Minutes of SAGE meetings (1 to 46) on Wuhan Coronavirus (Covid-19)

bookmarked and searchable by phrase

(Note that the gov website also now publishes various reports to which these minutes refer and which are illuminating.)

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Addendum to Precautionary SAGE meeting on Covid-19, *22nd January 2020*
Held in 10 Victoria St, London, SW1H 0NN

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees

Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Charlotte Watts (CSA DfID), Jonathan Van Tam (Deputy CMO), Neil Ferguson (Imperial), Carole Mundell (CSA FCO), Peter Horby (Oxford), Christine Middlemiss (CVO DEFRA), James Rubin (King's College), Cathy Roth (DFID), Jeremy Farrar (Wellcome), Phil Blythe (CSA DfT), Pasi Penttinen (ECDC), David Lalloo (LSHTM), Maria Zambon (PHE), Ben Killingley (UCL), John Edmunds (LSTHM), Jim McMenamin (Health Protection Scotland).*

Observers and Government officials: *Rupert Shute (dCSA HO), Kavitha Kishen (DfT), Stuart Wainwright (GoS), Tasha Grant (CCS), Samantha Harris (GoS).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be a complete list.

UPDATED, valid as of 1700 23 January

Precautionary SAGE meeting on Wuhan Coronavirus (WN-CoV)
22 January 2020
Held in 10 Victoria St, London SW1H 0NN

Situation update

1. DHSC provided an update on current declared cases, deaths and geographic spread.
2. China has recently revised case definitions. This makes comparisons difficult.
3. It was reported that diagnostic testing capability in Wuhan is overwhelmed.
4. There is considerable uncertainty around the data, with almost certainly many more cases than have been reported; a reasonable worst case cannot be made reliably under such circumstances.
5. WHO has received some environmental sampling from Wuhan: information on the zoonotic reservoir may be forthcoming shortly.
6. **** Following the meeting, authorities in Wuhan announced the suspension of public transport, including outbound trains and flights, from 0200 GMT 23 January. ****

Current understanding of WN-CoV

7. There is evidence of person-to-person transmission. It is unknown whether transmission is sustainable.
8. The incubation period is unclear – but appears to be within 5 to 10 days; 14 days after contact is a sensible outer limit to use.
9. It is highly probable that the reproductive number is currently above 1.
10. It is currently estimated that the mortality rate for WN-CoV is lower than for SARS, but it is too early to reliably quantify that rate.
11. There is insufficient information currently on the genetic strain to comment on WN-CoV's origin.
12. There is no evidence yet on whether individuals are infectious prior to showing symptoms.
13. There is no evidence that individuals are more infectious when symptoms are more severe, but that is likely.
14. There appears to be very little genetic diversity in WN-CoV based on sequences available so far.
15. It is reasonable to argue – based on lessons from MERS and SARS, and consistent with exported cases of WN-CoV – that individuals returning from Wuhan are no longer at risk if they show no symptoms after 14 days.

Summary and review of NERVTAG conclusions

16. NERVTAG does not advise port of entry screening, irrespective of the current limited understanding of the epidemiology.
17. NERVTAG does not advise use of screening questionnaires, pilot declarations or requiring confirmation of exit screening at Wuhan.
18. NERVTAG does support public health information efforts via leaflets, posters and broadcast messengers to passengers.
19. SAGE supports NERVTAG's position both on the value of port screening and on monitoring measures.
20. SAGE would review its position on port screening only if a simple, specific and rapid test was available and was deployable at scale across the UK. Temperature and other forms

of screening are unlikely to be of value and have high false positive and false negative rates.

Transport-related issues

21. The European Centre for Disease Prevention and Control (ECDC) has just published "Risk assessment guidelines for infectious diseases transmitted on aircraft (RAGIDA) - Middle East Respiratory Syndrome Coronavirus (MERS-CoV)".
22. ECDC advises use of MERS guidelines for the current outbreak, but acknowledges the limitations of its evidence base.

UK health readiness and planning

23. The UK currently has good centralised diagnostic capacity for WN-CoV – and is days away from a specific test, which is scalable across the UK in weeks. The sensitivity of the test is currently unknown. There are conflicting reports of the sensitivity of diagnostic tests from upper respiratory tract sampling.
24. DHSC is developing advice for UK healthcare workers on testing potentially infected individuals.
25. SAGE agreed that DHSC and PHE criteria for testing potentially infected individuals were appropriate, i.e. those with symptoms or signs of WN-CoV, and a history of travelling to or living in Wuhan in the 14 days prior to symptom onset, including those who accessed Wuhan healthcare facilities. SAGE advised that DHSC and PHE should be ready to revise those criteria as the situation evolves.
26. DHSC and PHE also preparing plans for isolating potentially infected individuals and the follow up of contacts.

    ACTION: CMO to share the latest iteration of the PHE isolation plan for suspected cases and contacts with some of the SAGE participants, in particular behavioural scientists, to get their view of its proportionality and advice on how to communicate uncertainty, in order to improve subsequent versions.

    ACTION: CMO/DHSC and **PHE** to consider how NHS primary care facilities might respond to an increase of cases and potential cases.

    ACTION: CMO/DHSC and **FCO** to work together to ensure consistent messaging on travel advice to/from Wuhan.

27. There are no practical preventative actions that HMG might undertake ahead of Chinese New Year.

Triggers for escalating HMG response

28. Of DHSC's current triggers, there has been infection of healthcare workers and probably some sustained human-to-human transmission, but not geographical spread unconnected to Wuhan.
29. SAGE agreed that HMG should review its response either in the case of onward spread of WN-CoV person to person outside of China or a severe confirmed case in the UK.
30. SAGE is unable to say at this stage whether it might be required to reconvene.

Summary of actions

CMO to share the latest iteration of the PHE isolation plan for suspected cases and contacts with some of the SAGE participants, in particular behavioural scientists, to get their view of its proportionality and advice on how to communicate uncertainty, in order to improve subsequent versions.

CMO/DHSC and **PHE** to consider how NHS primary care facilities might respond to an increase of cases and potential cases.

CMO/DHSC and **FCO** to work together to ensure consistent messaging on travel advice to/from Wuhan.

Attendees

SAGE participants: Patrick Vallance, Chris Whitty, Charlotte Watts, Jonathan Van Tam, Neil Ferguson, Carole Mundell, Peter Horby, Christine Middlemiss, James Rubin, Cathy Roth
By phone: Jeremy Farrar, Phil Blythe, Pasi Penttinen, David Lalloo, Maria Zambon, Ben Killingley, John Edmunds, Jim McMenamin

Observing: [redacted] Rupert Shute, Tasha Grant, [redacted] Kavitha Kishen, [redacted] Stuart Wainwright, Samantha Harris, [redacted]
Secretariat: [redacted]

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Addendum to the second SAGE meeting on Covid-19, 28 January 2020
Held in 10 Victoria St, London, SW1H 0NN

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees:

Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Charlotte Watts (CSA DfID), Jonathan Van Tam (dCMO), John Aston (CSA HO), James Rubin (King's College), Neil Ferguson (Imperial), Peter Horby (Oxford), Guy Poppy (CSA FSA), Carole Mundell (CSA FCO), Christine Middlemiss (CVO DEFRA), Jim McMenamin (Health Protection Scotland), Jeremy Farrar (Wellcome), David Lalloo (LSHTM), Maria Zambon (PHE), Andrew Rambaut (Edinburgh), Wendy Barclay (Imperial).*

Observers and Government Officials: *Tasha Grant (CCS), Stuart Wainwright (GoS), Samantha Harris (GoS).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

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Second SAGE meeting on Wuhan Coronavirus, 28 January 2020
Held in 10 Victoria St, London SW1H 0NN

Actions from previous meeting

1. DHSC to send PHE isolation plan to behavioural scientists (see further action below).
2. Others in train.

Situation update

3. SAGE is responsible for coordinating science advice across HMG, including from NERVTAG.
4. SAGE agreed that SPI-M (Scientific Pandemic Influenza Group on Modelling) is now a formal sub-group of SAGE for the duration of this outbreak.
5. A separate group has been convened outside SAGE to consider how UK science can contribute to the international effort to tackle the outbreak.
6. DHSC provided an update on current declared cases, deaths and geographic spread.
7. 50% of new cases in China are now occurring outside of Wuhan.
8. Diagnostics: Specific test should be ready by the end of week, with capacity to run 400 to 500 tests per day. Guidance being rolled out to laboratories in the UK. Sensitivity of test unclear, particularly in early phases of illness or when symptoms are mild. Currently it would not be useful to test asymptomatic individuals, as a negative test result could not be interpreted with certainty.

Current understanding of WN-CoV

9. Origin: Current evidence suggests a single point zoonotic outbreak, which is now being sustained by human-to-human transmission. No evidence of ongoing zoonotic transmission.
10. Case fatality rate: currently estimated to be lower than SARS, but many uncertainties remain.
11. Reproductive number: estimated as between 2 and 3, in accordance with estimates from the Chinese authorities, but these figures are uncertain.
12. Doubling rate: estimated at 3 to 4 days.
13. Clinical presentations: varied, from mild coughing to fever and pneumonia. Uncertainty regarding clinical symptoms for individuals with mild illness.
14. Incubation period: likely to be average of 5 days, but considerable variation in specific cases.
15. Duration of infectivity: unknown, but 14 days seems a reasonable estimate.
16. There is limited evidence of asymptomatic transmission, but early indications imply some is occurring. PHE developing a paper on this.
17. Transmission route: respiratory.
18. SAGE urges caution in comparing WN-CoV with SARS and MERS: the transmission dynamics are different.
19. Control measures: ideally infection control in healthcare settings and rapid detection of cases.
20. It was agreed that Pandemic Influenza infection control guidance should be used as a base case and adapted.
21. Currently no evidence of control measures having an impact on transmission rate, but this is to be expected: not enough time has passed since implementation of measures.
22. SAGE supported the principle of self-isolation (but requires behavioural science input on public communication).
23. SAGE endorsed NERVTAG's position that those coming into contact with returning travellers to the UK, e.g. Border Force agents, do not need additional infection control measures to those currently advised.

ACTION: SPI-M to advise on actions the UK could take to slow down the spread of the outbreak domestically, even if widespread globally.

ACTION: PHE to share paper on asymptomatic transmission with SAGE.

Reasonable Worst-Case Scenario (RWCS)

24. There are a number of scenarios that this outbreak could follow, depending on virulence and transmissibility.
25. The current RWCS is similar to an influenza pandemic where no vaccine or specific treatment is available.
26. The RWCS for the UK should be based on a reproductive number of 2.5 (middle of current estimates) and should assume that some of those who have returned from China are infectious.
27. SAGE also agreed that the UK RWCS should be based on pandemic influenza planning.

ACTION: DHSC to use existing planning assumptions for an influenza pandemic to develop a reasonable worst case for WN-CoV in the UK.

Triggers for change in HMG approach

28. For UK: SAGE agreed that the current triggers which would require a change in HMG's approach (sustained human-to-human transmission outside China and/or a severe UK case) are appropriate.
29. For changing travel advice for China: NERVTAG advised a change in the geographical aspect of case definition, from Wuhan to a number of Chinese provinces. SAGE agreed that this should inform travel advice – which Chinese provinces is to be determined.
30. SAGE agreed to keep these triggers under review, e.g. if there were multiple, geographically-spread mild cases in the UK.

ACTION: PHE to share map of Chinese provinces that have reported cases with FCO and CCS

Behavioural science and public understanding of risk

31. SAGE agreed on the importance of behavioural science informing policy – and on the importance of public trust in HMG's approach.
32. SAGE will keep under review whether further sub-groups, such as a behavioural science sub-group, are needed.

ACTION: PHE to open lines of communication with SAGE behavioural scientists and to share available polling data on the outbreak.

SAGE battle rhythm

33. SAGE stands ready to reconvene, as required.

List of actions

SPI-M to advise on actions the UK could take to slow down the spread of the outbreak domestically, even if widespread globally.

PHE to share paper on asymptomatic transmission with SAGE.

DHSC to use existing planning assumptions for an influenza pandemic to develop a reasonable worst case for WN-CoV in the UK.

PHE to share map of Chinese provinces that have reported cases with FCO and CCS.

PHE to open lines of communication with SAGE behavioural scientists and to share available polling data on the outbreak.

Attendees

SAGE participants: Patrick Vallance, Chris Whitty, Charlotte Watts, Jonathan Van Tam, John Aston, James Rubin, Neil Ferguson, Peter Horby, Guy Poppy.
By phone: Carole Mundell, Christine Middlemiss, Jim McMenamin, Jeremy Farrar, David Lalloo, Maria Zambon, Andrew Rambaut, Wendy Barclay

Observers: Tasha Grant, Stuart Wainwright, Samantha Harris, [redacted]

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Addendum to third SAGE meeting on Covid-19, *3rd February 2020*
Held by teleconference

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees:
Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (Deputy CMO), John Aston (CSA HO), Neil Ferguson (Imperial), John Edmunds (LSTHM), Graham Medley (LSHTM), Carole Mundell (CSA FCO), Phil Blythe (CSA DfT).*

Observers and Government officials: *Kavitha Kishen (DfT), Tasha Grant (CCS), Stuart Wainwright (GoS), Samantha Harris (GoS).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be a complete list.

Third SAGE meeting on Wuhan Coronavirus (WN-CoV), 3 February 2020
By teleconference

Summary

1. On the expected impact of travel restrictions, SAGE estimates – with limited data – that if the UK reduces imported infections by 50%, this would maybe delay the onset of any epidemic in the UK by about 5 days; 75% would maybe buy 10 additional days; 90% maybe buys 15 additional days; 95%+ maybe buys a month.
2. Only a month of additional preparation time for the NHS would be meaningful. It would also be meaningful if the outbreak were pushed out of usual winter respiratory season.
3. To prevent imported infections along these lines would require draconian and coordinated measures, because direct flights from China are not the only route for infected individuals to enter the UK.
4. Additional measures would be required and 50% reduction is probably about the best that could be achieved with a ban on direct travel from China alone.
5. Stopping travel would also have other impacts, including on supply chains.
6. SAGE will address the question of what package of measures might lead to a 1 month delay (including measures to stop spread within the UK).
7. SAGE will also seek to refine its estimates through further modelling; SAGE is next meeting on Tuesday 4 February 2020.

Situation update

8. The epidemic is still in its early stages. It is a reasonable hypothesis that the epidemic is still growing exponentially – doubling every 4-5 days.
9. Case ascertainment in China appears to be low: potentially 1 in 15 being identified, possibly 1 in 20. The scale of the epidemic in China could be in the region of 200,000 to 300,000 cases.
10. Incubation period (time between exposure to infection and symptom onset): consensus of modellers puts this at 5 days, but range is 2 to 14 days.
11. Generation time (the time between the infection of a primary case and one of its secondary cases) estimated at 6-7 days.
12. There is some evidence of younger people in China showing symptoms.
13. Sustained community transmission outside China should be expected.
14. Data challenges remain: data from Hubei province, where testing is more thorough, is most reliable.
15. To better understand the epidemic, it is important to have access to case numbers reported by onset date, data on numbers of people being tested, age distribution of cases and co-morbidity information – updated daily.

Travel restrictions: assessment of impacts

16. It is hard to determine numbers of people entering the UK from China: fill rates on direct flights must be estimated; indirect flights, rail and maritime are also routes into the UK.

ACTION: DfT and **Home Office** to produce more wide-ranging estimates on people entering the UK from China for the next SAGE meeting (February 4), splitting out numbers by different routes of entry.

17. Gaining 5 to 10 days of extra time for the NHS and wider HMG to prepare for a WN-CoV epidemic would be of limited value.
18. An extra month for the NHS and wider HMG to prepare for a WN-CoV epidemic – and to reduce the pressures arising from seasonal influenza – would offer a significant advantage.
19. There is considerable uncertainty around these estimates.
20. Ongoing transmission of WN-CoV in other countries would negate the effectiveness of travel restrictions on passengers coming directly from China – as might other

international travel restrictions which force travellers from China to use alternative means /routes to travel.

ACTION: SPI-M to consider whether the estimates on the impact of travel restrictions agreed by SAGE can be refined.

ACTION: SAGE, with support from **SPI-M**, to review (on February 4) what measures besides travel restrictions could contribute to delaying spread of WN-CoV to the UK by 1 month, and what further knowledge of WN-CoV is needed to inform those measures.

List of actions

DfT and **Home Office** to produce more wide-ranging estimates on people entering the UK from China for the next SAGE meeting (February 4), splitting out numbers by different routes of entry.

SPI-M to consider whether the estimates on the impact of travel restrictions agreed by SAGE can be refined.

SAGE, with support from **SPI-M**, to review (on February 4) what measures besides travel restrictions could contribute to delaying spread of WN-CoV to the UK by 1 month, and what further knowledge of WN-CoV is needed to inform those measures.

Attendees

SAGE participants: Patrick Vallance, Chris Whitty, Jonathan Van Tam, John Aston, Neil Ferguson, John Edmunds, Graham Medley, Carole Mundell, Phil Blyth

Observers: [redacted] Kavitha Kishen, Tasha Grant, Stuart Wainwright, Samantha Harris, [redacted]

SAGE Secretariat

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Addendum to the fourth SAGE meeting on Covid-19, 4 February 2020
Held in 10 Victoria St

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees

Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (dCMO), James Rubin (King's College), Peter Horby (Oxford), Neil Ferguson (Imperial), John Edmunds (LSHTM), Graham Medley (LSHTM), Carole Mundell (CSA FCO), Charlotte Watts (CSA DfID), Phil Blythe (CSA DfT), Maria Zambon (PHE), Jeremy Farrar (Wellcome), Cathy Roth (DfID), Andrew Rambaut (Edinburgh), Wendy Barclay (Imperial), Alaster Smith (dCSA DfE).*

Observers and Government Officials: *Kavitha Kishen (DfT), Tasha Grant (CSS), Samantha Harris (GoS), Rupert Shute (dCSA HO), Kate Thomas (DHSC).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be the complete list.

UPDATED, valid as of 1530 05 February
Fourth SAGE meeting on Wuhan Coronavirus (WN-CoV), 4 February 2020
Held in 10 Victoria Street

Summary

1. SAGE agreed that greater sharing of data on the outbreak is essential. HMG should make the case for data sharing at every opportunity.
2. The outbreak is likely to peak in Wuhan/Hubei in the next 3 to 5 weeks. This is currently a wide range, and SAGE would seek to refine this estimate as more data emerges. There will be a lag before it peaks in China, then further lags before it peaks elsewhere in the world if it spreads widely.
3. A delay now in the arrival and spread of WN-CoV in the UK would be beneficial for improving NHS readiness and ability to manage a UK outbreak and importantly may push any outbreak beyond the winter respiratory season. The NHS is currently facing winter pressures, and outside of the winter respiratory season there will be fewer people presenting at hospital with similar symptoms to WN-CoV.
4. SAGE remains content with the validity of the statement (issued 3 February) on the impact of international travel restrictions on delaying spread of WN-CoV.
5. SAGE agreed that, based on current evidence, domestic measures such as shutting down public transport or restricting public gatherings would probably be ineffective in creating any meaningful delay in spread of WN-CoV.
6. SAGE agreed that HMG should continue to plan using current influenza pandemic assumptions, which can be modified as data becomes more certain.
7. Modelling group SPI-M to produce projections of when the epidemic will peak, as well as other issues, including the impact of closing schools in different outbreak scenarios.

Introduction

8. Moving forward, SAGE will tackle science questions under standard headings: update on the outbreak; measures to limit spread and impact of those measures; virology; clinical management; and communicating the science.
9. Participants were asked to put confidence intervals around statements where possible.
10. All previous SAGE actions in hand.

Situation update

11. SAGE was updated on latest case numbers and fatalities: there was agreement that figures for China likely a significant underestimate.

Understanding WN-CoV

12. Lack of data sharing is seriously hampering understanding of WN-CoV.

ACTION: FCO to work with **CMO and DHSC Comms** to ensure there is a coordinated message coming from the UK on the need for greater sharing of data internationally.

13. Case ascertainment in China appears to be low: potentially 1 in 15 being identified (possibly 1 in 20). Case ascertainment outside China potentially 1 in 4.
14. Case fatality rate (CFR): considerable uncertainty around this, but reasonable confidence lower than for SARS or MERS. SAGE requires regular updates from modellers on CFR. Currently no reason to change pan-flu CFR assumptions.
15. Reproductive number: previous estimate (2 to 3) still valid, with doubling time still 4 to 5 days.
16. Incubation period: range remains 2 to 14 days, with average of 5 days.
17. Duration of infectivity: around 2 weeks, but could be longer. Average possibly 7 days. Duration will vary depending on severity of individual cases.
18. Duration of illness: median of 15 to 18 days, but great uncertainty around this. Longest time so far appears to be 41 days.

19. Asymptomatic transmission cannot be ruled out and transmission from mildly symptomatic individuals is likely.
20. Almost nothing is known about WN-CoV in children – though it is significant that there have been no reports of illness among children.
21. Under-20s appear to be least susceptible. WN-CoV appears to mirror a flu mortality curve, with most deaths among the over-60s.

ACTION: Neil Ferguson to share a confidential report on at risk groups with the SAGE secretariat.

Swabbing and testing

22. SAGE discussed different countries' approach to swab testing asymptomatic individuals leaving China.
23. Some individuals were swabbed twice – with some testing positive for WN-CoV on second swabbing.
24. More information is needed about swabbing and subsequent testing to inform modelling of the outbreak.
25. The UK, to date, has not swab tested returnees.
26. Although the UK is building regional diagnostic capability within weeks, overall capacity is limited. Capacity cannot be substantially increased during this winter influenza season.

ACTION*:* DCMO to understand what swabbing and subsequent testing of returning travellers has been undertaken globally and to review how often swabs need to be taken to be reliable. In addition, **DCMO** to consider whether the UK should swab those returning from China, including those currently in quarantine in the UK.

Global outlook

27. Human-human transmission outside China has occurred. Sustained human-to-human transmission outside China cannot be ruled out, but there is as yet no definitive evidence of a sustained outbreak/epidemic elsewhere.
28. More testing for WN-CoV globally as part of routine influenza testing would improve understanding of the scale and nature of the outbreak, but currently is logistically difficult.
29. The outbreak is likely to peak in Wuhan/Hubei in the next 3-5 weeks.
30. There will be a lag before it peaks in China (potentially a month), then further lags before it peaks elsewhere in the world.
31. The epidemic in Wuhan could last for 5 to 6 months in total.
32. This is currently a wide range for all of these figures, and SAGE would seek to refine this estimate as more data emerges.

ACTION: SPI-M to produce projections of when the epidemic will peak as well as overall duration of outbreak in 1. Wuhan, 2. China and 3. UK – if we get sustained person-to-person transmission. In addition, **SPI-M** to advise on countries that may be most affected.

ACTION: SPI-M to review, based on available data, what can be said regarding seasonality of the outbreak and risk factors, specifically age and if possible, smoking.

ACTION: UK science coordination group for WN-CoV, which includes GCSA, CMO (NIHR), PHE, DfID, FCO and research funders, to consider whether the UK can accelerate diagnostic capability to include WN-CoV alongside regular influenza testing before the onset of the winter influenza season.

Measures to limit spread

33. A delay now in the arrival and spread of WN-CoV in the UK would be beneficial for improving NHS readiness and ability to handle cases as the NHS would be dealing with fewer upper respiratory issues.
34. SAGE remains content with the validity of the statement (issued 3 February) on the impact of international travel restrictions on delaying spread of WN-CoV.
35. SAGE asked to be updated if the calculations underlying the statement were to change.
36. The effect of shutting schools to limit spread of WN-CoV is currently unknown, given ignorance about the impact of WN-CoV among children.
37. It is possible that school closures in reaction to further cases of WN-CoV in the UK would be less effective than in previous epidemics, when children were more susceptible to the disease, and infectivity periods were shorter.
38. As evidenced through previous behavioural science studies, regional closing of schools can be expected to have impacts elsewhere in the country as parents outside those regions would choose to withdraw children from school.
39. Measures within the UK – such as shutting down public transport and suspending public gatherings – would probably be relatively ineffective in limited spread of WN-CoV.
40. SAGE heard that NERVTAG advises that there is limited to no evidence of the benefits of the general public wearing facemasks as a preventative measure.
41. Facemasks and other personal protective equipment in the community is only advised for health and social care workers visiting individuals who may be infectious.
42. There is some evidence that wearing of face masks by symptomatic individuals may reduce transmission to other people, and therefore NERVTAG also recommends that symptomatic people should be encouraged to wear a surgical face mask, providing that it can be tolerated.
43. It is not known whether WN-CoV can be spread through air conditioning systems.
44. The next meeting of SAGE will consider other potential measures to delay spread, including measures to delay spread among vulnerable groups.

ACTION: SPI-M, with input from **James Rubin**, to consider the impact of closing schools in different outbreak scenarios, and advise SAGE on what triggers would require discussion as to whether schools should close.

Review of reasonable worst-case scenario and planning

45. SAGE agreed that, in the absence of more reliable data, HMG should continue to plan using influenza pandemic assumptions.

ACTION: SPI-M to review UK pandemic flu reasonable worst-case planning assumptions on a weekly basis and update SAGE on whether they should be revised, as new data emerges. In addition, **SPI-M** to forecast hospital demand.

Communicating the science

46. SAGE advised caution in explaining factors such as the case fatality rate to the general public. It is important to communicate that such factors are complex and can be calculated in different ways, meaning the public can expect to see different interpretations of the same factor.

List of actions

FCO to work with **CMO and DHSC Comms** to ensure there is a coordinated message coming from the UK on the need for greater sharing of data internationally.

Neil Ferguson to share a confidential report on at risk groups with the SAGE secretariat.

DCMO to understand what swabbing and subsequent testing of returning travellers has been undertaken globally and to review how often swabs need to be taken to be reliable. In addition, **DCMO** to consider whether the UK should swab those returning from China, including those currently in quarantine in the UK.

SPI-M to produce projections of when the epidemic will peak as well as overall duration of outbreak in 1. Wuhan, 2. China and 3. UK – if we get sustained person-to-person transmission. In addition, **SPI-M** to advise on countries that may be most affected.

SPI-M to review, based on available data, what can be said regarding seasonality of the outbreak and risk factors, specifically age and if possible, smoking.

UK science coordination group for WN-CoV, which includes GCSA, CMO (NIHR), PHE, DfID, FCO and research funders, to consider whether the UK can accelerate diagnostic capability to include WN-CoV alongside regular influenza testing before the onset of the winter influenza season.

SPI-M, with input from **James Rubin**, to consider the impact of closing schools in different outbreak scenarios, and advise SAGE on what triggers would require discussion as to whether schools should close.

SPI-M to review UK pandemic flu reasonable worst-case planning assumptions on a weekly basis and update SAGE on whether they should be revised, as new data emerges. In addition, **SPI-M** to forecast hospital demand.

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SAGE participants: Patrick Vallance, Chris Whitty, Jonathan Van Tam, James Rubin, Peter Horby, Neil Ferguson, John Edmunds, Graham Medley, Carole Mundell, Charlotte Watts, Phil Blythe, Kate Thomas
By phone: Maria Zambon, Jeremy Farrar, Cathy Roth, Andrew Rambaut, Wendy Barclay

Observers: [redacted] Kavitha Kishen, Tasha Grant, Samantha Harris, Rupert Shute, [redacted] Alaster Smith

Secretariat: [redacted]

SAGE Secretariat

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Addendum to fifth SAGE meeting on Covid-19, *6th February 2020*
Held by teleconference

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees
Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (Deputy CMO), Neil Ferguson (Imperial), John Edmunds (LSTHM), Graham Medley (LSHTM), Sharon Peacock (PHE), Jenny Harries (Deputy CMO).*

Observers and Government officials: *Sam Harris (GoS).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be a complete list.

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Fifth SAGE meeting on Wuhan Coronavirus (WN-CoV), 6 February 2020
By teleconference

Summary

1. The geographical element of the case definition (i.e. the criteria for deciding whether an individual has a disease) for WN-CoV before this meeting was anyone who has travelled from Hubei in the previous 14 days, or anyone who has travelled from mainland China and has developed possible symptoms.
2. In light of new evidence of human-to-human transmission beyond China, SAGE advises that the UK geographical case definition should be widened, taking into account available information on air travel volumes from Hubei to other countries, numbers of reported cases in other countries, and understanding of other travel routes.
3. SAGE now advises that individuals in the UK who have travelled from Thailand, Japan, Republic of Korea, Hong Kong, Taiwan, Singapore, Malaysia or Macau and are showing possible symptoms of WN-CoV should also be included in the case definition.
4. SAGE advises that this decision will need to be reviewed in the coming days as further information becomes available.

Situation update

5. SAGE was advised of a third UK case which has tested positive for WN-CoV.
6. The individual has not been to China, but has recently visited Singapore.

UK testing for WN-CoV

7. In light of this further evidence of human-to-human transmission beyond China, SAGE discussed whether advice should be changed and, if so, the most appropriate way to widen testing of suspected cases of WN-CoV in the UK, depending on their travel history.
8. SAGE considered that a pragmatic approach, based on currently available information, should factor in: air travel volumes from Wuhan to other countries, numbers of reported cases in other countries, and understanding of other travel routes from China.
9. There is a close correlation between countries reporting higher numbers of cases and air travel volumes from Wuhan to those countries.
10. As a result, SAGE now advises that individuals in the UK who have travelled from Thailand, Japan, Republic of Korea, Hong Kong, Taiwan, Singapore, Malaysia or Macau and who are showing possible symptoms of WN-CoV should also be included in the case definition.
11. SAGE advised that this widening should be regarded as a first step only. Further consideration of the breadth may be required in the coming days.

ACTION: SAGE to keep geographical parameters for case definition under review

Attendees

SAGE participants: Patrick Vallance, Chris Whitty, Jonathan Van Tam, Neil Ferguson, John Edmunds, Graham Medley, Sharon Peacock, Jenny Harries,

Observers: [redacted]

Secretariat: [redacted] Sam Harris [redacted]

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Addendum to the sixth SAGE meeting on Covid-19, 11 February 2020
Held in 10 Victoria Street, London, SW1H 0NN

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees

Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Sharon Peacock (PHE), James Rubin (King's College), Neil Ferguson (Imperial), John Edmunds (LSHTM), Graham Medley (LSHTM), Angela McLean (CSA MoD), Charlotte Watts (CSA DfID), Phil Blythe (CSA DfT), John Aston (CSA HO), Maria Zambon (PHE), Wendy Barclay (Imperial), Alaster Smith (dCSA DfE).*

Observers and Government Officials: *Kate Thomas (DHSC), Samantha Harris (GoS).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be the complete list.

Sixth SAGE meeting on Wuhan Coronavirus (Covid-19), 11 February 2020
Held in 10 Victoria Street

Summary

1. SAGE agreed that HMG should continue to plan using influenza pandemic assumptions.
2. SAGE advised it is essential that the maximum amount of information is derived from confirmed cases in the UK.
3. Assuming the reproduction number and doubling time are similar in the UK to the early stages of the outbreak in Wuhan, an epidemic in the UK could be expected to peak around 2 to 3 months following the establishment of widespread transmission, but there is low confidence around this. It is predicted to have a lower peak but broader duration than a pan flu outbreak.

Situation update

4. SAGE was updated on rough case numbers and fatalities for China and other countries.
5. The UK has 8 confirmed cases, all of whom acquired the virus overseas.
6. Swabbing is taking place of individuals quarantined at Arrow Park and Milton Keynes.
7. It is not possible for the UK to accelerate diagnostic capability to include Covid-19 alongside regular flu testing in time for the onset of winter flu season 2020-21.
8. Validated serology for clinical use in the UK is around 4 to 6 weeks away. Singapore and Hong Kong are close to validated serological capability.

ACTION: DCMO and **PHE** to understand what swabbing and subsequent testing of returning travellers has been undertaken globally, and to review results, how often swabs need to be taken to be reliable, and which tests are being used.

Understanding Covid-19

Key variables

9. Case fatality rate: uncertain but planning on the assumption 2-3%.
10. Reproduction number (R0): unchanged at 2-3 in Wuhan in the early stages of the epidemic.
11. Doubling time: unchanged at 4-5 days.
12. Incubation period: 4-5 days average, with range of 1-14 days.
13. Serial interval (i.e. the time between successive cases in a chain of transmission): 6 days, but uncertain.
14. Duration of infectivity: 14 days as upper limit (advice to self-isolate for 14 days still stands). Peak infectivity is probably around the start of symptom onset, average 2-6 days.
15. SAGE will not discuss these key variables again unless and until there is a material reason to do so (i.e. significant new data), following advice from SPI-M.

16. A lack of data from China continues to hamper understanding of Covid-19. Cases outside Wuhan are not well reported. It is possible China has changed its case definition.
17. Beyond China, surveillance is focused on travellers from Hubei, providing only a partial understanding of spread.
18. Data (including serological) from the cruise ship quarantined off Japan will be informative.
19. Virus shedding may reach significant levels just before onset of symptoms and continues for 1-2 days after (wide uncertainty).
20. Information about children remains limited. There is no clear modelling evidence that children are either protected or less susceptible, but clinical reports suggest that severity of disease may be less.
21. In China, unpublished data suggests 90% of cases are among those over 30, with incidence approximately independent of age above this.

ACTION: Neil Ferguson to share summary paper on vulnerable groups with SAGE secretariat.

22. Seasonality could be a factor in the spread of Covid-19 in the UK, but there is no current evidence for this. Seasonality of endemic UK coronaviruses is not well understood.
23. No new information available on virology: most data still quite speculative, but it doesn't appear that the virus is currently mutating.
24. Sequencing of UK cases is taking place.
25. SAGE advised it is essential that the maximum amount of clinical and biological information is derived from confirmed cases in the UK.
26. Confirmed cases in the UK need to be tested daily for stool, urine and respiratory secretions.

ACTION: PHE to ensure there are plans in place to collect the maximum amount of information from returning UK travellers who are testing positive for Covid-19, including daily swabbing and collection of blood samples. Data and samples need to be made available for analysis and use by research groups.

ACTION: PHE to work with **SPI-M** to develop criteria for when contact tracing is no longer worthwhile. This should include consideration of any limiting factors on testing and alternative methods of identifying epidemic evolution and characteristics.

Modelling the outbreak in China and internationally

27. There is an apparent slowing of the epidemic in Wuhan, where case numbers seem to have flattened (uncertainty remains).
28. UK modellers are in agreement that the epidemic is close to peaking in Wuhan – potentially in the next 1 to 3 weeks, around 2.5 months after it began in early December 2020.
29. The peak in the rest of China could be around 1 to 2 months behind Wuhan, but uncertain.
30. Outside China, case numbers correlate with air travel volumes from China, suggesting limited on-going transmission has yet to be detected outside China.

ACTION: DfID to share flight data with **SPI-M** secretariat [redacted], to facilitate modelling of global spread of WN-CoV.

ACTION: FCO and **DfID** to work with **SPI-M** secretariat to finalise the detailed break-down of data required from Chinese and other national authorities, and the routes through which this data should be shared. This request to be issued to all UK Heads of Mission in affected countries to pass to their host governments, with priority given to data from Japanese and Singaporean governments.

ACTION: SPI-M to review emerging papers on global spread, and provide conclusions on plausible scenarios at a future SAGE meeting (next week, timing TBC). These will be used to inform HMG international planning.

Modelling for the UK

31. Assuming the reproduction number and doubling time are similar in the UK to the early stages of the outbreak in Wuhan, an epidemic in the UK could be expected to peak around 2 to 3 months following the establishment of widespread transmission, but there is low confidence around this. It would be expected to have a lower peak but broader duration than pan flu.
32. It is expected that the all parts of the UK would be impacted at about the same time, with only small delays between regions.

33. It is important to understand hospital bed requirements, particularly requirements for respiratory support.

ACTION: SPI-M to report how their estimates of the time from widespread transmission to peak incidence would vary with different reproduction numbers and doubling times.

ACTION: SPI-M to work with NHSE and others on modelling the impact of the pandemic influenza reasonable worst case on the NHS, including the number of people requiring respiratory support.

Review of reasonable worst-case scenario and planning

34. SAGE agreed that HMG should continue to plan using influenza pandemic assumptions.
35. Epidemiological terms need to be made clearer in the planning documents to avoid ambiguity.
36. SAGE advised that HMG should plan for impacts on the NHS and also on the wider UK workforce.

For discussion at future meetings

37. SAGE: Measures to limit spread (including review of school options); public behaviour; public gatherings; advice on absenteeism.
38. NERVTAG: advice to frontline workers (only revising this advice if substantive changes occur); cleaning of surfaces.

SAGE and **NERVTAG secretariats** to agree clear division of responsibilities. **SAGE secretariat** to ensure that all approved science advice is readily accessible across HMG.

List of actions

DCMO and PHE to understand what swabbing and subsequent testing of returning travellers has been undertaken globally and to review how often swabs need to be taken to be reliable and which tests are being used.

Neil Ferguson to share summary paper on vulnerable groups with **SAGE secretariat**.

PHE to ensure there are plans in place to collect the maximum amount of information from returning UK travellers who are testing positive for Covid-19, including daily swabbing and collection of blood samples. Data and samples need to be made available for analysis and use by research groups.

PHE to work with **SPI-M** to develop criteria for when contact tracing is no longer worthwhile. This should include consideration of any limiting factors on testing and alternative methods of identifying epidemic evolution and characteristics.

DfID to share flight data with **SPI-M** secretariat [redacted], to facilitate modelling of global spread of WN-CoV.

FCO and **DfID** to work with **SPI-M secretariat** to finalise the detailed break-down of data required from Chinese and other national authorities, and the routes through which this data should be shared. This request to be issued to all UK Heads of Mission in affected countries to pass to their host governments, with priority given to data from Japanese and Singaporean governments.

SPI-M to review emerging papers on global spread, and provide conclusions on plausible scenarios at a future SAGE meeting (next week, timing TBC). These will be used to inform HMG international planning.

SPI-M to report how their estimates of the time from widespread transmission to peak incidence would vary with different reproduction numbers and doubling times.

SPI-M to work with NHSE and others on modelling the impact of the pandemic influenza reasonable worst case on the NHS, including the number of people requiring respiratory support.

SAGE and **NERVTAG secretariats** to agree clear division of responsibilities. **SAGE secretariat** to ensure that all approved science advice is readily accessible across HMG.

Attendees

SAGE participants: Patrick Vallance, Chris Whitty, Sharon Peacock, James Rubin, Neil Ferguson, John Edmunds, Graham Medley, Angela McLean, [redacted] Charlotte Watts, Phil Blythe, John Aston, Kate Thomas
By phone: Maria Zambon, Wendy Barclay, Alaster Smith

Secretariat: [redacted] Samantha Harris

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Addendum to seventh SAGE meeting on Covid-19, *13th February 2020*
Held in 10 Victoria St, London, SW1H 0NN

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees

Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Sharon Peacock (PHE), Brooke Rogers (King's College), James Rubin (King's College), Neil Ferguson (Imperial), John Edmunds (LSTHM), Charlotte Watts (CSA DfID), John Aston (CSA HO), Graham Medley (LSHTM), Peter Horby (Oxford), Maria Zambon (DD PHE), Alaster Smith (dCSA DfE).*

Observers and Government officials: *Kate Thomas (DHSC).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be a complete list.

Seventh SAGE meeting on Covid-19, 13 February 2020
Held at Government Office for Science

Summary

1. SAGE concluded that neither travel restrictions within the UK nor prevention of mass gatherings would be effective in limiting transmission.
2. SAGE advised that the most effective way to limit spread in prisons at this stage would be by reducing transfer of individuals *between* prisons.
3. Public messaging should stress the importance of personal responsibility and responsibility to others.
4. Public messaging should stress both the efficacy and sufficiency of any behaviours it recommends to reduce the likelihood of the public adopting further unnecessary or contradictory behaviours.

Situation update

5. SAGE and wider HMG should continue to work on the assumption that China will be unable to contain the epidemic.

ACTION: SAGE secretariat to circulate to what case definitions are being used in China (attached to this minute)

ACTION: PHE to work with **SPI-M** to produce a paper on principles for sharing of clinical and modelling data, including access to real-time data (for SAGE meeting on 18 Feb)

ACTION: NERVTAG to provide clinical assumptions to inform **SPI-M** modelling, as soon as sufficient data is available, of what proportion of the population could be infected with Covid-19, what proportion of these could be symptomatic, within this who will require hospital care and of those, what proportion will require respiratory support. This should be modelled by age group and by risk groups (comorbidities)

Measures to limit spread in the UK

6. SAGE discussed a range of potential measures to delay spread, based on a paper by SPI-M.
7. SAGE concluded that travel restrictions within the UK, unless draconian and fully adhered to, would not be effective in limiting transmission. They would also be ineffective if Covid-19 cases were already established in the UK.
8. There is no current evidence to suggest prevention of mass gatherings is effective in limiting transmission. Public actions in the absence of a mass gathering could have comparable impacts (e.g. watching a football match in a pub instead of a stadium as likely to spread the disease).
9. Presenteeism is an issue: around 20% of the population go to school or work when febrile (and this varies considerably among different types of employment).

ACTION: **SPI-M** to update its previous assessment on how many weeks a UK epidemic might be delayed through a combination of enhanced monitoring and contact tracing (for SAGE meeting on 20 Feb)

School closures

10. Any decision to close schools must consider what objective is being sought in terms of seeking to affect the epidemic curve (i.e. peak, duration, waves of infection).
11. School closures can potentially delay a) the first wave of an epidemic or b) the peak of an epidemic – but would require closures lasting weeks, and evidence suggests they would not alter total numbers affected.
12. Either would have impacts on schools, other services and the wider economy.

13. In an influenza pandemic, school children are critical to transmission because they have less immunity than adults and because of their social mixing patterns.
14. The impact of Covid-19 on school-age children remains poorly understood, but SAGE would like modelling to assume a similar pattern of infection to influenza (and sensitivity analyses around these).
15. The serial interval for Covid-19 is longer than it is for influenza – meaning that school closures would have to last longer than for influenza to achieve a similar impact.
16. The response of parents to school closures is a significant factor in their effectiveness. School closures would not have positive effects if children congregate in other places.

ACTION: Assuming Covid-19 is transmissible by children, **SPI-M** to use **DFE** data to model scenarios and parameters under which school closures could be useful and not useful in a) delaying the peak of the UK epidemic, and b) bringing down the peak of the UK epidemic (for SAGE meeting on 20 Feb). This should also:
- explore selective closures (e.g. secondary schools or non-public exam year groups only) and subsequent impacts
- provide quantitative and sensitivity analysis for what parameters will have the biggest impacts in achieving a) and b) above
- take into account behavioural consequences that might alter the effect

Prisons

17. SAGE discussed how to limit spread within the prisons estate and prisoner population. There is a high degree of movement across the prison estate.
18. SAGE advised that the current approach for the general UK population should be followed in prisons with regards to isolation, contact tracing and good personal hygiene.
19. SAGE advised that the most effective way to limit spread in prisons at an early stage of a UK outbreak is by reducing transfer of individuals *between* prisons.
20. Should Covid-19 become established within a prisoner population, there are no obvious recommended response measures specific to prisons, besides limiting prisoner transfers.

Behavioural science

21. Public behaviour where there is perceived risk of a forthcoming epidemic: available evidence suggests scepticism and general inaction dominate (certainly until the first confirmed domestic fatality).
22. Public reassurance is not the issue at this stage: more important, if necessary, is motivating the public to behave in specific, positive ways by making any risk feel relevant to individuals' lives.

23. Public response during an epidemic: this depends on a) perception of individual risk and risked to loved ones, and b) attitudes towards recommended behaviours, i.e. "Is that behaviour effective?" and "Does the behaviour have personal costs to me?" (e.g. financial, practical, emotional).
24. At this stage, public messaging should stress the importance of personal responsibility and responsibility to others, in order to drive positive public behaviours.
25. Public messaging should also stress *efficacy* of certain behaviours – and inform the public where behaviours are ineffective (e.g. avoiding certain types of people or products).
26. National messaging should be clear and definitive: if such messaging is presented as both precautionary and sufficient, it will reduce the likelihood of the public adopting further unnecessary or contradictory behaviours.
27. Panic – i.e. entirely irrational behaviour – is extremely rare: individuals can invariably explain why they display a range of behaviours (e.g. stockpiling food).

28. The public are more likely to take decisions for themselves in an information vacuum or to seek information from less reliable sources. Where counter-productive behaviours occur, HMG needs to understand the logic behind those behaviours in order to identify solutions and to improve messaging.
29. Perceived competition for limited resource (e.g. food, medicines) and/or perceived bias/preferential treatment in sharing or providing resources can increase social tensions: the key factor in determining public behaviour is whether there is trust in the institution(s) seeking to assure that there aren't resource shortages.
30. Civil unrest usually relates to underlying social issues, rather than to the specific crisis; the crisis itself tends to be the flashpoint which exposes the underlying issues.
31. SAGE agreed the importance of coherent and consistent public messaging being appropriate to the phase and scale of the outbreak, and properly informed by behavioural science insights. HMG should prepare public messaging for different phases of the outbreak to avoid abrupt shifts in public messaging as the outbreak evolves.

ACTION: SPI-B (Scientific Pandemic Influenza – Behaviour) sub-group to be established to provide behavioural science advice via SAGE throughout this incident

List of actions

SAGE secretariat to circulate to what case definitions are being used in China (attached to this minute)

PHE to work with **SPI-M** to produce a paper on principles for sharing of clinical and modelling data, including access to real-time data (for SAGE meeting on 18 Feb)

NERVTAG to provide clinical assumptions to inform **SPI-M** modelling, as soon as sufficient data is available, of what proportion of the population could be infected with Covid-19, what proportion of these could be symptomatic, within this who will require hospital care and of those, what proportion will require respiratory support. This should be modelled by age group and by risk groups (comorbidities)

SPI-M to update its previous assessment on how many weeks a UK epidemic might be delayed through a combination of enhanced monitoring and contact tracing (for SAGE meeting on 20 Feb)

Assuming Covid-19 is transmissible by children, **SPI-M** to use **DFE** data to model scenarios and parameters under which school closures could be useful and not useful in a) delaying the peak of the UK epidemic, and b) bringing down the peak of the UK epidemic (for SAGE meeting on 20 Feb). This should also:
- explore selective closures (e.g. secondary schools or non-public exam year groups only) and subsequent impacts
- provide quantitative and sensitivity analysis for what parameters will have the biggest impacts in achieving a) and b) above
- take into account behavioural consequences that might alter the effect

SPI-B (Scientific Pandemic Influenza – Behaviour) sub-group to be established to provide behavioural science advice via SAGE throughout this incident

Attendees

SAGE participants: Patrick Vallance, Chris Whitty, Sharon Peacock, Brooke Rogers, James Rubin, Neil Ferguson, John Edmunds, Charlotte Watts, John Aston, Kate Thomas

By phone: Graham Medley, Peter Horby, Maria Zambon, Alaster Smith

Secretariat: [redacted]

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Addendum to the eighth SAGE meeting on Covid-19, 18 February 2020
Held in 10 Victoria Street, London, SW1H 0NN

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees

Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Charlotte Watts (CSA DfID), Angela McLean (CSA MoD), John Aston (CSA HO), Phil Blythe (CSA DfT), Sharon Peacock (PHE), Ian Hall (Manchester), Neil Ferguson (Imperial), John Edmunds (LSHTM), Maria Zambon (PHE), Peter Horby (Oxford), Wendy Barclay (Imperial), Brooke Rogers (King's), Andrew Rambaut (Edinburgh), James Rubin (King's).*

Observers and Government Officials: None.

