

Witness Name:

Professor Andrew Hayward

Dated: 18.10.2022

Ref: M2/SAGE/01/AH

COVID-19 INQUIRY – MODULE 2

Updated Questionnaire Response – Professor Andrew Hayward

1: Overview of qualifications, career history, professional expertise and major publications:

Qualifications

1.1. The following table outlines my qualifications:

Table 1- Qualifications

2009	MD Infectious Disease Epidemiology, University College London
2000	Membership of the Faculty of Public Health Medicine
1996	MSc Communicable Disease Epidemiology, London School of hygiene and Tropical Medicine - Distinction
1994	Diploma in Tropical Medicine and Hygiene, Liverpool School of Tropical Medicine and Hygiene
1990	MBBS United Medical and Dental Schools, University of London-Pass
1987	BSc (Hons) Psychology, University of London- 2nd Class Upper Division

Employment History

1.2. The following table outlines my employment history:

Table 2- Employment History

2017-present	Director, UCL Institute of Epidemiology and Health Care and Co-Director, UCL Collaborative Centre for Inclusion Health - Professor Infectious Disease Epidemiology and Inclusion Health
2014-2017	Deputy Director, UCL Institute of Health Informatics – Professor Infectious Disease Epidemiology and Inclusion Health
2010-2014	Co-Director, UCL Centre for Infectious Disease Epidemiology, Deputy Head of Department of Infection and Population Health - Reader Infectious Disease Epidemiology UCL
2001-2009	Senior Lecturer Infectious Disease Epidemiology – UCL
1998-2001	Lecturer in Public Health – University of Nottingham
1994-1998	Research Registrar and Public Health Training Rotation - PHLS Communicable Disease Surveillance Centre. Leicester Health Authority – Health Protection, Southern Derbyshire Health Authority - General Public Health, Thames Regional Public Health Offices, Health Protection
1992-1994	Senior House Officer Public Health Training Rotation – Leicestershire Health Authority
1992	Senior House Officer Rheumatology – Leicester Royal Infirmary
1991-1992	Senior House Officer Accident and Emergency – Hereford General Hospital
1991	Junior House Officer - General and Respiratory Medicine - – St Thomas's Hospital London.
1990-1991	Junior House Officer – General Surgery – West Suffolk General Hospital

Career Overview

- 1.3. I am qualified in medicine, and following training in public health, became a member of the General Medical Council specialist register in public health. A substantial part of my early public health training (1994-98) was in the Respiratory Infection Section of the Communicable Disease Surveillance Centre working with Professor John Watson. Since my academic training

[Master's Degree in Communicable Disease Epidemiology 1996], most of my career has been based in academic posts, first in Nottingham working with Professor Van-Tam and then at UCL. At UCL I co-directed the Centre for Infectious Disease Epidemiology, was then deputy head of the Department of Infection and Population health, then Deputy Director of the UCL Institute of Health Informatics and most recently Director of the UCL Institute for Epidemiology and Health Care (one of the largest research institutes of its type covering applied health research, epidemiology, public health and behavioural science). I am also co-director of the UCL Collaborative Centre for Inclusion Health, which focusses on the health needs of socially excluded groups including people experiencing homelessness, people who use drugs, vulnerable migrants, sex workers and prisoners. I am UCL Professor of Infectious Disease Epidemiology and Inclusion Health and have a broad range of research in these areas. I have a Master's degree in Communicable Disease Epidemiology, a Diploma in Tropical Medicine and an MD in Infectious Disease Epidemiology.

Publications

- 1.4. With regards to important publications, I will focus on my pre-pandemic research that informed my thinking about the pandemic and influenced early advice I gave. A major focus of my work has been on epidemiology and control of acute respiratory infections and understanding their transmission, community incidence, risk factors, symptomatology **of community cases of infection**, immunology, and behaviours related to transmission.

Nursing Home Influenza Research

- 1.5. I led research on Influenza in nursing homes showing that vaccinating staff reduces influenza and associated hospitalisations and deaths in residents and highlighted the very high burden of respiratory infections in nursing homes and the important role of staff in transmitting infections to residents. <https://www.bmj.com/content/333/7581/1241> This made me aware that in the event of a pandemic nursing homes would likely be a key setting for transmission and that staff would play a role in this transmission. This was also of concern due to the high clinical vulnerability of nursing home residents.

1.6. I led a major MRC/Wellcome community cohort of influenza and other respiratory infections from 2006-2011 (Flu Watch) which helped to establish the fact that a high proportion of the population were infected each year, that the majority of these infections were asymptomatic and many did not meet clinical case definitions for influenza so remained undiagnosed. The great majority of cases were mild and did not attend for medical care and only a very small minority of those attending their doctor were picked up by primary care surveillance.

1.7. We found that even though the policy in the 2009 pandemic was to treat all those with influenza with antivirals through the ‘National Pandemic Flu Service’, less than 5% of cases were treated such that the impact of antivirals in the 2009 pandemic was limited.

[https://www.thelancet.com/journals/lanres/article/PIIS2213-2600\(14\)70034-7/fulltext](https://www.thelancet.com/journals/lanres/article/PIIS2213-2600(14)70034-7/fulltext)

1.8. Although Flu Watch findings mainly related to influenza, the study alerted me to the likelihood that, in the event of a pandemic of a respiratory virus there would likely be a very large community base of undiagnosed disease which would make it very difficult to assess the extent of spread of a new virus early in a pandemic since surveillance approaches can vastly underestimate the extent of spread. This in turn would lead to difficulties in estimating severity of the infection since understanding this requires knowledge of the numbers of deaths and hospitalisations and the community incidence of infection. This could lead to a situation where early in a pandemic we overestimate case fatality rates but markedly underestimate community infection rates, which could in turn lead to difficulties in decision making about the need for and timing of control measures. It also implied that control measures based on identification and isolation of symptomatic cases would likely be highly limited in controlling spread because most cases would not be identified. Additional analyses of Flu Watch showed that regular handwashing helped to reduce risk of acquiring infection.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8243225/>

1.9. We also showed, in analyses conducted very early after the emergence of SARS-CoV-2 that acute respiratory infections occurred at much greater frequency in the week following exposure to public activities such as shopping, going to parties, going to restaurants and entertainment venues, places of worship and using public transport.

<https://wellcomeopenresearch.org/articles/5-54>.

1.10. This implied that relatively casual contact in public spaces and long-distance aerosol transmission was likely important in the transmission of respiratory viruses and suggested that limiting contact in such settings could reduce transmission. Analyses of Flu Watch also allowed us to assess that seasonal coronavirus was even more common than influenza and along with other respiratory virus infections followed a highly seasonal pattern with much higher levels of transmission in the winter.

<https://wellcomeopenresearch.org/articles/5-52>

1.11. This contributed to my expectation that there would be a large winter wave of COVID-19. Since we had data on symptom profiles of respiratory infections in the community from the Flu Watch study (prior to COVID), we were able to compare these to symptoms of COVID-19 in early cases, helping to establish the accuracy (sensitivity and specificity) of different symptom profiles for distinguishing COVID-19 from other respiratory infections early in the pandemic. Also, because we had data on the frequency of these symptoms during normal winters we were able to assess the likely minimum capacity for diagnostic tests that would be needed if we were to offer testing to all those with these symptoms.

<https://www.medrxiv.org/content/10.1101/2020.09.03.20187377v1>

1.12. Other analyses of Flu Watch focussed on immunity and showed that cross reactive T cells were able to prevent symptoms in those infected, showing the potential value of stimulating T cell responses in vaccines rather than vaccines that just stimulate an antibody response.

<https://pubmed.ncbi.nlm.nih.gov/25844934/>

1.13. Since the Flu Watch study showed the importance of understanding the community-base of respiratory infections especially during a pandemic, I also led a pandemic preparedness grant that aimed to use the Health Survey for England to provide a representative population sample for tracking the extent of spread within the community using serological assays. This research was not reactivated, but I obtained funding to conduct the Virus Watch community cohort study from the first round of competitive funding following emergence of SARS-CoV-2.

1.14. Prior to the pandemic I had also conducted research using whole genome sequencing of influenza in all diagnosed cases in hospital. This allowed us to establish transmission chains in the hospital and show that spread of influenza in hospitals accounted for many cases highlighting the potential risk of spread of respiratory infection in hospital settings.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6800305/>

1.15. Other research that informed my thinking on the pandemic was the work we had done on establishing that socially excluded groups including homeless people, and prisoners, both of whom often live in communal shared airspace settings were at extremely high risk of tuberculosis (another infection spread via aerosols). <https://thorax.bmj.com/content/62/8/667.abstract>

1.16. This, combined with other work showing high risk of other respiratory infections in these groups suggested they would be highly vulnerable to acquiring COVID-19 infection as well. We also had conducted extensive work showing high levels of comorbidities in homeless people and prisoners. These findings made me highly concerned about the potential impact of COVID-19 in homeless and prison sectors.

[https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(17\)31869-X/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(17)31869-X/fulltext)

High prevalence of latent tuberculosis and bloodborne virus infection in a homeless population Thorax 2018 <https://thorax.bmj.com/content/73/6/557>

K Health-related quality of life and prevalence of six chronic diseases in homeless and housed people: a cross-sectional study in London and

Birmingham, England. BMJ Open – 2019.

<https://bmjopen.bmj.com/content/9/4/e025192>

Prevalence, incidence, and outcomes across cardiovascular diseases in homeless individuals using national linked electronic health records

European Heart Journal 2020.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7672531/>

Influenza vaccination, inverse care and homelessness: cross-sectional survey of eligibility and uptake during the 2011/12 season in London. BMC Public Health 2014

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3906096/>

1.17. Given this research track record I felt I was well placed to advise on the pandemic response.

1.18. Based on my experience in community surveys of infection, early in the pandemic I also established the Virus Watch Community Cohort study and its sister Health Equity study focusing on social and ethnic minority determinants of infection. (NIHR/MRC funded). This allowed us to study levels of COVID in different groups and conduct in-depth analyses of behaviours and contact patterns. We also used Virus Watch extensively to study occupational patterns of infection and behaviours as part of the PROTECT core study. Virus Watch was supplemented by DHSC to provide regular finger-prick antibody testing which was important in establishing the rapid decline in antibodies informing the national vaccination booster programme.

https://ucl-virus-watch.net/?page_id=10 – Virus Watch Community Cohort Study

<https://sites.manchester.ac.uk/covid19-national-project/research-themes/sector-specific-studies/use-of-existing-datasets-to-explore-occupational-risks-from-sars-cov-2/> - PROTECT CORE STUDY

1.19. I was also co-applicant on the SAFER study measuring infection rates in London Health Care workers based at UCLH. This was the first to show the extraordinarily high rates of infection in hospital staff.

<https://pubmed.ncbi.nlm.nih.gov/32653078/>

<https://www.uclhospitals.brc.nihr.ac.uk/news/study-tracks-covid-19-nhs-staff-safer-study>

- 1.20. My prior experience of research in nursing home settings led me to encourage my colleague Professor Shallcross to apply for research funding from ESRC to study the pandemic in nursing homes and this placed her in a strong position to subsequently be academic lead for the Vivaldi Nursing home core study: <https://www.gov.uk/government/collections/vivaldi-study-results>. I helped to secure funding for this and advised on design, analysis and interpretation and dissemination of findings including via NERVTAG.

2: List of groups I participated in and the relevant time period:

- 2.1. Prior to the pandemic I had been asked to join SAGE briefly during the Ebola incident (not an area of expertise for me) but was not invited to join the main SAGE group during the pandemic.
- 2.2. I have been a member of NERVTAG since its inception in 2017 **until the present**. I contributed to SAGE on an ad hoc basis when I was invited to present specific papers and on occasion when papers that I had contributed to were being presented but was not a member of the main SAGE group. I attended some meetings of the Senior Clinicians (CMOs) group to present analyses related to COVID symptoms and case definitions. I was a member of the SAGE EMG transmission subgroup and it's PHE forerunner from inception.
- 2.3. Aside from SAGE subgroups, I was a member of Healthy London Partnership group that led the COVID response for the homeless sector throughout the pandemic. I was also a member of an advisory group to the London Rail Network to support them in developing policy and a member of our University advisory group for COVID. **Below is a further breakdown of the groups I participated in and the relevant time periods:**

NERVTAG

- 2.4. **Member - NERVTAG Clinical Risk Stratification Group – 2020/2021: 8 meetings attended.** This group developed strategies to identify groups most at risk of COVID-19 hospitalisation and death and developed the Q-COVID risk

prediction model later used in expanding the Shielding list and informing decisions on prioritisation of vaccination.

Scientific Advisory Group for Emergencies (SAGE)

- 2.5. **Member - SAGE – Ebola Advisory Group – 2018:** Prior to the pandemic I had been asked to join SAGE briefly during the 2018 Ebola incident (not an area of expertise for me) but was not invited to join the main SAGE group during the pandemic.
- 2.6. **Ad-hoc contributions to SAGE main committee** when invited to present papers- 2020-2021:
- Impact of occupational exposure to disease, proximity to others during work and income on mortality from COVID-19, 27 May 2020.
 - “Preventing outbreaks in forgotten institutional settings: What are we missing?”, 28 May 2020.
 - EMG Transmission Group: COVID-19 transmission in prison settings, 25 March 2021.
- 2.7. **Member - SAGE – EMG – Transmission Subgroup – January 2021 – October 2021.**

Other Groups

- 2.8. **Member - PHE transmission subgroup – October 2020- December 2020 (this committee later became the SAGE EMG Transmission Subgroup).**
- 2.9. **Ad-hoc presentations to UK Senior Clinicians Group (Chief Medical Officers) on symptom profiles of COVID,** May 2020, September 2020.
- 2.10. **Healthy London Partnership Covid-19 control in Homeless Population – Response Coordination group – March 2020 – Present.**
- 2.11. **Ad Hoc Presentations to JCVI** on vaccination in Inclusion Health Populations (Jan 2021).
- 2.12. **Member - London Rail Group COVID Advisory Group – May-June 2020.**

3: Overview of involvement in groups between January 2020 and February 2022:

When and how you came to be a participant

3.1. **NERVTAG** : I have been a member of NERVTAG since its inception in 2017 to the current date. Membership positions were advertised openly and confirmed by formal interview – I was appointed due to my knowledge of public health and epidemiology of acute respiratory infections.

3.2. Summary of attendance at NERVTAG meetings

	2020 NERVTAG meetings 1 – 40: attendance	2021 NERVTAG meetings 41-63:attendance	2022 - NERVTAG meetings 64-65: attendance	2020 Birdtable meetings	Other Extraordinary meetings*	Non-COVID-19 meetings 2020-2022
Andrew Hayward	33	23	2	11	5	3

3.3. I was asked to become a member of the PHE transmission subgroup which later became the SAGE EMG Transmission subgroup by the chairs of the groups due to my experience in studying transmission of respiratory infections.

3.4. I was asked to contribute to the Senior Clinicians Group because I had conducted analyses of the accuracy of COVID-19 symptom profiles.

3.5. I was asked to join the Healthy London Partnership Homelessness Covid response group because of my expertise in infection and inclusion health.

3.6. NERVTAG Clinical Risk Stratification Group – 2020/2021 - 8 meetings attended – This group developed strategies to identify groups most at risk of COVID-19 hospitalisation and death and developed the Q-COVID risk prediction model later used in expanding the Shielding list and informing decisions on prioritisation of vaccination.

- 3.7. I contributed to general discussions in all the COVID-19 meetings I attended and through this mechanism to most of the NERVTAG papers presented to SAGE. I made a more direct and substantial contribution 20 NERVTAG papers submitted to SAGE as described below.
- 3.8. **PHE Covid transmission group:** I was a member of the PHE Covid-19 transmission group from its inception in October 2020 and I attended 7 meetings. **We discussed approaches to studying transmission.**
- 3.9. **SAGE-EMG transmission subgroup:** The PHE group then became the SAGE-EMG transmission subgroup in January 2021-October 2021 and I attended 18 main group meetings as well as many additional meetings to plan and develop papers of the group and to present findings to SAGE and through “Teach-Ins”. **This group produced papers for SAGE, summarising evidence on transmission in different settings.** I was asked to join by the chairs due to my experience in studying transmission of acute respiratory infections.

The number of meetings you attended, and your contributions to those meetings

- 3.10. Below is a summary of the main points discussed at **NERVTAG** meetings that I attended and my contribution to these meetings:
- 3.11. **13 January 2020 – Nervtag meeting to discuss Wuhan Coronavirus:** This was the first meeting when COVID-19 was discussed. A novel coronavirus was noted to be causing an outbreak in Wuhan China, with most cases associated with a wet food market that had been closed. China reported 41 cases including 7 severe cases and 1 death. They also reported 739 close contacts including 419 medical staff who had been followed up, and to date no related cases had, been found and other reports suggested limited human to human transmission. One case imported from Wuhan had been identified in Thailand through screening. Development of diagnostics were underway. Nervtag endorsed a PHE risk assessment saying the current risk to the UK was very low but that this needed to be kept under review. It was agreed contacts of cases should be followed up for 14 days. The committee endorsed PHE advice for travellers arriving from Wuhan, that they should seek medical attention if developing cough or fever within 14 days of travel and report their travel history so that

appropriate infection control could be initiated. Nervtag recommended posters be displayed at port of entry. Nervtag asked whether exit screening was being conducted by the Chinese at Wuhan as this would reduce the value of entry screening. Nervtag also highlighted that if incubation periods were long as was the case with MERS and SARS Cov2 then symptom screening would be of reduced value as people would be incubating disease at the time of screening without symptoms. NERVTAG noted that the body of scientific evidence and previous experiences indicated that port of entry screening, whilst not having zero effect, had very low efficacy and the benefit was very unlikely to outweigh the substantial effort, cost and disruption.

