

Witness Name: Professor Ian Hall

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**COVID-19 INQUIRY – MODULE 7**

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**WITNESS STATEMENT OF PROFESSOR IAN HALL**

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I, **PROFESSOR IAN HALL**, of the Department of Mathematics and School of Health Sciences at the University of Manchester, Oxford Rd, Manchester M13 9PL, will say as follows:

### **Section 1: Introduction**

- 1.1. I make this statement pursuant to the UK Covid-19 Inquiry's Rule 9 request of 31 October 2024 ('**The Rule 9**').
- 1.2. I previously submitted a response to the Inquiry's Rule 9 Questionnaire on 19 December 2023 for Module 2 ('**The Rule 9 Questionnaire Response**') [IH-7/01 - INQ000056544] and a response to the Inquiry's Rule 9 request dated 12 April 2023 on 20 July 2023 ('**Module 2 Witness Statement**') [IH-7/02 - INQ000223283].
- 1.3. Matters I set out within this statement are within my own knowledge save for where I state otherwise. Where I refer to facts not within my own knowledge, I will provide the source for those facts. The contents of this statement are, to the best of my knowledge and belief, both true and correct.
- 1.4. This statement addresses my role and involvement in the approach to testing, tracing and isolation ('**TTI**') adopted during the pandemic in England, Wales, Scotland and Northern Ireland from 1 January 2020 until 28 June 2022. This statement has been prepared based on my personal recollections, and the personal views expressed are my own.

#### *Qualifications and Career History*

- 1.5. I hold the following professional qualifications:
  - a) Masters degree in Pure Mathematics and Applied Mathematics (Hons) from the University of Exeter (1999); and
  - b) PhD in Applied Mathematics from the University of Exeter (2003).
- 1.6. I am currently employed by The University of Manchester as a Professor of Mathematical Epidemiology and Statistics in the Department of Mathematics and School of Health Sciences. I split my time in each department 80/20 respectively.
- 1.7. I am not currently employed by UK Health Security Agency ('**UKHSA**'), (formerly Public Health England ('**PHE**')), though I have held the position of Honorary

Senior Principal Modeller in Emergency Preparedness since 2019 and the University of Manchester received grant income for my time on specific projects (up to 20% FTE). We currently have no live projects funded by UKHSA, however collaborations are ongoing.

- 1.8. I previously held the following positions:
- a) Head of the Statistics and Probability Group at the University of Manchester from 2019 to 2022, which was a purely administrative function;
  - b) Reader in Mathematical Statistics at the University of Manchester from 2018 to 2021;
  - c) Principal Modeller in Emergency Preparedness (20% FTE) at Public Health England from 2018 to 2019;
  - d) Scientific Programme Leader and Principal Modeller in Emergency Preparedness (100% FTE) at Public Health England from 2006 to 2017; and
  - e) Senior Modeller in Emergency Preparedness (100% FTE) at Public Health England from 2002 to 2006.

*Professional expertise*

- 1.9. My primary areas of expertise are mathematical epidemiology, statistics, and modelling in public health, epidemiology, and adult social care.
- 1.10. In 2024, I was awarded an OBE for my services to public health, epidemiology, and adult social care, particularly during the Covid-19 Pandemic.
- 1.11. In my day-to-day professional work, I develop mathematical and statistical models of infectious disease to learn how to better control them.
- 1.12. During the pandemic I was academic chair of the Social Care Working Group ('**SCWG**') and a participant in SAGE and some of its other subgroups (listed below in more detail). I also attended the UKHSA Joint Modelling Team and the Ministry of Justice National Review Panel on regular occasions.
- 1.13. As co-lead for the University of Manchester Mathematical Epidemiology Group, I coordinated post-doctoral and PhD student efforts to support SAGE and subgroup requests. Specifically relevant to publications below, I was a co-supervisor of Martyn Fyles during his PhD and supervised Carl Whitfield and

Jingsi Xu as named researchers on related externally-funded work, who are co-authors of work cited below.

1.14. I was a named co-investigator on a number of research projects tangentially or directly related to supporting model development on the effectiveness of testing technology including:

- a) 'Gig workers: unsung heroes and a strategic role in the UK national response to the COVID-19 pandemic'<sup>1</sup>, Medical Research Council ('MRC') [IH-7/03 – INQ000536497];
- b) 'PROTECT', the national core study on transmission, led by the Health and Safety Executive [IH-7/04 – INQ000536498];
- c) 'Epidemic Modelling and Statistical Support for Policy: Sub-Populations and Long-Term Planning', Engineering & Physical Sciences Research Council ('EPSRC') [IH-7/05 – INQ000536499];
- d) 'TRACK: Transport Risk Assessment for COVID Knowledge', EPSRC [IH-7/06 – INQ000536500]; and
- e) 'Joint Universities Pandemic and Epidemiological Research ('JUNIPER')', MRC [IH-7/07 – INQ000536501].