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be the complete list.

Eighth SAGE meeting on Wuhan Coronavirus (Covid-19), 18 February 2020
Held in 10 Victoria Street

Summary:

1. There is some evidence that case incidence is decreasing in China. However, this does not rule out a resurgence once restrictions on internal movement are lifted.
2. SAGE agreed it is essential that the UK plans for how it will handle clinical trials and treatment should there be an outbreak of Covid-19 in the UK.

Situation update:

3. Data from China indicates that the incidence of Covid-19 is decreasing. However, this does not rule out a resurgence of the disease later in the epidemic as internal travel restrictions are lifted and schools return.
4. Indications from international partners suggests that children with Covid-19 are displaying milder symptoms, but this does not preclude them from being carriers of the disease.
5. Discussions are taking place across Government on how researchers can access clinical samples. An access committee, coordinated by UKRI, is being set up to balance the needs of the scientific community and consider what will have a demonstrable impact on controlling the epidemic.
6. Priorities will shift during a potential outbreak from containment and isolation on to delay and, finally, to case management.
7. Currently PHE can cope with five new cases a week (requiring isolation of 800 contacts). Modelling suggests this capacity could be increased to 50 new cases a week (8,000 contact isolations) but this assumption needs to be stress tested with PHE operational colleagues.
8. SAGE agreed that alongside contact tracing, early warning surveillance systems – community and sentinel based – need to feed into trigger points for decisions on when the current monitoring and contact tracing approach is no longer working.
9. When there is sustained transmission in the UK, contact tracing will no longer be useful.

ACTION: **PHE** to present a paper at the next SAGE meeting, informed by SPI-M, proposing trigger points for when the current approach to monitoring and contact tracing should be reviewed, revised or stopped.

ACTION: SAGE secretariat to share GCSA discussion with Singapore note with PHE; and China CDC paper and PHE paper on virology with SAGE participants.

Data from UK cases

10. To better understand asymptomatic cases, more comprehensive swabbing of returning global travellers during isolation would be useful.
11. Given the higher risk posed by passengers from the Diamond Princess, a different sampling regime will be required than for previous UK returnees.
12. Blood samples are being taken from all UK returnees in isolation, both upon discharge and later after completion of the isolation period. This regime will also be applied to those returning from the Diamond Princess.
13. Out of the 9 confirmed UK cases, 7 have had genetic sequencing. Samples taken from the respiratory tract appear to be most reliable for testing, with some positive detections in faeces.
14. There has been no positive detection from blood or urine so far. This suggests that the transmission route may be faecal-oral alongside respiratory (e.g. coughing and sneezing) and contact.
15. Detection appears most straightforward shortly after disease onset when viral load is higher, with viral detection usually gone after 10-12 days. However, definitive

conclusions are hard to draw on a small number of cases and, therefore, a 14-day isolation period remains a reasonable estimate.
16. Serology testing will not be available for several weeks.

ACTION: **Andrew Rambaut** and **PHE** to discuss use of virus genome sequencing to track transmission and spread of Covid-19.

Transmission characteristics

17. There is currently no evidence available on how temperature or humidity affects transmission of Covid-19 but there are data from other coronaviruses that could give a potential indication.
18. There is extremely limited evidence on whether vertical transmission by pregnant mothers is possible.

Persistence in the environment

19. There is evidence that Covid-19 persists in the environment for longer than the influenza virus.
20. The infection risk from environmental contamination will decline over time.
21. SAGE agreed that 72 hours is a reasonable threshold after which there is a negligible risk of the virus persisting in the environment. This does not guarantee a total absence of infectious virus after this point, but the likelihood of transmission will be very significantly reduced and likely absent.
22. SAGE agreed that these principles apply for both community and healthcare settings, and routine cleaning procedures are sufficient to prevent transmission of the virus.
23. It was noted that viruses typically persist less on soft surfaces (e.g. clothes) than on hard surfaces, and this is likely to be the case for Covid-19.
24. It was agreed that there is currently no evidence of the virus spreading via use of hand driers.

ACTION: PHE to share its decontamination guidance paper with SAGE secretariat.

Clinical management

25. Antiretrovirals including Lopinavir/ritonavir (LPV/r) are being trialled.
26. Chloroquine is being used in China to treat Covid-19. Chloroquine represents a potential treatment that is low cost and widely available. However, SAGE is unaware of any clinical trials assessing its effectiveness.
27. It is essential that the UK agrees principles for clinical trials and treatment should an outbreak occur on the UK, learning lessons from previous epidemics such as Ebola in West Africa and severe flu in the UK. This will support NHS planning.

ACTION: NERVTAG (with dCMO) to provide advice on principles for trialling Covid-19 treatments in the UK.

Review of reasonable worst-case (RWC) scenario and planning

28. There is currently no new data prompting review of the RWC planning assumptions.
29. Additional data is becoming available, which will help refine the case fatality rate within China. The implications of this, and of additional modelling, will be considered at the next SAGE meeting.

ACTION: PHE to check and confirm it is receiving data from all available international sources; other SAGE participants to advise PHE of available sources it might have missed.

ACTION: SAGE secretariat to explore how to create a single, accessible repository for relevant papers on Covid-19.

For discussion at future meetings

30. SAGE will meet again on 20 February and consider modelling related questions.

List of actions:

PHE to present a paper at the next SAGE meeting, informed by SPI-M, proposing trigger points for when the current approach to monitoring and contact tracing should be reviewed, revised or stopped.

SAGE secretariat to share GCSA discussion with Singapore note with PHE; and China CDC paper and PHE paper on virology with SAGE participants.

Andrew Rambaut and **PHE** to discuss use of virus genome sequencing to track transmission and spread of Covid-19.

PHE to share its decontamination guidance paper with SAGE secretariat.

NERVTAG (with dCMO) to provide advice on principles for trialling Covid-19 treatments in the UK.

PHE to check and confirm it is receiving data from all available international sources; other SAGE participants to advise PHE of available sources it might have missed.

SAGE secretariat to explore how to create a single, accessible repository for relevant papers on Covid-19.

Attendees:

SAGE participants: Patrick Vallance (Chair), Chris Whitty, Charlotte Watts, Angela McLean, John Aston, Phil Blythe, [redacted] *Sharon Peacock,* [redacted] *Ian Hall, Neil Ferguson, John Edmunds, Maria Zambon, Peter Horby, Wendy Barclay, Brooke Rogers, Andrew Rambaut,* [redacted] *James Rubin*

SAGE secretariat: [redacted]

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Addendum to ninth SAGE meeting on Covid-19, 20th February 2020
Held in 10 Victoria St, London, SW1H 0NN

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees

Scientific experts: *Patrick Vallance (GCSA), Jenny Harries (dCMO), Charlotte Watts (CSA DfID), Carole Mundell (CSA FCO), Angela McLean (CSA MoD), John Aston (CSA HO), Phil Blythe (CSA DfT), Sharon Peacock (PHE), Ian Hall (Manchester), Neil Ferguson (Imperial), John Edmunds (LSTHM), Brooke Rogers (King's College), James Rubin (King's College), Maria Zambon (PHE), Peter Horby (Oxford), Alaster Smith (dCSA DfE).*

Observers and Government officials: *Ben Warner (No. 10).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were either Observers and Government Officials were not consistently recorded therefore this may not be the complete list.

Ninth SAGE meeting on Wuhan Coronavirus (Covid-19), 20 February 2020
Held in 10 Victoria Street

Summary

1. Before consideration of measures to reduce spread is undertaken, it is essential to understand the ability of surveillance methods to pick up evidence of an epidemic (and how those methods might be improved), understand when evidence will become available, and – from that surveillance – the likely trajectory of an epidemic.
2. It is also essential to understand the objectives behind seeking to manage the epidemiological curve, informed by key challenges the NHS is seeking to mitigate.

Situation update

3. There is evidence of local transmission unlinked to individuals who have travelled from China in Japan, Republic of Korea and Iran.
4. There is evidence from China and Hong Kong that social distancing measures have had some impact in limiting the outbreak.

Understanding Covid-19

5. SAGE agreed there was no reason to revise the agreed numbers for key variables.
6. Duration of illness: SAGE table should read "great variance" re. the median, rather than "great uncertainty".

ACTION: NHS England to provide **SPI-M** with a list of precise and essential criteria upon which NHS planning depends (e.g. is an estimate of the percentage of patients needing respiratory support, and for how long, the most important thing to know for planning?), in order for SPI-M to model these in different outbreak scenarios.

Measures to limit spread

7. Before consideration of measures to reduce spread is undertaken, it is essential to understand the ability of surveillance methods to pick up evidence of an epidemic (and how those methods might be improved), understand when evidence will become available, and – from that surveillance – the likely trajectory of an epidemic.
8. It is also essential to understand the objectives behind seeking to manage the epidemiological curve (e.g. flattening the peak, spreading the duration, avoiding winter), informed by key challenges the NHS is seeking to mitigate.
9. Once there is clarity on those issues, SAGE should review all potential methods to limit spread (schools, travel, large gatherings, home working etc.), including their likely relative effectiveness.

ACTION: NHS England to clarify for SAGE the profile of the epidemic that would allow the best NHS response.

ACTION: SAGE to review all possible interventions to limit the spread of the disease at a dedicated future meeting, including an assessment of the effectiveness of these inventions, based on advice from **SPI-M** and **SPI-B**.

ACTION: SPI-B to consider the likely public response to interventions to limit the spread of the disease, and the impact of public response on the effectiveness of such interventions. **SPI-B** also to consider what conditions could lead to civil disturbance.

Contact tracing and case surveillance

10. SAGE discussed a PHE paper on monitoring and contact tracing, the purpose of which is detection and containment to delay spread of Covid-19.

11. SAGE concluded that individual cases could already have been missed – including individuals advised that they are not infectious (given the challenge of picking up the virus after the first week or so of infection).
12. SAGE advised that PHE's proposed triggers for reviewing whether to discontinue contact tracing are sensible. SAGE should offer further advice should those triggers be met.
13. Any decision to discontinue contact tracing will generate a public reaction – which requires consideration with input from behavioural scientists.
14. Data collected, as well as clarity around methodology and numbers (e.g. general practices, pneumonia cases, where and how many), are essential to judge the effectiveness of any approach to surveillance. Modelling is necessary to understand how likely the proposed approach is to detect cases, both geographically and at what point of any outbreak.
15. SAGE advised that the locations chosen for serological sampling are important (including where previous cases have been identified, as well as the Devolved Administrations).

ACTION: PHE to share detailed proposals for surveillance (numbers, locations, methods) from clinical settings with **SPI-M**.

ACTION: SPI-M to provide a consensus view (with confidence intervals) on the impact of **PHE** surveillance proposals, and to identify potential improvements. This should include consideration of:

at what stage an outbreak will be detected (including appropriate geographical coverage)
the likelihood of detecting an outbreak
predicting the trajectory of the outbreak.

ACTION: PHE to co-ordinate with the Devolved Administrations on the development of surveillance and monitoring proposals.

School closures

16. SAGE discussed a SPI-M paper on modelling of school closures, assuming children have a transmission role for Covid-19 similar to that of influenza.
17. It is possible that school closures could have a modest impact on delaying the peak of an epidemic, but timing of intervention will be key and this will require the ability to detect and monitor any outbreak with good surveillance.
18. Sequential serological evidence represents the best means to predict epidemiological peak.
19. A systematic review of the literature on school closures found greater parental compliance with shorter durations (i.e. 2 weeks; there is no apparent evidence of school closures lasting more than 4 weeks).
20. Social mixing is inevitable with longer closures, but could be mitigated by effective public messaging (including a clear explanation of the purpose of closures).

ACTION: SPI-M to consider the impact of selective school closures in different outbreak scenarios, framed by NHS needs.

ACTION: PHE to update SAGE at future meetings on progress on serology test development.

Review of reasonable worst-case (RWC) scenario and planning

21. There is currently no new data prompting review of the RWC planning assumptions.

List of actions

NHS England to provide **SPI-M** with a list of precise and essential criteria upon which NHS planning depends (e.g. is an estimate of the percentage of patients needing respiratory support, and for how long, the most important thing to know for planning?), in order for SPI-M to model these in different outbreak scenarios.

NHS England to clarify for SAGE the profile of the epidemic that would allow the best NHS response.

SAGE to review all possible interventions to limit the spread of the disease at a dedicated future meeting, including an assessment of the effectiveness of these inventions, based on advice from **SPI-M** and **SPI-B**.

SPI-B to consider the likely public response to interventions to limit the spread of the disease, and the impact of public response on the effectiveness of such interventions. **SPI-B** also to consider what conditions could lead to civil disturbance.

PHE to share detailed proposals for surveillance (numbers, locations, methods) from clinical settings with **SPI-M**.

SPI-M to provide a consensus view (with confidence intervals) on the impact of **PHE** surveillance proposals, and to identify potential improvements. This should include consideration of:

- at what stage an outbreak will be detected (including appropriate geographical coverage)
- the likelihood of detecting an outbreak
- predicting the trajectory of the outbreak.

PHE to co-ordinate with the Devolved Administrations on the development of surveillance and monitoring proposals.

SPI-M to consider the impact of selective school closures in different outbreak scenarios, framed by NHS needs.

PHE to update SAGE at future meetings on progress on serology test development.

Attendees

SAGE participants: Patrick Vallance (chair), Jenny Harries, Charlotte Watts, Carole Mundell, Angela McLean, John Aston, Phil Blythe, [redacted] *Sharon Peacock, Ian Hall, Neil Ferguson, John Edmunds,* [redacted] *Ben Warner*

By phone: Brooke Rogers, James Rubin, Maria Zambon, Peter Horby, [redacted] *Alaster Smith*

SAGE secretariat: [redacted]

SAGE secretariat

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Addendum to the tenth SAGE meeting on Covid-19, *25th February 2020*
Held in 10 Victoria St, London, SW1H 0NN

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees

Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (dCMO), Steve Powis (NHS), Charlotte Watts (CSA DfID), John Aston (CSA HO), Sharon Peacock (PHE), Graham Medley (LSHTM), Neil Ferguson (Imperial), John Edmunds (LSHTM), Jeremy Farrar (Wellcome), James Rubin (King's), Brooke Rogers (King's), Maria Zambon (PHE), Phil Blythe (CSA DfT).*

Observers and Government Officials: *Ben Warner (No.10).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be the complete list.

Tenth SAGE meeting on Wuhan Coronavirus (Covid-19), 25th February 2020
Held in 10 Victoria Street

Summary

1. SAGE advises that surveillance measures, which commenced this week, will provide actionable data to inform HMG efforts to contain and mitigate spread of Covid-19.
2. The risk of public disorder in the UK – defined to include opportunistic crime, community tension and rioting – is assessed to be very low in response to an epidemic. Pro-social behaviour and altruism are more likely public responses; public communications should seek to guide and promote such behaviours.

Previous actions

3. SAGE agreed that information from FCO posts overseas would not provide suitable data for modelling purposes, although any clinical data will be useful. Google data is unlikely to be relevant at this stage of the outbreak because of diagnostic uncertainty.

ACTION: NHS England to work with **NERVTAG** to ensure data collection and clinical trial plans are implemented as soon as possible

National case surveillance

4. SAGE agreed that PHE's surveillance approach provides sufficient sensitivity to detect an outbreak in its early stages. This should provide evidence of an epidemic around 9-11 weeks before its peak.
5. It was noted that increasing surveillance coverage beyond the current approach would not significantly improve our understanding of incidence.
6. Detection through surveillance of a severely ill case would indicate existence of a significantly larger number of cases in the community.
7. A case detection through surveillance measures should prompt a review of additional mitigations that could be implemented locally or nationally. It would not automatically constitute a trigger point to cease containment activity already underway.
8. PHE continue to focus on contact tracing if cases are confirmed. PHE is sourcing commercial solutions for point of care testing in hospitals as a priority.

ACTION: dCMO, PHE and NHS England to explore testing options for suspected pneumonia cases in hospitals which aren't or haven't become severe

ACTION: SPI-M to advise, as soon as possible, on the implications for geographical spread of an outbreak in one location

Measures to limit spread

9. Interventions should seek to contain, delay and reduce the peak incidence of cases, in that order. Consideration of what is publicly perceived to work is essential in any decisions.
10. SAGE discussed a paper modelling four non-pharmaceutical interventions: university and school closures, home isolation, household quarantine and social distancing, including use of interventions in combination.
11. All measures require implementation for a significant duration in order to be effective.
12. Evidence from social distancing and school closures implemented in Hong Kong, Wuhan and Singapore indicates that these measures can reduce the Covid-19 reproduction number to approximately 1 (a 50-60% reduction). Reduced spread in the UK through a combination of these measures was assessed to be realistic.
13. Any combination of measures would slow but not halt an epidemic. NHS needs must be considered in any decisions to alter the epidemic curve.

14. Extremely mild symptoms should be enough to trigger home isolation if this intervention is to be adopted. This would need to be clearly communicated to the public.
15. Although current confidence in SPI-M modelling conclusions is low, and further review is needed, SAGE agreed that further work is unlikely to generate different conclusions in the short term and that policy decisions would need to be based on the currently available modelling outcomes and the experience from other countries – Singapore, China etc.

ACTION: SPI-M to provide a consensus statement for SAGE on 3 March covering measures to seek to achieve containment, delay and adjustment of epidemiological peak – and the effects of early implementation of those measures

Behavioural considerations

16. Public messaging is likely to be most effective if recommendations to act are definitive, rather than presented as optional or voluntary measures.
17. Publicly perceived efficacy of any measure is key. Public uptake is significantly impacted by whether government is seen to be acting competently and whether people believe that the intervention would work.
18. The UK government will need to clearly communicate its rationale for its decisions. This is particularly important where the UK response differs to other countries'.
19. Advice to businesses to begin preparing for measures such as homeworking and social distancing would give owners time to plan and demonstrate that the UK has a strategy and is adhering to it.

ACTION: SPI-B to advise on what measures to limit spread the public will perceive as effective

Risk of public disorder

20. SPI-B advised that large scale public disorder during an epidemic is very unlikely. Altruism and pro-social behaviour are more likely public responses.
21. Flash points tend to happen where there is a perceived lack of equity, substantial police absenteeism, pre-existing social tensions or where the government response is perceived to be inadequate. People actively attempting to sow discord can also be a trigger, especially online.
22. Disorder is possible if there is a perception that the police are unable to retain control. Further assessment to understand the role of the police would be of value.
23. There is commonly a difference between the evidence for and public perception of what constitute effective measures to manage spread. The aim of any measures introduced should be communicated early, clearly and consistently to improve public understanding and expectations.
24. Public compliance is likely to be enhanced when a sense of collectivism or community spirit is promoted.
25. Government messaging may benefit from alignment with WHO messaging on a potential pandemic: this could offer an opportunity to lay out what a pandemic would look like in the UK, and what businesses and individuals might need to plan for.

Next SAGE meeting

26. SAGE will meet next on Thursday 27th February to review reasonable worst case planning assumptions and modelling to inform the NHS response.

List of actions

NHS England to work with **NERVTAG** to ensure data collection and clinical trial plans are implemented as soon as possible

dCMO, PHE and **NHS England** to explore testing options for suspected pneumonia cases in hospitals which aren't or haven't become severe

SPI-M to advise, as soon as possible, on the implications for geographical spread of an outbreak in one location

SPI-M to provide a consensus statement for SAGE on 3 March covering measures to seek to achieve containment, delay and adjustment of epidemiological peak – and the effects of early implementation of those measures

SPI-B to advise on what measures to limit spread the public will perceive as effective

Attendees

SAGE participants: *Patrick Vallance (chair), Chris Whitty, Jonathan Van Tam, Steve Powis, Charlotte Watts, John Aston, Sharon Peacock,* [redacted] *Graham Medley, Neil Ferguson, John Edmunds, Jeremy Farrar, James Rubin, Ben Warner,* [redacted]

By phone: Brooke Rogers, Maria Zambon, Phil Blythe

SAGE secretariat: [redacted]

SAGE secretariat

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Addendum to eleventh SAGE meeting on Covid-19, 27th February 2020
Held in 10 Victoria St, London, SW1H 0NN

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees:

Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (Deputy CMO), Steve Powis (NHS), Mike Prentice (NHS), Charlotte Watts (CSA DfID), Carole Mundell (CSA FCO), Angela McLean (CSA MoD), John Aston (CSA HO), Sharon Peacock (PHE), Graham Medley (LSHTM), Neil Ferguson (Imperial), James Rubin (King's College), Aidan Fowler (NHS).*

Observers and Government officials: *Ben Warner (No. 10).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be a complete list.

Eleventh SAGE meeting on Wuhan Coronavirus (Covid-19), 27th February 2020
Held in 10 Victoria Street

Summary

1. SAGE reviewed Covid-19 planning assumptions and advised that, in the reasonable worst case scenario, 80% of the UK population may become infected, with an overall 1% fatality rate in those infected. Only a proportion of those infected will experience symptoms. This fatality rate represents a reduction in the number of excess deaths relative to previous planning assumptions (in which a case fatality rate of 2-3% was based purely on identified cases rather than all infected individuals).

Situation update

2. dCMO has established a system, CO-CIN, to catalogue data from cases of Covid-19.
3. CMO's office is looking out for any secondary bacterial infections in reported Covid-19 cases, but to date there is little evidence for secondary infections.
4. NERVTAG is reviewing a range of therapies and related trial designs that NHS settings can realistically implement.

ACTION: dCMO to circulate note outlining what information the CO-CIN report will capture

ACTION: CMO's office to gather evidence about Covid-19 in children for discussion at SAGE on 5 March 2020

SAGE priorities

5. SAGE agreed its priority areas:
    - Detect & monitor any outbreak as effectively as possible
    - Understand effective actions to help contain a cluster
    - Understand measures to alter the shape of a UK epidemic
    - Model UK epidemic & identify key numbers for NHS planning
    - Understand risk factors around demographics, geographies and vulnerable groups (e.g. age)
    - Generate Behavioural Science insights for policymakers
    - Ensure NHS trials key interventions
    - Consider emerging therapeutic, diagnostic & other opportunities

Review of reasonable worst case scenario

6. SAGE reviewed Covid-19 planning assumptions and advised that, in the reasonable worst case scenario, 80% of the UK population may become infected, with an overall 1% fatality rate in those infected. Only a proportion of those infected will experience symptoms.
7. This fatality rate represents a reduction in the number of excess deaths relative to previous planning assumptions.
8. SAGE agreed that the case fatality rate (2-3%) remains the same, but the fatality rate for the overall infected population (identified and unidentified cases) is closer to 1%. This better reflects the expected proportion of mild and possible asymptomatic infections. It still includes an assumption that there is a higher fatality rate in vulnerable groups.
9. The case fatality and infection fatality rates only reflect deaths as a direct result of infection, not those related to NHS overload or other second order effects.

ACTION: NHS England to confirm finally with **SPI-M** the variables for which it needs numbers in order to model NHS demand

ACTION: UK academic modelling groups (Imperial, Oxford, London School of Hygiene and Tropical Medicine) and **NHS planners** to organise a working group (in week starting 2

March 2020) to analyse key clinical variables for reasonable worst case planning for the NHS: for review by SPI-M and then discussion at SAGE

ACTION: SPI-M to refine models to include consideration of age groups and geographical variation at its next meeting

Review of interventions to contain, delay or mitigate spread of Covid-19

10. SAGE reviewed a table summarising the impacts of non-pharmaceutical interventions – to be finalised at its next meeting.
11. Mitigations can be expected to change the shape of the epidemic curve or the timing of a first or second peak, but are not likely to reduce the overall number of total infections.
12. The optimal shape of the epidemic curve will differ according to sectoral or organisational priorities.
13. Modelling suggests that earlier and/or combined interventions will have more significant impact. Such interventions would have to be maintained for an extended period.
14. On the risk posed by national and international travel associated with large events (e.g. sports), SAGE advised that the additional numbers travelling are not significant relative to overall numbers, but that this question should be further investigated.
15. On large events, SAGE noted that alternative/replacement behaviours (e.g. going to the pub instead of a stadium) would pose comparable risk.

ACTION: SPI-M, in support of the existing table on non-pharmaceutical interventions, to produce a narrative describing effects of interventions attempted in other countries, and develop illustrative scenarios showing the plausible impacts of combinations of interventions in the UK (simple visuals of epidemic curves) – for review at SAGE on 2 March 2020. Existing table to be reviewed weekly to assess whether it requires updating

ACTION: DfT to produce numbers indicating numbers travelling to major sporting events, compared to overall numbers travelling, including from abroad

List of actions

dCMO to circulate note outlining what information the CO-CIN report will capture

CMO's office to gather evidence about Covid-19 in children for discussion at SAGE on 5 March 2020

NHS England to confirm finally with **SPI-M** the variables for which it needs numbers in order to model NHS demand

UK academic modelling groups (Imperial, Oxford, London School of Hygiene and Tropical Medicine) and **NHS planners** to organise a working group (in week starting 2 March 2020) to analyse key clinical variables for reasonable worst case planning for the NHS: for review by SPI-M and then discussion at SAGE

SPI-M to refine models to include consideration of age groups and geographical variation at its next meeting

SPI-M, in support of the existing table on non-pharmaceutical interventions, to produce a narrative describing effects of interventions attempted in other countries, and develop illustrative scenarios showing the plausible impacts of combinations of interventions in the UK (simple visuals of epidemic curves) – for review at SAGE on 2 March 2020. Existing table to be reviewed weekly to assess whether it requires updating

DfT to produce numbers indicating numbers travelling to major sporting events, compared to overall numbers travelling, including from abroad

Attendees

SAGE participants: *Patrick Vallance (chair), Chris Whitty, Jonathan Van Tam, Steve Powis, Mike Prentice, Charlotte Watts, Carole Mundell, Angela McLean, John Aston, Sharon Peacock,* [redacted] *Graham Medley, Neil Ferguson, James Rubin, Ben Warner, Aidan Fowler,* [redacted]

SAGE secretariat: [redacted]

SAGE secretariat

Addendum to the twelfth SAGE meeting on Covid-19, 3rd March 2020
Held in 10 Victoria St, London, SW1H 0NN

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees:
Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO),* Jonathan Van Tam (Deputy CMO), *Angela McLean (CSA MoD), Charlotte Watts (CSA DfID), Carole Mundell (CSA FCO), Phil Blythe (CSA DfT), Neil Ferguson (Imperial), John Edmunds (LSHTM), Graham Medley (LSHTM), James Rubin (King's), Sharon Peacock (PHE), Peter Horby (Oxford), Steve Powis (NHS), Gregor Smith (dCMO Scotland), Maria Zambon (PHE), Andrew Rambaut (Edinburgh), Brooke Rogers (King's).*

Observers and Government Officials: *Stuart Wainwright (GoS).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be the complete list.

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12th SAGE meeting on Wuhan Coronavirus, 3rd March 2020
Held in 10 Victoria Street

Summary:

1. SAGE discussed the impact of potential behavioural and social interventions on the spread of a Covid-19 epidemic in the UK, including the resulting public response. Going forward, agreement on the optimal timing of these interventions will be required.
2. NHS England confirmed it has sufficient information in relation to the reasonable worst case (RWC) scenario for operational planning.

Situation update:

3. PHE have implemented a surveillance and monitoring plan as per previous SAGE discussions.

ACTION: PHE to confirm level of disease surveillance already in place for next SAGE meeting (March 5).

Impact of potential interventions

4. SAGE reviewed non-clinical interventions to reduce and delay Covid-19 transmission, including their potential impact and behavioural science implications.
5. Adequate seroprevalence data and of behavioural data is required to track and assess effectiveness of these interventions in real time during an outbreak.
6. Social distancing for over-65s is likely to have a significant effect on overall deaths and peak demand for critical care beds, but will not significantly reduce overall transmission. This would be most effective for those living independently; it will be a challenge to implement this measure within communal settings such as care homes.
7. There is currently no evidence that cancelling large events would be effective.
8. There is likely to be geographical variation in the timing of localised peaks of the epidemic.
9. SAGE noted the importance of assessing the wider health implications of these interventions, e.g. the effect of self-isolation on mental health.

ACTION: SPI-M to provide timings for when interventions should be implemented for next SAGE meeting (March 5)

ACTION: SAGE participants to put basic confidence statements today around the evidence available for the impact of potential interventions.

Behavioural science considerations

10. Key to minimising barriers and facilitating compliance with the proposed interventions are communication, feasibility and equity.
11. Coherent and unambiguous communication, and suggesting replacement behaviours, will help increase compliance.
12. Encouraging positive behaviours as social norms can be powerful.
13. Many of the proposed measures will be easier to implement for those on higher incomes. Government should address this to avoid tension within communities and detrimental effects on compliance.
14. Unintended consequences should be considered – including potential alternative behaviours (e.g. people congregating elsewhere when events are cancelled).
15. Consideration should be given to how and when measures will be removed, and any impact this may have on the transmission of the disease (e.g. causing a second peak).

ACTION: **PHE** to begin drafting public guidance on potential interventions, informed by evidence of what constitutes effective guidance (including from behavioural science) – and to advise where there are evidence gaps requiring rapid research.

Science advice for NHS planning

16. NHS England confirmed it now has sufficient information for operational planning.
17. Singapore have developed a serology test with some cross-reactivity with SARS, meaning a second test for presumptive positives will be required.
18. Serology data from Wuhan will be extremely helpful in planning the UK response to Covid-19.

ACTION: SAGE secretariat to circulate clinical parameters broken down by age group before next SAGE meeting (March 5)

ACTION: PHE to ensure CO-CIN data is cross-checked against UK Severe Influenza System data.

ACTION: PHE to develop with **SPI-M** a proposal for required levels of serosurveillance for next SAGE meeting (March 5).

Most likely scenario

19. SAGE advised that infection attack rate and infection fatality rate are likely to be lower than the reasonable worst case, but this will depend on the effectiveness of potential interventions covered above.

Next SAGE meeting

20. It was agreed that SAGE would review excess deaths, age-related risks and vulnerable groups, and reasonable worst case numbers.

ACTION: NHS England to provide reasonable worst case and most likely case figures for deaths not resulting directly from the virus but from changes in care regimes – for next SAGE meeting (March 5).

List of actions

PHE to confirm level of disease surveillance already in place for next SAGE meeting (March 5)

SPI-M to provide timings for when interventions should be implemented for next SAGE meeting (March 5)

SAGE participants to put basic confidence statements today around the evidence available for the impact of potential interventions

PHE to begin drafting public guidance on potential interventions, informed by evidence of what constitutes effective guidance (including from behavioural science) – and to advise where there are evidence gaps requiring rapid research

SAGE secretariat to circulate clinical parameters broken down by age group before next SAGE meeting (March 5)

PHE to ensure CO-CIN data is cross-checked against UK Severe Influenza System data

PHE to develop with **SPI-M** a proposal for required levels of serosurveillance for next SAGE meeting (March 5)

NHS England to provide reasonable worst case and most likely case figures for deaths not resulting directly from the virus but from changes in care regimes – for next SAGE meeting (March 5)

Attendees

SAGE participants: *Patrick Vallance, Chris Whitty, Jonathan Van Tam, Angela McLean, Charlotte Watts, Carole Mundell, Phil Blythe, Stuart Wainwright, Neil Ferguson, John Edmunds, Graham Medley, James Rubin, Sharon Peacock, Peter Horby, Steve Powis, Gregor Smith,* [redacted]

By phone: Maria Zambon, Andrew Rambaut, Brooke Rogers, [redacted]

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Addendum to thirteenth SAGE meeting on Covid-19, 5th March 2020
Held in 10 Victoria St, London, SW1H 0NN

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees:

Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (Deputy CMO), Steve Powis (NHS), Angela McLean (CSA MoD), John Aston (CSA HO), Rob Orford (Health CSA Wales), Sharon Peacock (PHE), Graham Medley (LSHTM), Neil Ferguson (Imperial), David Halpern (CO), Andrew Rambaut (Edinburgh), Maria Zambon (PHE), Brooke Rogers (King's).*

Observers and Government officials: *Dominic Cummings (No. 10), Ben Warner (No. 10), Kate Thomas (DHSC), Stuart Wainwright (GoS).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be a complete list.

Thirteenth meeting on Wuhan Coronavirus (Covid-19), 5th March 2020
Held in 10 Victoria Street

Summary

1. There are currently no scientific grounds to move away from containment efforts in the UK.
2. There is epidemiological and modelling data to support implementation – within 1-2 weeks – of individual home isolation (symptomatic individuals to stay at home for 14 days) and whole family isolation (fellow household members of symptomatic individuals to stay at home for 14 days after last family member becomes unwell) to delay Covid-19 spread, modify the epidemic peak and reduce mortality rates.
3. In addition, there is scientific data to support implementation – roughly 2 weeks later – of social isolation (cocooning) for those over 65 or with underlying medical conditions to delay spread, modify the epidemic peak and reduce mortality rates.
4. SAGE agreed an updated set of reasonable worst case scenario planning assumptions for Covid-19.

Situation update

5. UK surveillance of intensive care units has identified Covid-19 cases. Not all of these have had overseas travel or contacts, suggesting sustained community transmission is underway in the UK.

Behavioural and social interventions

6. SAGE concluded that the UK remains in the containment phase of the epidemic.
7. HMG should plan for the introduction of behavioural and social interventions within 1-2 weeks to contain and delay spread; precise timings depend on progress of the epidemic.
8. SAGE advised that the science supports a combination of case isolation and whole family isolation.
9. The science supports that a third intervention has epidemiological advantages: to socially isolate those in vulnerable groups (the elderly and those with underlying conditions) approximately 2 weeks after these initial interventions.
10. If implemented in combination as modelled, this set of measures is understood to most effectively delay and modify the epidemic peak, and reduce mortality.
11. To be most effective, these measures should be implemented early in the epidemic and publicly adhered to throughout the peak period of infection.
12. The modelling undertaken assumed considerably less than total public compliance for these measures (e.g. 50% compliance for household quarantine).
13. SAGE discussed the relative merits of regional versus national enactment of these measures: this issue will be explored further over the next day or two.
14. SAGE agreed there is no evidence to suggest that banning very large gatherings would reduce transmission. Preventing all social interaction in public spaces, including restaurants and bars, would have an effect, but would be very difficult to implement.
15. SAGE agreed that school closures would have smaller effects on the epidemic curve than other options.
16. SAGE noted the importance of clear and sufficiently detailed public communication in advance of their implementation.
17. The point in time at which measures should be lifted will depend on epidemiological evidence, but is likely to be at least 12 weeks after initial implementation.
18. Cocooning of older and vulnerable patients can start later, and would have to continue longer, than other measures.

ACTION: Imperial group to model and compare triggers and timings for national-level and regional-level behavioural and social interventions, and share findings by end of working week (6 March)

Review of reasonable worst case scenario

19. SAGE reviewed the reasonable worst case scenario for Covid-19 and agreed revised assumptions for cross-government planning.
20. These assumptions will be reviewed once additional case and serology data are available.

ACTION: DHSC and **NHS England** to agree categories for public-facing version of Covid-19 reasonable worst case table

ACTION: PHE to produce specific criteria for when workers in critical sectors should self-isolate, for discussion at next SAGE meeting (10 March)

List of actions

Imperial group to model and compare triggers and timings for national-level and regional-level behavioural and social interventions, and share findings by end of working week (6 March)

DHSC and **NHS England** to agree categories for public-facing version of Covid-19 reasonable worst case table

PHE to produce specific criteria for when workers in critical sectors should self-isolate, for discussion at next SAGE meeting (10 March)

Attendees

SAGE participants: *Patrick Vallance (chair), Chris Whitty, Jonathan Van Tam, Dominic Cummings, Steve Powis, Angela McLean, John Aston, Rob Orford, Stuart Wainwright, Sharon Peacock,* [redacted] *Graham Medley, Neil Ferguson, Ben Warner, Kate Thomas, David Halpern*

Phone: Andrew Rambaut, Maria Zambon, Brooke Rogers

SAGE secretariat: [redacted]

SAGE secretariat

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Addendum to fourteenth SAGE meeting on Covid-19, 10th March 2020
Held in 10 Victoria St, London, SW1H 0NN

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees:

Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (Deputy CMO), Steve Powis (NHS), Charlotte Watts (CSA DfID), Angela McLean (CSA MoD), John Aston (CSA HO), Sharon Peacock (PHE), Graham Medley (LSHTM), Neil Ferguson (Imperial), John Edmunds (LSHTM), Brooke Rogers (King's), Russell Viner (UCL), Jeremy Farrar (Wellcome), Peter Horby (Oxford), David Halpern (CO), Osama Rahman (CSA DfE), Carole Mundell (CSA FCO), Maria Zambon (PHE), James Rubin (King's), Andrew Rambaut (Edinburgh).*

Observers and Government Officials: *Ben Warner (No.10).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be the complete list.

Fourteenth SAGE meeting on Wuhan Coronavirus (Covid-19), 10th March 2020
Held in 10 Victoria Street

Summary

1. SAGE agreed that social distancing measures for the elderly should apply to those aged 70+. Modelling using 65+ and 70+ deliver comparable results, but there is a large drop off in efficacy if the measures are confined to 80+.
2. SAGE advised that these social distancing interventions should consider 2 distinct groups: a) those aged 70+ who are generally well and b) vulnerable groups of all ages (including those aged 70+).
3. Limited evidence suggests that children can be at risk of Covid-19 and will mostly experience mild illness, though they probably transmit the virus.
4. SAGE will revisit its advice on the risks posed by different kinds of social gatherings/meetings and the impacts of restricting them on the epidemic curve at its next meeting (12 March). This will include consideration of the effects of physical distancing among individuals and duration of exposure on infectivity and transmissibility of Covid-19.

Situation update

5. Based on surveillance, including cases in intensive care units (for whom there is no travel history accounting for infection), the UK likely has thousands of cases – as many as 5,000 to 10,000 – which are geographically spread nationally.
6. Transmission is underway in community and nosocomial (i.e. hospital) settings.
7. Available data for the UK are accruing fast. Firmer estimates of infection rates will be available next week.
8. PHE has a serology test up and running for population-level analysis. Analysing greater volumes of samples is now the priority.
9. A test for frontline diagnostics may come from the private sector.
10. It was agreed that PHE and SPI-M should discuss how to make surveillance data more useful for modelling purposes (e.g. providing case location data).
11. It was reported that all pneumonia cases in hospital are now due to be tested.
12. The UK is considered to be 4-5 weeks behind Italy but on a similar curve (6-8 weeks behind if interventions are applied).

ACTION: PHE and NHS to report at the next SAGE meeting (12 March) on:

- Whether currently available capacity for population-based serology for Covid-19 is being fully exploited
- Plans for how PHE can move from 1,000 serology tests to 10,000 tests per week
- Whether all intensive care pneumonia cases are being tested for Covid-19 (as per current policy)
- Plans for consideration of commercial tests for frontline healthcare use.

ACTION: SAGE secretariat to consider how to provide a paper setting out where Italy, France, Germany and Spain are in terms of their epidemics and interventions (including efficacy of and behavioural change related to those interventions). This should be updated for each SAGE meeting.

Understanding Covid-19

13. The main symptoms are fever and/or cough. Public messaging on symptoms will be issued later this week and reviewed at SAGE on 12 March.
14. SAGE endorsed NERVTAG's advice that individual case isolation should last for 7 days from onset of symptoms. Individuals should self-isolate on more than one occasion if they have relevant symptoms (but SAGE recognised that compliance rates may drop the more this happens, hence the need to trigger this at the right time).

15. Children can be infected with Covid-19 and mostly experience mild illness, with less incidence of fever (limited evidence, low confidence). They likely transmit Covid-19, but there are no data on this.
16. For pregnant women infected with Covid-19, there is some evidence of premature delivery. There is no evidence of vertical transmission (mothers passing Covid-19 to unborn children). It does not appear that Covid-19 poses more of a risk to pregnant women than other infections, but the risk of premature delivery means that they should be considered in plans for vulnerable groups are developed.
17. Russell Viner agreed to share evidence on impacts of isolation and hospitalisation of children with DHSC and NHS England to inform policy development and NHS planning.

Behavioural and social interventions

18. Modelling suggests the UK is 10-14 weeks from the epidemic peak if no mitigations are introduced.
19. As per point 14, case isolation entails 7 days of self-isolation from onset of symptoms.
20. Household isolation entails 14 days of isolation for all household members from the point the first member has symptoms. If a household member develops symptoms on, say, day 12, the clock does not restart for other members. If the first symptomatic person is well after 7 days, s/he can leave the household, but not the other members.
21. Social distancing ("cocooning") is for those 70 and over, as well as those of any age in vulnerable groups.
22. The modelling concludes that restricting this group to 70+, rather than 65+, would not cause a significant increase in numbers of deaths.
23. SAGE agreed cocooning could be tiered, covering those at the highest risk, and those at increased risk but not in the highest risk.
24. The social distancing expected of those in the intermediate risk group may be less stringent. SAGE should review the policy proposal developed around this to consider any impacts (the trade off between stringency and compliance was noted).
25. GPs should have discretion to advise certain patients who do not automatically fall into the highest risk category that they should nevertheless follow the advice being issued to this group, based on the risk posed to them by Covid-19.
26. SAGE noted that a tiered approach to social distancing might reduce its overall impact on the epidemic curve and on mortality – this needs to be reviewed once the policy is worked up.
27. It also noted that in theory maximum efficacy from all interventions would be achieved through simultaneous introduction, but that there is some flexibility in timing that would not materially alter the effectiveness. Long periods of social isolation may have significant risks for vulnerable people.
28. SAGE agreed that a balance needs to be struck between interventions that theoretically have significant impacts and interventions which the public can feasibly and safely adopt in sufficient numbers over long periods.
29. Input from behavioural scientists is essential to policy development of cocooning measures, to increase public practicability and likelihood of compliance.
30. SAGE advised that special policy consideration be given to care homes and various types of retirement communities (where residents are more independent).
31. Once policies are formulated, SAGE should review them through the lenses of epidemiological modelling and behavioural science.
32. A summary of triggers and timings for the 3 interventions under consideration is set out in the table below.
33. It is vital to measure the impacts of these interventions (beyond disease surveillance) where possible.
34. SAGE noted that the public will face considerable challenges in seeking to comply with these measures, (e.g. poorer households, those relying on grandparents for childcare).

Measure and/or combination of measures	Suggested Trigger Point	Estimated time of occurrence
(1) Home Isolation of symptomatic cases	ICU cases tracking and other surveillance data, with a presumption that we have reached 100 ICU cases (cumulative)	Within the next 10 days
(2) Whole Household isolation	Based on cumulative ICU cases tracking and other surveillance data Actual trigger point: somewhere between 100 and 300 ICU cases (cumulative)	1-3 weeks after (1)
(3) Social distancing for 70+ and vulnerable groups	Cumulative ICU cases and other surveillance data Somewhere between 100 and 300 ICU cases (cumulative)	1-3 weeks after (1)

ACTION: DHSC and **Cabinet Secretariat** to develop policy around implementation of the three behavioural and social interventions under consideration (case isolation, household isolation, social distancing for elderly and vulnerable), clarifying eligibility, numbers affected and essential symptoms. This should be shared with SAGE and its advisory groups.

ACTION: SPI-B to consider how to measure resulting behavioural change from the implementation of behavioural and social interventions (e.g. engagement, compliance).

ACTION: SPI-M to consider the likelihood of secondary infection in confined spaces, e.g. households.

Reasonable worst case scenario

35. SAGE agreed that, for planning purposes, it is not useful at this stage to produce a "most likely" scenario until more UK data are available.
36. The reasonable worst case remains the most useful scenario for planning, but a most likely scenario will be more viable as additional data become available within 1-2 weeks.

Next meeting of SAGE

37. SAGE noted that public gatherings pose a relatively low but not zero public risk. People are more likely to be infected by people they know, not strangers. But it acknowledged the importance of advice in this area and agreed to review it and to look at different types of gatherings/meetings.

ACTION: SAGE advisory groups (SPI-M, SPI-B, NERVTAG) to reconsider for the next SAGE meeting (12 March) advice on public gatherings, including risk to individuals and the impact of restricting gatherings on the epidemic curve. This should include the relative risk of different types and sizes of public gatherings (e.g. football matches, religious gatherings, restaurants/bars).

- As part of this, NERVTAG to consider effects of distance and duration of exposure among individuals on infectivity and transmissibility of Covid-19.

List of actions

PHE and NHS to report at the next SAGE meeting (12 March) on:

- Whether currently available capacity for population-based serology for Covid-19 is being fully exploited
- Plans for how PHE can move from 1,000 serology tests to 10,000 tests per week
- Whether all intensive care pneumonia cases are being tested for Covid-19 (as per current policy)
- Plans for consideration of commercial tests for frontline healthcare use.

SAGE secretariat to consider how to provide a paper setting out where Italy, France, Germany and Spain are in terms of their epidemics and interventions (including efficacy of and behavioural change related to those interventions). This should be updated for each SAGE meeting.

DHSC and **Cabinet Secretariat** to develop policy around implementation of the three behavioural and social interventions under consideration (case isolation, household isolation, social distancing for elderly and vulnerable), clarifying eligibility, numbers affected and essential symptoms. This should be shared with SAGE and its advisory groups.

SPI-B to consider how to measure resulting behavioural change from the implementation of behavioural and social interventions (e.g. engagement, compliance).

SPI-M to consider the likelihood of secondary infection in confined spaces, e.g. households.

