Considerations in implementing long-term 'baseline' Non-Pharmaceutical Interventions (NPIs)

Introduction

This note considers why "baseline" measures are likely to be needed beyond the end of the current Roadmap process, and what these measures might be. Ultimately, in determining what measures to retain, a choice must be made in terms of the epidemiological risks and the societal and economic impacts of measures. There will also be a trade-off to be considered between the stringency of measures in place and the likelihood of having to reverse parts of the Roadmap.

The table provided in Annex A (Table 1 NPIs to support sustained transmission mitigation) considers a range of measures in terms of their theoretical potential effectiveness, current effectiveness as applied at the moment, and actions that could improve effectiveness. However, there are some important caveats.

- Measures do not generally have a simple additive effect as they interact. Also, since measures are not introduced in isolation and form part of a package, it is difficult to estimate the impact of individual NPIs. Therefore, it is important to consider packages of measures.
- A complex web of factors will influence the impact of NPIs, including how well people adhere to them. The level of adherence may be heterogeneous and hard to quantify. Low levels of adherence to interventions will erode their effectiveness. Past levels are not necessarily an accurate guide to the levels of adherence to measures that might be expected now and into the future.
- Each estimate of effectiveness is underpinned by a degree of uncertainty.
- The table does not provide an exhaustive list and there are some important measures out of scope of this paper.
- The table includes suggested measures that are likely to improve effectiveness, but it should not be assumed that these actions will be sufficient to optimise the impact. In some cases, trials for these suggested measures are required to test and improve their effectiveness.

The need for ongoing measures

As current measures are lifted, transmission will almost certainly increase. Though vaccines are expected to have some population level impact on transmission, this will be limited until those groups which have more contacts (e.g. younger adults) have been vaccinated. Even beyond the point when all adults have been offered the vaccine, keeping some level of measures in place both through summer and beyond would significantly decrease ongoing transmission. It is notable that countries (e.g. New Zealand) that have near-zero Covid-19 have decided to retain some baseline measures (e.g. wearing of masks on public transport) to reduce the impact of occasional outbreaks.

SPI-M modelling shows it is highly likely that there will be a resurgence in infections with a peak at some point after steps 3 and 4 have been taken because not everyone will have been vaccinated, vaccines are not 100% effective, and the virus will continue to circulate[1] [2]. The size and timing of a wave depends on what happens between now and then

[1] SAGE 85 Minutes, 31 March 2021

[2] SAGE 85 SPI-M-O: Summary of further modelling of easing restrictions – Roadmap Step 2, 31 March 2021

(vaccine rollout, waning immunity if any, behavioural response to the release of measures, new variants, etc.), as well as on the baseline measures in place.

Another wave would be expected to occur even if the assumed baseline measures reduce transmission by 25%; however, it would be much higher without these[3]. Sensitivity analysis from one model considered by SPI-M shows that if the reduction achieved by baseline measures is only modest (rather than the 25% central scenario), hospital occupancy could reach levels comparable to previous peaks[4].

It is highly likely that transmission will increase in autumn and winter. This may mean that the effectiveness of baseline measures may vary through the year, and they will have to be augmented to have the same impact. This increase in transmission is likely to be a mix of behavioural factors (e.g., moving indoors and closing windows in colder weather) and seasonal activities (e.g. education term holidays breaking contact networks; foreign holidays driving introductions). Seasonal or temperature effects on viral survival may also be a factor, although this is likely to be very minor in comparison. The healthcare burden of other infections through the year is also an important consideration. This may mean stronger measures may be desirable for autumn and winter all other things being equal.

Lifting restrictions may recreate the conditions for superspreader events, both person-driven (one highly infectious but possibly asymptomatic person going to multiple places) and setting-driven (nightclubs, religious events where crowding is experienced, low ventilation, loud activities etc.). Restrictions over the past year have significantly limited the number of settings where these events are possible. As greater numbers of people mix together, the probability of superspreader events (infector being present) and their size (number of people who are available to be infected) will increase. Any changes to NPIs should consider both individual and population level risks.