*Major publications relevant to TTI*

1.15. I set out below the publications I consider directly relevant to TTI:

- a) '**Using a household-structured branching process to analyse contact tracing in the SARS-CoV-2 pandemic**', Fyles Martyn, Fearon Elizabeth, Overton Christopher, University of Manchester COVID-19 Modelling Group, Wingfield Tom, Medley Graham F., Hall Ian, Pellis Lorenzo and House Thomas, 31 May 2021. [IH-7/08 – INQ000536502];

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<sup>1</sup> The link to the research project can be found here:  
<https://research.manchester.ac.uk/en/projects/gig-workers-unsung-heroes-and-a-strategic-role-in-the-uk-national>

- b) **'On the use of LFA tests in contact tracing: preliminary findings'**, Fearon, E., Fyles, M., House, T., Pellis, L., Hall, I., Jay, C., Crowther, P., Stage, HB., Das, R., Medley, G., Klepac, P., Hollingsworth, D., Davis, EL., Lucas, T. C. D., Wingfield, T., Yardley, L., Pi, L., & Blake, J, 15 November 2020. [IH-7/09 – INQ000074954];
- c) **'SARS-CoV-2 antigen testing: weighing the false positives against the costs of failing to control transmission'**, Fearon, Elizabeth; Buchan, Iain E; Das, Rajenki; Davis, Emma L; Fyles, Martyn; Hall, Ian; Hollingsworth, T Deirdre; House, Thomas; Jay, Caroline; Medley, Graham F, 14 June 2021. [IH-7/10 – INQ000536504];
- d) **'COVID-19 testing in outbreak-free care homes: what are the public health benefits?'**, Green, R; Tulloch, JSP; Tunnah, C; Coffey, E; Lawrenson, K; Fox, A; Mason, J; Barnett, R; Constantine, A; Shepherd, W, 12 January 2021. [IH-7/11 – INQ000536505];
- e) **'Modelling the impact of non-pharmaceutical interventions on workplace transmission of SARS-CoV-2 in the home-delivery sector'**, Whitfield CA, van Tongeren M, Han Y, Wei H, Daniels S, Regan M, et al, 5 May 2023. [IH-7/12 – INQ000536506];
- f) **'Simplified within-host and Dose–response Models of SARS-CoV-2'**, Jingsi Xu, Jonathan Carruthers, Thomas Finnie, Ian Hall, 20 March 2023. [IH-7/13 – INQ000536507];
- g) **'Modelling the impact of repeat asymptomatic testing policies for staff on SARS-CoV-2 transmission potential'**, Carl A. Whitfield, Ian Hall, 12 November 2022. [IH-7/14 – INQ000536508];
- h) **'Inferring the relationship between viral load and infectiousness in SARS-CoV-2 cases using contact tracing data'**, Martyn Fyles, Ian Hall, Lorenzo Pellis,

Thomas House, Elizabeth Fearon, 1 August 2024.  
[IH-7/15 – INQ000536509];

- i) **‘Faster detection of asymptomatic COVID-19 cases among care home staff in England through the combination of SARS-CoV-2 testing technologies’**, Ryan, Finola; Cole-Hamilton, Joanna; Dandamudi, Niharika; Futschik, Matthias E; Needham, Alexander; Saquib, Rida; Kulasegaran-Shylini, Raghavendran; Blandford, Edward; Kidd, Michael; O’Moore, Éamonn, 29 March 2024. [IH-7/16 – INQ000536510]; and
- j) **‘Modelling multiplex testing for outbreak control’**, Fyles, Martyn; Overton, Christopher E; Ward, Thomas; Bennett, Emma; Fowler, Tom; Hall, Ian, 1 October 2024. [IH-7/17 – INQ000536511].

## **Section 2: Testing Technologies**

- 2.1. I am asked to set out any relevant evidence in relation to testing technologies deployed during the pandemic. This includes the development and comparison of assays, testing systems and strategies for the pandemic, the role of scientific modelling in the TTI systems, and testing systems and strategies for future pandemics.
- 2.2. As a starting point, I believe it will be of use to provide what I consider to be the broad concept that is TTI, as the responses I give will be relative to its scope. In view of the array of work that I was involved in during the relevant period, some of the matters referred to in this statement relate to the application of testing technology and interventions in specific settings, such as care homes and prisons. Although not on a community or national scale of testing to trace and isolate contacts, I consider the work relevant to the draft scope of Module 7, looking at the various TTI systems that were adopted in the pandemic in England, Wales, Scotland and Northern Ireland.
- 2.3. As I have noted above, my areas of expertise are mathematical epidemiology, statistics, and modelling in public health. The nature of my work does not involve assays, and I am not best placed to provide a view on the development or comparison of assays during the pandemic.

*Testing systems and strategies during the pandemic*

- 2.4. If I interpret reference to 'testing systems' to mean the detailed practical aspects of the systems, for example the testing device and/or assays used to test the samples, then I am not able to provide any comment or details as I did not work with them. I was not involved in the manufacturing or design of the systems. However, I was involved with testing systems and strategies through my work with the SCWG and we gave a strong steer on how to deal with asymptomatic screening. I also collaborated with partners looking at contact tracing through an informal TTI modelling group.
- 2.5. In paragraph 1.15, I provide the details of 10 articles which I consider relevant to the 'spirit' and scope of the Request. In this section, I have set out in further detail how this work related to TTI.
- 2.6. Articles 1.15.a) to 1.15.c) focus on contact tracing and are based on work conducted in the early stages of the pandemic. This was led by Elizabeth Fearon under MRC funding, grant name: 'An analytical framework for TTI in UK'. I was not a Co-Investigator of the project but collaborated on the work. The first article was published in May 2021, but was based on work conducted early in the pandemic (January 2020 - May 2020). The implemented TTI policy was different to that proposed in the article; the article suggested using the household as the epidemiological unit. This early study highlights a number of key factors affecting TTI, including, asymptomatic cases being an important route of sustained transmission, and the fear or stigma associated with testing, leading to low uptake if not managed carefully. This shows that a TTI policy would only be effective (if the only means of control) under certain assumptions which were unlikely to manifest in reality. Article 1.15.b) was a refresh as LFD testing capacity grew. Article 1.15.c) was a plea to consider both the benefits and harms of interventions in tandem, rather than focus on one side of an argument even though that might be operationally easier to measure.
- 2.7. Article 1.15.d) considered application of testing to whole care homes in Liverpool in April 2020. This study was not specifically focussed on testing, but assessed the impact of Covid-19 in Liverpool care homes and found that eight care homes had asymptomatic cases that would otherwise have been undetected at that stage of pandemic. This shows potential evidence that regular testing enables early detection and management, when coupled with other control interventions.