SAGE advisory groups (SPI-M, SPI-B, NERVTAG) to reconsider for the next SAGE meeting (12 March) advice on public gatherings, including risk to individuals and the impact of restricting gatherings on the epidemic curve. This should include the relative risk of different types and sizes of public gatherings (e.g. football matches, religious gatherings, restaurants/bars).

- As part of this, NERVTAG to consider effects of distance and duration of exposure among individuals on infectivity and transmissibility of Covid-19.

Attendees

SAGE participants: *Patrick Vallance (chair), Chris Whitty, Jonathan Van Tam, Steve Powis, Charlotte Watts, Angela McLean, John Aston, Sharon Peacock,* [redacted] *Graham Medley, Neil Ferguson, John Edmunds, Brooke Rogers, Ben Warner,* [redacted] *Russell Viner, Jeremy Farrar, Peter Horby, David Halpern, Osama Rahman,* [redacted]

By phone: Carole Mundell, Maria Zambon, James Rubin, Andrew Rambaut

SAGE secretariat: [redacted]

SAGE secretariat

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Addendum to fifteenth SAGE meeting on Covid-19, 13th March 2020
Held in 1 Victoria St, London, SW1H 0NN

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees:

Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Steve Powis (NHS), Charlotte Watts (CSA DfID), Angela McLean (CSA MoD), John Aston (CSA HO), Sharon Peacock (PHE), Graham Medley (LSHTM), Neil Ferguson (Imperial), John Edmunds (LSTHM), Julia Gog (Cambridge), Brooke Rogers (King's), James Rubin (King's), Jeremy Farrar (Wellcome), David Halpern (CO), Osama Rahman (CSA DfE), Ian Diamond (ONS), Tom Rodden (CSA DCMS), Maria Zambon (PHE), Andrew Rambaut (Edinburgh), Jonathan Van Tam (Deputy CMO), Phil Blythe (CSA DfT), Wendy Barclay (Imperial).*

Observers and Government officials: *Ben Warner (No. 10).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be a complete list.

Fifteenth SAGE meeting on Wuhan Coronavirus (Covid-19), 13th March 2020
Held in 1 Victoria Street

Summary

1. Owing to a 5-7 day lag in data provision for modelling, SAGE now believes there are more cases in the UK than SAGE previously expected at this point, and we may therefore be further ahead on the epidemic curve, but the UK remains on broadly the same epidemic trajectory and time to peak.
2. The science suggests that household isolation and social distancing of the elderly and vulnerable should be implemented soon, provided they can be done well and equitably. Individuals who may want to distance themselves should be advised how to do so.
3. SAGE is considering further social distancing interventions – that may best be applied intermittently, nationally or regionally, and potentially more than once – to reduce demand below NHS capacity to respond. The modelling sub-group is discussing potential interventions on Monday 16th, for review by SAGE on Tuesday 17th.
4. The behavioural science suggests openly explaining to the public where the greatest risks lie and what individuals can do to reduce their own risk and risk to others, even if this is ahead of measures announced by the Government – but SAGE recognises that taking individual measures may be more feasible for some than others. Greater transparency could enable personal agency, send useful signals about risk and build trust.
5. Measuring the impact of all interventions depends on sufficient, relevant data delivered on time: it is a priority to ensure accurate and complete data are available with minimal delay.

Situation update

6. SAGE is keen to make the modelling and other inputs underpinning its advice available to the public and fellow scientists.
7. There are probably more cases in the UK than SAGE previously expected at this point, and we may be further ahead on the epidemic curve, but the UK remains on broadly the same epidemic trajectory. The change in numbers is due to the 5-7 day lag phase in data availability for modelling.
8. Office for National Statistics (ONS) is gathering data on a) availability and prices of key ("anxiety") goods b) labour market trends c) consumer spending across key sectors d) and business behaviour (e.g. home working).
9. ONS is also developing a new opinion survey, for which questions are being finalised over the weekend.
10. SAGE will review a dashboard containing the findings from these datasets at each meeting.

ACTION: SAGE secretariat to work with **HMG Communications** colleagues to agree what SPI-M and SPI-B information will be made public and a process to share this, ensuring this information is easily accessible and understandable. This needs to be done as soon as possible

ACTION: SPI-B and **SPI-M** to provide comments on what should be included in the ONS opinion survey via **SAGE secretariat** by 1200 on Sunday 15 March 2020

Understanding Covid-19

11. There is some evidence from Japan (not peer reviewed) that certain individuals spread the virus to multiple others, while other individuals are responsible for minimal spread.
12. It is clear that household quarantining would lead to increased risk of others within the household becoming infected, as described in the modelling.

ACTION: SPI-M to agree a position on the risk of secondary infection in a household for the next SAGE meeting (17 March)

Behavioural and social interventions

13. Household isolation lasts for 14 days, with certain individuals having to isolate for longer if they have symptoms (as per the case isolation policy).
14. There are no strong scientific grounds to hasten or delay implementation of either household isolation or social distancing of the elderly or the vulnerable in order to manage the epidemiological curve compared to previous advice.
15. However, there will be some minor gains from going early and potentially useful reinforcement of the importance of taking personal action if symptomatic. Household isolation is modelled to have the biggest effect of the three interventions currently planned, but with some risks.
16. SAGE therefore thinks there is scientific evidence to support household isolation being implemented as soon as practically possible.
17. SAGE recognised there are operational challenges to immediate effective and equitable implementation and that there are inevitable lags between the implementation of measures and impacts felt.
18. There are social and health disbenefits of cocooning (shielding) of the elderly as well as coronavirus-related benefits. It needs to be done in as equitable a way as possible. Timing should be soon for maximal effect, but recognising these health trade offs.
19. SAGE further agreed that one purpose of behavioural and social interventions is to enable the NHS to meet demand and therefore reduce indirect mortality and morbidity. There is a risk that current proposed measures (individual and household isolation and social distancing) will not reduce demand enough: they may need to be coupled with more intensive actions to enable the NHS to cope, whether regionally or nationally.
20. SAGE requested that SPI-M investigate what kinds of interventions might be sporadically or continuously implemented to enable the NHS to meet demand, and at what points, and to set out its confidence levels in the impacts of these interventions.
21. SAGE noted sufficient and timely flows of relevant data are critical to determining when any interventions should best be implemented.
22. SAGE also noted the importance of comparing UK interventions with those of other countries, such as Germany, and modelling the efficacy of those countries' interventions in the UK; some of these can be added as the epidemic progresses. (SAGE is separately creating a product to compare the epidemic curve in several countries.)
23. It was noted that Singapore had had an effective “contain phase” but that now new cases had appeared.
24. SAGE was unanimous that measures seeking to completely suppress spread of Covid-19 will cause a second peak. SAGE advises that it is a near certainty that countries such as China, where heavy suppression is underway, will experience a second peak once measures are relaxed.

ACTION: DHSC Moral and Ethical Advisory Group (MEAG) to be invited to consider the ethical ramifications of household quarantine, given the increased risk to other residents where one resident is symptomatic

ACTION: NHS to inform **SPI-M** of critical care capacity for all four nations, now and in future: across all four nations and regionally

ACTION: NHS, **PHE** and **SPI-M** to review the CHESS dataset and ensures it includes the data modellers need. **NHS** to be requested to urgently direct hospitals to input data onto this system

ACTION: SPI-M to review what further interventions will allow NHS to cope regionally (and nationally), and when these interventions should be taken. This work to include reference to the modelling uncertainty, whether these interventions need to be continuous or sporadic, and what the triggers for beginning/ending these interventions should be

Behavioural science considerations

25. The behavioural science points to openly explaining to the public where the greatest risks lie and what individuals can do to reduce their own risk, even if this is ahead of measures announced by the Government.
26. Supporting social distancing measures that are taking place anyway (e.g. sporting events, working from home) may be useful and reinforce the notion that all measures the UK implements need to be taken seriously. Not doing so potentially undermines the other actions and trust.
27. Greater transparency will help people understand personal risk and enable personal agency, send useful signals about risk in general and build public trust. Citizens should be treated as rational actors, capable of taking decisions for themselves and managing personal risk.
28. There is some evidence that people find quarantining harder to comply with the longer it goes on. The evidence is not strong but the effect is intuitive. There is no comparable evidence for social distancing measures, but experience suggests it is harder to comply with a challenging behaviour over a long period than over a short period.
29. There is no strong evidence for public compliance rates changing during a major emergency. There is, however, a link between public anxiety and protective behavioural change.
30. Difficulty maintaining behaviours should not be treated as a reason for not communicating with the public about the efficacy of the behaviours and should not be taken as a reason to delay implementation where that is indicated epidemiologically.
31. Where the UK does not adopt measures seen in other countries, Government should clearly explain its reasoning.
32. SAGE recognised that taking individual measures will be more feasible for those with greater personal resources – and that some social distancing is happening in the UK without HMG directing citizens to do so.

UK testing

33. Community testing is ending today – which will increase the pace of testing (and delivery of results) for intensive care units, hospital admissions, targeted contact tracing for suspected clusters of cases and healthcare workers. This includes faster confirmation of negative results.
34. A CHESS data system is being stood up this weekend, based on a winter flu reporting system.
35. The current limiting factor on serology is availability of samples. This needs to be resolved as soon as possible, and SAGE suggested several measures.

ACTION: PHE to urgently determine how it will ramp up to take 1,000 blood samples a week, taking advice from SAGE participants

ACTION: PHE to contact Italian counterparts to request serology samples. If available, **PHE** to test these samples to ascertain symptomatic vs asymptomatic case ratio. This should be stratified by age

Next meeting of SAGE

36. SAGE to discuss the ramifications of a second epidemic peak.

List of actions

SAGE secretariat to work with **HMG Communications** colleagues to agree what SPI-M and SPI-B information will be made public and a process to share this, ensuring this information is easily accessible and understandable. This needs to be done as soon as possible.

SPI-B and **SPI-M** to provide comments on what should be included in the ONS opinion survey via **SAGE secretariat** by 1200 on Sunday 15 March 2020

SPI-M to agree a position on the risk of secondary infection in a household for the next SAGE meeting (17 March)

DHSC Moral and Ethical Advisory Group (MEAG) to be invited to consider the ethical ramifications of household quarantine, given the increased risk to other residents where one resident is symptomatic

NHS to inform **SPI-M** of critical care capacity for all four nations, now and in future: across all four nations and regionally

NHS, **PHE** and **SPI-M** to review the CHESS dataset and ensures it includes the data modellers need. **NHS** to be requested to urgently direct hospitals to input data onto this system

SPI-M to review what further interventions will allow NHS to cope regionally (and nationally), and when these interventions should be taken. This work to include reference to the modelling uncertainty, whether these interventions need to be continuous or sporadic, and what the triggers for beginning/ending these interventions should be

PHE to urgently determine how it will ramp up to take 1,000 blood samples a week.

PHE to contact Italian counterparts to request serology samples. If available, **PHE** to test these samples to ascertain symptomatic vs asymptomatic case ratio. This should be stratified by age.

Attendees

SAGE participants: *Patrick Vallance (chair), Chris Whitty, Steve Powis, Charlotte Watts, Angela McLean, John Aston, Sharon Peacock,* [redacted] *Graham Medley, Neil Ferguson, John Edmunds, Julia Gog, Brooke Rogers, James Rubin, Ben Warner, Jeremy Farrar, David Halpern, Osama Rahman, Ian Diamond, Tom Rodden*

By phone: Maria Zambon, Andrew Rambaut, Jonathan Van Tam, Phil Blythe, Wendy Barclay

SAGE secretariat: [redacted]

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Addendum to sixteenth SAGE meeting on Covid-19, *16th March 2020*
Held in 10 Victoria St, London, SW1H 0NN

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees

Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (Deputy CMO), Steve Powis (NHS), Charlotte Watts (CSA DfID), Angela McLean (CSA MoD), John Aston (CSA HO), Sharon Peacock (PHE), Graham Medley (LSHTM), Neil Ferguson (Imperial), Brooke Rogers (King's College), James Rubin (King's College), Jeremy Farrar (Wellcome), David Halpern (CO), Ian Diamond (ONS), Tom Rodden (CSA DCMS), Aidan Fowler (NHS), Maria Zambon (PHE), Phil Blythe (CSA DfT), Wendy Barclay (Imperial), Peter Horby (Oxford), John Edmunds (LSTHM), Carole Mundell (CSA FCO).*

Observers and Government Officials: *Ben Warner (No.10), Stuart Wainwright (GoS).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be the complete list.

Sixteenth SAGE meeting on Wuhan Coronavirus (Covid-19), 16th March 2020
Held in 10 Victoria Street

Summary

1. On the basis of accumulating data, including on NHS critical care capacity, the advice from SAGE has changed regarding the speed of implementation of additional interventions.
2. SAGE advises that there is clear evidence to support additional social distancing measures be introduced as soon as possible.
3. These additional measures will need to be accompanied by a significant increase in testing and the availability of near real-time data flows to understand their impacts.
4. SAGE will further review at its next meeting whether, in the light of new data, school closures may also be required to prevent NHS capacity being exceeded.
5. SAGE did not review the work on intermittent application of measures nationally or geographically in detail but will do so.

Situation update

6. London has the greatest proportion of the UK outbreak. It is possible that London has both community and nosocomial transmission (i.e. in hospitals).
7. It is possible that there are 5,000-10,000 new cases per day in the UK (great uncertainty around this estimate).
8. UK cases may be doubling in number every 5-6 days.
9. The risk of one person within a household passing the infection to others within the household is estimated to increase during household isolation, from 50% to 70%.

Behavioural and social interventions

10. The objective is to avoid critical cases exceeding NHS intensive care and other respiratory support bed capacity. The figures for capacity are now clear but intensive care bed capacity will increase by 20% or more.
11. It is vital to understand numbers of cases regionally relative to NHS capacity, to know where local more stringent interventions might need to be introduced.
12. With sufficient interventions (assuming they are implemented and adopted effectively for a sufficient period of time), modelling indicates it may be possible to keep cases below the NHS's critical and respiratory care capacity.
13. The science suggests additional social distancing measures should be introduced as soon as possible.
14. Compliance with the measures by the public is key.
15. It is expected to take two to three weeks before the impacts of measures are observed (this needs to be monitored carefully and the appropriate metrics need to be in place).
16. SAGE cannot be certain that the measures being considered by HMG will be sufficient to push demand for critical care below NHS capacity but they may get very close under the RWC scenario.
17. While SAGE's view remains that school closures constitutes one of the less effective single measure to reduce the epidemic peak, it may nevertheless become necessary to introduce school closures in order to push demand for critical care below NHS capacity. However school closures could increase the risks of transmission at smaller gatherings and for more vulnerable groups as well as impacting on key workers including NHS staff. As such it was agreed that further analysis and modelling of potential school closures was required (demand/supply, and effects on spread).
18. SAGE agreed that its advice on interventions should be based on what the NHS needs and what modelling of those interventions suggests, not on the (limited) evidence on whether the public will comply with the interventions in sufficient numbers and over time.

ACTION: DHSC to compile numbers – to be updated daily – of cases regionally, set against local NHS ventilator and ICU capacity. **SPI-M** to check approach meets their needs. The data on epidemic growth and ventilator/ICU capacity need to be linked to predict areas of potential pressure (this model should be owned within DHSC or NHS – CMO has asked Clara Swinson)

ACTION: SPI-M to coordinate further rapid modelling of school closures taking account of key factors and at risk groups
ACTION: DfE to work with **DHSC** and **PHE** on specific guidance for schools and universities, including personal hygiene measures and methods to apply social distancing within these settings building on what has been done elsewhere (eg Singapore)

UK testing

19. SAGE highlighted the critical importance of scaling up antibody serology and diagnostic testing to managing the epidemic. A solution is urgently required, with a plan for implementation.
20. Antibody testing is particularly vital to address the central unknown question of the ratio of asymptomatic to symptomatic cases.
21. PHE explained how testing is being scaled up over the coming weeks to 10,000 per day – focused on intensive care units, hospital admissions and key workers.
22. PHE is urgently assessing commercial self-test options, with accuracy a key criterion.

ACTION: PHE to update **SAGE** on the efficacy and feasibility of rolling out a rapid home swab test for antigens, including the mechanism for collection (for next meeting).

ACTION: PHE to develop a proposal for ramping up antibody serology and diagnostic testing capacity, seeking input from **DSTL** and the **National Laboratories Alliance**

Data flows

23. Close to real-time, high-quality data are important to the strategy the UK is pursuing. All options to get this data flow need to be considered. NHS and PHE are arranging a workshop ASAP to discuss and make this happen. Duplication of effort on this needs to be avoided.
24. Duplication of effort also needs to be avoided on other data requirements, e.g. for measuring public behaviour (ONS will coordinate efforts on this).

ACTION: DHSC, NHSE and **PHE** to urgently work with **NHSX and GO-Science** on a data strategy, ensuring there is access to real time data to track the UK epidemic and that is delivered in a form of use to operational leads, SAGE and COBR

Publication of SAGE papers and other materials

25. SAGE agreed to publish a chronological set of papers and other documents which have informed the questions it has considered and its advice to date.
26. It is important to demonstrate the uncertainties scientists have faced, how understanding of Covid-19 has developed over time, and the science behind the advice at each stage.

ACTION: SAGE secretariat to explore option of launching release of SAGE materials at Science Media Centre, involving several SAGE participants

Next meeting of SAGE

27. The next meeting will revisit the effects of school closures (including impact on epidemic curve, behavioural effects, workforce consequences).

ACTION: SAGE to discuss at its next meeting how school closures could affect NHS critical care capacity, considering in particular:

a. additional epidemiological benefits of school and university closures over and above HMG measures to be announced (**SPI-M**)
b. effects of closing schools before Easter holidays vs not reopening schools after Easter holidays (**SPI-M**)
c. effects of partial school closures (e.g. allowing attendance for children of key workers only) and internal social distancing measures within schools (as per Singapore) (**SPI-M**)
d. whether the health benefits of school closures could be outweighed by the effects of children being looked after by grandparents/childminders and/or pupils interacting socially in other locations (**SPI-M** and **SPI-B)**
e. impacts of school closures on NHS staffing (including respiratory trained) (**NHS**)
f. Alternatives to closure

List of actions

DHSC to compile numbers – to be updated daily – of cases regionally, set against local NHS ventilator and ICU capacity. **SPI-M** to check approach meets their needs. The data on epidemic growth and ventilator/ICU capacity need to be linked to predict areas of potential pressure (this model should be owned within DHSC or NHS – CMO has asked Clara Swinson)

SPI-M to coordinate further rapid modelling of school closures taking account of key factors and at risk groups.

DfE to work with **DHSC** and **PHE** on specific guidance for schools and universities, including personal hygiene measures and methods to apply social distancing within these settings building on what has been done in other places (e.g. Singapore)

PHE to update **SAGE** on the efficacy and feasibility of rolling out a rapid home swab test for antigens, including the mechanism for collection (for next meeting)

PHE to develop a proposal for ramping up antibody serology and diagnostic testing capacity, seeking input from **DSTL** and the **National Laboratories Alliance**

DHSC, NHSE and **PHE** to urgently work with **NHSX and GO-Science** on a data strategy, ensuring there is access to real time data to track the UK epidemic and that is delivered in a form of use to operational leads, SAGE and COBR.

SAGE secretariat to explore option of launching release of SAGE materials at Science Media Centre, involving several SAGE participants

SAGE to discuss at its next meeting how school closures (all setting for under-18s) could affect NHS critical care capacity, considering in particular:

a. additional epidemiological benefits of school and university closures over and above HMG measures to be announced (**SPI-M**)
b. effects of closing schools before Easter holidays vs not reopening schools after Easter holidays (**SPI-M**)
c. effects of partial school closures (e.g. allowing attendance for children of key workers only) and internal social distancing measures within schools (as per Singapore) (**SPI-M**)

d. whether the health benefits of school closures could be outweighed by the effects of children being looked after by grandparents/childminders and/or pupils interacting socially in other locations (**SPI-M** and **SPI-B)**
e. impacts of school closures on NHS staffing (**NHS**)
f. Alternatives to closure.

Attendees

SAGE participants: *Patrick Vallance (chair), Chris Whitty, Jonathan Van Tam, Steve Powis, Charlotte Watts, Angela McLean, John Aston, Sharon Peacock,* [redacted] *Graham Medley, Neil Ferguson, Brooke Rogers, James Rubin, Ben Warner, Jeremy Farrar, David Halpern, Ian Diamond, Tom Rodden, Aidan Fowler*

By phone: Maria Zambon, Phil Blythe, Wendy Barclay, Peter Horby, John Edmunds, Carole Mundell

SAGE secretariat: [redacted]
Stuart Wainwright, [redacted]

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Addendum to seventeenth SAGE meeting on Covid-19, 18th March 2020
Held in 10 Victoria St, London, SW1H 0NN

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees

Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (Deputy CMO), Steve Powis (NHS), Charlotte Watts (CSA DfID), Angela McLean (CSA MoD), Graham Medley (LSHTM), Jeremy Farrar (Wellcome), David Halpern (CO), Ian Diamond (ONS), Aidan Fowler (NHS), Demis Hassabis (Data scientist), Maria Zambon (DD PHE), Phil Blythe (CSA DfT), John Edmunds (LSTHM), Carole Mundell (CSA FCO), Tom Rodden (CSA DCMS), Osama Rahman (CSA DfE), Wendy Barclay (Imperial), Neil Ferguson (Imperial), Brooke Rogers (King's College), James Rubin (King's College), Andrew Curran (CSA HSE).*

Observers and Government officials: *Ben Warner (No. 10), Stuart Wainwright (GoS), Rupert Shute (dCSA HO), Marc Warner (NHSX).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be a complete list.

Seventeenth SAGE meeting on Covid-19, 18th March 2020

Held in 10 Victoria Street

Summary

1. Based on limited available evidence, SAGE considers that the UK is 2 to 4 weeks behind Italy in terms of the epidemic curve. The consensus is that growth of the UK epidemic is tracking at the same rate as in other countries.
2. SAGE advises that available evidence now supports implementing school closures on a national level as soon as practicable to prevent NHS intensive care capacity being exceeded.
3. SAGE advises that the measures already announced should have a significant effect, provided compliance rates are good and in line with the assumptions. Additional measures will be needed if compliance rates are low.
4. Reliable data on the health impacts of existing interventions will only be available in 2-3 weeks. This would not be in time to inform judgements on additional interventions to limit NHS pressures, which are likely to be significant within 2-3 weeks. It may be possible to collect intermediate data, and this should be a priority.
5. Social distancing based on a) places of leisure (restaurants, bars, entertainment and public spaces) and b) indoor workplaces depend on compliance with the guidance issued earlier in the week. We do not yet have reliable compliance data and therefore collecting reliable compliance data should be a priority.
6. If the interventions are required, it would be better to act early.
7. Transport measures such as restricting public transport, taxis and private hire facilities would have minimal impact on reducing transmission in London.
8. Future SAGE meetings will consider broader aspects of Covid-19 including clinical science, genetics, virology, and treatments and vaccines.

Situation update

9. There are 1,950 cases in the UK (17/03 at 14:00), with 87 intensive care cases, of which 62 are in London. Testing capacity has reached 6,084 daily, with a goal to reach 25,000 tests as soon as possible.
10. The UK is following broadly the same exponential growth rate of cases as Italy, and there is consistency with patterns in other countries.
11. There is uncertainty on our exact position, but the consensus view is that we are 2-4 weeks behind the epidemic curve in Italy.
12. Assuming a doubling time of around 5-7 days continues to be reasonable, but this is before any of the measures brought in have had an effect; these measures are likely to slow the doubling time even if there is still an exponential curve.
13. Modelling suggests that, without mitigation, London could reach Covid-19-related intensive care capacity by early April.

Testing, data and information sharing

14. SAGE discussed the importance of good quality and timely data. CHESS data has improved but has not stabilised, so trend analysis is more challenging. The overall quality of data is improving, with short time lags to ensure data quality and consistency.
15. An NHSX hub should be in place from early next week ensuring a standardised, single source of data. Legacy data collection should continue for a short period to provide resilience.
16. Postcode-level data from NHS 111 and geospatial data may be utilised to provide a fuller picture, possibly by next week.
17. NHS updated on a joint NHS-PHE plan for testing, including 25,000 PCR tests a day, an increase in viral antigen detection tests and increased serosurveillance, including a more widely available serological test.

18. SAGE discussed how to ensure that key workers, particularly NHS staff, get full access to comprehensive testing and agreed the importance of ramping up testing as soon as possible.
19. SAGE discussed plans to release the academic models underpinning SAGE and SPI-M discussions and judgements. Modellers agreed that code would become public but emphasised that the effort to do this immediately would distract from other analyses. It was agreed that code should become public as soon as practical, and SPI-M would return to SAGE with a proposal on how this would be achieved.

ACTION: SPI-M to advise on how to make public the source code for academic models, working with relevant partners

School closures

20. SAGE reviewed available evidence and modelling on the potential impact of school closures. The evidence indicates that school closures, combined with other measures, could help to bring the R_0 number below 1, although there is uncertainty.
21. SAGE discussed the impact of school closures in terms of alternative childcare arrangements, particularly grandparents and older groups at risk from Covid-19. The evidence suggests that displacement of childcare from schools to grandparents would reduce the effect of closures, but this unwanted effect is likely to be limited.
22. It was reported that single parents often have younger parents, and so the grandparents are often in their 50s.
23. SAGE considered the impact of keeping schools open for particular groups, including for children of NHS workers and vulnerable groups. SAGE considered that a small (10-20%) reduction in compliance rates would have some impact in the overall effect of school closures, but this would not be significant enough to offset the measure. The effect of school closures would be significantly reduced if there was widespread mixing of children outside of schools.
24. SAGE considered the modelling now supports school closures on a national level and that the effect would be greatest if instituted early.
25. SAGE discussed behavioural science considerations on school closures. With limited evidence, SAGE considered the importance of clear public messaging and of drawing on the views of teachers on keeping schools open for key workers or vulnerable groups. There is a risk that even if schools remain open for the above groups, children may not attend.

Regional measures – London

26. The social distancing measures have only recently been implemented. Their effect depends on compliance levels, for which there are currently insufficient data. A verbal report of a single survey was given, which suggested that significant behaviour change was expected, but currently we do not have reliable data.
27. SAGE considered available evidence for London on current demand for transport and retail services, and on individual behaviours following the implemented interventions.
28. SAGE discussed additional interventions that could be made to reduce transmission, noting that London may be 1-2 weeks ahead of the rest of the country.
29. Measures with the strongest support, in terms of effect, were closure of a) schools, b) places of leisure (restaurants, bars, entertainment and indoor public spaces) and c) indoor workplaces. Modelling is unlikely to be able to analyse the impact of these interventions with great precision.

    Transport measures such as restricting public transport, taxis and private hire facilities would have minimal impact on reducing transmission. SAGE noted that there may be other hotspots where spread is more advanced, such as the Derby/Nottingham/Leicester area. It is possible that some of this is due to nosocomial transmission, but this is not yet known.

List of actions

SPI-M to advise on how to making public the source code for academic models, working with relevant partners.

Attendees

SAGE participants: *Patrick Vallance (chair), Chris Whitty, Jonathan Van Tam, Steve Powis, Charlotte Watts, Angela McLean,* [redacted] *Graham Medley, Jeremy Farrar, David Halpern, Ian Diamond, Aidan Fowler, Rupert Chute, Demis Hassabis, Marc Warner*

By phone: Maria Zambon, Phil Blythe, John Edmunds, Carole Mundell, Tom Rodden, Carole Mundell, Osama Rahman, Wendy Barclay, Neil Ferguson, Brooke Rogers, James Rubin, Ben Warner, Andrew Curran, [redacted]

SAGE secretariat: [redacted] *Stuart Wainwright,* [redacted]

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Addendum to eighteenth SAGE meeting on Covid-19, 23rd March 2020
Held in 10 Victoria St, London, SW1H 0NN

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees:

Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Charlotte Watts (CSA DfID), Ian Diamond (ONS), Sharon Peacock (PHE), John Aston (CSA HO), Jonathan Van Tam (Deputy CMO), Steve Powis (NHS), Maria Zambon (PHE), Angela McLean (CSA MoD), Phil Blythe (CSA DfT), John Edmunds (LSTHM), Carole Mundell (CSA FCO), Tom Rodden (CSA DCMS), Graham Medley (LSHTM), Jeremy Farrar (Wellcome), David Halpern (CO), Susan Michie (UCL), Wendy Barclay (Imperial), Neil Ferguson (Imperial), Brooke Rogers (King's College), James Rubin (King's College), Andrew Curran (CSA HSE), Aidan Fowler (NHS).*

Observers and Government Officials: *Morwenna Carrington (DHSC), Stuart Wainwright (GoS).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be the complete list.

Eighteenth SAGE meeting on Covid-19, 23rd March 2020
Held in 10 Victoria Street

Summary

1. UK case accumulation to date suggests a higher reproduction number than previously anticipated. High rates of compliance for social distancing will be needed to bring the reproduction number below one and to bring cases within NHS capacity.
2. Public polling over the weekend on behaviour indicated significant changes but room for improvement in compliance rates.
3. Estimated Covid-19 fatalities are anticipated to overlap with those who are likely to be within the final year of their lives. It is important to get an accurate excess deaths estimate, including potential deaths due to the measures taken.
4. Given the clear links between poverty and long-term ill health, health impacts associated with the economic consequences of interventions also need to be investigated.
5. Antibody screening for healthcare workers should aim to identify those with immunity who can care for the most vulnerable patients.

Situation update

6. The NHS is surging bed capacity over the next fortnight, with a focus on London.
7. The data suggest that London is 1-2 weeks ahead of the rest of the UK on the epidemic curve. Case numbers in London could exceed NHS capacity within the next 10 days on the current trajectory.
8. The accumulation of cases over the previous two weeks suggests the reproduction number is slightly higher than previously reported. The science suggests this is now around 2.6-2.8. The doubling time for ICU patients is estimated to be 3-4 days.
9. Increased community testing and surveillance will be invaluable to measure the effects of the interventions taken.
10. Genome sequencing is providing insight into the seeding of cases across the UK. Results suggests that there have been introductions from different parts of the world as well as community transmission and some nosocomial clusters (i.e. in hospital settings).
11. PHE are seeking to understand environmental dispersal of the virus in hospitals. They are working with SPI-M and NERVTAG, and will bring a paper back to SAGE.

ACTION: PHE, **SPI-M** and **MoD Chief Scientific Adviser** to review how the true infection rate in the community can be ascertained as a basis to measure the effects of interventions (Report back to SAGE w/c 30 March)

ACTION: NERVTAG and **DSTL** to investigate spread of Covid-19 in hospitals and environmental dispersal of the virus (Report back to SAGE w/c 30 March)

Clinical update

12. Emerging data on the virus is supportive of prior clinical knowledge. Reports of possible cardiac complications need further investigation.
13. Hospitalisation data for around 500 UK patients is being collected through the CO-CIN system, providing a detailed report of cases. The proportion of severely ill patients who have single organ compared to multi-organ failure is important for planning.
14. The RECOVERY trial started recruiting patients on 19th February, with wide participation from NHS trusts. Four other trials were discussed. Coordination of trial activity was discussed and a clinical trials forum is being explored.

15. Evaluation of credible licensed drugs that may be suitable for future trials is underway and there is support from the private sector.
16. Very limited observations, based on a few dozens of cases, suggest that vertical transmission cannot be ruled out. There have been no traces of the virus found in breast milk, amniotic fluid or in the placenta.
17. Genome sequencing work has started and is yielding important results already.

ACTION: dCMO and **DHSC** with **NERVTAG chair** to consider how to set up a UK forum to coordinate clinical trials. This should include protocols for adding extra testing arms if needed

ACTION: dCMO to consider what UK manufacturing capabilities are required to support the clinical trial supply chain

Reasonable worst case scenario

18. There is significant uncertainty concerning the impact of interventions brought in thus far on numbers of cases.
19. SAGE will update the reasonable worst case at its next meeting, taking interventions into account.

Behavioural and social interventions

20. SAGE noted that social distancing behaviours have been adopted by many but there is uncertainty whether they are being observed at the level required to bring the epidemic within NHS capacity.
21. Key areas for further improvement include reducing contact with friends and family outside the household, and contact in shops and other areas.
22. Surveys to assess behaviours must gather data on the nature, location and frequency of contacts that people are engaging in, rather than qualitative indications of compliance.
23. A nationally representative ONS survey over the weekend indicates significant behaviour changes in the UK. There is a positive correlation between behaviour change and age – higher compliance rates are reported among older groups.
24. Compliance levels vary throughout the country; higher levels of compliance are being observed in London.
25. Consumer spending has increased since measures were introduced, including major increases in food and drug spending.
26. Footfall in London transport hubs reduced by 80-90% over the weekend, but in retail and food outlets has decreased by a smaller margin. Footfall in London parks has trebled on average since social distancing measures were introduced.

ACTION: CCS and **ONS** to agree who is best placed to lead on evaluation of adherence to interventions, including avoiding duplication on public polling surveys and collecting quantitative data

ACTION: SAGE secretariat to share SAGE paper from behavioural scientists on options for increasing adherence to social distancing measures with **CCS** and **HMG Communications** leads

UK Borders

27. SAGE, on the advice of SPI-M, reconfirmed its previous advice that the effect of closing borders would have a negligible effect on spread.

28. Numbers of cases arriving from other countries are estimated to be insignificant in comparison with domestic cases, comprising approximately 0.5%. Compliance with protective measures by those entering the UK is unknown and should be explored.
29. SAGE noted that it is unlikely that current migration rates pose significant additional risk to border force workers.

Testing and treatments

30. NHS testing capacity in the UK is currently at around 5,000 a day, to be increased to 15,000 a day by mid-April. A platform in partnership with the private sector has been established to aim to increase capacity to 110,000 a day by mid-April.
31. It is essential to have a clear rationale for prioritising testing for patients and health workers, and to coordinate testing supplies across the UK to ensure the most urgent needs are being met.
32. Healthcare workers must be screened repeatedly and should take priority.
33. There is a worldwide shortage of key reagents, platforms and equipment. The priority for screening should be adhered to all by UK healthcare providers and there needs to be coordination to ensure that reagent supply gets to the PHE screening effort.
34. Data from serology will be discussed at the next SAGE. It is critical that this is used to understand the proportion of asymptomatic cases.
35. For serology, any positive results from a rapid screening approach should be followed up with a PHE test in healthcare workers, to ensure confidence in immunity.
36. Access to serological material from recovered patients is essential.
37. A network of recovered people is required to enable future medical testing, assays and blood donations.

ACTION: PHE to work with **NHS** to set out a national priority order for testing, including UK-wide procurement and distribution of reagents to support testing capacity (for next SAGE meeting)

ACTION: PHE and **Jeremy Farrar** to present a proposal for UK-wide serological screening priorities and distribution of essential equipment (for next SAGE meeting). **PHE** to provide a serology update at next SAGE meeting

Excess deaths planning

38. The science suggests that a proportion of the estimated fatalities from Covid-19 would be among those expected to die within a year.
39. NHSX and ONS data need to be combined by modelling groups to give a picture of deaths caused directly and indirectly by Covid-19.
40. Actuarial analysis is required to estimate numbers of deaths caused indirectly by Covid-19, including those caused by the social interventions. For planning, data on patient backgrounds and risk factors, including GP data, are needed. In due course, analysis of the effects of the interventions on other causes of death should be undertaken.

ACTION: SPI-M to provide **ONS** (Ian Diamond) with a summary on what mortality data is needed from **NHSX** to inform modelling (23 March). **HO Chief Scientific Adviser** to lead actuarial work on establishing excess death, taking into account those expected to die over the same period

List of actions

PHE, **SPI-M** and **MoD Chief Scientific Adviser** to review how the true infection rate in the community can be ascertained as a basis to measure the effects of interventions (Report back to SAGE w/c 30 March)

NERVTAG and **DSTL** to investigate spread of Covid-19 in hospitals and environmental dispersal of the virus (Report back to SAGE w/c 30 March)

dCMO and **DHSC** with **NERVTAG chair** to consider how to set up a UK forum to coordinate clinical trials. This should include protocols for adding extra testing arms if needed

dCMO to consider what UK manufacturing capabilities can support the clinical trial supply chain

CCS and **ONS** to agree who is best placed to lead on evaluation of adherence to interventions, including avoiding duplication on public polling surveys and collecting quantitative data

SAGE secretariat to share SAGE paper on options for increasing adherence to social distancing measures with **CCS** and **HMG Communications** leads

PHE to work with **NHS** to set out a national priority order for testing, including UK-wide procurement and distribution of reagents to support testing capacity (for next SAGE meeting)

PHE and **Jeremy Farrar** to present a proposal for UK-wide serological screening priorities and distribution of essential equipment (for next SAGE meeting). **PHE** to provide a serology update at next SAGE meeting

SPI-M to provide **ONS** (Ian Diamond) with a summary on what mortality data is needed from **NHSX** to inform modelling (23 March). **HO Chief Scientific Adviser** to lead actuarial work on establishing excess death, taking into account those expected to die over the same period

Attendees

SAGE participants: *Patrick Vallance (chair), Chris Whitty, Charlotte Watts,* [redacted] *Ian Diamond, Sharon Peacock, Morwenna Carrington, John Aston,* [redacted]

By phone: Jonathan Van Tam, Steve Powis, Maria Zambon, Angela McLean, Phil Blythe, John Edmunds, Carole Mundell, Tom Rodden, Graham Medley, Jeremy Farrar, David Halpern, Susan Michie, Carole Mundell, Wendy Barclay, Neil Ferguson, Brooke Rogers, James Rubin, Andrew Curran, [redacted] *Aidan Fowler, Stuart Wainwright*

SAGE secretariat: [redacted]

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Addendum to nineteenth SAGE meeting on Covid-19, 26th March 2020
Held via Zoom

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees:

Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (Deputy CMO), Sharon Peacock (PHE), Steve Powis (NHS), Calum Semple (Liverpool), Angela McLean (CSA MoD), Charlotte Watts (CSA DfID), Andrew Curran (CSA HSE), John Aston (CSA HO), Alan Penn (CSA MHCLG/UCL), Osama Rahman (CSA DfE), Peter Horby (Oxford), Graham Medley (LSHTM), Neil Ferguson (Imperial), John Edmunds (LSTHM), James Rubin (King's College), Brooke Rogers (King's College), Lucy Yardley (Bristol/Southampton), Ian Diamond (ONS), Andrew Rambaut (Edinburgh), Wendy Barclay (Imperial).*

Observers and Government officials: *Indra Joshi (NHSX), Stuart Wainwright (GoS).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be a complete list.

Nineteenth SAGE meeting on COVID-19, 26th March 2020
Held via Zoom

Summary

1. Data and modelling for NHS demand must be aligned completely with SPI-M modelling – and there must be a single version of the numbers in use across HMG.
2. Nosocomial transmission, risk markers for severe disease and severity scoring for COVID-19 cases need urgent attention.
3. It is vital not to make hasty decisions regarding treatments based on insufficient data.
4. SAGE will begin shifting attention to future phases of the epidemic to anticipate challenges and opportunities to minimise impacts and harms, release current measures safely and advise on long-term issues.

ACTION: SAGE secretariat to ensure key people are connected to align and ensure consistency of data between **SPI-M** and **NHS**

Priorities for SAGE ahead

5. Assuming interventions get R below 1 and demand on NHS critical care stabilises, SAGE needs to focus on behavioural and social interventions – monitoring, maintenance and release – and on the testing regime necessary for adjusting interventions.
6. SAGE will consider public messaging around interventions and explore potential behaviours linked to the easing and re-imposition of interventions and to mass testing.
7. More urgently, SAGE needs to understand nosocomial transmission and how to limit it.
8. SAGE needs to know more about immunology and its implications.
9. SAGE will focus on clinical trials (including when we might have meaningful results), treatments and vaccine options.
10. SAGE will consider how to minimise potential harms from the interventions, including those arising from postponement of normal services, mental ill health and reduced ability to exercise. It needs to consider in particular health impacts on poorer people.
11. SAGE's sub-groups will explore these issues in line with their remits. GCSA and CMO will discuss with Cabinet Office other priority questions for HMG.

ACTION: NHS (Steve Powis) to work with **PHE** to identify key questions for SAGE on nosocomial infection and to provide a plan for reducing nosocomial transmission

ACTION: **SAGE secretariat** to plan forward-looking piece of work on how and when to release measures and on future needs, including **SPI-B** to assess behavioural issues, **SPI-M** to define work on triggers for releasing measures, **NERVTAG** to identify at what point meaningful results from clinical trials might be available. **GCSA** and **CMO** to discuss other priority questions with Cabinet Office

Situation update

12. The data suggest a 3.3 day doubling time in hospitals.
13. New data collected from this week on human contact patterns will be used to estimate R for community spread. SPI-M is reviewing R later today.
14. Spare bed capacity is at roughly 20%, including in London. Surge capacity planning for London is underway.
15. Significantly fewer children are attending school than anticipated.
16. ONS data points to very high proportions of people in the UK changing their behaviour. Social interaction is greatly reduced, as is footfall on public transport, at parks and beaches. Mobile phone data for the over-65s suggest they are staying in one location. WiFi data suggests strong reductions in fast food outlet and supermarket use.
17. ONS is planning future surveys, including a dedicated survey for those experiencing social shielding.

18. CO-CIN data points to more men being admitted to hospitals than women, and more men than women dying. Cases cannot be triaged simply according to standard severity scores when they present at hospitals. Understanding is building of the most serious co-morbidities affecting mortality. New approaches to scoring severity and risk for COVID-19 are required.
19. ONS, DHSC and the HO Chief Scientific Adviser will produce a report on excess deaths by 8 March.
20. HSE found no material difference between the N95 and FFP2 respirator masks. Both provide protection as long as the wearer is face-fit tested. Choice of masks needs to risk-assessment driven. Further advice for NHS and PHE on overall PPE will be completed within 24 hours.
21. SAGE participants will receive advice about personal and digital security.

ACTION: SPI-M to reach consensus on R and doubling time by COP 26 March, reporting back to SAGE and DHSC

ACTION: ONS to circulate behavioural compliance data to SAGE participants immediately

ACTION: **ONS** to work with **John Edmunds** to ensure the most appropriate questions for modellers are incorporated into ONS surveys; **Brooke Rogers** to ensure mobile phone app data is fed to modellers and to link with **NHSX**

ACTION: **SAGE participants** to feed inputs on CO-CIN product direct to **Calum Semple**

ACTION: **SAGE secretariat** to circulate **HSE** report comparing N95 and FFP2 masks to SAGE participants, as well as the fuller PPE assessment. NHS and PHE to use this advice to inform their communications

Understanding COVID-19

22. The median time between onset of symptoms and hospitalisation is 4 days.
23. There is no evidence currently to suggest that virology phenotypes are changing.
24. In animal experiments to date, the virus is not being found in the central nervous system or urological tract. Anecdotal reports of cardiac involvement were noted.
25. There is some evidence of vertical transmission from mothers to new-born babies. To date, all babies born with COVID-19 have recovered. All were born by caesarean section.
26. There is no hard data on loss of taste or smell being a COVID-19 symptom – though it is a symptom of other respiratory viruses.
27. It is important to better understand risk markers/scoring systems for severe disease.
28. SAGE advises that there are currently conflicting data concerning potential treatments, such as chloroquine. No drug is completely safe, and it is vital not to make hasty decisions regarding treatments based on poor data. All cases should be used in some form of clinical trial.
29. As many people as possible need to participate in clinical trials. It is encouraging that 3 large international sister studies are being set up.

Reasonable worst case (RWC) scenario

30. SPI-M are reviewing 2 scenarios today using a consensus model from the Imperial group: the reasonable worst case and a more optimistic scenario. It is important that the outputs are presented in a format useful to HMG planners.
31. SAGE advises that, of these 2 scenarios, the reasonable worst case is the less likely.
32. Assuming good compliance, the epidemic peak in the UK can be expected in April – around 2 weeks after all interventions came into effect.
33. SAGE agreed that, for planning purposes, the scenarios should run to September only.
34. SAGE will separately review the various issues associated with a second epidemic peak.

ACTION: **SPI-M** to outline a set of scenarios for the RWC in a form that planners can use

Behavioural and social interventions

35. It may be helpful to prepare the public for the experience of hospital admission, including the risk of nosocomial transmission, through HMG messaging which focuses on the efforts to protect people in hospitals.

Testing and data

36. PHE described efforts to increase clinical testing, key worker testing and antibody testing. SAGE re-emphasised the importance of urgently ramping up testing with appropriate quality.
37. Testing priorities are set by CMO – and these need to be used by all testing providers.
38. The NHSX data hub will cover the whole of the UK, but is currently focused primarily on England.
39. Options to improve and coordinate data collection from ICUs are being explored, e.g. using medical students to input data. SAGE reiterated the crucial importance of data collection.

ACTION: **CMO** to communicate that prioritisation of testing – i.e. who gets tested first – sits with him. **Kathy Hall** to update SAGE at future meeting on testing timelines for NHS staff, including on the scale of testing required

Next meeting of SAGE

40. The next meeting is planned for Tuesday, 31 March. The agenda will include nosocomial transmission and an update on vaccines and treatments.

List of actions

SAGE secretariat to ensure key people are connected to align and ensure consistency of data between **SPI-M** and **NHS**

NHS (Steve Powis) to work with **PHE** to identify key questions for SAGE on nosocomial infection and to provide a plan for reducing nosocomial transmission

SAGE secretariat to plan forward-looking piece of work on how and when to release measures and on future needs, including **SPI-B** to assess behavioural issues, **SPI-M** to define work on triggers for releasing measures, **NERVTAG** to identify at what point meaningful results from clinical trials might be available. **GCSA** and **CMO** to discuss other priority questions with Cabinet Office

ACTION: SPI-M to reach consensus on R and doubling time by COP 26 March, reporting back to SAGE and DHSC

ONS to circulate behavioural compliance data to SAGE participants immediately

ONS to work with **John Edmunds** to ensure the most appropriate questions for modellers are incorporated into ONS surveys; **Brooke Rogers** to ensure mobile phone app data is fed to modellers and to link with **NHSX**

SAGE participants to feed inputs on CO-CIN product direct to **Calum Semple**

SAGE secretariat to circulate **HSE** report comparing N95 and FFP2 masks to SAGE participants, as well as the fuller PPE assessment. NHS and PHE to use this advice to inform their communications

SPI-M to outline a set of scenarios for the RWC in a form that planners can use

CMO to communicate that prioritisation of testing – i.e. who gets tested first – sits with him.
Kathy Hall to update SAGE at future meeting on testing timelines for NHS staff, including on the scale of testing required

Attendees

SAGE participants: Patrick Vallance, Chris Whitty, Jonathan Van Tam, Sharon Peacock, Steve Powis, Calum Semple, Angela McLean, Charlotte Watts, Andrew Curran, John Aston, Alan Penn, Osama Rahman, Peter Horby, Graham Medley, Neil Ferguson, John Edmunds, James Rubin, Brooke Rogers, Lucy Yardley, Ian Diamond, Andrew Rambaut, Wendy Barclay, Indra Joshi

SAGE secretariat: [redacted] *Stuart Wainwright*

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Addendum to twentieth SAGE meeting on Covid-19, 29th March 2020
Held via Zoom

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees

Scientific experts: *Patrick Vallance (GCSA), Angela McLean (CSA MoD), Jonathan Van Tam (Deputy CMO), Jenny Harries (Deputy CMO), Steve Powis (NHS), Charlotte Watts (CSA DfID), John Aston (CSA HO), Peter Horby (Oxford), Graham Medley (LSHTM), Neil Ferguson (Imperial), James Rubin (King's College), Gregor Smith (dCMO Scotland), Calum Semple (Liverpool), Rob Orford (Health CSA Wales), Andrew Morris (Scottish Covid-19 Advisory Group), Ian Young (CMO Northern Ireland).*

Observers and Government Officials: *Simon Whitfield (GoS).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be the complete list.