Other measures are also likely to be needed, which are not considered here as 'baseline' measures:

- **Vaccination**: The scenarios discussed assumed vaccination rates are maintained as are efforts to overcome hesitancy, especially among those who are at higher risk of infection and more vulnerable to hospitalisation and death.
- **Border controls:** These are also not considered in detail in this note but are important to reduce the rate of reseeding or introduction of variants of concern (VOCs).
- **Responses to VoCs**: Baseline measures are not designed to respond to the widespread transmission of one or more VoCs that are able to escape immunity from vaccination or infection: if this occurs the response is likely to need significantly more than baseline measures.
- **Hotspots and outbreaks**: As transmission increases, there will be continued heterogeneity across the country. Areas with higher levels of deprivation and/or lower levels of vaccine uptake, which are likely to be disproportionately impacted, are an enduring concern. Some degree of local reactive measures will be needed in all scenarios, alongside baseline measures. This may particularly be the case in response to VoCs, which is a key risk. Previous SAGE advice has reflected that the more rapidly such interventions are put in place, and the more stringent they are, the faster the reduction in incidence and prevalence, and that measures should not be applied in too specific a geographical area[5]. Previous waves have also shown that

[3] SAGE 81 SPI-M-O: Consensus statement on COVID-19, 17 February 2021

[4] SAGE 85 SPI-M-O: Summary of further modelling of easing restrictions – Roadmap Step 2, 31 March 2021

[5] SAGE 58 Minutes, 21 September 2020

high levels of transmission can occur in institutional settings including hospitals, care homes, prisons, and homeless shelters with infection seeded back into the community. Appropriate controls will need to be maintained and/or enhanced in these settings.

- **Antiviral treatments**: A new Antivirals Taskforce was announced on 20 April, which will seek to accelerate the development and deployment of two antiviral treatments this year. Antivirals could be another tool that the UK can use against further resurgences of the virus, as these drugs could have the ability to limit disease progression early on in the course of infection. Antivirals can in theory be given to anyone who is infected and it may also be possible to use them prophylactically in the event of outbreaks. Home use of prophylactic antivirals has the potential to reduce the need for self-isolation and motivate better uptake of testing, although this needs further examination (e.g., by mixed methods research) While this may be a future measure, the timescales for when they may be available and their effectiveness are not yet clear.

Importance of maintaining low prevalence

Although vaccination of most vulnerable groups will have reduced the proportion of community infections that lead to hospitalisation and death, there remain many advantages from an epidemiological perspective in maintaining both low prevalence and R<1. It makes it easier to prevent a return to rapid growth in the epidemic which could lead to the NHS being overwhelmed (e.g. because it gives more time to react to increases when starting from a low baseline, it is easier to spot outbreaks in advance of them growing large, and Test Trace and Isolate (TTI) can be more effective at lower prevalence). This has been shown in some countries that have very low or near-zero Covid-19, since occasional outbreaks can then be dealt with quickly, including rapid sequencing of all cases to search for new variants. Lower transmission also reduces the in-country risk of the emergence of variants of concern as well as slowing spread of any VoCs (including imported VoCs). Lower infection rates will also reduce impact of post-Covid syndromes and allow more NHS capacity to be used for routine care. Since groups from a lower socioeconomic position and minority ethnic backgrounds have higher risk of infection and lower vaccination rates then any increase in prevalence is also likely to increase health inequalities in Covid-related illness and death.[6] [7]

There is significant risk in allowing prevalence to rise, even if hospitalisations and deaths are kept low by vaccination. If it were necessary to reduce prevalence to low levels again (e.g., VoC become more pathogenic for others previously less affected), then restrictive measures would be required for much longer.

Objectives for baseline measures

Baseline measures should aim to do the following:

1. Reduce the likelihood that people who are infectious are mixing with others in the population.
2. For those potentially infectious people who are not isolated, reduce the likelihood that they enter higher risk settings or situations.
3. Decrease the transmission risk from an infectious person in any given environment.

[6] https://www.gov.uk/government/publications/drivers-of-the-higher-covid-19-incidence-morbidity-and-mortality-among-minority-ethnic-groups-23-september-2020

[7] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/976030/S1168_Ethnicity_Subgroup_Wave_1_and_2_qual_comparison.pdf

This prioritisation is consistent with the hierarchy of control which is a system for risk reduction. If some measures are reduced it is critical that actions are taken to ensure that baseline measures work as effectively as possible. A number of measures suggested as baseline are currently not very effective and will need further communications, changes in approach and investment to enable them to provide the level of mitigation needed to maintain sufficiently low transmission. This is summarised in Table 1.

1: Reducing the likelihood that people who are infectious are mixing with others in the population.