3.12. **21 January 2020- Nervtag Wuhan Novel Coronavirus meeting:** Nervtag reviewed additional reports showing increasing numbers of cases in China, including in other provinces and some evidence of transmission to healthcare workers. Case fatality amongst confirmed cases was around 2% but it was noted that this estimate may be inaccurate as cases had not finished their illnesses. Nervtag endorsed an elevation of the risk levels; For overall impact the threat was raised from low to medium, for current risk to the UK population the threat was raised from very low to low and the risk to travellers to affected areas was raised from low to medium. It was agreed that it was likely that cases would be seen in the UK. It was noted that 4/5 cases identified outside China had been identified through port of entry screening. It was discussed that exit screening in China would reduce the impact of screening in UK and that screening for fever would likely miss a high proportion of cases. Given the likely highly incomplete effectiveness of port of entry screening, it was recommended that the focus should be on information provision and encouragement of travellers who are unwell to attend healthcare facilities for investigation and infection control. It was noted that SAGE would be convened and some NervTag members invited to join.

3.13. **28 January 2020 - Nervtag Wuhan Novel Coronavirus Third Meeting:** The committee discussed increasing numbers of confirmed cases in China and the first case identified in Europe. The committee discussed some case reports suggesting asymptomatic transmission may occur but noted the evidence for this was extremely weak. I highlighted that presymptomatic transmission

occurred in influenza but that we do not know how much transmission occurs in asymptomatic patients. The committee could not agree on whether asymptomatic cases were likely to be less infectious than symptomatic cases. It was noted that estimates of R0 were high at 2-3 and that the doubling time for infections in China was short. It was noted that the extent of human to human transmission remained uncertain. In view of spread across more provinces of China, Nervtag recommended that the case definition for a suspected UK case be expanded to include additional provinces but noted the challenges of implementing this. Nervtag were asked if the public should be advised to wear face masks and said there was no evidence this would be an effective measure at the time. It was noted that the plan was to isolate any infected cases in High Containment Infectious Disease Settings. Nervtag were asked to comment on whether modifications to high containment PPE were advisable (introduction of a hood). They advised that it may be better to stick with the current PPE with which staff were familiar. Nervtag commented that mask availability in primary care needed to be reviewed.

3.14. 3 February 2020- Nervtag Wuhan Novel Coronavirus Fifth Meeting:

Nervtag considered evidence on handwashing for prevention of respiratory infections and noted that this was likely to be a helpful intervention, but that there should be an emphasis on regular handwashing not just handwashing in response to respiratory events like nose blowing or sneezing. Nervtag discussed mask use in different settings, and based on available evidence recommended:

- Health and social care workers providing care to individuals with respiratory symptoms should wear PPE.
- Wearing a facemask by symptomatic people is recommended, if tolerated.
- Wearing of facemasks by well-people living with symptomatic people is not recommended.
- Wearing facemasks by well people interacting with well member of the public (either occupationally or otherwise) is not recommended,

3.15. Nervtag endorsed the development of the Coronavirus Clinical Information Network and PHE advice on environmental decontamination.

- 3.16. **21 February 2020 - Nervtag - Novel Coronavirus Seventh Meeting:** Nervtag endorsed the PHE Risk assessment of the novel Coronavirus which had increased the current threat to the UK from low to medium, but Nervtag noted that this assessment was likely to change. I recall saying that if we find evidence of transmission in multiple countries, this risk level should likely be increased. One committee member had technical difficulties in being heard during the meeting but after the meeting recommended raising this risk to high based on evidence of transmission in other countries. Nervtag endorsed reasonable worst case future scenarios, estimating that 85% of the population could become infected, 50% of the population may become ill, at least 4% of those who become ill may be hospitalised and 2-4% of those who become ill may die.
- 3.17. **6 March 2020 Nervtag meeting** – We discussed hospital infection guidance, in particular the grade of face masks used in different situations. This was in response to a proposed change in guidance that reduced the use of FFP3 masks during contact with suspected but unconfirmed COVID cases. Part of the rationale for prioritising their use was pragmatic because stockpiles of FFP3 masks would otherwise run out quickly. The committee endorsed the change. With respect to COVID patients requiring surgical intervention, I suggested they be placed last on operating lists to reduce risk of transmission to other patients on the list. We also discussed duration of isolation for community cases asked to self-isolate based on evidence of duration of infectivity. We recommended between 7 and 14 days, with the longer periods recommended in the early containment phase of the pandemic.
- 3.18. **27 March 2020 Nervtag meeting** – We discussed the deteriorating epidemiological picture. We noted reports of outbreaks in nursing home settings. Community surveillance data was discussed and it was noted that although useful the Royal College of General Practitioner swabbing programme was highly limited by the fact that symptomatic people were being advised not to attend their GP. It was noted that the CO-CIN study was beginning to be able to assess risk factors for mortality and that age was a very strong predictor. It was recommended that trials of non-invasive vs invasive ventilation be developed. Preliminary results of studies of environmental sampling in hospital

- were discussed. Initial evidence of anosmia as a symptom of COVID-19 was discussed.
- 3.19. **29 March 2020 Nervtag meeting** – We discussed the deteriorating epidemiological picture in UK and the need for more research about transmission in children, uncertainties in the extent of asymptomatic transmission and the need to revise guidance on use of PPE in healthcare settings in light of scientific evidence and dwindling availability of stocks of PPE. A subgroup including myself was convened to address this.
- 3.20. **3 April 2020 Nervtag meeting-** Members reviewed community surveillance data sources and noted that it would be valuable to make surveillance reports publicly available. We discussed data from the CO-CIN study, suggesting risk factors for severe disease included age and obesity. The study also showed spill over into healthcare workers and the importance of nosocomial transmission. We discussed continuing uncertainty about the extent of transmission from asymptomatic or pre-symptomatic cases but that transmission was assumed within current modelling. We discussed duration of infectivity and noted that whilst people could remain infectious for longer than 7 days a 7-day period of isolation for community cases was reasonable. We discussed evidence of immunity and reinfection and noted that data was sparse and further research was needed. I highlighted data from the Flu Watch Study showing reinfection with the same strain of seasonal coronavirus was uncommon but reinfection with a different strain occurred more frequently. We noted that anosmia was a potential symptom but further work was needed before including in clinical case definitions.
- 3.21. **9 April 2020 Nervtag** – The committee received outbreak reporting data showing large numbers of outbreaks in nursing homes. They asked that this issue be raised as a priority with DHSC. The committee noted that patients from hospital should not be discharged to nursing homes within 14 days. In light of international changes in positions about community mask use, Nervtag agreed to review the evidence for this. Nervtag recommended a review of which procedures were considered to be aerosol generating.

- 3.22. **17 April 2020 Nervtag** – The large amounts of outbreaks in nursing homes was discussed. It was noted that in many outbreaks widespread testing was not available so the numbers of cases were likely to be greatly underestimated. It was recommended that additional studies are needed to assess transmission in this setting. It was noted that PHE guidance to reduce transmission was being updated. It was recommended that transmission between homes by staff needs to be considered. It was suggested that intermediate care between hospital and nursing home be considered. We enquired whether there was a specific taskforce for the strategy in care homes and were told NHS IPC had this remit with support of PHE. Nervtag discussed data on nosocomial transmission in hospitals and recommended that it would be helpful to feed this data back to NHS Trusts. We discussed evidence of obesity being a risk factor for severe disease and whether patients who were obese should be recommended to shield. It was recommended they should be placed on the group who were recommended for enhanced social distancing rather than shielding. Nervtag were asked to review anosmia as a symptom and agreed to review the Zoe tracker app analyses of this.
- 3.23. **24 April 2020 Nervtag**- We discussed analyses of excess mortality due to different causes during COVID and noted that the number of excess deaths was substantially higher than the number of deaths reported as due to COVID. We recommended further breakdown of this (e.g. by ethnicity) and for data reports to be made public. We discussed large scale outbreaks in military barracks. We discussed extremely high levels of asymptomatic infection in some nursing home studies with the majority of residents and staff being infected. We noted that we had not been asked to advise on nursing home measures. We noted that pre-symptomatic transmission exists and may account for 40% of transmission. Members were asked to comment on contact tracing policy and the use of the proposed NHS Digital contact tracing app. A follow up meeting was agreed.
- 3.24. **26 April 2020 Nervtag Spi-M, Spi-B Extraordinary meeting to discuss contact tracing**: The committees were asked to advise on key issues related to how the proposed NHS contact tracing app and the PHE manual contact tracing system would work. The most important of these was that, in order to

maximise effectiveness of contact tracing after lockdown was lifted, contact isolation should not wait until after diagnosis of the index case but that contacts could be released from isolation if the index case tested negative. The NHSD app was based on this principle. I advised that this could cause people in some occupations with frequent public contact to be asked to isolate repeatedly, which could exacerbate inequalities. Nervtag recommend that the Government consider measures to mitigate the socioeconomic impact of serial quarantine. The committee also noted this may have an impact on compliance with quarantine and/or uptake of the app.

- 3.25. The committee advised that on its own, contact tracing would be insufficient to control transmission.
- 3.26. **1 May 2020 Nervtag:** I agreed to undertake a review of the proportion of patients that are asymptomatic. We highlighted that asymptomatic transmission occurs, but we do not know the relative infectivity of asymptomatic and symptomatic cases. We highlighted a series of measures that might reduce transmission in nursing homes including PCR positive staff not caring for patients. I presented a literature review of different symptoms and the sensitivity and specificity of these symptoms for identifying COVID-19. No single symptom was sufficiently sensitive or specific meaning that combinations of symptoms would be needed. PHE data from symptomatic cases from the First Few Hundred Study was presented but it was noted that the absence of negative cases precluded estimates of both sensitivity and specificity. It was noted that some forms of weighted symptom scores could be a helpful approach for contact tracing. I agreed to analyse available data from 1st few hundred study and the Flu Watch cohort to assess sensitivity and specificity of different symptom profiles and to request further data from the Zoe Symptom tracker app to assess this.
- 3.27. **15 May 2020: Nervtag BirdTable 1:** Continuing decline in cases was noted. I noted that the ONS infection study would be a valuable data source to investigate symptom sensitivity and specificity, and agreed to contact Sir Ian Diamond to enquire about the use of the data in this way. Sir Ian Diamond passed this onto a colleague but they did not respond further to the enquiry.

- 3.28. **22 May 2020 Nervtag Bird table 2:** We discussed continuing drops in infection rates but evidence of outbreaks in workplaces, hospitals and nursing homes and schools. I highlighted the need to plan ahead for greater capacity in test & trace based on high community frequency of cough and fever in normal winters. In summer this was about 100,000 per day in winter up to 500,000 per day. It was agreed that Test and Trace capacity planning would be raised with Baroness Harding and the Boston Consulting Group. Higher than expected rates of asymptomatic infection were noted in the ONS infection study data but it was suggested this may be due to the cross-sectional nature of the testing and insufficient follow up to identify symptoms developing before or after the test.
- 3.29. **29 May 2020 Nervtag BirdTable 3:** We highlighted the need to learn from outbreaks through thorough investigation and for better studies of the risk of transmission in different settings and of occupational differences in mortality
- 3.30. **5 June 2020. Nervtag BirdTable 4:** We discussed surveillance data showing continuing decline in rates of infection but evidence of outbreaks in schools and hospitals. We highlighted the likelihood of COVID transmission in non-clinical areas of hospitals where control measures may be more relaxed. We highlighted the need for SAGE to continue to operate as a central conduit for scientific advice.
- 3.31. **12 June 2020. Nervtag BirdTable 5:** We discussed intensive control measures in prisons. I highlighted that SAGE had requested research on COVID in prisons and other institutional settings. We noted continuing declines in community infection rates and hospitalisations and in nursing homes but noted increased numbers of outbreaks in other settings including schools and workplaces and hospitals. I highlighted concerns about reopening of communal airspace night-shelters for homeless.
- 3.32. **19 June 2020 Nervtag:** We discussed surveillance data noting low levels of infection in the community but ongoing outbreaks in workplaces, schools and nursing homes. We highlighted challenges in research funding with this mainly being directed through large consortia potentially limiting the contribution of individual researchers to investigate specific issues.

- 3.33. **26 June 2020 nervtag BirdTable 7:** We discussed surveillance data which generally showed low levels of transmission but outbreaks in schools and workplaces. We discussed the need to continue community surveillance. We discussed the potential value of using sewage for monitoring COVID levels. We discussed the frequency and types of coinfections that occur with/after COVID. I agreed to update our review of asymptomatic infections as there were a wide range of different estimates. I presented findings from a systematic review of symptom profiles for COVID-19 noting that although the current definition had high sensitivity the main limitation to estimates of sensitivity was the fact that people are more likely to present if they meet the case definition which will lead to an underestimate of sensitivity. Adding additional symptoms could increase sensitivity. It was also noted that symptom profiles may vary by age. I agreed to produce a further paper synthesising evidence, including analyses from the Zoe Tracker app stratified by age and relating this to policy. We discussed surveillance data and potential reasons for why some areas continued to have high prevalence of infection.
- 3.34. **14 August 2020: Nervtag COVID-19 Twenty-Ninth Meeting:** I highlighted the high risks of COVID transmission from sharing cars and the high mortality rates in Taxi drivers. It was noted that this concern had been raised with DHSC and car sharing guidance was being considered. Members of the committee requested resources to support their work on behalf of the committee.
- 3.35. **20 August 2020: Nervtag COVID-19 Thirtieth Meeting:** We discussed COVID transmission in and from children. We noted children were very unlikely to suffer severe disease and higher rates of asymptomatic infection. We noted children could transmit effectively in home situations and there was evidence of transmission in schools. We noted that death and hospitalisation rates were decreasing but case rates were increasing and queried whether this might be due to changes in severity of the virus. I provided an update on the analysis of the tracker app. The current symptom definition gives ~84% sensitivity + ~50% specificity. Considering the US symptom definition, including sore throat, shortness of breath or muscle pain gives ~94% sensitivity + ~19% specificity. If fatigue is added to the current UK definition, it gives ~95% sensitivity + ~23% specificity. The implications on the number of tests required if the symptom

definition sensitivity is increased. In the over 75s there was a greater presentation of delirium and fatigue. It was agreed that the paper for discussion at the next meeting would be circulated prior to the meeting

- 3.36. **4 September: Nervtag COVID-19 Thirty-first Meeting:** We discussed a presentation from Test and Trace. We highlighted the need to use data from Test and Trace to inform pandemic response. We discussed evidence of reinfection and immunity to COVID. We noted reinfection could happen but was rare. We noted that antibodies to COVID wane over time. I presented an updated paper on the proportion of COVID-19 infections that were asymptomatic based on systematic literature review. This noted about 1/3 of cases remained symptomatic throughout infection but that studies with less intense follow up of symptoms tended to report a higher proportion were asymptomatic. I presented a paper on specificity of symptom profiles for COVID-19 based on analyses of First few Hundred study data and Flu Watch data and a further analysis of data from the Zoe Tracker app. It was noted that sensitivity of the case definition could be raised by inclusion of additional symptoms that are common in the population but that this would markedly increase the number of tests needed. It was discussed that it might more important to increase the proportion of people with symptoms meeting the current case definition who seek a test rather than changing the case definition. It was concluded that there was no good reason to recommend changing the definition for adults but that there was a need for further information in children and the elderly. Delirium as a common symptom in the elderly was highlighted.
- 3.37. **9 October 2020: Minutes of the Nervtag Bird Table 8:** We reviewed surveillance data noting low levels of non-Covid infections, low population levels of immunity to COVID-19 (5% of blood donors had antibodies), increasing rates of infection, outbreaks in schools and nursing homes and universities. I highlighted the low number of non-household contacts identified by Test and Trace. We noted that PHE had started a case control study using Test & Trace participants to identify risk factors for transmission. We discussed the SIREN healthcare worker study and evidence of reinfection. At the time risk of reinfection was noted to be low.