Twentieth SAGE meeting on COVID-19, 29th March 2020
Held via Zoom

Summary

1. SAGE endorsed the reasonable worst case and optimistic scenarios, incorporating changes discussed in the meeting.
2. Further work is required to understand how best to release measures and the scale of any resultant epidemic peaks.
3. Further work is required on age distribution of ICU cases.

Situation update

4. The average length of stay in ICU was taken as 9.5 days on NHS advice.
5. Vast majority of admissions to ICU and high dependency units are aged between mid-40s and 70. There are fewer admissions among the over 70s.
6. ICU care may not reflect the full burden of disease, as now many patients are being cared for in other settings.
7. NHS reported that critical care bed occupancy is not yet reaching saturation levels, London included.
8. There is evidence that severity varies by sex (men are affected more severely), but there is no evidence that transmission varies by sex.
9. NHS models use numbers approved by SAGE, but they are run more frequently and need to provide regional and other detail – leading to quantitative, but not qualitative differences in projected scenarios.

Reasonable worst case (RWC) and optimistic scenario

10. SAGE noted that the underlying epidemiology is unchanged, but cases within the NHS have grown rapidly, affecting bed requirements.
11. Some numbers contained in the scenarios derive from data; others are assumptions – for example, around compliance.
12. Age profile of ICU patients is not critical to modelling the trajectory of the epidemic – but modelling will need to evolve to reflect emerging practice in referrals to ICU.
13. The modelling draws on both admission and death data.
14. SAGE endorsed the document under review, subject to the following changes:
    - there needs to be a clearer narrative, clarifying areas subject to uncertainty and sensitivities
    - it makes clear that these are scenarios, not absolute predictions, and that timings are only indicative
    - it makes clear that R assumptions are different for each scenario, and highly dependent on levels of contact among the population (i.e. on compliance)
    - it clarifies that assumptions about compliance are based on survey and other data, but these do not measure contacts, which must be inferred: the reality could be better or worse
    - it explains that the scenarios are modelled for 6 months, both predicting a second epidemic peak when measures are released
    - the wording around workplace contacts needs to be clearer
    - it makes clear the modelling does not consider sex, and this does not affect outputs
    - it makes clear the modelling makes no judgments about who is admitted to ICUs.
15. Further work is required to understand how best to release measures and the scale of the second epidemic peak. This is a priority for SAGE in the coming week.
16. Further work is required on age distribution of ICU cases.

ACTION: SPI-M/SAGE secretariat to revise reasonable worst case and optimistic case scenarios to:

- Make clear that these are scenarios, not predictions

- Explain how assumptions on compliance have been made
- Make clear these have been modelled over 6 months, assuming continued social distancing measures, but there will be a second peak when measures are released and that further work is needed to model release of measures
- Include R values in the different scenarios
- Not include age profiling within this iteration

For future discussion at SAGE

17. It would be useful to understand regional variation in compliance with measures, and whether compliance correlates with social deprivation levels.

Attendees

SAGE participants: Patrick Vallance, Angela Mclean, Jonathan Van Tam, Jenny Harries, Steve Powis, Charlotte Watts, John Aston, Peter Horby, Graham Medley, Neil Ferguson, James Rubin, [redacted] *Gregor Smith, Calum Semple, Rob Orford, Andrew Morris, Ian Young*

SAGE secretariat: [redacted] *Simon Whitfield,* [redacted]

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Addendum to twenty-first SAGE meeting on Covid-19, 31st March 2020
Held via Zoom

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees:

Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (Deputy CMO), Jenny Harries (Deputy CMO), Steve Powis (NHS), Maria Zambon (PHE), Angela McLean (CSA MoD), Charlotte Watts (CSA DfID), Carole Mundell (CSA FCO), John Aston (CSA HO), Gregor Smith (dCMO Scotland), Rob Orford (Health CSA Wales), Ian Diamond (ONS), Andrew Morris (Scottish Covid-19 Advisory Group), Peter Horby (Oxford), Graham Medley (LSHTM), Neil Ferguson (Imperial), James Rubin (King's College), Calum Semple (Liverpool), Jeremy Farrar (Wellcome), Brooke Rogers (King's College), John Edmunds (LSTHM), Wendy Barclay (Imperial), Andrew Rambaut (Edinburgh).*

Observers and Government Officials: *Indra Joshi (NHSX), Vanessa MacDougall (HMT), Ben Warner (No. 10), Stuart Wainwright (GoS), Simon Whitfield (GoS).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be a complete list.

Twenty-first SAGE meeting on COVID-19, 31st March 2020
Held via Zoom

Summary

1. NHS will set up a group to urgently understand and tackle nosocomial transmission. This group should include a range of science disciplines and engineering.
2. SAGE agreed scientific priorities for future work.

Situation update

3. SAGE noted that the trends in ICU admissions and deaths appeared consistent with a straight line increase rather than an exponential increase.
4. NHS reported that critical care bed occupancy has not yet reached saturation levels, with around 1,000 beds in London, but that surge capacity was being used, with large teaching hospitals under most pressure.
5. It was noted that data on deaths in the community are now available, as well as hospital deaths. These will be reported weekly. This would include deaths where a doctor identified Covid-19 as a cause, although testing would not necessarily have been carried out. This added 40 extra deaths to the week ending 20th March. Getting an agreed single source of information of deaths, with dates and test status is important.
6. R is estimated to be around 0.6, with an upper bound of 0.9.
7. NHS reported that the doubling time in HDU/ICU is 5 days (±0.12) nationally and 6.2 days (±0.14) in London.
8. The true community infection rate is not yet available.
9. More detailed clinical coding will provide better understanding of the disease.

ACTION: NHS, PHE and ONS to work together to agree a single source of information on deaths and test status

ACTION: PHE to take responsibility for ascertaining the true community infection rate with testing and report back to SAGE (w/c 6 April)

ACTION: SPI-M to clarify for **NHSX** what key questions it needs to answer based on NHS data within 24 hours

ACTION: SAGE secretariat to confirm data coding requirements (with input from **Andrew Morris**) and send to **NHS** within 24 hours

Understanding Covid-19 and nosocomial transmission

10. NHS provided some research options on nosocomial transmission and potential interventions, noting that ongoing work on PPE guidance is also linked to this.
11. CO-CIN data appear to indicate an increasing proportion of nosocomial cases among overall cases. The data indicate a trend but not the scale of the issue (it was noted that clear definition of nosocomial transmission will be important, rather than cases simply being identified in hospital).
12. SAGE agreed that viral genome sequencing of cases from healthcare settings is important to understand the transmission, and that these cases should be a priority for sequencing by the Covid-19 Genomics UK Consortium. This work is underway and a report will be produced for next SAGE.
13. SAGE noted ongoing research to understand the impact of ACE inhibitors on the disease. MHRA has produced a report. Current advice from MHRA is that there is no need to discontinue treatment.

ACTION: NERVTAG to review duration of infectiousness (and whether the recommendation for 7 days isolation remains appropriate); whether anosmia or ageusia are reliable diagnostic

features to trigger self-isolation; and markers of disease severity (and which studies are underway or needed to understand this better)

ACTION: PHE to ensure samples from hospitals are being sent to **Covid-19 Genomics UK consortium** for priority sequencing

ACTION: NHS to urgently create and chair a nosocomial infection sub-group, with **dCMO** support, involving modelling, genomics, clinical expertise and engineering: the sub-group needs to consider the role of healthcare workers in nosocomial spread, the risk to care homes and solutions for reducing nosocomial spread

SAGE Forward look

14. SAGE discussed priorities for research and discussion in the coming weeks and agreed some additional topics.
15. SAGE agreed that the Royal Society's international work should be supported, and that coordination between this and other international work led by FCO/DfID is important.
16. HMT provided an update on economic work being considered elsewhere.

ACTION: SAGE secretariat to update paper on future questions for SAGE to include:

- Long-term impacts of interventions on health, including socioeconomic effects on health
- Applying the findings of clinical trials
- Community testing strategies and options
- Psychological impacts in the short, medium and long terms
- International issues, including comorbidities such as malaria and malnutrition

Testing and treatments

17. The importance of testing was re-emphasised. It was agreed that SAGE will not consider operational questions, but rather clarify the scale and requirements from the testing programme – the scale of testing required to manage the next phase

ACTION: DHSC and PHE to define future UK testing requirements at an upcoming meeting, including required scale and approaches (i.e. serology and community testing, tracing and isolation) and public understanding/interpretation of testing

List of Actions

NHS, PHE and ONS to work together to agree a single source of information on deaths and test status

PHE to take responsibility for ascertaining the true community infection rate and report back to SAGE (w/c 6 April)

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DHSC and PHE to define future UK testing requirements at an upcoming meeting, including scale and required approaches (i.e. serology and community testing, tracing and isolation) and public understanding/interpretation of testing

Attendees

SAGE participants: Patrick Vallance, Chris Whitty, Jonathan Van Tam, Jenny Harries, Steve Powis, [redacted] Indra Joshi, Maria Zambon, Angela Mclean, Charlotte Watts, Carole Mundell, John Aston, Gregor Smith, Rob Orford, Ian Diamond, Vanessa MacDougall, Ben Warner, Andrew Morris, Peter Horby, Graham Medley, Neil Ferguson, James Rubin, Calum Semple, Jeremy Farrar, Brooke Rogers, John Edmunds, Wendy Barclay, Andrew Rambaut

SAGE secretariat: [redacted] Stuart Wainwright, Simon Whitfield

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Addendum to twenty-second SAGE meeting on Covid-19, 2nd April 2020
Held via Zoom

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees

Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (Deputy CMO), Steve Powis (NHS), Calum Semple (Liverpool), Maria Zambon (PHE), Ian Diamond (ONS), Angela McLean (CSA MoD), Charlotte Watts (CSA DfID), Carole Mundell (CSA FCO), John Aston (CSA HO), Andrew Morris (Scottish Covid-19 Advisory Group), Jeremy Farrar (Wellcome), Graham Medley (LSHTM), Julia Gog (Cambridge), Neil Ferguson (Imperial), John Edmunds (LSTHM), Sebastian Funk (LSHTM), Peter Horby (Oxford), Brooke Rogers (King's College), James Rubin (King's College), Lucy Yardley (Bristol/Southampton), Therèse Marteau (Cambridge), Wendy Barclay (Imperial), Andrew Rambaut (Edinburgh), Gregor Smith (dCMO Scotland), Rob Orford (Health CSA Wales).*

Observers and Government Officials: *Ben Warner (No. 10), Vanessa MacDougall (HMT).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be the complete list.

Twenty-second SAGE meeting on COVID-19, 2nd April 2020
Held via Zoom

Summary

1. SAGE agreed the importance of consistent recording hospital and community fatalities by date of death.
2. A national testing strategy requires overall target volumes for understanding infection rates among a) hospital patients b) NHS staff c) age-stratified population survey participants and d) communities.
3. SAGE agreed that it is unlikely before week 13th April it can start to advise whether the interventions in place are having enough of an effect. SAGE does not currently recommend that changes be made at that point.
4. There is a danger that lifting measures too early could cause a second wave of exponential epidemic growth – requiring measures to be re-imposed.

Situation update

5. A nosocomial transmission sub-group will be co-chaired by the National Infection Service and the NHS nursing director, with a secretariat from NHS. It will meet twice weekly starting immediately.
6. Adult critical care bed capacity continues to be available, including in London. The lowest English demand is currently in the South-West.
7. CO-CIN data is signalling nosocomial infection more strongly than previously. SAGE will discuss this in detail at its next meeting following output from the specialist sub-group.
8. No update on R or doubling time since SAGE #21.
9. SAGE agreed that the reasonable worst case scenario remains valid.
10. SAGE re-emphasised the importance of consistent recording hospital and community fatalities by date of death. This will be in place by the end of this week.
11. The chief statisticians of the DAs are working to ensure data consistency and reduce time lags in making data available.
12. SAGE agreed that the Nowcast could be a useful resource for HMG once data are fully reconciled.

ACTION: ONS to coordinate agreement with **PHE** and **NHS** on a single method of reporting Covid-19 deaths numbers, by the end of the week

ACTION: SPI-M to review Nowcast to ensure consistency of data interpretation

Understanding Covid-19

13. There are no current signals that secondary bacterial infection is a major issue. NERVTAG continues to investigate this.
14. CO-CIN data suggests that obesity, lung disease, heart disease and neurological disease are important risk markers for Covid-19. Conventional risk scores do not seem helpful.
15. SAGE can expect an update next week on results from genome sequencing, with a particular focus on nosocomial spread.

Testing

16. PHE is exploring the quality of commercially available tests in measuring both exposure and immunity.
17. The UK is at least 4-6 weeks away from implementing reliable antibody testing for healthcare workers.
18. SAGE advised that serology testing should be rolled out to NHS laboratories rapidly once assessed – and noted the importance of PHE guidance to NHS on delivery of this

testing. Interpretation of these tests may well not be straightforward and requires further research.

19. SAGE agreed that a feasible and successful, long-term testing strategy:
    - is linked to the UK's overall strategy for managing the epidemic, and will be important for lifting interventions
    - needs to match the performance of tests against the prevalence of infection
    - requires clear and consistent use of technical terms
    - should involve a clear public communications element to address confusions about what different tests can/cannot do (active infection, vs antibody, immunity etc), and how they will be deployed.
20. Critically, the testing strategy requires target volumes for detecting infections and understanding infection rates among a) hospital patients b) NHS staff c) age-stratified population survey participants (these are already available) and d) wider communities and outbreak detection.
21. Wider community detection will require large volumes of testing and SAGE would like to review the proposal and numbers required.
22. Separately, HMG policy leads should calculate target testing volumes for critical workers in other sectors.
23. The quality of testing and interpretation and communication of results is critical. There is a risk of individuals receiving incorrect test results or misinterpreting them, leading to unsafe behaviours by workers or unsafe demands being made of workers by employers.

ACTION: For the next meeting of SAGE, **CMO** and **NHS clinical director** to advise on target volumes for hospital patients and NHS staff; **SPI-M** to advise on volumes for community testing (following strategic guidance from **GCSA** and **CMO** on issues including frequency and levels of control scenarios)

ACTION: NIHR to develop a single public communications plan around testing, with input from **SPI-B** and **PHE (Maria Zambon)**

Lifting interventions

24. SAGE agreed that, by 13th April (i.e. 3 weeks following the introduction of interventions), it should able to advise whether interventions in place are having an effect – or whether further interventions might need to be considered.
25. SAGE does not recommend that there will be sufficient scientific data for changes to interventions be made at that point: there is a danger that lifting measures too early could lead to a second wave of exponential growth of the epidemic, requiring measures to be re-imposed.
26. Until and after 13th April, SAGE will consider which measures could be relaxed and in what sequence from an epidemic perspective – for which it will need to understand, with input from SPI-M, which measures are having the greatest impacts on disease progression.
27. SAGE agreed it is not advisable to combine epidemiological and economic or secondary health effect analysis in a single model.
28. SAGE will look further at how shielding of the vulnerable can be incorporated in future modelling.
29. Specific work may be required to understand particular risks, e.g. around certain occupations, and how evidence can be generated in relation to those risks. SAGE cautioned about the difficulty of interpreting such work
30. Behavioural science suggests that if, as advised, interventions are to be continued, clear communication around how they help in reducing infection rates (e.g. in hospitals, workplaces) will be important to maintain public compliance. On/Off approaches were discussed and some of the difficulties with such approaches noted.

31. A group led by Ian Diamond and John Aston – and including NHS, HO, Government Actuaries Department – is considering longer-term impacts on overall health from the interventions as part of its work on excess deaths.

ACTION: **Ian Diamond** and **John Aston** to consider how best to expand membership of the excess deaths modelling group to cover longer-term health impacts from interventions

ACTION: Ian Diamond to explore whether mobile phone data can be used to understand co-location in certain workplaces (e.g. construction sites) and whether that would help identify specific workplace contact issues

International

32. DfID will discuss modelling in relation to low-income countries with SPI-M and NERVTAG.
33. FCO can, where required, use diplomatic channels to urge sharing of better data from other countries. It was noted that the Royal Society is also setting up a data group to provide information on this to SAGE.
34. A future meeting of SAGE will look at what the UK can learn from actions on other countries.

List of Actions

ONS to coordinate agreement with **PHE** and **NHS** on a single method of reporting Covid-19 deaths numbers, by the end of the week

SPI-M to review Nowcast to ensure consistency of data interpretation

For the next meeting of SAGE, **CMO** and **NHS clinical director** to advise on target volumes for hospital patients and NHS staff; **SPI-M** to advise on volumes for community testing (following strategic guidance from **GCSA** and **CMO** on issues including frequency and levels of control)

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Attendees

SAGE participants: Patrick Vallance, Chris Whitty, Jonathan Van Tam, Steve Powis, Calum Semple, Maria Zambon, Ian Diamond, Angela Mclean, Charlotte Watts, Carole Mundell, John Aston, Andrew Morris, Jeremy Farrar, Graham Medley, Julia Gog, Neil Ferguson, John Edmunds, Sebastian Funk, Peter Horby, Brooke Rogers, James Rubin, Lucy Yardley, Therèse Marteau, Wendy Barclay, Andrew Rambaut, Ben Warner, Gregor Smith, Rob Orford, Vanessa MacDougall

SAGE secretariat: [redacted]

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Addendum to twenty-third SAGE meeting on Covid-19, 7th April 2020
Held via Zoom

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Attendees

Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (Deputy CMO), Steve Powis (NHS), Sharon Peacock (PHE), Calum Semple (Liverpool), Maria Zambon (PHE), Ian Diamond (ONS), Angela McLean (CSA MoD), Charlotte Watts (CSA DfID), John Aston (CSA HO), Andrew Morris (Scottish Covid-19 Advisory Group), Jeremy Farrar (Wellcome), Graham Medley (LSHTM), Neil Ferguson (Imperial), John Edmunds (LSTHM), Peter Horby (Oxford), Brooke Rogers (King's College), James Rubin (King's College), Andrew Rambaut (Edinburgh), Ian Young (CMO Northern Ireland), Rob Orford (Health CSA Wales).*

Observers and Government Officials: *Stuart Wainwright (GoS).*

The name of 1 participant has been redacted under the national security exemption.

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be a complete list.

Twenty-third SAGE meeting on COVID-19, 7th April 2020
Held via Zoom

Summary

1. SAGE agreed that a better understanding of some types of transmission (in hospitals, between children, and in the environment) would be valuable.

Situation update

2. There is no current evidence that transmission is accelerating; it may be slowing.
3. ICU admission doubling times are lengthening, particularly in London, and are now at 8.8 days in London and 6.5 days elsewhere. NHS & SPI-M views are consistent on this.
4. There remains NHS capacity in London and elsewhere, with the Nightingale hospitals available in addition to this.
5. It was agreed that Local Resilience Forums (LRF) should be given approximate ranges or related descriptions for potential death numbers to support their planning if required.
6. SPI-M is continuing to calibrate its outputs to reported data as part of its nowcasting work but is still working on how to reconcile different datasets. SPI-M members noted their preference to carry out more of this work themselves rather than relying on others or specific approaches determined by others.

ACTION: NHS to provide summary of NHS sitrep for SAGE meetings

ACTION: SPI-M to take responsibility for bringing regular expert-reviewed forecasts to SAGE. ONS to work with SPI-M to ensure data consistency as needed

Understanding Covid-19

7. CO-CIN data indicate obesity is a significant risk factor, both for admission to hospital and for severity of disease. While not the most critical factor for individuals, its prevalence makes it an important one for the population which may need to be considered in public communications and advice.
8. NERVTAG concluded that increased use of masks would have minimal effect (in terms of preventing the uninfected general population from becoming infected), based on a review of the available evidence. Questions were raised about whether this would change if it were found that individuals have high levels of pre-symptomatic/ asymptomatic infectiousness (in which case could masks reduce early pre-symptomatic spread).
9. NERVTAG reviewed the evidence on duration of infectiousness and advised that the seven day isolation period remained appropriate.
10. The evidence on the impact of children on spread is not clear. SAGE agreed that although children typically have less severe cases than adults, schools are an efficient way of connecting households meaning that closing schools may have a significant effect. The social, developmental and psychological impacts of closing schools were noted.
11. It was agreed that a better understanding of environmental dispersal would be useful.

ACTION: NERVTAG to produce paper on facemasks in the context of pre-symptomatic and asymptomatic viral shedding (for 14 April)

ACTION: **NERVTAG** to table a note setting out full rationale for its position on 7 days of self-isolation and any associated risks (for 14 April)

ACTION: SPI-M to produce paper on evidence of role of children in transmission, with clinical input from **NERVTAG** and behavioural input from **SPI-B** – paper to include research priorities (for week commencing 13 April). Involving Russell Viner in this discussion may be helpful

ACTION: SAGE secretariat to gather questions on environmental dispersion today from SAGE participants in order to commission academic paper

Nosocomial infection

12. The nosocomial group is looking at: determining rates of nosocomial infection, mechanisms for surveillance and indicators, optimal frontline practices, and existing studies and research gaps.
13. SAGE agreed that a focus on solutions was important and that practical measures would need to be implemented in the NHS quickly. Looking at spatial issues and engineering solutions should be part of the process.

ACTION: **Nosocomial group** to present a paper next week on the major causes of infection in hospitals and what can be done immediately to reduce infection

Excess deaths

14. SAGE noted the work in train and agreed to discuss it further at its next meeting.

NHS app

15. It was agreed that the proposed app could be a useful supplement to other measures. SAGE raised some science questions which would need to be resolved.
16. There is a decision needed on whether identification of cases would rely on symptoms or testing. The specificity and sensitivity of the diagnosis would need to be understood and the impact modelled in the two scenarios.
17. There were also questions about response, including how quickly people needed to isolate after being in contact with an infected person; whether there would be a mechanism to tell people to stop isolating, if a presumed positive diagnosis changed; and how often people might be advised to isolate, particularly those with jobs involving significant human interaction.
18. SAGE noted that people using the app as a diagnostic tool needed to be screened for potentially more serious conditions, which NHS111 might be able to advise on.
19. There was a view that linking to viral test diagnosis is likely to be important.
20. It was highlighted that integration with testing and existing contact tracing approaches needed to be considered, and the impact on testing demand needed to be understood.
21. Potential issues around privacy, uptake and accessibility were highlighted. An ethics advisory board has been established. A communications campaign is planned, including promoting the app to users of the King's app.
22. The value of trialling the app, possibly regionally, was noted.
23. It was agreed that SPI-M and SPI-B would be able to provide useful input.

ACTION: **SAGE secretariat** to provide summary of key science questions to NHSX. **NHSX** to return to SAGE having considered these questions, for SAGE to validate the approach and advise on its coordination with other measures

Exit strategy and related testing strategy

24. SAGE noted that advice will likely be needed on the impact of different NPI reductions individually and in combination.
25. SAGE will consider direct and indirect health impacts of measures, both on Covid-19 cases and more widely (e.g. postponement of other NHS care, and socioeconomic effects). A subset of SAGE participants and other experts will be convened to carry out this work.
26. It was agreed that therapeutics and vaccines will have a critical role, but that some decisions on social distancing will be needed much sooner than these will be available.
27. It was agreed that a cross-disciplinary subgroup should consider the impact of the interventions and the impacts that lifting them would have.

ACTION: **SAGE secretariat** to coordinate a workshop with a subset of SAGE participants and others later this week

List of Actions

NHS to provide summary of NHS sitrep for SAGE meetings

SPI-M to take responsibility for bringing regular forecasts to SAGE, and to identify experts to carry out any work on its behalf. ONS to work with SPI-M to ensure data consistency if needed

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Attendees

SAGE participants: Patrick Vallance, Chris Whitty, Jonathan Van Tam, Steve Powis, Sharon Peacock, Calum Semple, Maria Zambon, Ian Diamond, Angela McLean, Charlotte Watts, John Aston, [redacted] *Andrew Morris, Jeremy Farrar, Graham Medley, Neil Ferguson, John Edmunds, Peter Horby, Brooke Rogers, James Rubin, Andrew Rambaut, Ian Young, Rob Orford*

SAGE secretariat: [redacted] *Stuart Wainwright,* [redacted]

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Addendum to twenty-fourth SAGE meeting on Covid-19, 9th April 2020
Held via Zoom

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees:
Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (Deputy CMO), Steve Powis (NHS), Sharon Peacock (PHE), Calum Semple (Liverpool), Maria Zambon (DD PHE), Ian Diamond (ONS), Angela McLean (CSA MoD), Charlotte Watts (CSA DfID), John Aston (CSA HO), Andrew Morris (Scottish Covid-19 Advisory Group), Jeremy Farrar (Wellcome), Graham Medley (LSHTM), Neil Ferguson (Imperial), John Edmunds (LSTHM), Peter Horby (Oxford), Brooke Rogers (King's College), James Rubin (King's College), Wendy Barclay (Imperial), Andrew Rambaut (Edinburgh), Ian Young (CMO Northern Ireland), Rob Orford (Health CSA Wales).*

Observers and Government Officials: *Vanessa MacDougall (HMT), Simon Whitfield (GoS).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be the complete list.

Twenty-fourth SAGE meeting on COVID-19, 9th April 2020
Held via Zoom

Summary

1. The epidemic may be reaching its peak, but it could remain at a plateau for some time. There is no expectation for bed occupancy to decrease over the next 2 weeks.
2. SAGE advises there is no evidence globally pointing to high levels of population immunity gained at this stage in the pandemic.
3. SAGE advises that work to date on excess deaths may be using an underestimate of the fall in UK GDP. It agreed the importance of further investigation, beyond 6 months, into impacts by region and by demographic, with particular focus on vulnerable social groups.

Situation update

4. ICU numbers appear to be flattening and new admissions to hospitals stabilising. Doubling times in hospitals continue to lengthen.
5. Calls to NHS111 and 999 – possible indicators of community cases – appear to have peaked and be on the decline.
6. The epidemic may be reaching its peak, but could remain at a plateau for some time. There is no expectation for bed occupancy to decrease over the next 2 weeks.
7. It is important to model hospital transmission separately, and for the CO-CIN study to record nosocomial infection rates, as defined by various time intervals (below 14 days).
8. The Nosocomial Working Group is collecting data from hospital groups. SPI-M will need relevant data to model hospital transmission.
9. NERVTAG advice on self-isolating for 7 days remains sound, but is to be reviewed and a paper produced.
10. SAGE is satisfied with the content of the SPI-M nowcast.
11. The exit strategy subgroup is meeting on Friday 10th April.

ACTION: NERVTAG to produce papers on a) infection duration of Covid-19 and b) use of facemasks (taking into account the potential of pre-symptomatic or asymptomatic transmission), including any behavioural aspects related to the use of masks (drawing on SPI-B where necessary) for next SAGE meeting (14th April)

ACTION: SPI-M, **Nosocomial Working Group** and **CO-CIN** to ensure data on nosocomial infection is collected in a way that is useful for epi-modellers

ACTION: SAGE Secretariat to develop a process to take relevant nowcasting output from SPI-M to NHS (full set) and CCS (consensus summary)

Understanding Covid-19

12. WHO has concluded there is currently no conclusive evidence that facemasks are beneficial for community use.
13. SAGE will review a NERVTAG paper on facemasks at its next meeting, covering their value in limiting spread from pre-symptomatic/asymptomatic cases and what potential research studies might be commissioned.
14. NERVTAG advised there is still insufficient data to reach any conclusion about whether loss of taste and smell should be added to the case definition for Covid-19.
15. The Chief Veterinary Officer has advised that the risk of transmission from cats to humans is low.

ACTION: Peter Horby to circulate "Neutralising antibody response in SAR-CoV-2 and those recovering from COVID19 recovered patient cohort and their implications"

ACTION: NERVTAG (Wendy Barclay) to produce a paper on the immune system and duration of immunity, and how this relates to the requirements and limitations of testing

ACTION: SAGE Secretariat to circulate CVO paper on infectiousness of pets

ACTION: Charlotte Watts to advise on which academic group can investigate role of pollution in Covid-19 morbidity/mortality levels and to return to SAGE with the output

Testing strategy

16. Overall responsibility for this strategy lies with CMO. It needs to be linked to the overall exit strategy.
17. The Royal Society is examining comparative international approaches to testing.

ACTION: SAGE secretariat to confirm timelines for output from **Royal Society**

Viral testing

18. SAGE agreed that all available testing capacity should be used and noted the importance of anticipating future need, including as social interventions are lifted.
19. NHS estimates that patient testing requires around 8,000 tests per day and NHS staff testing requires a maximum of 6,000 to 7,000 tests per day.
20. LSHTM has done an initial assessment of community testing volumes, which can be further refined and will be reviewed at next meeting.
21. Any consideration of mass testing should consider impacts, if any, on clinical management – including whether testing can anticipate future demand on the NHS – and on enabling people to return to work.
22. It would also need to consider: the relationship between testing and contact tracing; how statistical sampling can inform testing volumes needed; testing in support of shielding the vulnerable; and behavioural consequences of the availability of mass testing (including whether more testing would encourage greater self-isolation).

ACTION: CMO (with **PHE** and **devolved CMOs**) to produce a strategy paper on prioritising viral testing of Covid-19 (covering e.g. critical workers, care homes and reducing nosocomial spread) and test numbers needed

ACTION: John Edmunds modelling group to further refine work on mass testing requirement for next meeting of SAGE (14 April)

ACTION: Angela McLean to produce a strategy paper on longer-term epidemiological modelling of Covid-19 and number of tests needed (viral tests)

Serology

23. The serology working group has responsibility for the UK's overall approach, including research studies and testing capacity.
24. Data is emerging internationally on antibody response. SAGE advises caution over interpreting the presence of antibodies as evidence of presence of neutralising antibodies. It is not known whether antibodies confer resistance against disease and against carriage of virus.
25. Low levels of seroprevalence (c. 0.8-15%) are being reported internationally.
26. SAGE advises there is no evidence globally that we can expect high levels of immunity to have been gained at this stage in the pandemic.
27. Evidence on seropositivity needs to differentiate between positive for prior exposure to the virus versus positive for protection against reinfection.
28. The only commercially viable assay offers low sensitivity – but useful information can be derived from it where testing is repeated. It suggests antibodies may fall away quite quickly over time.
29. More sensitive assays are being developed but are not yet capable of high throughput.

30. No rapid home tests are yet sufficiently reliable, including for potential "immunity passports" in future, but they may be useful for seroprevalence studies.
31. SAGE advised that planning for the use of serology (e.g. in care homes, understanding transmission within households) should be done in advance of being able to deploy a reliable test.
32. SAGE noted the importance of adopting consistent sera standards across the UK (and suggested that NIBS takes this on).
33. SAGE also noted the importance of there being enough material (samples) to develop assays.

ACTION: SPI-B to consider public messaging and behavioural aspects of antibody testing, directly commissioning relevant research where necessary

ACTION: Serology Working Group to a) further clarify requirements for access to samples for serological testing (already funded – ISARIC) and ensure join up between CO-CIN, NIBSC, NHSBT and the relevant access committee; b) ensure that sufficient samples are collected; c) that a single national repository for standards is created; and d) draw up a plan for future uses of serological testing

ACTION: Jeremy Farrar, supported by **Serology Working Group**, to stimulate and drive academic work on improving serological testing, drawing where necessary on relevant funding (e.g. NIHR, MRC) – and to update SAGE (week commencing 20 April)

Nosocomial infection

34. SAGE stressed the importance of the Nosocomial Working Group issuing recommendations to hospitals quickly on how to reduce transmission.
35. The Group has sent a survey to all NHS trusts in order to support the development of best-practice guidelines.

ACTION: Nosocomial Working Group to produce clear, practical advice for NHS as soon as possible

Excess deaths

36. SAGE acknowledged the high quality of the work completed so far.
37. It advised that work to date may underestimate the fall in UK GDP. It agreed the importance of further investigation, beyond 6 months, into impacts by region and by demographic, with a particular focus on vulnerable social groups.

ACTION: SAGE Secretariat to provide a relevant version of the paper on excess deaths to CCS

Next meeting

38. Agenda will include an update on vaccine and therapeutics developments.

List of Actions

NERVTAG to produce papers on a) infection duration of Covid-19 and b) use of facemasks (taking into account the potential of pre-symptomatic or asymptomatic transmission), including any behavioural aspects related to the use of masks (drawing on SPI-B where necessary) for next SAGE meeting (14th April)

SPI-M, **Nosocomial Working Group** and **CO-CIN** to ensure data on nosocomial infection is collected in a way that is useful for epi-modellers

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SAGE Secretariat to circulate CVO paper on infectiousness of pets

Charlotte Watts to advise on which academic group can investigate role of pollution in Covid-19 morbidity/mortality levels and to return to SAGE with the output

SAGE secretariat to confirm timelines for output from **Royal Society**

CMO (with **PHE** and **devolved CMOs**) to produce a strategy paper on prioritising viral testing of Covid-19 (covering e.g. critical workers, care homes and reducing nosocomial spread) and test numbers needed

John Edmunds modelling group to further refine work on mass testing requirement for next meeting of SAGE (14 April)

Angela McLean to produce a strategy paper on longer-term epidemiological modelling of Covid-19 and number of tests needed (viral tests)

SPI-B to consider public messaging and behavioural aspects of antibody testing, directly commissioning relevant research where necessary

Serology Working Group to a) further clarify requirements for access to samples for serological testing (already funded – ISARIC) and ensure join up between CO-CIN, NIBSC, NHSBT and the relevant access committee; b) ensure that sufficient samples are collected; c) that a single national repository for standards is created; and d) draw up a plan for future uses of serological testing

Jeremy Farrar, supported by **Serology Working Group**, to stimulate and drive academic work on improving serological testing, drawing where necessary on relevant funding (e.g. NIHR, MRC) – and to update SAGE (week commencing 20 April)

Nosocomial Working Group to produce clear, practical advice for NHS as soon as possible

SAGE Secretariat to provide a relevant version of the paper on excess deaths to CCS

Attendees

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SAGE secretariat: [redacted] *Simon Whitfield*

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Addendum to twenty-fifth SAGE meeting on Covid-19, 14th April 2020
Held via Zoom

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees:

Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Angela McLean (CSA MoD), Jonathan Van Tam (Deputy CMO), Steve Powis (NHS), Sharon Peacock (PHE), Yvonne Doyle (PHE), Maria Zambon (PHE), Calum Semple (Liverpool), Ian Diamond (ONS), Charlotte Watts (CSA DfID), John Aston (CSA HO), Andrew Curran (CSA HSE), Carole Mundell (CSA FCO), Mike Parker (Oxford), Andrew Morris (Scottish Covid-19 Advisory Group), Jeremy Farrar (Wellcome), Graham Medley (LSHTM), Neil Ferguson (Imperial), John Edmunds (LSTHM), Julia Gog (Cambridge), Peter Horby (Oxford), Brooke Rogers (King's College), James Rubin (King's College), Lucy Yardley (Bristol/Southampton), Wendy Barclay (Imperial), Andrew Rambaut (Edinburgh), Ian Young (CMO Northern Ireland), Rob Orford (Health CSA Wales), Gregor Smith (dCMO Scotland), Fliss Bennee (Health CSA Wales), Venki Ramakrishnan (Royal Society), Cath Noakes (Leeds), Ian Boyd (St Andrews).*

Observers and Government officials: *Vanessa MacDougall (HMT), Dominic Cummings (No 10), Stuart Wainwright (GoS).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be a complete list.

Twenty-fifth SAGE meeting on COVID-19, 14th April 2020
Held via Zoom

Summary

1. The number of deaths is plateauing, with transmission in the community highly likely to be declining.
2. Nosocomial transmission accounts for an increasing proportion of cases.
3. Relatively small changes to social distancing measures could push R back above 1 in the community. It is therefore too early to recommend releasing any measures.
4. When measures do start to be released, the lowest-risk changes should be considered first. The impact of any changes will need to be closely monitored.
5. Risk of outdoor transmission is significantly lower than indoors.

Situation update

6. Data indicate that hospital death numbers are still high, but may have reached a plateau, with a possible decline in London. There is a decline in hospital admissions newly confirmed with COVID-19, which may have peaked, though detailed analysis to support this is not yet available.
7. Transmission in the community has slowed and it is highly likely that R in the community is less than 1 (any value in the range 0.5 to 1 is considered plausible).
8. There is significant transmission in hospitals. This may have been masking the decline in cases in the community. It is not known whether R is higher or lower than 1 in hospitals nationally, though heterogeneity means that it will be in some hospitals; where it is, outbreaks will be self-sustaining.
9. Nosocomial cases are therefore making up an increasing proportion of overall cases.
10. Care homes also remain a concern. There are less data available from these.
11. SAGE advises that increased testing in these settings, supported by modelling, is important. PHE is doing some survey work to better understand transmission and infection prevention & control (IPC) in these settings.
12. CO-CIN data show that obesity is an independent risk factor.
13. The Nowcast has been further developed to include deaths by region. This is being provided to CCS.
14. PHE has been looking at its use of ISARIC samples and supporting development of standards for serological testing.

ACTION: Nosocomial Working Group to widen viral sampling in hospitals and care homes – including a rapid review of infection, prevention and control – to test for infection. Note that asymptomatic individuals should be tested in certain circumstances.

ACTION: Sharon Peacock to a) share report on PHE use of ISARIC samples with SAGE and b) discuss with **Calum Semple** whether there are issues around materials for handling of samples for serological testing and prioritise accordingly (for next SAGE meeting on 16th April)

Understanding Covid-19

15. Evidence does not currently support use of face masks to protect the wearer in the general population.
16. There is mechanistic evidence for efficacy of face masks in reducing transmission when used by someone who is infected with (a source of) the virus. Direct trial evidence does not support effectiveness in practice in other diseases. The fundamental difference with COVID-19 is the shedding of virus during asymptomatic and presymptomatic infection.

17. There are theoretical drawbacks to increased use of masks in the population. However, the evidence on these drawbacks may not be applicable to the current situation, particularly evidence around compliance.
18. Overall, the evidence that masks could prevent spread is weak, but probably marginally in favour of a small effect. If there are benefits, these are only likely in specific circumstances.
19. Circumstances where there may be benefits included enclosed environments with poor ventilation, and around vulnerable people. Conversely, there are unlikely to be any significant benefits in use of masks outdoors.
20. There are communication considerations around any change in advice on masks. Communications are likely to be required around fitting and usage as well as on the importance of maintaining the other, more effective, measures in place.
21. Other operational considerations include supply chain and distribution impacts but these were not considered as part of this review.
22. SAGE agreed that the existing advice on self-isolation remains the most important action for anyone with infection.

ACTION: NERVTAG to produce a shorter paper that could be used to inform ministers (along with policy and operational advice from **CMO**'s office and **DHSC**) on options for using face masks in different environments, setting out the evidence base, likely magnitude of effect and any unintended consequences based on discussion at SAGE today (for next SAGE meeting on 16th April)

Environmental transmission

23. It is difficult to determine how far the virus can travel in different settings, but in most cases, it will be diluted over distance, particularly outdoors.
24. Evidence suggests that transmission risk outdoors is significantly lower than indoors.
25. Ventilation in buildings is an important consideration, particularly for nosocomial transmission, but also as people return to work.

ACTION: Cath Noakes to a) establish and chair a new working group on environmental spread, with support from **SAGE secretariat** to ensure group is interdisciplinary and draws on expertise from RAMP (Rapid Assistance in Modelling the Pandemic taskforce); **Cath** to also ensure this work is fed into **Nosocomial Working Group** (SAGE secretariat to provide link)

Releasing measures

26. Though R in the community is currently highly likely to be below 1, relatively small changes to the approach could push it back above 1. It is therefore too early to recommend releasing any measures.
27. The release of measures should be done in a logical order, starting with lower-risk changes such as reducing restrictions on outdoor activity. This would aid monitoring and adaptation of the approach, as well as being more likely to obtain public acceptance.
28. Relaxing restrictions on the use of outdoor spaces to permit a greater range of activities, while maintaining social distancing from those outside the household, would be very likely to have no more than a negligible direct impact on transmission but have a positive impact on health and wellbeing.
29. Where appropriate, steps to support the safe release of measures, such as changes to workplace environments or practices, should be put in place ahead of changes being made.

30. Assumptions and evidence around transmission, and principles for its reduction, are needed to assess the relative risks of different types of activity including different types of work.
31. Previous SAGE advice on school occupancy remains unaltered.
32. SAGE noted that evidence suggests a prolonged/deep recession would have significant health impacts.
33. SAGE advised that a better understanding of household transmission, and transmission in other residential settings is needed.
34. SAGE advised that it is complex to obtain good data to assess the impact of measures on shielded and vulnerable groups, but a better understanding is needed.

ACTION: SPI-M to identify and set out potential principles/assumptions on transmission such as contact time and proximity, which could be used in assessing relative risks of different types of activity including different types of work, and in further refining policy on social distancing measures (for next SAGE meeting on 16th April)

ACTION: PHE to review household transmission – understanding studies already underway and commissioning new studies, including within specific communities/groups (e.g. barracks, boarding schools) – and report back to SAGE, with timescales, in week beginning 20th April

ACTION: SAGE secretariat to work with ONS, SPI-M, Calum Semple and PHE to determine what data can be obtained to assess the impact of measures on shielded and vulnerable groups (for next SAGE meeting on 16th April).

Excess deaths

35. SAGE supported the work being undertaken to improve the health data research infrastructure.

ACTION: John Aston and **Andrew Morris** to progress with plan as outlined in paper and to link up with NHS audit data holders and commission other new relevant data sets to support analysis of Covid-19.

List of Actions

Nosocomial Working Group to widen viral sampling in hospitals and care homes – including a rapid review of infection, prevention and control – to test for infection. Note that asymptomatic individuals should be tested in certain circumstances.

Sharon Peacock to a) share report on PHE use of ISARIC samples with SAGE and b) discuss with **Calum Semple** whether there are issues around materials for handling of samples for serological testing and prioritise accordingly (for next SAGE meeting on 16th April)

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John Aston and **Andrew Morris** to progress with plan as outlined in paper and to link up with NHS audit data holders and commission other new relevant data sets to support analysis of Covid-19.

SAGE secretariat to work with ONS, SPI-M, Calum Semple and PHE to determine what data can be obtained to assess the impact of measures on shielded and vulnerable groups (for next SAGE meeting on 16th April).

Attendees

SAGE participants: Patrick Vallance, Chris Whitty, Angela McLean, Jonathan Van Tam, Steve Powis, Sharon Peacock, Yvonne Doyle, Maria Zambon, Calum Semple, Ian Diamond, Charlotte Watts, John Aston, Andrew Curran, Carole Mundell, Michael Parker, Andrew Morris, Jeremy Farrar, Graham Medley, Neil Ferguson, John Edmunds, Julia Gog, Peter Horby, Brooke Rogers, James Rubin, Lucy Yardley, Wendy Barclay, Andrew Rambaut, Ian Young, Rob Orford, Gregor Smith, Fliss Bennee, Venki Ramakrishnan, Cath Noakes, Vanessa MacDougall, Dominic Cummings, Ian Boyd

SAGE secretariat: [redacted] *Stuart Wainwright*

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Addendum to twenty-sixth SAGE meeting on Covid-19, 16th April 2020
Held via Zoom

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees

Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (Deputy CMO), Angela McLean (CSA MoD), John Aston (CSA HO), Charlotte Watts (CSA DfID), Osama Rahman (CSA DfE), Carole Mundell (CSA FCO), Andrew Morris (Scottish Covid-19 Advisory Group), Steve Powis (NHS), Sharon Peacock (PHE), Maria Zambon (PHE), Yvonne Doyle (PHE), Andrew Rambaut (Edinburgh), Wendy Barclay (Imperial), Peter Horby (Oxford), Calum Semple (Liverpool), Graham Medley (LSHTM), Neil Ferguson (Imperial), John Edmunds (LSTHM), Julia Gog (Cambridge), James Rubin (King's College), Brooke Rogers (King's College), Therèse Marteau (Cambridge), Ian Diamond (ONS), Jeremy Farrar (Wellcome), Ian Young (CMO Northern Ireland), Fliss Bennee (Health CSA Wales), Gregor Smith (dCMO Scotland), Venki Ramakrishnan (Royal Society), Mike Parker (Oxford), Ian Boyd (St Andrews).*

Observers and Government Officials: *[none]*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be the complete list.

Twenty-sixth SAGE meeting on Covid-19, 16th April 2020
Held via Zoom

Summary

1. SAGE agreed on the importance of getting an accurate estimate of R and community prevalence over the next few weeks to inform decisions on lifting or modifying social distancing measures. SAGE advised that sufficient testing capacity needs to be reserved for repeated large-scale community testing.
2. SAGE will produce revised advice on masks in the week commencing 20th April.
3. SAGE agreed to advise that the Nosocomial Working Group's recommendations to reduce nosocomial spread should be adopted immediately.

Situation update

4. Hospital numbers are plateauing, with numbers of new admissions falling. There has been a small drop in ICU numbers and in ventilated cases. Daily death numbers are not increasing.
5. There is some regional variation in compliance with distancing measures – with London having the highest compliance and the South West of England and Wales the lowest.
6. There appears to be a relationship between compliance levels and epidemic growth levels. It was noted that the epidemic entered the South West of England last.
7. CO-CIN data indicate clinician bedside-defined obesity as a risk factor for Covid-19.

