Witness Name: Professor Ian Hall

Statement No: 3

Exhibits: IH3/1 – IH3/76

Dated: 12 June 2025

UK COVID-19 INQUIRY – MODULE 6

THIRD WITNESS STATEMENT OF PROFESSOR IAN HALL

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: -

PART A - INTRODUCTION AND BACKGROUND

1. This statement addresses my role and involvement in the issues in Module 6, namely the impact of the Covid-19 pandemic on the publicly and privately funded adult social care sector ("the Care Sector"). The matters which I set out within this statement are within my own knowledge save for where I have stated otherwise. Where I refer to facts not directly generated by myself, my research group at University of Manchester, wider collaborators or Social Care Working Group, 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.

2. I have previously submitted several documents to the inquiry:

    a. A response to the Inquiry's Rule 9 Questionnaire on 19 December 2023 for Module 2 ('The Rule 9 Questionnaire Response') (INQ000056544);

    b. A response to the Inquiry's Rule 9 request dated 12 April 2023 on 20 July 2023 ('Module 2 Witness Statement') (INQ000223283); and

c. A response to the Inquiry's Rule 9 request dated 6 May 2025 ('Module 7 Witness Statement') (INQ000587485).

3. This witness statement will cover some of those areas contained within my Module 2 Witness Statement, I have exhibited this statement for completeness but will summarise the contents within this statement **(IH3/1 - INQ000223283)**.

4. This statement is divided into sections, as follows:

   a. Introduction and Background (this section);

   b. Expert Advisory and Modelling Groups;

   c. Modelling;

   d. Key SCWG Papers and Consensus Statements;

   e. Analysing and Understanding Key Issues; and

   f. Reflections, Lessons Learned, and Recommendations.

5. The period referred to in the Request is from 1 March 2020 to 28 June 2022 and asks for evidence relating to my role as role as Academic Co-Chair of the CHWS/SCWG and as a participant in SAGE, SPI-M and SPI-M-O. Where it is necessary to refer to events outside the date range, I will make that clear and explain why I have referred to the event.

Professional Background

6. I received an Undergraduate Masters degree in Pure Mathematics and Applied Mathematics (Hons) from the University of Exeter in 1999. Following this, I was awarded a Doctorate in Applied Mathematics from the University of Exeter in 2003.

7. I am not currently employed by the UK Health Security Agency ("UKHSA"), (formerly Public Health England ("PHE")). However, I held the position of Honorary Senior Principal Modeller in Emergency Preparedness since 2019 and the University of Manchester has received grant income for my time on specific projects (up to 20% FTE). I was previously a Principal Modeller in Emergency Preparedness (20% FTE) from 2018 to 2019, a Scientific Programme Leader and Principal Modeller in Emergency Preparedness from 2006 to 2017, and a Senior Modeller in Emergency Preparedness from 2002 to 2006 (both 100% FTE).

8. I am currently employed by the University of Manchester and have held the position of Professor of Mathematical Epidemiology and Statistics since 2021. I was Head of Statistics and Probability Group from 2019 to 2022 and a Reader in Mathematical Statistics from 2018 to 2021 (at 80% FTE in 2018, and 100%FTE from 2019 onwards). I hold an appointment split 80% with the Department of Mathematics and 20% with the School of Health Sciences.

9. I have contributed to many major publications, a list of which I exhibited within my Module 2 witness statement **(IH3/2 - INQ000215661)**.

10. My primary areas of expertise are mathematical epidemiology, statistics, and modelling applied to public health, epidemiology, and adult social care. In my day-to-day professional work, I develop mathematical and statistical models of infectious disease to learn how to better control them.

11. In 2024, I was awarded an OBE for my services to public health, epidemiology, and adult social care, particularly during the Covid-19 Pandemic.

PART B - EXPERT ADVISORY AND MODELLING GROUPS

12. I was involved in various scientific and technical advisory groups and sub-groups during the relevant period, as I set out in my Witness Statement for Module 2. These included the following groups:

    a. SPI-M (2006 onwards): 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;

    b. SPI-M-O (January 2020 onwards): 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;

    c. EMG (April 2020 – April 2022): I was initially asked to participate in EMG as a representative of SPI-M (to provide a conduit between the two groups) and due to my previous involvement in environmental modelling work (I had been involved in quantitative microbial risk assessment projects in Public Health England pre-pandemic and led a work package on an EU project considering pandemic risks to transport hubs). Over time, however, I became a regular, core participant in EMG and provided regular input to discussions. I attended 23 out of 39 meetings across

this period. I understand that EMG did not keep formal meeting minutes, therefore, I am unable to provide copies of these.

d. SCWG - formerly CHWS (April 2020 onwards): In April 2020, Graham Medley contacted me in his role as Chair of SPI-M-O and asked me to set up a care home working group focussed on modelling and data. 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 **(IH3/3 - INQ000610601)**. It was for this reason that I was tasked with setting up this precursor to SCWG. 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.

13. In respect of SWCG, shortly after it was established Charlotte Watts (Chief Scientific Advisor, Department for International Development) set up a SAGE Care Home Working Sub-group ("CHWS") to consider hazard mitigation and respond to a commission. Graham Medley referred Charlotte Watts to me in an email sent on 23 April 2020 as I had already established a subset of a CHWS **(IH3/4 - INQ000215644)**. Accordingly, our group was adopted as a sub-group of SAGE and extended to be more interdisciplinary.

14. In September 2020, Dame Jennifer Harries, Deputy Chief Medical Officer ("DCMO"), replaced Charlotte Watts as co-chair of the CHWS and the terms of reference for the group were amended to reflect its new parameters **(IH3/5 - INQ000215646)**. Pursuant to the new terms of reference, CHWS was renamed as SCWG.

15. Paragraph 6 of the new terms of reference stated that SCWG could receive commissions from SAGE and/or DHSC **(IH3/5 - INQ000215646)**. Further, as UKHSA were secretariat for SCWG, where DHSC or SAGE commissioned SCWG to carry out work, as the final report was reached by consensus, the advice within the consensus report was de facto advice from UKHSA as well as SCWG.

16. I was also involved in the Joint Modelling Team. This was a group of mathematicians and modellers working within UKHSA that had established honorary contracts with PHE at the start of the pandemic. The group was reviewing the modelling work being undertaken at PHE (and then UKHSA). There were also perspectives from all four nations on the group.

17. The University of Manchester Mathematical and Statistical Epidemiology group is based in the Department of Mathematics. It is a research group currently of about 25 individuals across career stages (numbers change given research funding and studentships but 10 core academic staff are affiliated with research interests in this area). During the pandemic the members of this group at the time acted to support the three participants in SPI-M-O (Thomas House, Lorenzo Pellis and myself) and supported me on SCWG with modelling related tasks as necessary and appropriate.

SAGE

18. SAGE provides scientific and technical advice to support government decision makers during times of emergency. I was a participant in SAGE from February 2020 to April 2022. I first attended SAGE in the 2020 February half term, in my capacity as acting chair of SPI-M. I attended 18 SAGE meetings and 5 of these as an observer. I exhibited the minutes of the SAGE meetings where I was in attendance to my Module 2 witness statement. When acting as a participant, I offered comments where relevant and provided a steer on outputs.

19. As I was only occasionally attending SAGE meetings, I cannot comment more widely on its process and procedures. As I was not a regular participant in SAGE, I cannot comment on the matters discussed (other than when I was present), or on what advice SAGE gave to the government.

20. I am not aware of specific examples where the advice of SAGE, in relation to matters concerning or impacting the ASC sector, conflicted or differed from advice provided by other advisors or advisory entities.

21. The conceptual framework for SAGE is sound and operates effectively to provide immediate scientific advice in an acute emergency. In my view, the membership of SAGE had sufficient expertise to fulfil its remit. It operated by providing commissions to its sub-groups. Following this, the sub-groups considered the commissions, discussed these at sub-group meetings and drafted a report which was provided to SAGE.

22. These reports were termed 'consensus reports' as they represented the agreed consensus and view of the individuals in the sub-group who attended the sub-group meetings. Throughout my involvement in SAGE's sub-groups, there was a high degree of appropriate challenge amongst the participants. Although we were working at pace, the participants were inquisitive and would ask questions to ensure that thy understood the discussion before agreeing to any consensus report. When we presented our findings

from SCWG to SAGE, I felt that the stakeholders listened to our findings and sought to develop advice quickly based on our reports. Whilst my role did not include policy discussions or developments, I felt that our consensus reports were valued and were considered as part of SAGE's advice to the government.

23. I am aware of general criticism pre-pandemic that the geographic diversity of SAGE and its sub-groups was confined to London. With the pre-pandemic expectation of SAGE being set up for acute period with in-person meetings some geographic proximity is to be expected for practical reasons. The move to and acceptance/expectation of remote working breaks down this London-centric barrier. I am only able to comment on the geographic diversity of modellers on SPI-M and SPI-M-O as this is within my knowledge and professional expertise.

24. The geographic distribution of participants in SPI-M was and is diverse. The two largest modelling centres in the UK are located in London (Imperial College London and London School of Hygiene). I was based in Manchester and other participants were based in Cambridge, Warwick and Scotland. In my view, geographic diversity was dictated by the location of senior experts in the field of modelling.

CHWS/SCWG

25. I am unable to comment on the reasons that SAGE felt it necessary to establish the CHWS care-home focused sub-group at this point in the pandemic, or the rationale for establishing the CHWS as a full sub-group of SAGE rather than keeping it as a modelling sub-group of SPI-M-O. The issue would have been discussed at a SAGE meeting which I did not attend. I recall Graham Medley informing me that SAGE had discussed the need for the subgroup and, as I was already working on the SPI-M-O subgroup, it made sense to adopt that as a sub-group of SAGE.

26. As I was not a regular participant in SAGE, I cannot give a great deal of evidence about the implications of our becoming a full SAGE sub-group. The main implication from my perspective was that we gained secretariat support from the Department of Health and Social Care.

27. There was a clear need as we moved from the early work on data landscape to wider research questions to broaden the skills and experience of the group. This was done on a case-by-case basis as questions arose by direct invitation of experts.

28. I have also been asked to comment on any challenges that arose as a result of SCWG being adopted as a sub-group of SAGE. On occasion, I believe that some participants in the SAGE sub-groups found it difficult to balance their personal contributions to the sub-group meetings with their institutional roles. For example, when we were working on the consensus regarding the discharge of Covid-19 positive patients from hospital to care homes we were unable to reach a unanimous consensus at SCWG as one participant felt that our consensus was at odds with the interests of her employer. This could be examined for future pandemics to ensure that participants of sub-groups can effectively balance their commitments.

29. Furthermore, where commissions were received by SCWG directly from DHSC, this did lead to temporary delays in relation to the dissemination of information as DHSC found it more difficult to find a mechanism to publish reports in as timely manner as SAGE, for example the SCWG advice on vaccine coverage levels in residents and staff **(IH3/6 - INQ000215662)**. This was not a critical issue as the policy teams had the advice in a timely manner, but this could be an area of improvement for future pandemics to ensure the expedient dissemination of scientific findings".

30. Commissions were raised via our secretariat, who then brought them to the chairs during a chairs' briefing session early in the week. The chairs would then approach specific members to conduct work when a clear 'owner' of the commission existed or seek volunteers for a task and finish group at the next working group meeting.

31. I commented on the relationship between SAGE and CHWS/SCWG in my Module 2 Statement. In summary, there was the potential for tension between the two around the distinction between scientific investigation and operational implementation. By way of example, as a sub-group of SAGE, we would advise that testing should be carried out, but we would not advise or discuss how this should be implemented as this was beyond our remit.

32. For example, in a SCWG paper on the commission *'What are the appropriate layers of mitigation to deploy for care homes in the context of post vaccination risk landscape?'* dated 26 May 2021, we went into a lot of detail about implementation **(IH3/7 - INQ000215628)**. My feeling was we had to do that as implementation was integral to the strategic considerations because as stated above variation or bottlenecks in implementation or adherence would strongly affect effectiveness in settings. A SAGE meeting took place where the paper was described as too "operational" in nature, this was not a point of tension between participants in SAGE (in this case myself and CMO)

instead it is an issue with reporting in an emergency. That report had different readerships (science and policy), and we could not draft two versions for each group in the time available.

33. I purposely established SCWG (formerly CHWS) as a diverse multi-disciplinary group. Initially, the geographic diversity of its participants was led by my own contacts and the immediate expertise that was required for the initial commission as the group needed to be established at pace. As time went on, the participant base in SCWG evolved to suit the demands of the service and the participants grew in number. I cannot comment on diversity of other subgroups other than to say the expertise appeared to be well represented for the demands of the service.

34. Care homes are the focus of scientific research in general and were so prior to the COVID-19 pandemic. However, the specifics of respiratory disease transmission and its control represented a gap and needed further research on fundamental transmission mechanisms and integration with quality of life. We are currently attempting to address this with research grants. I cannot comment on the focus of SAGE prior to my invitation to SAGE.

35. In terms of pandemic preparedness, after the pandemic in 2009 we produced two papers on the issue of enclosed societies and gave advice to the Department of Health in, I believe, around 2011-12, through SPI-M. My previous expertise in this field was I think what led to Graham Medley approaching me in 2020.

36. I have exhibited the two papers both of which I co-authored at Public Health England, and which show the state of scientific understanding of transmission potential in such enclosed societies at that time.

37. The first of these is titled *"Behaviour and control of influenza in institutions and small societies"* (2012) **(IH3/8 - INQ000606701)**, it was a literature review which demonstrated that regardless of how isolated a community is, even where there are no complicating factors it will still be vulnerable to a pandemic. The paper states that pre-pandemic planning is essential and rapid intervention is essential for the control of influenza spread in such circumstances. We found that delay in diagnosis, detection of an outbreak or the implementation of control measures can result in the majority of the enclosed population succumbing to the disease.