- 3.38. **23 October 2020: Nervtag Bird Table 10:** We discussed COVID-19 in nursing homes describing very high levels in staff and residents. We noted that rates were highest in geographical areas with high background COVID rates. I presented data from the Vivaldi Nursing home study which highlighted the role of staff in transmission, homes with poor staff ratios, homes that did not pay sick leave and did not cohort staff with residents being risk factors for infection and outbreaks. VIVALDI 2 was a serological study of about 100 Care Homes across the country. Bloods were taken in June and July; overall there was about 29% seropositivity in residents and 25% in staff. By the second round about 15% of those who were previously positive were seronegative. Higher mortality was noted in those with asymptomatic infection compared to those with no infection.
- 3.39. I highlighted that data from the test & trace programme showed that the average number of non- household contacts identified was less than one, suggesting that contact tracing was primarily identifying household contacts and limiting its impact.
- 3.40. **6 November 2020: Nervtag Bird Table 10:** We discussed rising numbers of cases in students and increased case fatality in hospitals as more elderly patients were being admitted, we discussed a strain of COVID in Mink in the Netherlands which had led to mass culling.
- 3.41. **11 December 2020:** We discussed a paper on immunity certification. We noted that PHE was conducting a further analysis of use of face coverings in community settings. We noted the emergence of a new variant in Kent and the fact that if it were more transmissible it would be much harder to control. We endorsed PHE plans to intensify surveillance.
- 3.42. **18 December 2020: Nervtag COVID-19 Bird table 11:** We discussed the rapid emergence of B117 variant. We concluded with moderate certainty that it was substantially more transmissible than earlier strains, but there was insufficient evidence to assess changes in severity. We highlighted single gene target failure (SGTF) on routine PCR diagnostics could be used as a marker for surveillance and epidemiological analysis without full sequencing.

- 3.43. **21 December 2020: Extraordinary meeting of Nervtag COVID-19 and SPI-M on SARS-CoV-2 variants:** We discussed transmissibility, biology and severity of the rapidly emerging B117 variant. We concluded it was highly likely that it was more transmissible than the original variant but there was insufficient data to tell if it was more or less severe. I presented data from the Vivaldi Nursing home study suggesting the viral load of patients was increasing over time which supports the notion of increased transmissibility.
- 3.44. **Nervtag 23 December 2020- Extraordinary meeting to discuss South African Variant:** The committee reviewed evidence in transmissibility, immune escape, and severity. It concluded there was evidence of likely increased transmissibility, concerns about immune escape but insufficient evidence to assess severity. Strengthened quarantine procedures for those arriving from South Africa was suggested.
- 3.45. **8 January 2021: Nervtag:** We discussed evidence of increased transmissibility of B.1.1.7 but highlighted no evidence of differential transmissibility between adults and children. We discussed potential immune escape of the South African Variant.
- 3.46. **15 January 2021 Nervtag:** We discussed evidence of increased transmissibility of B.1.1.7, limited evidence of increased severity and limited evidence of immune escape. We discussed evidence of immune escape in the South African Variant.
- 3.47. **22 January 2021 Nervtag:** We discussed evidence suggesting increased severity of B117 and concluded it was likely to have a higher case fatality rate than previous strains as well as being more transmissible. I presented some data from Virus Watch suggesting symptom profiles were similar in areas with and without high levels of B.1.1.7.
- 3.48. **29 January 2021:** We considered further evidence showing increased severity of B.1.1.7, We considered data from the Vivaldi nursing home study showing that antibodies were protective against future infection but that reinfection could occur. I presented data from a metanalysis I had conducted showing the protective of antibodies derived from natural infection in studies with at least 3 months follow up. This showed reinfections did occur but antibodies derived

- through natural infection were protective with a greater degree of protection against symptomatic compared to asymptomatic infection.
- 3.49. **5 February 2021 Nervtag:** We considered nursing home data on reinfections – Vivaldi study data were presented suggesting reinfections had lower viral load than first infections.
- 3.50. **12 February 2021 Nervtag:** We discussed data suggesting higher infectivity and severity of B.1.1.7 variant.
- 3.51. **19 February Nervtag:** We discussed further data on severity and transmissibility of B.1.1.7.
- 3.52. **26 February 2021 Nervtag:** I provided data on the serial interval and duration of symptoms for cases in areas with high levels of B117 compared to others, concluding there was no evidence of a difference in these parameters.
- 3.53. **5 March Nervtag:** We discussed reinfections in nursing homes and transmissibility and immune escape of the Brazil variant.
- 3.54. **16 April 2021:** We discussed data on variants of concern and agreed to produce a paper on duration of immunity.
- 3.55. **14 May 2021 – Nervtag:** I agreed to update the metanalysis of duration of immunity for a paper on immunity. We discussed evidence for faecal transmission of COVID-19. We expressed concern about increasing transmission of B1.617.2 variant.
- 3.56. **21 May 2021 – Nervtag:** We reviewed data suggesting higher transmissibility of B.1.6.17.2 compared to B.1.1.7 , minimal evidence of increased severity and some evidence of immune escape and reduced vaccine effectiveness. We highlighted the importance of control measures to reduce transmission.
- 3.57. **28 May 2021 – Nervtag:** We reviewed data on B.1.1.7 .2 noting increased severity and decreased vaccine efficacy.
- 3.58. **4 June 2021 – Nervtag:** We reviewed data on Delta variant severity and noted there was evidence that hospitalisation rates were greater than for alpha and that was strong evidence of decreased vaccine effectiveness.

- 3.59. **11 June 2021- Nervtag:** We reviewed evidence of Delta severity concluding there was insufficient evidence to conclude severity was increased but that there was evidence of increased transmissibility and decreased vaccine effectiveness, especially following one dose of vaccine.
- 3.60. **18 June 2021 – Nervtag:** We discussed data on vaccine effectiveness against severe disease with the delta strain. I presented data from Virus Watch suggesting people's swabbing behaviour had changed over time with swabbing rates peaking in the second wave and more recently people who did not have classical symptoms seeking a swab. We considered evidence from the Zoe tracker app suggesting runny nose, blocked nose or headache had increased. We noted the challenges of distinguishing COVID from other respiratory infections in the event of co-circulation. We discussed data showing poor understanding of which symptoms should trigger testing by the public and high levels of not testing when symptomatic. We considered data on reduced mortality rates in nursing homes since introduction of vaccination.
- 3.61. **2 July 2021 Nervtag:** We discussed that the Delta variant was now the dominant variant. We discussed challenges due to limited sequencing capacity and difficulty in obtaining samples from imported strains. I presented data from Virus Watch showing large declines in antibody levels following first vaccine dose, lower antibody levels following Astra Zeneca vaccine than Pfizer and low levels of antibodies following vaccine for some clinically vulnerable groups.
- 3.62. **9 July 2022 extraordinary Nervtag COVID-19 meeting on Human Challenge Studies:** We discussed findings from a human challenge study and the implications for policy for use of lateral flow tests, hand hygiene, mask use and social distancing.
- 3.63. **30 July 2021:** We discussed hospital transmission studies. COVID variants and antibody levels in vaccinated care home residents.
- 3.64. **10 September 2021:** We discussed COVID-19 variants and the production of a report on coinfections.
- 3.65. **22 October 2021 Nervtag:** We made a series of recommendations in relation to likely co-circulation of COVID-19 with other viruses in the winter, in particular

recommending the value of multiplex PCR testing to identify different pathogens.

- 3.66. **19 November 2021 Nervtag:** We discussed COVID-19 variants and the likelihood of widespread use of direct acting antivirals generating antiviral resistance, especially if used as single agent regimes.
- 3.67. **17 December Nervtag:** We discussed risk assessment of the Omicron variant, noting it had high levels of transmission and decreased vaccine effectiveness against infection but no evidence of increased severity.
- 3.68. **14 January 2022 Nervtag:** We discussed the risk assessment of Omicron and the accuracy of lateral flow tests.

Your role in providing research, information and advice

- 3.69. In all of these groups my role was to provide independent scientific advice based on my expertise as a public health academic / expert in infectious disease epidemiology with particular expertise in studying epidemiology and control of acute respiratory infections
- 3.70. My role included contributing as a committee member to risk assessments of emerging threats, including following the emergence of COVID-19 and for successive variants of COVID, contributing as a committee member to early advice on border controls and screening of travellers, assessment of emerging evidence pertinent to control (e.g face mask, handwashing, immunity certification), and contributing bespoke analyses of data relevant to questions posed to the committees.
- 3.71. Via NERVTAG/DHSC I was also asked to contribute to revision of guidance on use of face masks by Health and Social Care workers with PHE. On the 23rd March, in discussion with Susan Hopkins at PHE, I drafted initial recommendations to extend the use of face masks to health and social care staff for all patient encounters as well as mask recommendations for all patients. The proposals highlighted the global shortage of PPE, lack of UK manufacturing capacity and, to prevent wastage, recommended moving away from disposing of surgical masks between each patient to a system of sessional mask usage. This document (available on request) was subsequently refined

by others and taken through professional bodies leading to a rapid increase in mask use in hospital and social care settings.

- 3.72. I was also asked by NERVTAG to provide input into the implications of choosing different symptom profiles for the National Test and Trace Service (see below for more detail). I provided input into the feasibility of using postal submission of specimens for test and trace (based on methodologies used in Flu Watch. I provided input into assessment of risk factors for mortality and hospitalisation from COVID to guide shielding and vaccination prioritisation as part of the NERVTAG Clinical Risk Stratification Subgroup of COVID.
- 3.73. I submitted and presented analyses of occupational data to SAGE on the excess mortality in occupational groups who could not work from home and the relationship between mortality, occupational proximity, and low pay.
- 3.74. I advised PHE/HSA on approaches to using data from the national test and trace programme to identify where transmission was occurring, using case control studies.
- 3.75. Through the PHE transmission subgroup established at the request of SAGE in October 2020 and which later became the SAGE EMG transmission subgroup (from Jan 2021) I made a major contribution to documents summarising our knowledge about COVID-19 transmission in a range of settings and likely effectiveness of different interventions to prevent transmission.

Outside of formal SAGE committee structures

- 3.76. In the run up to the first lockdown I presented evidence to DHSC regarding the high risk of transmission of respiratory infections in public spaces and on public transport arguing that urgent social distancing measures were necessary.
- 3.77. I played a major role in highlighting the need for action in the homeless sector leading to the national Every-One in response that housed around 35000 homeless people in hotels with wraparound support. I co-wrote the Homeless Sector Covid Plan which was widely used by the sector throughout the pandemic but failed to get endorsement of this from PHE, NHS or MHCLG. I was part of the leadership team coordinating this response across the London homeless sector including developing active surveillance for COVID across

homeless settings (run by UCL during the first pandemic wave), outreach of testing and vaccination, and establishment of a COVID-care hotel for homeless people with COVID. Working with colleagues across the homeless sector I successfully lobbied for communal air space night shelters not to be reopened and for continuation of single room accommodation in hotels. Together these initiatives averted widespread transmission and excess mortality in the homeless population.

- 3.78. I provided the Homeless Sector Covid plan to senior public health officials in Prison Health (March 2020) and this was adopted to inform the extensive control measures introduced in prisons.
- 3.79. Early in the pandemic (March 2020), recognising the high risk of infection in nursing homes and other institutional settings, I made representations via NERVTAG and DHSC to prioritise testing and use of PPE and other approaches such as cohorting in these settings.
- 3.80. With PHE/HSA I presented evidence to JCVI on the need to prioritise vaccination for homeless people and prisoners (homeless people but not prisoners were prioritised). On behalf of EMG transmission subgroup, I also led and presented a paper to SAGE on transmission in prisons recommending prioritisation for vaccination.
- 3.81. My team presented Virus Watch evidence on differential antibody levels achieved following Pfizer and Astra Zeneca Vaccine, lower levels of post-vaccine antibodies in different clinical groups and the elderly, rapid waning of antibody levels and the association between antibody levels and infection to the Vaccine Effectiveness working group and to JCVI. This contributed to decisions about the booster programme including timing and targeting of boosters and the vaccines to use for booster doses.
- 3.82. I am a member of the National Expert Working Group for nMABs and antivirals in Covid-19.

4: Summary of documents to which I contributed for the purposes of advising groups:

NERVTAG PAPERS SUBMITTED TO SAGE

Face mask use in the community

- 4.1. Early in the pandemic I provided detailed input into two NERVTAG papers for SAGE on evidence related to face mask use in the community. These papers highlighted that evidence for general community use of facemasks was weak and needed to be considered in the context of face mask shortages in healthcare settings and widespread social distancing measures in place at the time which would be expected to reduce transmission.

NERVTAG: Face mask use in the community, 13 April 2020.

<https://www.gov.uk/government/publications/NERVTAG-face-mask-use-in-the-community-13-april-2020>

NERVTAG: Wearing facemasks in a community setting - options and evidence, 16 April 2020.

<https://www.gov.uk/government/publications/NERVTAG-wearing-facemasks-in-a-community-setting-options-and-evidence-16-april-2020>

Duration of infectivity and recommended isolation periods

- 4.2. I contributed to a NERVTAG paper on duration of infectivity to inform decisions on the duration of isolation for COVID-19 cases. This paper highlighted that whilst SARS-Cov-2 can often be detected using PCR beyond 7 days, culturable (live) virus was rarely detected after this period. It recommended that in general 7 days isolation should be adequate to substantially reduce transmission but that longer periods (14 days) and special care would be needed for certain groups. In particular, based on comments I had made on the paper it stated, “Particular caution should be exercised in COVID-19 patients discharged from hospital to nursing homes, homeless shelters, or other institutions where there are vulnerable individuals”.

NERVTAG: Duration of infectiousness following symptoms onset in COVID-19, 13 April 2020.

<https://www.gov.uk/government/publications/NERVTAG-duration-of-infectiousness-following-symptoms-onset-in-covid-19-13-april-2020>

Symptom profiles for isolation and community testing

- 4.3. I led analyses of data from the PHE first few hundred COVID-19 study and the pre-pandemic Flu Watch cohort. This compared symptom profiles in those with confirmed COVID-19 (first few hundred study) to symptoms in controls with non-COVID acute respiratory infections (Flu Watch). Sensitivity and specificity of different symptom combinations were assessed, and a summary document submitted to SAGE. I worked with the Senior Clinicians (UK CMOs) to present these data in more detail and allow them to choose a suitable case definition balancing sensitivity, specificity, and simplicity of communication. After reviewing a range of definitions, they settled on Cough or fever or loss of sense of smell for the purposes of isolation and testing. Our analyses showed that this combination had high sensitivity for symptomatic infection but limited specificity (i.e. would also identify large numbers of people who do not have COVID-19). Adding additional symptoms could further increase sensitivity but at the expense of the need for isolation and testing of large additional numbers of people.

NERVTAG: Case definitions for contact tracing, 7 May 2020.

<https://www.gov.uk/government/publications/NERVTAG-case-definitions-for-contact-tracing-7-may-2020>

- 4.4. I also led a further analysis of symptom profiles submitted to SAGE in September 2020 using data from the ZOE Covid Tracker app and further analyses of the combined First few Hundred study data and Flu Watch data. This explored the implications of adding further symptoms to case definitions including using the wider range of symptoms used in US case definitions. Again, it concluded that adding additional symptoms such as fatigue or headache (which are common symptoms even in people without respiratory infections) could further increase sensitivity but at the cost of needing to isolate and test many more people who do not have COVID-19 compared to the UK case definition.

NERVTAG: Community case definitions for COVID-19, 2 September 2020. <https://www.gov.uk/government/publications/NERVTAG-community-case-definitions-for-covid-19-2-september-2020>

- 4.5. Finally, on behalf of the Senior Clinicians Group (UK CMOs) I convened a meeting of investigators from the ONS Infection Study, Virus Watch, the REACT community study and the ZOE tracker app study to compare analyses conducted by these groups on the sensitivity and specificity of various symptom profiles. A detailed paper was produced and discussed with UK CMOs in March 2021. These analyses again highlighted that marginal increases in sensitivity could be achieved by adding additional symptoms but at the cost of needing to test and isolate large additional numbers of people.
- 4.6. More detailed papers and presentations regarding these analyses can be provided but are not currently on public websites.
- 4.7. A paper based on similar analyses was later published on Wellcome Open <https://wellcomeopenresearch.org/articles/7-84>

Transmission from pre-symptomatic infection

- 4.8. In April 2020 I contributed to a review of the evidence of pre-symptomatic transmission from COVID-19 cases to inform decisions on periods of time prior to symptoms for contact tracing. This showed the possibility of pre-symptomatic transmission based on a small number of case reports and investigations.

NERVTAG: Assessment of pre-symptomatic transmission of COVID-19, 30 April 2020.

<https://www.gov.uk/government/publications/NERVTAG-assessment-of-pre-symptomatic-transmission-of-covid-19-30-april-2020>

- 4.9. In April 2020 I contributed to a NERVTAG paper on evidence of protective immunity to COVID. In the course of discussing this issue at NERVTAG I presented data from analyses of the Flu Watch community cohort which also tested for seasonal coronaviruses. The analysis showed that reinfection with the same strain of seasonal coronavirus in the year following infection was rare but that reinfection with a different coronavirus strain could occur. This analysis was subsequently published on Wellcome Open <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7786426/>

4.10. The NERVTAG paper on protective immunity showed a high level of uncertainty about whether there was protective immunity following infection with SARS-Cov-2 at this early stage of the pandemic and recommended further research to address this knowledge gap. We highlighted that antibodies against COVID developed after infection in most patients but that we did not have evidence as to the extent these antibodies protect against infection or severe disease outside of animal models. We also highlighted that we would expect antibodies to wane over time potentially leading to reinfections.