Identifying and isolating infectious people can have a significant impact on transmission by eliminating many of the opportunities for transmission (elimination is the first level in the hierarchy of controls). If successful, this may reduce the need for the measures outlined under 2 and 3.

Test Trace and Isolate (TTI) systems are key to this, and can include all forms of testing (symptomatic and asymptomatic, including contact testing, school and workplace testing, pre and post-travel testing) as well as other surveillance (e.g. wastewater monitoring). Operational effectiveness of these systems is important and improvement in uptake essential in populations at high risk of and from infection.

Self-isolation is critical. It needs to become routine and normative that people with symptoms do all they can to self-isolate. Engagement with testing is also needed, but only isolation prevents transmission. If **all** individuals were able to fully isolate upon symptom onset (so that they caused no further onward transmission) R could be reduced by around 50%[8]. Some transmission would remain due to asymptomatic and pre-symptomatic transmission. This drops to 39% with a one-day delay before isolation and 25% with a two-day [9]delay. This highlights the importance of enabling isolation from the onset of symptoms, not just from the receipt of a positive test result. It should be noted that such full isolation would require no onward transmission even within the household and that there are major disincentives preventing many people from isolating this way.

While rates of self-reported isolation among people who have already received a positive test result are high[10], among the wider population many people with a cough, fever, or loss of sense of taste or smell, report neither requesting a test nor self-isolating[11]. The majority of those self-isolating after a test report being unable to keep themselves completely separate from other household members, particularly those with dependent children[12], which may also reduce effectiveness. Data on adherence is limited, with much based on self-reporting, and options to improve this data should be considered[13].

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[8] Comparison of molecular testing strategies for COVID-19 control: a mathematical modelling study Grassly, Nicholas CAinslie, Kylie et al. The Lancet Infectious Diseases, Volume 20, Issue 12, 1381 – 1389 https://www.thelancet.com/article/S1473-3099(20)30630-7/fulltext

[9] SPI-M - Effectiveness of symptomatic self-isolation in reducing onwards transmission of SARS-CoV-2 (unpublished)

[10] ONS: Coronavirus and self-isolation after testing positive in England: 8 March to 13 March 2021

[11] BMJ: Adherence to the test, trace, and isolate system in the UK: results from 37 nationally representative surveys, 31 March 2021

[12] https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandwellbeing/bulletins/coronavirusandselfisolationaftertestingpositiveinengland/8to13march2021

[13] SAGE 76 Minutes

Quarantine after international travel is also an important measure to reduce the likelihood of people who are infectious mixing with others in the population when rates of infection or of VoCs are higher in other countries than the UK. As prevalence drops, the relative importance of this measure to prevent new seeding of transmission chains increases.

Intervention studies including RCTs, case-control studies, cohort studies and ethnographic research would be a valuable way of collecting evidence on effectiveness of some interventions. Studies will need the appropriate design and expertise to provide clear evidence on effectiveness and acceptability. Ethnographic research in specific at-risk settings and communities would also enable specific barriers and enablers to be identified.

2: For those potentially infectious people who are not isolated, reducing the likelihood that they enter settings or situations.

These approaches make it possible to eliminate or substitute some of the higher risk situations where transmission may occur – elimination and substitution are the first two levels in the hierarchy of controls.

One approach to this is certification (based on negative testing, vaccination, or proof of prior infection) that there is a lower probability that an individual is infectious, or that an individual will suffer severe symptoms if the virus is transmitted to them. This can in some cases be achieved via certification[14] [15] [16] [17], though there are a number of practical and ethical[18] issues to be considered, including whether any form of certification is equally accessible across the population and whether the certification is reliable.

Minimising frequency and duration of exposure is also important. It is possible to reduce chance of an infected person being present by reducing the overall number of occasions when people enter settings where there is higher risk of exposure and/or the duration they spend in a setting, e.g.

i. Encouraging substitution of indoor contacts with outdoor ones
i. Replacing physical contact with teleconferencing (e.g. work or worship at home)
ii. Discouraging multiple indoor interactions with different groups of people (e.g. using cohorts in workplaces)
iii. Reducing the number, size, and duration of interactions

3: Decreasing the transmission risk from an infectious person in any given environment.