- 2.8. Articles 1.15.e) to 1.15.h) demonstrate the application of mathematical models to evaluate the effectiveness of testing. These findings may be important when considering false negative results due to low host viral load at the time of testing.
- 2.9. Article 1.15.i) related to validation work conducted after the pandemic based on data collected in the pandemic using a combination of Polymerase Chain Reaction ('PCR') and Lateral Flow Device ('LFD') testing to test for asymptomatic staff.
- 2.10. Article 1.15.j) relates to the usage of multiplex testing which is an emerging technology, used after the pandemic period, where multiple pathogens can be tested in tandem from one swab. Testing for multiple infections with a single swab is advantageous because it allows more specific clinical management of the case and fewer swabs to be taken, e.g. if individual was frail say repeated tests may not be appropriate.
- 2.11. Following the pandemic, I drafted a paper with UKHSA which discussed eight different ways in which testing can be used: Test-to-Validate, Test-to-Diagnose, Test-to-Treat, Test-to-Isolate, Test-to-Confirm, Test-to-Release, Test-to-Enable and Test-to-Understand. This paper was recently published and aims to provide a helpful framework to assess the rationale and driver for a successful TTI campaign [IH-7/17a - INQ000587358].
- 2.12. As the paper was not written or published during the relevant period the conclusions that were reached were based on reflective learning from experiences during the pandemic. Some of the key issues highlighted in this paper would have been discussed at the time but we now have a better way of articulating them.

*Role of scientific modelling in the development, implementation and evaluation of TTI systems*

- 2.13. Mathematical modelling provides a representation of a phenomenon or idea which may be difficult to observe directly. As such, disease transmission and mitigation is a natural application of modelling. A model should allow transparent and reproducible scrutiny of the impact of proposed intervention scenarios. However, a model is underpinned by assumptions and data and so assumptions can and should be tested and challenged. Often there is no single model involved in assessment, and having a range of models with different assumptions mitigates against reliance and sensitivity to assumptions.

- 2.14. Early models at the start of the pandemic were developed from a traditional, fixed specificity/sensitivity point of view. There are four outcomes from a test; a true positive (a case that tests positive), a false negative (a case that tests negative), a true negative (an uninfected person that tests negative) and a false positive (an uninfected person that tests positive). At the time, the probabilities of tests providing either a false negative or false positive result i.e. the undesirable outcomes, was considered (discussed in article 1.15.a) and 1.15.c) above). The probability of a false negative test (the chance that a test of an infected, and possibly infectious, person returns a negative result) changes due to the variability of viral load in their body (after exposure the virus grows to some peak load and then reduces as the case recovers). The parsimonious assumption of constant false negative probability over part of a person's infection history was driven by two factors; time for advice was short and there was little evidence to inform more complex model assumptions. It took a few months to identify evidence for the extent that an individual's viral load changes over the course of the infection (as then used in articles 1.15.e) – 1.15.h)). I do not believe this assumption would change the major conclusions of those studies significantly but may have helped inform public debate.
- 2.15. In the course of our pandemic response work, we conducted modelling on an infected individual's viral load (see articles 1.15.f), 1.15.g) and 1.15.h) above). There were other independent studies which considered how the viral load changes over time and these were used as evidence in these (and other) works. For example:
- a) 'Viral dynamics of acute SARS-CoV-2 infection and applications to diagnostic and public health strategies' by Kissler et al, 12 July 2021. [IH-7/18 – INQ000536512];
  - b) 'Daily longitudinal sampling of SARS-CoV-2 infection reveals substantial heterogeneity in infectiousness' by Ke et al, 28 April 2022. [IH-7/19 – INQ000536513]; and
  - c) 'Safety, Tolerability and Viral Kinetics during SARS-CoV-2 Human Challenge' by Killingley et al, 31 March 2022. [IH-7/20 – INQ000231441].