ACTION: Calum Semple to refine definition of obesity, with a view to providing public health advice

ACTION: NERVTAG to review anosmia evidence from symptom tracking app (for week starting 20th April)

ACTION: Calum Semple and **Sharon Peacock** to review and ensure common expectations and appropriate use of ISARIC samples

Community viral testing

8. SAGE agreed on the importance of getting an accurate estimate of R and community prevalence over the next 2-3 weeks to inform decisions on lifting or modifying social distancing measures and to fill knowledge gaps. SAGE advised that sufficient testing capacity needs to be reserved for repeated large-scale community testing.
9. PHE confirmed it was unable to deliver a community testing programme. SAGE agreed that if PHE is unable to undertake the programme then this should be undertaken within a repeated ONS-led household survey programme.
10. SAGE also discussed testing for contact tracing. Even in scenarios featuring low incidence of infection, contact tracing would require testing capacity running into the hundreds of thousands per day (and commensurate quarantining of people).

ACTION: Jeremy Farrar to lead a small group to design approach for surveying infection to establish true prevalence in the population (by close of play on 17th April)

ACTION: GCSA to send a letter today to SoS DHSC regarding testing capacity and prioritisation, in relation establishing infection prevalence in the population

ACTION: Angela McLean to ensure actuarial work coordinated by RAMP and any relevant data from ONS are connected to CO-CIN data on vulnerable groups; **Calum Semple** to assess whether CO-CIN data can be filtered to identify vulnerable group presentations

Ethnicity and clinical outcomes

11. CO-CIN data are giving a signal that black people have a higher risk of being admitted to hospital and of death, when adjusted for them having fewer comorbidities. CO-CIN data on this issue will become clearer over the coming weeks.
12. RCGP data are producing a similar signal.
13. Investigation is also underway to understand why relatively more BME healthcare workers are dying.
14. PHE has identified a signal – from weak evidence – of South Asian communities disproportionately testing positive and experiencing severe symptoms, but not dying.

ACTION: Calum Semple, Andrew Morris, Jonathan Van Tam and **Charlotte Watts** to develop robust study on ethnicity in mortality data, drawing where necessary on other data sources (for week commencing 20th April)

Transmission among children

15. A sub-group comprising SPI-M, SPI-B and NERVTAG members has looked at this issue.
16. Evidence is patchy, with very limited evidence on pre-school and other non-school settings.
17. Children typically present with milder symptoms, but their susceptibility to infection relative to adults is unclear.
18. Results from an Australian study into school-based clusters and related households may be available shortly.
19. Whole-household testing could be the best way to understand infectivity of children.
20. SAGE advised that any release of school closures needs to be predicated on the clear understanding that children are not a homogenous group and feature a range of educational, psychological and potentially, if facing more serious symptoms, clinical needs.
21. SAGE further advised that changes to school-related measures should be based on integrated science and policy thinking.
22. SAGE recognised that there are inevitably value judgements in any decisions which might be taken on schools and in the reactions of parents and children to those decisions.

ACTION: Julia Gog to lead an integrated group of SPI-M, SPI-B and NERVTAG members to provide recommendations on transmission of Covid-19 in children and within schools, ensuring research questions are fed into relevant studies and research requiring new funding is fed directly into UKRI (by week starting 27th April)

Facemasks

23. SAGE agreed that any additional advice on community face mask use is for the purposes of consideration as part of releasing SD measures and not relevant to the current situation where strong SD measures are still in place.
24. SAGE remained of the view that mask supply should be prioritised for high-risk environments, where they are clearly necessary. Beyond healthcare settings, evidence of effectiveness is weak but as noted at the last meeting, marginally positive. If increasing community use were to threaten stocks of masks for medical, nursing, social care or other high-risk environments this would be a net increase in risk in public health terms.
25. Symptomatic individuals should self-isolate. Masks cannot be used to allow such individuals to leave their homes.
26. SAGE advised that if there is ultimately a policy decision in favour of mask use in certain situations and for vulnerable groups, this should not be linked to or confused with lifting or modification of other measures (i.e. masks will not substitute for other measures).
27. SAGE will produce revised advice on masks in the week starting 20th April,
28. Advice will then need to be integrated with other considerations, such as availability.

ACTION: SPI-M and **NERVTAG** to provide a numerical value on the effectiveness or otherwise of wearing face masks (including different mask types), concentrating on absolute (rather than relative) risk of not doing so – to share with CMO

ACTION: CMO to produce a summary of recommendations on wearing face masks, drawing on evidence synthesis from DELVE and SPI-M/ NERVTAG numerical modelling

Releasing measures

29. SAGE discussed the challenges of evaluating the effectiveness of shielding vulnerable groups.

ACTION: SPI-M to provide indicative numbers for testing volumes required for a track and trace approach against a range of epidemiological case rates

ACTION: SAGE Secretariat to convert SPI-M paper on principles of transmission into a table for use by policy makers (for presentation to SAGE on 21st April)

Nosocomial infection

30. The Nosocomial Working Group has identified marked variation among hospital trusts on implementation of infection prevention control (IPC) guidelines. IPC policy will be updated and circulated, as will guidelines on cleaning and on use of face masks.
31. The Group is continuing to review segregation practices when individuals present at hospitals, and options for using dedicated non-Covid-19 sites to deliver elective procedures safely. Testing is an important part of controlling transmission in hospitals and care homes.
32. SAGE advises that the Group's recommendations should be adopted immediately in a coordinated fashion across all 4 nations.
33. Notwithstanding the challenges, SAGE advised that longer-term thinking on using separate sites for confirmed Covid-19 patients should be considered – as well as repeat testing of patients testing negative.

ACTION: Nosocomial Working Group to review how to operationalise recommendations urgently to reduce nosocomial infection

Next meeting

34. The agenda will include an update on vaccine and therapeutics developments, serology, and principles for releasing measures.

List of Actions

Calum Semple to refine definition of obesity, with a view to providing public health advice

NERVTAG to review anosmia evidence from symptom tracking app (for week starting 20th April)

Calum Semple and **Sharon Peacock** to review and ensure common expectations and appropriate use of ISARIC samples

Jeremy Farrar to lead a small group to design approach for surveying infection to establish true prevalence in the population (by close of play on 17th April)

GCSA to send a letter today to SoS DHSC regarding testing capacity and prioritisation, in relation establishing infection prevalence in the population

Angela McLean to ensure actuarial work coordinated by RAMP and any relevant data from ONS are connected to CO-CIN data on vulnerable groups; **Calum Semple** to assess whether CO-CIN data can be filtered to identify vulnerable group presentations

Calum Semple, Andrew Morris, Jonathan Van Tam and **Charlotte Watts** to develop a robust study on ethnicity in mortality data, drawing where necessary on other data sources (for week commencing 20th April)

Julia Gog to lead an integrated group of SPI-M, SPI-B and NERVTAG members to provide recommendations on transmission of Covid-19 in children and within schools, ensuring research questions are fed into relevant studies and research requiring new funding is fed directly into UKRI (by week starting 27th April)

SPI-M and **NERVTAG** to provide a numerical value on the effectiveness or otherwise of wearing face masks (including different mask types), concentrating on absolute (rather than relative) risk of not doing so – to share with CMO

CMO to produce a summary of recommendations on wearing face masks, drawing on evidence synthesis from DELVE and SPI-M/NERVTAG numerical modelling

SPI-M to provide indicative numbers for testing volumes required for a track and trace approach against a range of epidemiological case rates

SAGE Secretariat to convert SPI-M paper on principles of transmission into a table for use by policy makers (for presentation to SAGE on 21st April)

Nosocomial Working Group to review how urgently to operationalise recommendations to reduce nosocomial infection

Attendees

SAGE participants: Patrick Vallance, Chris Whitty, Jonathan Van Tam, Angela McLean, John Aston, Charlotte Watts, Osama Rahman, Carol Mundell, Andrew Morris, Steve Powis, Sharon Peacock, Maria Zambon, Yvonne Doyle, Andrew Rambaut, Wendy Barclay, Peter Horby, Calum Semple, Graham Medley, Neil Ferguson, John Edmunds, Julia Gog, James Rubin, Brooke Rogers, Theresa Marteau, Ian Diamond, Jeremy Farrar, Ian Young, Fliss Bennee, Gregor Smith, Venki Ramakrishnan, Mike Parker, Ian Boyd

SAGE secretariat: [redacted]

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Addendum to twenty-seventh SAGE meeting on Covid-19, 21st April 2020
Held via Zoom

This addendum clarifies the roles of the SAGE attendees listed in the minute. There are three categories of attendee. Scientific experts provide evidence and advice as part of the SAGE process. HMG attendees listen to this discussion, to help inform policy work, and are able to provide the scientific experts with context on the work of government where appropriate. The secretariat attends in an organisational capacity. The list of attendees is split into these groups below.

Attendees

Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (Deputy CMO), Jenny Harries (Deputy CMO), Angela McLean (CSA MoD), John Aston (CSA HO), Carole Mundell (CSA FCO), Andrew Curran (CSA HSE), Charlotte Watts (CSA DfID), Andrew Morris (Scottish Covid-19 Advisory Group), Steve Powis (NHS), Sharon Peacock (PHE), Maria Zambon (PHE), Yvonne Doyle (PHE), Cath Noakes (Leeds), Andrew Rambaut (Edinburgh), Wendy Barclay (Imperial), Peter Horby (Oxford), Calum Semple (Liverpool), Graham Medley (LSHTM), Neil Ferguson (Imperial), John Edmunds (LSTHM), Julia Gog (Cambridge), James Rubin (King's College), Brooke Rogers (King's College), Lucy Yardley (Bristol/Southampton), Ian Diamond (ONS), Jeremy Farrar (Wellcome), Ian Young (CMO Northern Ireland), Rob Orford (Health CSA Wales), Nicola Steedman (dCMO Scotland), Venki Ramakrishnan (Royal Society), David Spiegelhalter (Cambridge), Mark Walport (Chief Executive UKRI), Mike Parker (Oxford), Ian Boyd (St Andrews).*

Observers and Government officials: *Stuart Wainwright (GoS).*

Secretariat: [redacted]

Names of junior officials and the secretariat are redacted.

Participants who were Observers and Government Officials were not consistently recorded therefore this may not be a complete list.

Twenty-seventh SAGE meeting on Covid-19, 21st April 2020
Held via Zoom

Summary

1. SAGE advises that, on balance, there is enough evidence to support recommendation of community use of cloth face masks, for short periods in enclosed spaces where social distancing is not possible.
2. There is heterogeneity among people's antibody response to infection, and longer-term immunity is unclear.

Situation update

3. Hospital numbers are plateauing, with numbers of new admissions falling. NHS remains well within bed capacity, but with challenges around capacity for some forms of specialist treatment such as renal replacement therapy.
4. There is no indication that R is greater than 1 across any region, but there could still be more localised outbreaks.

ACTION: SAGE secretariat to establish destination and use of 'Nowcasts' in Cabinet Office to ensure these are being fed to local planners and NHS (before next SAGE meeting on 23 April)

Understanding COVID-19

5. There is a clear signal that obesity is a risk factor. CMO will consider what the appropriate public advice is, and for which groups.
6. Anosmia is a common symptom. There is little evidence for it presenting ahead of or unaccompanied by other symptoms. It may be possible to analyse data from previous studies to better understand the predictive value of changing the case definition.
7. It will be useful to reconsider other potential symptom clusters, particularly ahead of implementation of any rapid contact tracing.
8. Further work is being carried out on ethnicity, deprivation, and mortality, including making use of multiple datasets to better understand socioeconomic and other factors. This is a high priority and the support of NHSX will be important.

ACTION: CMO to consider public messaging on obesity and risk for Covid-19

ACTION: Calum Semple to provide a further update on ethnicity and mortality to SAGE on 28 April, including indicative timelines for a full report – to include data from Andrew Morris, ONS and research commissioned by NIHR; **NHSX** to confirm it is placing a high priority on collecting data to understand ethnicity and mortality

ACTION: NERVTAG and **dCMO** to finalise assessment of anosmia and consider other symptom clusters which might be critical to contract rapid contact tracing after release of distancing measures

ACTION: CSA FCO to investigate differences in mortality rates between Germany (and other countries) in relation to demography, ethnicity and other factors and report back by 28 April

Community face mask use

9. The evidence on effectiveness of masks for source control (i.e. stopping infectious people – pre-symptomatic/asymptomatic – from infecting others) is weak. Evidence for protecting the mask wearer from becoming infected is also weak. The unusual situation for COVID is the relatively high infectiousness before symptoms appear.
10. Overall, the evidence that exists is marginally positive for the use of masks.

11. The effect of wearing a mask is likely to be small but not zero. The RCT evidence is weak and it would be unreasonable to claim a large benefit from wearing a mask.
12. Any policy decision taken must not jeopardise supply of masks to those settings where the evidence for use of masks is stronger and the effect size important (i.e. Health and Social Care settings).
13. SAGE advice below refers to cloth masks – specifically in the context of releasing lockdown measures.
14. On balance, there is evidence to recommend the use of cloth masks in certain higher-risk settings as a precautionary measure where masks could be at least partially effective.
15. The common denominator is that these settings are enclosed spaces where social distancing is not possible consistently, creating a risk of close social contact with multiple parties the person does not usually meet.
16. Public transport and some shops (if crowded) are examples of such settings. Distancing remains the preferred option where possible.
17. In such settings, evidence would support a policy where cloth masks could be used for short durations where unavoidable closer interactions with others are occurring or likely.
18. By contrast, SAGE does not think there is good evidence for use for long periods where people regularly mix with the same people.
19. Working environments vary in many respects and where there is a risk of close social contact with multiple parties the person does not usually meet, use of masks may offer some benefit.
20. The evidence does not support a recommendation to wear masks outdoors in either urban or non-urban environments, unless in an unavoidable crowded situation.
21. This advice does not replace or change existing advice on other measures – such as hand washing, 2-metre distancing and self-isolation – which remain more important (because of stronger evidence and larger effects).
22. Negative behavioural impacts cannot be ruled out, e.g. those with symptoms who should isolate instead choose to break quarantine wearing a mask or repeated handling of the mask could increase hand-face contact
23. Equally, wearing masks in the context of lifting NPIs could reduce anxiety about release of measures, or reinforce the need for distancing measures.
24. Clear public guidance would be needed on mask design/construction, wearing, handling, cleaning and disposal.

ACTION: PHE, with **NHS** and **HSE**, to review understanding of Covid-19 survival rates on a range of mask types, and processes for mask sterilisation (for next SAGE meeting on 23 April)

ACTION: SAGE secretariat to summarise SAGE advice today on public use of cloth face masks for **CMO** to submit to Ministers alongside policy and operations advice

Testing and immunity

25. There is heterogeneity in people's antibody response to infection, though most have a response within 10 days. In milder cases measurable antibody responses take longer or in some cases are undetectable.
26. It is important to understand whether antibodies being measured are neutralising antibodies or binding antibodies.
27. It is not known how long the antibody response lasts, and there is mixed evidence from other coronaviruses. It will not be possible to develop a clearer answer on the long-term response for some time, given the novelty of Covid-19.
28. This makes using serology to understand how many people have had the virus difficult, and presents challenges around "immunity passports", for which retesting would be required.

29. If vaccines become available, the immunity derived from them may look different from natural immunity.
30. SAGE advises that testing volume requirements for viral tests will be dependent on incidence levels and the extent of contact tracing linked to testing.

ACTION: SAGE secretariat to summarise sampling numbers against various future options to inform testing strategy, including inputs from John Edmunds (paper already reviewed) and from CMO and NHS (on health and social care needs) and send to Cabinet Office

ACTION: UKRI (and other research funders) to consider funding of longitudinal research studies on immunity (as identified in *Immune Response to SARSCoV2* paper)

ACTION: GCSA to discuss seroprevalence studies with **Jeremy Farrar** before next SAGE meeting on 23 April

Principles for reducing transmission

31. SAGE noted the outline principles and agreed that the table developed should be shared with Cabinet Office.
32. Work underway to better understand transmission in schools was noted.
33. Work underway to better understand the impact of distancing measures on vulnerable groups was noted.

ACTION: DfID CSA to provide an update on the role of children in Covid-19 transmission, including the effects of increased school attendance (for next SAGE meeting on 23 April)

SAGE Secretariat to send "Principles for reducing transmission" paper to Cabinet Office by 21 April

Nosocomial transmission

34. SAGE noted plans underway for prevalence studies in hospitals, which could support analysis intended to understand whether nosocomial transmission levels could be correlated to IPC practices.
35. SAGE noted the importance of providing rapid feedback to hospitals where data suggested transmission was a potential issue. The risk of hospitals amplifying transmission in communities was highlighted.
36. PHE confirmed that links to NHS and action to implement changes are all in place and working.

List of Actions

SAGE secretariat to establish destination and use of 'Nowcasts' in Cabinet Office to ensure these are being fed to local planners and NHS (before next SAGE meeting on 23 April)

CMO to consider public messaging on obesity and risk for Covid-19

Calum Semple to provide a further update on ethnicity and mortality to SAGE on 28 Apr, including indicative timelines for a full report – to include data from Andrew Morris, ONS and research commissioned by NIHR; **NHSX** to confirm it is placing a high priority on collecting data to understand ethnicity and mortality

NERVTAG and **dCMO** to finalise assessment of anosmia and consider other symptom clusters which might be critical for the contract rapid contact tracing after release of distancing measures

CSA FCO to investigate differences in mortality rates between Germany and other countries and report back by 28 April

PHE, with **NHS** and **HSE**, to review understanding of Covid-19 survival rates on a range of mask types and processes for mask sterilisation (for next SAGE meeting on 23 April)

SAGE secretariat to summarise SAGE advice today on public use of cloth face masks for **CMO** to submit to Ministers alongside policy and operations advice

UKRI (and other research funders) to consider funding of longitudinal research studies on immunity (as identified in *Immune Response to SARSCoV2* paper)

SAGE secretariat to summarise sampling numbers against various future options to inform testing strategy, including inputs from John Edmunds and from CMO and NHS (on health and social care needs) and send to Cabinet Office

GCSA to discuss serology testing with **Jeremy Farrar** before next SAGE meeting on 23 April

DfID CSA to provide an update on the role of children in Covid-19 transmission, including the effects of increased school attendance (for next SAGE meeting on 23 April)

SAGE Secretariat to send "Principles for reducing transmission" paper to Cabinet Office by 21 April

Attendees

SAGE participants: *Patrick Vallance, Chris Whitty, Jonathan Van Tam, Jenny Harries, Angela McLean, John Aston, Carole Mundell, Andrew Curran, Charlotte Watts, Andrew Morris, Steve Powis, Sharon Peacock, Maria Zambon, Yvonne Doyle, Cath Noakes, Andrew Rambaut, Wendy Barclay, Peter Horby, Calum Semple, Graham Medley, Neil Ferguson, John Edmunds, Julia Gog, James Rubin, Brooke Rogers, Lucy Yardley, Ian Diamond, Jeremy Farrar, Ian Young, Rob Orford, Nicola Steedman, Venki Ramakrishnan, David Spiegelhalter, Mark Walport, Mike Parker, Ian Boyd*

SAGE secretariat: [redacted]
Stuart Wainwright

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Twenty-eighth SAGE meeting on Covid-19, 23rd April 2020
Held via Zoom

Summary

1. SAGE discussed volumes needed for a viral testing strategy and behavioural aspects associated with testing

Situation update

2. Latest numbers indicate a slow but steady reduction in hospital admissions and bed numbers (including for ICUs).
3. Hospital deaths recorded by date of death are showing a declining trend despite daily fluctuations in the data.
4. A small but significant proportion of deaths relate to deaths in care homes, rather than in hospitals.
5. A study of the first 100 UK hospital patients gives an average length of stay in ICU of 10 days.

ACTION: SPI-M to share insights on nosocomial infection in specific NHS Trusts with NHS Medical Director to ensure this is fed appropriately to relevant NHS Trusts

ACTION: NHS to send ICNARC data to be placed in SAGE papers repository (ahead of next SAGE meeting on 28 April)

Understanding Covid-19

6. There is weak evidence internationally on how long the virus can survive on facemasks; it may survive for up to 7 days.
7. PHE is leading UK-funded research to understand this, which should be completed within the next three weeks.
8. SAGE asked that funders, including UKRI, actively engage in the Health Data Research (UK) process when making funding decisions on SAGE priority questions relevant to health data.

ACTION: SAGE secretariat to circulate Health Data Research paper to SAGE participants for comment, including on prioritisation (Appendix 2) by 27 April; **John Aston** and **Andrew Morris** to incorporate questions from the 'Research Questions for Covid-19' into Appendix 2

ACTION: UKRI to publish 'Research Questions for Covid-19' on its Covid-19 web portal, subject to SAGE secretariat confirmation; **UKRI** to liaise with **John Aston** and **Andrew Morris** on how to link questions in Health Data Research paper to its Covid-19 web portal

Testing Strategy and lifting measures

9. SAGE discussed indicative numbers required for viral testing.
10. The NHS is asking Trusts to start testing every patient admitted to hospital from Monday onwards, rather than only testing symptomatic patients.
11. Over the weekend 11 NHS Trusts will be testing 500 asymptomatic staff to inform a strategy for routine staff testing.
12. SAGE agreed the importance of understanding total testing capacity and what level of incidence it could cope with, as well as how far the epidemic needs to wane before the system can feasibly track and trace.
13. Preliminary calculations suggest the level of incidence could fall to ~4,000 cases a day by May 4th, and to ~1,000 cases per day by May 11th. These are to be reviewed by SPI-M, who should return, including with confidence intervals.
14. SAGE agreed that further discussions are needed to determine a testing strategy to reduce spread in care homes and advised that a suitable leader for this work is required.

ACTION: CMO and **NHS** to provide viral testing volumes needed for hospital entrants and patients returning to social care settings by COP 23 April as part of an overall paper on testing numbers (action completed during meeting)

ACTION: DfID CSA to lead working group to advise on testing strategy for care homes (including volumes required) and on reducing spread

15. SAGE discussed behavioural considerations associated with antibody testing, including false positive results and their potential impacts on behaviour.
16. Studies have shown that people who think they've already contracted Covid-19 are less likely to adhere to social distancing.
17. SAGE advised that DHSC officials developing the testing strategy, including for home antibody kits, should factor in the behavioural insights produced by SPI-B.
18. SAGE reiterated the importance of clear public communications around the purpose of antibody testing, and what different results mean in terms of immunity, to influence public behaviour post testing. Currently we do not know enough to be able to provide this information in relation to immunity status.
19. SAGE noted the importance of exploring potential variation in behaviours according to socio-economic status; there is some evidence that poorer people are engaging in more social contacts outside the home (as are people who have previously self-diagnosed for Covid-19 and now possibly feel immune).

ACTION: SAGE secretariat to send SPI-B's initial view on behavioural considerations for testing to DHSC (Tasmin Berry) by 24 April

ACTION: **SAGE secretariat** to send SPI-B's initial view on behaviours required for a suppress and control route to Cabinet Office by 24 April

Public order

20. SAGE noted the importance of continually considering and testing the legitimacy and equity of lockdown measures, as well as thinking about approaches to addressing this.
21. SAGE also noted the importance of developing evaluation strategies before measures are lifted.

ACTION: SPI-B to contact No10 (Ben Warner) on accessing polling data (if not already available) and identify any additional questions which should be included in polling surveys (ahead of next SAGE meeting on 28 April)

ACTION: SAGE Secretariat to highlight to C-19 secretariat SAGE advice on developing evaluation strategies before measures are lifted

Vaccines and therapeutics

22. Work is underway to engage with international biotech and vaccine companies; and to develop UK vaccine manufacturing capacity in the short and longer term.
23. On therapeutics, the UK has initiated clinical trials in primary care, and for patients in hospital and in ICU, focusing on repurposed medicines
24. Repurposed medicines are unlikely to deliver a game-changing breakthrough for treating the virus; there is a separate focus on alternative treatments including novel, pre-licensed compounds, with urgent trials starting shortly.

ACTION: CMO, **GCSA** and **NHS Medical Director** to consider options to increase take up of participants in vaccine and therapeutic trials (ahead of next SAGE meeting on 28 April)

List of actions

SPI-M to share insights on nosocomial infection in specific NHS Trusts with NHS Medical Director to ensure this is fed appropriately to relevant NHS Trusts

NHS to send ICNARC data to be placed in SAGE papers repository (ahead of next SAGE meeting on 28 April)

SAGE secretariat to circulate Health Data Research paper to SAGE participants for comment, including on prioritisation (Appendix 2) by 27 April; **John Aston** and **Andrew Morris** to incorporate questions from the 'Research Questions for Covid-19' into Appendix 2

UKRI to publish 'Research Questions for Covid-19' on its Covid-19 web portal, subject to SAGE secretariat confirmation; **UKRI** to liaise with **John Aston** and **Andrew Morris** on how to link questions in Health Data Research paper to its Covid-19 web portal

CMO and **NHS** to provide viral testing volumes needed for hospital entrants and patients returning to social care settings by COP 23 April as part of an overall paper on testing numbers (action completed during meeting)

DfID CSA to lead working group to advise on testing strategy for care homes (including volumes required) and on reducing spread

SAGE secretariat to send SPI-B's initial view on behavioural considerations for testing to DHSC (Tasmin Berry) by 24 April

SAGE secretariat to send SPI-B's initial view on behaviours required for a suppress and control route to Cabinet Office by 24 April

SPI-B to contact No10 (Ben Warner) on accessing polling data (if not already available) and identify any additional questions which should be included in polling surveys (ahead of next SAGE meeting on 28 April)

SAGE Secretariat to highlight to C-19 secretariat SAGE advice on developing evaluation strategies before measures are lifted

CMO, **GCSA** and **NHS Medical Director** to consider options to increase take up of participants in vaccine and therapeutic trials (ahead of next SAGE meeting on 28 April)

Attendees

Scientific experts: Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (dCMO), Jenny Harries (dCMO), Angela McLean (CSA MoD), John Aston (CSA HO), Carole Mundell (CSA FCO), Charlotte Watts (CSA DfID), Steve Powis (NHS), Calum Semple (Liverpool), Maria Zambon (PHE), Yvonne Doyle (PHE), Graham Medley (LSHTM), Neil Ferguson (Imperial), John Edmunds (LSHTM), Julia Gog (Cambridge), James Rubin (King's), Brooke Rogers (King's), Theresa Marteau (Cambridge), Cath Noakes (Leeds), Andrew Rambaut (Edinburgh), Wendy Barclay (Imperial), Peter Horby (Oxford), Andrew Morris (Scottish Covid-19 Advisory Group), Ian Diamond (ONS), Ian Young (CMO Northern Ireland), Rob Orford (Health CSA Wales), Nicola Steedman (dCMO Scotland), Jeremy Farrar (Wellcome), Venki Ramakrishnan (Royal Society), Mike Parker (Oxford), Ian Boyd (St Andrews), Mark Walport (UKRI)

HMG: Dominic Cummings (No. 10)

SAGE Secretariat: [redacted]

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Twenty-ninth SAGE meeting on Covid-19, 28th April 2020
Held via Zoom

Summary

1. SAGE agreed priority studies including work on potential Kawasaki like syndrome in children, longitudinal studies on survivors to assess immunology and respiratory function, and further work around biological mechanisms of key risk factors.
2. Hospital admission numbers are currently likely to provide a better basis for ongoing monitoring of the disease than estimated community incidence levels, given the greater certainty in the hospital numbers.
3. The '2m rule' remains appropriate, though closer contacts of a short duration are likely to pose a very low risk. Other considerations for reducing transmission include cleaning, building occupation density and ventilation.

Introduction

4. SAGE welcomed and endorsed plans to increase transparency, including releasing names of consenting participants. Advice on security and media handling will be provided.
5. Ian Boyd suggested ways SAGE might operate more effectively, in his role as an independent challenge function.
6. SAGE agreed to update the minute from SAGE 27 on 21 April to clarify its advice on face masks, to include the line 'the RCT evidence is weak and it would be unreasonable to claim a large benefit from wearing a mask'.

ACTION: SAGE secretariat to circulate advice on personal and cyber security and on responding to media queries to SAGE participants by 30 April, ahead of putting attendance details into the public domain. SAGE participants to provide contact details for security information.

ACTION: SAGE secretariat to place ongoing SAGE action list (with completion status) and summary of SAGE advice to date in the document repository

ACTION: SAGE secretariat to update minutes from SAGE 27 on 21 April to include point on RCT evidence

Situation update

7. Latest numbers indicate a continued reduction in hospital admissions and bed numbers. The peak in care home cases and mortality is later than for hospital cases.
8. Short-term forecasts indicate linear decreases on all measures over the next 2 weeks.
9. The proportion of cases acquired through nosocomial transmission may be increasing again. SAGE noted work underway to test new admissions to hospital, as well as asymptomatic staff.
10. Infection fatality rate and infection hospitalisation rate estimates vary depending on the data sources used. More serology would make this clearer.
11. Death data reporting improvements were noted and welcomed. Excess all-cause mortality was agreed to be the most useful comparison between countries.

ACTION: Angela McLean to work with **SPI-M** to search for consensus across the differing research groups on assumed infection hospitalisation rates by age; **Angela McLean** and **Neil Ferguson** to send their assumptions on infection fatality rates to SPI-M, SAGE secretariat and GCSA by 30 April

Nosocomial working group and PHE to provide full update to SAGE on nosocomial infection at 30 April meeting

Understanding Covid-19

12. Possible Kawasaki-like syndrome in children was noted, with a probable link to Covid-19. SAGE agreed that work to understand this should be coordinated.
13. Previous SAGE advice on immunity remains current. A better understanding would require more serology and longitudinal studies.
14. SAGE reiterated the importance of cohort studies of Covid-19 survivors to understanding longer-term effects.
15. CO-CIN analysis indicates that differences in admissions to ITU and mortality by ethnicity can be explained by comorbidities and are unlikely to be a result of management pathways in hospital. Other studies on this issue are underway, and SAGE will consider these when results are available, which may be next week.
16. SAGE agreed that mechanistic studies of key risk factors such as sex and obesity, and effects of increased thrombogenicity, would be valuable.

ACTION: CMO, NHS Medical Director, Jeremy Farrar and Calum Semple to ensure efforts to understand potential new syndrome in children possibly related to Covid-19 are coordinated

ACTION: UKRI to review whether ISARIC cohort studies following discharged Covid-19 patients are sufficient and to identify any addition longitudinal research required, with input from **Calum Semple**, **NHS Medical Director, dCMO,** and **UK Biobank**

ACTION: CMO to present full review of ethnicity risk factors when study results are available

ACTION: NERVTAG to consider risk scoring approaches for propensity to Covid-19, including obesity individually or among a group of factors; **UKRI** to consider funding research on Covid-19 risk factors, including obesity and sex, by end of the week.

Testing strategy and monitoring

17. SAGE agreed that hospital admissions are currently likely a better basis for ongoing monitoring than estimates of incidence in the community (but are a lagging indicator). When considering changes to NPI, an acceptable level of admissions could be determined and tracked against (though this is not for SAGE to determine). Regional and local variation should be expected and needs to be monitored.
18. Estimates of community incidence should improve when the ONS study begins to report.
19. Combining several indicators for monitoring is likely to be preferable to relying upon a single one. This could include some which are more leading indicators than hospital admissions. PHE plans for monitoring and surveillance were noted. SAGE views the urgent establishment of monitoring and surveillance as a key requirement for managing Covid-19.
20. SAGE would be able to provide an estimate of the number of tests required as part of a contact tracing programme based on the policy mix chosen. SAGE has provided a framework for some of the policy choices.
21. SAGE agreed to consider whether there is merit in testing all contacts of index cases.

ACTION: Charlotte Watts to present paper on testing in care homes at 7 May meeting

ACTION: SAGE secretariat to circulate small-group meeting note on monitoring to SAGE participants today; **PHE** to provide comments by 30 April on potential early monitoring indicators and their sensitivity to detecting outbreaks

ACTION: SPI-M and **NERVTAG** to provide testing paper for 30 April meeting, addressing whether all contacts need to be tested - **SPI-B** and **Mike Parker** to provide input and international evidence to be considered

NPI modelling

22. SAGE endorsed the SPI-M consensus paper and agreed it was not practical to give detailed quantitative advice on the impact of changes to individual measures.
23. SAGE will provide principles to Cabinet Office to support design of policy packages and will provide advice on the possible impact of options developed. SAGE will provide a summary chart of removal of BSIs and broad magnitude of effect (similar to the chart produced for starting BSIs).

Environmental Transmission

24. SAGE endorsed the paper from the Environmental and Modelling group.
25. The 2m rule remains appropriate, though short-duration closer contacts are likely to present very low risk.
26. SAGE noted that the virus is likely to survive much longer on surfaces than in air. The risk of airborne transmission is relatively low outside healthcare settings.
27. Cleaning will remain important as changes are made to BSIs and it will be important to enable that (e.g. through appropriate provision of materials and facilities). This may also need to be reflected in guidance to organisations such as employers and service providers.
28. Other factors to consider will include building occupancy density, and ventilation.
29. SAGE noted the importance of understanding the different activities that make up different jobs in order to assess associated risks.

ACTION: Cath Noakes to prepare shareable version of EMG paper for SAGE endorsement for 30 April meeting, ahead of circulation within HMG

Borders

30. As the number of cases in the UK decreases, the potential proportion of imported cases may increase. It is possible to estimate the number of cases which may be imported and their proportion of the total.
31. Determining a tolerable level of risk from imported cases requires consideration of a number of non-science factors and is a policy question.
32. Measures implemented at the border may change the level of risk and these will be reviewed.

ACTION: SAGE secretariat to provide COG evidence on overseas seeding of Covid-19 in UK to CSA HO by 28 April; CSA HO to present SAGE advice to Cabinet Office, and follow up with SAGE as required

List of actions

SAGE secretariat to circulate advice on personal and cyber security and on responding to media queries to SAGE participants by 30 April, ahead of putting attendance details into the public domain. SAGE participants to provide contact details for security information.

SAGE secretariat to place ongoing SAGE action list (with completion status) and summary of SAGE advice to date in the document repository

SAGE secretariat to update minutes from SAGE 27 on 21 April to include point on RCT evidence

CMO, NHS Medical Director, Jeremy Farrar and Calum Semple to ensure efforts to understand potentially new syndromes in children possibly related to Covid-19 are coordinated

Angela McLean to work with **SPI-M** to search for consensus across the differing research groups on assumed infection hospitalisation rates by age; **Angela McLean** and **Neil Ferguson** to send their assumptions on infection fatality rates to SPI-M, SAGE secretariat and GCSA by 30 April

PHE to provide full update to SAGE on nosocomial infection at 30 April meeting

UKRI to review whether ISARIC cohort studies following discharged Covid-19 patients are sufficient and identify any addition longitudinal research required, with input from **Calum Semple**, **NHS Medical Director, dCMO,** and **UK Biobank**

CMO to present full review of ethnicity risk factors when study results are available

NERVTAG to consider risk scoring approaches for propensity to Covid-19, including obesity individually or among a group of factors; **UKRI** to consider funding research on Covid-19 risk factors, including obesity and gender by 5 May

Charlotte Watts to present paper on testing in care homes at 7 May meeting

SAGE secretariat to circulate small-group meeting note on monitoring to SAGE participants today; **PHE** to provide comments by 30 April on potential early monitoring indicators

SPI-M and **NERVTAG** to provide testing paper for 30 April meeting, addressing whether all contacts need to be tested - **SPI-B** and **Mike Parker** to provide input and international evidence to be considered

Cath Noakes to prepare shareable version of EMG paper for SAGE endorsement for 30 April meeting, ahead of circulation within HMG

SAGE secretariat to provide COG evidence on overseas seeding of Covid-19 in UK to CSA HO by 28 April; CSA HO to present SAGE advice to Cabinet Office, and follow up with SAGE as required

Scientific experts: *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (dCMO), Jenny Harries (dCMO), Andrew Curran (CSA HSE), Angela McLean (CSA MoD), John Aston (CSA HO), Carole Mundell (CSA FCO), Charlotte Watts (CSA DfID), Steve Powis (NHS), Calum Semple (Liverpool), Maria Zambon (PHE), Yvonne Doyle (PHE), Graham Medley (LSHTM), Neil Ferguson (Imperial), John Edmunds (LSHTM), James Rubin (King's), Brooke Rogers (King's), Cath Noakes (Leeds), Andrew Rambaut (Edinburgh), Wendy Barclay (Imperial), Peter Horby (Oxford), Andrew Morris (Scottish Covid-19 Advisory Group), Ian Diamond (ONS), Ian Young (CMO Northern Ireland), Rob Orford (Health CSA Wales), Fliss Bennee (Health CSA Wales), Sheila Rowan (CSA Scotland), Nicola Steedman (dCMO Scotland), Jeremy Farrar (Wellcome), Venki Ramakrishnan (Royal Society), Mike Parker (Oxford), Ian Boyd (St Andrews), Mark Walport (UKRI)*

HMG: *Vanessa MacDougall (HMT), Ben Warner (No. 10), Stuart Wainwright (GO-S), Paul McCloghrie (GO-S), [redacted] Bev Nash (PHE), Laura Pimpin (No. 10), [redacted]. A number of other departments were in attendance.*

SAGE secretariat: [redacted]

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Thirtieth SAGE meeting on Covid-19, 30th April 2020
Held via Zoom

Summary

1. SAGE endorsed papers from the Environmental and Modelling Group and from the Chief Veterinary Officer – and SPI-M's most recent consensus statement on R.
2. SAGE advised on the need for more comprehensive availability and deployment of the seasonal flu vaccine this coming winter.
3. SAGE subgroups will meet on 1 May to provide advice on testing and on options for opening schools.

Situation update

4. Hospital admissions are declining consistently across the country.
5. CO-CIN is recording hospital readmissions – these data will be analysed in due course.
6. CO-CIN evidence shows improving survival rates for ventilated patients compared to the start of the outbreak.
7. SAGE agreed with the most recent SPI-M assessment of R, including regional values.
8. There is no evidence that compliance with social distancing measures is declining in terms of contacts.
9. SAGE noted that genomics data are an increasingly rich source, including for understanding the origins of initial UK cases and identifying nosocomial transmission.

Nosocomial update

10. There is variation in levels of nosocomial transmission, with a rebound and persistent rise in some Trusts, according to CO-CIN data.
11. There remains significant transmission in care homes, but numbers are plateauing. It will take a few more days before there can be greater confidence that these numbers are in fact stabilising.
12. The Nosocomial Working Group has 4 workstreams exploring: evidence synthesis, including work within the UK, international comparators and literature; modelling to understand the role of hospital onset Covid-19 infection and the impact of IPC; surveillance, including CO-CIN data and refining definitions, and intervention/ implementation, including cascading guidance and tools to Trusts.
13. There is sufficient genetic variation to use viral sequencing to help identify specific outbreaks.
14. A substantial surveillance system is needed to reduce transmission.
15. A recent NHS study suggests a positive test rate among asymptomatic healthcare workers of 5-6%.
16. Understanding the causes of transmission in care homes is more challenging, where the key limiting factors are availability of metadata and material to sequence.

ACTION: Nosocomial Working Group and **SAGE subgroup on care homes** to ensure evidence, strategy and approach are shared and coordinated. Advice needs to be fully linked to NHS for action.

ACTION: Nosocomial Working Group to ensure all relevant SPI-M modelling on hospital-borne infections is incorporated into its analysis

Understanding COVID-19

17. SAGE endorsed the Environmental and Modelling Group paper, which contains additional thinking on maintaining two metres distance in social situations and requested an updated version for final review.
18. SAGE agreed that the single most important metric for understanding the overall impact of pandemic is all-cause mortality, age-standardised, since it accommodates changing

definitions of the disease over time and indirect deaths, and it better enables valid international comparisons.

19. SAGE also noted the value of other metrics, including years of life lost and partitioning of contributory factors to all-cause mortality (although data on these won't be available for some months).
20. SAGE endorsed a paper from the Chief Veterinary Officer on zoonosis, which is not currently contributing to the overall epidemic.
21. SAGE agreed on the importance of sequencing the virus in animals.

ACTION: Cath Noakes to share final version of Environmental and Modelling Group paper with SAGE secretariat to allow a final review, via correspondence, by SAGE

ACTION: APHA to contact Sharon Peacock if animal isolates of Covid-19 suitable for genomic sequencing exist

Therapeutics

22. There are 3 platform trials in the UK for repurposed drugs, of which the biggest is the RECOVERY trial.
23. RECOVERY is currently testing 5 drugs and is looking to begin trialling convalescent plasma shortly. There are currently no safety concerns. Initial outcomes are expected in around a fortnight.
24. The new ACCORD initiative is rapidly evaluating more novel and unlicensed drugs, mainly biologics, in smaller numbers of patients to identify any potentially game-changing signals.
25. The US trial on Remdesivir headline results suggest a statistically significant signal of efficacy that was not seen in a smaller Chinese trial. Full results from the US trial are not yet available.
26. SAGE noted the challenges of manufacturing Remdesivir and the importance of funding trials for therapeutics as well as for vaccines.

Vaccines

27. There are around 200 candidate vaccines worldwide – of which around 70 or so are credible and fewer than a dozen might be considered front runners.
28. SAGE was updated on the status of the Oxford and Imperial vaccine trials – and noted the importance of innovative trial design.
29. SAGE noted the risk of focusing too heavily on the spike protein in developing a viable vaccine, and the value of exploring other protein targets and alternative approaches such as small interfering RNAs and neutralising antibodies.
30. SAGE advised that, in addition to the importance of developing a vaccine for Covid-19, a clear UK plan is required for the seasonal flu vaccine for winter 2020-21, including consideration of whether to vaccinate the entire UK population.

ACTION: DHSC to develop a clear policy on prioritising uptake of seasonal flu vaccine for 2020

Testing and contact tracing

31. SAGE discussed principles for testing in a contact tracing system – as well as the various challenges involved.
32. It agreed that the speed at which test results can be returned and the performance of testing are important factors in determining whether contacts should be isolated following a positive test for the index case, or following reported symptoms only.
33. The speed at which contacts are identified and isolated is important and the paper analysing effects at 24, 48 and 72 hours was noted.

34. Behavioural considerations are also important. Factors such as length of isolation required and the acceptability of tracing methods may impact adherence.
35. SAGE agreed that a sub-group of participants would hold a dedicated meeting on 1 May to seek to finalise advice. At the meeting, the sub-group will discuss/review the following:

    a) questions -

    i. Does SAGE agree we would ideally want to isolate contacts of an index case and identify more than 80% of those contacts within 24 hours? What would be the implications of a delay to 48 or 72 hours?

    ii) If rapid test results (within 24/48 hours) can be turned around is it reasonable only to isolate contacts after a positive test result? It is assumed that contact *tracing* would happen in advance of test result, this is contact notification.

    b) principles -

    iii. While testing of contacts is challenging (because of false negatives), some sample testing of contacts is needed in order to optimise the overall testing and tracing system.

    iv. It may be possible to work out the number of contact tracing workers required based on the principles SAGE proposes alongside the overall incidence of new cases.

    v. The effectiveness of the overall system needs to be measured.

    vi. Backwards contact tracing from index cases may also be useful. Comparison with what other countries have done is essential

Children and schools

36. SAGE noted that evidence concerning the role of children in transmission and their susceptibility to infection remains inconclusive. Data suggest that children who are infected have similar viral loads to adults.
37. The sub-group examining this set of issues has modelled the impacts of 7 scenarios suggested by DfE, with input from SPI-M, SPI-B and NERVTAG.
38. Results from 4 different models – all based on a conservative assumption that children are equal to adults in terms of spreading the virus and in terms of susceptibility to it – were largely consistent across the 7 scenarios.
39. There is uncertainty about whether younger children may be less susceptible than older children and it is possible a differential policy between primary and secondary school might be supportable. This should be explored.
40. SAGE agreed to hold a dedicated meeting on 1 May to discuss the findings of the sub-group and a range of issues, including susceptibility of children to infection, behavioural aspects and the broader context of other social measures which may remain in place.

List of Actions

Nosocomial Working Group and **SAGE subgroup on care homes** to ensure evidence, strategy and approach are shared and coordinated

Nosocomial Working Group to ensure all relevant SPI-M modelling on hospital-borne infections is incorporated into its analysis

Cath Noakes to share final version of Environmental and Modelling Group paper with SAGE secretariat to allow a final review, via correspondence, by SAGE

APHA to contact Sharon Peacock if animal isolates of Covid-19 suitable for genomic sequencing exist

DHSC to develop a clear policy on prioritising uptake of seasonal flu vaccine for 2020

Attendees

Scientific experts (40): Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (dCMO), Jenny Harries (dCMO), Andrew Curran (CSA HSE), Angela McLean (CSA MoD), John Aston (CSA HO), Carole Mundell (CSA FCO) (first half), Charlotte Watts (CSA DfID) (second half), Osama Rahman (CSA DfE), Steve Powis (NHS), Calum Semple (Liverpool), Maria Zambon (PHE), Sharon Peacock (PHE), Yvonne Doyle (PHE), Graham Medley (LSHTM), Julia Gog (Cambridge), Neil Ferguson (Imperial), John Edmunds (LSHTM), [redacted] *Brooke Rogers (King's), Lucy Yardley (Bristol), Cath Noakes (Leeds), Andrew Rambaut (Edinburgh), Wendy Barclay (Imperial), Peter Horby (Oxford), Andrew Morris (Scottish Covid-19 Advisory Group), Ian Diamond (ONS), Ian Young (CMO Northern Ireland), Rob Orford (Health CSA Wales), Fliss Bennee (Health CSA Wales), Sheila Rowan (CSA Scotland), Nicola Steedman (dCMO Scotland),* [redacted]*, Jeremy Farrar (Wellcome), Venki Ramakrishnan (Royal Society), Michael Parker (Oxford), Ian Boyd (St Andrews), Mark Walport (UKRI), Jim McMenamin (Health Protection Scotland)*

Government officials (9): Vanessa MacDougall (HMT), [redacted] *Ben Warner (No. 10), Dominic Cummings (No. 10),* [redacted] *Indra Joshi (NHSX), Stuart Wainwright (GO-S)*

SAGE secretariat [redacted] *Simon Whitfield (GO-S),* [redacted]

Total participants: 60

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Thirty-first SAGE meeting on Covid-19, 1st May 2020, 1115-1215
Held via Zoom

Summary

1. Younger children might be less susceptible to infection (low degree of confidence) but are less susceptible to clinical disease (moderate to high degree of confidence) than adults; there is not enough evidence to determine whether this is also the case for older children.
2. It is not clear whether transmissibility by children is lower than in adults, but some variable evidence indicates that this may be the case for younger (up to age 11-13) children (low confidence).
3. For a variety of reasons reopening options relating to younger children are lower risk than those related to older children.
4. Indirect effects of re-opening schools (regardless of which option is taken) are likely to have a greater impact on transmission than schools themselves (e.g. work-related reopening, behaviour changes)
5. SAGE advises that effective measures should be in place to monitor the effects of any change in schools, and to respond to cases within schools.