These approaches use engineering, administrative controls and PPE to reduce risk (these are lower in the hierarchy of control than elimination or substitution, but still make an important contribution to risk reduction). The mitigation measures need to consider all transmission routes (airborne, close range aerosols and droplets, and fomites), and could include:

[14] SAGE 72 Minutes (not yet published)
[15] SAGE 72 SPI-B Certification paper (not yet published)
[16] SAGE 79 Minutes
[17] SAGE 79 Immunity Certification NERVTAG paper (not yet published)
[18] SAGE 72 Certification Ethics paper (not yet published)

a. **Physical distancing** (to reduce risk from droplets and short-range aerosols)[19] [20] [21]

b. **Ventilation** (to reduce risk from long range aerosols) [22] [23] [24]

c. **Face coverings** (to reduce emission of virus and exposure to droplets and larger aerosols)[25]. Other forms of barriers (e.g. Perspex screens) may provide some protection from droplets in some circumstances though consideration needs to be given to airflows, as in some cases they may increase risk of aerosol transmission.

d. **Hand hygiene and surface cleaning** (to reduce risk from fomites).

Risk assessments which use the hierarchy of control approach are important in all settings for determining the most effective and practical approaches, but particularly in settings which are higher risk either due to the environment and activities[26] [27] [28] (e.g. nightclubs) and/or the vulnerability of people within the setting (e.g. care homes, hospitals, prisons, homeless shelters). The duration of time that people spend in a setting is an important factor when assessing the risk.

Impacts of measures on individual and collective risks

The optimum package of measures will depend on the policy objective(s) and will need to consider social and economic factors as well as the epidemiological impact on transmission. It will therefore be important for policymakers to specify objectives over the short, medium and long term in order to design packages of measures that could be expected to achieve each of them.

It is difficult, if not impossible, to pre-determine which set of NPIs or behaviour changes would result in the levels of transmission previously modelled to occur after the Roadmap by SPI-M[29] [30]. This is because the impact of different measures results from a complex interaction between physical, biological and behavioural factors, and there are multiple aspects where understanding of transmission is very uncertain. Some measures will have much greater epidemiological impact than others, with the impact of each depending on the context in which it is implemented, how it is implemented, and interactions between sets of interventions. As such, measures cannot be considered in isolation.

[19] SAGE 40 EMG Transmission of SARS-CoV-2 and Mitigating Measures – update, 4 June 2020
[20] SAGE 51 Minutes and SAGE 51 PHE/EMG: Aerosol and droplet generation from singing, wind instruments and performance activities, 13 August 2020
[21] SAGE 76 EMG: Application of physical distancing and fabric face coverings in mitigating the B117 variant SARS-CoV-2 virus in public, workplace and community, 13 January 2021
[22] SAGE 76 EMG: Application of physical distancing and fabric face coverings in mitigating the B117 variant SARS-CoV-2 virus in public, workplace and community, 13 January 2021
[23] SAGE 60 Minutes, 1 October 2020
[24] SAGE 60 EMG: Role of ventilation in controlling SARS-CoV-2 transmission, 30 September 2020
[25] SAGE 76 EMG: Application of physical distancing and fabric face coverings in mitigating the B117 variant SARS-CoV-2 virus in public, workplace and community, 13 January 2021
[26] SAGE 86 Leisure, hospitality and retail paper (not yet published)
[27] SAGE 70 Minutes, 26 November 2020
[28] SAGE 70 PHE: Factors contributing to risk of SARS-CoV-2 transmission in various settings, 26 November 2020
[29] SAGE 81 SPI-M-O: Consensus statement on COVID-19, 17 February 2021
[30] SAGE 85 SPI-M-O: Summary of further modelling of easing restrictions – Roadmap Step 2, 31 March 2021

Trials can and should be used to gather evidence of the effectiveness of individual measures or packages of measures and to test alternative versions of measures, combinations, different approaches to communications and messaging etc.

Survey and other data on contacts and case transmission (e.g. CoMix and CTAS) may also provide data on effectiveness after implementation. Given the uncertainty around the impacts of packages of NPIs, including the unknowns around vaccine coverage and effectiveness at reducing transmission, and the role of new VoCs, it will be essential to embed mechanisms for monitoring, evaluation and research within frameworks that allow for adaptation in response to developing knowledge.