38. The second paper is titled *"An analysis of influenza outbreaks in institutions and enclosed societies"* (2014) **(IH3/9 - INQ000606700)**, this considered the spread of influenza in

societies that are isolated from the wider community and have greater opportunities for contact between members which would aid the spread of disease, based on data found. It found that children and military personnel suffer a greater attack ratio than other occupational types. We also observed that as community size increases, the attack ratio (here defined as total observed cases but total community size of the setting) gets smaller.

39. We knew that enclosed societies were at particular risk from respiratory disease from the work outlined above. I am not aware of any specific modelling work in relation to care homes in the interim (i.e. between 2012-2020), but one would not have known the characteristics of any specific disease or pandemic in order to undertake modelling work to quantify impacts.

40. I do not believe I had been involved in any further specific advisory work in terms of such data or using models for this kind of outbreak between 2012 and 2020, but that is not to say that research was not being undertaken.

41. Furthermore, a recent (currently unpublished) literature review by my group suggests there were very few models of care home outbreaks, and those that exist lacked real world data for parameterising them or verifying them. This is a potential risk as it means models used for advice may not be validated or verified with real world information.

42. Given the lack of modelling, interdisciplinary research is needed to

    a. create protocols for data collection on contacts, cases and impacts of disease on individuals in the setting – so that necessary data is collected faster in future outbreaks (subject to funding)

    b. open source code implementing the models - for faster application of models and review of model assumptions

    c. clarify assumptions made in the absence of data – to improve communication of uncertainty

    d. engage with stakeholders (policy, residents, staff) – to improve translation of advice

    e. work with policy teams to understand drivers for decisions – to improve communication and translation.

PART C - MODELLING

Background to Modelling

43. 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 could allow transparent and reproducible scrutiny of 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 discussion as having a range of models with different assumptions mitigates against reliance and sensitivity to assumptions.

44. Mathematical models are not always correct and the reliability of models are impacted by the reliability and availability of the underlying data. This can be viewed as a 'limitation' of modelling and is something that we were very careful to stress and reiterate in consensus statements of the sub-groups that I participated in. If an assumption was made that was structurally flawed, the impact of that would not be accounted for by the simulation. Hence it remains critical to state assumptions. Mathematical models can be hard to categorise. However, the types of models that consider transmission and mitigation of disease tend to fall into a few (loose) methodological frameworks:

    a. **Compartmental modelling** involves dividing the population at risk into compartments with specified flows between them. These can get arbitrarily complex, but the cornerstone model of this type is the SIR (Susceptible, Infected, and Removed) model. These models are based on ordinary differential equations (ODEs).

    b. **Stochastic models** are an extension of Compartmental models, that is to say events within the model can be simulated randomly. This means stochastic models give a different answer each time they are run (if the random seed is different) and so one gets a characterisation of uncertainty inherent in the model given the assumptions made in its construction.

    c. **Individual or agent-based simulation** would be frameworks which could permit greater structure in mixing or transition, but at the cost of requiring more data or less clarity in assumptions being made to set them up and more computational time. Rather than dividing population into compartments of infection ‘types’ here each individual in population is assigned a ‘behaviour’ separately.

45. The specific choice of model framework is clearly important, but checks are made around sensitivity to assumptions and identifiability of parameters given the available data, so advice is ideally given based on a range of models. There are increasing moves to create model software frameworks to enable more transparent and reproducible work (such as PyGOM (for ODE based models) and JUNE (for agent based simulation).

46. Statistical models can be and were also used. Such regression analysis attempts to estimate the relationship between one variable (i.e. numbers of cases or deaths) and one or more other variables (such as date or location). These models tend to involve less mechanistic assumptions about say transmission (*"Excess mortality for care home residents during the first 23 weeks of the COVID-19 Pandemic in England"* **IH3/10 - INQ000575269**) or case fatality ratio calculation (*"Novel methods for estimating the instantaneous and overall COVID-19 case fatality risk among care home residents in England"* **IH3/11 - INQ000575276**) and so identify correlation rather than causal links. For example, in the excess death work CWC deaths were predicted given other explanatory factors for each home before and during the pandemic to assess difference.

47. Towards the end of the pandemic, we were using hybrid approaches of compartmental models with Generalised Additive Models (essentially fitting a wiggly line through the data rather than the more typical straight line). For example, *"Time-varying reproduction number estimation: fusing compartmental models with generalized additive models"* **(IH3/12 - INQ000606693)**.

48. A range of models were used/presented to SCWG. All models involve assumptions being made, whether those assumptions are about homogeneity of mixing or the impact of interventions, they need to be clearly articulated. An often-quoted statement is that *'all models are wrong, some are useful'* from George Box. To unpack this more bluntly, with a model you are guessing (based on assumptions and data available), without a model you are hoping.

49. There is a general understanding amongst experts that the quality of the data in directly affects the quality of the results which are produced.

50. The data required to "run" a model can fall into four broad areas.

    a. Firstly, information on the disease (epidemiological factors: i.e. timescale for infection, infectivity, and severity).

b. Secondly, information on mixing patterns (social factors, including who meets whom and when in the settings).

c. Thirdly, surveillance data from the settings (number of cases over time).

d. Fourthly, quality of life factors (what is the cost of disease to the individual and what is the cost of intervention).

51. A model needs at some level all of these datasets, and if any data is missing, then the projections are less certain or useful. At the start of the pandemic all data sets were missing as is natural for a new disease. The epidemiological factors were identified during the start of 2020 during Wave 1 of the pandemic. As outbreaks occur surveillance data was available and by September 2020 the data was of good quality.

52. It was very hard to identify good quality datasets to measure aspects traditionally considered by health economics analysis of outbreaks (such as quality of life metrics or cost of interventions), which is a critical area of future research to balance the appropriate mix of interventions. Tools such as the Adult Social Care Outcomes Toolkit ("ASCOT"), that have been piloted in such settings are critical to enable this in future **(IH3/13 – INQ000611202)**.

53. There was also very little data on social mixing in settings. The CONTACT study, run through the University of Leeds attempted to address this by deploying Bluetooth technology, and there were a few social surveys in other settings in the UK. In both cases the issue is generality – all care homes are different – but the researchers on CONTACT also found practical issues deploying technology in a pandemic with restricted movements.

54. Simply simulating from a model, you may only need data from areas a and b above, but without c you will have no understanding of whether the model is valid for the setting. To calibrate and then project a model to a local context one needs at least data from a, b and c which improves validity and confidence in the model. Data from d enables greater contextual advice.

PART D - KEY SCWG PAPERS AND CONSENSUS STATEMENTS

55. I set out below what I consider to be the key SCWG papers and consensus statements that we produced.

56. On 12 May 2020, in response to a request from the CMO and GCSA to provide a scientific view on testing strategy to reduce transmission in care homes, we provided a paper for SAGE to consider titled, *"Care Home Analysis"* **(IH3/14 - INQ000253601**. The paper provided an overview and assessment of current evidence on the types of homes that are most vulnerable to Covid-19 outbreaks, optimal approaches to testing, and the potential value of other protection approaches.

57. The paper answered the following questions:

    a. What does the current evidence tell us about the main routes of transmission mechanisms between care homes and within care homes (risk to the vulnerable population), and what forms of care home are at greatest risk? Are there key differences by geography, including across the DAs?

        i. The evidence supported the proposition that nursing homes had consistently higher rates of reporting outbreaks than care homes and that both rates increase as home size increases. This is a pattern which was reflected across Scotland, Northern Ireland and Wales.

        ii. There were multiple means of introduction of new disease cases to care homes. We had medium confidence that this was linked to the connection between care homes and hospitals, and the connection between staff and community. We could not say which was more influential at this stage.

    b. What are current and projected trends in transmission in Care Homes? Do recent declines in cases suggest that the situation is under control?

        i. There was an overall decline in the number of all cause deaths reported to CQC from the peak in mid-April. This decline was present in both nursing and care homes. However, at that stage, there was no evidence of confirmed Covid-19 deaths decreasing. There was, however, evidence of a decline in the number of new outbreaks reported to PHE, which had dropped from 150 per day to 100 across England.

    c. What approach to swabbing and testing is likely to be most effective in reducing rates of infection?

        i. Our research allowed us to conclude with 'medium confidence' that testing should include homes that do not report cases, as well as those with suspected or confirmed cases due to the risk of asymptomatic infection and

transmission. If no testing had been done, the priority should be given to larger care homes that are at higher indicators of risk, as detailed above.

ii. The evidence also supported a strong scientific rationale for testing all residents, irrespective of whether symptomatic or not, and all staff working in the homes. For the staff, it was also felt to be important that the results could be linked to all of the care homes they had worked in, and follow-up testing in other homes conducted.

iii. With regards to the test results themselves, we determined that all homes should be re-tested each week to check for ongoing transmission, importation of disease or false negative results from previous testing rounds every week.

d. What impact may different approaches to reducing risk have?

i. Non-rotation of care home workers – we concluded with 'medium confidence' that reducing interactions between people in a care home and the wider community reduced the risk of Covid-19 importation. This included reducing contact between staff and the community, testing any new resident and isolating those who tested positive.

ii. Cohorting of residents – Cohorting with a small number of carers had the potential to reduce transmission through limiting contact, albeit this carried an element of risk especially if residents needed to be moved. We concluded that any decisions would be guided by vulnerability of individuals and the level of stress caused by any cohorting.

iii. Handwashing, regular surface cleaning, monthly deep cleaning – there was limited data on the role of the physical environment on infection risk within care homes and of the efficacy of deep cleaning with Covid-19. Instead, there was better evidence emphasising the importance of regular cleaning, including of communal spaces.

58. On 18 June 2020, we provided a paper to SAGE titled *"Update on Evidence to Inform Emerging Policy questions for Adult Social Care"* **(IH3/15 - INQ000562877)**. This was submitted but not discussed in detail at SAGE as it was an incremental update. The paper was a follow-up paper to *Care Homes Analysis* and I believe was also shared with DHSC.

59. The paper set out:

    a. Improvements in the collection and linking of data.

    b. A strong rationale, based upon moderate evidence, for extending the use of face masks to care homeworkers (and face coverings by the public) in care homes, especially given the high prevalence of frailty and co-morbidity of the residents.

60. In relation to visiting, the paper noted that:

    a. Based upon current understanding of the risk of transmission, there is medium evidence to suggest that visits of a short duration, where appropriate social distancing and infection control measures are adhered to, are likely to pose a lower risk to residents than the risk of infection by care home staff, who by the nature of their occupation, are likely to have more frequent and sustained contact with residents.

    b. When deciding whether to allow visitors, the benefits to the individual in seeing the visitor need to be weighed against the risk to other residents and staff (noting higher infection rates, levels of frailty, and risk of asymptomatic transmission), as well as the risk to the visitor.

    c. Decisions should be informed by local assessments of risk and benefit. If a policy supporting visitation is proposed, at a facility level, suitable infection control processes must be in place, and at a local authority level, testing systems should be able to support the regular testing in care homes, to ensure that any new outbreak can be rapidly identified. Maintaining and enforcing a visitor log to support tracing of affected individuals would be recommended.

61. The paper also recommended that the strategy for testing care homes separately considered care homes with confirmed or suspected cases and identification of new outbreaks. The paper noted that:

    a. If a care home has a confirmed or suspected case:

        i. Given the prevalence of asymptomatic infection, there is a strong scientific rationale to test all staff and residents as soon as possible, irrespective of symptoms, to assess whether there is an infection and the scale of the outbreak.

ii. There is a less strong scientific basis to inform the subsequent frequency of testing. Whilst priority should be given to ensuring that sufficient support is provided to control infection, this may not require regular testing of residents, and there is a clinical rationale to recommend that the frequency of testing be balanced with the care needs and frailty of residents.

iii. Irrespective of testing practice during an outbreak, there is moderate evidence to strongly recommend the testing of all residents and staff after 28 days since the last presentation with symptoms/positive test for COVID-19.

b. If the care home is not reporting cases, or it has been established that there is no infection in the home:

i. New residents (from own home, from non-hospital setting and direct discharges from hospitals) and residents who are returning from hospital should be tested prior to returning to the home to confirm that they do not have COVID-19.

ii. If testing resources allow, there is moderate evidence to suggest that the weekly, complete testing of residents and care home workers would ensure a high probability of rapidly identifying new outbreaks in homes (with the week being based on average incubation period and generation time).

iii. If testing resources are more limited, the frequency of testing for different homes should be influenced by assessments of the levels of risk of the home (indicated by the connectivity of the home to the broader community and hospital system, or other indicators of risk).

iv. If resources are restricted, there is emerging weak evidence from modelling to suggest that testing only staff and recent returning residents is as effective in identifying new outbreaks as testing all residents and staff. As above, the frequency should depend upon the size of home and/or other assessments of risk.

v. Given the importance of quickly identifying new outbreaks in care-homes, it is recommended that all staff and residents in care homes for the elderly are offered testing every month (i.e. 28 days between tests), if this has not occurred otherwise through the above procedures.

62. We provided a further update paper to SAGE for their meeting on 24 September 2020 titled *"Social Care Working Group update paper"* **(IH3/16 - INQ000422314)**. Jenny Harries and I co-presented the paper at the SAGE meeting, and it was shared with DHSC.

63. The update report was provided primarily for information and built on increasing knowledge from ongoing studies of Covid-19 infection ingress and transmission risk within care homes, and relevant mitigation opportunities in the context of a resurgence of cases in long term care facilities.