Infection and transmission in children

6. Evidence indicates that the severity of disease in children is lower than in adults (high degree of confidence).
7. The susceptibility of younger (up to age 11-13) children to clinical disease is lower than for adults (moderately high degree of confidence). For older children there is not enough evidence to determine whether susceptibility to disease is different to adults.
8. The susceptibility of younger (up to age 11-13) children to infection might be lower than for adults (low degree of confidence). For older children there is not enough evidence to determine whether susceptibility to infection is different to adults.
9. There is no evidence to suggest that children transmit the virus any more than adults. There are some studies that suggest that younger children may transmit less, but evidence is mixed and provides a low degree of confidence at best.
10. These dynamics may vary continuously with age in children. It is also possible that there is discontinuity caused by either biological or behavioural factors, for example factors related to puberty.

Impact of reopening schools

11. Options for partial and full reopening of schools have been modelled.
12. The estimated absolute effect of each option on R varies significantly based on the model and data used and other assumptions made. The models are particularly sensitive to assumptions around susceptibility and infectivity. Some factors cannot practicably be modelled such as increased hygiene and social distancing within schools.
13. Although the overall magnitude of impact varies, the models provide a broad consensus around the relative ranking of impact of different options.
14. SAGE agreed the rank order presented of the impact of the options (moderate confidence).
15. Those options which involve early years settings have a lower impact than those involving primary schools, which in turn have a lower impact than those involving secondary schools. This is driven by the numbers of pupils, and the numbers of contacts per pupil.
16. The consequences of changes in behaviour or contacts outside of schools as a result of schools reopening (such as changes to adherence to measures and to working patterns) are likely to have a larger effect on R than the effect of the schools themselves. These consequences are complex and highly uncertain. Even a short period of reopening may

result in some of these occurring, which may persist even after schools close again for holidays.

17. Social distancing has not been factored into the models. It is difficult to put some of these measures into place in practice in schools, particularly with younger children, but some elements may be achievable. Hygiene will continue to be important in schools.
18. SAGE advises that effective monitoring and reporting is put in place ahead of any reopening. Serology testing to be carried out at the start of the opening period, and repeated would be useful as part of a monitoring programme.
19. SAGE advises that appropriate response plans are put in place to address cases in schools, which may include reactive closures of schools or classes.

Scientific experts: Patrick Vallance (GCSA), Chris Whitty (CMO), Jenny Harries (dCMO), Angela McLean (CSA MoD), Charlotte Watts (CSA DfID), Osama Rahman (CSA DfE), Graham Medley (LSHTM), Julia Gog (Cambridge), Neil Ferguson (Imperial), John Edmunds (LSHTM), Peter Horby (Oxford), Ian Young (CMO Northern Ireland), Rob Orford (Health CSA Wales), Sheila Rowan (CSA Scotland), Nicola Steedman (dCMO Scotland), Jeremy Farrar (Wellcome), Michael Parker (Oxford), Ian Boyd (St Andrews), Russell Viner (UCL), Chris Bonell (LSHTM), Rebecca Allen (Oxford)

HMG & DA Observers: Vanessa MacDougall (HMT), [redacted] Lorna Howarth (DfE), Ben Warner (No. 10), Dominic Cummings (No.10) [redacted] Jim McMenamin (Health Protection Scotland), [redacted] Jonathan Slater (Perm Sec DfE)

SAGE secretariat: [redacted] Simon Whitfield, [redacted] Stuart Wainwright

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Thirty-second SAGE meeting on Covid-19, 1 May 2020
Held via Zoom

Summary

1. SAGE discussed the test and trace system in development. It agreed that at least 80% of contacts of an index case would need to be contacted for a system to be effective.
2. SAGE had high confidence that isolation of contacts of individuals who have Covid-19 within 48 hours was desirable (but the practicality of this will be checked against international experience).
3. Ideally, testing should be so rapid that contacts of an index case are only asked to isolate on the back of a positive test result in the index case.
4. There is currently insufficient evidence to determine whether the testing of index case contacts would significantly impact the epidemic compared with isolation alone (nor is it clear when to test to avoid false negatives).

Maximum tolerable time to notification and isolation of contacts

5. The modelling assumes the index case is immediately isolated.
6. Time periods of 0, 24, 48, and 72 hours to the isolation of contacts were modelled (on top of a 48-hour lag for contact tracing).
7. Modelling using app-based tracing assumes contacts are contacted immediately.
8. Modelling suggests that any delay beyond 48-72 hours total before isolation of contacts, results in a significant impact on R. The sooner it is done the better.
9. There is considerable biological and epidemiological uncertainty which has the potential to impact the model. There is uncertainty around potential for transmission before symptom onset: if this is significant (which we believe it is), then the impact of tracing and isolation is much more sensitive to delay.

Optimal number of contacts and tracing time

10. The objectives for a test and trace system should be to isolate as many contacts as possible as quickly as possible while minimising false positives (i.e. isolating contacts unnecessarily because the index case does not have Covid-19).
11. SAGE agreed that at least 80% of contacts of an index case would need to isolate for an effective test and trace system.
12. Tracing of contacts should begin as soon as a new suspected case is identified, in parallel to testing. All individuals declaring symptoms should be tested as quickly as practicable.
13. SAGE agreed, with high confidence, that for the test and trace system to be effective, isolation of contacts of individuals with Covid-19 within 48 hours was desirable but recognised that international experience should be studied.

Isolation of contacts linked to testing

14. SAGE advised that, in the initial phase of the test and trace programme (i.e. over the summer months), contacts should be requested to isolate as soon as they are identified (i.e. based on symptomatic notification), even if test results for the index case are not yet available. Contacts can be released from isolation if the index case tests negative.
15. The aim should be to develop the capability to test index cases in less than 24 hours. When this is possible, contacts could be requested to isolate only when the index case has tested positive.
16. It is considered essential that this testing capability is reached before the autumn/winter flu season when a large number of those reporting symptoms may not have Covid-19.
17. UK test and trace performance and targets should be benchmarked against relevant comparator countries to test the practicability of the proposal against best international experience (e.g. S. Korea, Germany). Final advice on timings will be taken once this information has been reviewed.

18. There are concerns that while the PCR for the test is highly accurate, swabbing – particularly home swabbing – might produce significant false negatives.
19. SAGE advised it is likely that more than one test will be required to confirm that an index case is not positive before contacts can be released, to reduce the risk of releasing potentially infectious people from isolation.
20. A high level of adherence to requests to isolate is required for the system to be effective.
21. Risks include individuals becoming less willing to comply if they are repeatedly asked to isolate and if they are impacted financially from being asked to isolate.
22. The ability to test and release contacts could help mitigate this risk. An accessible offer of financial support to those in need could reduce the risk of non-adherence.
23. The behavioural science opinion was that contact isolation based on a positive test is preferable to contact isolation based on symptoms followed by fast release (<48h) with a negative test.
24. Behavioural scientists also noted that contacts of symptomatically-positive cases could be given different advice to those of test-positive cases to maximise adherence. Over time, both the app and the manual tracing system will be able to stratify risk of infection due to length and nature of contact with an individual who has Covid-19.

Testing of contacts

25. The ability to test and release contacts is desirable from a behavioural (and economic) perspective. However, there is currently insufficient evidence as to how this could be done effectively.
26. For example, the optimal time to test is unclear, given the lag between the point of infection and the replication of the virus to a detectable level. Also unclear is how many tests might be needed to confirm that a contact is not infected.
27. Further evidence is required to establish the relevant parameters. A study should be carried out as soon as the test and trace system is operational.
28. Systematic testing of contacts is therefore not recommended at present but should be reviewed when evidence is available.
29. In the meantime, all contacts should be requested to isolate for 14 days (and be released earlier if the index case is negative). A testing study should be undertaken to determine whether testing can be applied reliably in contacts.
30. There is also a lack of information on modes of transmission in the UK – i.e. how and where people are becoming infected – both in hospitals and in the community. A case-control study is urgently needed.
31. SAGE agreed that backwards contact tracing is part of best practice and should be incorporated into a test and trace strategy.
32. SAGE agreed that ethical issues related to testing and tracing should be examined.

ACTION: CMO to liaise with **NIHR** to put out a high-level call for a study on modes of community and hospital-based transmission; **PHE** to conduct a parallel study

ACTION: CMO to commission **Moral and Ethical Advisory Group** to produce a paper outlining ethical issues raised by the contact tracing app

ACTION: FCO/Cabinet Office international group (Alex Ellis) to produce a paper for SAGE by 7 May comparing international test and trace strategies – including time to test of index case; time to case isolation; whether contacts are isolated after index case tests positive or based on reported symptoms; and protocols for contact release if index case tests negative – and including summaries for key countries such as South Korea and Germany

ACTION: Imperial to share its paper on South Korean test and trace strategy for SAGE meeting on 7 May

ACTION: PHE to consider how backward contact tracing might be incorporated into the system

List of Actions

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PHE to consider how backward contact tracing might be incorporated into the system

Attendees

Scientific experts (19): Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (dCMO), Andrew Curran (CSA HSE), Angela McLean (CSA MoD), Yvonne Doyle (PHE), Graham Medley (LSHTM), Neil Ferguson (Imperial), John Edmunds (LSHTM), [redacted] James Rubin (King's), Lucy Yardley (Bristol), Peter Horby (Oxford), Ian Diamond (ONS), Ian Young (CMO Northern Ireland), Rob Orford (Health CSA Wales), Sheila Rowan (CSA Scotland), Nicola Steedman (dCMO Scotland), Jeremy Farrar (Wellcome)

Observers and Government officials (6): [redacted] *Ben Warner (No. 10), Dominic Cummings (No. 10),* [redacted]

SAGE secretariat [redacted] *Simon Whitfield,* [redacted]

Total participants: 34

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Thirty-third SAGE meeting on Covid-19, 5th May 2020
Held via Zoom

Summary

1. The overall reproduction number, R is in the range 0.5-0.9. If health and social care settings are excluded it is likely to be at the lower end of this range. As community incidence decreases, hospitals and care homes account for an increasing proportion of the overall number of cases. These settings can then drive transmission elsewhere.
2. SAGE advises that, based on current data, focus should be maintained on reducing transmission in health and care settings. Urgent action should be taken in establishments where relevant measures are not already in place, in line with previous advice (such as avoiding movement of patients or staff between establishments, separating people as far as is practical, and testing extensively).
3. SAGE advises that the timing of any changes to NPIs should be determined based on incidence levels and other relevant data and not on predetermined dates.
4. The first phase of the modelled option (as set out in paper 2d – consensus statement) will have a modest impact on R and is unlikely to push it above 1 (high confidence). The second phase of the modelled option is not likely to push R above 1, but this is dependent on an effective test and trace programme being in place (moderate confidence). As this currently stands phase 4 of the modelled option is highly likely to push R above 1 (high confidence).
5. For workers with a high number of contacts, changes to working arrangements may be needed (e.g. half shifts, week on/week off). SAGE recommends against reopening of personal care service businesses as one of the earlier changes to measures.
6. Effective monitoring will need to be in place at a local level when any changes are made, in order to identify and respond to any outbreaks. Monitoring should include sampling of high contact professions.

Reproduction number, incidence and prevalence

7. The overall epidemic can be considered as three separate, but interacting, epidemics: in the community; in hospitals; and in care homes.
8. The overall reproduction number, R is in the range 0.5-0.9. If health and social care settings are excluded it is likely to be at the lower end of this range. A higher degree of precision will be possible with the reporting of the prevalence data being collected by ONS.
9. The rate of decline of hospital Covid-19 admissions is slowing and appears to be flattening in some regions. The rate of decline in R is decreasing, probably driven by the spread related to health and care sectors.
10. As community incidence decreases, hospitals and care homes account for an increasing proportion of the overall number of cases. These settings can then drive transmission elsewhere.
11. It is therefore necessary to reduce transmission in care homes and hospitals in order to effectively manage the epidemic. Reducing this transmission will become a prerequisite to any larger changes in NPIs.
12. Analysis of hospital data indicates that those with better IPC have lower levels of nosocomial transmission, as might be expected. Similar data are not available from care homes.
13. Better data are needed from care homes, as is a better understanding of the different environmental factors affecting spread in care home settings.
14. Data suggest that urgent action should be taken in settings where it is not already underway, in line with previous advice (such as avoiding movement of patients or staff between establishments, separating people as far as is practical, and testing extensively).

15. Estimates of community incidence and prevalence were noted. There is a wide range of estimates for incidence, due to uncertainty about the proportion of infections which are asymptomatic. Currently, it is estimated from ONS data that the prevalence is about 179,000 (based on the number of people who would have swabbed positive with SARS-Cov-2 on 3rd May), and based on this the daily incidence can be estimated at around 18,000 using the assumption that an individual would swab positive for around 10 days. These estimates have very high confidence intervals (confidence in estimates is low).
16. Preliminary swabbing results indicate that a significant proportion of infections are associated with healthcare workers, in both patient-facing and other roles, and in both COVID and non-COVID areas.
17. More work is needed to understand transmission mechanisms, including in care homes and hospitals and in different contact situations. This should include understanding behaviours of healthcare workers.

PHE to confirm the data on different types of transmission in hospitals (healthcare worker to patient, patient to patient, and health care worker to health care worker), by 7 May

ONS to include and over-sample healthcare workers in the next phase of its work on incidence and seroprevalence

Nosocomial Working Group and Environmental Measures Group to work together to consider key questions and data (including international comparators) required to understand more about the detail of transmission in different situations and feed these to UKRI/NIHR for potential research call into Covid-19 transmission mechanisms (including in children and different contact jobs)

Andrew Morris, with **Charlotte Watts** and **Cath Noakes** to identify available data and further requirements on infection transmission of Covid-19 within care home settings, as soon as possible (to be discussed at SAGE on 12 May)

SPI-B to consider adherence to social distancing by healthcare workers, by 12 May

Options for changing non-pharmaceutical interventions

18. SAGE advises that the timing of any changes to measures should be made based on incidence levels and other relevant data and not on a set predetermined date. Modelling of options has been based on some indicative dates provided as part of the Cabinet Office commission (set out in paper 2d), but these should not be seen as fixed. The modelling undertaken relies on assumptions around contact patterns.
19. Though SAGE has primarily considered the effect of these options on R, the starting level of incidence is of critical importance. Setting the tolerable level of incidence which allows for changes to measures is a decision for policy makers. SAGE advises keeping the level of incidence low.
20. The scale required of an effective contact tracing and isolation system is dependent on incidence. App-based contact tracing efficacy scales with the square of uptake (as both contacts need to have it), and needs to be part of an integrated system of contact identification and rapid isolation.
21. The first phase of the modelled option (as set out in paper 2d) will have a modest impact on R and is unlikely to push it above 1 (high confidence).This phase of this option includes encouraging those who are already permitted to work or attend school to do so, allowing exercise more than once per day, permitting use of outdoor spaces for leisure and opening of some additional outdoor workplaces.
22. The second phase of the modelled option (as set out in paper 2d) is not likely to push R above 1, but this is dependent on having an effective test and trace programme being in

place (moderate confidence). This phase of the option is modelled based on some further changes around retail, leisure and schools.

23. As things currently stand Phase 4 of the modelled options is highly likely to push R above 1 (high confidence). This phase of the option involves more extensive relaxing of measures across a range of areas.
24. For workers with a high number of contacts, working patterns which reduce the number, duration and/or variety of contacts should be considered to reduce risk both to those individuals, but also the wider community.
25. SAGE recommends against reopening personal care services as one of the earlier changes to measures, as these typically rely on highly connected workers who may accelerate transmission.
26. Effective monitoring will need to be in place at a local level when any changes are made, in order to identify and respond to any outbreaks. This should include monitoring of people in high contact jobs.
27. The idea of 'bubbles' has many merits and should be explored further. There are both positive and negative behavioural aspects to be considered. Experience from other countries should be drawn upon.

SPI-B to provide further advice to BEIS and CO on behavioural aspects within work environments following release of measures

SPI-B and SPI-M to provide an integrated view on 'social bubbles', by 12 May

Ian Diamond to provide an update from the evaluation subgroup to SAGE

SAGE participants to send any comments on Mike Parker's paper *'Ethics of emerging from lockdown'* to SAGE secretariat by 6 May ahead of it being endorsed out of committee

SAGE secretariat to issue a summary of all advice to date and to update this document following each meeting with specific, defined advice

List of actions

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ONS to include and over-sample healthcare workers in the next phase of its work on incidence and seroprevalence

Nosocomial Working Group and Environmental Measures Group to work together to consider key questions and data (including international comparators) required to understand more about the detail of transmission in different situations and feed these to UKRI/NIHR for potential research call into Covid-19 transmission mechanisms (including in children and different contact jobs)

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SAGE participants to send any comments on Mike Parker's paper *'Ethics of emerging from lockdown'* to SAGE secretariat by 6 May ahead of it being endorsed out of committee

SAGE secretariat to issue a summary of all advice to date and to update this document following each meeting with specific, defined advice

Scientific experts (31): Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (dCMO), Angela McLean (CSA MoD), Andrew Curran (CSA HSE), Yvonne Doyle (PHE), Graham Medley (LSHTM), Neil Ferguson (Imperial), John Edmunds (LSHTM), James Rubin (King's), Lucy Yardley (Bristol), Peter Horby (Oxford), Ian Diamond (ONS), Ian Young (CMO Northern Ireland), Fliss Bennee (Health CSA Wales), Sheila Rowan (CSA Scotland), Jeremy Farrar (Wellcome), John Aston (CSA HO), Charlotte Watts (CSA DfID), Carole Mundell (CSA FCO), Andrew Morris (Scottish Covid-19 Advisory Group), Steve Powis (NHS), Sharon Peacock (PHE), Maria Zambon (PHE), Calum Semple (Liverpool), Brooke Rogers (King's), Venki Ramakrishnan (Royal Society), Ian Boyd (St Andrews), Mike Parker (Oxford), Mark Walport (UKRI), Catherine Noakes (Leeds),

Observers and Government officials (7): [redacted] Imran Shafi (No. 10), Vanessa MacDougall (HMT), [redacted] Ben Warner (No. 10), Kata Escott (CO)

SAGE Secretariat [redacted] Stuart Wainwright, Simon Whitfield, [redacted]

Total participants: 49

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Thirty-fourth SAGE meeting on Covid-19, 7th May 2020
Held via Zoom

Summary

1. SAGE reiterated its advice that there should be extensive testing of healthcare workers including asymptomatic workers.
2. It is important that the public understands the symptoms of Covid-19 disease in order for testing and tracing to be effective.
3. SAGE agreed scientific principles to inform approaches to risk assessment in the workplace.
4. Assessment of the introduction of bubbles is not straightforward and potential unforeseen risks accompany the potential benefits. SAGE advises that further work is done to understand this more to inform any decision.
5. As steps are taken to ease the lockdown, each step needs to be accompanied by very clear communication of the continued public health justification for remaining restrictions.

Introduction

6. SAGE noted the important contribution made by Neil Ferguson over the course of the response and agreed the importance of continuing to draw upon the work of the Imperial College London team.
7. SAGE reemphasised that its own focus should always be on providing clear scientific advice to government and the principles behind that advice.
8. A better mechanism for filtering commissions and requests for SAGE's advice is needed to ensure that participants of SAGE are only required to respond urgently to requests when those matters specifically relate to an urgent science question. This will help the resilience of participants of SAGE who will continue to work under intense pressure on the Covid-19 response for many more months. Commissions should be coordinated by the SAGE Secretariat.
9. The need for pastoral support to be available to participants was noted. Ian Boyd is an independent participant whose role includes providing this type of support.
10. A sub-group has been established to focus on evaluation under the leadership of Ian Diamond.

Action: SAGE Secretariat to work with **Cabinet Office** to improve the commissioning process and ensure that the right questions are put to SAGE or related groups in a timely manner. Expert subgroup chairs to work with **SAGE secretariat** to agree priorities for groups.

Action: SAGE Secretariat to make pastoral support available to participants.

Outstanding Actions

11. Granular data are not yet currently available from PHE to fully understand transmission pathways in healthcare settings. Preliminary data suggests the prevalence of Covid-19 in healthcare settings is 2-4%.
12. Genomic epidemiological analysis is in progress in both healthcare and care home settings.
13. Preliminary data from the convalescent plasma programme shows that after 24 days, almost all people infected with Covid-19 have formed a serological immune response. This will be helpful for testing strategies for healthcare workers but does not provide detail about long-term immunity to the disease.
14. SAGE reiterated the importance of addressing the epidemic in the healthcare and care home sectors, and reiterated its advice that there should be extensive testing of

healthcare workers including asymptomatic workers as well as the application of other measures previously advised. SAGE participants offered to provide advice to the healthcare worker testing programme if required.

15. Strategies and plans for testing in care homes are being rolled out and a paper will be presented to SAGE next week which covers frequency and focus of testing.
16. SAGE agreed that serology testing should be used to understand if asymptomatic infected individuals have had a serological response.
17. An ONS survey is underway measuring prevalence in the population by repeat household testing for both virus and antibodies. Work with SPI-M will produce estimates of R, which will be estimated twice a week. Regional estimates will also be provided.
18. Preliminary results of a study indicate that the Covid-19 virus decays rapidly when exposed to artificial sunlight – paper to come next week.
19. SAGE noted some rare symptoms or complications which are emerging including cerebrovascular events, renal disease, and systemic endothelial and organ dysfunction.
20. SAGE also noted the existence of longer-term health sequelae (such as persistence of extreme tiredness and shortness of breath for several months) and the importance of monitoring these impacts through longer-term cohort studies (as agreed previously and being taken forward by funders).
21. A paper will be presented to SAGE at a later date on the breadth of clinical presentation of the disease.

Action: Serological Testing Strategy Group to develop a serological testing strategy to utilise high through-put serology testing becoming available. This is important for surveillance and potentially for individual application.

Action: NERVTAG to consider a broader clinical syndrome definition and its use, for CMO. Should also link this to long-term cohort study.

Testing and tracing

22. The sensitivity and specificity of several potential symptom combinations for identifying Covid-19 patients was developed by NERVTAG. The most accurate definition includes: upper respiratory AND gastrointestinal OR generalised signs (see paper 4c).
23. It was noted that different case definitions may be needed for different individuals (e.g. Health Care Workers). The senior clinical group will refine the definition and pass it onto NHSX. ONS should test the NERVTAG definition through its survey.
24. SAGE noted the importance of the public understanding Covid-19 symptoms for testing and tracing to work.

Action: ONS to test the **NERVTAG** case definition though its survey; **NERVTAG** to provide case definition to test and trace group. **SPI-B** to advise on communication of this to the public.

Risk assessment approach for environmental mitigation measures

25. A paper was presented to SAGE on risk assessments and how these should be carried out for different work activities and in different work settings. The paper highlights the scientific principles of risk assessment to inform those who need to develop operational guidance. SAGE did not endorse the paper in its current form as SAGE does not give specific operational advice. This is a matter for HSE and the safer working place group.
26. SAGE agreed with underpinning scientific principles in the paper. A greater focus should be given in the paper to the quantitative methodology. The principle that PPE was a defence only required for very high transmission risk situations where other mitigations were not possible should be emphasised.

27. Once re-drafted the paper should be shared with BEIS and the HSE for their consideration as they develop policy.

Action: Cath Noakes to update paper to clarify that the purpose is to provide the scientific principles for risk assessment, and to share paper with **HSE** and **BEIS**.

Bubbling

28. The concept of 'bubbles' has potential benefits, such as supporting mental wellbeing or allowing childcare to be shared between households. However, there are also risks, particularly if bubbles were to be introduced alongside other changes or if there is poor adherence.
29. The effects of bubbles are complex. Introducing bubbles alongside other changes could reconstruct extensive networks, particularly when combined with any increase in contacts in other settings. These networks could enable transmission through the population. It will be difficult to assess the effects of individual policy changes on R if multiple changes are introduced together.
30. Mitigation of these risks would require very careful policy design. Key mitigations will include maximising adherence of those within bubbles to other measures and maintaining exclusivity of bubbles (which would be difficult to enforce). Size of bubbles will also be an important factor, with smaller bubbles being lower risk. There are many variables that would need to be considered to establish design principles.
31. A safe approach to bubbles would need to include isolation of all members of a bubble in the case of one member showing symptoms. This would lead to increased frequency of isolation for people, particularly in the winter months.
32. There are also equity considerations in the design of bubbles. Additional factors would need to be considered around vulnerable people, healthcare workers, and other groups who may be affected differently. The approach needs to consider the effects on households of different sizes, including those in HMOs. Introducing bubbles may affect people in different cultural groups differently, for these reasons and others.
33. Further work is required to fully understand the potential impact of bubbles, which has not been possible to do in the timeframe or with the parameters given. Until a detailed approach is developed, it will not be possible to assess the level of risk with any degree of confidence.
34. The conclusion is that introduction of bubbles is not straightforward and carries potential unforeseen risks. SAGE can undertake more work on this and would advise understanding this more to inform any decision.

Action: SPI-M & **SPI-B** to work together to further consider principles for safe bubble design, to be based on further input from **CO**.

Infection transmission in protests

35. Public assembly, including protest, is currently restricted by the Covid-19 regulations. As part of the longer-term release of measures, restriction of public assembly will need to be reconsidered.
36. It is not expected that protest or social disorder will automatically follow from an easing of restrictions. Nor is it expected that any resistance to new measures will emerge which reflect patterns of protests in other countries, because such events appear to be specific.
37. SAGE agreed that as steps are taken to ease the lockdown, each step needs to be accompanied by very clear communication of the continued public health justification for any remaining restrictions. Tracking of emerging patterns of public support, non-adherence and potential social disorder may be useful.
38. It was noted that a useful addition to control measures SAGE considers (in addition to scientific uncertainty) would be the feasibility of monitoring/enforcement.

List of actions

SAGE Secretariat to work with **Cabinet Office** to improve the commissioning process and ensure that the right questions are put to SAGE or related groups in a timely manner. Expert subgroup chairs to work with **SAGE secretariat** to agree priorities for groups.

SAGE Secretariat to make pastoral support available to participants.

Serological Testing Strategy Group to develop a serological testing strategy to utilise high through-put serology testing becoming available. This is important for surveillance and potentially for individual application.

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ONS to test the **NERVTAG** case definition though its survey; **NERVTAG** to provide case definition to test and trace group. **SPI-B** to advise on communication of this to the public.

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Observers and Government officials (7): [redacted]
Ben Warner (No. 10), Kata Escott (CO), [redacted] *Vanessa MacDougall (HMT),* [redacted]

SAGE Secretariat [redacted]
Simon Whitfield, Stuart Wainwright

Total Participants: 50

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Thirty-fifth SAGE meeting on Covid-19, 12th May 2020
Held via Zoom

Summary

1. The credible range for R is nationally is now 0.7-1.0 and while it is very likely to be less than 1 it could be close to it. It is almost certain to be lower than this in the community (outside hospitals and care homes), where it could be as low as 0.5-0.6.
2. There is a limit to the precision and timeliness with which R can be estimated. There should be an increasing reliance on incidence data for decision making as the quality of those data improve. Leading indicators will also be valuable for timely decision making.
3. There is evidence that sunlight rapidly reduces viral stability as well as some evidence that increased temperature and humidity reduce stability.
4. Workforce management and behaviours are key factors in transmission in care homes and hospitals. In particular, operating models and staff availability present a barrier to reducing transmission in care homes.
5. SAGE reiterated the importance of extensive and rapid testing focused on those at highest risk of becoming infected and transmitting the virus to others including health and social care workers.
6. SAGE remains of the view that a monitoring and test, trace & isolate system needs to be put in place.

Situation update

7. The published recovery strategy was noted. SAGE has previously advised that Phase 1 as modelled (20% increase in work contacts) is not likely to push R above 1. Phase 2 is dependent on response to Phase 1. The modelling underpinning this advice is based upon the assumption of a very effective test and trace system being operational, which is not currently the case.
8. The announcement of the Joint Biosecurity Centre was welcomed. SAGE agreed on the value of integrating data from multiple sources and being able to identify and respond rapidly to local outbreaks (in line with its previous advice)
9. The rate of decline of new hospital cases may be beginning to slow. The credible range for R is nationally now 0.7-1.0 and while it is very likely to be less than 1 it could be close to it.
10. R is almost certain to be lower than this in the community (outside hospitals and care homes), where it could be as low as 0.5-0.6. Key workers and their households are likely to represent a significant proportion of infections in the community (this is consistent with published ONS analysis).
11. The central case in each region still forecasts a declining number of deaths and new hospital cases. However, uncertainty means that in some regions plateaus or even increases cannot be ruled out.
12. It is not possible to provide a precise value of R, as data sources are subject to delays and assumptions are made in modelling. There should be an increasing reliance on incidence data for decision making as the quality of those data improve. Leading indicators will be crucial for timely decision making, and SPI-M will provide a view on what indicators should be considered.
13. There is a clinically meaningful and statistically significant improvement in case fatality rates for shielded groups. It is not clear what the relative contributions to this effect are from shielding and from improved clinical care. It is also not known whether there has been a change in the severity of cases.
14. Mutations of the spike protein do not provide cause for immediate concern, but further work is needed to better understand variants of the virus and their biological effects. NERVTAG will review the evidence on this.
15. Evidence suggests that SARS-CoV-2 is stable for long periods (half-life measured in hours) in indoor environments, both on surfaces and when aerosolised (experimentally).

There is some evidence for it becoming less stable at higher temperature and humidity within typical indoor operating ranges (moderate confidence), and some evidence that it is very stable at low temperatures (low confidence).

16. This could be reflected in operational guidance for relevant organisations, though the evidence for ventilation is stronger, so changes to temperature or humidity should only be considered where ventilation can still be maintained. Previous advice on the relative contribution of droplets and aerosols to transmission remains current.
17. These data increase the possibility there may be a degree of seasonality.
18. There is evidence that sunlight rapidly reduces viral stability (to a half-life of a few minutes), based on laboratory simulations (high confidence). This supports the previous advice that there is a much lower risk of transmission outdoors than indoors, especially from surfaces. There may be some scope for use of certain types of light (e.g. UV) indoors to reduce risk in some settings.

ACTION: SAGE secretariat to arrange for Tom Hurd (Joint Biosecurity Centre) to present to a group of SAGE participants; Ian Diamond to present design principles for monitoring from the Evaluation subgroup by 15 May

ACTION: Angela McLean and **SPI-M secretariat** to provide a short explanatory note on R for HMG communication experts by 13 May

ACTION: SPI-M to advise on leading indicators on changing infection rates following lifting of various measures, ahead of fully functioning testing and tracing and scale-up of the Joint Biosecurity Centre, by 14 May (SAGE remains concerned about the lack of a monitoring and test, trace and isolate system in place)

ACTION: CO-CIN to investigate the case fatality rate by age band and presence or not of one or more comorbidities over time and provide a view on factors behind improvements in case fatality rates for shielded groups by 19 May

ACTION: NERVTAG to provide a paper on biological effects of variants of the virus and implications for infections by 14 May

ACTION: Environmental and Modelling Group to consider whether updates to advice to HSE or others are needed and investigate what role UV light could play in indoor environments by 18 May; **Jonathan Van Tam** to frame question on risks and potential for UV light use and other potential mitigations in dentistry for group to consider

Care homes

19. Extensive testing of both residents and staff is crucial both in care homes which have reported cases and those which have not.
20. Preventing cases coming into homes should be a key aim, with avoiding transmission within homes also important.
21. Workforce management and behaviours are key factors in transmission. SAGE reiterated the need to minimise, and ideally avoid completely, staff moving between homes. This presents a challenge to the operating model of many care home providers.
22. Working conditions in the sector similarly present challenges, including disincentives to self-isolate. Addressing these issues is critical to reducing transmission.
23. Infection prevention and control procedures are important and should draw upon expertise from healthcare.
24. There are other settings where similar issues may arise, such as domiciliary care, hostels, and university halls of residence. Similar principles may apply in these settings.

25. Further targeted studies, including to understand variation in scale of outbreaks between different care homes and the reasons for this, are needed. Serological data, viral sequencing, behavioural data, and data from DAs will also be valuable.
26. SAGE endorsed the paper from the Care Home Group subject to some changes to reflect SAGE discussion.

ACTION: Environmental and Modelling Group to link to work by Andrew Hayward (UCL) on other high-risk environments/disadvantaged settings where transmission could be high by 19 May

ACTION: Care Homes Group to agree with ONS, PHE and DHSC and other relevant groups or partners what additional data sources could be used to monitor care home infection and how this can be provided, by 14 May

ACTION: DHSC and Care Homes Group to draw on infection protection and control guidance from hospital environments to inform care homes guidance by 14 May

Nosocomial transmission

27. Data indicate that the number of nosocomial cases is plateauing, and therefore comprising an increasing proportion of total cases (as the number of new cases in the community falls).
28. Better data feeds are needed to understand patterns at a local level, which are being developed.
29. There are interventions already in place within hospitals. The focus of the next phase of work is on reducing transmission between healthcare workers and on urging rapid implementation of recommendations from the Environmental and Modelling Group.
30. The importance of extensive and rapid testing was reiterated, for both patients and staff. This should include point of care testing. The question of whether all visitors and entrants to hospitals should wear masks should be considered.
31. All staff need to be considered including those not directly employed in the NHS, as well as visitors and others working in hospitals. Understanding behavioural factors and adherence will be an important part of this.
32. The Chief Nurse will lead the implementation of this work within the NHS.

ACTION: Nosocomial Group to work with SPI-B on a survey of health care workers; consider possible infection spread from visitors, outpatients, and day patients; and ensure improved data collection of nosocomial cases from all NHS Trusts by 19 May

ACTION: ONS to provide data on asymptomatic cases from household survey to NERVTAG; **NHS Medical Director** to provide any relevant NHS data on asymptomatic cases to NERVTAG by 12 May. **NERVTAG** to produce updated paper on asymptomatic transmission.

Planning scenarios

33. SAGE endorsed the scenarios from SPI-M and will review further scenarios once these are developed.

Future meetings

34. The next meeting will consider bubbling, relative infection rates in asymptomatic people, and improving understanding of regional variations.
35. There is work underway on the potential effects of winter on the virus and response, and on serology and immunology. SAGE will consider these in future meetings.

List of actions

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Angela McLean and SPI-M secretariat to provide a short explanatory note on R for HMG communication experts by 13 May

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Attendees

Scientific experts (32): *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (dCMO), Jenny Harries (dCMO), Angela McLean (CSA MoD), John Aston (CSA HO), Charlotte Watts (CSA DfID), Stephen Powis (NHS), Sharon Peacock (PHE), Maria Zambon (PHE), Calum Semple (Liverpool), Graham Medley (LSHTM), John Edmunds (LSHTM), Ian Hall (Manchester), Peter Horby (Oxford), Brooke Rogers (King's), Lucy Yardley (Bristol), Wendy Barclay (Imperial), Andrew Rambaut (Edinburgh), Cath Noakes (Leeds), Sheila Rowan (CSA Scotland), Nicola Steedman (dCMO Scotland), Jim McMenamin (Health Protection Scotland), Andrew Morris (Scottish Covid-19 Advisory Group), Rob Orford (Health*

CSA Wales), Fliss Bennee (Wales Technical Advisory Cell), Ian Young (CMO Northern Ireland), Mark Walport (UKRI), Venki Ramakrishnan (Royal Society), Jeremy Farrar (Wellcome), Mike Parker (Oxford), Ian Boyd (St Andrews)

Observers and government officials (9): [redacted] *Bob Butcher (DHSC), Ben Warner (No. 10),* [redacted] *Vanessa MacDougall (HMT),* [redacted]

SAGE secretariat (16): [redacted] *Stuart Wainwright,* [redacted] *Paul McCloghrie, Simon Whitfield,* [redacted]

Total participants: 57

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Thirty-sixth SAGE meeting on Covid-19, 14th May 2020
Held via Zoom

Summary

1. SAGE advised that social bubbles have the potential to create significant unwanted effects and advised against their introduction in the short term, when other distancing measures have only just been lifted, or in conjunction with release of other measures.
2. SAGE advised that further release of distancing measures should not be contemplated until effective outbreak surveillance and test and trace systems are up and running.

Situation update

3. The steady decline in hospital and care home deaths continues; the rate of decrease is slowing, but not more than would be expected.
4. There is a continued downward trend in hospital admissions, with some regional variation.
5. CO-CIN data show a decline in absolute numbers of hospital acquired infections (but they are increasing as a proportion of total).
6. Latest ONS data show overall prevalence is driven in part by healthcare workers. There are roughly 12,000 new cases per day and currently around 150,000 infected overall in England. Prevalence was slightly higher than in the last set of results but the difference is expected due to small numbers of cases.
7. Estimate of R remains between 0.7 and 1. SPI-M will advise on lead indicators for detecting changes in numbers of infections or R at SAGE on 19 May.
8. Data show increased seropositivity over time in London, with an adjusted seroprevalence of 13-17.4% (medium confidence). Seropositivity is higher in London than in other parts of the country (high confidence). Data for child seropositivity suggest it is roughly equivalent to that for adults. Data for infections from ONS also show a broadly similar infection rate for adults and children.
9. SAGE agreed the importance of serological and other testing data that is being collected in many hospitals locally, including from longitudinal studies of healthcare workers, being collected in one place. This will help determine whether seropositivity is associated with reduced infection and reduced carriage.
10. SAGE endorsed the Environmental and Modelling Group paper on principles of risk assessment.
11. Further research on environmental questions should be organised via a consortium, given the multidisciplinary requirements.

ACTION: Environmental and Monitoring Group and **NERVTAG** to advise UKRI on potential consortium members for research funding on a) environmental spread and b) infectiousness (and relation to PCR positivity)

ACTION: SAGE secretariat to circulate the SAGE-endorsed **Environmental and Monitoring Group** paper "Using understanding of transmission routes to inform risk assessment and mitigation strategies" to key departments, with clear instructions to act on relevant recommendations; **Cath Noakes** to make one alteration to paper in relation to faecal transmission (by 15 May)

ACTION: NHS Medical Director to ensure regional aspects of the ONS survey are fed into NHS planning and to liaise with **Ian Diamond** over future requirements (by 19 May)

ACTION: Health Data Research UK (Andrew Morris) to identify an approach to aggregate serological data from studies and surveys (including NIHR and other longitudinal studies); **NHS Medical Director** to capture any relevant serological data from NHS Trusts for this data repository (by 19 May)

Social bubbling

12. SAGE advised strong caution concerning the introduction of social bubbling – particularly in the short term, when other distancing measures have only just been lifted, or in conjunction with release of other measures. SAGE has advised previously against making too many changes at once.
13. While SAGE noted the impact of lockdown on wellbeing and theoretical benefits of bubbling for some people (e.g. those experiencing loneliness, stress, economic hardship), it cannot be regarded as a universal good; for some people bubbling is impossible, too complicated or there may be no other household for them to link to.
14. Any bubbling will increase infection risk. If introduced, bubbling should only happen when it is safe to do so from an epidemiological perspective and on a very modest basis initially.
15. Currently, incidence is too high and R close to 1. Active contract tracing should be a pre-condition of introducing bubbling.
16. Modelling of risk to date has assumed schools remain closed and that R is 0.8 or lower. Risk would be amplified if schools are open and if workplaces are busier.
17. For bubbling itself, risk can be minimised if participating households are small, i.e. two one-person households interacting (1+1) or (slightly more risky) a one-person household interacting with a larger household (1+n). Bubbles of larger households with multiple individual connections provide a significant potential risk.
18. Consideration is needed, however, of bubbling involving multi-generational families including older people, of families which include vulnerable individuals or which include a healthcare worker.
19. SAGE also noted significant challenges to operationalising bubbling and setting out unambiguous guidelines. Isolation on contact with an index case would have to involve the whole bubble.
20. Messaging needs to be clear prior to launch to prevent/reduce non-adherence.
21. SAGE advised that non-adherence with guidelines could lead to spread of the infection, and that non-adherence was likely, especially if larger households are bubbled together.
22. SAGE noted a paucity of evidence from the adoption of bubbling in other countries – but that there is already some evidence of potentially significant non-adherence with bubbling guidelines.
23. Other unintended consequences are possible.
24. SAGE concluded that bubbling may be appropriate in limited circumstances – and that policy development in the area would benefit from being able to quantify and compare its impacts with other measures, though quantification is challenging and data sparse.
25. DHSC polling could in future ask about interactions among households to determine whether bubbling is already happening.

ACTION: SAGE secretariat to provide a covering summary note on social bubbling, setting out SAGE's advice and caveats (by 15 May)

Surveillance

26. SAGE noted the challenges facing the Joint Biosecurity Centre (JBC), including how to identify local outbreaks, the required pace of testing, what NPIs could be implemented in response (and how quickly), public messaging, the potential for outbreaks undefinable by local geography (e.g. more likely linked to workplaces than schools) and variation in regional capacity.
27. SAGE noted the importance for the JBC of clearly defining its overall objective – plus the value of user-centred design, lead indicators as well as lag indicators, connected multi-dimensional data, privacy issues and public buy-in (including economic incentives/ disincentives to identify outbreaks); early identification of any outbreaks should be a cause for public celebration and recognition.
28. SAGE advised that further release of distancing measures should not be contemplated until effective monitoring and test and trace systems are up and running.

29. SAGE offered ongoing rapid support and advice to JBC.

ACTION: SAGE secretariat to capture key science questions and advice around the design of monitoring and relevant measures for the Joint Biosecurity Centre (by 15 May); **Evaluation Sub-group**, with input from SAGE volunteers, to refine these questions as basis for further modelling and behavioural commissions (including modelling of reactive closures at the level of an individual workplace) and provide advice to JBC by 15 May

ACTION: NHS Medical Director to ensure input from NHS is fed into design of Joint Biosecurity Centre (by 15 May)

Asymptomatic cases and infection

30. NERVTAG has reviewed various studies on asymptomatic infection. Many do not differentiate between asymptomatic/pauci-symptomatic individuals and pre-symptomatic individuals.
31. SAGE noted that longitudinal sampling in the ONS study will assist in clarifying this difference going forward but needs to include more than "asymptomatic on the day of infection".
32. Taking all evidence into account, between 10% and 35% of individuals may be truly asymptomatic (low confidence), and many more may have few symptoms. Review of ONS data will help refine the estimate.
33. It is possible that asymptomatic individuals are less infectious, but this cannot currently be quantified. There is a key knowledge gap concerning how positive testing correlates with the presence of live, recoverable virus (i.e. infectiousness), although PHE is currently investigating this.

ACTION: PHE (Maria Zambon) to provide current summary of Covid-19 biology for consideration by NERVTAG (by 15 May) to inform its input to planned consortium researching infectiousness

Virus variants

34. SAGE noted that it is currently hard to interpret the biological consequences of sequence variations in the virus – but acknowledged the ramifications of mutation and virus recombination in areas such as diagnostics and vaccines.
35. SAGE agreed that the biology of the virus should be the focus of an open research call.

ACTION: Wendy Barclay and **Peter Horby** to liaise with **Wellcome (Jeremy Farrar)** to develop with **UKRI** an open research call to better understand biology of Covid-19 variants

List of actions

Environmental and Monitoring Group and **NERVTAG** to advise UKRI on potential consortium members for research funding on a) environmental spread and b) infectiousness (and relation to PCR positivity)

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NHS Medical Director to ensure regional aspects of the ONS survey are fed into NHS planning and to liaise with **Ian Diamond** over future requirements (by 19 May)

Health Data Research UK (Andrew Morris) to identify an approach to aggregate serological data from studies and surveys (including NIHR and other longitudinal studies);

NHS Medical Director to capture any relevant serological data from NHS Trusts for this data repository (by 19 May)

SAGE secretariat to provide a covering summary note on social bubbling, setting out SAGE's advice and caveats (by 15 May)

SAGE secretariat to capture key science questions and advice around the design of monitoring and relevant measures for the Joint Biosecurity Centre (by 15 May); **Evaluation Sub-group**, with input from SAGE volunteers, to refine these questions as basis for further modelling and behavioural commissions (including modelling of reactive closures at the level of an individual workplace) and provide advice to JBC by 15 May

NHS Medical Director to ensure input from NHS is fed into design of Joint Biosecurity Centre (by 15 May)

PHE (Maria Zambon) to provide current summary of Covid-19 biology for consideration by NERVTAG (by 15 May) to inform its input to planned consortium researching infectiousness

Wendy Barclay and **Peter Horby** to liaise with **Wellcome (Jeremy Farrar)** to develop with **UKRI** an open research call to better understand biology of Covid-19

Attendees

Scientific experts (32): *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (dCMO), Jenny Harries (dCMO), Angela McLean (CSA MoD), Robin Grimes (CSA MoD), John Aston (CSA HO), Charlotte Watts (CSA DfID), Andrew Curran (CSA HSE), Stephen Powis (NHS), Yvonne Doyle (PHE), Sharon Peacock (PHE), Maria Zambon (PHE), Ian Diamond (ONS), Andrew Morris (Scottish Covid-19 Advisory Group), Nicola Steedman (dCMO Scotland), Rob Orford (Health CSA Wales), Fliss Bennee (Wales Technical Advisory Cell), Wendy Barclay (Imperial), Peter Horby (Oxford), Cath Noakes (Leeds), Michael Parker (Oxford), James Rubin (KCL), Andrew Rambaut (Edinburgh), Calum Semple (Liverpool), Lucy Yardley (Bristol), John Edmunds (LSHTM), Graham Medley (LSHTM), Ian Boyd (St Andrews), Jeremy Farrar (Wellcome), Venki Ramakrishnan (Royal Society), Mark Walport,(UKRI)*

Observers and government officials (6): [redacted] *Vanessa MacDougall (HMT), Ben Warner (No. 10)*

SAGE secretariat (13): [redacted] *Simon Whitfield, Stuart Wainwright*

Total participants: 51

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Thirty-seventh SAGE meeting on Covid-19, 19th May 2020
Held via Zoom

Summary

1. Current modelling indicates that an effective Test, Trace, and Isolate system will be necessary (but not sufficient on its own) to allow further substantive adjustments to distancing measures without pushing R above 1.
2. SAGE noted the continued importance of measures such as hand hygiene, particularly as other measures are adjusted, and the role of supporting systems and infrastructure (e.g. hand sanitising points) in enabling and prompting individual behaviours. The importance of integration of measures (e.g. hand hygiene and face coverings) in some settings was noted.