- 2.16. These citations are the definitive final published copy, but we may have had earlier access via archive server copies or personal correspondence with the authors. I do not remember the precise timing we were given access to these works.
- 2.17. I should note that although I was a co-author in the papers related to contact tracing. I was not operationally involved in model development. My main focus during that period was on care homes. I do recall engaging in discussions relating to the potential methods, results and conclusions of contact tracing.
- 2.18. Through the course of the Whitfield work on asymptomatic testing and viral load (articles 1.15.e) and 1.15.g)), we became acutely aware that the adherence to testing would change. You can have the perfect test, but if people do not adhere to testing or test incorrectly, the system is ultimately set up to fail. As such, we had to model for adherence of the population at risk, as well as their viral loads.
- 2.19. We applied these models to care homes and prisons. Based on the data available, it appeared that some groups may be less likely to adhere to testing policies than others.
- 2.20. Through modelling, we were also able to consider the effectiveness of policy implementation within prisons and care homes. Policies such as the requirement to produce a negative test result before you could attend work risked staff missing days at work due to potential false positive test results. In theory, we could have modelled the impact of staff absence to varying sophistications with good data, but there wasn't enough good data available to develop our advice. For example, the impact on service provision from members of staff being unavailable compared to the reduction in disease risk. It will be important in future response to a pandemic to consider the health economics of false positive and false negative tests. As noted in article 1.15.c) it is important to have methods of transparent and rapid data collection of impacts beyond transmission reduction in future.
- 2.21. The biggest challenge faced in the early work during pandemic was individuals who presented with little or no symptoms. It meant that our data was biased by symptomatic cases. In the beginning, we were heavily reliant on PCR test data. However, when LFD tests were disseminated, there was more scope to identify asymptomatic cases. This was because PCR testing required access to laboratory equipment and transfer of testing to laboratories, whilst LFD testing

can be completed in a setting. PCR technology tests for infection and tends to be more sensitive, specific and people can test positive a number of weeks after exposure. However, the turn-around-time for test results erodes effectiveness for infection control. LFD testing is usually effective for a shorter window of time (correlated with infectiousness) and results are available very quickly [IH-7/21 – INQ000348178].

- 2.22. Following the pandemic, we started to see the emergence of multi-plex testing. These are tests which simultaneously analyse the samples for multiple pathogens to differentiate between, for example, SARS-CoV-2 and Influenza. In article 1.15.j) above you can see the evolution of this advice, but from a public health point of view having a range of pathogens on the assay means that specific treatment can be offered. For example, anti-virals could be offered if influenza was detected rather than Covid-19.

*Testing systems and strategies in future pandemics*

- 2.23. During the relevant period, we were primarily concerned with solving the immediate problem. When the infection rate eased off in 2022, we started looking to the future.
- 2.24. In December 2023, we were awarded funding to set up a project where we looked at what a community infection survey might look like in the future. This started in April 2024 and is expected to last around 4 years, subject to any extensions. [IH-7/22 – INQ000536516]. It is funded by Wellcome Trust. My role is to lead a work package with the focus on settings, such as care homes and prisons. My colleague, Professor Thomas House, is principal investigator of this study. It is too early in the project to provide analyses or conclusions from this project. During the pandemic, there was a national core study on the transmission of Covid-19, led by the Health and Safety Executive called 'PROTECT' [IH-7/04 – INQ000536498]. Multiple academics conducted the investigations for this flagship work, including myself, and some work from this study will be relevant to future design of pandemic response strategies.
- 2.25. Colleagues involved in the PROTECT national core study attempted to secure funding for a healthcare hub, with the aim of investigating disease transmission in vulnerable settings. The funding bid started in late 2022 and was submitted in

November 2023<sup>2</sup>. This study was intended to build a multi-disciplinary community to consider disease transmission and mitigation in settings, specifically considering the viral, environmental and behavioural components of disease transmission. Diagnostics and testing would have been part of this hub activity to consider future pandemic responses. However, funding was unsuccessful, and we were unable to progress the project. With the lack of funding and investment in projects, we are limited in our scope of research. It is relatively simple to get funding to build and start a network and for specific research questions, however, it is very difficult to get funding to keep a network together. Even where the network has research interest and commonality, it is still incredibly difficult to secure funding to continue that and allow early career researchers to build a career in the area.

- 2.26. Another major programme conducted during the pandemic was, 'Covid-19 National Diagnostic Research and Evaluation Platform' ('CONDOR'), which was used to evaluate diagnostic testing in clinical settings [IH-7/23 – INQ000536517]. I was not involved in this study and cannot comment further.

**Section 3: List of groups (i.e. SAGE and/or any of its sub-groups or other groups/committees) of which I have been a participant, during the relevant time period**

*Relevant evidence in respect of any involvement or advice given regarding the system of Test, Trace and Isolate*

- 3.1. I have been asked to provide information on SAGE and its sub-groups' meetings that I attended during the relevant period.
- 3.2. I provide detailed information on my involvement in SAGE and its sub-groups in paragraphs 3.3 to 3.37 below. However, to summarise and as advised in my Module 2 response, I was a participant in the following groups:
- a) SAGE;
  - b) Scientific Pandemic Influenza Group on Modelling ('SPI-M');
  - c) Scientific Pandemic Influenza Group on Modelling, Operational sub-group ('SPI-M-O');
  - d) SWCG;

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<sup>2</sup> Link to the funding opportunity can be found here:  
<https://www.ukri.org/opportunity/research-and-partnership-hubs-for-health-technologies/>

- e) Hospital Onset COVID-19 Working Group ('**HOCI**');
- f) Environmental Modelling Group ('**EMG**');
- g) UKHSA Joint Modelling Team ('**JMT**');
- h) Ministry of Justice National Review Panel ('**NRP**'); and
- i) Test, Trace and Isolate Modelling group ('**TTI modelling**')

#### *SAGE*

- 3.3. I was a participant in SAGE from February 2020 to April 2022. When acting as a participant, I offered comments where relevant and provided a steer on outputs. I do not recall the specific details of the discussions that I participated in through SAGE.
- 3.4. I attended 18 SAGE meetings across the relevant period, 5 of these as an observer as per the minutes of such meetings [IH-7/24 - INQ000106114 to IH-7/41 - INQ000215647].

