. The obvious solution is to test regularly or, for one-off events, to test on multiple occasions in the run-up to the planned activity.

42. I note that fit-to testing/test-on-request was a crucial element of the Covid safety measures that were so effective in a variety of settings, from health care to professional sports. The key was to introduce regular testing – and, where necessary, self-isolation – alongside whatever hygiene, ventilation and physical distancing measures were practicable. In my view that approach could have been extended much more widely, greatly reducing any need for social distancing.

43. I note that fit-to testing/test-on-request is a crucial element of the strategy of cocooning vulnerable individuals by a combination of Covid safety measures and regular screening of their contacts. This would have allowed a switch from shielding by self-isolation (which was undesirable and, in many cases, impractical) to having a restricted number of safe contacts. Personal experience tells me that this approach was both feasible and effective.

44. In her Witness Statement to the Inquiry (Exhibit MW-7/09 [INQ000309529), Dame Angela McLean – Deputy CSO in 2020 – commented that she felt "there were a number of operational issues and complexities that needed to be considered by decision-makers" before implementing fit-to-work testing for care home workers, implying that logistic challenges may have dissuaded government from adopting the approach as a means to better protect care home residents.

45. That comment is valid of itself. But 'operational issues' can be addressed given the will to do so. This is a topic I discussed with Paul Kellam – virologist and member of SAGE – in early April 2020. As I stated in an e-mail to Ben Warner – Downing Street advisor – on April 28th 2020 (Exhibit MW-7/10 [INQ000317536]), "we need to raise our game". I meant by this that, whatever the logistic or operational barriers to fit-to testing of care home workers might be, government should be working hard to overcome them.

46. I feel that the then Deputy CSO's remarks were symptomatic of a lack of ambition for testing that pervaded the entire scientific advisory system throughout 2020 and 2021. I came up against it on multiple occasions. If we had been more ambitious, many lives would have been saved and the worst harms of lockdowns avoided.

47. The UK government's announcement of the Moonshot testing programme in September 2020 was a welcome statement of ambition for testing. However, the idea was – as far as I can tell – never endorsed by SAGE. I understand that they were skeptical about the scale and costs.

48. In the event, the ambitions of the Moonshot programme were realized but only once lateral flow tests became available (LFTs are a much more suitable technology for mass testing than RT-PCR). Even then, community-wide roll-out (as free tests) did not happen until April 2021. I am not aware that SAGE expressed

any support for whole-community mass testing before April 2021 (though they did support targeted use of LFTs).

49. In my view, it would have been better had SAGE given its full backing to the concept of the Moonshot programme and focused on solving the challenges rather than merely pointing them out. If they had, then mass self-testing might have been deployed more quickly and reduced the need for social distancing measures in late 2020 and early 2021, quite possibly making the January 2021 lockdown unnecessary.

50. Test-to-release is a strategy to minimise the disruption caused by people who have been required or advised to self-isolate but do not in fact have Covid (false positives). Test-to-release can be used for suspected cases, the contacts of confirmed or suspected cases, and those asked to quarantine.

51. In January 2021 test-to-release was available for suspected cases but not for the contacts of confirmed or suspected cases. This was despite data from the REACT survey the previous month indicating that 98% of contacts of a suspected case did not have Covid and 92% of contacts of a confirmed case did not have Covid. A different study indicated that over 80% of household contacts (one of the highest risk categories) did not have Covid.

52. Test-to-release was made available to quarantining travellers, but at that time this was partial release (self-isolate at home) and they had to pay for the test(s).

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

54. I note that the biggest practical barrier to widespread use of test-on-request and test-to-release before November 2020 was lack of access to sufficient numbers of RT-PCT tests (LFTs not being in use at that stage). The 100,000 target set in April/May fell very far short of what was required at the time, and capacity only grew slowly over the summer (when possibly the falling numbers of cases caused

complacency). That said, it was always going to be difficult and expensive to scale up RT-PCR testing to the required extent.