4.11. NERVTAG: View on SARS-CoV-2 protective immunity, 27 April 2020.

<https://www.gov.uk/government/publications/NERVTAG-view-on-sars-cov-2-protective-immunity-27-april-2020>

Asymptomatic Infection

4.12. At request of NERVTAG I led a systematic review and meta-analysis of the proportion of COVID infections that were asymptomatic throughout the period of infection. The meta-analysis focussed on studies that had sufficiently intensive follow up to identify if symptoms occurred rather than cross sectional studies without this follow up. The review estimated that around 11% of infections were asymptomatic and noted studies with higher estimates of this proportion often had insufficient follow up to exclude whether symptoms developed. This review was included in a NERVTAG paper discussing asymptomatic infection which gave a likely range from 10% to 35% of infections were asymptomatic.

NERVTAG: Asymptomatic SARS-CoV-2 infection, 13 May 2020.

<https://www.gov.uk/government/publications/NERVTAG-asymptomatic-sars-cov-2-infection-13-may-2020>

4.13. Updating of this systematic review and meta-analysis in September 2020 (to include further evidence that had accumulated) led to a revised estimate that 28% of infections were asymptomatic.

NERVTAG: Rapid review of the asymptomatic proportion of PCR-confirmed SARS-CoV-2 infections in community settings, 9 September 2020.

<https://www.gov.uk/government/publications/NERVTAG-rapid-review-of-the-asymptomatic-proportion-of-pcr-confirmed-sars-cov-2-infections-in-community-settings-9-september-2020>

- 4.14. The meta-analysis was subsequently published in Wellcome Open in November 2020: <https://wellcomeopenresearch.org/articles/5-266>

Effectiveness of handwashing to prevent COVID-19

- 4.15. I contributed to a review of the effectiveness of hand hygiene interventions including a previous systematic review that I had conducted on handwashing and acute respiratory infections and an analysis I led showing that regular handwashing reduced the risk of seasonal coronavirus infections. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8243225/>

- 4.16. The NERVTAG paper recommended regular handwashing and widespread provision of handwashing / hand sanitising materials in work and public spaces. NERVTAG/EMG: Hand hygiene to limit SARS-CoV-2 transmission, 2 July 2020. <https://www.gov.uk/government/publications/NERVTAGemg-hand-hygiene-to-limit-sars-cov-2-transmission-2-july-2020>

Assessment of transmission through musical events

- 4.17. I contributed to this NERVTAG review, **which highlighted that group singing in indoor spaces was likely to be a risk factor for transmission.**

NERVTAG: Assessment of transmission of COVID-19 through musical events, 16 July 2020.

[https://www.gov.uk/government/publications/NERVTAG-assessment-of-transmission-of-covid-19-through-musical-events-16-july-2020.](https://www.gov.uk/government/publications/NERVTAG-assessment-of-transmission-of-covid-19-through-musical-events-16-july-2020)

Covid-19 Seasonality

- 4.18. I contributed to a NERVTAG analysis of seasonality and COVID by conducting a bespoke analysis of contact and activity diaries collected during the Flu Watch cohort. This unpublished analysis of over 6000 contact diaries completed by Flu Watch study participants between 2006 and 2010 suggests that contact rates were higher during the autumn/winter than in spring/early summer (adjusted IRR 1.21 (1.11-1.33) $p < 0.001$).

NERVTAG: NERVTAG: Seasonality and its impact on COVID-19, 22 October 2020. <https://www.gov.uk/government/publications/NERVTAG-seasonality-and-its-impact-on-covid-19-22-october-2020>

B.1.1.7 Severity

- 4.19. I contributed to the assessment of evidence that B.1.1.7 had increased severity.

NERVTAG: Update note on variant B.1.1.7, 27 January 2021.

<https://www.gov.uk/government/publications/NERVTAG-update-note-on-variant-b117-27-january-2021>

NERVTAG: Update note on B.1.1.7 severity, 11 February 2021.

<https://www.gov.uk/government/publications/NERVTAG-update-note-on-b117-severity-11-february-2021>

Transmissibility of B.1.1.7

- 4.20. I contributed to a NERVTAG paper assessing increased transmissibility of B.1.1.7. In particular I provided analyses from the Virus Watch Cohort suggesting that increased growth rates of B.1.1.7 were not likely to be due to reductions in serial interval (the time between successive cases in a chain of transmission).

NERVTAG: note on growth rate of SARS-CoV-2 B.1.1.7, 22 April 2021.

<https://www.gov.uk/government/publications/NERVTAG-note-on-growth-rate-of-sars-cov-2-b117-22-april-2021>

Immunity Certification

- 4.21. I contributed to an update note on immunity certification. In particular, I conducted a meta-analysis of published and unpublished studies with more than 3 months follow up showing the extent of protection following natural infection.

NERVTAG: Update Note on Immunity Certification Feb 2021

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/999936/S1076_NERVTAG_Immune_Certification_Update.pdf

- 4.22. I also updated this meta-analysis with data from additional published and unpublished studies in May 2021:

NERVTAG: Update note on immunity to SARS-CoV-2 after natural infection, 27 May 2021. <https://www.gov.uk/government/publications/NERVTAG-update-note-on-immunity-to-sars-cov-2-after-natural-infection-27-may-2021>

Interaction between COVID-19 and other respiratory infections

- 4.23. In October 2021 I contributed to a NERVTAG paper for SAGE on interactions between respiratory viruses.

NERVTAG: Respiratory infections, their interactions with SARS-CoV-2 and implications for winter 2021/2022, 20 September 2021.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1027606/S1396_NERVTAG_Respiratory_infections_their_interactions_with_SARS-CoV-2_and_implications_for_winter_2021_2022_20_September_2021.pdf

In particular, I led a review of evidence for so called Viral Interference, where infection with one virus changes the risk of being infected with a second different infection. This suggested there was no strong reason to think COVID-19 circulation would prevent circulation of other respiratory viruses, so if social distancing measures were not in place, we would expect co-circulation. I also contributed data from analyses of Flu Watch and Virus Watch showing the great overlap in symptom profiles of COVID and other respiratory infections, emphasising the need for testing for diagnosis and treatment.

Review of transmission and mitigation strategies in the context of the Delta variant

- 4.24. I contributed to a joint NERVTAG/EMG paper:

EMG-NERVTAG Update on transmission and environmental and behavioural mitigation strategies, including in the context of Delta, 13 October 2021, updated 26 November 2021.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1036475/S1395_EMG-

[NERVTAG Update on Transmission and Environmental and Behavioural Mitigation Strategies including in the context of Delta.pdf](#)

Development of antiviral resistance

- 4.25. I contributed to a NERVTAG review on the potential emergence of antiviral resistance and strategies to mitigate this.

Antiviral drug resistance and the use of directly acting antiviral drugs (DAAs) for COVID-19, 8 December 2021.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1039516/S1430_NERVTAG_Antiviral_drug_resistance_and_use_of_Direct_Acting_Antiviral_Drugs_.pdf

EMG TRANSMISSION SUB-GROUP PAPERS

Covid occupational risks

- 4.26. I played a major role in drafting a review of evidence for occupational risks of COVID transmission.

EMG - Transmission Group: COVID-19 risk by occupation and workplace - 11 February 2021.

<https://www.gov.uk/government/publications/emg-covid-19-risk-by-occupation-and-workplace-11-february-2021>

N.B. See also papers submitted to advisory groups outside of the formal committee structure for analysis of excess occupational mortality risks in May 2020.

Festivals

- 4.27. I contributed to an EMG transmission Subgroup paper on transmission risk at festivals, **which highlighted that attending festivals increases the risk of acquiring COVID-19.**

EMG Transmission Subgroup: Consensus Statement on SARS-CoV-2 Transmission Risk at Festivals, 23 December 2021.

<https://www.gov.uk/government/publications/emg-transmission-subgroup-consensus-statement-on-sars-cov-2-transmission-risk-at-festivals-23-december-2021--2>

Prisons

- 4.28. I led an EMG Transmission Group report on transmission in settings including the potential value of prioritising prisoners and prison staff for COVID-19 vaccination:

EMG Transmission Group: COVID-19 transmission in prison settings, 25 March 2021 -

<https://www.gov.uk/government/publications/emg-transmission-group-covid-19-transmission-in-prison-settings-25-march-2021>

Hotels and quarantine facilities

- 4.29. I contributed to a SAGE EMG transmission group paper:

EMG: COVID-19 Transmission in Hotels and Managed Quarantine Facilities (MQFs), 9 September 2021

<https://www.gov.uk/government/publications/emg-covid-19-transmission-in-hotels-and-managed-quarantine-facilities-mqfs-9-september-2021>

In particular, I contributed data comparing levels of infection in Every-One in hotels for people experiencing homelessness (single room ensuite accommodation) to those in homeless hostels (shared facilities) showing similar risk of infection in hotels to that in the general population but higher risk in hostels.

Hospitality, retail and leisure

- 4.30. I contributed to the drafting of the 'EMG Transmission Group: Insights on transmission of COVID-19 with a focus on the hospitality, retail and leisure sector, 8 April 2021':

<https://www.gov.uk/government/publications/emg-transmission-group-insights-on-transmission-of-covid-19-with-a-focus-on-the-hospitality-retail-and-leisure-sector-8-april-2021>

Effectiveness of Plan B measures

- 4.31. In October 2021 I contributed to a SAGE EMG SPI-B, SPI-M and EMG paper : Considerations for potential impact of Plan B measures, 13 October 2021.

<https://www.gov.uk/government/publications/spi-b-spi-m-and-emg-considerations-for-potential-impact-of-plan-b-measures-13-october-2021>

- 4.32. In particular, I contributed data from the Virus Watch study showing the higher risk of infection in those who left home for work or education. (full analysis available here: <https://wellcomeopenresearch.org/articles/7-199>)
- 4.33. I also contributed evidence from the Flu Watch cohort **to the Plan B measures report** that showed that outside of the context of a pandemic only a minority of working adults with PCR confirmed influenza infection took time off from work. “Continuing to attend a workplace while ill with a respiratory illness was common prior to the SARSCoV-2 pandemic. Only 34% of working adult participants (40% overall) in the Flu Watch study (2006-2011) took time off work or education for their illness with PCR-confirmed influenza A infection”. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5818341/>
- 4.34. The report recommended that reintroduction of work from home advice would likely be the most important non-pharmaceutical intervention in the event of a resurgence of COVID-19.

Work outside NERVTAG & SAGE EMG Transmission sub-group formal committee structures [Additional papers submitted to SAGE outside of NERVTAG or SAGE EMG transmission sub-group structure]

Risk of acquiring respiratory infection in public settings

- 4.35. 02/03/2020 – I emailed an analysis from the Flu Watch cohort entitled “Public activities associated with the onset of acute respiratory infection syndromes in adults in England - implications for the control of pandemic respiratory infections” to Deputy CMO Professor Van Tam , NERVTAG Chair Peter Horby and Susan Hopkins PHE. This was forwarded by DCMO to the CMO and Chief Scientific Advisor and I understand that this was discussed at SAGE Modelling Subgroup (SPI-M) but I do not know if it was discussed at the main SAGE committee or not. The analysis was important because it showed that non-household mixing in crowded public spaces including restaurants, bars, supermarkets, and parties increases risk of acquiring acute respiratory infection and therefore that limiting exposure to such settings could make important contribution to control. Further refinements of the analysis (also shared with

DHSC) also showed that exposure to public transport was a risk factor for acute respiratory infection. I highlighted that the data supported the need to introduce widespread social distancing measures.

- 4.36. The final analysis was published on Wellcome Open on 30th March - <https://wellcomeopenresearch.org/articles/5-54>.

Covid-19 in institutional settings

- 4.37. Early in the pandemic (17th March) I highlighted **in an email** to DHSC and NERVTAG concerns about the risk of COVID-19 in nursing home and homeless settings. I said there was an urgent need for advice for use of testing, cohorting, and PPE in institutional settings including nursing homes, homeless hostels and prisons and wrote that whilst testing capacity is limited there needs to be some prioritisation to use of this to prevent institutional outbreaks. I suggested this as a topic that NERVTAG should review but was advised that this was outside the remit of NERVTAG as it was not primarily a scientific question and more an operational and resource allocation issue.
- 4.38. I was extensively involved in the COVID-19 response in the homeless sector and the Every-One In approach to housing people experiencing homelessness in hotels with wrap around health and social care and outreach testing and co-wrote the Homeless Sector COVID-19 plan. This activity was largely outside the national COVID-19 scientific advisory structure. We sought, but did not receive, official endorsement of the plan from PHE, NHS and MHCLG. The guidance was published on the Pathway Homeless Health Charity website on 14th of April <https://www.pathway.org.uk/wp-content/uploads/COVID-19-Clinical-homeless-sector-plan-160420-1.pdf> and formed the basis of the COVID-19 response for homeless settings nationally. I also shared the guidance with colleagues leading public health in the prison sector and it was modified to inform the response in prison settings. I worked closely with the Healthy London Partnership operational group who co-ordinated the response across London and we produced extensive guidance, resources and information dissemination events in this area. <https://www.healthylondon.org/our-work/homeless-health/covid-19-resources/>

- 4.39. In May 2020 I presented a report to SAGE “Preventing outbreaks in forgotten institutional settings: What are we missing?”, 28 May <https://www.gov.uk/government/publications/preventing-outbreaks-in-forgotten-institutional-settings-what-are-we-missing-28-may-2020>
- 4.40. This was discussed in SAGE 39 (see SAGE minutes points 15-20 and associated action points). The action points recommended pro-active preventative actions across a wide range of institutional settings including homeless venues, prisons, immigration reception centres and additional research. No additional research was funded.
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/895862/S0468_Thirty-ninth_SAGE_meeting_on_Covid-19.pdf
- 4.41. On 28th January 2021 I presented a paper to JCVI Covid vaccine subgroup on COVID vaccination in Inclusion Health groups along with colleagues from DHSC inclusion health team– The paper is not available online and I am unable to locate the JCVI minutes of this meeting on their website. I presented further evidence at a later meeting soon after this specifically on risk of COVID in homeless groups which resulted in a recommendation to prioritise homeless people for vaccination.
- 4.42. NB – I also led a SAGE -EMG Transmission report on COVID transmission in prisons (see above) highlighting the value of prioritising prisoners and prison staff for COVID-19 vaccination.

Occupation and Covid-19

- 4.43. I conducted an analysis of publicly available ONS data to demonstrate comparative mortality in occupational groups and submitted this to SAGE 39. This showed occupations with high levels of contact, proximity, low pay and exposure to ill people had greatly increased mortality rates.
- 4.44. Impact of occupational exposure to disease, proximity to others during work and income on mortality from COVID-19, 27 May 2020

<https://www.gov.uk/government/publications/flu-watch-impact-of-occupational-exposure-to-disease-proximity-to-others-during-work-and-income-on-mortality-from-covid-19-27-may-2020>

- 4.45. The SAGE website incorrectly reports that this paper was available to read for members but was not discussed – I presented the findings and these were discussed - as reported in minutes of SAGE 39 (point 21-22) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/895862/S0468_Thirty-ninth_SAGE_meeting_on_Covid-19.pdf

Winter preparedness 2020/2021

- 4.46. I contributed to an academy of medical sciences report to SAGE on the likely resurgence of COVID-19 in the winter of 2020/2021 and measures needed to prepare for this.

- 4.47. In particular, I provided evidence on the seasonality of acute respiratory infections including seasonal coronavirus, evidence on the community frequency of symptoms that would prompt testing during winter periods showing the need to greatly upscale testing capacity. <https://wellcomeopenresearch.org/articles/5-225>, the high mortality from COVID-19 in ethnic minority groups (<https://wellcomeopenresearch.org/articles/5-88/v2>) and evidence on the importance of exposure to public places on risk of COVID-19. <https://wellcomeopenresearch.org/articles/5-54> As part of this group I argued strongly for the need to adjust model parameters to take account of seasonality based on extensive evidence of seasonality of other coronaviruses and respiratory viruses in the UK through our community studies. This resulted in a substantial recalibration of the reasonable worst-case scenario which turned out to be very close to the actual situation in the second wave

- 4.48. COVID-19: Preparing for a challenging winter 2020/21, 7 July 2020: <https://www.gov.uk/government/publications/covid-19-preparing-for-a-challenging-winter-202021-7-july-2020>

Relative importance of different non-household activities to COVID transmission in successive waves of the pandemic

4.49. In December 2020 I submitted a paper to SAGE to inform recommendations on social distancing. This made the following conclusions:

4.50. “Both during periods of intense restrictions and no restrictions shopping accounted for the highest proportion of infections acquired outside the home. Going to Work and Public transport use were also important predictors of infection. Intense restrictions largely prevented transmission in hospitality, entertainment, beauty services and sports during the second wave of the pandemic. During a period of no restrictions parties, hospitality were associated with increased risk indoors but not outdoors. Participating in sports indoors or outdoors was associated with increased risk (although this may relate to associated social activities). There was no good evidence of increased risk from attending cinemas, theatres, concerts or indoor sports events or for beauty services”:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1045002/S1470_Non_household_activities_covid_risk_1_.pdf

4.51. This report was available for SAGE members to read but not discussed at the committee.

4.52. I was involved in the Vivaldi Core Study – Evidence submitted to advisory groups is summarised in the submission of UCL Professor Laura Shallcross.