There are some additional considerations for policymakers when assessing the risk associated with the package of baseline measures. The effectiveness of baseline measures is conditional on engagement with the relevant behaviours. Evidence suggests that sustained behaviour change requires sustained interventions acting on multiple levels, as outlined in the accompanying SPI-B paper[31].

a. There are some measures where there appears to be scope to have significantly more impact on transmission than is currently being achieved. This includes improving adherence to isolation (including a culture change so that people are less likely to attend workplaces when unwell), improved ventilation, and continued working from home where possible.
b. There is a need to consider both individual risk and collective risk. This is also important for communicating why controls are needed, and why a person facing low personal risk still needs to adhere. Perception of risk, both personal and collective, is likely to change significantly as a result of vaccine rollout and from the fact that measures have been lifted (e.g. if certain rules no longer apply then people may assume the same is true of others).
c. There is an aggregate effect of small changes in risk across large numbers of people, which may be much greater than for a large change in risk for small number of people, so things which make a small difference to individual risk can make a large difference to collective risk if applied across the population. This so-called 'prevention paradox' may create challenges in terms of risk communication, as marginal differences in risk between two options may be very low at individual level but appreciable at population level, especially because any increases in transmission are multiplicative rather than additive.
d. Some risk factors concentrate among relatively few people. Over multiple chains of transmission, that small subset of the population with large relative risk (substantial exposure and onward transmission risks) has significant contributions to the overall infection rates as risk factors among the relatively few can sustain even generalised epidemics in the community. Therefore, interventions also need to consider the overall number of downstream infections averted based on differential impacts in different communities.
e. 'APEASE' criteria - Acceptability, Practicability, Effectiveness, Affordability, Side-effects, and Equity - provides a useful framework for evaluating existing and proposed interventions.[32]

[31] SAGE 87 SPI-B: Sustaining behaviours to reduce SARS-CoV-2 transmission, 22 April 2021 *(tbc, being discussed at SAGE 87 alongside this Workshop paper)*

[32] Michie S, Atkins L, West R. (2014) The Behaviour Change Wheel: A Guide to Designing Interventions. London: Silverback Publishing. www.behaviourchangewheel.com
https://www.ucl.ac.uk/behaviour-change/resources/achieving-behaviour-change-guides-local-and-national-government-and-partners
https://www.unlockingbehaviourchange.com/pdfs/5c766be7b6281890464249.pdf

f. Given this, more intensive support for adherence could be considered for the specific settings and population sectors at highest risk. Developing feasible and effective guidance, communication and support for target communities, including those with different cultural backgrounds, can benefit from participatory co-design (i.e. in collaboration with target communities).[33]

[33] https://www.gov.uk/government/publications/emgspi-btweg-mitigations-to-reduce-transmission-of-the-new-variant-sars-cov-2-virus-22-december-2020

Annex A

Table 1 NPIs to support sustained transmission mitigation

EMG: **Enabling effective NPIs to support sustained transmission mitigation**

Estimates of effectiveness given in the table relate to the effect with respect to the relevant objective and are not necessarily comparable between objectives I.e. measures that are high impact for objective one would not have an equivalent impact on transmission of measures that are high impact for objective 2 or 3.. Measures must be applied as part of a package that addresses all the factors that determine transmission.

1. *Reducing the likelihood that people who are infectious are mixing with others in the population (confidence ratings in this table are not directly comparable to tables 2 and 3, measures in this table (1) have the highest impact)*			
Measure	**Theoretical Potential effectiveness**	**Current effectiveness**	**Steps that could improve**
Symptomatic testing and isolation (following a positive test, or symptoms)	High if testing and isolation are both effective and prompt: (high confidence).[i,ii] High if testing and isolation are both effective and prompt, including among populations at highest risk: (high confidence).[iii,iv] Role of backwards contact tracing[v]: Backward contact tracing is part of best practice and important for identifying clusters of infections and providing evidence on routes and settings for transmission (SAGE 32, 41, 61, 63 and others). Isolation following a positive test has the potential to be highly effective at reducing the number of infected people interacting. Important to link to effective, rapid test and trace to minimise numbers of those who pass on the virus before isolating.	Low-Medium: (low confidence) Engagement with testing is heterogeneous with less engagement in areas of higher social deprivation where there may be barriers such as precarious employment or stigmas around infection. NHSTT published the Rùm model, which estimates that the total effect of TTI interventions in an October-like environment due to symptomatic testing and contact tracing would be a reduction in R number of 18-33%. However, the model assumes that symptomatic individuals isolate upon symptom onset, and so the actual effect of testing is uncertain.[vi] ONS surveys on self-reported adherence to isolation after a positive test and after being a contact of a positive case report high adherence (82%). However, this is	Addressing major disincentives to testing and barriers to isolation – and drivers of inequalities in both transmission and impact - in terms of economic costs and employment, especially for people on low incomes and/or in precarious employment (e.g. provision of paid leave to support quarantine and isolation). Further emphasis on the need to seek testing for mild symptoms.[ix] Daily contact testing as a supplement/alternative to quarantine[x,xi]. Provision of out of home isolation facilities for those unable to isolate within the home[xii].