55. The NHS app was designed to enable identification and notification of contacts, essentially automated contact tracing. This was a welcome addition to the top-down, labour-intensive approach to contact tracing by the public health agencies.

56. Uptake of the NHS app never reached the levels believed to be necessary to control Covid, but it had the potential to be considerably more effective than it was; the impact of contact tracing apps rises rapidly with increased uptake, doubling uptake should more than double the number of cases prevented.

57. Even so, one study estimated that use of the NHS app averted several hundred thousand cases in England in the last 3 months of 2020, despite it being used by just 28% of the population. This may have been one reason why the November 2020 lockdown was more successful than some advisors had predicted.

58. The "pingdemic" of the summer of 2021 – where hundreds of thousands of people were identified by the NHS app as contacts needing to self-isolate – is thought to have driven a "massive" fall in transmission rates in late July 2021. I have heard it described as 'more effective than lockdown'.

59. This led to another pingdemic being proposed to tackle the Omicron wave in late 2021. In the event, mass self-testing was an effective alternative.

60. SPI-M-O modelling examined the likely impact of TTI and the factors that influenced its effectiveness on multiple occasions. However, not all the models used (through SAGE) to inform policy-makers incorporated TTI, especially in the early stages of the pandemic. They did, however, generally incorporate the self-isolation of cases and sometimes households.

61. My recollection is that at critical times – for example, the build up to the November 2020 lockdown in England – SPI-M-O and SAGE advice was much more to do with strengthening social distancing measures to bring Covid back under control than achieving this by strengthening TTI through improved case finding, contact tracing or adherence to self-isolation.

62. Mass testing is a strategy for screening an entire population. Screening (i.e. testing in the absence of symptoms) has the important advantage that it can, in principle, detect asymptomatic and pre-symptomatic infections as well as symptomatic infections.

63. The case for mass testing as a potentially effective countermeasure is directly related to the main reason why TTI – however well implemented – was never likely to be a solution in its own right. This is because the mainstay of TTI was the testing of suspect cases identified by symptoms. As a Covid-19 case is infectious in the pre-symptomatic phase (and some infections are entirely asymptomatic), this approach can only reduce transmission so far. If cases not (yet) showing symptoms are to be identified then that requires screening, i.e. testing to pick up infection in the absence of symptoms.

64. I note that extent of infectiousness in the absence of symptoms differed between SARS-CoV-2 and the original SARS coronavirus. For the latter, most of the infectiousness occurred while the case was symptomatic. This made control by TTI much easier to achieve and largely accounts for the success of the international effort to prevent a SARS pandemic, without a mass vaccination programme or resorting to lockdowns.

65. An effective mass testing device must be cheap, easy to use, quick and accurate. RT-PCR fulfils only the last of these criteria. LFTs fulfil the first three criteria, but there were initial concerns about their accuracy.

66. Those concerns were understandable, but they turned out to be misplaced. A report published in November 2020 concluded that LTFs have 95% sensitivity for people with high viral loads (i.e. when most likely to be infectious) and 99.7% specificity (meaning there are very few false positives). The UK Health Security Agency later concluded that "lateral flow devices are effective at finding people with high viral loads who are most infectious and most likely to transmit the virus to others". Despite this evidence, it was not until well into 2021 that the need to confirm a positive LFT with a RT-PCR test was dropped.

67. I note that the outcry from scientists and scientific advisors when free lateral flow tests were withdrawn in February 2022 was considerably louder than the calls for

their introduction in the first place, suggesting that attitudes had changed in the light of practical experience.

68. In hindsight, I feel that TTI suffered from 'the perfect being the enemy of the good'. That it was not a complete solution by itself in its 2020 form (using RT-PCR and top-down implementation by the public health agencies) did not mean it couldn't make a valuable contribution to controlling Covid-19. The advisory system seemed to prefer solutions that were simpler to explain and far easier to deliver – such as lockdown. Maximizing the effectiveness of TTI takes considerably more effort and investment – from government and from the public health agencies – than imposing a lockdown. It also takes more time and so needs to be planned for. Good forward planning in the midst of a pandemic in turn demands realistic assessment of future needs – something that was not done well by any of the UK administrations in 2020.