4.53. As part of the Virus Watch Study we conducted surveillance of antibody responses following COVID-19 vaccination – My colleague Professor Rob Aldridge submitted several reports to JCVI and the Vaccine Effectiveness Group based on analyses of these data (available on request but not currently publicly available). These showed, much higher levels of antibodies following vaccination with Pfizer than Astra Zeneca, Lower levels of post vaccine antibody in the elderly and those with chronic illness, rapidly waning antibody levels, correlations between antibody levels and risk of infection. These analyses contributed to decisions on timing of second doses in those with chronic illness and the elderly, and the need for 3rd doses of vaccine.

5: Summary of articles, interviews and/or evidence:

5.1. The following are news stories based on interviews I have given that were picked up by UCL media. **The headlines in the links to the news articles & interviews do not completely represent my comments. Reading the articles and listening to the interviews gives a more accurate idea of my comments. Where I can, I have indicated the original media source that my comments appeared in:**

5.2. **[Comment on the likely future impact of COVID-19 on sickness absence](#) :
Financial Times 4th April 2022**

5.3. **[Airline disruptions because of Covid's impact](#):**

Due to Covid there is “an unprecedented level of mild illness at the moment and that’s obviously quite disruptive for the workforce,” Professor Andrew Hayward (UCL Epidemiology & Health) 5 April 2022.

5.4. **[Covid likely to disrupt workforce for a long time](#):**

“I don’t think anybody is going to escape infection ultimately — whether they’ve been vaccinated or not. We could get infected every year or every few years — either way that means more sick days” said Professor Andrew Hayward (UCL Institute of Epidemiology&Health).4 April 2022- **The Financial Times**.

5.5. **[Removal of free lateral flow tests unlikely to make big difference to Covid rates](#):**

Professor Andrew Hayward, co-director of the UCL Institute of Epidemiology and Health Care, said that although LFTs have contributed to control, uptake had been patchy, meaning their removal was unlikely to make a major difference to overall rates. “Lateral flow tests remain useful in high-risk settings such as health care and social care and ... prisons and homeless venues” but their removal is unlikely to change overall rates, says Professor Andrew Hayward(UCL Institute of Epidemiology & Health).4 April 2022.- **The Guardian**.

5.6. **[Did Scotland's cautious coronavirus approach yield results](#):**

Recent increases in Scottish Covid deaths might be explained by the fact that fewer Scots were infected and killed in previous waves as “a lower proportion

of the population will be immune,” says professor Andrew Hayward (UCL Epidemiology & Health).15 February 2022- [Financial Times](#)

5.7. [Coronavirus pandemic ‘will end’:](#)

Professor Andrew Hayward (UCL Institute of Epidemiology & Health) has said that people will live with Covid continuing to transmit “but causing much less disruption in the future,18 January 2022- [Interview with Times Radio](#)

5.8. [Deaths from Covid are ‘absolutely tragic’:](#)

Professor Andrew Hayward (UCL Epidemiology & Health) said that the number of people who had died from Covid was “tragic” and that “many of them were avoidable if we had acted earlier in the first and second wave.” 10 January 2022- [Radio 4 programme & quoted in various media sources](#)

5.9. [Playing outdoor sports, going to the gym and shopping are most likely to raise the risk of catching Covid:](#)

Going shopping poses a bigger risk of catching Covid than theatres, sporting events or public transport, a new study by researchers including Professor Andrew Hayward (UCL Epidemiology & Health) suggests.10 January 2022

5.10. [Avoid New Year’s parties even if they are well ventilated:](#)

Professor Andrew Hayward (UCL Epidemiology & Health) said that “going to an indoor New Year’s Eve Party is not cautious, even if it is well ventilated.” 28 December 2021- [The Mirror](#)

5.11. [Britain still in Omicron danger zone:](#)

Britain is not yet out of the “danger zone” from the Omicron surge despite studies showing the variant has a milder impact on many people says Professor Andrew Hayward (UCL Epidemiology & Health).23 December 2021- [BBC Today Programme, and reported in a range of other media outlets](#)

5.12. [No decision yet on new Covid restrictions:](#)

Although the government is yet to reach a decision on the latest Covid restrictions, Professor Andrew Hayward (UCL Epidemiology & Health) says that it is crucial to have a few weeks of “more intense control measures” to prevent

and mitigate deaths and hospitalisations.21 December 2021- [Radio 4 pm programme.](#)

5.13. [Reducing social contact is necessary to slow the spread of Omicron:](#)

Professor Andrew Hayward (UCL Epidemiology & Health) said that it makes sense for people to be “really quite cautious” around socialising and there needs to be “clearer messaging” about people reducing their social contacts. 16 December 2021- [Newsnight Interview.](#)

5.14. [No clear communication from leaders on ‘sensible behaviour’ in the face of Covid:](#)

There has been a lack of “clear communication” from leaders about how people’s own behaviour can help the NHS as it faces the impact of a large wave of Omicron infections, says Professor Andrew Hayward (UCL Epidemiology&Health).

13 December 2021- [LBC Radio.](#)

5.15. [Tightening of rules reflects scientists’ concerns:](#)

Boris Johnson has announced a package of new Covid restrictions but Professor Andrew Hayward (UCL Epidemiology & Health) says that “Plan B won’t contain this wave but it will help to slow it down.” 9 December 2021- [Sky News and on a range of other media outlets.](#)

5.16. [Can masks reduce the risk of catching Covid?:](#)

Professor Andrew Hayward (UCL Institute of Epidemiology & Health) explains how research into the effectiveness of masks against Covid is carried out and examined.

6 December 2021- [Radio 4 More or Less Programme.](#)

5.17. [Boris Johnson contradicts expert advice to cancel Christmas socialising:](#)

Professor Andrew Hayward (UCL Epidemiology & Health) says that the “intensification of mixing at Christmas social events will provide a boost to transmission at just the time when the Omicron variant will probably be picking up speed.” 1 December 2021- [The Mail Online.](#)

5.18. [Comment on the value of immunity to reduce the impact of the pandemic:](#)

[We’re in a better place with Covid now, expert says. The UK is in a “different](#)

situation" now to the start of the pandemic and "we're definitely not going back to the start again", a Government scientific adviser has assured. Professor Andrew Hayward, an epidemiologist at UCL and a member of the Nervtag advisory group, said: "When you define a pandemic, one of the sort of key points of that is that it's coming into a population with no immunity. "Now, that's just not the case anymore. We may have lost some of that immunity, but we still have a reasonable amount of it. "I think that doesn't mean that it's not going to cause a problem. I think what you tend to see in pandemics is that you'll get two or three or four reasonable-sized waves, and then it will just sort of fade into the background along with other infections." "Now, we've been able to accelerate the speed with which it's going to fade into the background by boosting immunity and as new strains emerge over time, we'll get a broader level of protection," he added on Times Radio. "So, I think that the long-term picture is good, but we do have a potential problem over this winter. We need to monitor it, we need to be cautious still, I'm afraid, 1 December 2021- Times Radio.

5.19. **UK must be ready to impose Covid restrictions this winter:**

Professor Andrew Hayward (UCL Epidemiology & Health) says that the UK is "on a knife edge" when it comes to plans such as mandatory vaccines and fresh lockdowns.²² November 2021- [Radio 4 Today Programme and reported in various media outlets.](#)

5.20. **Covid immunity needs to be high ahead of winter:**

"Whenever we approach a winter period we expect respiratory virus infections to increase, so it's very important that we go into that with as high a level of population immunity," says Professor Andrew Hayward (UCL Institute of Epidemiology & Health).²⁰ October 2021- [Radio 4 World at One and reported across a range of media channels.](#)

5.21. **Covid booster vaccines rollout 'too slow':**

Covid infections are rising as immunity in the most vulnerable is falling, causing "huge potential for the NHS to come under a lot of pressure," says Professor Andrew Hayward (UCL Epidemiology & Health).¹⁹ October 2021- [Times radio and reported across a range of media outlets.](#)

5.22. [All children could catch Covid without jabs:](#)

Any child that is unvaccinated against Covid is likely to catch the infection as it is not an illness you can “escape without vaccination,” says Professor Andrew Hayward (UCL Epidemiology & Health).k 23 September 2021- [Radio 4 pm programme.](#)

5.23. [Covid vaccines mean this winter will be ‘very different’ to last:](#)

Now a large percentage of the population has been vaccinated “we can do more and we can rely on the vaccine more than we did last year and reduce the social distancing measures,” says Professor Andrew Hayward (UCL Epidemiology & Health).16 September 2021- [BBC today Programme 15 September 2021, and reported in the Sun on 16 September 2021.](#)

5.24. [Covid Plan B is necessary to prevent deaths:](#)

The government’s Plan B for Covid, which includes working from home guidance, compulsory mask wearing and vaccine passports is needed in case things “spiral out of control,” says Professor Andrew Hayward (UCL Epidemiology & Health).15 September 2021

5.25. [Ethics of Covid boosters questioned:](#)

Professor Andrew Hayward (UCL Epidemiology & Health) has questioned the ethics of the UK giving boosters to large numbers of low-risk individuals at a time when poorer nations are desperateforvaccines 7 September 2021

5.26. [Biggest wave of Covid infection yet to come:](#)

“Even though the [Covid] vaccine will substantially reduce the number of deaths and hospitalisations, it’s still likely that we will see somewhere in the low tens of thousands of deaths even if we are cautious,” says Professor Andrew Hayward (UCL Epidemiology &Health).7 September 2021

5.27. [Global vaccination drive needed now:](#)

A global drive to boost Covid-19 vaccination rates is needed, and richer countries like the UK must do more to help countries without adequate vaccine supplies, says Professor Andrew Hayward (UCL Epidemiology & Health). 1 September 2021- [BBC Today Programme.](#)

5.28. **'Covid will soar annually like flu – and we won't need lockdowns':**

Covid will become an “endemic disease” that soars annually like flu but will not need further lockdown to keep it under control, says Professor Andrew Hayward (UCL Epidemiology & Health).11 August 2021- **BBC Today Programme and reported in various media outlets.**

5.29. **Why the Covid experts are not sure that the pandemic is over:**

Although high levels of Covid antibodies and cautious behaviour among the public mean that the situation bodes well for summer and early autumn, the picture for the UK becomes more uncertain after that, says Professor Andrew Hayward (UCL Epidemiology & Health).10 August 2021- **The Guardian.**

5.30. **Caution key in Covid unlocking:**

Removing all lockdowns restrictions now means “we are heading into the biggest wave of Covid infection that we have ever seen,” cautions Professor Andrew Hayward (UCL Epidemiology & Health), adding that people should continue to minimise contact with others.19 July 2021- **Sky News and reported in a range of media outlets.**

5.31. **Isolation still an important tool in controlling Covid-19:**

Controlling Covid-19 using distancing and isolation is important even after restrictions end, as “if we get to a very small percentage of a massive number of cases getting hospitalised, that’s still a very large number,” says Professor Andrew Hayward (UCL Epidemiology & Health).8 July 2021- **BBC Today Programme and reported in a range of other media.**

5.32. **What will lockdown ending mean for Covid spread?:**

Covid cases are likely to rise rapidly once restrictions are lifted, but at some point new infections will slow and eventually reduce due to vaccination and natural immunity, says Professor Andrew Hayward (UCL Epidemiology & Health), 6 July 2021- **BBC pm Programme.**

5.33. **Delay lockdown easing to suppress Covid-19 Delta variant:**

The spread of the Delta variant of Covid-19 among unvaccinated people is “extremely worrying,” and means a delay to further lockdown easing is needed

to ensure a third wave of the virus doesn't spread out of control, says Professor Andrew Hayward (UCL Epidemiology & Health).14 June 2021- [Andrew Marr Show and reported in a range of media.](#)

5.34. [Extending November lockdown would have saved lives:](#)

If the November Covid-19 lockdown had been extended “the great majority of second-wave deaths could have been avoided,” says Professor Andrew Hayward(UCL Epidemiology & Health).28 May 2021- [The Guardian.](#)

5.35. [Delay lockdown easing until higher proportion vaccinated:](#)

The final stage of lockdown easing should be delayed until more of the population have had both doses of the Covid-19 vaccine, say Professor Christina Pagel (UCL Mathematics) and Professor Andrew Hayward (UCL Epidemiology & Health).28 May 2021- [BBC Today Programme and reported in a range of media.](#)

5.36. [UK could be at the start of new Covid-19 wave:](#)

The spread of the Indian variant of Covid-19 could be the start of a new wave of Covid-19 due to its increased transmissibility, warns Professor Andrew Hayward (UCL Epidemiology & Health).20 May 2021

5.37. [Comments on the potential consequences of the Delta Variant:](#) Asked on BBC Breakfast if the country was at the start of the third wave, he said: “I think so. “I think what we can see is that this strain can circulate very effectively, although it was originally imported through travel to India, it’s spread fairly effectively first of all within households and now more broadly within communities, so I don’t really see why it wouldn’t continue to spread in other parts of the country. “Obviously we’re doing everything we can to contain the spread of that, but it’s likely that more generalised measures may start to be needed to control it.” Speaking in a personal capacity about the Indian variant, Prof Hayward said he was “very concerned”.

5.38. He added: “I think that concern largely arises from the fact that it’s more transmissible than the previous variants which was already substantially more transmissible than the variant before that. “So, whilst I think we’ve always thought that we would have another wave of Covid, the size of that wave is

going to very much depend on how transmissible the variant that causes it is and what proportion of the population have been vaccinated when it hits. “Fortunately, we’ve had a good proportion of the population vaccinated, but there’s still people who aren’t vaccinated in high-risk groups, the vaccine isn’t 100% effective, and also even in the younger groups if you get many, many thousands or hundreds of thousands of cases, then you will expect a lot of hospitalisations and deaths to result from that. “So that’s the threat. And it’s really over the next week or two we will see how much these outbreaks that at the moment are relatively localised, how much they become generalised across the population. And if that happens, that’s when we’re going to be much more worried.”

5.39. “And this is one of the reasons why it’s important to really minimise travel full-stop, whether it’s to red list or amber list countries, because there is mixing involved in travelling both on aeroplanes, in airports, and of course in the country where you go to. “I think at the moment, over the next period of time whilst we’re really trying to get as much of the population vaccinated as possible, so we’ve got that whole population protection type approach, then we don’t really want to waste the opportunity of that through too much travel.” He said he thought the approach adopted by Australia and New Zealand “would be the most successful model at keeping Covid out from other countries” but it was for Government to decide when balanced against other factors. “And there’s also arguments on the other side that if you’ve got similar levels of Covid in another country, that people are vaccinated, then what’s the fuss?,” he said. “So it’s not a black-and-white issue.” Prof Hayward said he backed the policy of vaccinating older people with two doses before moving onto younger age groups. He added that it was his “hunch” that the Indian strain would become dominant in the UK and possibly across the world. “That really brings it back down to this race against the vaccine and the virus, except the virus just got faster,” he said, 20th May 2021 – BBC Breakfast and reported in various other media.

5.40. **Concerning amount of unknowns surround Covid-19 variant:**

The lack of data on the transmissibility of the Indian Covid-19 variant, as well as whether it can evade the immunity offered by vaccines, is concerning and

means we should slow the easing of lockdown restrictions, says Professor Andrew Hayward (UCL Epidemiology & Health).17 May 2021- [BBC Radio 4](#).

5.41. [Important to be wary of variants as lockdown eases:](#)

Emerging variants of Covid-19 are still a danger as lockdown eases, and “we still need to be following the plan and taking things step by step,” says Professor Andrew Hayward (UCL Epidemiology & Health).11 May 2021- [BBC Radio 2 News](#).

5.42. [Cautious approach to international travel needed:](#)

Erring on the side of caution and banning travel to or from places with emerging Covid-19 variants is prudent, even if further research proves certain variants are not a cause for concern, says Professor Andrew Hayward (UCL Epidemiology & Health).20 April 2021- [The Sun](#).

5.43. [Difficult to predict impact of lockdown easing:](#)

The easing of the Covid-19 lockdown “is likely to lead to a resurgence in cases although the speed and extent of this is difficult to predict,” warns Professor Andrew Hayward (UCL Epidemiology & Health).29 March 2021- [The Mirror](#).

5.44. [Travel restrictions can’t completely stop Covid-19 transmission:](#)

As some travel is needed for essentials such as freight entering the country, any travel restrictions can at best slow the transmission of Covid-19 from one country to another, but can’t prevent it completely, says Professor Andrew Hayward(UCL Epidemiology & Health).29 March 2021- [BBC Radio 4 PM show](#).

5.45. [Big cities could become centres of Covid-19 infection:](#)

As lockdown restrictions ease, there are still a lot of people who could get seriously ill, especially in areas of big cities where vaccine uptake rates have been lower, says Professor Andrew Hayward (UCL Epidemiology & Health). 24 March 2021- [The Times](#).