64. The key findings of the paper are set out at Paragraphs 4.1 – 4.6 and are reproduced below:

> *4.1 Although staff-to-staff transmission has been observed to have been a contributory factor in specific outbreaks, it is important not to generalise to all outbreaks and emphasise one route over another without clear evidence - studies undertaken so far indicate that multiple introductions are common. Clusters of cases have been observed but many outbreaks involve cases that are spread out over a longer period, again indicating multiple introduction routes / different lineages.*
>
> *4.2 Retrospective genomic analysis and seropositive studies in care homes therefore find evidence for multiple routes of virus ingress to care homes, but are not systematic enough to quantify the relative frequency of different routes of ingress. Furthermore, these studies do not definitively rule out any mode of ingress so staff, visitors, visiting professionals, hospital discharges and new admissions and persistent infections may all contribute to the introduction of disease.*
>
> *4.3 The weight of evidence is stronger in some areas than others, however. Evidence of staff to staff transmission has emerged in the genomic analysis (high confidence). Weak evidence on hospital discharge and modelling the impact of visitors (see also para 6 below) does not suggest a dominant causal link to outbreaks from these sources.*
>
> *4.4 Public Health measures that reduce community incidence could be effective in reducing ingress into care homes. In the first wave, care homes appeared to show less impact from lockdown measures, with numbers continuing to rise more than cases in the community. It is thought that greater internal infection control measures now in place will make it easier to understand where infection is coming from.*

4.5 Asymptomatic or atypically symptomatic presentation in residents' and staff mean that ingress may be hidden for a number of generations of disease.

4.6 Sequencing community tests to understand the comparator population is critical for the future.

Visitor Policy in Care Homes Consensus Statement and Visiting Restrictions

65. Visiting restrictions were a complex and difficult issue. In the early stages of the pandemic in April and May 2020, our models failed to account for the psychological impact of isolating residents from their loved ones. Essentially, the problem was that as scientists working on infectious diseases, we were predominantly geared up for thinking about infection risk. A standard method for analysing infection risk with wider societal impacts would be a form of health economic evaluation, where we would balance the cost of treatment against the value of the lives that said treatment would save.

66. One difficulty in this area is that, whilst we can count cases and/or mathematically simulate an outbreak, we cannot easily quantify the benefits of a social visit. With an infection, we can point to deaths or long-term health consequences, but how can we compare this to the sadness of not being able to see your loved ones? This links to the further issue that ascribing value to certain aspects of wellbeing is a political issue, whereas we were meant to be looking at hard scientific concepts. This might explain why we did not consider isolation initially. However, staff were already a point of ingress, so in fact the risk from a visitor would not increase a great deal. As summer progressed, we had more conversations about this.

67. At our SCWG meeting on 26 June 2020 we discussed a paper that had been written by Dr Lisa McGarrigle and Professor Chris Todd titled *'The adverse effects of social isolation and loneliness on psychological and physical health outcomes in care home residents during Covid-19'* **(IH3/17 - INQ000575273)** which was independent research that had been funded by the National Institute for Health Research. The paper was shared with SAGE and DHSC.

68. The briefing for the paper was to consider the evidence for the adverse health effects of social isolation and loneliness in the general population and care home settings in light of Covid-19. This included a review of Google Scholar, followed by a more formal search for evidence from systematic reviews in MEDLINE (Ovid). This was a rapid review, which inevitably implies some caveats to the findings.

69. The research found compelling evidence to suggest a strong link between social isolation and loneliness and ill health in the general population and there was further evidence to suggest higher prevalence rates of isolation and loneliness in long-term care settings. Although there was, at the time, no direct evidence for the negative impact Covid-19 social distancing measures may have on the health care of care home residents, we felt able to conclude that these measures are likely to have led to an increased sense of isolation and loneliness, which, as already identified, are established risk factors in mortality.

70. By way of interventions to lessen the impact of the isolation caused by Covid-19 measures, this report recommended that care homes make use of digital solutions (e.g. tablet devices which could support video calls). It also highlighted the importance of regular and meaningful telephone conversations and mail deliveries.

71. Further, in the summer of 2020, I commissioned a Alexander Thompson, (a health economist at the Manchester Centre for Health Economics) to analyse the wellbeing issues associated with isolation using a cost-consequence framework. He did also find some evidence on wellbeing and the long-term harm brought about by isolation **(IH3/18 – INQ000611199; IH3/19 – INQ000611201)**.

72. The analysis by Alexander Thompson found that the risk of loneliness to care home residents was likely an order of magnitude higher than the disease risk, particularly given that staff would always represent a point of ingress additive to visitor risks, so we felt safe to advise that visitors could come back in with appropriate mitigations. The data is limited but advice on the balance of risks was relatively straightforward especially with vaccine and other interventions. If NPIs were the only intervention and there was no prior immunity from Wave 1 this may have been a more nuanced piece of advice but to my knowledge that scenario has not been worked through in detail.

73. On 2 November 2020 we finalised the *"Social Care Working Group: Consensus Statement on family or friend visitor policy into care home settings"* **(IH3/20 - INQ000215625)**. On 5 November 2020, SAGE considered the consensus statement at their meeting, and it was also shared with DHSC.

74. The consensus statement was designed to provide an update to policymakers in consideration of further questions on the benefits and risks associated with visiting policy, building on the SAGE paper from 18 June 2020. The statement reported the consensus from the SCWG on the future direction for the work, following the discussions that had

occurred over the summer, including examining the issue from a health economics perspective.

75. We sought to finely balance the recognised benefits to residents of visitors, whilst also managing the risk of disease introduction and transmission. At that point in time, our understanding had evolved such that there was then strong evidence of the significant negative impact caused by loneliness and isolation on care home residents. It was advised that *"Policy decisions therefore need to take into consideration not only the scientific evidence about the two sorts of harm risk of harm from COVID-19 and risk of harm from isolation - but also the views of, and impact on, all of those affected, residents, their loved ones, staff and community"* **(IH3/20 - INQ000215625)**.

76. In an effort to progress this complex discussion further, we recommended that new, appropriately designed and funded studies ought to be commissioned so as to provide important data to be used to inform future policy decisions.

77. Several options were suggested, including simulation models of care homes with a range of policies implemented, further studies on residents' wellbeing, and even convening a citizen jury or similar consensus method to evaluate and decide value judgements. Ultimately, at that time, there was no simple solution to balance quantifiably both harm and benefit to inform policy development.

78. With regards to convening a citizen jury we stated:

> *Convening a citizen jury, or similar consensus method to evaluate and decide value judgements to be used. NICE has accessible citizens' juries see https://www.nice.org.uk/Get-Involved/Citizens-Council. This jury could review:*
>
> i. *appropriate specific thresholds taking account of the age of the population in care homes;*
>
> ii. *which outcome should be the main focus for the committee (EQ-5D-3L, ICECAP-O and/or ASCOT);*
>
> iii. *if/how health and capability should be balanced and what discount rate should be applied; and*
>
> iv. *the jury could be, or include, a Care Home jury designed to gather views from the key players in these settings. This would include residents and those who can represent them (where mental capacity is a lacking), relatives/ friends,*

the essential visiting professional, staff and provider organisations **(IH3/20 - INQ000215625)**

79. I was concerned in relation to this suggestion due to the difficulties in considering how to convene a representative jury. If we were to convene a jury from the general population, this would likely include individuals with no interest in care homes, but if we were to include only care home residents and family members of care home residents, this would create ethical dilemmas. Going forward, we should consider how to go about conducting this assessment in a reliable and balanced manner as part of planning and preparedness for any future pandemic. This type of work requires planning and funding.

80. At our SCWG meeting on 19 March 2021 we considered *'Family visits to care homes: experiences and perspectives on policies and practices during the COVID-19 pandemic. A summary of ongoing UK research'* **(IH3/21 - INQ000575270)**. This was a briefing paper commissioned by DHSC, PHE and the SCWG to the NIHR Policy Research Unit in Older People and Frailty.

81. It was designed to be a summary of ongoing research in the UK into the experiences and preferences of care home staff, families, and relatives on visiting in the time of the pandemic. This was part of our broader, continual work to gain a more complete understanding of the balance between protecting residents from disease ingress and transmission and the benefits to residents' wellbeing by allowing family visits.

82. The paper identified 17 ongoing UK-based research studies and emerging findings drawn from these studies highlighted the differential impacts of blanket visiting policies were perceived to be particularly unsuitable for the high proportion of residents with cognitive impairment. We further found that there was a need to appreciate the role of many family members in providing additional care, and the importance of clear communications between care homes and families.

83. Notwithstanding the conclusions, the summary did find that there were problems with the studies sampled. The main issue was that the majority of studies with emerging findings had only sampled very low numbers of participants and care homes, meaning that it was difficult to properly assess the impact that care home characteristics would have on the development and implementation of visiting policies and practice. Further, we found that the studies were lacking detailed perspectives on finance and resourcing implications of visiting policies and practice.

84. Overall, there are some methods for trying to quantify the benefits and risks of visitors, specifically QALY measured via EQ-5D metrics and ASCOT, but it is very hard to quantify "wellbeing"- particularly when it may be transitory. We did not have the tools then (or now) to quantify these factors fully. The ASCOT tool permits, by design, evaluation of quality of life specifically in the social care context but needs further research on generalizing and usage. Ultimately, the data available was limited and the modelling presented the challenges I have identified above.

85. There is an ongoing piece of work (funded by UKHSA) to pilot better means of quantifying these factors, with Anne-Marie Towers at Kings College London, who is a developer of ASCOT framework with colleagues at the University of Kent.

86. We were planning to develop a research grant extending this pilot by integrating models with these metrics, but there is no existing live grant targeted at applied research. Anne Marie and I had a discussion and agreed it would be better led by her from a social care perspective than centred on modelling, targeting NIHR funding options. This would have been translational/applied research but in my opinion, there is also gap for fundamental, low technology readiness interdisciplinary research. With that in mind I am currently targeting the UKRI multi-disciplinary call to consider more foundational questions about quality-of-life challenges across these settings connected to transmission and control of infectious diseases and model building.

87. The data on recovery of quality of life from periods of isolation in elderly population (and compound effect on their families) is very weak and more data should be collected. This is similar to the need to conduct work on the wellbeing of staff operating in setting (see below regarding PTSD in frontline NHS staff, paragraphs 151-152).

88. I have been asked about advice on local risk assessment or empowering local clinical judgement on allowing visitors. This was not a formal SAGE commission I recall explicitly receiving, though we considered dynamic risk assessment (paragraph 60 above) and we had representatives from devolved administrations and directors of public health participating or observing SCWG meetings. We considered aspects of this in later advice post vaccination, but we did not get involved in operationalising the advice. In September 2020 I was involved in some discussion of modelling risk for the Scottish Government, and I believe there was some piloting of dynamic risk assessment in Scotland but there were implementation challenges around suitable estimates of local disease prevalence in a timely manner and generalising across care homes on rates of ingress from staff,

visitors and health care professionals **(IH3/22 – INQ000611198; IH3/23 – INQ000611200)**.

89. I have been asked about the impact of visiting restrictions on people with learning disabilities and the lack of day-care access. I do not recall an explicit commission to provide advice, but we considered the issue of disease impact in this group later (see paragraph 179). This advice would not likely have been feasible to address in detail because of 1) a lack of denominator data (who/how many people are impacted), 2) the lack of measures of wellbeing impact, 3) comparative measures of disease risk. I should note a personal interest as I was seeing this precise impact on my sister who was becoming more socially distant/withdrawn as the pandemic progressed and who took time to recover. Virtual events were not a perfect replacement. More work is needed to plan for support to these groups in future events of this magnitude and this is not my area of expertise.

Hospital Discharge Consensus Statement

90. The Covid-19 Hospital Discharge Service Requirements were published on 19 March 2020 before the formation of CHWS. We were dealing with so much at the time that this was not something I was specifically aware of. It was not my role to review all government policy, unless specifically asked and at that time I had no specific mandate to advise on Social Care policy; we (that is the University of Manchester Mathematical Epidemiology group) were focusing on our other advisory work around doubling time of case numbers at the time.

91. We were not asked to produce any advice or modelling, prior to 19 March 2020, on the potential impact of the hospital discharge policy. In any event, we were not a formally mandated group at that time.

92. In November 2020, the Department of Health and Social Care commissioned SCWG to provide a consensus statement on the association between the discharge of patients from hospitals and COVID-19 in care homes. The consensus statement was to consider work already undertaken by NHS England and Public Health England and any relevant analysis from the devolved administrations.

93. For a time, we were in discussion about undertaking similar analysis on data from NHS England (which would have a larger sample size and so potentially greater confidence in results), but in July 2021 it became apparent that NHSEI data would not be available therefore we had to rely on the studies from PHE, Public Health Wales, Public Health

Scotland and the Department of Health Northern Ireland studies. The statement also included consideration of work done prior to the consensus statement such as the VIVALDI-1 survey which included the question *'How many residents have returned to the care home from hospital since March 2020'* **(IH3/24 – INQ000611203).**

94. Given the work done on discharge seeding outbreaks in Wales, Scotland, Northern Ireland and by UKHSA (via secondary data) there is a gap for similar retrospective analysis for England and it is disappointing that this was not conducted. Questions would remain though around the counting of cases in the early stages of a pandemic, as it takes a few months to link the data within NHSE. I believe data linkage is faster in Wales (via SAIL databank) and Scotland, but I am not an expert in those data sources.