69. Additional effort and investment required to deliver more effective TTI would have enabled at least some of the harms from social distancing – such as the harms of closing schools – to be avoided. That argument holds even if TTI doesn't negate the need for social distancing measures entirely. One way to express this is that more effective TTI increases the 'R budget', enabling greater relaxations of social distancing measures than would otherwise be advisable.

70. TTI in the UK was greatly hampered by poor case finding. Only about 10% of Covid cases were detected in in the first wave, and the detection rate never got much above 50%. This greatly reduced the effectiveness of TTI.

71. The utility of contact tracing is highly dependent on the time course of an infection (appearance of symptoms, incubation period, latent period, infectious period and pre-clinical infectious period). Data from pre-planned studies of these characteristics early on in a pandemic should be used to generate estimates of how effective contact tracing is expected to be in reducing transmission rates. This will calibrate expectations and justify the level of investment made.

72. The marginal impact of the more labour-intensive elements of a top-down, public health agency-led contact tracing programme may be modest. For Covid-19 in the UK, it was usually the case that more than half of contacts ever identified

came from the same household. Those can be addressed by well-publicized household-level isolation policies, without the need for formal contact tracing.

73. TTI in the UK was also hampered by imperfect adherence to self-isolation, which could be improved by providing better support to those asked to self-isolate and by making self-isolation requirements more proportionate. The risk of those identified as contacts of cases (by whatever means) was consistently low (see paragraph 51); one in twenty would be a typical estimate. In other words, the great majority of self-isolation was unnecessary. More effort to confirm contacts as uninfected – e.g. by daily testing – would reduce unnecessary self-isolation and potentially improve compliance too.

74. Making the self-isolation requirement unnecessarily onerous (e.g. far longer than the typical infectious period) is likely to have reduced compliance, with a net reduction in the effectiveness of self-isolation in reducing transmission. Again, such a highly risk-averse approach is appropriate if the goal is elimination but is much harder to justify if we are 'living with the virus'.

75. Household-level isolation policies are problematic when they place vulnerable household members at risk. In such situations, alternative accommodation may be needed for the case. Where the case is a carer, alternative caring arrangements will be needed. Pandemic planning must address these needs.

76. Switching to mass self-testing in late 2021 required a marked change in attitudes to case reporting from the public health agencies. It is understandable that there is an instinct to consider a pandemic threat a 'notifiable' disease, meaning every case should be reported to the authorities. And there is no doubt that not all self-test results will be reported, which was a concern during Covid. But, in my view, the advantages of self-testing as an effective intervention greatly outweigh that disadvantage.

77. I am concerned that one factor that delayed the roll-out of mass testing in 2020-21 was that public health officials were reluctant to devolve so much control of the pandemic response. Mass self-testing transfers a lot of the onus for managing the pandemic from the state to the public. The way the state behaves in this scenario will still be vital, but it will be different from the top-down approach that was adopted

during the first 2 years of Covid. Future Government planning will need to reflect that.

Testing in Scotland

78. Prior to the creation of SGCAG I had advised on the importance of surveillance, case detection and contact tracing in my briefings to the CMO Scotland from January 21st onwards (Exhibit MW-7/11 [INQ000103367]), but we did not discuss the mechanics of diagnostics and testing in any great detail at the time.

79. I was aware of the importance of community surveillance for infection from experience of and knowledge of previous epidemics including swine flu and Ebola. I believed that this was widely understood; it had been discussed in depth in a Foresight report on infectious diseases I co-authored in 2006.

80. The Foresight report presaged the need for "cheap, quick, easy-to-use, over-the-counter products, perhaps resembling today's home pregnancy test kits", a close description of the lateral flow tests (LFTs) that were used to control Covid-19 in the winter of 2021-22.

