Witness Name: Dr Edward Mervyn Hill
Statement No: 1
Exhibits: EH1/1- 26
Dated: 9 May 2025

UK COVID-19 INQUIRY

MODULE 7

WITNESS STATEMENT OF DR EDWARD MERVYN HILL

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1. I, Edward Mervyn Hill, will say as follows: -

Introduction

2. I make this statement in response to a request from the UK Covid-19 Public Inquiry (the Inquiry) dated 1 November 2024 made under Rule 9 of The Inquiry Rules 2006 (the Request) asking for a witness statement for Module 7 of the Inquiry, relating to events in the period 1 January 2020 to 28 June 2022 (the relevant period).

3. This statement is to the best of my knowledge and belief accurate and complete at the time of signing.

4. The below evidence is drawn from my own experience. I do not provide a view on Government decision making as I was not directly involved in that process. I also do not provide any statements on behalf of any committee I was a member of.

Professional expertise

5. I have been researching in the field of epidemiological modelling since 2013. On 22 August 2017 I was awarded a Doctor of Philosophy in Interdisciplinary Mathematics and Complexity Science. My professional expertise focuses on mathematical

epidemiology and mathematical modelling of infectious disease dynamics. Prior to the relevant period, I studied respiratory infections (including seasonal influenza and pandemic influenza) and livestock infections (such as avian influenza and foot-and-mouth disease). I have written or co-authored over 40 publications.

Appointments

6. During the relevant period, I was a postdoctoral researcher at the University of Warwick. I was a member of the Zeeman Institute for Systems Biology and Infectious Disease Epidemiology Research (SBIDER). SBIDER is a University of Warwick based Research Centre, with a research specialism in using quantitative methods to address challenges in the biological sciences. In terms of infectious diseases, SBIDER has experience in understanding and analysing human, wildlife and livestock diseases.

7. From spring 2020, I was also linked to Joint UNIversities Pandemic and Epidemiological Research (JUNIPER) from its formation. JUNIPER is a collaborative network of researchers from across the UK who work at the interface between mathematical modelling, infectious disease control and health policy.

8. After the relevant period, I held my postdoctoral researcher role at the University of Warwick until 25 September 2022. Subsequently, from 26 September 2022 to 31 August 2024 I was a Lecturer in the Mathematics Institute at the University of Warwick. Since 1 September 2024, I have been a Tenure Track Fellow in Health Protection Data Science at the University of Liverpool. I have remained linked to JUNIPER throughout this time.

Use of modelling for TTI systems

9. Epidemiological models can be used to help understand the spread of a disease through populations. Uses include (but are not limited to) projecting how fast a disease may spread; how many individuals may become infected and may require treatment; and the potential epidemiological impact of interventions (such as those used in relation to Test, Trace and Isolate (TTI)).

10. Scientific models of real-world systems are a simplified representation of reality that try to capture the important aspects. Models are often limited by the available data, and the quality of a model's output is impacted by the quality of the data that goes into it. Epidemiological models, such as those used in relation to TTI, are no exception to this and cannot, and do not try to, account for every possible detail.

SPI-M-O

11. I was a participant of the Scientific Pandemic Influenza Group on Modelling, Operational sub-group (SPI-M-O), a sub-group of the Scientific Advisory Group for Emergencies (SAGE). I began attending meetings relating to SPI-M-O on 27 March 2020. My participation was suggested to Graham Medley (co-chair of SPI-M-O) by Matt Keeling. Matt Keeling was, prior to this, the only participant of SPI-M-O from the University of Warwick. I attended 85 main meetings of SPI-M-O from 6 April 2020 to its last meeting on 23 March 2022.

12. In general, SPI-M-O participants responded to commissions communicated to us via the SPI-M-O secretariat. These commissions provided a structure for the SPI-M-O committee to submit work relevant to policy decisions in a timely manner. Participants were also encouraged to submit other non-commissioned work that we felt to be important.

13. My contributions in these meetings and in email discussions was to provide scientific advice and insight with my expertise on mathematical epidemiology and modelling of infectious disease dynamics. These contributions included: presenting research undertaken by myself and others; reading, listening to and critically reviewing others' contributions; and contributing to group discussions that were then represented by the SPI-M-O secretariat in consensus statements.