Reasonable Worst-Case Scenario (RWCS)

3. The RWCS being developed is unlikely (but possible) and is one of several scenarios modelled by SPI-M.
4. Four groups have modelled the scenarios. There are differences between results from different models, primarily due to different assumptions about projected incidence on June 1. Once numbers are normalised to the presumed number of weekly hopitalisations on June 1 the models give similar results. Three of the models give rather similar absolute numbers of deaths each week, whilst the fourth has numbers more than twice as large. SPI-M has selected a single model to provide the consensus RWCS.
5. The RWCS is one where behavioural and social interventions (BSI) easing on 1 June pushes R to 1.7 for four weeks, at which point reversal of BSI easing brings R down to 0.7 until incidence levels are similar to those at 1 June, and R returns to 1 for the rest of 2020. This RWCS is based on assumptions of system failure that should be made clear in the presentation of the scenario.
6. This RWCS is a short-term tool, and does not consider winter pressures, which are the subject of another piece of work.
7. SAGE noted that a period of 4 weeks with R at this level would require multiple system failures, such as a failure to quickly identify increasing incidence and failure to respond in a timely manner.
8. SAGE will review the RWCS again at its next meeting, informed by a more detailed explanation of the assumptions used and the models' sensitivity to them.

ACTION: SAGE participants, including NHS, to review latest reasonable worst case for final consideration, including underlying assumptions, at next meeting on 21 May

Situation update

9. SAGE noted the short-term forecasts and agreed that a better understanding of hospital readmissions (and their effect on data and modelling outputs) is important as readmissions that are not due to new infections may be included in current data flows (this would lead to a potential overestimate of R).
10. ONS' most recent published deaths data contain a bank holiday effect from VE day and may not be directly comparable to other weeks.
11. CO-CIN data indicate a decreasing number of new cases due to nosocomial transmission.

ACTION: SAGE secretariat to provide paper for next SAGE meeting combining age related risk of Covid-19 hospitalisation, severe disease, and death, with the ONS data on age profiles of parents and grandparents of primary school aged children.

ACTION: NHS Medical Director to investigate underlying data in relation to apparent hospital readmission of Covid-19 cases, and liaise with SPI-M

Environmental transmission

12. SAGE endorsed the Environmental and Modelling Group papers on disinfection technologies and on risk mitigation on public transport.
13. SAGE noted the continued importance of measures such as hand hygiene, particularly as other measures are adjusted, and the role of supporting systems and infrastructure (e.g. hand sanitising points) in enabling and prompting individual behaviours. The importance of integration of measures (e.g. hand hygiene and face coverings) in some settings was noted.

ACTION: SAGE secretariat to circulate SAGE-endorsed **Environmental and Monitoring Group** papers: a) *Summary of disinfection technologies for microbial control* to DHSC and b) *Transmission and control of SARS-CoV-2 on public transport,* to BEIS, DfT, HSE and other relevant departments with instructions to act on relevant recommendations (by 19 May)

Test, Trace, and Isolate (TTI)

14. SAGE noted the Royal Society DELVE report on Test, Trace, and Isolate (TTI). The key findings reinforce existing SAGE advice.
15. An effective Test, Trace and Isolate system will be necessary (but not sufficient on its own) to allow further adjustments to distancing measures without pushing R above 1. It is a consensus view of current SPI-M modelling that high-quality contact tracing will be needed to keep R below 1 under any substantive adjustments to distancing measures.
16. As noted previously the system should be based on testing rather than symptoms alone, and the process from case identification to testing, contract tracing and isolation needs to be fast. SAGE has previously advised that isolation of contacts within 48 hours of identification of an index case is desirable. The DELVE paper has longer timelines, but SAGE advice remains with this shorter recommendation. International evidence indicates that this is achievable.
17. A high degree of adherence to instructions on reporting, testing, and isolation is also required for the system to be effective.
18. Other factors in system effectiveness are the ability to target contact tracing resource based on intelligence from monitoring, and integration of systems (e.g. digital and manual contact tracing, local and national systems). This is part of the proposed Joint Biosecurity Centre (JBC).
19. There are potential approaches which combine both symptoms and testing (e.g. using symptoms to assess risk to contacts in the period while awaiting test results). The effectiveness of these could be assessed in trials. This was discussed previously at SAGE
20. Approaches to isolation affect transmission within households. In some cases, isolation away from the rest of the household may be preferable, e.g. in households containing clinically vulnerable people.
21. Manual contact tracing may be able to collect useful information about the environments in which outbreaks happen.
22. SAGE will incorporate its views on TTI into advice for the Joint Biosecurity Centre (JBC) and advice on adjustments to BSIs.

Future meetings

23. The next meeting will consider the Joint Biosecurity Centre, TTI, schools, and adjustments to BSIs.

List of actions

SAGE participants, including NHS, to review latest reasonable worst case for final consideration, including underlying assumptions, at next meeting on 21 May

SAGE secretariat to provide paper for next SAGE meeting combining age related risk of Covid-19 hospitalisation, severe disease, and death, with the ONS data on age profiles of parents and grandparents of primary school aged children.

NHS Medical Director to investigate underlying data in relation to apparent hospital readmission of Covid-19 cases, and liaise with SPI-M

SAGE secretariat to circulate SAGE-endorsed **Environmental and Monitoring Group** papers: a) *Summary of disinfection technologies for microbial control* to DHSC and b) *Transmission and control of SARS-CoV-2 on public transport,* to BEIS, DfT, HSE and other relevant departments with instructions to act on relevant recommendations (by 19 May)

Attendees

Scientific experts (33): *Patrick Vallance (GCSA), Chris Whitty (CMO), Angela McLean (CSA MoD), Robin Grimes (CSA MoD), John Aston (CSA HO), Charlotte Watts (CSA DfID), Carole Mundell (FCO CSA), Andrew Curran (CSA HSE), Stephen Powis (NHS), Mark Wilcox (NHS), Yvonne Doyle (PHE), Maria Zambon (PHE), Graham Medley (LSHTM), John Edmunds (LSHTM), Ian Diamond (ONS), Andrew Morris (Scottish Covid-19 Advisory Group), Nicola Steedman (dCMO Scotland), Sheila Rowan (CSA Scotland),* Jim McMenamin (Health Protection Scotland), *Rob Orford (Health CSA Wales), Fliss Bennee (Wales Technical Advisory Cell), Ian Young (CMO Northern Ireland), Peter Horby (Oxford), Cath Noakes (Leeds), Michael Parker (Oxford), James Rubin (KCL), Brooke Rogers (KCL), Andrew Rambaut (Edinburgh), Wendy Barclay (Imperial), Calum Semple (Liverpool), Ian Boyd (St Andrews), Jeremy Farrar (Wellcome), Venki Ramakrishnan (Royal Society), Anne Johnson (Royal Society), Mark Walport (UKRI)*

Observers and government officials (6): [redacted] *Vanessa MacDougall (HMT), Ben Warner (No. 10)*

SAGE secretariat (14): [redacted] *Simon Whitfield,* [redacted] *Stuart Wainwright, Paul McCloghrie,* [redacted]

Total participants: 53

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Thirty-eighth SAGE meeting on Covid-19, 21st May 2020
Held via Zoom

Summary

1. SAGE provided advice on sequencing of social distancing NPIs – see paragraphs 9 to 22.
2. SAGE advised that overall public adherence with social distancing measures will likely be diminished by HMG signalling its intent to release even some of the measures.
3. SAGE warned that if the test, trace and isolate (TTI) system begins operating when there is a relatively high level of incidence and prevalence of Covid-19 in the population, the system could very rapidly become overwhelmed.

Reasonable Worst-Case Scenario (RWCS)

4. SAGE reviewed again (as requested by Cabinet Office) the RWCS discussed at the last meeting in which behavioural and social interventions (BSI) easing on 1 June push R to 1.7 for four weeks, at which point reversal of BSI easing brings R down to 0.7 until incidence levels are similar to those at 1 June, and R returns to 1 for the rest of 2020.
5. SAGE reiterated that the RWCS model predicts a rise in R to 1.7 due to a lack of rapid detection of increased incidence in the population. Early warning signals, as well as an effective TTI programme, should be designed to prevent R rising to this level (or above 1).
6. SAGE advised that flexible localised capacity planning is required within the NHS to enable it to respond to rises in R.
7. SAGE cautioned that other scenarios, such as a rise in R to 1.2, could be more difficult to detect, and over time lead to a gradual increase in hospitalisations and deaths, and that this scenario should also be planned for.
8. SAGE approved the RWCS paper once changes were made.

ACTION: SPI-M to update RWCS to include caveats on a) detecting incidences quickly and b) different effects of R above 1, both low as well as high values, so RWCS can be incorporated in return on Cabinet Office commission (by 22 May)

ACTION: Welsh Government to reconcile its modelling with SAGE-endorsed RWCS

Sequencing of social distancing NPIs

Situation update

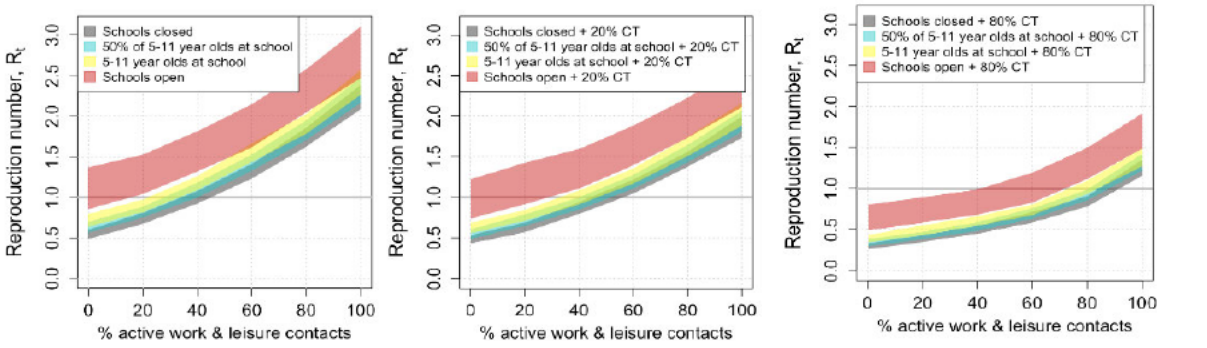
9. The best estimate of R in the UK is between 0.7 and 1.0. While it is highly likely to be under one, it could be close to it. There is little evidence of regional variation in R. Because the number of cases and deaths is smaller on a subnational level, there is greater uncertainty in these estimates of R. It is likely that R is less than one in all UK nations and regions.
10. The number of cases in the community has decreased more quickly than the number in, or seeded from, care homes or hospitals. As a result, hospital or care home cases now represent a higher proportion of total cases, possibly a majority. This means that the rate at which the overall epidemic is shrinking in terms of cases has slowed.
11. Incidence of Covid-19 infection remains uncertain with the latest ONS data suggestion about 8-9,000 cases per day (0.11 cases/100 people per week or 61,000 new Covid-19 infections per week in England, with wide confidence intervals). Modelling estimates are higher and range from 10,000-60,000 new infections per day based on case incidences, ICU admissions and deaths, which represent a larger data set than the ONS sample size. ONS estimates that, between 4 May and 17 May 2020, an average of 0.25% of the community population in England had COVID-19 (95% confidence interval: 0.16% to 0.38%).

Changes to measures

12. It is not yet possible to accurately assess the impact of changes already made to NPIs. Changes in transmission which have happened in the last 2 weeks will not yet be reflected in clinical data.
13. SAGE agreed that the presentation of school reopening options under different track, trace and isolate (TTI) scenarios and with varying levels of work and leisure contacts (e.g. from reopening non-essential retail) illustrates how the impacts of multiple, separate changes accumulate (graphic below is from paper 4a). With schools closed and R 0.7-1.0, as now, there is little headroom with no contact tracing in place. Moreover, the figure does not take into account any changes as a result of phase 1. SAGE noted that the figure is illustrative rather than fully quantitative and should not be used to extract predictions of the impacts of packages of measures. The more modest re-opening options are lower risk, but the level of risk depends on TTI performance. It will be important to know accurately the actual, proven TTI performance at the time when changes are made.
14. SAGE noted that overestimation of TTI capacity could lead quickly to R returning to 1.7 (the reference value in the RWC). It was noted, however, that the summer school holidays would in effect reinstate school closures in July, potentially unwinding the impacts of re-opening, and allowing monitoring of effects if other NPIs remain stable.
15. SAGE advised that either social bubbling or opening both primary and secondary schools had the potential to recreate significant transmission networks, which would have a large effect on the epidemic.
16. SAGE noted the relatively young age profile of parents and teachers, which means that a lower level of risk in general (though some individuals within those groups may be higher risk for other reasons). Further work is needed to understand the proportion of children living with grandparents who are more likely to be in higher-risk age groups.
17. SAGE advised that opening schools or non-essential retail safely would require a significant effort to ensure that environments are appropriate to minimise transmission (for example distancing and hygiene measures, ventilation). Systems to evaluate this, and, potentially, enforcement mechanisms will be required. In this context it was noted that modelling of the effects of opening non-essential retail assume that a modest increase (10 percentage points for work and 10 percent for leisure) in contacts occur. It is not known with confidence what the change would be in practice and any change would require effective distancing, hygiene and environmental control.
18. SAGE emphasised the importance of very careful monitoring and evaluation of infection in schools after any re-opening. This could begin with a virological and serological study of the current school population and should include serial testing for the virus and antibodies, with the appropriate control study. Jeremy F, ONS and PHE to design a study protocol with DfE to take this forward. CMO and GCSA to facilitate funding. A similar study in the retail sector should also conducted (where there may already be good data on contact patterns in open shops). PHE to lead.
19. Further to this, SAGE noted that the precise impacts of lifting NPIs are not possible to predict accurately. It recommends that any changes are done in such a way that impacts can be measured and evaluated, with systems for this in place at the outset, and that this evaluation is made before any subsequent steps are taken.
20. SAGE considered that the behavioural responses in the event of multiple, simultaneous changes to current restrictions were highly unpredictable and that the possibility of large, unintended, negative consequences with respect to adherence to remaining measures was significant.
21. SAGE advised that the lower the number of infections at the point when measures are lifted, the better this would be in terms of managing the epidemic. Not only would there be fewer people being infected, becoming ill and dying but:

a. Contact tracing and testing capacities are less likely to be overwhelmed. If TTI is overwhelmed, re-imposition of significant NPIs is the only way to regain control of the epidemic. The risks of TTI failure will be greatest in winter and at the start of TTI if the number of cases is still relatively high and the system is not mature.
b. Fewer people in total will be required to isolate having been identified by TTI as a contact of an infected individual (currently at 10,000 cases per day and 20-30 contacts per person very large numbers may need to be isolated).
c. Individuals are less likely to get multiple "stay home" warnings from contact tracing.
d. If R does rise above 1, the time window to detect from a lower level of incidences therefore would be longer.

22. It is also important to note that the prevalence of non-Covid-19 respiratory disease in the community is also a critical determinant of the scale of TTI required and may easily swamp the number of Covid-19 cases (i.e. test capacity and any contact isolation based purely on symptoms will need to take this into account).



Level of Contact Tracing (CT) –None | Level of Contact Tracing – 20% | Level of Contact Tracing – 80%

Note: On the x-axis, 0% is full lockdown with household contacts only. The current measures (with key workers etc) have only taken us to ~20%. We are currently on the left-hand graph (no TTI) in the pale blue (with children of key workers at school) at R 0.7-1.0. These graphs are indicative on changes in R against relaxation of measures for a given level of TTI, they do not represent absolute levels of R. Modelling of the effects of opening non-essential retail assume a modest increase of 10% for work and 10% for leisure; these were treated separately and are not a straight addition in the graphs above. Therefore, the effect in the ready reckoner above, will be somewhere between 10-20%.

ACTION: SAGE secretariat to send summary of SAGE advice on sequencing of NPIs to Cabinet Office (by 22 May)

ACTION: Jeremy Farrar and **ONS** to develop protocol for study to assess prevalence and infection rate among children and teachers currently attending schools (by 26 May)

ACTION: PHE to develop protocol for study to assess infection within essential retail that is currently open (by 26 May)

ACTION: SPI-B and **Children's Sub-group** to identify research questions around understanding behaviours that are influenced by social distancing protocols in schools and options for taking such research forward; **Children's Sub-group** to also understand proportion of children living with grandparents in higher-risk age groups (by 28 May)

ACTION: SAGE secretariat to provide paper summarising current SAGE understanding of SARS-CoV-2, epidemiology of Covid-19 and mitigations, e.g. environmental and test, trace and isolation (by 28 May)

Test, trace, and isolate (TTI)

23. SAGE was updated on the Joint Biosecurity Centre and TTI, including testing capacity, local authority planning, the development of a JBC scenario "playbook" (which SAGE will support) and the role of the NHSX contact tracing app.
24. The Joint Biosecurity Centre (JBC) will provide insight and analysis to drive the TTI system. A *beta* version of JBC will be operational by 1 June.
25. Local Authorities, with the support of PHE, will be tasked with developing local action plans, to include: supporting care homes, identifying high-risk settings, deploying local testing rapidly, providing sufficient resource for local contact tracing and helping people self-isolate. SAGE was supportive of local areas being empowered to identify infections at local levels and to make decisions to address these, using a clear list of actions and triggers for actions.
26. SAGE highlighted that TTI capacity needs to be scaled according to the number of people who have both Covid-19 and also Covid-19 comparable symptoms (this is a far higher number than for Covid-19 cases alone). At current prevalence and incidence, a test and trace capacity of 10,000 a day will likely not be sufficient, as it does not take into account non-Covid-19 symptoms.
27. SAGE recognised that transparency and early public engagement are essential to ensure public buy-in for TTI. Challenges include conveying to individuals the need to self-isolate if they have come into contact with a positive case. Incentives and protections are required to encourage people to self-isolate on several occasions.
28. SAGE recognised the importance of the JBC and the TTI system improving over time. Collection of data from index cases, including locations and job roles, should improve knowledge of how the disease is transmitted.
29. SAGE recognised the absolute requirement for the JBC to work in tandem with the TTI system and for both to be guided at every level by organisationally embedded science. A challenge will be to reduce the prevalence of Covid-19 to very low levels and for JBC to identify and prioritise data that provide early indications of rising infection levels.
30. SAGE approved a paper on science aspects of the JBC once changes were made. The paper should set out the projected number of deaths if the incidence of Covid-19 in the population is at 100 or 1,000 cases per day. SAGE reiterated its view that incidence should be as low as possible before an effective TTI and JBC system can work. The decision as to what level of incidence to choose is an operational one and not for SAGE.
31. SAGE warned that if the TTI system begins operating when there is a relatively high level of incidence and prevalence of Covid-19 in the population, the system could very rapidly become overwhelmed.

ACTION: SAGE secretariat to share draft paper on infection transmission in other high-risk environments/disadvantaged settings with Joint Biosecurity Centre

ACTION: SAGE secretariat to send SAGE advice on testing requirements for cases and contacts to Joint Biosecurity Centre (by 22 May)

ACTION: Joint Biosecurity Centre (Tom Hurd) to ensure its data is available for research purposes

ACTION: SPI-B to advise NHSI Team directly on behaviour change required for effective design of TTI

ACTION: Ian Diamond to update and circulate Evaluation Subgroup paper on Joint Biosecurity Centre design principles, to reflect discussion on rates and levels of Covid-19 incidences (by 22 May); **Evaluation Subgroup** to provide ad hoc advice as necessary directly to Joint Biosecurity Centre

SAGE participants to email SAGE secretariat with recommended names for chief medical/science officer in JBC/TTI programme

SAGE secretariat to provide a paper summarising the current state of SAGE understanding of SARS-CoV-2

List of actions

SPI-M to update RWCS to include caveats on a) detecting incidences quickly and b) different effects of R above 1, both low as well as high values, so RWCS can be incorporated in return on Cabinet Office commission (by 22 May)

Welsh Government to reconcile its modelling with SAGE-endorsed RWCS

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SAGE secretariat to provide a paper summarising the current state of SAGE understanding of SARS-CoV-2

Attendees

Scientific experts (35): *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (dCMO) Angela McLean (CSA MoD), Robin Grimes (CSA MoD), John Aston (CSA HO), Charlotte Watts (CSA DfID), Carole Mundell (FCO CSA), Andrew Curran (CSA HSE), Osama Rahman (CSA DfE), Stephen Powis (NHS), Mark Wilcox (NHS), Yvonne Doyle (PHE), Sharon Peacock (PHE), Maria Zambon (PHE), Graham Medley (LSHTM), John Edmunds (LSHTM), Ian Diamond (ONS), Nicola Steedman (dCMO Scotland), Jim McMenamin (Health Protection Scotland), Rob Orford (Health CSA Wales), Fliss Bennee (Wales Technical Advisory Cell), Ian Young (CMO Northern Ireland), Peter Horby (Oxford), Cath Noakes (Leeds), Michael Parker (Oxford), Brooke Rogers (KCL), Lucy Yardley (Bristol), Wendy Barclay (Imperial), Calum Semple (Liverpool), Julia Gog (Cambridge), Ian Boyd (St Andrews), Jeremy Farrar (Wellcome), Venki Ramakrishnan (Royal Society), Mark Walport (UKRI), Dido Harding (NHSI) Paul Cosford (PHE).*

Observers and government officials (9): [redacted] *Vanessa MacDougall (HMT), Ben Warner (No. 10), Imran Shafi (No. 10), Henry Cook (No10), Louis Watt (NHSI).*

SAGE secretariat (15): [redacted] *Simon Whitfield,* [redacted] *Stuart Wainwright,* [redacted]

Total participants: 59

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Thirty-ninth SAGE meeting on Covid-19, 28th May 2020
Held via Zoom

Summary

1. SAGE approved updated estimates of R (including for the 4 nations) and noted ongoing high incidence of infection in the UK.
2. SAGE advised strongly that identification of high-risk institutional settings is essential (e.g. homeless shelters and prisons) and that plans to reduce transmission in these setting must be proactive. Research is also needed to better understand risks in these settings.
3. SAGE agreed the importance and urgency of identifying (high contact) occupations at greatest risk of infection and transmission, and of involving workers themselves in designing layers of protection.
4. SAGE gave advice on the alert level proposals and noted the importance of linking Joint Biosecurity Centre alert levels to NPIs both nationally and locally – and of building public trust in the approach to setting and changing alerts.

Situation update

5. SAGE approved SPI-M nowcasts, for which data streams are now aligning more closely. SAGE noted that projections are downwards for all nowcasts.
6. SAGE also approved the following estimates of R: the UK is between 0.7 and 0.9; England is between 0.7 and 0.9; Scotland is between 0.6 and 0.9; Wales is between 0.7 and 1.0; Northern Ireland is between 0.7 and 1.0.
7. There is no evidence of difference in R across the 4 nations – but R is easier to estimate for England, given larger amounts of data.
8. SAGE advised that as R and numbers come down, the challenge in managing the epidemic will be to identify and tackle local outbreaks. Virus sequencing may help understand origins of outbreaks and transmission patterns.
9. Nosocomial infection in hospitals outside London – albeit at reduced levels compared to earlier in the outbreak – remains a significant concern. The NHS has a new site-specific nosocomial sitrep. The SAGE nosocomial subgroup continues to give science advice to the NHS.
10. According to CO-CIN data, 1 in 3 people admitted to hospital with Covid-19 have died.
11. SAGE noted ongoing high incidence of infection – at around 10,000 cases per day.
12. SAGE reiterated the importance of detailed field investigation of generation time, i.e. the time between onset of symptoms in a primary and secondary case. This has been noted before and SAGE reiterated the importance of this study being undertaken, ideally by PHE.
13. SAGE noted a verbal report of outbreaks in schools, including residential settings and schools for children with special educational needs: these need to be investigated and PHE are doing so.
14. Whilst there is currently no new data for SAGE to review its advice on 2-metre distancing, the Environmental and Modelling Group is producing further advice on mitigations for different transmission routes. It was noted that the advice provides enough information for further policy decisions to be made.

ACTION: GCSA to share UKRI email on REF recognition with SAGE attendees

ACTION: SAGE secretariat to work out how to provide a rapid meeting summary for public release on a routine basis

ACTION: PHE to review its capacity to model infection rates in essential retail currently open in order to assess effectiveness of distancing measures (by 29 May); Jeremy Farrar and ONS to consider alternatives if PHE unable to action

ACTION: PHE to provide a response to the need for an epidemiological study into Covid-19 generation time; **SPI-M** to provide details of research needs to PHE (and to UKRI in parallel)

ACTION: COG UK to produce an update at future SAGE meeting (timing to be determined by Sharon Peacock)

ACTION: UKRI to provide status report on review cohort studies following discharged Covid-19 patients and additional longitudinal studies (by 4 June)

ACTION: PHE to circulate emerging data from Covid-19 outbreaks (e.g. in special educational needs settings) to relevant sub-groups (including Children), JBC and DfE (by 29 May)

ACTION: SAGE participants to provide comments by email to **CMO** on *Serology testing strategy – for discussion at SAGE* paper (by 31 May)

High-risk institutional settings

15. SAGE endorsed the paper by Andrew Hayward and Ian Hall, which highlights risks in the homeless sector, prisons sector (including custody suites), in immigrant reception centres and other institutions featuring vulnerable populations and communal facilities.
16. SAGE advised strongly that efforts to limit transmission in these settings (including testing and surveillance) must be proactive (rather than waiting for outbreaks to occur) – and that they must be treated differently from settings such as care homes, given trust issues and particular challenges around test, trace and isolate.
17. SAGE advised that research is needed to understand both environmental and human issues in these settings (including co-morbidities and mental ill health), and that thinking is needed about seasonal challenges, especially winter.
18. SAGE also noted the importance of engaging experts and trusted third parties who understand marginalised groups, such as inclusion health teams.
19. If required, SAGE will establish a dedicated small group to focus on issues around high-risk institutional settings.
20. SAGE noted that a discussion has already taken place with MoJ, HO and MHCLG and the paper was shared.

ACTION: SAGE secretariat to circulate SAGE-endorsed *Preventing outbreaks in institutional settings* paper to MHCLG, DfE, HO and MOJ – with clear advice to develop action plans in response to its recommendations.

ACTION: HO and MHCLG CSAs to work with Andrew Hayward to develop research studies on outbreaks in institutional settings; Jeremy Farrar to provide advice on existing serological studies if required (by 4 June)

High-connectivity occupations and reducing transmission in social networks

21. SAGE agreed the importance and urgency of identifying high contact occupations at greatest risk and of methods to reduce risks of transmission including across social networks.
22. ONS data has signalled relationships between each of a) low pay, b) high-contact occupations and c) work in healthcare settings with risk of mortality.
23. For individuals able to work from home, risk of mortality is reduced substantially. It is often the case that people working in jobs where social distancing is difficult (or solutions have not been introduced) are also reliant on public transport.
24. Public control measures need to protect such workers, many of whom cannot afford not to work.
25. SAGE agreed that making workplaces Covid-safe is complex – but emphasised the importance of "co-creation" in designing layers of protection (as opposed to single

solutions). Co-creation requires full consultation with frontline workers at most risk, including on risk assessments.

26. SAGE also agreed the importance of clear risk communication, to empower individuals to protect themselves and colleagues and be vigilant at all times – including during breaks in work (risks from social interaction in staff rooms were noted) and commuting.
27. SAGE recognised that public communication on these issues will be challenging and cannot be achieved by existing messaging alone. Engagement and education are needed for both relevant occupations and the general public.
28. The Joint Biosecurity Centre should take a close interest in this area, given the risk of outbreaks in particular occupations and related workplaces. The testing in these high-risk groups could provide a useful warning system.

ACTION: Lucy Yardley (with **Cath Noakes, Charlotte Watts, Ian Diamond** and **Andrew Hayward**) to expand *Communicating behaviours to reduce transmissions between social networks* paper to incorporate additional evidence (by 4 June) for distribution to CSA Network and BEIS (which was considered the most appropriate department to own the actions and messaging); **SAGE secretariat** to consider organising a related policy seminar to provide information to departments across Whitehall. A list/map of high-risk occupations would be useful.

Joint Biosecurity Centre (JBC) alert levels (JBC present at discussion)

29. SAGE endorsed papers from SPI-M and the Evaluation Sub-group on JBC alert levels; these are already informing JBC policy development, and the levels remain a work in progress.
30. SAGE noted the importance of linking alert levels to NPIs both nationally and locally (locally not necessarily defined geographically); of segmented messaging through trusted voices (e.g. by occupation, local leaders or NGOs); of public transparency around who determines alert levels and how, and direction of travel; and of keeping alert level setters separate and independent from policy makers.
31. SAGE further noted the importance of clear public communications from the beginning, in order to foster trust.
32. SAGE advised that decisions to change alert levels would be better based on more than a single criterion or measure; judgements will be required, and it is important to consider both relevant data sources and what steps will be required when thresholds are met (particularly as levels escalate between levels 2, 3 and 4).

ACTION: Welsh Government to share paper on "circuit breakers" and indicators of infection for placing in SAGE repository (by 29 May)

ACTION: JBC to follow up directly with SAGE subgroups on dialogue and advice around JBC design

ACTION: **SAGE members** to assist with names of potential CSO/CMO for JBC.

AOB

33. SAGE participants reaffirmed their recent advice that numbers of Covid-19 cases remain high (around 10,000 cases per day with wide confidence intervals); that R is 0.7-0.9 and could be very close to 1 in places across the UK; and that there is very limited room for manoeuvre especially before a test, trace and isolate system is up and running effectively. It is not yet possible to assess the effect of the first set of changes which were made on easing restrictions to lockdown.

List of actions

GCSA to share UKRI email on REF recognition with SAGE attendees.

SAGE secretariat to work out how to provide a rapid meeting summary for public release on a routine basis.

PHE to review its capacity to model infection rates in essential retail currently open in order to assess effectiveness of distancing measures (by 29 May); Jeremy Farrar and ONS to consider alternatives if PHE unable to action.

PHE to provide a response to the need for an epidemiological study into Covid-19 generation time; **SPI-M** to provide details of research needs to PHE (and to UKRI in parallel).

COG UK to produce an update at future SAGE meeting (timing to be determined by Sharon Peacock).

UKRI to provide status report on review cohort studies following discharged Covid-19 patients and additional longitudinal studies (by 4 June).

PHE to circulate emerging data from Covid-19 outbreaks (e.g. in special educational needs settings) to relevant sub-groups (including Children), JBC and DfE (by 29 May).

SAGE participants to provide comments by email to **CMO** on *Serology testing strategy – for discussion at SAGE* paper (by 31 May)

SAGE secretariat to circulate SAGE-endorsed *Preventing outbreaks in institutional settings* paper to MHCLG, DfE, HO and MOJ – with clear advice to develop action plans in response to its recommendations.

HO and MHCLG CSAs to work with Andrew Hayward to develop research studies on outbreaks in institutional settings; Jeremy Farrar to provide advice on existing serological studies if required (by 4 June)

Lucy Yardley (with **Cath Noakes, Charlotte Watts, Ian Diamond** and **Andrew Hayward**) to expand *Communicating behaviours to reduce transmissions between social networks* paper to incorporate additional evidence (by 4 June) for distribution to CSA Network and BEIS (which was considered the most appropriate department to own the actions and messaging); **SAGE secretariat** to consider organising a related policy seminar to provide information to departments across Whitehall. A list/map of high risk occupations would be useful.

Welsh Government to share paper on "circuit breakers" and indicators of infection for placing in SAGE repository (by 29 May)

JBC to follow up directly with SAGE subgroups on dialogue and advice around JBC design

SAGE members to assist with names of potential CSO/CMO for JBC.

Attendees

Scientific experts (37): *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (dCMO), Angela McLean (CSA MoD), Robin Grimes (CSA Nuclear), John Aston (CSA HO), Charlotte Watts (CSA DfID), Carole Mundell (FCO CSA), Andrew Curran (CSA HSE), Stephen Powis (NHS), Mark Wilcox (NHS), Yvonne Doyle (PHE), Sharon Peacock (PHE), Paul Cosford (PHE), Maria Zambon (PHE), Ian Diamond (ONS), Graham Medley (LSHTM), John Edmunds (LSHTM), Peter Horby (Oxford), Cath Noakes (Leeds), Michael Parker (Oxford), James Rubin (KCL), Lucy Yardley (Bristol/Southampton), Wendy Barclay (Imperial), Calum Semple (Liverpool), Andrew Rambaut (Edinburgh), Ian Hall (Manchester),*

Andrew Hayward (UCL), Ian Boyd (St Andrews), Jeremy Farrar (Wellcome), Venki Ramakrishnan (Royal Society), Sheila Rowan (CSA Scotland), Andrew Morris (Scottish Covid-19 Advisory Group), Nicola Steedman (dCMO Scotland), Jim McMenamin (Health Protection Scotland), Rob Orford (Health CSA Wales), Ian Young (CMO Northern Ireland).

Observers and government officials (12): [redacted] *Emma Payne (CO),* [redacted] *Vanessa MacDougall (HMT), Ben Warner (No. 10), Imran Shafi (No. 10),* [redacted] *Charlie Edwards (JBC),* [redacted]

SAGE secretariat (16): [redacted] *Simon Whitfield, Kavitha Kishen,* [redacted] *Stuart Wainwright,* [redacted]

Total participants: 65

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Fortieth SAGE meeting on Covid-19, 4th June 2020
Held via Zoom

Summary

1. SAGE highlighted the importance of cluster tracing – including location tracing, understanding of environmental factors and backwards contact tracing – to the TTI programme.
2. There is an increased risk from Covid-19 to BAME groups, which should be urgently investigated through social science research and biomedical research, and mitigated by policy makers.
3. SAGE continues to advise at least 2m separation where possible, given the significant reduction in risk compared to shorter distances. Mitigations are available in some situations, and the principles of mitigation have been clearly identified.

Situation update

4. SAGE agreed the latest R estimates: 0.7-0.9 for the UK; 0.7-1.0 for England; 0.6-0.8 for Scotland; 0.7-0.9 for Wales; 0.7-1.0 for Northern Ireland.
5. CO-CIN data suggest it is highly likely that a significant proportion of total transmission is derived from hospitals or care homes. Nosocomial infection is responsible for an increasing proportion of cases and accounts for why R remains close to 1. The majority of cases currently coming into hospital may be linked to nosocomial spread.
6. R will start to tend towards one, which means confidence intervals will include values greater than one. This will present a communications challenge in which it will be important to also emphasise incidence levels.
7. ONS and the King's College London Zoe app are reporting lower incidence (7-8,000 per day) than modelled estimates, where models are converging around an estimated 35,000 infections per day; more work is needed to reconcile model outputs with ONS data and understand the discrepancies. The ONS data are seen as more direct.
8. Potentially one third to one half of hospital admissions labelled as Covid-19 admissions are readmissions or not acute Covid-19 disease: it is necessary to understand how the NHS is recording these patients to know whether its data is distorting modelling work.
9. SAGE endorsed the SPI-M paper on clusters and highlighted the importance of cluster tracing – including location tracing, understanding of environmental factors and backwards contact tracing – to the TTI programme. This has already been discussed with the TTI programme and will be reiterated.
10. SAGE reiterated the importance of robust TTI to prevent rising incidence of infection.
11. PHE has received advice on a generation time study from John Edmunds – and will confirm whether it has capacity to lead this investigation and, if not, which organisation will.
12. SAGE approved the latest excess deaths paper (to inform the reasonable worst case scenario) for use by Cabinet Office.

ACTION: NHS Medical Director to clarify for SPI-M which hospital admissions are recorded as Covid-19

ACTION: NERVTAG to advise on a) incubation time and b) proportion of asymptomatic cases as part of overall advice on infectiousness for next SAGE meeting on 11 June

ACTION: SAGE participants to comment on revised SPI-M 'Superspreading and Clusters' paper within next 24 hours (out-of-committee approval assumed)

ACTION: SAGE secretariat to send papers 'Estimating Additional Deaths to Expand the RWCS' and 'Adjusting RWCS for Total Deaths' to CCS for amalgamation and dissemination with existing excess deaths estimates

ACTION: Nosocomial group and **NHS Medical Director** to consider Wendy Barclay's 'Viral dynamics of infectiousness' paper ahead of next SAGE meeting on 11 June, particularly its recommendation for testing Covid-19 patients prior to hospital discharge

ACTION: **SPI-M** and **NERVTAG** to advise on optimal duration of pre-symptomatic timeframe for backwards contact tracing for next SAGE meeting on 11 June

Immunology

13. There is an antibody response in nearly all infected people, including those who are asymptomatic. It is not yet known how long these responses last, or what degree of protection is conferred.
14. The response includes some neutralising antibodies. While it is not yet known which antibodies give protection, and neutralising antibodies are not the only protective element, it is reasonable to infer there is some degree of protection.
15. The T-Cell response is also important and may confer cross-reactivity from seasonal coronaviruses. This T-cell cross-reactivity might explain some differences in clinical susceptibility.
16. It should not be assumed (indeed it is unlikely) that there will be true sterilising immunity, either from vaccines or from natural immunity. Immunity may provide protection from disease but not necessarily complete protection from infection. Antibody responses to vaccination may vary between groups, with elderly patients possibly needing adjuvant.
17. Different demographic groups, particularly the elderly, may have different responses to vaccines, and there are research gaps around gender and ethnicity. Additional sampling in some groups may be helpful.
18. Preliminary results show seroprevalence of around 17% in London, with higher rates in healthcare workers (up to 35%), and much higher rates in care homes which experienced outbreaks (in one case up to 70%). There is value in bringing together different datasets on seroprevalence in a single place.
19. Uncertainties around the implications of antibody test results mean that clinical use of serological testing is some way off. Immunity passports or equivalents are not advisable for similar reasons.
20. SAGE endorsed the paper on serological testing priorities, subject to it being updated to reflect the discussion in the meeting.
21. Key unknowns were identified as (a) degree of protection conferred by seropositivity (and which antibodies are protective), (b duration of any protection, and (c) whether seropositivity prevents acquisition and transmission of virus.

ACTION: UKRI, PHE and **Paul Moss** to ensure linkage between academic immunology research and PHE serological testing

ACTION: Andrew Morris and **Paul Moss** to identify how data from immunology research and PHE seroprevalence studies can be effectively captured and coordinated for wider use

ACTION: PHE (Maria Zambon) to ensure link up between JCVI (setting vaccination strategy and priority groups) and CMO testing strategy to ensure sufficient and appropriate serology data are collected for future vaccination programmes

Ethnicity

22. SAGE endorsed the summary paper drafted by the SAGE secretariat, which noted increased non-uniform risk among BAME groups of catching Covid-19 – potentially linked to economic inequality, deprivation, occupation, household size and other cultural features causing increased social contacts and levels of exposure.
23. The summary paper also noted increased risk of ICU admission and death from Covid-19 among BAME groups compared to non-BAME groups experiencing the same severity and duration of illness on admission to hospital. CO-CIN data show a 20% increase in

the chance of death among hospitalised Covid-19 patients of South-Asian background after adjusting for other risk factors including age, gender, comorbidities, and available markers of social deprivation. This in-hospital difference in outcomes may relate to biological factors including cardiovascular disease.

24. Preliminary NHS analysis of deaths of healthcare workers also identifies ethnicity as a major factor.
25. DHSC polling finds comparable levels of worry, trust and handwashing among BAME and non-BAME groups, but lower knowledge of Covid-19 symptoms among BAME groups.
26. SAGE further noted that considerable differences exist within current ethnic categories (e.g. among "South Asians"); that improved, tailored public messaging, while important, cannot overcome structural obstacles/inequalities; and fundamental sociological factors that may contribute to the observed increase in risk.
27. There are opportunities to analyse occupation by ethnicity within CO-CIN data.
28. Both social science research (quantitative and qualitative) and bio-medical research are urgently needed to better understand risk factors related to ethnicity.
29. Important to social science research is investigating issues such as health-seeking behaviours among BAME groups; levels of exposure to the virus and causes thereof; discrimination within occupations and healthcare roles (e.g. differential access to PPE); trust, social stigma and their behavioural impacts during and after the epidemic (including for social cohesion, inclusion, job seeking, in employment).
30. SAGE recognised the importance of recent sub-group work on high-contact occupations to understanding risk for BAME groups.
31. SAGE also noted the importance of involving BAME groups in framing research questions, participating in research projects, sharing findings and implementing recommendations.

ACTION: SAGE secretariat to circulate 'Ethnicity and Covid-19' summary paper (and supporting papers) to Cabinet Office and DHSC for onward dissemination to Cabinet Secretary, Heads of Departments and all relevant leads, once updated to include discussion of stigmatisation risk

ACTION: Lucy Yardley to ensure ethnicity is captured in summary report on high-contact occupations by 11 June

ACTION: SPI-B to provide advice on targeted messaging for BAME groups; chairs of SPI-B to discuss with No10 communications

ACTION: SAGE secretariat to speak to Science Media Centre about press briefing on ethnicity and Covid-19 by 8 June

ACTION: UKRI to consider priorities for social and biomedical research on ethnicity and Covid-19 by 11 June

ACTION: PHE, **HSE** and **Faculty of Occupational Medicine** to be contacted to implement strategies to mitigate ethnicity as Covid-19 risk factor; **PHE** to lead

Environmental transmission and mitigations

32. Risk of transmission varies in a continuous non-linear way with distance of separation and with duration of contact. Physical distancing is an important mitigation measure.
33. SAGE continues to advise at least 2m separation where possible, given the significant reduction in risk compared to shorter distances. Current evidence suggests that 1m separation carries 2-10 times the risk of 2m separation, though there remains significant uncertainty.

34. Given the continuum in risk, 2m separation should not be treated as an absolute rule, with greater distances presenting lower risk, and shorter distances presenting higher risk.
35. Other mitigations can reduce risk and should particularly be considered where it is necessary for people to be closer than 2m for a prolonged period, or where someone has multiple, frequent interactions with others at a shorter distance. Selection of measures should be tailored to the environment and activities.
36. SAGE endorsed the paper on transmission and mitigation measures.
37. SAGE endorsed the paper on mask wearing to reduce transmission in hospitals, and agreed that similar consideration should be given to care homes so that coordinated and consistent advice can be given. SAGE recognised a number of practical challenges that will need to be addressed for this policy to be operational.

ACTION: SAGE Secretariat to circulate approved EMG paper 'Mitigating transmission' and these minutes to key departments, including BEIS, DHSC, DfT and Cabinet Office

ACTION: Care Homes subgroup to consider recommendations from Nosocomial group paper 'Mask wearing to reduce virus transmission in hospitals', and assess its implications for care homes, before Nosocomial group paper is endorsed at SAGE subgroup chairs meeting on 8 June

Next meeting

38. Agenda will include infectiousness and science advice for the longer term.

ACTION: SAGE participants to comment on 'Science requirements and governance for next phase of Covid-19 response'

ACTION: SAGE secretariat to capture inputs from Devolved Administrations, Joint Biosecurity Centre and DHSC on 'Science requirements and governance for next phase of Covid-19 response' ahead of next SAGE meeting on 11 June

List of actions

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SAGE secretariat to capture inputs from Devolved Administrations, Joint Biosecurity Centre and DHSC on 'Science requirements and governance for next phase of Covid-19 response' ahead of next SAGE meeting on 11 June

Attendees

Scientific experts (48): *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (dCMO), Jenny Harries (dCMO), Angela McLean (CSA MoD), Robin Grimes (CSA Nuclear), John Aston (CSA HO), Charlotte Watts (CSA DfID), Carole Mundell (FCO CSA), Osama Rahman (CSA DfE), Andrew Curran (CSA HSE), Stephen Powis (NHS), Mark Wilcox (NHS), Yvonne Doyle (PHE), Sharon Peacock (PHE), Maria Zambon (PHE), Ian Diamond (ONS), Graham Medley (LSHTM), John Edmunds (LSHTM), Peter Horby (Oxford), Cath Noakes (Leeds), Michael Parker (Oxford), James Rubin (KCL), Brooke Rogers (KCL), Lucy Yardley (Bristol/Southampton), Wendy Barclay (Imperial), Calum Semple (Liverpool), Andrew Rambaut (Edinburgh), Ian Boyd (St Andrews), Charles Bangham (Imperial), Peter Bruce (Oxford), Janet Lord (Birmingham), Deborah Dunn-Walters (Surrey), Paul Moss (Birmingham), Michael Ferguson (Dundee), Iyiola Solanke (Leeds), Vittal Katikireddi (Glasgow), Jonathan Benger (Bristol), Kevin Fenton (PHE), Jeremy Farrar (Wellcome),*

Venki Ramakrishnan (Royal Society), Mark Walport (UKRI), Sheila Rowan (CSA Scotland), Andrew Morris (Scottish Covid-19 Advisory Group), Nicola Steedman (dCMO Scotland), Jim McMenamin (Health Protection Scotland), Rob Orford (Health CSA Wales), Ian Young (CMO Northern Ireland)

Observers and government officials (12): [redacted] *Emma Payne (CO),* [redacted] *Stephen Aldridge (MHCLG),* [redacted] *Vanessa MacDougall (HMT), Ben Warner (No. 10), Imran Shafi (No. 10),* [redacted]

SAGE Secretariat (16): [redacted] *Simon Whitfield,* [redacted] *Stuart Wainwright,* [redacted]

Total participants: 76

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Forty-first SAGE meeting on Covid-19, 11th June 2020
Held via Zoom

Summary

1. Short-term forecasts project a downward trend in all indicators modelled, including hospital admissions and deaths, across all geographies modelled.
2. Current advice to isolate for seven days in the case of mild infection, or seven days after symptoms have ended for more severe cases, remains sound (but would not catch 100% of infectious individuals).
3. SAGE agreed strongly on the value of linking all health data, as well as linking health data to other data systems (e.g. social security).

Situation update

4. SAGE agreed the latest R estimates: 0.7-0.9 in the UK; 0.8-1.0 in England; 0.6-0.9 in Scotland; 0.7-1.0 in Wales; 0.6-1.0 in Northern Ireland. Short-term forecasts project a downward trend in all indicators modelled, including hospital admissions and deaths, across all geographies modelled.
5. CO-CIN data indicate that the North West of England continues to have higher proportion of hospital acquired infections than other regions. Individual settings and outbreaks can have a significant impact on regional figures.
6. Analysis of CO-CIN data can provide case fatality ratios by age and comorbidity. It would be valuable to combine this with other data to estimate infection fatality rates by age and co-morbidity.
7. SAGE endorsed the paper 'Reducing transmission in high connectivity occupations' with minor changes.
8. NHS serology data indicate 16% seroprevalence in healthcare workers and 20% in hospital patients but these data should be seen as provisional.