81. As an infectious disease epidemiologist, I have held a long-standing frustration that diagnostics and surveillance have received relatively little attention (compared with, for example, therapeutics and vaccines) from the health research and development community. The Foresight study was an attempt to change this but, at best, had only a modest impact on attitudes.

82. So I was disappointed but not surprised that more effort was not made to improve diagnostic capacity in early 2020. In my view, the decision to ramp up testing in the UK did not need to wait, and should not have waited, until April.

83. Disease surveillance is formally defined as an ongoing process that involves the systematic collection, analysis, interpretation, and dissemination of information regarding the occurrence of disease(s) in defined populations for public health action to reduce morbidity and mortality.

84. Surveillance is a key component of any pandemic response. Without it, we are flying blind. This has been well understood by experts in public health since the

discipline was formerly recognised over 100 years ago. Routine surveillance for respiratory and other infections is carried out by the public health agencies, and this is valuable. The challenge is to identify ways to ramp up surveillance efforts quickly and dramatically – perhaps by a 100-fold or more – if required in an emergency. This should not be difficult in principle, but it requires the systems to be in place in advance, including the capacity to source/produce and then deploy suitable diagnostics tests rapidly and at scale. In my view, that should be a key component of future pandemic preparedness planning.

85. In the period before the March 2020 lockdown, we did not have information on the extent the epidemic had been seeded in the UK in the second half of February. Subsequent genome sequencing studies demonstrated that the sheer volume of imported cases gave the epidemic a head start and brought it forward by several weeks. Since this was not known at the time, most advisors – myself included – thought we had more time than we did. Better surveillance, coupled with genomic studies, would have facilitated better advice and better decision making during this crucial period.

86. Our poor situational awareness in February 2020 – directly resulting from the absence on an effective disease surveillance system – meant that decisions about countermeasures were taken in haste. This includes the decision to go into lockdown in March 2020. The best way to avoid lockdown is to intervene early: earlier action can be less drastic action. With hindsight, more moderate interventions introduced three weeks earlier could have negated the need for full lockdown, with schools remaining open, and many workplaces too. I believe that would have been much more likely to happen (and I would certainly have advised it more strongly than I did) if we had a better understanding of the number of cases and their rate of increase at the time. That kind of information was routinely provided by ONS and REACT surveys from the second half of 2020 – but we needed to have had such surveillance systems in place in February 2020.

87. I recognised the need for contact tracing from the outset of the pandemic, reflecting that Covid was in many respects similar to SARS. I included it in my January 26th briefing to CMO Scotland (Exhibit MW-7/12 [INQ000103354]). Nonetheless, I did not think that case detection and isolation (as it was conceived in 2020) would be

sufficient to bring the epidemic under control by itself. This view was subsequently supported by a report from the Royal Society published in May 2020 (Exhibit MW-7/06 [INQ000351836]). However, some countries (e.g. South Korea, Taiwan and Japan) did manage to contain Covid in 2020 without resorting to national lockdowns. Contact tracing made a substantial contribution to those outcomes.

88. I have not seen an assessment of the performance of Scotland's Test & Protect (T&P) scheme. I think that a detailed review would be helpful given the large investment in effort and resources. T&P had the potential to make a significant contribution to the pandemic response in Scotland, but I cannot say how much of this potential was actually delivered.

89. The World Health Organization's definition of a 'contact' for Covid-19 was initially being within 2 metres distance for more than 15 minutes. This binary classification ignored highly relevant contextual information such as whether the contact indoors or outdoors or whether or not masks worn. Treating all WHO-defined contacts as equally likely to result in transmission is a gross oversimplification.

90. The risk of an adverse outcomes from a contact, i.e. transmission of infection leading to a severe case, is even more heterogenous. Using that metric some contacts are literally millions of times riskier than others.

91. The realisation that Covid could be transmitted in the absence of symptoms was pivotal. In this respect, Covid was less like SARS and more like influenza, implying that it might not be possible contain an epidemic using case detection and isolation alone because it is too difficult to detect cases in the first place. This is an important reason why social distancing is the intervention of choice for influenza, and the same rationale came to be used to justify social distancing for Covid. This happened despite the knowledge that social distancing would have to be much more severe if we did not implement other measures to reduce transmission at the same time. This is because the R number for Covid was considerably higher than for influenza.