5.46. [Another wave of Covid-19 is possible:](#)

A surge in Covid-19 infections is possible if mistakes are made when exiting lockdown, but “will cause substantially fewer deaths and hospitalisations because of high levels of vaccination,” says Professor Andrew Hayward (UCL

Epidemiology & Health).22 March 2021- [Times Radio and reported in a range of media.](#)

5.47. [Traffic light system for Covid could facilitate travel:](#)

A system where some countries “are no-go areas...other areas where there will be more severe restrictions...and maybe there will be some low-risk countries that you can go,” could allow travel during the Covid-19 pandemic, says Professor Andrew Hayward (UCL Epidemiology & Health).22 March 2021- [BBC Radio 4.](#)

5.48. [Covid-19 inquiry should focus on learning for the future:](#)

Any inquiry into the UK’s response to the Covid-19 pandemic should focus on “learning for the future rather than culpability,” says Professor Andrew Hayward (UCL Epidemiology & Health).17 March 2021- [The Guardian.](#)

5.49. [South African Covid-19 variant likely widespread:](#)

As the South African variant of Covid-19 is identified through gene sequencing, and around 5-10% of cases are sequenced, “you can immediately tell from that that we have a big under-estimation of the number of cases,” says Professor Andrew Hayward (UCL Epidemiology & Health).16 March 2021- [The Sun.](#)

5.50. [How to ease lockdown without deepening social divisions:](#)

We must boost resources for disadvantaged areas to ensure that they can benefit from testing and vaccination and not be disadvantaged by the need to self-isolate during the Covid-19 pandemic, says Professor Andrew Hayward (UCL Epidemiology & Health).15 March 2021- [The Guardian.](#)

5.51. [We must remain cautious on Covid-19:](#)

Covid-19 vaccines will help to reduce deaths from the virus but will not eliminate it completely, and we it isn’t “time to return to a more risky approach,” warns Professor Andrew Hayward (UCL Epidemiology & Health).10 March 2021- [Times Radio and Reported in a range of media.](#)

5.52. [Society must learn to live with Covid-19](#)

The worst levels of Covid-19 mortality are probably over, but we must learn to live with the virus in much the same way as we do the winter flu, says Professor Andrew Hayward (UCL Epidemiology & Health). 5 March 2021- [Times Radio](#).

5.53. [New vaccine approval 'exciting'](#):

The approval of a single-dose Covid-19 vaccine which can be stored easily is “exciting” and should help with vaccine rollout worldwide, says Professor Andrew Hayward (UCL Epidemiology & Health). 1 March 2021- [BBC World Service](#).

5.54. [Studies on vaccine effectiveness are 'promising'](#):

While new studies on Covid-19 vaccine effectiveness weren't large enough to be completely conclusive, they are “very promising and in line with what we hoped for from the trials,” says Professor Andrew Hayward (UCL Epidemiology & Health). 23 February 2021- [BBC World at One](#).

5.55. [Covid-19 shielding update is based on more sophisticated system](#):

The new Covid-19 shielding list takes national data and calculates risk in a more sophisticated way, incorporating age, illness, and ethnicity, among other factors, says Professor Andrew Hayward (UCL Epidemiology & Health). 17 February 2021- [BBC 4 Today Programme](#).

5.56. [Covid-19 vaccination programme must reach marginalised people](#):

The UK's Covid-19 vaccination rollout needs to reach excluded and marginalised people such as refugees, asylum seekers and the homeless, says Professor Andrew Hayward (UCL Epidemiology & Health). 15 February 2021- [Huffington Post](#).

5.57. [Hotel quarantine scheme is too little, too late](#):

Introducing a quarantine for arrivals into the UK to prevent new variants entering the country is unlikely to be effective, as the variants in question have already been imported into the UK, says Professor Andrew Hayward (UCL Epidemiology & Health). 10 February 2021- [BBC Radio 2 News](#).

5.58. [Covid-19 restrictions could be loosened significantly by summer](#):

The seasonality of Covid-19, coupled with the vaccine rollout, mean that a “significant return to normality,” should be possible by the summer, says Professor Andrew Hayward (UCL Epidemiology & Health). 4 February 2021- [BBC Radio 4 Today Programme and reported in a range of other media.](#)

5.59. [‘Sustainable strategy’ needed to tackle Covid-19 mutations:](#)

New variants of Covid-19 will continue to pose a risk, and the UK cannot keep borders shut forever, meaning a “sustainable strategy” is needed to deal with future mutations, says Professor Andrew Hayward (UCL Epidemiology & Health), 2 February 2021- [Sky News and reported in a range of media.](#)

5.60. [Covid-19 rates continue to climb:](#)

Professor Andrew Hayward (UCL Epidemiology & Health) discusses the climbing rates of Covid-19 in the UK, the potential danger of new mutations, and reports from Israel which claim the first dose of the Pfizer vaccine doesn't give as much protection as initially thought. 20 January 2021- [BBC Radio 4 Today Programme and reported in a range of media.](#)

5.61. [Lockdown has ‘split the population in two’:](#)

Financial support is needed for those who currently can't afford to stay home, or Covid-19 will continue to spread, warns Professor Andrew Hayward (UCL Epidemiology & Health). 15 January 2021- [Times Radio.](#)

5.62. [UK coronavirus deaths pass 100,000:](#)

As Covid-19 deaths in the UK exceed 100,000, Professor Andrew Hayward (UCL Epidemiology & Public Health) and Professor Christina Pagel (UCL Mathematics) say the toll will continue to increase in the coming weeks. 14 January 2021- [The Guardian.](#)

5.63. [Approval of new Covid-19 vaccine “a game-changer”:](#)

The approval of the Oxford-AstraZeneca Covid-19 vaccine is “exactly what we need” as it can be stored at normal fridge temperatures and delivered anywhere it is needed, rather than only in specialist centres, says Professor Andrew Hayward (UCL Epidemiology & Health). 7 January 2021- [BBC Breakfast.](#)

5.64. **Covid-19 lockdown will take time to have an impact:**

Deaths from Covid-19 will keep increasing in the short term despite new lockdown restrictions, as there is a lag of two to three weeks between measures coming into effect and them having an impact on the number of cases, says Professor Andrew Hayward (UCL Epidemiology & Health).7 January 2021- [BBC Breakfast](#).

5.65. **New national lockdown needed to control Covid-19 spread:**

The tier system's mixed results in containing Covid-19 and the more infectious variant mean that a strict national lockdown may be necessary, warn Professor Andrew Hayward, Professor Robert West (both UCL Epidemiology & Health) and Professor Christina Pagel (UCL Mathematics).7 January 2021- [BBC Radio 4 Today Programme](#) and reported on multiple media outlets.

5.66. **Tougher restrictions needed to halt Covid-19 spread:**

The speed with which London and the South-east saw an increase in Covid-19 cases shows that tougher restrictions will be needed to halt the spread of the virus, says Professor Andrew Hayward (UCL Epidemiology & Health). 6 January 2021- [The Guardian](#).

5.67. **Testing vital to halt Covid-19 spread:**

Up to 500,000 people a day present with coronavirus-like symptoms every winter, with or without a pandemic, meaning getting tested is absolutely vital to ensure minimal Covid-19 spread, says Professor Andrew Hayward (UCL Epidemiology & Health).17 December 2020

5.68. **Christmas plans could lead to a third Covid-19 wave:**

Plans to allow household mixing over Christmas risk increased transmission and pressure on the NHS, says Professor Andrew Hayward (UCL Epidemiology & Public Health).8 December 2020- [BBC 2 Newsnight](#).

5.69. **“Substantial risks” if mixing allowed at Christmas:**

Allowing people to mix over Christmas would lead to increased Covid-19 risk, particularly for older people, and it would be “tragic” to throw away gains in suppressing the virus just as a vaccine is on the horizon, argues Professor

Andrew Hayward (UCL Epidemiology & Health).19 November 2020- [BBC Radio 4 Today Programme](#) and reported in a range of other media.

5.70. [Why are we facing another national lockdown?](#):

With lockdowns an option of last resort, Professor Andrew Hayward (UCL Epidemiology & Health) explains why one is necessary now, saying that it was initially suggested at the end of September and the delay has caused a much higher death rate and more damage to the economy. 2 November 2020- [BBC Radio 4 Today Programme](#)

5.71. [Will a tiered Covid-19 lockdown work?](#):

Professor Andrew Hayward (UCL Epidemiology & Health) discusses the issues with a system of tiered lockdowns and argues that the restrictions introduced in each tier do not go far enough to halt the spread of Covid-19. 21 October 2020- [Channel 4 News](#)

5.72. [Timely circuit-break lockdown would have prevented need for longer-term restrictions:](#)

Professor Andrew Hayward (UCL Epidemiology & Health) explains how UK Government ministers ignored Sage experts' advice to implement shorter lockdowns weeks ago, which would have reduced the need for much more intensive and longer-term lockdowns in the future.13 October 2020- [BBC Radio 4 Today Programme](#)

5.73. [Covid-19 deaths 3.4 times higher than flu and pneumonia:](#)

Professor Andrew Hayward (UCL Epidemiology & Health) explains the latest ONS data and adds "You cannot necessarily [see] it from these data, because they do not show the number of infections, but Covid-19 has a much higher case fatality rate than influenza."9 October 2020- [The Guardian](#)

5.74. [Local lockdowns appear to be working:](#)

Local lockdown measures are "unfortunate" but appear to be curbing the spread of Covid-19 across north-east England, says Professor Andrew Hayward (UCL Epidemiology & Health). 30 September 2020

5.75. [Are the new Covid-19 restrictions necessary?:](#)

Professor Andrew Hayward (UCL Epidemiology & Health) agrees with the UK Government's recent curfew on pubs and says "if we don't curve the speed of increase (of new coronavirus cases), these pandemics can get out of hand extraordinarily quickly." 29 September 2020

5.76. [University students debate whether to return home:](#)

Professor Andrew Hayward (UCL Epidemiology & Health) comments on online learning and adds that whilst for most subjects, the content could be delivered just as effectively online, "the quality of the social experience of the university is clearly dramatically reduced this year." 28 September 2020- [**BBC Radio 4 World at One**](#)

5.77. [UK case rises are 'concerning':](#)

Independent Sage members Professor Susan Michie (UCL Psychology & Language Science) and Professor Andrew Hayward (UCL Epidemiology & Health) criticise the UK Government's confusing messaging and express concern at the "very worrying increases in cases" of Covid-19 in England. 8 September 2020- [**Radio 4 Today Programme 8th September 2020 and reported in multiple media outlets**](#)

5.78. [New study into Covid-19 transmission and immunity launched:](#)

Virus Watch, led by Professor Andrew Hayward (UCL Epidemiology & Health), is inviting 42,500 people to take part in one of the largest and most comprehensive studies of Covid-19 in the UK to investigate the next phase of the pandemic. 23 June 2020: [**23rd June 2020 UCL Press Office**](#)

5.79. [Preventing and containing Covid-19 outbreaks in prisons:](#)

Reducing Covid-19 coronavirus spread by "moving the most vulnerable prisoners to less-crowded parts of the prison system, where outbreaks are easier to prevent and contain...could save many lives," Explains Professor Andrew Hayward (UCL Epidemiology & Health). 23 March 2020.

5.80. [Comment on control of COVID-19 in prisons and institutional settings:](#)

[**Andrew Hayward, professor of infectious disease epidemiology at UCL, said: "Isolating suspected cases is important but because some people spread infection before they develop symptoms. Outbreaks can still start easily and**](#)

spread rapidly through overcrowded prisons.“Moving the most vulnerable prisoners to less-crowded parts of the prison system, where outbreaks are easier to prevent and contain, and reducing mixing with other prisoners could save many lives.”Hayward, who is also on a government national advisory committee for tackling coronavirus, added: “One of my main concerns is that we’ve not really got to grips with the likelihood of big outbreaks in institutional settings.”-, 23 March 2020- The Guardian

5.81. [How to care for homeless with coronavirus:](#)

Agencies should stop bringing homeless people into shared spaces, instead supporting them on the street and opening places where they can be tested for symptoms, explains Professor Andrew Hayward (UCL Epidemiology & Health). 20 March 2020- Faculty for Homeless and Inclusion Health Conference reported in New Statesman 20th March 2020.

5.82. My publications in Scientific journals and on pre-print servers related to COVID-19 can be found on Google Scholar:

https://scholar.google.com/citations?hl=en&user=MPoKBygAAAAJ&view_op=list_works&sortby=pubdate and are summarised below:

Title	Publication	Year	Comment
Public activities preceding the onset of acute respiratory infection syndromes in adults in England-implications for the use of social distancing to control pandemic respiratory infections.	Wellcome open research	2020	Research showing exposure to public spaces increases risk of respiratory infections with discussion on implications for pandemic control
Seasonality and immunity to laboratory-confirmed seasonal coronaviruses (HCoV-NL63, HCoV-OC43, and HCoV-229E): results from the Flu Watch cohort study	Wellcome Open Research	2020	Research showing the seasonality of seasonal coronavirus and risk of reinfection with discussion of implications for pandemic control
Impacts of COVID-19 on vulnerable children in temporary accommodation in the UK	The Lancet Public Health	2020	Research showing the difficulties families in temporary accommodation have during lockdown
Black, Asian and Minority Ethnic groups in England are at increased risk of death from COVID-19: indirect standardisation of NHS mortality data	Wellcome open research	2020	First published study showing increased risk of death from COVID in ethnic minority groups.
The UK hibernated pandemic influenza research portfolio: triggered for COVID-19	The Lancet Infectious Diseases	2020	Paper discussing the triggering of pandemic preparedness research studies
Hand hygiene practices and the risk of human coronavirus infections in a UK community cohort	Wellcome Open Research	2020	Research showing the protective effect of regular hand washing on prevention

Updated Questionnaire Response – Professor Andrew Hayward

			of seasonal coronaviruses with discussion of the implications for control of COVID.
A rapid review and meta-analysis of the asymptomatic proportion of PCR-confirmed SARS-CoV-2 infections in community settings	medRxiv	2020	A systematic review to assess the proportion of COVID-19 infections that are asymptomatic
SARS-CoV-2 virus and antibodies in front-line health care workers in an acute hospital in London: preliminary results from a longitudinal study	MedRxiv	2020	A study in a north London hospital which was the first to show the extremely high levels of Covid-19 infection in front line health care workers
Protocol for the development and evaluation of a tool for predicting risk of short-term adverse outcomes due to COVID-19 in the general UK population	medRxiv	2020	A paper describing the methodology of research to identify groups at high risk of severe COVID using electronic health records
Pandemic peak SARS-CoV-2 infection and seroconversion rates in London frontline health-care workers	The Lancet	2020	A study in a north London hospital which was the first to show the extremely high levels of Covid-19 infection in front line health care workers
COVID-19: digital equivalence of health care in English prisons	The Lancet Digital Health	2020	A review of digital health interventions used in COVID
Impact of baseline cases of cough and fever on UK COVID-19 diagnostic testing rates: estimates from the Bug Watch community cohort study	Wellcome open research	2020	A study assessing the frequency of symptoms that might need a COVID test in pre-pandemic periods to give insight into potential capacity requirements for community diagnostic tests
COVID-19 among people experiencing homelessness in England: a modelling study	The Lancet Respiratory Medicine	2020	A study that modelled the effectiveness of the UK response to COVID-19 in the homeless showing large numbers of lives saved and hospital admissions prevented
Risk factors associated with SARS-CoV-2 infection and outbreaks in Long Term Care Facilities in England: A national survey	medRxiv	2020	A study showing risk factors for outbreaks in nursing homes showing the importance of staff in infecting residents and the need to provide sick pay and prevent staff moving between homes
Risk factors, symptom reporting, healthcare-seeking behaviour and adherence to public health guidance: protocol for Virus Watch, a prospective community cohort study	BMJ open	2021	A paper describing the methodology of the Virus Watch community cohort study
Factors associated with SARS-CoV-2 infection and outbreaks in long-term care facilities in England: a national cross-sectional survey	The Lancet Healthy Longevity	2021	A study showing risk factors for outbreaks in nursing homes showing the importance of staff in infecting residents and the need to provide sick pay and prevent staff moving between homes
Study Protocol: Understanding SARS-Cov-2 infection, immunity and its duration in care home residents and staff in England (VIVALDI)	Wellcome Open Research	2020	A paper describing the methodology of the Vivaldi nursing home study
Incidence of SARS-CoV-2 infection according to baseline antibody status in staff and residents of 100 long-term care facilities (VIVALDI): a prospective cohort study	The Lancet Healthy Longevity	2021	A study showing the protective effect of antibodies derived from natural infection against COVID in nursing home staff and residents.