95. We published our Consensus on Hospital Discharge on 26 May 2022 and concluded that:

    a. *Any person infected with COVID-19 going into a care home could introduce infection into the care home. Hospital discharge to care homes connects 2 high contact environments, where contact rates with carers in the course of care are high, and potential consequences of COVID-19 in vulnerable populations severe.*

    b. *Overall, we interpret the identified studies as showing that at least some care home outbreaks were caused or partly caused or intensified by discharges from hospital.*

    c. *However, based on the very much larger associations between care home size (a proxy for all footfall) and outbreaks, hospital discharge does not appear to have been the dominant way in which COVI D-19 entered care homes.*

    d. *Hospital discharge of people to care homes without testing early in the pandemic is highly likely to have caused some outbreaks or been one of the often multiple introductions of infection to care homes which experienced an outbreak. However, it is highly unlikely to have been the dominant driver of all care home outbreaks in wave 1.*" **(IH3/25 - INQ000215624).**

96. As mentioned above, we analysed the studies from PHE, Public Health Wales, Public Health Scotland and the Department of Health Northern Ireland studies to enable us to reach our consensus and I summarise these studies below.

97. The PHE study *"A data linkage approach to assessing the contribution of hospital-associated SARS-CoV-2 infection to care home outbreaks in England, 30 January to 12 October 2020* **(IH3/26 - INQ000234332)** was considered as part of our evidence base for the consensus statement.

98. This was a report commissioned by DHSC and SCWG to investigate care homes that received Covid-19 positive patients discharged from hospital, and subsequently experienced an outbreak

99. The study involved the creation of a process to derive residential property classifications of laboratory confirmed COVID-19 cases in collaboration with the PHE GIS Cell. This facilitated identification of cases residing in care homes.

100. Hospital discharge records were then linked to these records to identify care home residents who may have acquired their COVID-19 infection whilst in hospital and subsequent to their discharge, their care homes experienced an outbreak of COVID-19.

101. The main findings were as follows:

    a. from 30 January to 12 October 2020, there were a total of 43,398 care home residents identified with a laboratory confirmed positive COVID-19 test result;

    b. of these, 35,740 (82.4%) were involved in an outbreak, equivalent to a total of 5,882 outbreaks;

    c. 1.6% (n=97) of outbreaks were identified as potentially seeded from hospital associated COVID-19 infection, with a total of 804 (1.2%) care home residents with confirmed infection associated with these outbreaks; and

    d. the majority of these potentially hospital-seeded care home outbreaks were identified in March to mid-April 2020, with none identified from the end of July until September where a few recent cases have emerged.

102. The findings suggested that hospital associated seeding accounted for a small proportion of all care home outbreaks. The results further suggested that the policies implemented around 15 April 2020 (systematic testing prior to hospital discharge for patients discharged to care homes, and where a test result was still awaited, the patient would be discharged and pending the result, isolated in the same way as a COVID-positive patient) were, in some part, successful.

103. The Public Health Scotland study *"Discharges from NHSScotland Hospitals to Care Homes between 1 March and 31 May 2020"* presented management information statistics on people aged 18 and over who were discharged from an NHS Scotland hospital to a care home between 1 March and 31 May 2020 **(IH3/27 - INQ000325321)**.

104. One of the main findings of the study was as follows:

    a. In the statistical modelling analysis:

        i. Hospital discharge is associated with an increased risk of an outbreak when considered on its own. It is important to note that after accounting for care home size and other care home characteristics, the estimated risk of an outbreak due to hospital discharge reduces. No statistically significant association was found between hospital discharge and the occurrence of a care home outbreak. However, due to the uncertainty observed, we cannot rule out a small effect, particularly for those patients who were discharged untested or discharged positive.

        ii. Care home size is much more strongly associated with the risk of an outbreak than other care home characteristics, including the different types (negative test, untested, positive test) of hospital discharge.

105. The Northern Ireland report to the Minister for Health *"Clinical Analysis of Discharge Patterns from HSC Hospitals in Northern Ireland during early 2020 and any Link with COVID-19 Outbreaks in Care Homes"* identified that the weekly pattern of care home outbreaks during the first wave of COVID-19 appeared to be more closely correlated with COVID-19 hospital admissions rates during the same week (a reasonable surrogate for general community transmission and infection) than with the associated rates of unscheduled discharges to care homes **(IH3/28 - INQ000325326)**.

106. The patient-level analysis of those testing positive during weeks when the number of people discharged to care homes was more than usual, found that only about 1% (5 out of 465) of those people tested positive for COVID-19 in the fortnight after discharge to a care home. This was based on testing of symptomatic residents. It did not support a hypothesis that this group of people was a substantial cause of COVID-19 outbreaks in care homes.

107. The Public Health Wales study *"Risk factors for outbreaks of COVID-19 in care homes following hospital discharge: A national cohort analysis"* examined 3115 hospital discharges to a national cohort of 1068 adult care homes and subsequent outbreaks of COVID-19 occurring between 22 February and 27 June 2020 **(IH3/29 - INQ000213185)**.

108. The study used a Cox proportional hazards regression model to assess the impact of time-dependent exposure to hospital discharge on incidence of the first known outbreak,

over a window of 7-21 days after discharge, and adjusted for care home characteristics, including size and type of provision.

109. The study found that exposure to hospital discharge was not associated with a significant increase in the risk of a new outbreak after adjusting for care home characteristics and that large homes were at considerably greater risk of outbreaks throughout the epidemic.

110. The consensus statement also referred to a study from March 2021 titled *"Genomic epidemiology of COVID-19 in care homes in the east of England"* which was a large-scale study in the East of England carried out by the University of Cambridge **(IH3/30 - INQ000591858)**.

111. The consensus statement referenced the study as follows:

> *"Viral genomic analysis can help identify whether care home outbreaks are due to a single introduction of infection or whether outbreaks are driven by multiple separate introductions of infection. A large scale study in the East of England found that only 5.8% of care home cases were definitely hospital acquired. When the genomes of care home residents were compared to a control group of community cases the diversity of the genomic lineages was similar suggesting hospital discharges were not the primary driver. There was epidemiological evidence linking some outbreaks in different care homes to professional visitors."* **(IH3/25 - INQ000215624)**

112. This was further supported by a study that was published on 29 June 2021 titled *"Large-scale sequencing of SARS-CoV-2 genomes from one region allows detailed epidemiology and enables local outbreak management"* **(IH3/31 - INQ000610608)**. The consensus statement confirmed:

> *Similarly an outbreak involving 6 care facilities in a small geographical area of Norfolk and Suffolk, identified a genomically distinct lineage which was not found in community surveillance or in hospital inpatients. Only 2 out of 89 cases were definitely hospital acquired, suggesting that these care homes cross infected each other, most likely because of shared staff or professional visitors.* **(IH3/25 - INQ000215624)**

113. I understand the Chair would like to know my views on the March 2020 discharge policy. It is easy to attribute outbreaks in care homes to hospital discharges because the discharge is an observable event. But, Covid-19 was a largely asymptomatic infection, and care homes had many staff coming in and out on a daily basis, so one cannot be sure that outbreaks really were attributable to the discharges.

114. Overall, the hospital discharge policy was a risk, and one I would have been cautious of if it had been my decision. However, there was an unknown, but in my opinion likely, counterfactual where the rising levels of hospital admissions could have led to critical capacity issues if radical discharge policies had not been considered (given the 3-day doubling time in cases in March 2020). It is not a zero-sum scenario, carefully designed and calibrated tools are needed to support decision makers in these scenarios.

PART E - ANALYSING AND UNDERSTANDING KEY ISSUES DURING THE PANDEMIC

Early Data & Modelling

115. In February and March the Mathematical Epidemiology Group at the University of Manchester produced work on the potential role of 'cocooning' care homes (see paragraph 160 for more detail).

116. For the SPI-M meeting on 20 April 2020, I shared a paper entitled *'Preliminary analysis of PHE Care Home data'* written with UKHSA. The paper was also discussed at the SAGE meeting on 21 April 2020 and shared with DHSC.

117. This paper used a 'SIS' model for care home outbreaks drawing on data from two data sets: (i) data showing the number of new care homes reporting an outbreak of at least one case each day by PHE Centre, and (ii) data from the CQC on all cause mortality (i.e. total deaths in an institution, not necessarily Covid-19 related). Using this data and modelling, we made two significant findings:

    a. *a natural conclusion is that with no change in disease transmission in future we might expect at least 90% of care homes to report at least one case eventually if current reporting trends are maintained (currently about 20% have reported such). Given social distancing timing it does not appear to affect these outbreaks.*

    b. *However, it may be that the vehicle of connecting care homes is the staff and staff seem to be suffering disease at similar number to residents (though reason for staff absence is unclear in the data and may be that staff are absent for precautionary reasons). If staff work in multiple care homes then these high attack rates may lead to depletion of susceptible staff and so reduce transmission in time. Moreover, staff interact with households and community and so infection can be passed to and from care homes in this manner. This is uncertain and so should not be factored into planning yet.* **(IH3/32 - INQ000575257)**

118. A week later at the SPI-M-O meeting of 27 April 2020 we discussed a paper that our SPI-M Care Home Working Group had been working on entitled "*Progress update on Care Home data and modelling'* **(IH3/33 - INQ000215640)**. The paper was intended to provide a summary of the progress of the SPI-M Care Home working group and to answer some specific questions provided as part of our policy brief. In so doing, we drew on five different data sets to give an insight into the situation in care homes:

    i. the PHE daily line list;

    ii. CQC all cause mortality data;

    iii. swabbing data;

    iv. capacity tracking; and

    v. HPZone data (curated by PHE CROC each day which gives the number of care homes reporting outbreaks in PHE centres and regions).

119. Our analysis showed that the number of outbreaks within upper tier local authorities did not seem randomly distributed thus there was provisional evidence of clustering, although at the time we had concerns that this data may be biased. Further, the data was unclear as to whether larger care homes were more infectious or more susceptible, whether there was a difference between residential care homes and nursing homes, or whether there was a role that carers played in transmission dynamics.

120. On 7 May 2020, our Care Home Working Group produced *'Rapid increase of Care Homes reporting outbreaks a sign of eventual substantial disease burden'*. In this paper we used a 'GAM' ('Generalised Additive Model') to analyse data obtained from Public Health England through its network of Health Protection Teams. The data used was a weekly variant of the number of new care homes reporting an outbreak of at least one case each day between 8 March 2020 – 24 April 2020. We found that the model seemed to be suggesting 3 phases of growth in the data, initially very rapid growth followed by a couple of weeks of slower growth followed by 2 weeks of plateauing **(IH3/34 - INQ000575258)**.

121. In May 2020, we also produced *'Using statistics and mathematical modelling to understand infectious disease outbreaks: Covid-19 as an example'*. A large part of this paper was seeking to address, and mitigate the impact of, biases in the data arising from a growing force of infection, changes in the reporting rate, truncated data samples and a varying travel rate. The paper stated that many of the questions and techniques presented could be further developed as the availability of data and research interests evolved but

were compiled into the paper as an overview of methodology and scientific approaches beyond the standard SIR textbook model that could benefit the ongoing efforts in tackling the Covid-19 pandemic and other outbreaks **(IH3/35 - INQ000575263)**. I discuss this paper further in the cocooning section below.

122. Our University of Manchester Covid-19 Modelling Group and the Public Health England Modelling team produced *"Outbreaks in care homes may lead to substantial disease burden if not mitigated"* **(IH3/36 - INQ000575271)**. This was a paper that I lead-authored for The Royal Society of Publishing on their theme issue of 'Modelling that shaped the early Covid-19 pandemic response in the UK'. It was based on the work done through March, April and May 2020 but it took a year for the work to progress through peer review. This is indicative of the reporting delay between reports supporting SAGE papers/consensus statements and the eventual peer reviewed public record.

123. We were focusing on the specific risk for care homes given that in a care home context the staff population is much better connected to a wider community and the frailty of the residential population is greater, meaning that contact rates are likely higher and eventual outcomes worse.

124. As part of this paper, we analysed the data reported to PHE by its network of Health Protection Teams which provided us with the number of care homes newly reporting an outbreak of at least one case each day in England for a 16-week period between 8 March 2020 – 27 June 2020. We then had further available data with the postcodes of affected care homes so that we could cross-reference these against the CQC register of care homes to consider the risk of outbreaks over space.

125. Once we had collated the data, we then used a Generalised Additive Model ('GAM') to look at trends over time in England and, as a separate analysis, we used the data and postcodes to create a dataset of presence and absence to a specific time point.

126. Our research showed that there was a clear and rapid growth in the number of new outbreaks in early to mid-March 2020 (this was consistent with what had been observed in other surveillance schemes) before plateauing out in late April and levelling off in June. Therefore, we felt able to conclude that the number of outbreaks had changed over time due to a combination of national lockdowns reducing the force of infection into care homes, the role of testing staff and residents, and specific infection control within care homes.

127. This work was extended in a later paper in 2024 by Pang et al (also mentioned in paragraph 47) **(IH3/12 - INQ000606693)** which looked at the reproduction number in care home settings. The reproduction number gives a measure of the number of people an infected individual would likely infect, and so is potentially more interpretable than the growth rate (calculated in earlier work). This study showed that layering on top of the GAM mechanistic assumptions about disease epidemiology, can generate an estimate for the control reproduction number—the number of people infected per case in a wholly susceptible population, and the effective reproduction number—the number of people infected per case given current mixing patterns and, importantly, partial susceptibility in the population. The application of the model to real world data was promising and adaptable but it confirmed that care homes are home to elderly people with strong staff contacts and it is not clear what impact age has on the mechanics of disease progression. Therefore, the estimates were mainly illustrative of the methodology, and further work is needed to compare them with the transmission estimates from community surveillance. Work is ongoing (with Wellcome Trust grant funding and UKHSA PhD studentships) to extend this reproduction number inference to multiple groups (like staff and residents).