		self-reported data and could be biased, as well as being complicated by factors such as imperfect understanding of self-isolation rules and guidance. ONS found that people with positive PCR tests report high adherence to isolation[vii]. CORSAIR data suggest that many people in the community with cough, fever or loss of sense of smell or taste neither seek a test nor self-isolate[viii].	Practical factors such as same day supermarket deliveries for people required to isolate[xiii]. Provision of effective antiviral treatments for cases, and prophylactics for households if these are shown to be effective.
Contact isolation	High: (medium confidence) Potential to be very effective providing contact tracing happens quickly following detection of the index case, as this isolates people before they become infectious and breaks the chain of transmission. Limited by proportion of contacts it is feasible to find, timescales for contact tracing to happen, and some transmission may be between people who do not meet the definition of a 'contact'.	Low: (low confidence) This is for a number of reasons including lack of reporting of contacts, inability to effectively follow up with contacts, speed of follow up with contacts, contacts not isolating and the definition of a contact (typically only those 2m or less)[xiv]. Analysis of over 1.2 million cases and their named contacts through Test and Trace showed that only 19% of cases had been previously identified as a close contact of another case, and these are dominated by household contacts.[xv,xvi]	As above on supporting isolation.
Stay home when sick	High: (high confidence) Likely to have a similar benefit to positive case isolation for COVID, plus also reduces the burden of other diseases, including those that may be mistaken for COVID-19.	Low (medium confidence): Effectiveness will depend on the culture within workplaces and education settings and is likely to be heterogeneous. It would require a culture shift to overcome "presenteeism". Limited sick pay in workplaces is a significant barrier to this.	Enable adequate sick pay and policies across all employers. Effective messaging around not working, attending education or socialising when one is sick[xvii].

2. For those potentially infectious people who are not isolated, reducing the likelihood that they enter settings or situations (confidence ratings in this table are not directly comparable to tables 1 and 3, measures in table 1 have the highest impact)			
Measure	**Theoretical Potential effectiveness**	**Current effectiveness**	**Steps that could improve**
Asymptomatic testing	Medium (medium confidence):[xviii,xix] Enables testing at large scale and with regular testing could provide an early warning of rising cases in some settings such as schools and workplaces. Potentially effective at picking up cases at the point they are most infectious.[xx,xxi ,xxii ,xxiii]	Medium (medium confidence): There will be false negatives and false positives.[xxiv] Inequalities in take up of testing including access to tests and reluctance in those who do not have the means to isolate. Only effective where action is taken on a positive test – see positive case testing and isolation above. Uptake is variable across settings (e.g. high in schools, low in HE).	Support to enable isolation as above. Continued messaging that a negative test is only valid at that point in time. Co-production of testing communications with local communities, and involvement of local resources and community champions. Ensure reporting is as easy as possible to maintain engagement. Develop greater evidence base on factors influencing use of tests, and reporting of results.
Certification	Medium: (medium confidence) Certification to demonstrate a negative test[xxv] could reduce the likelihood of an infected person being present but depends on the quality of the test and the time that has elapsed since it was taken[xxvi,xxvii]. Certification to prove vaccination or prior infection can reduce risk of severe illness but is not yet certain whether it will reduce transmission.	Not sufficient evidence yet to judge: Refer to statement above on asymptomatic testing.	Effectiveness needs to consider systems and their practicality/accessibility and the equity of certification Important to have a clear purpose for why the certification is needed and what it is expected to achieve. Testing and vaccination achieve different things. Assessing and mitigating any potential negative effects of certification will be required[xxviii].
Work from home (WFH),	High (high confidence):	Medium (high confidence):	Analysis to determine the heterogeneity in the impacts of

including hybrid model	WFH significantly reduces contacts, including associated transport and social interactions which has a strong impact on R. Prior to the pandemic, most contacts were in the workplace. This is one of the most effective measures available, however there is limited data on how a hybrid WFH model would impact on transmission. Hybrid model likely to be more impactful if includes bubbling. As we reduce restrictions this measure is likely to become less effective.	Ability to WFH is very variable and depends on role and employer. Those who have to go to work tend to also be those in most precarious employment and those with greatest number of other risk factors. Impacts are heterogeneous with regions that are office work dominated able to reduce rates more than those dominated by manufacturing/distribution roles.	WFH, particularly as hybrid approaches are brought in. Prevent employers from requiring attendance at workplace when not essential and understand / mitigate other barriers to working from home[xxix].