The Isaac Newton Institute Higher Education (INI HE) Working Group

14. I was a contributor to the INI HE Working Group, which was active from October 2020 to August 2021. The working group was comprised of academics from nine universities around the UK (Bath, Bristol, Cambridge, Edinburgh, Glasgow, Manchester, Nottingham, Southampton, and Warwick).

15. The working group analysed the impact of SARS-CoV-2 in higher education settings and submitted two documents to SPI-M-O during the relevant period associated with TTI in higher education, which I co-authored. I discuss these reports further at paragraph 30-34 below.

Documents submitted to SPI-M-O

TTI in workplaces

16. I was a co-author of three documents associated with TTI in workplaces submitted to SPI-M-O during the relevant period, all of which were considered by SPI-M-O to inform consensus statements. The documents are as follows:

    a. "Working patterns analysis", dated 18 May 2020 **(EH1/1 - INQ000533222)**;

    b. "The impact of worker networks and contact tracing upon transmission in workplaces", dated 03 June 2020 **(EH1/2 – INQ000533220)**;

    c. "Workplace contact networks: the impact of forward and backward contact tracing and reactive closure of workplaces", dated 10 June 2020 **(EH1/3 – INQ000533224)**.

17. This body of work assessed the impact of workplace targeted non-pharmaceutical disease controls against epidemic spread of SARS-CoV-2 amongst a population of workers. It used a network-based model with layered contacts capturing multiple encounter settings (workplaces, households, social and other). Following several model iterations, the model ultimately accounted for work sector, workplace size and the division of time between work and home (informed by UK data).

18. The reports studied three workplace focused interventions: (i) a specified fraction of each work sector working from home; (ii) temporally asynchronous work patterns; (iii) introduction of COVID-secure workplaces. They also examined the role of adherence to isolation and test and trace measures. The modelling results indicated that isolation guidance and engaging with contact tracing alone could be an effective tool to curb transmission, but it was highly sensitive to adherence levels.

19. This body of work was also the basis of a research article published on 16 June 2021 in *PLOS Computational Biology* for which I was co-lead author, titled "A network modelling approach to assess non-pharmaceutical disease controls in a worker population: An application to SARS-CoV-2" **(EH1/4 – INQ000533211; EH1/5 – INQ000533218)**.

"Christmas Bubbles" policy

20. I was author of two documents submitted to SPI-M-O in December 2020 associated with TTI and the "Christmas bubbles" policy . This referred to a planned easing of restrictions in England between 23-27 December 2020, with Christmas bubbles allowing people from up to three households to meet throughout the holiday period. Both documents were considered by SPI-M-O to inform consensus statements **(EH1/6 – INQ000533223; EH1/7 – INQ000533219).**

21. The documents report on a stochastic individual-based model for a synthetic population of 100,000 households, used to estimate the epidemiological impact of both this and alternative bubble strategies that allowed extending contacts beyond the immediate household. The findings indicated that visiting family and friends over the holiday period for a shorter duration and in smaller groups was less risky than spending the entire five days together. The increases in infection from greater amounts of social mixing disproportionately impacted the eldest.

22. I subsequently authored a research article based on this work, published on 26 October 2022 in the *Journal of Theoretical Biology*, titled "Modelling the epidemiological implications for SARS-CoV-2 of Christmas household bubbles in England" **(EH1/8 – INQ000533200)**.

TTI in schools

23. I was co-author of multiple documents submitted to SPI-M-O during the relevant period associated with TTI and schools, all of which were considered by SPI-M-O to inform consensus statements.

24. Dated 17 December 2020, the document "Report on COVID-19 in schools in England, September - December 2020" analysed the Department for Education (DfE) Educational Settings data for England. These data record daily absences of students and staff for each school in England, along with information regarding the reason for that absence (for example, confirmed infection with SARS-CoV-2, or isolation because of being identified as a contact). It is important to note that these data did not record whether infection happened within schools. These data were utilised to indicate the likely prevalence of SARS-CoV-2 amongst those attending school through time from September to December 2020, and how that varied by NHS region and by the level of intervention (tier) that was in place at the time.