128. I have been referred to *'Impact of Interventions to reduce risk of outbreak occurrence in care homes', 2 September 2020'* **(IH3/37 - INQ000422262)**. I was not an author of this paper, which was produced by Strathclyde University. I have however exhibited it as I understand the Chair wishes to consider it. At the time it was made available I can confirm that it was an informative paper and supported the growing evidence base critically adding an agent-based simulation to the collection of models used.

Estimating Mortality Rates and Excess Deaths

129. In July 2020 our Social Care Working Group heard a presentation from one of my post-doctoral research assistants entitled '*Estimates of Excess Mortality in Domiciliary Care Data in England'*. The presentation analysed a complete dataset of CQC mortality data from 1 January 2017 to 22 June 2020. The presentation from Carl Whitfield concluded that excess deaths were significantly higher than recorded COVID-19 deaths, but this was not observed for unexpected deaths. The presentation also concluded that excess deaths recorded were significantly higher than recorded COVID-19 deaths. The presentation raised several 'open questions' as to the reasons for this **(IH3/38 - INQ000606705)**.

130. On 13 November 2020 the Social Care Working Group met to hear presentations from PHE and NHS England on their studies into deaths of people with learning disabilities

(IH3/39 - INQ000606703). The PHE report used data from the Learning Disabilities Mortality Review (LeDeR) programme **(IH3/40 - INQ000610605; IH3/41 - INQ000610604; IH3/42 - INQ000610603; IH3/43 -** INQ000101220 **)**.

131. We endorsed the PHE's report findings which were as follows:

    i. *COVID-19 accounted for 54% of deaths of adults with learning disabilities in residential care in the review period, slightly less than for people with learning disabilities generally, but still much more than in the general population.*

    ii. *The rate of COVID-19 deaths for adults with learning disabilities in residential care was higher than the rates of COVID-19 deaths of adults with learning disabilities generally, estimated from LeDeR. It was 2.3 times the rate calculated from actual LeDeR notifications and 1.5 times the estimated rate adjusting for under-notification. This difference is likely in part to reflect the greater age and disability in people in residential care.* **(IH3/42 - INQ000610603)**

132. We also shared concern about the raised level of deaths for people with learning disabilities in residential care settings and recognised that data gaps were flagged in both sets of reports. We endorsed the importance of collecting good data to ensure that people with learning disabilities were not disadvantaged.

133. In November 2020, I co-authored *'Excess mortality for care home residents during the first 23 weeks of the Covid-19 pandemic in England: a national cohort study'* **(IH3/10 - INQ000575269)**. The study was funded by NIHR and shared with DHSC and was based on work presented to SCWG in August and September 2020 by Marcello Morciano.

134. The aim of the paper was to estimate excess mortality for care home residents during the first 23 weeks of the Covid-19 pandemic, exploring associations with care home characteristics. We analysed the daily death notification data provided to PHE by the CQC between 1 January 2017 – 7 August 2020.

135. Death notification data were then linked at a care home level with CQC registers of active care homes in England, providing data on care home characteristics: setting type (nursing or residential home), client types (offering services for people aged 65+ and/or people with dementia or offering services to children and adults), ownership status (whether not-for-profit, charity/NHS/ local-authority-run homes, or for-profit), whether known to CQC to be independent or affiliated to a large provider / brand and their registered maximum bed

capacity (coded as small (less than 23 beds), medium (24–40 beds), and large (41 or more beds).

136. To calculate excess deaths overall and by care home characteristics, we first used data from the pre-COVID19 period to estimate expected death trends. After comparing predictive accuracy with more complex models structures, a Poisson regression model was selected, with covariates including a quartic polynomial of week-of-the-year (to account for seasonality) and local authority fixed effects (to account for determinants of deaths that differ across local authorities but do not change over time).

137. In summary, we found that up to 7 August 2020, there were 29,542 excess deaths in all care homes, which represented 6.5% of all care home beds. Further, the data suggested that the rate of excess mortality was higher in nursing (8.4%) than in residential care homes (4.6%). However, of those excess deaths, 64.7% of them had confirmed / suspected Covid-19.

138. The main conclusion that we could draw from the data was that, to limit excess mortality, policy should be targeted at care homes to minimise the risk of ingress of disease and limit subsequent transmission. Given the absence of reliable data, we were unable to conclude with any great confidence what interventions were optimal. We found that the efficacy of interventions depended upon the care home setting in which they were implemented and the behavioural responses of residents and staff. Critically, we noted that any benefits from such policies would need to be weighed against costs and potential adverse outcomes, such as reduced quality-of-life or psychological well-being.

139. A further paper I co-authored with my University of Manchester Colleagues, this time regarding estimating mortality rates, was *'Novel methods for estimating the instantaneous and overall Covid-19 case fatality risk among care home residents in England'* **(IH3/11 - INQ000575276)**. This paper was produced in December 2020 and shared with SCWG. The aim was to highlight the importance of the Case Fatality Risk ('CFR') tool, which quantifies the proportion of cases that result in death, and to show how we can use novel methods to evolve and improve our understanding of CFR as a measure for monitoring the UK epidemic. Crucially, we were concerned with correcting the distribution of times between someone testing positive and dying.

140. Firstly, we analysed non-identifiable, time series data on persons with confirmed SARS-CoV-2 infection and resident in care homes in England obtained from PHE systems. We then matched this data against the Ordnance Survey and CQC data to confirm the

individual's residence in a care home. Secondly, we utilised the daily death notification data obtained directly from CQC systems. By linking the two data sets by postcode, we obtained time series for the number of positive tests per day and the number of deaths (and deaths reported) per day.

141. We then used a variety of models, both traditional and novel, to account for the delay between infection and death. It's not as simple as dividing the number of deaths on a given day by the number of cases on that day, because many deaths are likely to be in individuals that tested positive on prior days. If the epidemic were constant, this would not be an issue, as the number of cases would be the same each day. However, in reality, epidemics change over time, with cases either growing or decaying. Therefore, it is important to construct an appropriate denominator that considers the number of cases on historic days and scales by the time to death delay distribution.

142. In summary, we said:

> *"The typical method for estimating the CFR is the "cohort" method, which requires line-list data linking cases to deaths. This method is easy to apply and interpret, but such data are often not readily available. When only time series data are available, the typical method is the "backward" method. Whilst this method is easy to apply to time series data, it is not as easy to interpret as the "cohort" method. To address this, we developed a novel "forward" method, which acts as an approximation to the "cohort" method that can be estimated from time series data rather than line-list data. Through comparing these methods, we found the forward method to be a good approximation to the cohort method"* **(IH3/11 - INQ000575276)**.

143. The most significant impact of this paper was that it produced a real-time tool for the assessment of information. Every time a new set of data was received, we could see, in close to real time, whether there was a change in severity. We ran the analysis every week approximately. We ran this in December 2020 as the vaccine was being delivered and it was possible to see the case-fatality ratio reduced as the vaccine took effect. Later, when Omicron emerged, we had the necessary information quickly, and we could see that the deaths weren't accelerating as quickly as cases, which meant we could give clear advice to government on the effects of the variant.

The Transmission of Covid-19

144. The CHWS/SCWG understanding of COVID-19 in the ASC sector is set out in the papers and consensus statements summarised above.

145. Transmission was a large area of focus for SCWG, measured indirectly by the growth rate and eventually by the reproduction number (see paragraphs 120-127) from surveillance data. Throughout our SCWG meetings we had a standing agenda for outbreaks and trends which enabled us to identify the trends through the data signals and understand the transmission of the virus.

146. The UKHSA Easter 6 study provided early concrete evidence of transmission within settings **(IH3/44 - INQ000325353)**. The types of epidemic model structures that could be used to consider patterns and drivers of transmission in care homes and the data required to form reliable models were detailed in Annex 1 of our SCWG paper prepared for SAGE dated 12 May 2020 *'Care Homes Analysis'* **(IH3/14 - INQ000253601)**. In this paper we also stated that within care home transmission was highly likely due to data on positive and negative swab results and that there was strong evidence of asymptomatic transmission in care homes. We identified that the collection of data on individual staff and residents (for example staff role and whether individual had joined/re-joined home recently) were critical to understand the transmission patterns and monitor efficacy of future interventions. We also highlighted a lack of reliable data on contact patterns within care settings and on staff movement which would be critical to infer who was passing infection to whom within the setting and so enable simulation/counterfactual evaluation of outbreaks

147. One specific aspect that is critical is the potential ingress to the setting from the community. The September 2020 *Social Care Working Group update paper* highlighted that disease could enter care homes by visitors, visiting professionals, community admissions, hospital discharges, and staff. Given the nature of transmission via aerosol, droplet or fomite all could be potential routes of ingress of disease and once in the setting cause onward transmission. The paper confirmed that there was evidence of staff-to-staff transmission, and this had been observed to have been a contributory factor in specific outbreaks **(IH3/16 - INQ000422314)**. This, in addition to other research and scientific investigation, led to interventions to discourage care home staff from working in multiple care homes.

148. I have been asked about the role of the environment and staff behaviour on transmission within care homes and the rest of the ASC sector:

    a. I am not aware of specific work on environmental factors within care home settings. However, the SAGE EMG group consider general risks with advice that would have translated to care homes and as a participant in EMG I would have been able to

highlight the links where necessary (some EMG participants also attended SCWG where possible). This included advice on environmental factors that influence transmission (May 2020 – **IH3/45 - INQ000606692**), the role of aerosols in transmission (July 2020 – **IH3/46 - INQ000606682**), and the role of ventilation (Sept 2020 – **IH3/47 - INQ000203993**). There was also a deep dive into transmission in prison settings (March 2021 – **IH3/48 - INQ000192160**) that whilst not directly the same shared some characteristics as care homes.

b. The CONTACT study, funded by NIHR and awarded to a team from the University of Leeds attempted to use small, wearable, inexpensive, digital devices within secure 'plug and play' wireless networks in homes to provide reliable real-time and historic contact data. Such wearables can increase the quantity and quality of contact data using technologies similar to those already present in homes: access fobs, cards and wristbands. This could quantify contacts between staff and staff, staff and residents and residents to resident. I was not a co-investigator, so details of the challenges with this would need to be provided by the team itself **(IH3/49 - INQ000610610; IH3/50 - INQ000610609)**.

Staffing Issues and Structure

149. I understand the Chair is keen to understand whether or not knowing more about complex staffing issues at the start of the pandemic may have improved the modelling conducted, or advice given as a result of the research carried out (for example, in relation to the effectiveness of cocooning care homes as an early intervention).

150. I am not an expert in social care staffing, and for up-to-date evidence I would suggest contacting the policy research unit in social care staff (https://www.kcl.ac.uk/hscwru). However, there were two themes that come to mind as I recollect on questions arising during pandemic about complexity of staffing.

151. Firstly, that pay is low in the sector and so during summer there was concern of staff moving from social care to the leisure industry or other roles (and so increasing workloads for those remaining in posts) and secondly that the NHS were regularly conducting staff morale surveys ("Mental health of staff working in intensive care during Covid-19" **IH3/51 - INQ000339417**) which showed front line workers suffering PTSD akin to front line soldiers.

152. I am aware of no similar survey of social care staff which feels like a gap. My understanding is that there is no collective staff representation either across the social

care sector or offering training and advice. Having such an organisation to engage with may have helped coordinate adherence.

153. Given the nature of modelling advice, in the early stages of the pandemic, detailed knowledge of the complexity may not have changed advice at the time of wave 1. Part of the complexity often overlooked beyond pay and working arrangements is that social care staff have families and households away from work. Co-habiting may have been a factor in boosting prevalence in staff above that of the general community at salient times.

154. I would say that more information always improves modelling. It would always be useful to have more / better data about staff and it would inevitably improve modelling. We are undertaking some research to understand contact patters between staff in prisons and we have a PhD student in Manchester working with experts at Leeds University who is researching contact patterns within care home. We intend to submit the ethics application in August 2025 and then start the study later in the year. We have received funding from his UKHSA supervisor to purchase the Bluetooth sensors. The paper from Strathclyde University referred to above also addresses this issue.

Enclosed Societies

155. In late March/early April I was working with the UKHSA Joint Modelling Team on outbreaks in cruise ships and prisons. On 6 April 2020, I shared a paper we had been working on entitled *"Modelling outbreaks in enclosed societies"* with our SPI-M group and DHSC secretariat in response to conversations that we had held the previous week. This was a preliminary analysis of small, enclosed societies such as care homes, prisons, or cruise ships. We created a model which suggested it was plausible that infection attack rates (IAR) could be around 80% for a specific enclosed society of about 50 people with 20 staff, with outbreak lasting about 1 month for bulk of cases. However, the model parameters in the paper were uncertain and could have been refined with data or discussion **(IH3/3 - INQ000610601; IH3/52 - INQ000215645)**.

156. The SCWG set out the features of enclosed settings in our *"Care Homes Analysis"* paper dated 12 May 2020 **(IH3/14 - INQ000253601_0015)**:

> *5.1 The household structure and semi-closed (yet interconnected) nature of the care home sector make homes especially vulnerable to high attack rates during infectious disease outbreaks. Risk is however not uniform and is affected by household size and composition, (e.g., small care homes can have higher incidence of influenza outbreaks than larger ones)*

5.2 UK care home residents are primarily >80y 18, thus in the age group with the reported highest mortality rates for COVID-19, and considerable outbreaks are being reported in the sector worldwide.