#### *SPI-M*

- 3.5. SPI-M is not a sub-group of SAGE, but rather is a standing group attached to the Department of Health and Social Care ('**DHSC**') that advises the government on preparations to manage the risk of pandemics using mathematical and statistical modelling. SPI-M is active during non-pandemic periods meeting, on average, every three months.
- 3.6. I have been an active member of SPI-M since 2006, with Professor Graham Medley sitting as the Academic Chair until 2023. Since then, the Academic Chair has been Deirdre Hollingsworth.
- 3.7. The general operating procedure for SPI-M is that a potential policy question will be raised by secretariat of committee following DHSC review and this is discussed by committee with potential for members to conduct work on topic for more detailed/informed discussion later.

#### *SPI-M-O*

- 3.8. SPI-M-O is a sub-group of SAGE and is called into existence by SAGE at a time of suitable emergency to provide expert advice to the UK government on

infectious disease modelling and epidemiology. SPI-M-O had wider participation from the infectious disease modelling community than SPI-M.

- 3.9. I was a participant in SPI-M-O from January 2020 (when SPI-M-O was mandated) to April 2022.
- 3.10. In February 2020 I held the position of acting chair for a short period of one week whilst Professor Graham Medley was on leave. During this time, I also attended SAGE meetings.
- 3.11. As expert modellers, we designed tools for evaluating infectious diseases and the associated level of direct harm. We were not necessarily experts in the harm of wider impacts and where a commission required input that was outside our area of expertise, such as economics, education or behavioural science, we would collaborate with experts in those fields to inform our report and enable us to provide a comprehensive response to any commission.
- 3.12. I attended 100 out of the 104 SPI-M-O meetings over this period.

#### SCWG

- 3.13. In order for SPI-M-O to fulfil the role that it had been commissioned for by SAGE, it had the remit to establish various sub-groups to gather and collate specialist expertise. As chair of SPI-M-O, it is my understanding that Professor Medley had operational flexibility to be responsive to developments without seeking direct approval from SAGE.
- 3.14. In April 2020, Professor Graham Medley contacted me in his role as Chair of SPI-M-O and asked me to set up a care home working group. Professor Graham Medley thought I would be best placed for this role, as he was aware that I had undertaken work on outbreaks in enclosed institutions pre-pandemic. He was also aware I had been looking at cruise ships (with UKHSA), prisons (with UKHSA and Ministry of Justice), as well as reasonable worst case for care homes with DHSC adult social care team in the previous few weeks [IH-7/42 - INQ000215645]. At the time of setting up the group, I understood the group would be a 'task and finish' group, meaning that the group would be set up to deliver a particular objective; in this case to understand the data available and scope of modelling possible.
- 3.15. Shortly after this, SAGE invited Professor Charlotte Watts (Chief Scientific Advisor, Department for International Development) to set up a formal SAGE

Care Home Working Sub-group ('CHWS') to consider hazard mitigation and to respond to a commission. Professor Medley referred Professor Watts to me in an email sent on 23 April 2020 as I had experience in this area, having already established the informal subgroup of SPI-M-O a few weeks prior [IH-7/43 - INQ000215644]. Accordingly, our group was adopted as the core of the new CHWS sub-group of SAGE, headed, at that point, by Professor Charlotte Watts acting as academic co-chair and participant of the group from April 2020 to April 2022. Executive co-chairs were Professor Watts (April 2020 to September 2020), Professor Dame Jenny Harries, the Deputy Chief Medical Officer ('DCMO') (September 2020 to April 2021), Dr Eamonn O' Moore (April 2021 to April 2022), and Dr Thomas Waite (September 2021 to April 2022). As a co-chair, I helped to facilitate discussion in meetings to assist the group in reaching a consensus, created task and finish groups or specified individuals to deliver reports, received and assessed commissions, and when called, I attended SAGE.

- 3.16. It quickly became clear that the issue of social care was a multi-disciplinary issue and that there would be ongoing scientific questions in relation to social care throughout the pandemic. In September 2020, Professor Dame Harries replaced Charlotte Watts as co-chair of the CHWS and the terms of reference for the group were amended to reflect its new parameters [IH-7/44 - INQ000215646].
- 3.17. Pursuant to the new terms of reference, CHWS was renamed as SCWG in September 2020. It and provided expert modelling and evidence review functions to support scientifically based policy decisions to limit the impact of Covid-19 in social care service provision. SCWG also had the remit to set up temporary working groups to consider questions relating to social care, as specified in paragraph 9 of the Terms of Reference for SCWG [IH-7/44 - INQ000215646].
- 3.18. As Professor Dame Harries was also a participant in SAGE it was not necessary for me to attend the majority of SAGE meetings. When she became Chief Executive of the UKHSA in April 2021, I was invited to participate in SAGE more regularly as it was no longer possible for her to attend.
- 3.19. Transmission was a large area of focus for SCWG. The types of epidemic model structures that we used to consider patterns and drivers of transmission in care homes, and the data required to form reliable models, are detailed in a SCWG paper prepared for SAGE on Care Homes Analysis dated 12 May 2020 [IH-7/45 - INQ000215643].