25. We observed that the percentage of students with confirmed infection was greater in secondary schools than in primary schools, whilst infection levels in teachers appeared of similar magnitude in both secondary and primary schools. During the period under observation, we observed some regional variation in absences, whilst following the introduction of the tier system and the November 2020 lockdown (when schools remained open) absences in teachers were observed to decrease across all tiers, whilst absences in students increased until late November 2020.

26. The work was included as Annex B of a Children's Task and Finish Group update paper on the role children in transmission of COVID-19, considered at SAGE 74 on 22 December 2020 **(EH1/9 – INQ000533201)**.

27. Further reports giving an analysis of school absences were submitted on a regular basis to SPI-M-O between 24 November 2021 to 23 March 2022.

28. Dated 3 March 2021, the report submitted to SPI-M-O titled "The impact of uptake and adherence on transmission and absences resulting from secondary school reopening strategies involving rapid testing" used an individual-based model to understand the impact of school control measures on pupil-to-pupil SARS-CoV-2 transmission, pupil absences and testing volume. The report also quantified the impact of uptake (pupils agreeing to participate in rapid testing), adherence (participating pupils taking tests at home), close contact group size, and transmission on within-school test days. Modelling outputs showed that mass testing, with isolation or serial contact testing,

can result in high levels of absences – as more infections are detected. The implication of this was a trade-off between minimising infection (which required high levels of testing coupled with isolation) and minimising school absence (which occurs when testing is limited and few infections are detected). This report was available for participants to read at SAGE 83 on 11 March 2021 **(EH1/10 – INQ000533209)**.

29. This work was the basis of a research article published on 27 May 2022 in *PLOS Computational Biology* for which I was a co-author, titled "Assessing the impact of lateral flow testing strategies on within-school SARS-CoV-2 transmission and absences: A modelling study" **(EH1/11 – INQ000533213; EH1/5 – INQ000533218; EH1/12 – INQ000533199; EH1/13 – INQ000533198; EH1/14 – INQ000533207; EH1/15 – INQ000533202; EH1/16 – INQ000533210; EH1/17 – INQ000533203)**.

TTI in higher education

30. As discussed above, I contributed to the INE HE Working Group from October 2020 to August 2021, which submitted two reports relating to TTI in higher education.

31. The first report was submitted to SPI-M-O in January 2021, titled "COVID-19 and Universities: Report from the Higher Education working group at the Isaac Newton Institute", which was considered at SAGE 76 on 14 January 2021 **(EH1/18 – INQ000533205)**. The report covered (i) the potential influence of a staggered return of students to universities in January 2021, (ii) the potential for spillover transmission from HE settings to the community, (iii) the impact of the emergence of more transmissible variants on HE settings and (iv) the effectiveness of mass testing and the impact of adherence to intervention measures upon transmission. This report found that adherence to measures (including TTI) was anticipated to have a more substantial impact upon transmission than any marginal gains from staggered student returns. Another finding was that the emergence of a more transmissible variant may result in impaired effectiveness of mass testing of students.

32. Work from this first report was subsequently published as a peer-reviewed research article on 04 August 2021 in *Royal Society Open Science*, titled "SARS-CoV-2 infection in UK university students: lessons from September–December 2020 and

modelling insights for future student return". I was co-lead author of this research article **(EH1/19 – INQ000533217)**.

33. The second INE HE Working Group report was submitted to SPI-M-O in April 2021, titled "Higher Education - return of Face-to-Face Teaching, Lateral Flow Testing and potential impact on the Road Map" **(EH1/20 – INQ000533221)**. This report studied the impact of a return to face-to-face teaching and lateral flow testing upon transmission both within universities and in the wider community. There were four main conclusions which were considered by SPI-M-O to inform consensus statements:

    a. The impact of a return to face-to-face teaching on R was highly uncertain and may vary from region to region, potentially amplifying geographic variability in transmission;

    b. The background community prevalence may influence the effect that any campus outbreaks may have on R;

    c. A potential return of international students from 17th May 2021 may increase the risk of importation of variants of concern;

    d. We did not expect a direct relationship between re-opening of university campuses and an increase in R. However, we may expect an increased potential for spillover events to occur from universities to the local community.