ACTION: NHS Medical Director and **SPI-M** to resolve remaining uncertainties concerning hospital admissions recorded as Covid-19

ACTION: Care Home subgroup to send 'Wearing of mask coverings to reduce infections within care homes and other potentials settings' paper, once complete, to DHSC and to SAGE secretariat for placement in repository

ACTION: CSA MoD to establish current status of external actuarial research on case fatality ratios and on ascertaining proportion of infected people who end up in hospital by 18 June

ACTION: SAGE secretariat to send 'Reducing transmission in high connectivity occupations' paper to PHE, HSE, Cabinet Office, NHS T&T/JBC, BEIS, DfT by 12 June (after checking language around describing risk with HSE)

Publication of regional data

9. Estimating R across smaller populations results in wider confidence intervals and means that outbreaks and individual settings can have a significant impact on R inference. SAGE agreed that estimating and publishing R at a regional level was currently viable, but as incidence and prevalence decrease, the reliability of these estimates will decline to a point where they will not be accurate or meaningful.

10. SAGE agreed that regional growth rates should be published alongside regional R values as growth rates are not reliant on assumptions around the generation time interval for which data are not currently available.
11. ONS intends to publish regional incidence and prevalence figures weekly from the beginning of July. This observed data will be more robust than modelled estimates.
12. All these data should be accompanied by an explanation of terms and guidance on interpretation. In particular, the low reliability and high variability over time in estimates of R when case numbers are low needs to be communicated.

ACTION: SPI-M to advise in future on growth rate alongside R and to produce suitable explanation of both (plus statement indicating that incidence and prevalence will become a more useful measure than R in future) by 18 June; **SAGE secretariat** to discuss with Cabinet Office how best to publish these by 18 June

ACTION: SPI-M to advise on criteria for when individual areas R would cease to be an accurate or meaningful indicator of infection spread by 18 June

Infectiousness

13. The average incubation period estimate remains 5 days. The peak of viral load occurs just before or around the time of symptom onset.
14. Data indicate that people are infectious for up to 8-12 days after symptom onset. RT-PCR testing may still detect virus after this point, but it is unlikely to be viable.
15. Viral load (determined by RT-PCR) is a good indicator of whether live virus can be recovered from a sample. However, the relationship of virus recovery to infectiousness is unknown.
16. Viral load does not appear to correlate with disease severity.
17. Infectiousness does correlate with duration of disease/severity. For mild cases, there is a low probability of infectiousness 7-9 days after symptom onset (moderate confidence). For hospitalised patients, there is a low probability of infectiousness 14 days after symptom onset (moderate confidence).
18. In general, the presence of antibodies negatively correlates with infectiousness. Antibody response is seen as early as day 10-14 in most people and may account for reduced infectivity.
19. Overall, this evidence indicates that the current advice to isolate for seven days in the case of mild infection, or seven days after symptoms have ended for more severe cases, remains sound.
20. It may be possible to develop a risk-based assessment, combining multiple factors (e.g. symptom onset and duration as well as both antibody and antigen testing). This may be of particular value for decisions involving those people coming into contact with vulnerable people or other higher-risk situations. Review of the advice is a matter for CMOs and PHE.
21. Further work would be needed to develop such an assessment and consider its application. Further studies on infectiousness between 7 and 14 days after infection would also be valuable and could be incorporated into existing and planned studies (serology group and ONS).

ACTION: PHE (with senior clinicians' group, as appropriate) to determine additional advice on testing to enable safe return of patients and staff to settings involving vulnerable people (e.g. care homes).

ACTION: Jeremy Farrar and **ONS** to provide update on any additional research relating to infectiousness which can be commissioned using existing cohort studies by 18 June

Test, trace and isolate

22. SAGE continues to recommend backwards contact tracing. It will be important to determine over what period contacts should be considered for tracing. The main value of backward contact tracing is to identify potential clusters.
23. It is difficult to determine a reasonable period for backward contact tracing for those who test positive but do not display symptoms, as time of onset of infection will be unknown. The percentage of people who are asymptomatic remains uncertain and could be between 30-80%; it may vary by age and other characteristics.
24. The predictive value of testing depends on prevalence levels, as well as operational specificity and sensitivity of the testing process. SAGE will consider this further at its next meeting.

ACTION: SPI-M to advise NHS T&T/JBC directly on optimal time for backward testing and tracing and share supporting papers by 15 June

ACTION: SAGE Secretariat to commission item on double testing and release, quarantine and antibodies (including updated paper on false positive/false negative testing) for next SAGE meeting

Health Data Research

25. SAGE strongly endorsed HDR's work, agreed that open research and sharing of data through accessible secure research environments is required to prevent response work becoming fragmented, and agreed to continue to identify any blockers against data sharing.
26. SAGE agreed that a coherent approach to mapping serology and antigen testing data for research purposes across the four nations is essential.
27. SAGE agreed not only on the value for Covid-19 research of linking all health data, but also linking health data to other data systems (e.g. ONS, education and social security).
28. SAGE agreed links to the JBC are important and that an abstracted research data infrastructure is essential.
29. A registry of national Covid-19 studies may be of value.

ACTION: SAGE Secretariat to convene small group to consider concept for a national Covid-19 studies collection

ACTION: HDR UK to work with partners to define a plan for the creation of serology and testing data research asset that is linkable to other data sources, and to report back to SAGE in due course

ACTION: HDR UK to work with ONS and other partners to accelerate linkage of cross-sectoral datasets, and to report back to SAGE on progress in due course

Environmental transmission

30. Public toilets are a potential vector for transmission because of the stacked risk of aerosol presence, faecal matter, frequently touched surfaces, confined space and public queuing.
31. SAGE will consider environmental transmission in more detail at its next meeting.

ACTION: CSA Defra to circulate paper on environmental spread in outdoor environments to SAGE participants by 12 June

List of Actions

NHS Medical Director and **SPI-M** to resolve remaining uncertainties concerning hospital admissions recorded as Covid-19

Care Home subgroup to send 'Wearing of mask coverings to reduce infections within care homes and other potentials settings' paper, once complete, to DHSC and to SAGE secretariat for placement in repository

CSA MoD to establish current status of external actuarial research on case fatality ratios and on ascertaining proportion of infected people who end up in hospital by 18 June

SAGE secretariat to send 'Reducing transmission in high connectivity occupations' paper to PHE, HSE, Cabinet Office, NHS T&T/JBC, BEIS, DfT by 12 June (after checking language around describing risk with HSE)

SPI-M to advise in future on growth rate alongside R and to produce suitable explanation of both (plus statement indicating that incidence and prevalence will become a more useful measure than R in future) by 18 June; **SAGE secretariat** to discuss with Cabinet Office how best to publish these by 18 June

SPI-M to advise on criteria for when individual areas R would cease to be an accurate or meaningful indicator of infection spread by 18 June

PHE (with senior clinicians' group, as appropriate) to determine additional advice on testing to enable safe return of patients and staff to settings involving vulnerable people (e.g. care homes)

Jeremy Farrar and **ONS** to provide update on any additional research relating to infectiousness which can be commissioned using existing cohort studies by 18 June

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CSA Defra to circulate paper on environmental spread in outdoor environments to SAGE participants by 12 June

Attendees

Scientific Experts (38): *Patrick Vallance (GCSA), Chris Whitty (CMO), Jenny Harries (dCMO), Angela McLean (CSA MoD), John Aston (CSA HO), Andrew Curran (CSA HSE), Charlotte Watts (CSA DfID), Carole Mundell (CSA FCO), Robin Grimes (CSA Nuclear), Gideon Henderson (CSA Defra), Andrew Morris (Scottish Covid-19 Advisory Group), Steve Powis (NHS), Mark Wilcox (NHS), [redacted] Maria Zambon (PHE), Yvonne Doyle (PHE), Peter Horby (Oxford), Calum Semple (Liverpool), Graham Medley (LSHTM), John Edmunds (LSHTM), Lucy Yardley (Bristol/ Southampton), Brooke Rogers (King's), Ian Diamond (ONS), Jeremy Farrar (Wellcome), Venki Ramakrishnan (Royal Society), Ian Boyd (St Andrews), Michael Parker (Oxford), Catherine Noakes (Leeds), Rob Orford (Health CSA Wales), Fliss Benee (Wales Technical Advisory Cell), Nicola Steedman (dCMO Scotland), Jim McMenamin (Health Protection Scotland), Wendy Barclay (Imperial), Andrew Rambaut (Edinburgh), Paul Cosford (PHE), Rhoswyn Walker (HDR-UK), David Seymour (HDR-UK), Caroline Cake (HDR -UK)*

Observers (8): *Ben Warner (No.10), [redacted] Vanessa MacDougall (HMT), [redacted] Imran Shafi (No 10), [redacted]*

Secretariat (16): *[redacted] Simon Whitfield (GO-S), [redacted] Stuart Wainwright (GO-S)*

Total participants: 62

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Forty-second SAGE meeting on Covid-19, 18th June 2020
Held via Zoom

Summary

1. SAGE congratulated the RECOVERY trialists on the hydroxychloroquine and dexamethasone results, which reaffirm the central importance of randomised trials.
2. SAGE noted the importance of understanding risk to marginalised groups, including migrant workers, and the need to prepare for anticipated outbreaks in areas of high deprivation. The issue will be taken up with Cabinet Office.
3. SAGE agreed that double testing of travellers could enable quarantining terms of less than 14 days.
4. SAGE noted that super-spreading environments and clusters of infections are particularly important.
5. SAGE agreed that the risk of environmental transmission will likely increase in the winter months. Public toilets were identified as of particular concern.

Situation update

6. SAGE approved the latest R estimates for publication: for the UK, R is 0.7 to 0.9 (90% confidence interval). R estimates have not changed significantly from the previous week.
7. SAGE approved growth rate estimates for publication: for the UK, the growth rate is -4% to -2% per day (90% confidence interval). Growth rate estimates are based on different data from R estimates are more statistically stable.
8. Case numbers and fatalities are declining, but the rate of decline is slowing.
9. Hospital acquired infections are declining, with an approximate 30% decrease in cases occurring in hospitals after day 8. CO-CIN data also point to an improving situation.
10. SAGE reiterated its concerns about the risk of discharging patients from hospital while still infectious. Advice from SPI-M and from NERVTAG about pre-discharge testing of patients is being considered by the Senior Clinicians Group, which contains those who have accountability for determining actions to be taken.
11. SAGE noted the importance of fully understanding NHS admissions data to reconcile operational needs with requirements for accurate modelling. This requires more detailed information on patients being admitted.
12. SAGE noted the excellent findings from the RECOVERY trial on dexamethasone, which demonstrated clearly the importance of randomised trials. The UK should aim for even higher numbers enrolled in clinical trials and this work should start now.
13. ONS (supported by DHSC and the Government Actuaries Department) will publish national statistics each month on excess deaths under 4 categories, including analysis of potential causes (publication starting a fortnight from now).
14. Further to previous SAGE discussion of transmission risk in institutional settings, SAGE noted the importance of understanding risk to migrant workers (e.g. DEFRA understanding risk to fruit pickers) who often live in dormitory-style settings. Better demographic data are needed for all vulnerable and marginalised groups. The importance of joining up different pieces of work on this issue which have been discussed at SAGE was reiterated.
15. SAGE also noted the need to prepare for outbreaks in areas of high deprivation and/or featuring high concentrations of BAME communities – and consider research in these areas.
16. Social contact data trends remain flatter than mobility data trends – pointing to public cautiousness following the release of lockdown measures.
17. SAGE will receive a COG-UK paper at a future meeting on introductions of the virus to the UK during March.

ACTION: Graham Medley, PHE and **NHS Medical Director** to convene group to resolve 'ground truth' on hospital admissions recorded as Covid-19; **PHE** to confirm status of

epidemiological study into Covid-19 generation time and its response to John Edmunds's note on epidemiological data requirements (circulated at SAGE40) by 25 June

ACTION: Cabinet Office to decide how to address potential Covid-19 outbreaks in vulnerable/marginalised groups (e.g. migrant agricultural workers) building on 'Impact of occupational exposure to disease, proximity to others during work and income on mortality from COVID-19' paper and work by Andrew Hayward, and linking to Mary Dixon-Wood's new group, by 25 June; **UKRI** to identify associated research priorities, by 2 July

ACTION: PHE to link its new work on risk of Covid-19 in night shelters and hostels to ongoing work in MHCLG on institutional settings (already discussed at previous SAGE meetings) by 25 June

Quarantine release

18. SAGE reviewed several papers on repeat testing, which reached consistent conclusions.
19. Given the current state of the epidemic in the UK, SAGE reiterated its previous advice that quarantining of travellers entering the UK is most effective when those travellers come from a country with higher incidence than the UK.
20. Double testing of travellers significantly reduces the risk of false negatives, and could enable quarantine duration of less than 14 days. The optimal days of testing are between days 5-8 post exposure (moderate confidence).
21. If initial testing is carried out prior to travellers entering the UK, the duration of quarantine in the UK could be shortened further (with the caveat that travellers should self-isolate between testing and travelling). Pre-testing of this kind would require international agreements and common standards.
22. SAGE noted some complicating factors, including test turnaround times; ongoing uncertainty around test positivity over time in asymptomatic cases; the importance of public adherence; the challenges of establishing true incidence in some countries; and that the approach to quarantine for TTI cannot be identical to that of travellers entering the UK (because of the problem of an increased likelihood of false positives).

ACTION: PHE to develop policy options for screening incoming visitors to the UK based on SAGE advice and papers, by 23 June; this advice to go to DfT, HO and DHSC and also cover double testing and release of contacts identified through contact tracing

Super spreaders

23. SAGE agreed there is strong evidence for the existence of epidemiological (rather than biological) super-spreading events. These events are caused by a combination of the characteristics of infected individuals and environmental factors.
24. Individuals likely to facilitate the seeding of super-spreading events may be asymptomatic or paucisymptomatic. Understanding asymptomatic infection is key to understanding super-spreading events.
25. Environments linked to super-spreading events tend to be internal, crowded locations where it may be necessary to speak loudly.
26. Studies of cluster tracing approaches adopted internationally (in particular Japan) have highlighted that schools and possibly universities do not appear to be centres of super-spreading events (low confidence). These studies advocate a cluster-based approach to contact tracing, as has been previously recommended by SAGE (including with backward contact tracing).
27. It may be relatively straightforward to retrospectively identify super-spreading events when they occur in a single setting, but more challenging to identify if transmission occurs across multiple, disparate settings.
28. Genomics analysis has potential in linking apparently un-clustered cases to a single super-spreading individual, but probably greater potential to unlink apparently connected

clusters. The UK is in a unique position to do this work given the scale of its genomic efforts, but the response would need to be regional and rapid.

29. SAGE re-emphasised that a key metric for understanding effectiveness of a test and trace system is the number of new cases picked up through the system versus the number occurring outside of it.
30. SAGE again agreed that cluster tracing is very important, as is capturing information on features of super spreaders unrelated to the disease itself, e.g. occupation, location. This may help identify other likely super spreaders in future.
31. SAGE reiterated the importance of understanding the optimum duration for backwards contact tracing.

ACTION: JBC to confirm metrics that relate to known clusters and linked cases versus infections not detected by test and trace, including how genomics could assist in case linkage and verification, by 23 June

ACTION: SPI-M to incorporate additional consensus input from Wendy Barclay and PHE on asymptomatic viral shedding in its advice to NHS T&T/JBC on optimal time frame for backward tracing, by 23 June

Outdoor and wider transmission

32. SAGE approved the paper 'Evidence of wider environmental transmission', contingent upon a number of minor amendments.
33. There is no clear link between outdoor air quality and the likelihood of transmission, owing to rapid dilution of the virus in external environments and its relatively short lifetime.
34. There remains uncertainty around the dose of the virus required to cause infection and the decay rate of the virus in natural (as opposed to laboratory) settings.
35. During winter the virus will survive for longer on surfaces because of decreased day-light, humidity and temperature, which will lead to greater outdoor surface transmission.
36. SAGE noted that public toilets pose a comparatively high risk of transmission, with the main transmission route in that setting being from surfaces. This is due to a combination of low levels of natural light, confined space and the risk of faecal or urine transmission.
37. There is a low risk of infection from treated wastewater, or fresh or marine bodies of water, though risk may increase slightly after heavy rainfall.
38. SAGE acknowledged that more work is required to better understand surface and faecal transmission.

ACTION: Wider Environmental Subgroup to update 'Evidence of wider environmental transmission of SARS-CoV-2' paper and send to DEFRA, MHCLG, DCMS and other relevant departments by 19 June

ACTION: UKRI and **HSE** to consider additional research questions and commissioning relating to Covid-19 risks from external fomites

Future meetings

39. SAGE agreed to consider the impacts of universities restarting teaching (online and face to face) and of student mobility (including the risks posed to vulnerable groups).

ACTION: DfE to consider effect on infection rates from return of students to universities for SAGE by 2 July

List of actions

Graham Medley, PHE and **NHS Medical Director** to convene group to resolve 'ground truth' on hospital admissions recorded as Covid-19; **PHE** to confirm status of epidemiological

study into Covid-19 generation time and its response to John Edmunds's note on epidemiological data requirements (circulated at SAGE40) by 25 June

Cabinet Office to decide how to address potential Covid-19 outbreaks in vulnerable/marginalised groups (e.g. migrant agricultural workers) building on 'Impact of occupational exposure to disease, proximity to others during work and income on mortality from COVID-19' paper and work by Andrew Hayward, and linking to Mary Dixon-Wood's new group, by 25 June; **UKRI** to identify associated research priorities, by 2 July

PHE to link its new work on risk of Covid-19 in night shelters and hostels to ongoing work in MHCLG on institutional settings (already discussed at previous SAGE meetings) by 25 June

PHE to develop policy options for screening incoming visitors to the UK based on SAGE advice and papers, by 23 June; this advice to go to DfT, HO and DHSC and also cover double testing and release of contacts identified through contact tracing

JBC to confirm metrics that relate to known clusters and linked cases versus infections not detected by test and trace, including how genomics could assist in case linkage and verification, by 23 June

SPI-M to incorporate additional consensus input from Wendy Barclay and PHE on asymptomatic viral shedding in its advice to NHS T&T/JBC on optimal time frame for backward tracing, by 23 June

Wider Environmental Subgroup to update 'Evidence of wider environmental transmission of SARS-CoV-2' paper and send to DEFRA, MHCLG, DCMS and other relevant departments by 19 June

UKRI and **HSE** to consider additional research questions and commissioning relating to Covid-19 risks from external fomites

DfE to consider effect on infection rates from return of students to universities for SAGE by 2 July

Attendees

Scientific Experts (37): *Patrick Vallance (GCSA), Chris Whitty (CMO), Jenny Harries (dCMO), Jonathan Van Tam (dCMO), John Aston (CSA HO), Andrew Curran (CSA HSE), Charlotte Watts (CSA DfID), Carole Mundell (CSA FCO), Robin Grimes (CSA Nuclear), Osama Rahman (CSA DfE), Gideon Henderson (CSA Defra), Andrew Morris (Scottish Covid-19 Advisory Group), Steve Powis (NHS), Mark Wilcox (NHS), Sharon Peacock (PHE),* [redacted] *Maria Zambon (PHE), Yvonne Doyle (PHE),* [redacted] *Peter Horby (Oxford), Calum Semple (Liverpool), Graham Medley (LSHTM), John Edmunds (LSHTM), Lucy Yardley (Bristol/Southampton), Michael Parker (Oxford), Wendy Barclay (Imperial), Ewan Birney (European Bioinformatics Institute), Adam Kucharski (LSHTM), James Rubin (KCL), Catherine Noakes (Leeds), Ian Diamond (ONS), Jeremy Farrar (Wellcome), Venki Ramakrishnan (Royal Society), Ian Boyd (St Andrews), Rob Orford (Health CSA Wales), Fliss Bennee (Wales Technical Advisory Cell), Nicola Steedman (dCMO Scotland)*

Observers (8): *Ben Warner (No.10),* [redacted] *Vanessa MacDougall (HMT),* [redacted]

Secretariat (all GO-Science) (21): [redacted] *Simon Whitfield,*

[redacted] *Stuart Wainwright,* [redacted]

Total: 63

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Forty-third SAGE meeting on Covid-19, 23rd June 2020
Held via Zoom

Summary

1. Releasing a significant number of measures in combination presents a material risk of accelerating transmission and the impacts will need to be carefully monitored.
2. Reintroduction of measures will need to be considered at a local level in response to outbreaks.
3. There will be trade-offs to be made when considering what measures need to be retained or reintroduced, and equity will be an important consideration in making these trade-offs given the varying impacts on different sections of society.
4. SAGE recommends co-creation of public guidance to engage communities and deliver effective communications.

Situation update

5. Hospital case numbers continue to decline; the rate of decrease continues to slow.
6. Latest ONS data show a flattening trend for infection prevalence and incidence.
7. SPI-M and NHS discussions on recording of Covid-19 re-admissions are continuing but the latest data from NHS suggest that the figure is less than 5% of total.

Cabinet Office commission

8. SAGE endorsed papers from SPI-M and SPI-B on potential changes to measures, subject to minor updates.
9. Releasing a significant number of measures in combination presents a material risk of accelerating transmission and the impacts will need to be carefully monitored. An increase in local outbreaks is highly likely. Modelling indicates that, in the absence of enhanced levels of immunity provided by vaccination, contact tracing and COVID-secure measures are unlikely to be sufficiently effective to allow a return to 'pre-COVID' normality without increasing infections rates.
10. As previously advised measures should be considered in combination, and cannot meaningfully be assessed individually. There will be trade-offs to be made when considering what measures need to be retained or reintroduced, and equity will be an important consideration in making these trade-offs given the varying impacts on different sections of society.
11. It will take some time (one month or more) for the impact of changes to measures on transmission to become apparent, due to both the lag in people's response, and the lag in measurement of key indicators such as hospital admissions. Some people's responses will also occur ahead of changes being introduced, and the overall effect is one of gradual change in levels of contact (this is true both when imposing and releasing measures).
12. Reintroduction of measures will need to be considered at a local level in response to outbreaks. Data from contact tracing and outbreak investigations will be essential in informing any decisions. The PHE outbreak report will be valuable, and this should be integrated with the work of the JBC.
13. Some behavioural data can give a more timely indication of changes than epidemiological data and a behavioural situation report would be valuable in bringing together different sources of data to support monitoring. The CoMix behavioural contact survey is one source of such data; early indications from the most recent CoMix data suggest an increase in contacts and consequently in R, possibly bringing it close to 1.
14. As measures are reversed, behavioural responses will not necessarily mirror those observed as measures were imposed, as a result of the different psychological context (which may include altered levels of trust, fear and anger).
15. There are still large numbers of people without a basic understanding of some elements of COVID-19, including awareness of symptoms (cough or fever only recognised by 65% of people). It will be important to deliver effective communications both on these

elements and on more complex issues such as network effects, in order to effectively convey risk and explain the rationale for measures. SAGE recommends co-creation of guidance to engage communities and deliver effective communications.

16. There may be a need to change measures at the end of the summer in order to be able to keep R below 1 whilst proceeding with the planned reopening of schools. Planning for safe full reopening should take place now and should take account of the health benefits of reopening schools as well as the educational benefits.
17. There are different risks over the summer period, from different patterns of behaviour and as people move around the country, which may link networks and place additional pressure on areas where there is an influx of people, such as rural and coastal areas.
18. The 'ready reckoners' in the endorsed SPI-M paper provide a useful way to consider the risks associated with changes in different scenarios. It will be important to measure the extent to which sectors are COVID-Secure in order to be able to understand the likely impact on R of any changes. Further work is needed to understand how COVID security can be measured.

ALL ACTIONS FROM THIS AGENDA ITEM ARE CAPTURED IN THE LIST BELOW

Future meetings

19. A small number of SAGE participants will meet on 25th June to review R and growth rate estimates.

List of actions

SAGE secretariat to ensure SPI-M ready reckoner is seen and understood by Cabinet Office and DHSC policy officials

SAGE secretariat to circulate responses to Questions 1-3 of Cabinet Office Stage 3 commission to all SAGE participants by 24 June

PHE to provide weekly sitrep summarising outbreaks of Covid-19 and link this with JBC by 2 July

SPI-B chair to brief Alex Aiken and other comms and policy leads on behavioural considerations and communications around reinstating distancing measures by 2 July

C-19 secretariat to develop weekly sitrep combining polling and behavioural data by 2 July

John Edmunds to circulate most recent CoMix data to SAGE participants by 25 June

Cath Noakes, **Andrew Curran**, **Graham Medley** and **James Rubin** to identify how 'Covid security' (i.e. effectiveness of risk mitigation measures in reducing transmission for a given contact) can be measured by 2 July

DfE advised to work with subgroups to consider how schools can re-open safely (by July 9th)

Lucy Yardley to produce annex on high contact situations and linking networks to paper 'Reducing transmission in high connectivity occupations' by 2 July

Attendees

Scientific Experts (36): *Patrick Vallance (GCSA), Chris Whitty (CMO), Jonathan Van Tam (dCMO), Jenny Harries (dCMO), Angela McLean (CSA MoD), John Aston (CSA HO), Andrew Curran (CSA HSE), Charlotte Watts (CSA DfID), Carole Mundell (CSA FCO), Robin*

Grimes (CSA Nuclear), Osama Rahman (CSA DfE), Andrew Morris (Scottish Covid-19 Advisory Group), Steve Powis (NHS), Mark Wilcox (NHS), Sharon Peacock (PHE), [redacted] Yvonne Doyle (PHE), Paul Cosford (JBC), [redacted] Peter Horby (Oxford), Graham Medley (LSHTM), John Edmunds (LSHTM), James Rubin (KCL), Lucy Yardley (Bristol/Southampton), Michael Parker (Oxford), Wendy Barclay (Imperial), Calum Semple (Liverpool), Cath Noakes (Leeds), Ian Boyd (St Andrews), Venki Ramakrishnan (Royal Society), Mark Walport (UKRI), Sheila Rowan (CSA Scotland), Nicola Steedman (dCMO Scotland), Jim McMenamin (Health Protection Scotland), Rob Orford (Health CSA Wales), Ian Young (CMO Northern Ireland).

Observers (9): *Ben Warner (No.10), [redacted] Vanessa MacDougall (HMT), [redacted]*

Secretariat (all GO-Science) (18): *Stuart Wainwright, Kavitha Kishen, Simon Whitfield, [redacted]*

Total: 63

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Forty-fourth SAGE meeting on Covid-19, 25th June 2020
Held via Zoom

R and growth rates

1. Short term forecasts continue to project a downward trend in all indicators modelled, including ICU bed occupancy and number of deaths.
2. SAGE approved the latest estimates of R and growth rate. For the UK, R remains between 0.7 and 0.9, and the growth rate is estimated as being between -2% and -4% per day.
3. It was noted that some of the Devolved Administrations will soon reach a level of incidence for which R cannot be reliably estimated. SAGE agreed to expand on this point in next week's meeting.
4. The terms 'cluster', 'outbreak' and 'epidemic' are currently used to describe different sizes of outbreak, but the differences between these terms have not been properly defined. Clearer definitions would improve communications and public understanding.

List of actions

ACTION: SPI-M to investigate the point at which R can no longer be reliably estimated for the next SAGE meeting

ACTION: CMO to define the terms 'cluster', 'outbreak' and 'epidemic' for use in describing different sizes of outbreak

Attendees

Scientific Experts (7): Patrick Vallance (GCSA), Chris Whitty (CMO), Angela McLean (CSA MoD), Graham Medley (LSHTM), Iain Bell (ONS), Rob Orford (Health CSA Wales), Roger Halliday (Chief Statistician Scotland),

Observer (1): [redacted]

Secretariat (all GO-Science) (5): [redacted]

Total: 13

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Forty-fifth SAGE meeting on Covid-19, 2nd July 2020
Held via Zoom

Summary

1. Nosocomial transmission is decreasing both in terms of numbers and proportion of cases.
2. Routine genomic sequencing has the potential to detect or refute clusters of infections where this is not possible by other means. SAGE agreed the importance of integrating genomics into the public health response.
3. There is evidence that individuals who are both antibody positive and PCR positive are much less likely to be infectious (medium confidence). This may offer a potential way forward, in the short term, for releasing some individuals from self-isolation or quarantine.

Situation update

4. SAGE approved the latest SPI-M estimates of R and growth rate. For the UK, R remains between 0.7 and 0.9, with an estimated growth rate between -6% and 0% per day.
5. These estimates are a lagging indicator. They do not include estimates from CoMix, which uses pre-infection data to estimate R and is not affected by low case numbers, and shows a potential slight increase.
6. SAGE agreed there are two circumstances where R cannot be reliably estimated: i) when incidence in a region is very low, e.g. fewer than 5 deaths per day, and ii) when a region is highly heterogeneous due to one or more isolated outbreaks. The latter circumstance can be overcome through the use of a heterogeneity indicator.
7. According to these criteria, R in Wales, Scotland and Northern Ireland cannot be estimated reliably due to low case numbers. This is also true for all NHS England regions excluding North East and Yorkshire, and North West.
8. Further work is required to communicate R effectively to avoid public behaviour being dictated by these estimates. Many of these rely on hospital data, which feature an approximate 3-week lag.
9. Short-term forecasts show levelling off of all indicators measured, including ICU bed occupancy and numbers of deaths.
10. SAGE highlighted the importance of getting the maximum amount of information into the public domain for people to understand the epidemic in totality.
11. SAGE proposed that JBC should be responsible for integrating and publishing available data on a single website, including incidence and prevalence figures. Until then, GCSA and CMO will approve R and growth estimates.
12. CO-CIN data show decreasing nosocomial transmission both in terms of numbers and proportion of cases. This was also confirmed by the chair of the Nosocomial Working Group.
13. NHS data show key metrics (including Covid-19 admissions) falling, but more slowly.
14. SAGE endorsed the annexe to the paper 'Managing Infection risk in high contact occupations'.

ACTION: SAGE secretariat to send networks annex to 'Reducing transmission in high connectivity contact occupations' paper to JBC, C-19 Taskforce, CCS and BEIS by 3 July

ACTION: SAGE secretariat to send most recent CoMix paper to JBC by 3 July

ACTION: JBC and **PHE** to devise an integrated approach to publication of R and other national and regional indicators by 9 July; **SAGE secretariat** to amend wording on website concerning reliability of regional R

ACTION: JBC to ensure localised testing data is being fed to ONS and SPI-M to inform future modelling

ACTION: SAGE secretariat to circulate PHE sitrep to CSAs and SPI-M

Genomics update

15. SAGE approved the COG UK paper on sequencing and transmission and noted that the UK is world-leading in this area.
16. Initial seeding of Covid-19 in the UK appears to have come largely from Europe (Spain, France and Italy).
17. Routine surveillance sequencing has the potential to detect or refute clusters of infections where this is not possible by other means. Rapidly suppressing clusters could have a significant impact in reducing overall transmission.
18. The ancestral variant of the virus (D variant) has a lower R than the G variant, which has rapidly spread across the world. One study estimates the G variant R to be 1.26 times greater than the ancestral version, with no apparent difference in disease severity.
19. SAGE agreed the importance of integrating genomics into the public health response and endorsed the proposal that COG UK should continue to work to improve data flows to get as close to real-time sequencing as possible.

Antibody testing and immunity

20. SAGE endorsed the commissioned paper on antibody testing and immunity.
21. Antibody tests provide information on an individual's immune response but cannot yet determine whether that individual is protected from infection or from disease. Animal study data suggest some protection is conferred (medium confidence) – but human challenge studies have not been undertaken.
22. Volunteer human challenge studies would increase understanding of protection conferred by antibodies, but probably require the availability of a rescue therapeutic (this is also being explored for vaccine studies).
23. It is possible, based on animal studies, that an individual with antibodies could still shed the virus and be infectious.
24. Immunity to coronaviruses from neutralising antibodies is known to wane in humans (most commercial tests do not currently screen for this kind of antibody). There is some international evidence that antibodies to Covid-19 may wane within 3 months in some people (low confidence).
25. However, in the short term, there is evidence that individuals who are both antibody positive and PCR positive are much less likely to be infectious (medium confidence). This offers a way forward for releasing individuals from self-isolation or quarantine.
26. PCR testing is highly sensitive and can identify presence of the virus long after an individual has ceased to be infectious. It is important to understand a PCR threshold level for infectiousness (as described in previous SAGE paper, 'Duration of Infectiousness', 8 June 2020, presented at SAGE#41).
27. There are now hundreds of commercial antibody tests available. Sensitivity and specificity are improving, with some suitable for home use, but the range in quality is broad (some quantify antibody levels, others only provide a positive or negative result). Common industry standards will be important.
28. If population-level seroprevalence is low, there is a risk that a higher proportion of positive tests will be false positives.
29. The UK life insurance industry is currently in dialogue with the BMA regarding the implications of seropositivity for life insurance.
30. These conclusions should be understood in combination with previous SAGE work on testing and behaviours, including the risk of reduced compliance from seropositive individuals and public attitudes towards vaccines.
31. SAGE advised that, based on current understanding, it would be premature to introduce immunity passports, but it advised that use of antibody positivity for short-term decisions may be possible.

32. SAGE noted the importance of sampling during outbreak investigations to understand antibody immunity and advised PHE and NHSTT to undertake such studies.

ACTION: Senior Clinicians Group to assess 'Tests for antibodies against SARS CoV2' paper as part of consideration of a testing strategy for release from quarantine/isolation, including swab testing and Ct

Hand hygiene

33. SAGE endorsed the NERVTAG/EMG paper on hand hygiene.
34. Hand hygiene is an effective measure, especially when adopted in concert with other measures, but it has to be positively encouraged. It is worth revisiting behavioural interventions to increase uptake.
35. CoMIX data suggest a gradual decline in self-reported handwashing frequency over the course of the epidemic, except among those who wash their hands very frequently. It is possible to gather objective data on handwashing, e.g. from sensors on taps.

SAGE secretariat to publish 'Hand hygiene to limit SARS-CoV-2 transmission' without appendices and send to PHE, DfE and C-19 Taskforce to support further communication on hand hygiene, by 3 July

Public unrest

36. SAGE noted the SPI-B paper highlighting evolving social conditions, the potential for public unrest and the associated risks to public health.
37. SAGE recognised a need to review the latest evidence for risks from mass gatherings and protests, but also noted that risk may be more closely linked to activities around mass gatherings, e.g. transport, pubs and events such as block parties. It was noted that there was no increase in incidence recorded following mass protests in the US (low confidence).
38. Alcohol consumption may exacerbate some of these risks (low confidence).

ACTION: HO CSA to establish process to ensure relevant papers from SPI-B on law and order go directly to HO, bringing papers to SAGE if required

ACTION: SPI-B to consider existing evidence which can provide any assessment of risk of transmission of Covid-19 via public gatherings and associated activities, and report directly to Home Office as necessary

Future meetings

39. The next meeting will consider reopening of schools, challenges linked to winter, co-infection and immunity, and children.
40. The challenges around measuring 'Covid Security' are currently being considered by HSE and EMG, and may be brought for further discussion next week.
41. Future meetings will consider the Leicester outbreak and ways to help academic SAGE participants to manage competing demands on their time.

ACTION: CMO to report on lessons learned from Leicester outbreak; **JBC** to update on detection and management of outbreaks, both at future SAGE meeting

ACTION: SPI-M/EMG to report back to SAGE on the viability of measuring 'Covid Security' and produce a paper, if appropriate, for 9 July

List of actions

SAGE secretariat to send networks annex to 'Reducing transmission in high connectivity occupations' paper to JBC, C-19 Taskforce, CCS and BEIS by 3 July

SAGE secretariat to send most recent CoMix paper to JBC by 3 July

JBC and **PHE** to devise an integrated approach to publication of R and other national and regional indicators by 9 July; **SAGE secretariat** to amend wording on website concerning reliability of regional R

Joint Biosecurity Centre to ensure localised testing data is being fed to ONS and SPI-M to inform future modelling

SAGE secretariat to circulate PHE sitrep to CSAs and SPI-M

Senior Clinicians Group to assess 'Tests for antibodies against SARS CoV2' paper as part of consideration of a testing strategy for release from quarantine/isolation, including swab testing and Ct

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CMO to report on lessons learned from Leicester outbreak; **JBC** to update on detection and management of outbreaks, both at future SAGE meeting

SPI-M/EMG to report back to SAGE on the viability of measuring 'Covid Security' and produce a paper, if appropriate, for 9 July

Attendees

Scientific Experts (37): *Patrick Vallance (GCSA), Chris Whitty (CMO), Jenny Harries (dCMO), Jonathan Van Tam (dCMO), Angela McLean (CSA MoD), John Aston (CSA HO), Andrew Curran (CSA HSE), Charlotte Watts (CSA DfID), Carole Mundell (CSA FCO), Robin Grimes (CSA Nuclear), Andrew Morris (Scottish Covid-19 Advisory Group), Steve Powis (NHS), Mark Wilcox (NHS), Sharon Peacock (PHE), Maria Zambon (PHE), Yvonne Doyle (PHE), Paul Cosford (PHE), Peter Horby (Oxford), Calum Semple (Liverpool), Graham Medley (LSHTM), John Edmunds (LSHTM), Lucy Yardley (Bristol/Southampton), Michael Parker (Oxford), Wendy Barclay (Imperial), Clifford Stott (Keele), Brooke Rogers (KCL), James Rubin (KCL), Catherine Noakes (Leeds), Ian Diamond (ONS), Venki Ramakrishnan (Royal Society), Ian Boyd (St Andrews), Mark Walport (UKRI), Rob Orford (Health CSA Wales), Fliss Bennee (Wales Technical Advisory Cell), Nicola Steedman (dCMO Scotland), Jim McMenamin (Health Protection Scotland), Ian Young (CMO Northern Ireland)*

Observers (8): [redacted], *Vanessa MacDougall (HMT),* [redacted]

Secretariat (All GO-Science) (14): [redacted] *Simon Whitfield,* [redacted]

Total: 59

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Forty-sixth SAGE meeting on Covid-19, 9th July 2020
Held via Zoom

Summary

1. As numbers continue to fall, SPI-M does not have confidence that regional R estimates are sufficiently robust to inform decisions.
2. SAGE advised that features specific to Further and Higher Education should be addressed in guidance to these sectors well before the next academic year.
3. Regarding reopening of schools, SAGE reiterated its advice that there is a low risk to children's health from Covid-19 and significant harms from schools being closed. Reopening requires sufficient headroom in terms of overall infection rates and numbers, and clear communication with parents and teachers.
4. SAGE agreed that full preparations for winter are an urgent priority. Simple, clear messaging during autumn is important to prepare the public for winter.

Situation update

5. SAGE noted that the conclusion of the Senior Clinicians Group that, at present, a testing strategy that includes antibody testing, swab testing and Ct value assessment to enable release of individuals from self-isolation or quarantine cannot be operationalised – and that further data are needed before an optimal strategy can be designed.
6. Following clarification of NHS data, SPI-M models are now matching ONS data on prevalence and incidence more closely.
7. The latest estimate of R for the UK is 0.7 to 0.9. The daily growth rate estimate is -5% to -2%. In England, R is estimated at 0.8 to 1.0, with a daily growth rate of -4% to -1%.
8. SPI-M does not have confidence that regional R estimates are sufficiently robust to inform decisions, since they are based on low case numbers and/or are dominated by clustered outbreaks. This needs to be made clear when they are published.
9. GO-S will continue to publish weekly R and growth rate estimates until the JBC/PHE integrated approach is ready to take this on.
10. SAGE welcomed the first situational awareness summary report from PHE.
11. The causes of high case incidence in food processing plants are not yet understood, but are thought to be linked to a combination of working conditions (including low temperatures and protein residues) and culture (zero-hour contracts, working when unwell), poor and crowded living conditions and limited transport options available to workers. Where groups of people work, live and travel together, risk of transmission is likely to increase.
12. Incidence in Leicester is probably declining. SAGE noted that other current hotspots are mainly in the Midlands and North of England and are in areas with deprivation, high-density living conditions and significant BAME (particularly south Asian) communities. Communications need to reflect this epidemiological picture. Policy leads in CO and DHSC will need to take note and act accordingly.
13. In light of the WHO's recent communications on the risk of airborne spread, SAGE noted that its papers and guidance have consistently acknowledged that shorter-range aerosol transmission is a risk, especially in poorly ventilated settings featuring a highly-infectious person. The contribution of aerosol transmission relative to droplets and fomites remains unknown, but aerosol is unlikely to be the dominant transmission route. Research is underway on this subject and a UK research consortium has been formed.

ACTION: EMG to review advice on Covid-19 airborne transmission risks in light of new evidence, data and medical input: this review to consider face coverings, school and university settings, and winter challenges, by 16 July

ACTION: SAGE secretariat to ensure wording on gov.uk relating to R is approved by SPI-M chairs before updated R and growth rates are published by 10 July

ACTION: SAGE to review ‘Covid Security’ paper at its next meeting on 16 July; SAGE participants to provide input in advance

ACTION: SPI-B to assess messaging around Covid-19 in hard-to-reach and marginalised groups/communities and report to CMO by 16 July

ACTION: NHS Medical Director to circulate recent letter on regular testing of NHS staff to SAGE

Further and Higher Education

14. There are features specific to Further Education (FE) and Higher Education (HE) settings which differ from other educational settings (such as schools) and other workplaces.
15. Around two-thirds of FE learners were in some form of employment pre-Covid-19, often as part of a course or apprenticeship.
16. FE learners are more likely to be from groups identified as vulnerable (e.g. based on age, income or ethnicity). FE educators also tend to be older than schoolteachers.
17. HE settings often generate internal (and international) migration to towns and cities, and involve formation of new households, particularly at the start and end of terms. There may also be movement during the term between households.
18. University student populations engage in a broad range of activities, which result in complex networks.
19. These factors and others should be considered in guidance to these sectors ahead of autumn terms starting.

ACTION: DfE CSA to establish new science advisory group for Higher and Further Education drawing on expertise from SAGE participants, subgroups and PHE, providing advice directly to DfE and seeking SAGE advice where necessary

ACTION: SPI-M to consider any relevant updates to 'Ready Reckoners' in light of re-opening of Higher and Further Education by 16 July

Schools

20. SAGE endorsed the paper on ‘Risks associated with the reopening of education settings in September’, subject to minor amendments, and recommended that the findings are considered carefully as DfE develops its policies.
21. SAGE agreed that there was a low risk to children’s health from Covid-19 but significant harms from schools being closed, and that it was therefore strongly in the interests of children for schools to be open.
22. Decisions on opening schools in the autumn also need to consider the health of adults, including teachers and the wider community.
23. Emerging evidence suggests that outbreaks in schools are extensions of community outbreaks and comprise small numbers, rather than indicating that schools are high-risk settings. Spread from children to adults appears to be low.
24. Applying and releasing measures in a way which can be explained to the public logically helps to maintain support and adherence. Given the health and educational benefits of opening schools – and the health and other risks of not doing so – there is strong case for prioritising opening schools over other establishments. Clarity of messaging will be important to building the trust of parents and teachers.
25. It is important to ensure that there will be enough 'room' in terms of the epidemic to open schools in September.
26. The surveillance study in schools is underway and will need to be expanded (and modified) by September.

27. Education policies should consider impacts on and challenges associated with public transport.

ACTION: SAGE secretariat to update “Interdisciplinary Task & Finish Group on the Role of Children in Transmission: Risks associated with the reopening of education settings in September” for final ex-committee SAGE endorsement and circulation to DfE, DfT and C-19 Taskforce, by 10 July

ACTION: DfE to consider relevant communication to teachers and parents from ‘Risks associated with the reopening of education settings in September’ paper

ACTION: PHE to develop protocol for wide-scale surveillance testing of children ahead of schools re-opening, based on lessons from Shamez Ladhani-led study

Winter

28. SAGE endorsed the independent paper ‘Preparing for a Challenging Winter’ from the Academy of Medical Sciences, subject to minor amendments. The reasonable worst case scenario, which demonstrates the possible effects of a second wave during the winter, is not endorsed by SAGE and was described by the lead author as an 'illustrative example in order to build options and scenarios'.
29. While NHS and PHE provided assurance that many of the recommendations detailed in the report are already being considered or actioned, SAGE agreed that preparations for winter should begin urgently across government and that the report should provide a template for checking that all aspects are considered.
30. Simple, clear messaging in advance of winter is important. Engaging the public in autumn will increase confidence before what may be a frightening period for many people.
31. It is crucial that public advice is followed to mitigate the risks associated with winter, particularly in disadvantaged areas. Buy-in from communities is crucial and would be improved through co-creation of guidelines.
32. It is currently too early to predict the severity of this winter, but weather conditions may be worse than those considered in the report. Flooding, excessive ice or excessive snowfall would lead to increased problems.
33. It is unclear whether recovered Covid-19 sufferers have increased susceptibility to other winter viruses. They should be considered for flu vaccination.
34. There is no evidence yet that influenza modulates disease severity, although it is likely to cause diagnostic and therapeutic difficulties (high confidence). Early use of antiviral and combination therapies should be considered. An expanded flu vaccination programme has previously been recommended by SAGE. Multiplex testing for flu and Covid is recommended if available.
35. Indoor environments should be optimised to limit transmission of the virus and outdoor environments adapted for better use in winter. Ventilation is a key mitigation, particularly as people are less likely to open their windows and doors during winter.
36. People living in poor-quality homes may be affected by the compounded risks of poor ventilation and an inability to afford increased heating costs. Household heating costs are likely to escalate this winter as more people work from home.

ACTION: SAGE secretariat to circulate final AMS report ‘Preparing for a challenging winter 20/21’ to DHSC, DfT, MHCLG, C-19 Taskforce and CCS; GCSA and CMO to write to Heads of Departments with a copy of the report by 16 July; reasonable worst case scenario in report should be flagged as an example from the authors and not an endorsed RWCS

List of actions

EMG to review advice on Covid-19 airborne transmission risks in light of new evidence, data and medical input: this review to consider face coverings, school and university settings, and winter challenges, by 16 July

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Observers (11): [redacted] *Vanessa MacDougall (HMT),* [redacted] *Ben Warner (No.10), Adam Jackson (No.10),* [redacted] *Emma Davies (DfE),*

Secretariat (All GO-Science) (19): [redacted] *Stuart Wainwright, Simon Whitfield,* [redacted]

Total: 71

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