- 3.20. Further, on page 6 of the same SCWG paper (originally published under CHWS) dated 12 May 2020, we considered the routes of transmission in care homes [IH-7/45 - INQ000215643]. This paper concluded that the main route of transmission into care homes was care home staff, particularly as around January to March 2020, care home staff were often working in multiple care homes which accelerated transmission. This, in addition to other research and scientific investigation, led to interventions to discourage care home staff from working in multiple care homes. We also highlighted a lack of reliable data on contact patterns within care settings and on staff movement.
- 3.21. The asymptomatic testing of staff was a primary focus of SCWG. This can be seen in the Care Home Analysis paper that was drafted in approximately April/May 2020 for SAGE [IH-7/45 – INQ000215643]. The paper provides an assessment of care homes that are most vulnerable to Covid-19 outbreaks and optimal approaches to testing whilst considering other protection approaches. The modelling within the paper was based on a lack of pharmacological interventions at that stage of the pandemic. We had to model non-pharmacological interventions ('NPIs') where we did not know the potential effectiveness. Regarding testing specifically, if we have greater capacity to test more frequently, then we'll know if we have cases or not. The paper advocated for more frequent testing in care homes, when we said more frequent testing, we meant PCR testing as that was the technology available at that time. However, due to the volume of testing required it would have required a huge amount of lab space therefore, the frequency of testing may not be optimal for infection control, but early detection of outbreaks enable other interventions to be put in place to mitigate transmission.
- 3.22. In another paper for SAGE, we looked at what was required following the roll out of vaccinations in 2021 [IH-7/46 – INQ000215628]. Within that paper, we looked at the pros and cons of a large number of interventions, including what we thought the intervention was doing and what harm was present in the setting in question. Often that harm is missed when you are only focussing on the positives. It's important to weigh up the negative output impacts of interventions. For example, in August/September 2020, the decision was taken to close care homes to visitors to prevent virus transmission (see item 3.23 below). At the time, that was evaluated as a sensible risk-based policy, because it became clear people could unknowingly carry the virus. The negative impact of that

decision was that the individuals in the care homes were isolated and unable to have in-person contact with their loved ones, even when they were receiving end of life care for illness unrelated to Covid-19, or natural causes. There was then of course the knock-on effect on their loved ones who were not able to see their family in care homes during their last few days. In short, we needed to be able to find way of balancing the harm of virus transmission versus isolation.

- 3.23. In August and September 2020, SCWG worked rapidly to find evidence for harms of both these things. We were able to show that the harm of isolation was real and quantifiable to some extent. By carrying out modelling, we were able to show that the increased transmission of the virus from visitors was marginal, when one accounts for the staff entering the care homes having previously been in the community given intervention in place (including testing). Our ultimate conclusion was that allowing visitors was beneficial on the balance of increased risk of harm versus not being able to see their families [IH-7/47 – IINQ000536541].
- 3.24. All of this said, it was hard to know whether the work we did directly resulted in decisions made by ministers. The only example that I can recall is from around February and March 2020, where we looked at the doubling time (i.e. the time required for the number of infections to double) of the pandemic. We very quickly submitted a paper into SPI-M to state that the transmission rate was doubling fast and we need to lockdown as soon as possible [IH-7/48 – INQ000215641]. Within a few days or hours, we were locked down. That was an example where you could clearly identify cause and effect.

#### *HOCI*

- 3.25. HOCI was another sub-group of SAGE. The group was formed to focus on hospital onset Covid-19 infection to provide thought leadership, direction to analysis and to support policy change and interventions that would lead to a rapid and sustained reduction in the rate of HOCI.
- 3.26. I cannot comment on how effective HOCI was or how it communicated with other sub-groups as my role was primarily to provide updates in relation to social care and aside from this, my involvement with HOCI was minimal.

#### *EMG*

- 3.27. I also participated in EMG, another sub-group of SAGE, from April 2020 to April 2022. The purpose of this group was to identify and steer the role that environmental modelling, data analysis and environmental sampling can play in understanding Covid-19 transmission, with a view to understanding transmission routes, factors that influence this and the impact of environmental and behavioural interventions and mitigations.
- 3.28. I was initially asked to participate in EMG as a representative of SPI-M to act as a conduit between the two groups due to my environmental modelling work. Prior to the pandemic I had been involved in quantitative microbial risk assessment projects in Public Health England leading a work package on an EU project considering pandemic risks to transport hubs. Over time, however, I became a core participant in EMG and provided regular input to discussions.
- 3.29. I attended 23 out of 39 meetings across this period. I understand that EMG did not keep formal meeting minutes.

#### *TTI Modelling*

- 3.30. I was invited to TTI modelling group as a collaborator with the: 'An analytical framework for TTI in the UK' MRC grant. The TTI modelling group was a collective name for researchers collaborating with this grant and was designed by the principal investigator to be inclusive. There were no formal terms of reference; rather the TTI modelling group was made up by people who made contributions and were not necessarily named and funded on the grant. Research questions and outputs were led by the project Co-Is rather than collaborators. As a member, I would have agreed to conclusions of modelling outputs ahead of presentation at SAGE subgroup meetings. The TTI modelling group advised the TTI programme. However, it was not funded by it, or indeed a subset of it.
- 3.31. In addition to the involvement in the groups set out above, I was invited to join UKHSA JMT as an existing trusted academic collaborator/advisor and the NRP as academic chair of SCWG and an expert in models of disease transmission in enclosed settings

#### *Your role in providing research, information and advice in respect of TTI*

- 3.32. I facilitated discussion and guided subgroups of participants working in responses to commissions, drafting and finalising consensus statements for SAGE and DHSC policy teams during my time in SCWG.