34. I was also lead author of a research article during the relevant period associated with TTI in higher education. Titled "Modelling SARS-CoV-2 transmission in a UK university setting", the study characterised SARS-CoV-2 transmission in a UK university student population by using a network-based model to include heterogeneities in contact structure. The research article contained analysis that was discussed at the INI HE working group, assessing household isolation, contact tracing, room isolation and mass testing control measures. It was published on 29 June 2021 in *Epidemics* **(EH1/21 – INQ000533208; EH1/22 – INQ000533212)**.

Contributions to other research articles related to TTI

35. Here I detail research articles from the relevant period related to TTI that I contributed to, which were not based on documents submitted to SPI-M-O.

TTI in schools

36. Related to TTI and schools, I was a co-author of the research article "Quantifying within-school SARS-CoV-2 transmission and the impact of lateral flow testing in secondary schools in England". This article was published on 1 March 2022 in *Nature Communications* **(EH1/23 – INQ000533204**; **EH1/24 – INQ000533214)**. The article reports the use of community swab testing data to inform community prevalence of SARS-CoV-2 for schools according to their local area and to inform a school's level of participation in lateral flow testing. It also used secondary school absences data to inform the size of group a school isolates upon identification of a positive case.

37. The model was adapted and applied to the community swab testing data in 11–16-year-olds and secondary school absences data. We used the model to evaluate the impact of twice weekly lateral flow testing of pupils on transmission, finding that twice weekly mass testing likely played an important role in controlling pupil-to-pupil transmission in secondary schools in England. We also considered the counterfactual impact of alternative strategies, finding that strategies involving mass testing had the potential to control within-school transmission while substantially reducing absences.

TTI and COVID-19 contact tracing mobile applications

38. I was co-author of a research article published associated with TTI and COVID-19 contact tracing mobile applications, published on 27 June 2022 in *Communications Medicine.* Titled "The effect of notification window length on the epidemiological impact of COVID-19 contact tracing mobile applications", the article reports on the use of an epidemiological model of SARS-CoV-2 transmission that captures the profile of infection to consider the trade-off between active app-usage and the notification window length (referring to the number of days preceding a positive test that contacts are notified as an app's notification window). We focused on 5-day and 2-day notification windows lengths, corresponding to the notification window lengths used by the NHS COVID-19 app in England and Wales before and after 2nd August 2021,

respectively. Modelling results suggested that short windows can be more effective at reducing transmission if they are associated with higher levels of active app usage and adherence to isolation upon notification. The findings suggest an importance in considering the level of adherence to control measures when setting notification windows for COVID-19 contact tracing applications **(EH1/25 – INQ000533206**; **EH1/26 – INQ000533216)**.

Lessons learned

39. Uses of testing include monitoring a pathogen in a population to help ensure relevant information is available to inform public health decisions and actions. Such information can include estimates of incidence (number of new infections of the disease identified during a specified time period) and prevalence (proportion of the population that test positive for the disease in the community at any given point in time). The UK was at the forefront by having two of the largest and most comprehensive coronavirus monitoring studies, namely the Office for National Statistics COVID-19 Infection Survey (ONS CIS) and the Real-time Assessment of Community Transmission (REACT) Study. Data linkages to health data held by NHS England and other NHS bodies have helped improve our understanding about the natural history of SARS-CoV-2 infection, including asymptomatic infection, Long COVID, hospitalisations and deaths.

40. I consider it important that sufficient attention is paid to the ability to establish and guarantee prolonged support to such testing programmes in response to future widespread infectious disease outbreaks. To help the NHS prepare for potential winter pressures and improve public awareness of respiratory infection levels, it would also be informative to have annual editions of surveys, akin to the ONS Winter Coronavirus (COVID-19) Infection Study, monitoring multiple respiratory infections of public health concern (including COVID-19, influenza and RSV).

41. There were instances of variable quality and formatting of data between the four nations, with different countries providing different data in different formats. These inconsistencies create extra barriers. These delays can ultimately prevent analyses

being conducted in the timeframes required for its insights to help inform the decision-making process.

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: 09 May 2025