92. With these considerations in mind, I quickly came to advocate mass screening, i.e. the testing of large numbers of people in the absence of clinical symptoms. Mass

screening linked to self-isolation would reduce, perhaps even remove, any need for social distancing.

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

94. Mass testing was eventually rolled out in the form of free lateral flow tests made available in Scotland in April 2021. I regret that this was not done sooner, given that LFTs had been piloted in Liverpool in November 2020. If it had been rolled out immediately after the Liverpool trial then that could have obviated the need for the January 2021 lockdown.

95. On June 11th 2020 I wrote to SGCAG Andrew Morris and CMO Gregor Smith (Exhibit MW-7/13 [INQ000103476]). In that e-mail I argued – in line with my earlier advice – that Scotland needed far more ambitious targets for testing capacity, suggesting that these be scaled up by at least a factor of 10 with the ultimate aim of allowing regular testing of the bulk of the population. The 10-fold increase was not achieved in 2020 but I accept that that was always going to be extremely difficult, and expensive, to do using RT-PCR tests. The lateral flow tests (LFTs) that were piloted in England in November 2020 were a game-changer, and made mass testing a realistic possibility.

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

97. The mass self-testing (using LFTs) appears to have been more effective than the top-down approach (using RT-PCR) deployed earlier in the pandemic, particularly during the omicron wave. I note that in late 2021/early 2022 uptake of free self-

testing was high, with 80% of the Scottish population reporting testing once per week and 50% multiple times per week (Exhibit MW-7/14 [INQ000369763]). If people acted on their test results – and, if not, why test in the first place? – then this would have had a major impact on the course of the omicron wave.

98. I do not understand why lateral flow tests – an established technology – took so long to be developed and rolled out at a scale. I note that the UK government's 'Moonshot' testing programme was announced in August 2020 and LFTs were piloted that November but, even then, the initial roll-out of mass testing had to wait until the following April.

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

100. The potential of mass testing to accelerate the exit from lockdown and prevent future waves was discussed by SGCAG on several occasions from mid-2020. I do not know whether or not ministers were aware of those discussions.

101. TTI relies on cases self-reporting. Towards the end of 2020, I became concerned about the disparity between reported Covid cases in Scotland and estimates from ONS surveillance. The latter suggested that roughly half of cases in Scotland were being missed, and it seemed reasonable to doubt that these cases were self-isolating or triggering contact tracing. Given the importance of self-isolation, I likened this to fighting the epidemic with one hand behind our back. Finding these cases and thereby triggering self-isolation would have helped reduce the transmission rate and so saved lives and reduced the need for social distancing.

102. Scottish Government put great weight on a WHO threshold of fewer than 5% positive test results indicating that an epidemic was under control. 5% positivity

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

103. Wastewater testing was used to detect the presence of the virus, particularly during periods when there were few positive tests. This is consistent with its established use as check on the elimination of infection, e.g. for polio virus. Wastewater testing was not designed to reduce transmission but it has proved a valuable surveillance tool.

Lessons learned and Recommendations

104. I am asked to give my views as to lessons learned of relevance to TTI and any recommendations for further changes. These are provided in bullet point form below:

i. Diagnostics remains the poor cousin of medical technologies. The research and development (R&D) community needs to give diagnostic development as much attention as it gives to vaccines and therapeutics.

ii. The UK needs a standing capacity to develop, deploy and (crucially) scale up diagnostic testing capacity far more quickly than was done in 2020. Future pandemic planning should prioritise these capabilities.

iii. Different diagnostic testing technologies have their strengths and weaknesses. These need to be clearly communicated to decision-makers so that they understand what capability is being delivered by the tests.

iv. Studies to assess and monitor diagnostic test accuracy at the earliest feasible stage should be built into pandemic response planning.