- 3.33. Initially, my role for SPI-M-O was as an expert on spatial modelling and stochastic processes i.e. outbreaks in specific populations and Quantitative Microbial Risk Assessment ('QMRA'<sup>3</sup>). This later expanded to focus on social care and environmental modelling.
- 3.34. For EMG and HOCl, my role involved facilitating communications between SAGE subgroups and being an expert on epidemic modelling and outbreaks in enclosed societies.
- 3.35. During my role within SCWG and EMG, my primary involvement was in the research of care homes (and to a lesser extent, other semi-closed settings, such as prisons). Relaxation of interventions in care homes and other vulnerable settings was difficult and complex. As well as seeking to reduce the R number, we also needed to focus on the compound impact of the interventions that were in place.
- 3.36. In early May 2020 EMG wrote a paper introducing the established risk mitigation of the hierarchy of control (first published on 7th May 2020 and updated on 14th May 2020) [IH-7/49 - INQ000215633]. Here we said that measures needed to consider all transmission routes and all activities - thinking about mitigating risks in workplaces specifically. EMG mentioned the need for multiple measures more explicitly in a paper published on 4 June 2020 [IH-7/50 - INQ000215630], and from then on, I think always emphasised this in EMG and cross SAGE papers.
- 3.37. These papers set the scene for advice given on TTI. Specifically, that an effective TTI operation would reduce community infections and so reduce ingress into vulnerable settings like care homes and prisons thus reducing infections and impact. The advice related to this would have been made through the TTI modelling group of which I was a named collaborator, rather than investigator. My role was to peer-review and challenge, rather than instigate research.

**Section 4: Summary of documents to which I contributed, articles, interviews and/or evidence for the purposes of advising SAGE and/or its related subgroups in respect of Test, Trace and Isolate**

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<sup>3</sup> Quantitative microbial risk assessment is a tool for estimating human health risks from exposure to pathogens via food, water, air, and other environmental routes.

## *Documents*

- 4.1. I was a primary or contributing author on three SAGE reports that named testing as a policy for social care:
- a) SCWG: Care Homes Analysis - 12 May 2020. [IH-7/45 – INQ000215643];
  - b) S1257 SCWG Post Vaccination Mitigations. [IH-7/46 – INQ000215628]; and
  - c) S1453 SCWG: Chairs summary of role of shielding. [IH-7/51 – INQ000312455].
- 4.2. There were a number of SPIM-O papers related to TTI that were presented in meetings of SPIM-O when I was present. These papers would have been marked as authored from the University of Manchester or TTI modelling group. I would have read, reviewed and commented on the papers ahead of SPI-M-O, whilst others I would have reviewed and critiqued at SPI-M-O and been party to any associated consensus statement. A full list of papers can be found at IH-7/52 – INQ000536546.

## *Interviews*

- 4.3. I featured in the media in the relatively early stages of the pandemic including Panorama, Lockdown 1 documentary and 'Was the scientific advice for lockdown flawed?' on BBC News, Newsnight [IH-7/53 – INQ000536547]. I cannot remember if I said anything specifically on TTI but I would think this is unlikely as the focus was on evidence for lockdown and later the management of the pandemic through regional tiers.

### **Section 5: Views on lessons that can be learned and recommendations for further changes**

*Lessons that can be learned of relevant to Test Trace and Isolate and Module 7's outline for scope; and*

There were four key lessons that I took from the pandemic related to TTI:

- 5.1. Capacity – If you are detecting infection via a testing platform (PCR or LFD), then it is important that you acknowledge those that are asymptomatic. You really need a test that has the capacity to test anyone, where you are going to conduct mass screening. Mass screening may be different in scope than the specific Module 7 focus on TTI, but once you get past containment, the capacity to test and follow up, needs to be factored into planning, and effectively

exercised ahead of time in future. Capacity relates to supply of tests given demand and ensuring data flows are effective to support response given the cost outlaid on tests.

- 5.2. Adherence – People may not test because they don't want to test or because they forget. The virus will be still present in them and the people that they meet are still exposed. In a world where people simply forget and each test opportunity is a coin toss, then there is a consistent, if eroded, benefit. But if people consistently avoid a test, then this will leave a subset of the population with limited protection, and the dynamics may be different, particularly if that subset are more connected with each other. Forgetfulness and stubbornness may change through the pandemic in response to perceived threat in ways that are hard to measure. In reality, there is not neat categorisation, but what this means is that modelled predictions may not manifest and that tools to collect adherence data in general community and in specific groups is important, in tandem with epidemiological data. I am not a behavioural scientist, so I don't know how to most efficiently collect that type of data but this is something SPI-M might need to work more closely with SPI-B on, and that a more multi-disciplinary approach could be adopted in the future. I will discuss this in more detail in the following section.
- 5.3. Interdisciplinary communication – the multi-disciplinary approach comes with pitfalls of its own. Modellers on SPI-M-O use technical language familiar with modelling community. We can get through meetings without necessarily thinking of the translation of what we're speaking about. SPI-B is the same and can talk about things in their language at pace. The difficulty follows that you cannot use highly technical language when you are speaking with people across multiple disciplines. Subgroups, however, become very effective in these situations (such as the TTI modelling group). Long-term preparatory work is needed to bring together a multi-disciplinary community that can operate at pace in emergencies.
- 5.4. Viral load – Viral load is also an important consideration that we had not built into early models at the beginning of the pandemic, though we were aware of 'viral load' models in literature (see introduction of article 1.15.f) above and discussion in 2.14 above). In pre-pandemic consideration of how a form of TTI might work my memory was that the focus of review discussion was not on how well tests actually work. This may be because the past focus was on testing for influenza. See for example, a paper reviewing the Targeted Layered Containment (TLC) of