Updated Questionnaire Response – Professor Andrew Hayward

Spread of a variant SARS-CoV-2 in long-term care facilities in England	New England Journal of Medicine	2021	A study showing how the Alpha variant spread rapidly through nursing homes
Vaccine effectiveness of the first dose of ChAdOx1 nCoV-19 and BNT162b2 against SARS-CoV-2 infection in residents of long-term care facilities in England (VIVALDI): a prospective cohort study	The Lancet Infectious Diseases	2021	A study showing the effectiveness of vaccines in nursing home residents
Trends, patterns and psychological influences on COVID-19 vaccination intention: Findings from a large prospective community cohort study in England and Wales (Virus Watch)	Vaccine	2021	A study of people's intentions regarding COVID vaccine showing greater vaccine hesitancy in ethnic minority groups.
Deprivation and exposure to public activities during the COVID-19 pandemic in England and Wales	J Epidemiol Community Health	2022	A study showing how people in socially deprived areas are more likely to need to undertake activities that place them at risk of COVID
Household overcrowding and risk of SARS-CoV-2: analysis of the Virus Watch prospective community cohort study in England and Wales	medRxiv	2021	A study showing that household overcrowding is a risk factor for COVID
Symptom profiles and accuracy of clinical definitions for COVID-19 in the community. Results of the Virus Watch community cohort	medRxiv	2021	A study examining the accuracy of different symptom combinations for identifying COVID-19
Occupation, work-related contact and SARS-CoV-2 anti-nucleocapsid serological status: findings from the Virus Watch prospective cohort study	Occupational and environmental medicine	2022	A study showing the increased risk of COVID-19 in frontline occupations and how this is mediated by workplace contact
Household serial interval of COVID-19 and the effect of Variant B. 1. 1. 7: analyses from prospective community cohort study (Virus Watch)	Wellcome open research	2021	A study assessing whether B.1.1.7 transmits between individuals more quickly than previous strains.
Spike-antibody responses to ChAdOx1 and BNT162b2 vaccines by demographic and clinical factors (Virus Watch study)	MedRxiv	2021	A study showing higher levels of antibodies after Pfizer vaccine than after Astra Zeneca and showing lower responses in the elderly and those with chronic illness
Prevalence of persistent symptoms in children during the COVID-19 pandemic: evidence from a household cohort study in England and Wales	medrxiv	2021	A study assessing the frequency of long COVID in children
Relative perceived importance of different settings for SARS-CoV2 acquisition in England and Wales: Analysis of the Virus Watch Community Cohort	medRxiv	2021	A study reporting where people think they caught COVID-19
SARS-CoV-2 lineage B. 1. 1. 7 is associated with greater disease severity among hospitalised women but not men: multicentre cohort study	BMJ open respiratory research	2021	A study assessing the relative severity of B.1.1.7 compared to previous strains in hospitalised patients
Changes in mobility pre and post first SARS-CoV-2 vaccination: findings from a prospective community cohort study including GPS movement tracking in England and Wales (Virus Watch)	medRxiv	2021	A study assessing the extent to which vaccination influenced people's movements and contact with others
COVID-19 and homelessness in England: a modelling study of the COVID-19 pandemic among people experiencing homelessness, and the impact of a residential intervention to isolate vulnerable people and care for people with symptoms	MedRXIV	2020	A study that modelled the effectiveness of the UK response to COVID-19 in the homeless showing large numbers of lives saved and hospital admissions prevented
Protocol: Risk factors, symptom reporting, healthcare-seeking behaviour and adherence to public health guidance: protocol for Virus Watch, a prospective community cohort study	BMJ Open	2021	A paper describing the methodology of the Virus Watch community cohort study

Updated Questionnaire Response – Professor Andrew Hayward

Spike-antibody waning after second dose of BNT162b2 or ChAdOx1	The Lancet	2021	A study showing rapid waning of antibodies after the first dose of vaccine
Profile of humoral and cellular immune responses to single doses of BNT162b2 or ChAdOx1 nCoV-19 vaccines in residents and staff within residential care homes (VIVALDI): an observational study	The Lancet Healthy Longevity	2021	A study showing the antibody and T cell response to vaccines in nursing home staff and residents.
Robust SARS-CoV-2-specific and heterologous immune responses after natural infection in elderly residents of Long-Term Care Facilities	medRxiv	2021	A study showing antibody responses after natural infection in nursing home residents
Risk prediction of covid-19 related death and hospital admission in adults after covid-19 vaccination: national prospective cohort study	bmj	2021	A study using electronic health records to predict risk of severe covid after vaccination
Reported exposure to SARS-CoV-2 and relative perceived importance of different settings for SARS-CoV-2 acquisition in England and Wales: Analysis of the Virus Watch Community Cohort	Wellcome Open Research	2021	A study reporting where people think they caught COVID-19
Prevalence and duration of detectable SARS-CoV-2 nucleocapsid antibodies in staff and residents of long-term care facilities over the first year of the pandemic (VIVALDI study): prospective cohort study in England	The Lancet Healthy Longevity	2022	A study reporting the level of antibodies in nursing home residents and staff and how these wane over time
The Alpha variant was not associated with excess nosocomial SARS-CoV-2 infection in a multi-centre UK hospital study	Journal of Infection	2021	A study suggesting the alpha variant did not lead to increases in hospital transmission
Waning of SARS-CoV-2 antibodies targeting the Spike protein in individuals post second dose of ChAdOx1 and BNT162b2 COVID-19 vaccines and risk of breakthrough infections: analysis of the Virus Watch community cohort	medRxiv	2021	A study showing how antibodies wane over time following vaccination and how this waning is associated with breakthrough infections
Differential Risk of SARS-CoV-2 Infection by Occupation: Evidence from the Virus Watch prospective cohort study in England and Wales	medRxiv	2021	A study showing the increased risk of COVID-19 in a range of occupations who could not work from home
Workplace contact patterns in England during the COVID-19 pandemic: Analysis of the Virus Watch prospective cohort study	The Lancet Regional Health-Europe	2022	A study showing how contact patterns differ across occupations
Prevalence and duration of detectable SARS-CoV-2 nucleocapsid antibody in staff and residents of long-term care facilities over the first year of the pandemic (VIVALDI study): prospective cohort study	medRxiv	2021	A study reporting the level of antibodies in nursing home residents and staff and how these wane over time
Comparative effectiveness of ChAdOx1 versus BNT162b2 vaccines against SARS-CoV-2 infections in England and Wales: A cohort analysis using trial emulation in the Virus Watch community data	medRxiv	2021	A study comparing the effectiveness of Astra Zeneca and Pfizer vaccine
Digital mHealth and Virtual Care Use in Pandemics: A Rapid Landscape Review of Interventions Used Internationally During COVID-19 in 4 Countries.	JMIR Formative Research	2021	A review of digital health interventions used in COVID
Outcomes of SARS-CoV-2 Omicron infection in residents of Long-Term Care	medRxiv	2022	A study describing rates of hospitalisation and death in nursing home residents during the Omicron wave
SARS-CoV-2 anti-spike antibody levels following second dose of ChAdOx1 nCov-19 or BNT162b2 in residents of long-term care facilities in England (VIVALDI)	medRxiv	2022	A study showing antibody levels after the second dose of vaccine in nursing home residents
COVID-19 infection and attributable mortality in UK care homes: cohort study using active surveillance and electronic records (March–June 2020)	Age and ageing	2021	A study showing the number of deaths attributable to COVID in nursing homes
Nucleocapsid and spike antibody responses post virologically confirmed SARS-CoV-2 infection: An observational analysis in the Virus Watch community cohort	medRxiv	2022	A study showing antibody levels following COVID infection
Inequalities in access to paid sick leave among workers in England and Wales	medRxiv	2022	A study showing which groups in the population do

Updated Questionnaire Response – Professor Andrew Hayward

			not have access to sick pay and discussion of the ability to comply with self-isolation during Covid
Anti-spike antibody trajectories in individuals previously immunised with BNT162b2 or ChAdOx1 following a BNT162b2 booster dose	medRxiv	2022	A study showing antibody levels after booster doses of vaccine
Comparative effectiveness of different primary vaccination courses on mRNA based booster vaccines against SARS-CoV-2 infections: A time-varying cohort analysis using trial emulation in the Virus Watch community cohort	medRxiv	2022	A study comparing the effectiveness of Astra Zeneca and Pfizer vaccine
Symptom profiles and accuracy of clinical case definitions for COVID-19 in a community cohort: results from the Virus Watch study	Wellcome Open Research	2022	A study examining the accuracy of different symptom combinations for identifying COVID-19
Duration of vaccine effectiveness against SARS-CoV2 infection, hospitalisation, and death in residents and staff of Long-Term Care Facilities (VIVALDI): a prospective cohort study, England, Dec 2020-Dec 2021	medRxiv	2022	A study showing the duration of vaccine protection against infection, hospitalisation and death in nursing home residents.
Glasses and risk of COVID-19 transmission-analysis of the Virus Watch Community Cohort study.	medRxiv	2022	A study suggesting that people who wear glasses are less likely to catch COVID
Outcomes of SARS-CoV-2 omicron infection in residents of long-term care facilities in England (VIVALDI): a prospective, cohort study	The Lancet Healthy Longevity	2022	A study reporting on rates of hospitalisation and death in nursing home residents in the Omicron wave
Robust SARS-CoV-2-specific and heterologous immune responses in vaccine-naïve residents of long-term care facilities who survive natural infection	Nature Aging	2022	A study describing antibody and T cell results in nursing home residents who have been infected with COVID.
Occupation, Worker Vulnerability, and COVID-19 Vaccination Uptake: Analysis of the Virus Watch prospective cohort study	medRxiv	2022	A study describing how prevalence of COVID risk factors, vaccine uptake and workplace exposure differ across occupations
Severe Acute Respiratory Syndrome Coronavirus 2 Anti-Spike Antibody Levels Following Second Dose of ChAdOx1 nCov-19 or BNT162b2 Vaccine in Residents of Long-term Care Facilities in England (VIVALDI)	JOURNAL OF INFECTIOUS DISEASES	2022	A study showing levels of antibodies following vaccination in nursing home residents
Antibody and cellular immune responses following dual COVID-19 vaccination within infection-naïve residents of long-term care facilities: an observational cohort study	The Lancet Healthy Longevity	2022	A study showing immune responses to vaccine in nursing residents who have not previously been infected.
Duration of vaccine effectiveness against SARS-CoV-2 infection, hospitalisation, and death in residents and staff of long-term care facilities in England (VIVALDI): a prospective cohort study	The Lancet Healthy Longevity	2022	A study investigating the duration of protection from vaccines in nursing home residents
Settings for non-household transmission of SARS-CoV-2 during the second lockdown in England and Wales—analysis of the Virus Watch household community cohort study	Wellcome Open Research	2022	A study showing the most important settings in which non-household transmission of COVID occurs
Clinical effectiveness of SARS-CoV-2 booster vaccine against Omicron infection in residents and staff of Long-Term Care Facilities: a prospective cohort study (VIVALDI)	medRxiv	2022	A study showing the effectiveness of booster vaccines against COVID 19 in nursing home residents during the Omicron wave
SARS-CoV-2 antibodies and breakthrough infections in the Virus Watch cohort	Nature communications	2022	A study showing the relationship between antibody levels following vaccination and risk of breakthrough infections
A case-crossover study of the effect of vaccination on SARS-CoV-2 transmission relevant behaviours during a period of national lockdown in England and Wales	medRxiv	2022	A study examining the extent to which vaccination affects COVID risk behaviours

Exploring the relationship between job characteristics and infection: Application of a COVID-19 Job Exposure Matrix to SARS-CoV-2 infection data in the United Kingdom	medRxiv	2022	A study examining the extent to which a scoring system for occupational COVID exposure predicts risk of infection
Spike-antibody responses to COVID-19 vaccination by demographic and clinical factors in a prospective community cohort study	Nature communications	2022	A study showing higher levels of antibodies after Pfizer vaccine than after Astra Zeneca and showing lower responses in the elderly and those with chronic illness

6: Views as to whether the work of the groups in responding to the Covid-19 pandemic succeeded in its aims.

The composition of the groups and/or their diversity of experience

- 6.1. In general, I thought the varied expertise on the groups in which I was involved (NERVTAG and SAGE EMG Transmission subgroup) was exceptional and led to a high quality of scientific advice.
- 6.2. I was concerned that SAGE may not have had sufficient representation from people who focus on measurement of respiratory infection burden and risk factors at the community level and in settings such as hospitals, nursing homes and homeless venues. The major epidemiological input into SAGE was through modelling. Whilst modelling is extremely valuable it is important to recognise that it is just one branch of infectious disease epidemiology. I felt infectious disease epidemiologists who were not modellers were underrepresented in advisory groups. They can play a valuable role in inputting into discussions of construction and interpretation of models because they bring a good understanding of the potential extreme biases in source data, the likely highly differential burden in different populations and settings (rarely considered in models) and a realistic view of the practical limitations of implementing interventions included in modelling scenarios.
- 6.3. Early in the pandemic, models substantially underestimated the extent of spread of the virus, which contributed to late introduction of social distancing and “lockdown” measures which likely could have avoided a large number of hospitalisations and deaths in the first wave of the pandemic if applied earlier. I was not party to these discussions at SAGE but I felt that wider scrutiny of models and discussion with empirical infectious disease epidemiologists might

have led us to understand that we in fact had very little idea of the extent of spread and that it could be very much higher than our assumptions, increasing the urgency for the need for implementation of control measures.

- 6.4. Similarly, the extreme problems of transmission in hospitals, nursing homes and other institutional settings and the highly differential effects across occupational groups, urban and rural areas, areas of deprivation and in ethnic minority groups was not adequately foreseen or prepared for. Greater involvement of empirical epidemiologists and public health researchers on the main SAGE group, or a separate SAGE transmission group (as was established late in the pandemic) might have allowed these, and other issues to be anticipated and addressed earlier. I was not a member of the main SAGE group, and these areas were not part of NERVTAG remit, so I was left needing to raise these concerns through more informal channels and the pathways for doing this were unclear to me.
- 6.5. Similarly, the SAGE EMG group had excellent expertise in virology and environmental science but little input from empirical infectious disease epidemiologists. It was not until January 2021 that a primarily epidemiological transmission subgroup of SAGE EMG was established. In my opinion this group should have been established from the start of the pandemic as it is able to provide an additional expertise and perspective on control measures that was not well covered elsewhere.
- 6.6. Although SAGE is a “scientific advisory group”. I think it would have benefited from greater involvement and representation from Public Health practitioners working at local, regional and national levels as their real-world experience is highly relevant to implementing control measures. I do not think separation of the scientific advice from the public health function is always helpful when advising on control measures. For example, sometimes this separation would lead to challenges into tracking whether scientific advice was making its way into policy.
- 6.7. I am not sure whether economists were included on any of the advisory groups but given the massive direct and indirect financial implications of control measures some attention to cost effectiveness by scientists with the skills to

assess this would seem important. Generally, committees I was involved in were advised that economic considerations are outside of our remit, although normally as a public health scientist they would be a key consideration in discussion of any interventions.

- 6.8. In most areas of science and policy there is now a major emphasis on extensive involvement of representatives of the public in shaping policy but this public voice, was, as far as I am aware, largely absent from committees.
- 6.9. In terms of membership, I think it is an important principle that regardless of urgency there needs to be some process whereby scientists with relevant experience can apply and be selected according to the relevance of their expertise - as is the case in almost all other advisory committees of national importance.

The way in which the groups were commissioned to work on the relevant issues

- 6.10. It was not always clear to me how different groups were commissioned to work on different issues and because, early in the pandemic the minutes of most advisory groups were not published, or made available to members of different committees, it was very difficult to understand what was being discussed where, and therefore what gaps might exist. Even availability of the agendas for the range of meetings would have helped with this. On occasions I was frustrated that the issues NERVTAG, was being asked to advise on were not the ones I considered to be the most important issues. For example, I was surprised that NERVTAG was not asked to look at social distancing measures early in the pandemic, which I felt were critical to the response. When I made enquiries, I was told this this being looked at by the modelling group. This meant, that as a member of NERVTAG I was unable to present or consider evidence on this area of central importance. As a result, when I had empirical evidence available that was pertinent to this, I needed to make it available to senior decision makers outside of the formal committee processes and it was not clear through what processes these information flows should happen. Similarly, when I raised concerns about the high risk of severe outbreaks in institutional settings and proposed measures to address this very early in the pandemic these topics

were considered outside of the scope of NERVTAG on the basis that it was an operational rather than scientific question. It was not clear whether, or where, these issues were being addressed or where to raise concerns further. There can be a challenge in deciding what is a scientific question and what is an operational question, but the divide between operational and scientific advice can potentially mean important things fall through the gaps in a crisis.

- 6.11. So, in general I thought the division of responsibilities between committees worked to ensure relevant expertise was applied to specific scientific questions. However, the divide between scientific and operational questions sometimes made it hard to know where questions should be addressed, or even if they were being addressed, and made it difficult to know how to raise concerns that there may be important areas (scientific or operational) that were not being addressed. This issue was mainly in the early stages of the pandemic, so it is perhaps not surprising, but it needs careful thought in planning for future pandemics.

The resources and support that were available

- 6.12. The secretariat and chair of all the groups I was involved in were extremely good but there were many occasions where it would have been very helpful to have dedicated researcher time to support the process.
- 6.13. From my perspective the area where this is most obviously lacking is in researchers with skills in systematic literature review. Assessment of the emerging evidence is critical to decision making and systematic reviews with clearly agreed search strategies, methods, inclusion and exclusion criteria, assessment of quality of evidence and grading of the strength of evidence is important to ensure the validity of reviews. Waiting for systematic reviews to be published by others is too slow and because of the rapid accumulation of evidence reviews need to be frequently updated.
- 6.14. I was involved in some such systematic reviews for NERVTAG but was not provided with any resource for this apart from a very small contribution to “backfill” my teaching responsibilities. I think for pharmaceutical interventions this was well covered through bodies such as MHRA and NICE but the same cannot be said for assessment of key epidemiological parameters relevant to

control, effectiveness of non-pharmaceutical interventions, accuracy of diagnostic tests etc. In general, we ended up using rapidly put together “expert” reviews or narrative reviews, which are a weaker form of evidence than systematic reviews. Availability of a cadre of systematic reviewers to support the committees could have led to better, regularly updated evidence-based advice. We all did the best we could to fill these evidence gaps rapidly and to carefully consider the strength of recommendations but more availability of staff to support rapid reviews with input from advisory group members would have led to more complete and thorough evidence synthesis and allowed regular updates. Secondment of researchers with these skills could help to rapidly provide this capacity.