5.3 While the particular kind of society (prison, care home, school, barracks, etc.) was not a significant factor in an adjusted model of attack ratio, a person's occupation within the society was. In particular, children and military personnel suffer a greater attack ratio than other occupational types (staff, prisoners, etc.). There was no temporal trend in final attack ratio nor, with the exception of 1918, do pandemic years show abnormal attack ratios.

157. As is evident from the references in that paper (many of which pre-date COVID-19), the vulnerability of care homes to infection from respiratory illness was, in broad terms, already known before the start of the pandemic. As I have said above, this was communicated to government via SPI-M after the 2009 pandemic.

158. Advice on risk and vulnerability was also laid out in the May SCWG paper and its follow up paper later in the summer these papers are both summarised in Part D above. In our May 2020 paper, we defined frailty as a long-established clinical expression that implies concern over an older person's vulnerability and prognosis. We stated that the prevalence of frailty in care homes is very high given that inability to cope and reduction in activity of daily living is a major reason for admission to a residential care home. We also confirmed that old age and frailty had been associated with the most adverse outcomes for COVID-19 with the highest case fatality rates found amongst the oldest groups **(IH3/14 INQ000253601)**.

159. Further, in our June 2020 paper we confirmed that there was elevated vulnerability to severe COVID-19 impacts in care home settings and high prevalence of frailty and co-morbidity of care home residents. These documents were available to decision makers. I cannot comment as to the extent of any communications pre-pandemic, save that I was part of discussions with PHE in early 2020 regarding the risk to prison and justice settings **(IH3/15 - INQ000562877)**.

Cocooning

160. In February / March 2020 the Manchester Mathematical Epidemiology group undertook modelling work in relation to 'Cocooning'. This work was undertaken as the Government were starting to think more about how some of the non-pharmaceutical interventions (NPIs) – now being branded as 'behavioural and social interventions' – would need to

work in practice. The specific briefing was to consider whether if a policy of social distancing (particularly for the elderly and/or vulnerable) were to be introduced, does modelling suggest that certain types of social interactions should be targeted/emphasised over others. Our work showed that even with significant reduction in connectivity substantive mortality and hospital demand would arise **(IH3/53 - INQ000606681; IH3/54 - INQ000575255)**.

161. This was commissioned by DHSC to SPI-M who had been asked for their views. My understanding is that the results of this work were subsequently shared with the Government given they had requested the work. I cannot comment on whether or not the UK Government adopted any recommendations regarding cocooning as I was not involved in implementation or policy decisions.

162. Further in May 2020 we produced *'Using statistics and mathematical modelling to understand infectious disease outbreaks: Covid-19 as an example'*. The paper was a collection of work-streams addressing various technical questions faced by the group as part of the ongoing response to COVID-19 and was designed to assist in gauging the effectiveness of various intervention and control measures. There was also emphasis placed on the modelling of disease outbreaks and spread, and it contained an extended analysis with the 'cocooning' model (paragraph 160) in care homes, acknowledging their susceptibility as a 'closed population' **(IH3/35 - INQ000575263)**.

163. That paper said in relation to cocooning (section 3.2) and noting that *p* is the probability that a median sized care home experiences a disease introduction:

> *"Reducing p corresponds to increasing protection of the vulnerable population in care homes by preventing introduction of infection (e.g. screening, testing and promoting hygiene among staff, etc.), a policy sometimes termed 'cocooning' or 'shielding'. The results show that reducing p from 0.99 to 0.1 corresponds to a reduction of around 22,000 (83%) in the number of deaths and around 131,500 in the number of hospitalisations (83%). Strategies aimed at reducing the probability of introduction into a care home, such as reducing the number of visitors or increased monitoring and protection of care home staff, are therefore predicted to have a large impact on the number of cases in vulnerable care home populations.*

164. And later:

> *"We develop a tool for analysing the risk posed to this population by determining the peak size of the epidemic within the care homes and the number of deaths. Applying*

this model to COVID-19, we find that by "cocooning" the care homes, i.e. shielding them to reduce the chance of introduction from the external outbreak, we can significantly reduce the size of the peak and therefore reduce the number of deaths. However, assessing the necessary level of shielding requires accurate characterisation of the external force of infection, and underestimating this may invalidate shielding efforts. A limitation to the proposed model is the deterministic within care home epidemic. However, since the average size of care homes is relatively large and we assume a high R_0 within care homes, the deterministic assumption is unlikely to significantly alter the conclusions". **(IH3/35 - INQ000575263)**

165. I recall that Mark Woolhouse was a passionate proponent of cocooning, but the practicalities of it were challenging. He stated that the UK government *"could and should have done far more to protect the most vulnerable during the second wave"* **(IH3/55 - INQ000215632)**. With the benefit of hindsight, it is always possible to argue that more could and should have been done. This is particularly true in relation to care homes and in light of the impact that the second wave of the Covid-19 pandemic had on those in care homes. However, whilst shielding is conceptually simple, it is a challenge to implement.

166. A "Chair's briefing" from later in the pandemic in December 2021 also set out the practical difficulties of shielding **(IH3/56 - INQ000312455)**. The reality is that care homes had staff (and visitors), who have lives and interactions outside of the home. For cocooning to be effective, it would be necessary to cocoon the staff, their children, and so on. This is unlikely to be practicable at scale (anecdotal reports of some staff living on some care home sites were reported but not all care homes had land for such accommodation). These practical difficulties would apply at any stage of the pandemic, particularly as there was no national precedent.

167. Shielding also became more workable once there was capacity for daily testing, which was not available at the start of the pandemic. I cannot recall whether any secondary concerns in relation to cocooning were raised in early 2020 such as the potential impact of isolating care home residents on their wellbeing.

168. My memory is that SCWG were focusing on the high number of infections; the CFR was about 20% at the time, so we were focusing largely on that and issues around surveillance data, and SCWG were not thinking particularly about secondary complications around isolation in April/May 2020.

169. The secondary concerns were considered in July/August 2020 where there was a lot of work carried out regarding visiting, and the impact of restrictions on care home residents (set out above).

170. The hospital discharge paper which I have addressed above showed that a small number of outbreaks were directly caused by discharge. This comes back to end-of-life wellbeing decisions, and the importation risk given the flux in and out of the setting in general. Care homes are homes and not fortresses/prisons. More work is needed to evaluate the balance of risks in older populations. Interdisciplinary thinking is critical, and I am not an expert in aging, frailty or clinical management and so wider engagement with research community is needed, but also involvement with stakeholders, particularly those with lived experiences.

171. I cannot comment on what, if anything, the UK government did to 'cocoon' care homes in the early months of the Covid-19 pandemic. We were focused on our modelling work, and it was not part of our role to monitor government actions or translation of advice to policy, beyond inferring indirect impact of interventions in data trends.

Attack rates, morbidity, and risk factors for care homes

172. It is accepted that there will be higher attack ratios in semi-enclosed settings as a result of pre COVID-19 research and there is a general expectation that older people will have more severe illness/outcomes than younger people, this was particularly true after the initial report of SARS-COV2 severity from China in February 2020 **(IH3/57 – INQ000215642)**.

173. Death, the ultimate measure of severity, is well characterised in care home settings, see for example the papers summarised above *"Excess mortality for care home residents during the first 23 weeks of the Covid-19 pandemic in England: a national cohort study"*, **(IH3/10 - INQ000575269)** and *"Novel methods for estimating the instantaneous and overall COVID-19 case fatality risk among care home residents in England"* **(IH3/11 - INQ000575276)**.

174. The SCWG subgroup wrote 3 papers on the general frailty of the population at risk:

    a. *Frailty and care homes. Briefing paper for Scientific Advisory Group for Emergencies Care Home Working Group*; April 2020 **(IH3/58 - INQ000606702)**.

b. *Multimorbidity and frailty in care homes and implications for COVID-19 planning. Presentation and briefing paper for Scientific Advisory Group for Emergencies Care Home Working Group*; May 2020 **(IH3/59 - INQ000606704)**.

c. *Adverse effects of social isolation and loneliness. Briefing paper for Scientific Advisory Group for Emergencies Care Home Working Group*; June 2020 **(IH3/17 - INQ000575273)**.

175. Even after 5 years, the understanding of attack rates continues to be developed and worked on. The care home observatory work building on VIVALDI legacy is critical for future monitoring of such factors, and VIVALDI was critical during pandemic to provide evidence of disease impacts. I would suggest contacting UKHSA or UCL for an update on the VIVALDI plans.

176. In the early stages of the pandemic (March/April 2020) the UKHSA Easter 6 study was profoundly important to characterise impacts of disease *"Seropositivity and risk factors for SARS-CoV-2 infection in staff working in care homes during the COVID-19 pandemic"* **(IH3/60 - INQ000606690)** and *"Enhanced Outbreak Investigations - London Care Homes – April 2020"* **(IH3/44 - INQ000325353)**. There is much published work on this, and for more information I suggest that the Chair approaches UKHSA.

177. The pattern of impact on larger and smaller care homes changed over the pandemic; smaller settings seemed to get more ingress during Omicron than in earlier stages. The spatial spread was considered (Luke Webb thesis, chapter 5) with some spatial clustering in Wave 1. Using COVID-19 mortality reports within a care home, this showed clustering of outbreaks in Wave 1 in London, North West and Midlands with a spatial distribution then changing by wave **(IH3/61 - INQ000606912)**. This may be a signal of past outbreaks offering natural protection or artefact of data collection and needs further analysis with mechanistic models.

178. It is potentially important to consider the number of care homes in a region rather than just the number of outbreaks. Additionally, care homes that are smaller tend to be for younger people and so the disease risks are different.

179. People with learning disabilities were and are under-studied. There was work by UKHSA and a report was reviewed by SCWG (paragraphs 130-132 above), but given the lack of data there was no commission arising beyond advice to improve data collection. As the brother of someone with learning disabilities I am shocked at the poor state of data for

this subgroup of the population, and it is a critical national health equity issue. Without data there is not effective means for categorization of risk.

180. I understand the chair would like me to comment on international perspectives and experiences. I presented aspects of SCWG work to Africa CDC and WHO coordination groups during the pandemic. This was well received but did not lead to major coordination (note that in Africa the age pyramid is different so the risk from ASC was manifestly different). As well as different age profiles in countries, the organisation and management of ASC is different (in US the long-term care facilities operate somewhat differently). Participants were free to offer perspectives from collaborators in other countries.

181. I do not recollect receiving a commission regarding physical disabilities and prior health conditions. UKHSA Health Equity division were heavily involved in subgroup activity and would be best placed to provide further information in relation to this.

Testing

182. I have already provided a witness statement as part of Module 7 but focus on the approach to ASC in this statement. SWCG provided several pieces of advice in respect of testing.

183. We provided advice regarding testing in our SCWG papers in May and June 2020 set out above. The update paper in June 2020 provided the most detail with regards to testing. Annex 1 of the paper provided the commissioning statement from DHSC which confirmed that we advised in our May 2020 paper that staff and residents in all care homes should be re-tested weekly. DHSC stated they were working towards achieving this but also wanted to expand testing across the care sector. DHSC asked for our view to direct and prioritise testing capacity for the wider care sector and the options for incremental expansion as testing capacity increases.

184. On prioritisation of testing resources, we advised that existing outbreak status in a care home and the rate of likely introduction of disease are the key considerations for testing priority. This meant care homes with confirmed or suspected cases should test all staff and residents. We also advised that all other care homes should be tested to enable the identification of new outbreaks. We also provided advice on how frequently these tests should be carried out and who should be tested if the testing resources were more limited.

185. We confirmed that:

Policies on the approach to testing consider what approach to testing may be most acceptable/least distressing for residents and staff. Ideally there would be flexibility in the options provided, to accommodate the differing needs of the vulnerable populations. If a staff member (or resident that has moved recently) tests positive it is critical that they are followed up and investigated by contact tracing services with a good understanding of the locality (i.e. Health Protection Teams), who can explore whether they have worked in or been to other care settings and take appropriate actions. Given the nature of employment contracts, such staff may need to be supported in accessing services to support them financially for the duration of isolation. **(IH3/15 - INQ000562877)**

186. With regards to importance/weighting of testing domiciliary carers and the supported living sector. We advised that nursing homes had a higher number of outbreaks at that time compared to residential homes and should be prioritised. With regards to domiciliary care, it was difficult with the lack of data to assess the scale of domiciliary care and the connectivity to community and hospital settings. It was thought that large outbreaks were unlikely but difficult to detect and further analysis was required.

187. We also confirmed that analysis showed that care homes for the elderly, especially those providing dementia care had the highest level of outbreaks and the level of outbreaks in homes specialising in care of people with learning disabilities were low, but the client group was at high risk of mortality. We therefore recommended that risk assessments for these settings would have to be made based on their size, their connection to hospital (are residents frequently visiting hospital) and the number of staff they have and how many homes these staff work in **(IH3/15 - INQ000562877)**.

188. In our SPI-M meeting on 21 October 2020 we considered a paper which was authored by Alicia Roselló and Rosanna Barnard, on behalf of CMMID working group, LSHTM entitled *'Comparison between the current PCR testing regimen and higher frequency, faster turnaround, lower sensitivity testing (e.g. Novel lateral flow device testing) in long-term care facilities)'* **(IH3/62 - INQ000575265)**.

189. The results of this modelling study suggested that higher frequency faster turnaround tests for example lateral flow tests could prove extremely valuable in long term care facilities, preventing small and large outbreaks even under low sensitivity assumptions. It stated that testing using saliva specimens is also a much less invasive procedure than nasopharyngeal swabbing and may have wider acceptance than PCR testing which is particularly complicated for long term care facility residents with complex care requirements, e.g. residents suffering from dementia.