v. Data on the time course of a typical infection (clinical symptoms, incubation period, latent period, infectious period, pre-clinical infectious period, transmission route) are needed as early as possible.

vi. Such data provide essential information for determining what is (and what is not) a ‘contact’, and so calibrates the algorithms used in contact tracing (whether manual or automated).

vii. These data can also be used to generate estimates of how effective contact tracing is expected to be in reducing transmission rates. This will manage expectations and justify the level of investment made.

viii. The way TTI is implemented must be aligned with wider strategy. If the aim is elimination then there is some justification for a highly risk-averse approach. If it is anticipated that the infection will become endemic (as, entirely predictably, did Covid-19) then the approach must be proportionate and sustainable.

ix. RT-PCR testing is slow, not least because of the need to transport specimens to a central laboratory. Large-scale deployment of drones could decrease transport times significantly.

x. Testing and Covid safety measures kept workplaces (from hospitals to professional soccer clubs) operating even through some of the worst phases of the pandemic. This approach should be extended as far as practicable in future epidemics.

xi. Even partially effective TTI reduces the need for social distancing, so is potentially worth investing in without necessarily being a complete solution.

xii. TTI in the UK for most of 2020-21 was significantly hampered by poor case finding and imperfect adherence to self-isolation.

xiii. TTI implemented in a top-down fashion is an essential tool for high-consequence outbreaks. This was the kind of event that public health agencies had planned for and they implemented TTI accordingly in 2020.

xiv. However, top-down TTI is less effective if the number of cases is high because of the challenge of scaling up, so it is less well suited to a large-scale epidemic than to a localized outbreak. This weakness was recognised but that recognition was not acted upon by changing the way TTI was implemented until well into 2021 when there was a switch a more public-led approach.

xv. Mass self-testing can be effective whatever the number of cases, provided suitable tests (e.g. LFTs) the required volume can be made available.

xvi. Self-administered lateral flow tests are much better suited to mass testing than laboratory-based RT-PCR tests.

xvii. TTI implemented by the public – where contact tracing is automated (with clear guidelines plus apps) and self-testing is available – has a major advantage: it is self-scaling, and so a better approach for large-scale epidemics.

xviii. Mass testing – self-testing using LFTs – was one of the most successful interventions for Covid-19.

xix. As a general rule, public-led responses are far more easily scalable than top-down approaches led by government agencies.

xx. This distinction matters when making recommendations for the future; the perceived limitations of top-down models of TTI are not a reason to reject public-led models. The two must not be parceled together and accepted or rejected as if they are the same thing.

xxi. A lack of ambition delayed the deployment of mass testing in the UK during the Covid-19 pandemic.

xxii. We should plan to roll out mass testing much more quickly in future pandemics (well within 100 days).

xxiii. We should plan to roll out contact tracing apps far more quickly (within weeks) in future pandemics – that requires a pre-existing generic platform that can be tuned to the characteristics of the emergency but is otherwise ready to go.

xxiv. During Covid, the implementation – and therefore the effectiveness – of TTI was patchy across society, exacerbating pre-existing health and socioeconomic inequalities.

xxv. Considerable government effort is needed to ensure that the availability, acceptability and take-up of testing tools, tracing tools and self-isolation support is equitable and does not leave any group behind.

105. In the final quarter of 2020 SAGE was not supportive of the UK government's proposed mass testing initiative – the Moonshot programme. Yet there were strong arguments in favour of mass testing at the time, subsequently validated by its success during the omicron wave. If we had invested in mass testing earlier, the

January 2021 lockdown could have been largely avoided. I believe this would have been much more likely to happen had SAGE taken a different stance on the matter.

106. In the future, the UK needs a science advisory system that does not become wedded to a single response measure – in the case of Covid-19 a hugely damaging one, lockdown – and is more open to alternative approaches, presents the government with options, and is able to work with government not against it.

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.

Personal Data

Signed: ____ ______________________________

Dated: _____________14/04/2025______________________