- 6.15. I felt that the dismantling of PHE in the middle of a pandemic and handing over many of its responsibilities to other agencies including, to a very large extent, private sector organisations, reduced the coherence of the public health response. On several occasions I was asked to provide advice to consultants for private sector organisations who had been given responsibility for issues ranging from community testing strategies for COVID, to outreaching vaccine to socially excluded groups. It was clear that they had no real knowledge or insight of the complex issues involved and from my perspective it seemed a strange use of resource that would have been much better invested in the existing public health infrastructure.

The advice given and/or recommendations that were made

- 6.16. In general, I think the remit of the scientific groups was to provide assessment of the science, so that the potential implications of different actions could be assessed rather than to make recommendations about what should be done, although I think often this distinction is difficult to make, and sometimes NERVTAG was asked to make specific recommendations on policy issues. It should be the responsibility of government bodies to translate advice and recommendations into policy decisions, taking into account issues that are wider than scientific considerations.
- 6.17. The scientific advisory groups were able to provide extensive, evidence-based advice and this was, to a large extent, underpinned by science funded through

our competitive national funding streams, through the CORE studies programme (largely awarded without open competition) and through scientific work conducted by PHE and ONS.

- 6.18. It is difficult to assess appropriateness of advice retrospectively as the advice given is dependent on knowledge at the time and there are large degrees of uncertainty. Also, I was not a member of the main SAGE group which was the main conduit for scientific advice so I can only comment on SAGE advice based on what was written in minutes. Omissions in scientific advice are also important but were difficult for members of scientific advisory groups to assess at the time since it was not always obvious who was discussing what across the wide range of different scientific advisory and policy groups.
- 6.19. I think early in the pandemic, the extent of spread of the infection was significantly underestimated and therefore the time available to implement major control measures was overestimated. I have discussed some potential reasons for this above. From what I have read in SAGE minutes this was compounded by a belief that “going too early” would be counterproductive – whereas it is now clear that earlier decisive intervention would have been much more effective. This delay in introducing widespread social distancing measures was also partly because pandemic plans were primarily based on an influenza pandemic, and did not give sufficient consideration to widespread social distancing measures as a realistic possibility to substantially reduce mortality in the event of a very highly transmissible respiratory virus threat. This was not an area of policy the groups I were on was asked to consider.
- 6.20. I think the importance of longer-range transmission in public spaces as opposed to transmission through close contact was underestimated, which was partly due to prevailing, but poorly evidenced views on the relative importance of aerosol and droplet transmission in the transmission of respiratory infections. Wider involvement of empirical infectious disease epidemiologists may have led to a more balanced view on the potential importance of aerosol long-range transmission earlier in the pandemic. This is much harder to study than transmission due to close contact and partly because of this, the role of aerosol transmission is likely underestimated in respiratory infection, potentially leading to overreliance on measures such as 1m/2m rules rather than avoidance of

- public spaces. It is also relevant in relation to how much reliance one puts on contact tracing (which identifies close contacts) and surgical mask use (which blocks droplets to a much greater extent than aerosols) as means to control transmission. This is not to say that contact tracing and surgical face mask use are not of value, just that in a non-immunised population they will not be enough to suppress transmission and move R below 1 if a substantial proportion of transmission is through longer range aerosol transmission.
- 6.21. This over-reliance on identification and isolation of cases and contacts as an approach to control, was particularly problematic early in the pandemic when there was no testing available at community level. Symptoms are often mild and difficult to distinguish from the common cold, for these reasons, containment strategies based on identification and isolation of cases and contacts were never going to delay spread for long. Even when testing became more widely available there was an overreliance on this system, and an under-appreciation of the major limitations of Test and Trace, in part because of poor availability of data and in part because it seemed to be viewed as the “silver bullet” that would let us return to normality. I think this may have contributed to belief that a Test Trace and Isolate system would be sufficient to control the pandemic and to late instigation of more population-wide measures sufficiently early or intensively, particularly during the 2020/21 winter. This overreliance on Test and Trace may also have contributed to earlier lifting of restrictions before infection levels had been brought down sufficiently. Although I felt there was an overreliance on Test and Trace it was not part of the remit of committees on which I sat and it was not clear who to express these concerns to.
- 6.22. There was insufficient appreciation that a major resurgence of COVID during the 2020/21 winter was almost inevitable given remaining low levels of population immunity, seasonality of respiratory infections, very high transmissibility of COVID and continuing widespread circulation of the virus. It was clear that this would likely have a catastrophic influence on hospitalisations, deaths and long COVID in the pre-vaccine era as well as creating a substantial backlog of NHS activity. In my view we should therefore have been expecting the need for intense restrictions over the 2020/21 winter period and planning on this basis, rather than reacting after intense

transmission was re-established. The Academy of Medical Sciences report – “Preparing for a challenging winter” was important but it is not clear whether its recommendations were acted on. The B.1.1.7 variant made the winter wave even more challenging but, a large winter epidemic would almost certainly have occurred regardless of this.

- 6.23. In my view there was an overreliance on the tier system whereby restrictive measures were of different intensity in different areas according to the extent of spread, this meant that areas with low levels of infection inevitably became areas with high levels of infection and interventions and control measures were implemented too late leading to higher than needed hospitalisations and mortality. It also made it hard for members of the public to understand what measures were in place in different times and locations. This was not an area of policy the groups I were on was asked to consider.
- 6.24. Aside from the furlough scheme I felt there was insufficient attention to enabling those on low income, who were not covered by the scheme (zero hours contracts, GIG economy workers, self-employed) to comply with control measures by ensuring they could afford to do so. This may have contributed to major social and ethnic inequalities in mortality. This was not an area of policy the groups I were on was asked to consider. I felt there was a “one-size-fits all” approach to communicating risk and control measures which did not take account of the diversity of the population or adequately harness local community knowledge and influence. This was not an area of policy the groups I were on was asked to consider.
- 6.25. Early in the pandemic I felt there was insufficient planning or resource put into preventing intense transmission in institutional settings including hospitals and nursing homes even though early evidence and prior knowledge of other respiratory infections showed the extreme vulnerability of these settings. This was addressed earlier in prison and homelessness settings (but not because of advice from scientific committees). Similarly, I felt there was insufficient attention given to social drivers of infection risk including social deprivation, ethnicity, and occupation. These were not areas of policy that the groups I was on were asked to consider.

- 6.26. The vaccination programme was highly effective but I felt there was insufficient attention and resource to addressing community concerns and to providing resource to outreach vaccine to underserved populations. This was not an area of policy that the groups I were on was asked to consider.
- 6.27. It could be considered that many of these areas fell under the remit of PHE, NHS and DHSC rather than scientific advisory bodies but the distinction is not always clear. Whilst these may not be considered primarily scientific questions, they were clearly important.

The extent to which the groups worked effectively together

- 6.28. Overall, I think scientific advisory groups worked well together but I felt that communication with policy groups and delivery groups may have been insufficient. The section above demonstrates some of the wide range of issues that collectively need to be considered by different scientific advisory, policy and delivery groups. Whilst it makes sense to give different committees responsibilities for different areas, this also leads to challenges for scientific committee members in knowing what is being covered by whom and where the gaps are. It also makes it difficult to raise concerns if this is not an issue being considered by a committee on which you serve. The chairs of committees, Chief Scientific advisor, CMO and DCMOs did an exceptional job of harnessing this wide range of input and advising political decision makers but there were no real opportunities for committee members to have dialogue with decision makers, which I think could have been beneficial. “Teach-in” sessions, which were developed much later on in the pandemic, were valuable for communicating with civil servants and other stakeholders. Introducing them earlier would have been valuable.

The extent to which applicable structures and policies were utilised and /or complied with and their effectiveness

- 6.29. As far as I know applicable policies were complied with.
- 6.30. There was insufficient time available to ensure annual appraisals of NERVTAG members and the 3-year maximum term for membership was extended under the circumstances of the pandemic.

- 6.31. I understand there were some instances when NERVTAG papers were leaked to the press (not by me), which was unfortunate but difficult to prevent when committee membership and observers were numerous.
- 6.32. I thought the early policy of some committees not publishing their minutes was unhelpful as transparency is important to public confidence in the advice and to enable advisors from other committees to understand what has, and has not, been discussed. Minutes, necessarily represent a partial view of everything that was said, and, in an online meeting, comments posted in the chat are also an important part of the meeting discourse. Routine recording of meetings and the chat could be a helpful supplement to minutes.
- 6.33. I was impressed with the “Open Sage” model and the scientific technical enquiry model of publicly live streaming meetings, but I think this may inhibit free and frank discussion.

Policies and practices related to media engagement

- 6.34. With regard to policies on press engagement, the terms of reference for NERVTAG committee members are as follows

“The Secretariat with the Department of Health Press Offices will usually be responsible for handling media enquiries about the NERVTAG and its work. Members who are approached directly by the media with enquiries relating to NERVTAG business should contact the Secretariat in the first place, for advice on handling”.

Members may, in the course of their work, address conferences and seminars, or have other speaking arrangements at which the media are present. In these circumstances, members should take care to make it clear that they are speaking in a personal capacity and not as a member of the NERVTAG”.

- 6.35. When NERVTAG members are asked to provide comment by the press, this is generally as a scientist with expertise in the area rather than to discuss the work of NERVTAG. I tried to make it clear when speaking that it was in a personal capacity but sometimes this was not included in excerpts, particularly in written media where one has little control over this. It was also unhelpful that the SAGE website listed many people as members of SAGE when they were not. This

led the media to assume we were members of SAGE and to introduce us a such, requiring us to waste valuable air-time correcting this.

- 6.36. The NERVTAG terms of reference do not make any stipulations about not discussing policy. There was, however, frequent pressure, communicated to members via Go-Science and Chairs of advisory group meetings, to confine our media commentary to explaining science rather than discussing policy. In practice, in many media interviews, questions are about our views on the scientific rationale for policy and our scientific understanding of what is likely to happen if different courses of action are followed or not.
- 6.37. There are times when **not** discussing policy openly in media interviews would conflict with the GMC code of practice for medical practitioners and the Faculty of Public Health professional code of practice (my own professional body).
- 6.38. For example, the GMC code of good practice states that a key duty of a doctor is to

“Protect and promote the health of patients and the public”

The Faculty of Public Health code of practice states -

10. You have a duty to safeguard and protect the health and wellbeing of your population.

21. You must make sure that relevant information is shared. This includes a duty of candour: you must ensure that information is not withheld, where it may affect a decision or course of action that would have an impact of health.

22. You must make sure information to be shared is meaningful. You must share with the public, in a way they can understand, the information they want or need to know about their health and health care and the health options available to them, including associated risks and uncertainties. You should respond to the public’s questions and keep them informed about the progress of interventions aimed at improving their health.

- 6.39. Failure to discuss policy in media interviews can conflict with these professional codes. For example, public understanding of the rationale for policies that impact their lives, and which the public are requested, or legally required, to comply with, is needed to help people make decisions that affect the health of

themselves and others. An example for this might be explaining the scientific rationale for a “work-from-home where possible” policy.

- 6.40. Failure to discuss policy may also conflict with these professional codes of practice when there are policies that might negatively impact on health or an absence of policies that may positively impact on health. For, example, failing to discuss the likely negative implications on health of a policy decision to allow families to come together to celebrate Christmas 2020/21, I felt, would have conflicted with my professional code of practice. In an unvaccinated population, this policy could have led to large numbers of hospitalisations and deaths. Similarly, failing to discuss the need for measures to be taken to reduce the impact of an impending wave of infection would conflict with my professional codes of practice as failure to introduce such measures could lead to many deaths. Also discussing the potential value of such a policy may help members of the public draw their own views about how to balance risks relevant to their health.

7: Lessons that can be learned

Population Health Intelligence

- 7.1. There needs to be investment in systems that rapidly allow the community burden and spread of emerging infections to be accurately assessed. In practice this may mean continuous community level surveillance of respiratory infections that can be scaled up in the event of emergence of a problem. This might have allowed us to realise the extent of spread of infection earlier and take effective action earlier in the pandemic.
- 7.2. Information systems that were developed during the pandemic, in particular those that allow different data streams from different organisations to be linked were critical to assessment of the threat, targeting of interventions, assessment of severity and transmissibility of different strains, identification of groups at most risk, assessment of the effectiveness of vaccines against hospitalisation and death etc. These systems however took many months to develop. These linked data systems are also of high value for research and public health actions more generally. It is only by maintaining these systems during non-emergency periods that they will be rapidly deployable in emergencies. Major barriers for

usage are lengthy, restrictive and complex permissions systems that do not serve public health well. These need to be reviewed and the progress made during the pandemic not lost.

- 7.3. Large programmes such as test & trace could have collection of meaningful epidemiological and clinical data as part of their role. This would have allowed more timely assessment to inform case definitions, and to identify risk factors for infection. Scientific advisory groups could have a role in advising on data collection alongside national infrastructures such as this.
- 7.4. Core studies were very valuable and it is understandable that due to time pressures they were not allocated through a competitive process. The funding available for so-called pandemic-preparedness studies that were to be triggered in the event of a pandemic turned out to be highly inadequate in many cases. Also, the scale of funding available for early rounds of research in the pandemic was very small given the size of the threat. As an example, our Virus Watch community cohort study was one of the largest awards within this round of funding, but the entire running costs of the programme through the pandemic was less than one month's running costs of the ONS Infection Study. There needs to be pre-planning of the larger scale research that will be needed in future pandemics with competition and/or involvement of scientists from across institutions in the development of these plans and systems for peer review. There also needs to be more realistic funding envelopes available for research competitively commissioned early in the pandemic
- 7.5. There needs to be planned resource and capacity for advisory groups to undertake formal, systematic reviews with regular updates. To some extent protocols for these could be developed prior to pandemics.

Balance of Expertise

- 7.6. The SAGE transmission subgroup to consider epidemiological evidence on transmission was not established until very late in the pandemic – this group, or an equivalent should be established early in a pandemic. It should have strong representation of empirical infectious disease epidemiologists working in academia and health protection. Such a group might have provided early advice on issues related to assessment (rather than modelling) of transmission

such as: assessment of the extent of spread early in the pandemic; likely importance of long range aerosol spread based on interpretation of epidemiological evidence; limited impact of testing and contact tracing on transmission; very high risk of spread in various residential institutional settings (hospitals, nursing homes, homeless venues, prisons and more); high risk of spread in various populations related to social deprivation and ethnicity; research infrastructures needed to better understand transmission and effectiveness of non-pharmaceutical interventions.

- 7.7. A major amount of excess mortality was attributable to ethnic and social inequalities, but little was done to anticipate or address this – A SAGE subgroup focussed on advising on inequalities could help ensure these important dimensions are not forgotten.
- 7.8. There need to be systems for scientific considerations of cost effectiveness [i.e. **Whether interventions to reduce COVID-19 are good value for money**] as well as effectiveness of interventions. Related to this, there need to be more formal frameworks for helping to weigh up the benefits of major societal interventions to reduce COVID-19 mortality against the negative consequences of these interventions to support decision making.
- 7.9. There needs to be better engagement of the public in scientific advisory groups including the “general public” and people from communities that have a very high burden of infection. Some sort of SAGE public advisory group could be a mechanism to achieve this. The Academy of Medical Sciences report, “Preparing for a difficult winter”, explicitly addressed this. I was also involved in a Scottish Parliament public engagement event to help direct policy. However, as a member of UK Scientific Advisory Groups there were no structured opportunities to engage with public views.
- 7.10. A competitive process for recruiting members to SAGE and its subgroups may provide a better balance of expertise than the current approach. This could be done rapidly, or in advance of a pandemic as it is for NERVTAG.

Communication and Transparency

- 7.11. There needs to be a clearer system for members of advisory groups to understand what is being discussed in other groups (including scientific, policy and delivery groups) to help prevent gaps in advice.
- 7.12. There needs to be clarity about routes for submitting evidence in areas that do not relate to the work of your committee and opportunities for members of groups to raise concerns about areas they think need to be covered but are not being considered by their own group alongside systems to allow them to understand which groups are discussing this.
- 7.13. Minutes of all meetings of scientific advisory groups should be published in a timely way. When this involves time-critical decisions this may require a very short-turnaround of minutes.
- 7.14. I don't feel that advisory group members should be pressurised into not discussing policy with the media. It is important to be open about advantages and disadvantages of different policy options and for there to be open debate about this. As per current advice it should be clear when this commentary comes from an individual scientist rather than representing the views of any advisory group. Guidance for the media in this attribution may also help.
- 7.15. From early on in a pandemic there need to be greater opportunities for scientific groups to interact with policy makers, delivery groups and public health practitioners, for example through Teach-in sessions – these were useful in later stages of the pandemic but underused early on.

8: Documents that I hold

- 8.1. Where documents are publicly available, I have tried to provide links to them. Other electronic information including unpublished documents [eg.more detailed analysis of symptom profiles] and emails related to the issues described above [attempting to highlight concerns over the need for more intensive social distancing measures and the need for more intensive control in nursing homes and other institutional settings in spring 2020] have been saved and are available on request.