190. A higher frequency, faster turnaround testing strategy would, however, require a much larger number of tests, and therefore result in a larger number of false positives than the PCR testing strategy that was in place. The study stated that this could lead to the unnecessary isolation of residents (which is known to be deleterious to their physical and psychological wellbeing) and could lead to staff shortages due to the absence of staff who test false positive. A higher rate of positive tests would also rely on long term care facilities having the capacity to isolate a larger number of residents.

191. In November 2020 I co-authored a paper alongside colleagues at PHE and various Liverpool-based medical and research institutions entitled *'Covid-19 testing in outbreak-free care homes: what are the public health benefits?'* The main objective of the paper was to describe the epidemiology and transmission of Covid-19 in outbreak free care homes **(IH3/63 - INQ000575267)**.

192. A two-point prevalence survey of COVID-19, in 34 Liverpool care homes, was performed in April and May 2020. We analysed the changes in prevalence in an effort to identify associations between care home characteristics, reported infection, prevention and control interventions. The study faced some limitations, such as the low prevalence of infection which made certain variables hard to study.

193. No residents developed COVID-19 symptoms during the study. Between the two rounds of testing, there was no significant difference between either the prevalence of COVID-19 within homes or the percentage of homes containing positive residents. However, care homes providing nursing care and employing agency staff were more likely to contain test positive residents. Male residents were more likely to have asymptomatic infection than female residents. Closing residents' shared space was not associated with residents testing positive.

194. Having analysed the data from the prevalence survey, we concluded that asymptomatic Covid-19 care homes showed no evidence of disease transmission or development of outbreaks; suggesting that current infection prevention and control measures are effective in preventing transmission. Further, we found that repeat testing at 2 – 3 weeks had limited or no public health benefits over regular daily monitoring of staff and residents for symptoms. We recommended that these findings should inform policies calling for regular testing of *asymptomatic* residents.

195. On 29 January 2021 we produced *"Social Care Working Group: Interim position statement on testing in residential care settings to prevent outbreaks of Covid-19 and to*

effectively control outbreaks once declared" **(IH3/64 - INQ000606685)**. The paper was produced for DHSC and built on earlier advice to the ASC policy team on the appropriate testing regime for staff and residents to prevent outbreaks where PCR and LFD testing availability had been defined.

196. The paper looked in more detail at the evidence for two further outbreak management opportunities:

    a. Resident testing to prevent outbreaks

    b. Testing following outbreak declaration

197. On regular testing before an outbreak, the paper said:

    a. Modelling suggests that more regular testing of residents beyond current protocols will have a very marginal benefit that may be indistinguishable from other proposed testing strategies which focus on staff. Given the additional harm and distress potentially caused to residents this may not improve outcomes overall.

    b. Testing residents on a monthly basis as per current protocol should be maintained both as a "safety net" to detect outbreaks (analysis ongoing to assess role in outbreak detection) and to enable effective and comprehensive monitoring of vaccine campaign. It is also important to ensure new variants can be detected and monitored.

198. On testing following outbreak declaration, the paper stated:

    a. It is recommended that both LFD & PCR testing of all staff and residents is deployed on advice from PHE HPTs in response to an emergent outbreak. LFD and PCR testing should be undertaken concurrently, in order to gain the benefits of the speed of LFD tests with the increased sensitivity of PCR.

    b. Testing is only of value where it triggers action (for example to isolate positive staff or residents, or to monitor positive residents more closely). For example, the value of additional resident LFD testing in an outbreak depends on what action is taken based on this result. Actions determined by public health outbreak management teams should follow on identification of LFD test positive staff and residents, including isolation and contact tracing protocols.

c. To limit transmission within the care home LFD testing alongside PCR testing should be included in the current outbreak testing protocol for all asymptomatic staff and residents on day 0; on day 4-7 for those staff and residents who tested negative (or who were missed on first round), and on day 28 following last test positive or symptomatic case for recovery testing.

199. On 14 June 2021, '*SARS-CoV-2 antigen testing: weighing the false positives against the costs of failing to control transmission'* was published. I co-authored this paper with various academic modelling colleagues. The paper considered whether, as prevalence of COVID-19 fell, the economic and social cost of people having to isolate following receipt of a false-positive test result outweighed the ongoing threat from the virus **(IH3/65 - INQ000536504)**.

200. The paper stated that no measures to control SARS-CoV-2 transmission are without cost or harm, and these costs and harms are not experienced equally across society. Further asymptomatic testing interventions should not be dismissed on the basis of numbers of people isolating after false-positive test results alone without assessing their worth in preventing both onwards transmission and more widespread restrictive interventions.

201. In July 2022 our University of Manchester Covid-19 Modelling Group produced '*Modelling the impact of repeat asymptomatic testing policies for staff on SARS-CoV-2 transmission potential.'* The work was shared with the SCWG (in interim form prior to cessation of SAGE activity in April 2022) and eventually published on 2 November 2022. The study developed a model based on data available in the literature to predict the potential impact of repeat asymptomatic testing on Covid-19 transmission. Overall, the study found that even with different model parameterisations, in theory regular asymptomatic testing would be likely to be highly effective in reducing transmission in work-places, with the caveat that adherence to the testing policy is more important than the precise testing regime implemented **(IH3/66 - INQ000536508)**.

202. The results concerning high risk settings were used to inform policy advice for staff testing in social care from the SCWG. The key question here was whether substituting a weekly PCR test with an extra LFD test resulted in better, worse or similar outcomes, depending on the underlying assumptions. While 3 LFDs could replicate the 2 LFD/1 PCR model under certain conditions, this depended on sensitivity of the LFD tests and adherence to the 3 LFD tests (where it was assumed that the 1 PCR was mandatory). "Daily LFDs" outperform "3 LFDs + 1 PCR" (at 100% adherence) since the high frequency of testing counteracts the low sensitivity by providing multiple chances to test positive.

203. Testing capacity varied throughout the pandemic and to some extent this did impact on our advice. Our advice was always based on assumptions, which were - as much as possible - based in the real world. Therefore, our assumptions would have taken account of things like real-world testing capacity.

204. To add to that, it is not possible to test frail people every day because (for example) they don't have enough saliva. Geriatricians who were part of the SCWG were concerned about testing too frequently. An example of how testing capacity directly impacted our advice was that, as soon as LFD testing was available, we pivoted from testing residents to testing staff, to allow us to test residents less.

205. After SCWG stood down we continued development and research into testing approaches. In June 2023, I co-authored (with UKHSA) '*Faster detection of asymptomatic COVID-19 cases among care home staff in England through the combination of SARS-CoV-2 testing technologies'.* The study aimed to assess the effectiveness of using day 0 PCR and LFD testing combined with day 3/4 LFD testing for care home staff between December 2020 and April 2021. It found that the speed of turnaround for LFD meant that likely infectious staff were removed quicker, but PCRs were more helpful for identifying staff in the earlier stages of infection **(IH3/67 - INQ000536510)**.

206. This has important implications for future pandemic testing policy; although one test may be more sensitive, supplementing that test with another that assesses different viral material can prove beneficial in detecting more cases or cases more quickly. Further research is required to determine the effectiveness of other asymptomatic testing regimes and the most effective combination of tests.

207. Further in 2024, I co-authored (with UKHSA) *"Modelling multiplex testing for outbreak control"*. This study focused on singleplex versus multiplex testing, i.e. whether a test is designed to test for the presence of a single pathogen or multiple. The latter may be more cost effective in a scenario where Covid-19 levels are less prevalent. Test sensitivity, however, particularly in LFD tests, is highly conditional on the viral concentration dynamics of individuals **(IH3/68 - INQ000536511)**.

208. To inform the use of multiplex testing in outbreak detection it is therefore necessary to investigate the interactions between outbreak detection strategies and the differing viral concentration trajectories of key pathogens. Strategies that use a combination of multiplex LFD and PCR tests achieve high levels of detection, detect outbreaks rapidly, and have the lowest burden of testing across multiple pathogens. Influenza B was

estimated to have lower rates of detection due to its modelled viral concentration dynamics.

209. The dominant testing strategy appears to be 'concurrent testing', where symptomatic cases are first tested using LFD tests, and if a negative LFD is observed they are immediately retested using a PCR test. This provides the main benefit of LFD tests, in the form of cheap and rapidly available results for the majority of cases, while still maintaining a high outbreak detection probability due to the PCR testing of negative cases to compensate for the sometimes-poor sensitivity of LFD tests.

210. Overall, the results suggest that multiplex LFD tests can be effectively deployed to detect SARS-CoV-2 and influenza A/B outbreaks. Care should be taken to ensure that multiplex LFD tests have a sufficient level of influenza B test sensitivity. According to the modelled metrics, it appears that the best strategy is the concurrent testing strategy, which uses each test according to the strengths of that test; initial use of rapid tests to rapidly detect high viral concentration cases, and PCR testing to detect cases with small viral concentrations. Solely relying on LFD tests may lead to some outbreaks not being detected, whereas solely relying on PCR tests can add unnecessary delays into the process and diminish the effectiveness of subsequent interventions **(IH3/68 - INQ000536511)**.

211. Future research into testing should in my opinion focus on the interactions between testing staff, testing residents (given the frailty of residents), and their wellbeing. This of course goes beyond just testing and to the actions that arise from testing to mitigation transmission. Testing is not itself an intervention but a means of collecting actionable evidence.

IPC and PPE

212. We produced research and advice on Infection Prevention and Control measures. I set out below the various research and advice.

213. In September 2020, a paper authored by Prof Chris Todd, Dr Lisa McGarrigle, and Dr Elisabeth Boulton entitled '*The effectiveness of PPE in reducing the transmission of COVID-19 in unpaid carers and those delivering care within the same parameters as unpaid carers'* was discussed and edited in our SCWG meeting and prepared in response to a question from DHSC asking if unpaid carers could do anything other than hand washing and physical distancing to protect the person they care for in the same household **(IH3/69 - INQ000058351; IH3/70 - INQ000058378)**.

214. The key conclusion was that "*It is highly likely that the use of masks, gloves, gowns and other PPE together with behavioural infection control measures, such as hand washing and physical distancing, will result in a decreased risk of coronavirus transmission between unpaid carers and the cared for person. However the major caveat here is that these procedures must be properly instigated (including donning, doffing, and disposal of used PPE) and consistently followed if they are to be effective. Standard precautions should be taken where risk is low (e.g. hand washing and use of masks). Contact and droplet precautions should be taken for suspected or confirmed cases of COVID-19 (e.g. handwashing, mask, gown, googles, and gloves). However, we note that in the home situation faced by unpaid carers there is high transmission risk when the infected person is asymptomatic.*" **(IH3/69 - INQ000058351)**. The paper was shared with the DHSC policy team.

215. Further on 24 September 2020 in our SCWG update paper to SAGE also shared with DHSC, in relation to PPE for unpaid carers we stated that *rather than it simply being a matter of the availability of PPE for carers that determines effectiveness, the behaviour of carers and cared for persons are major determinants of transmission. It is crucial that protective behaviours are implemented prior to symptom development. The behavioural evidence suggests that co-resident carers are less likely to wear PPE routinely in the home (although it should be made available to those who wish to avail of it) and physical distancing is often seen as less acceptable. As most research appears to have been conducted in relation to masks and gowns, we particularly advocate the use of this kind of PPE by unpaid carers. We also strongly advise that appropriate training and behaviour change measures must be provided using evidence based interventions such as Germ Defence* **(IH3/16 - INQ000422314)**.

216. In late May 2021, our SCWG produced "*What are the appropriate layers of mitigation to deploy for care homes in the context of post vaccination risk landscape?"* This was provided to SAGE for their meeting on 27 May 2021 and shared with DHSC. The report was the result of multiple commissions from DHSC considering testing, staffing and IPC provision following the vaccine campaign in care home settings and wider social care **(IH3/7 - INQ000215628)**.

217. The paper stated that it would be natural to consider whether it is time to reduce the level of IPC, PPE in social care settings due to the high vaccine coverage achieved and low community prevalence. However, due to the collective implementation of multiple mitigations, it was very hard to evaluate specific contributions from single interventions. The paper attempted to review each of the interventions to assess how each was working

as an integral part of the overall package of mitigations. In the table of interventions, the effect of hand hygiene, mask use and other PPE was stated as unknown and the harms of masks and PPE were set out for example they could confuse residents, particularly those with dementia, and were a barrier to communication and recognition. I provide more detail on this paper in the Vaccination section below.

218. At our SCWG meeting on 17 December 2021 we reviewed "*The effectiveness of PPE in reducing the transmission of COVID-19 in health and social care settings: December 2021 update*" **(IH3/71 - INQ000575275)**. This paper was also shared with SAGE and DHSC. The paper was an update of the May 2021 paper above in light of the identification of the Omicron variant.

219. The paper reviewed literature into PPE use in healthcare workers; masks; other PPE (gowns, gloves, eye protection); training; behaviour; hand washing; and use of PPE. It concluded that *there is likely to be an intersection between high risk, high exposure and low resource, which needs to be addressed when considering how best to reduce transmission across different health and social care settings. It is highly likely that the use of masks, gloves, gowns and other PPE together with behavioural infection control measures, such as hand washing, will result in a decreased risk of coronavirus transmission in social care* **(IH3/71 - INQ000575275)**.