an influenza pandemic in the United States which focused on how peoples contact behaviour would change, because it assumed test would detect cases [IH-7/54 – INQ000536548]. The viral load dynamics in host of the flu virus and Covid-19 are quite different and they are detectable at different stages. With Covid-19, you can be detected until the second week post-infection with LFD. With influenza, it can be up to a week post-infection. This means that you have people coming back as negative, but it might simply be that the test was conducted too late. This is not a fault of technology, but the implementation and interpretation of results (if part of a combined testing strategy).

- 5.5. Social impacts – If people have to isolate at home then there needs to be a consideration of the impact on personal wellbeing and social mixing. We had no mechanism to evaluate impact of staff days lost in sectors. Indeed, my criticism of the potential translation of TLC type ideas to UK pre-pandemic was that isolation required assumptions of social mixing that were not validated (though that was for a different health system and jurisdiction). In particular, isolating certain occupational sectors, such as schoolteachers, prison wardens, nurses, has different impacts on their workplaces and on society. The question that I arrived at was How do you quantify that to balance out the harms and the positives?
- 5.6. Funding – Finally, if you want people to do reflective research, then there needs to be funding in place to support this outside of emergency situations like the pandemic with clear coordinated strategic aims.

*Any recommendations for further changes that you think the Inquiry should consider making relative to Test, Trace and Isolate*

- 5.7. If TTI is implemented, and I believe in the right epidemiological situation it has a role, it is important that data flows are considered and made accessible to all researchers responding to an emergency through appropriate and trusted research channels. There may for example be critical insights on transmission or severity from following contacts. By looking at how many contacts develop illness and their symptom status, we can get a sense of transmission risk and potential biases. If it takes too long for the data to flow to modelling groups, the advantages of collecting the data will not be realised in the response. It may still be a useful forensic piece for posterity after careful cleaning and analysis but would also be useful to the response with ad-hoc methods on partially cleaned data.

## **Section 6: Consideration of unequal impact on individuals across the UK**

- 6.1. I have been asked by the Inquiry to consider the issue of the unequal impact of the pandemic on individuals across the UK. Specifically, I have been asked whether this impact was considered when creating policies and accordingly whether any decisions were made to mitigate the impact of said policies.
- 6.2. Considering TTI specifically, my understanding was that one aim was to slow infection by removing infected cases and their contacts from social mixing. This relies on sufficient capacity in system to conduct asymptomatic testing and to follow up contacts. Understanding sectors of population that may live in households with multiple generations or that may be reticent of divulging contacts in future would help consider impact or effectiveness.
- 6.3. As an early mitigation an effective TTI would, in theory, put a break on the pandemic spreading through the population and so act to reduce health inequalities by fewer cases, and providing time for other interventions to be put in place on vulnerable sub-sets of population. COVID-19 was, it seems, simply too transmissible and widespread for the implemented version to be effective, but there may be other epidemiological scenarios that TTI (in implemented form or in modified form) would be worth deploying to protect the population.
- 6.4. Social care settings tend to not be physically located in areas with low deprivation. However, social care settings experienced a major impact from the pandemic, with large excess deaths and continued morbidity and mortality through pandemic (impacts still being evaluated). So, a holistic plan is needed to avoid subsets of community being adversely affected which needs to be tempered against strategic, tactical and operational objectives.
- 6.5. During the pandemic, as part of my involvement in the 'PROTECT' national core study referenced in 1.14.b), there was work on transmissions and interventions schools and workplaces. Given my responsibility for social care at the time I was not directly involved in much of this work and others will be better placed to comment on equity considerations.
- 6.6. Modelling was also used in relation to hospitals. We used modelling to understand how many cases were going into hospitals and how best to meet the resulting demand for services. Those with chronic infection/needing treatment may be adversely affected by the Covid-19 case burden in hospital, so policies to

reduce community incidence were needed. TTI was intended to be part of this strategy.

- 6.7. Since the pandemic, we've received grant funding to work with UKHSA on virus transmission in homeless settings, mainly looking at seasonal influenza. In the last calendar year, our work involved looking at transmission amongst the homeless. This work built a lot on legacy of the pandemic, where we previously looked at the outbreak risk in homeless settings, such as hostels, night shelters, and the inequalities in access to support and protection that exist therein. I would imagine that the homeless population would have been missed by TTI as a policy and so layered interventions are key, with health equity central to planning.

**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:** 6/5/2025

**Annex A: Exhibit Schedule**

*Please see attached.*