220. A significant issue in analysing the efficacy of IPC and PPE is that we are faced with what Australian virologist Ian McKay termed the 'Swiss cheese' model. As I mentioned in my Module 2 statement at paragraph 131, *"This is a simple conceptual analogy that the various interventions that were in place (i.e. face masks, hand hygiene, social distancing etc.) and the numerous 'layers' that the virus must travel through to be transmissible. At some point, the holes in the 'Swiss cheese' will align and the virus will transmit, but the challenge is understanding which interventions can be removed whilst ensuring that the holes in the 'Swiss cheese' do not align."*

221. Overall, we advised that there was consistent and robust evidence that PPE and mask wearing reduced infection risk from the virus. Along with vaccination and testing with LFD and PCR, it is highly likely that the use of masks, gloves, gowns and other PPE together with behavioural infection control measures, e.g. hand washing, would result in decreased risk of coronavirus transmission in social care. However, to be effective these procedures had to be properly instigated (including donning, doffing, and disposal of used PPE) and consistently followed. We also advised that more PPE and IPC training was required in social care. Evidence suggested that exposure to COVID-19 in a household

or private setting is associated with increased risk of infection in health care workers and household or private setting exposure is a stronger risk factor than work exposure.

222. Additionally, the following work is relevant to this topic:

a. A cross-SAGE non-pharmaceutical interventions paper from 21 September 2020 which emphasised the need for packages of measures though that was more around widespread restrictions rather than masks and ventilation **(IH3/72 - INQ000215629)**.

b. In November 2022 I co-authored *'Modelling the impact of non-pharmaceutical interventions on workplace transmission of SARS-CoV-2 in the home-delivery sector'*, which concluded that *"without interventions, significant transmission could have occurred in these workplaces, but that these posed minimal risk to customers. We found that identifying and isolating regular close-contacts of infectious individuals (i.e. house-share, carpools, or delivery pairs) is an efficient measure for stopping workplace outbreaks."* **(IH3/73 - INQ000536506)**

Vaccines

223. We prepared a number of papers in respect of Vaccines and their impact.

224. At our SCWG meeting on 5 February 2021 we reviewed *"Vaccine impact on Care Homes in England"* **(IH3/74 - INQ000575268)**. This was a paper our University of Manchester Epidemic Modelling Group prepared which showed our work from January 2021 as a preliminary assessment on the vaccine impact. This paper was also shared with SPI-M-O and DHSC.

225. The paper was designed to evaluate the impact that the vaccine was having on care homes. More specifically, we were focused on whether the vaccine had curbed the mortality rate in care homes. As part of this paper, we reviewed and compared daily mortality notifications to CQC during the first wave (i.e. January 2020 – July 2020) and the second wave (i.e. August 2020 – January 2021).

226. This paper concluded that using current estimates of 90% vaccine coverage in residents, a single dose with 70% efficacy drops an R = 1.8 (similar to that seen in early January prior to lockdown in southern England) to RV = 0.66 in a care home with no prior exposure to COVID-19.

227. To explain, R is the reproduction number of the virus, so this conclusion indicated that 90% vaccine coverage would reduce the reproduction number from 1.8 (which would lead to approximately a 70% attack rate) to 0.66, which is a substantive reduction leading to qualitatively different manifestation of outbreaks. A rate of R less than 1 means that typically outbreaks are not sustained and the scale is decreasing, an R=0.66 as in this study would suggest on average that for every 3 primary cases there are 2 secondary cases, so each future generation is smaller in size.

228. On 26 February 2021 our SCWG discussed a paper I had produced on behalf of the University of Manchester Epidemic Modelling Group entitled *"Vaccine Coverage and Impact"* **(IH3/75 - INQ000606686)**. The paper was also shared with SPI-M-O and DHSC. In summary, this identified that:

a. Deaths appeared to have reached a peak and there was 95% confidence of decay (i.e. that we were 95% likely to see deaths reducing week on week all other things being equal).

b. We had previously estimated that 75% coverage for staff and residence was necessary to bring the R number below 1 and mitigate outbreaks.

c. This paper builds on that assessment including consideration of staff and resident mixing and the force of infection into the care homes.

d. Including distinct mixing between staff, between residents and within staff and residents one gets a more complicated relationship for R0 (with uncertain parameters).

e. Assuming specific structure on the mixing matrix, and assuming 90% coverage in residents, with single dose efficacy of 55%, staff coverage above 80% would be needed to control outbreaks.

f. Staff coverage rates were reported to be around 65%.

g. Two options were explored - providing second does to a third of residents in each home and seeking to vaccinate an additional 15% of staff. The paper suggested that similar impact would be seen from both.

h. I noted that, whilst this was about twice the number of vaccines being administered, identifying residents may be easier than staff (due to working patterns, hesitancy and access to vaccine centres).

229. Following the two papers above, at the end of March 2021, we produced *"Social Care vaccine and testing modelling response to recent commissions"* **(IH3/76 - INQ000610606)**. The paper was reviewed at SPI-M-O and SCWG and shared with DHSC. It considered the vaccine efficacy directly and the impact of new variants on the vaccines. The paper was produced in response to two commissions from DHSC as follows:

    a. *DHSC requests whether policy teams can use the SAGE Social Care working group guidance suggesting that a take up rate of 80% in staff and 90% in residents in each individual care home setting would provide a minimum level of protection against COVID-19 as part of the public consultation?*

    b. *DHSC requests does SAGE support the position to move from a weekly PCR to a twice weekly LFT testing regime of staff in the ASC sectors such as home care and day services, we welcome SAGE's views on the evidence, risks and considerations of such a change.*

230. In response to the first DHSC request, we produced a model which suggested that:

    i. *Current proposed minimum vaccine rates of 80% in staff and 90% in residents are just sufficient to bring local reproduction number below 1 based on a single dose (as presented before) and likely to be more effective for reported efficacy of two dose regime.*

    ii. *If a new variant emerged against which current vaccines had lower efficacy if those efficacies are below and to left of green line then it is unlikely that homes will be protected whilst if they are above and to right of black line protection is more likely. If the new variant increased transmission then reanalysis would be needed.* **(IH3/76 - INQ000610606)**

231. In response to the second DHSC request our work suggested that:

    i. *A single LFD is unlikely to be sufficient (with reported sensitivity of 0.6-0.8). However, two LFD tests per week are likely to detect 84-96% of cases (calculated depending on whether to use sensitivity of 60% or 80%). The lower value may reflect lower sensitivity from testing at home rather than at a central location.*

    ii. *This analysis assumes the mean sensitivity is representative and the time varying nature of sensitivity may be important. Considering this with the Kissler NBA data viral load trajectories and other data on LFD from PHE we can calculate the*

reduction factor (that for a single test per week would be the test sensitivity) and see testing every 2-3 days with LFD is likely similar to single PCR and sufficient depending on adherence to regime. **(IH3/76 - INQ000610606)**

232. Further in March 2021, the SCWG provided a consensus statement to estimate the minimum level of vaccine coverage that would achieve a level of protection in care homes against widespread outbreaks given the epidemic situation. The statement was published on 21 May 2021 **(IH3/6 - INQ000215662)**.

233. In order to provide this estimate, we drew on modelling analysis, published in the SPI-M consensus statement of 11 March 2021, which estimated that 75% of staff (given that 90% of residents in each individual care home had been vaccinated) provided a level of protection sufficient to limit outbreaks assuming other mitigations are in place. During March this analysis was updated to 80% coverage in staff and 90% in residents reflecting a slight change in evidence for efficacy of vaccination.

234. We concluded that these values represented the minimum rate that would achieve the desired level of protection in care homes. Critically, the 80% coverage for staff was derived given that 90% of residents were vaccinated and both groups had had a single dose of vaccine.

235. We noted, however, that the mathematics underpinning these conclusions was relatively simplistic (though justifiable as a way of informing policy), it was the best estimate that we could have provided in March 2021 and given the changing epidemiological situation, they should be continually reviewed as evidence emerges.

236. We identified that there was limited data on contact within the care homes both between staff and residents and within staff and resident groups. Given the unique transmission dynamics within care homes, we felt that further data on resident interactions was crucial to inform future policy decisions and for the continual review of vaccine efficacy as new evidence emerges.

237. We highlighted that *"vaccine is not a silver bullet, just part of our armoury against COVID-19. There is a risk that vaccination may lead to a reduced use of testing, PPE and IPC at a time that vigilance is needed against new variants with poorer vaccine efficacy"* **(IH3/6 - INQ000215662)**.

238. As mentioned above in May 2021, SCWG produced and shared with SAGE and DHSC a paper entitled *'What are the appropriate layers of mitigation to deploy for care homes in*

the context of post vaccination risk landscape?' **(IH3/7 - INQ000215628)**. This was a report to examine the evidence of the impact of interventions to mitigate Covid-19 that were in place in residential and nursing homes (i.e. not adults receiving social care services in their homes). We also considered further scenarios for future mitigation provisions.

239. In summary, we concluded that vaccines have proven to be (and will continue to be) the key transformational intervention. We found that vaccination was unique amongst the interventions deployed in care homes as it impacted all four identified hazards. It reduced the susceptibility of staff and visitors to infection and reduced ingress rates by reducing community transmission. It had a reported reduction on transmission, reduced susceptibility of residents to limit outbreaks and reduced severity of infection.

240. In terms of the efficacy of vaccines in care homes, we found that mortality patterns in wave two were more akin to seasonal mortality patterns that we would expect to see in any given year. Therefore, not removing any interventions, it was possible for us to say with medium confidence that the residual mortality risk in a vaccinated set of residents was of the same order as pre-pandemic seasonal flu.

241. We also considered the case for easing restrictions and how any such easing should be done. It was important that we balanced the consequences of standing down interventions in terms of infection control and general wellbeing and the threats from new variants and prevalence in the community. We decided that it was best to devise a risk-based scenario system to deal with (i) baseline, (ii) defend, and (iii) outbreak. For each scenario we would then recommend the interventions that we considered to best strike the balance between easing interventions and managing the risk of prevalence within the community:

    a. ***Baseline****: In areas with low incidence (measured as no outbreaks in homes nearby or low community incidence) and no reports of VOC in local community: weekly PCR testing for staff, LFD testing for visitors up to a maximum of twice per week, no testing of residents unless returning from external setting as per current advice, and monitor vaccine coverage rates at individual home level to ensure consistently high level of vaccine in staff and residents.*

    b. ***Defend****: In areas where there are either consistently rising levels of infection (measured through number of outbreaks in nearby care homes or community incidence) or VOC in community then move to more defensive posture. If*

community transmission of VOC, trigger whole home care home testing as part of surge testing (ahead of any detected cases or outbreaks in care homes); otherwise, implement weekly PCR testing and twice weekly LFD testing of staff; threshold testing for visitors to maximum of twice per week; no resident testing unless returning from external setting. All suitable PCR test positive cases (staff, residents and visitors) to be sent for whole genome sequencing. Push vaccine coverage to desirable levels for staff and residents (especially new staff and residents) at home level. Advise all visitors to take up offer of vaccine. Cohort staff and residents and limit cross deployment of staff.

c. ***Outbreak**: If confirmed case(s) in home then trigger whole home testing as per current outbreak protocol including daily LFD testing of staff; for duration stated in protocol restrict visiting to essential only and threshold test on every visit; stand up all IPC measures as per protocol.*

PART F - REFLECTIONS, LESSONS LEARNED, AND RECOMMENDATIONS

242. There were numerous things that went well during a difficult time. SCWG were agile in providing advice and identified issues around impact of visitors or impact of testing on residents, and modified advice accordingly with appropriate evidence.

243. Surveillance data was shared (or access provided) with minimal fuss by CQC and then DHSC, which became the bedrock for our analysis on trends in care home settings to both SPIM-O and SCWG.

244. More emotive advice, such as around impact of hospital discharge, was conducted. This took a while to be put in the public domain and this could have happened faster if data linkage in general was better (so there were social care episode statistics equivalent to hospital episode statistics) across the whole UK and specifically if the NHS had completed the analysis of the linked data in England (similar to the analysis in Scotland and Wales but with a larger population).

245. The SAGE subgroup (either CHWG or SCWG) ran effectively with very engaged participants. My personal opinion is that a standing multidisciplinary committee to review the evidence base for advice and identify scientific gaps for social care is useful as much that it enables different groups to know each other ahead of next emergency. The risk is that this becomes a 'talking shop' between pandemics, but that could be mitigated with thought around timing and focus of meetings.

246. The science questions posed during pandemic needed multidisciplinary input and were not limited to modelling (that was just an early focus of activity). During the pandemic there were many knowledge gaps, some of these were filled sufficiently and some remain, such as around balance of risks to quality of life and characterisation of contact patterns. Conducting research in settings during a pandemic is challenging, so major gaps should be considered during periods of less pressure and be adequately resourced.

247. Social care staff do an incredibly difficult job, and there should have been support in place to measure their wellbeing but also it is important to note that there is no blame intended in any papers written about spread of the virus within settings by staff. In many cases, they would have been largely asymptomatic and so a language needs to be developed to enable a conversation about transmission without seeming to apportion blame and increase trust between settings and advisory groups.

248. SAGE is a very well-run process. My experience of observing SAGE exercises for different national risks suggest this does and would work effectively. The long-term nature of a pandemic may offer some unique challenges that could be mitigated in future, such as sustaining an advisory workforce, dissemination of science to relevant stakeholders in appropriate format and the iterative nature of advice (in particular data and modelling improves over time and increments so reports are not 'static').

249. Common size of secretariat for SAGE subgroups – the SCWG had 1 person providing secretariat, with additional ad hoc support provided. Perhaps a subgroup should have a 'paper' descriptor for working arrangements and support, and a uniform policy on note keeping.

250. SAGE papers being made equivalent in some way to traditional "peer review" papers to save SAGE participants time converting and duplicating effort on the same work and also the subjectivity of journal editors. This would also help with the apparent timing of advice in the public domain (and multiple copies of advice).

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: 12/6/2025