3. *Decreasing the transmission risk from an infectious person in any given environment[xxx] (confidence ratings in this table are not directly comparable to tables 2 and 3, measures in table 1 have the highest impact)*			
Measure	**Theoretical Potential effectiveness**	**Current effectiveness**	**Steps that could improve**
"COVID-Secure" Measures for workplaces and other relevant settings	Medium: (medium confidence) A strategy based on a thorough risk assessment using the hierarchy of control involving levels of protection is likely to ensure workplaces (and other relevant settings) bring in effective measures to reduce the likelihood of infectious people in the workplace (or other relevant settings) and to take appropriate control measures for the three routes of transmission (air, surface, and person-to-person). The risk assessment should be subject to regular monitoring and review so that new evidence can be incorporated. This is likely to encompass several of the measures below and in other tables.	Medium: (medium confidence) HSE has undertaken over 200,000 spot checks of businesses in Great Britain. The vast majority of businesses with which HSE has had contact have been able to provide assurance that they have complied with relevant guidance to introduce controls to reduce the risk of workplace transmission of SARS-CoV-2. However, this represents a subset of organisations and does not cover all sectors, and it is less certain whether updated guidance is followed by those inspected in the early stages of the pandemic. It is also a measure of following guidance, rather than a measure of	Improved communications, increased staff training and involvement in the co-creation of the risk assessment, sharing best practice, demonstration of efficacy through natural experiments and increased inspections. Stress the need to keep risk assessment under review as new information emerges (VOC, monitoring of efficacy at the enterprise level, changes in guidance on ventilation etc).

		effectiveness of the organisation's approaches in reducing transmission. It may be possible to compare effectiveness between different workplace types/settings if correlation to case data can enable clusters to be measured.	
Ventilation	Medium-High: (medium-high confidence) Good ventilation can reduce airborne risks by up to 70% compared to poor ventilation[xxxi], but the measure only works against the airborne component of transmission. Likely to be particularly important in superspreader events and local cluster outbreaks, which may impact on the population level transmission. Evidence for airborne transmission is hard to get.	Low: (low/variable confidence) Effectiveness is likely to be very variable and there are poor data. This is influenced by the building (some have very good ventilation; many others have poor ventilation) and the awareness of the importance of ventilation. Improving ventilation often requires expert guidance and capital investment – many businesses do not know what to look for and how to get the right advice to support a decision. Ventilation (non-domestic) is largely not within the control of individuals.	Require businesses and other organisations to achieve minimum standards of ventilation and provide practical guidance on how to achieve this. Trial use or mandating of measures such as CO_2 monitoring to enable better awareness of ventilation quality and to support public and organisational decision making[xxxii]. Training for industry to ensure the correct guidance and information is provided to workplaces. Quality standards for ventilation equipment and monitors. Financial support to enable investment in ventilation and air cleaning technologies where needed. Guidance for households on importance of ventilation to minimise risks within the home[xxxiii,xxxiv]

Handwashing	Medium: (medium confidence) Provides mitigation of fomite transmission routes of the virus only. This is likely to be less important than direct exposure to the virus through inhalation, and fomite transmission is unlikely to be significant in superspreading or driving the pandemic. Evidence is hard to get and there is limited direct evidence for SARS-CoV-2, but evidence from other diseases suggests hand hygiene can reduce transmission by 15-20%. [xxxv]Hand hygiene is likely to be more effective than enhanced cleaning for reducing fomite risks. Has benefits for other disease transmission too which reduces healthcare burdens.	Medium: (low confidence) Self-reported data suggests uptake is high, but these data are subject to significant bias. There are few objective data. Focus should be on maintaining good hand and respiratory hygiene rather than driving new initiatives.	Ensuring effective comms relating to hand hygiene Ensure infrastructure is in place to enable people to practice good hand hygiene, especially when in public spaces.
QR code check in and collecting contact details	Low-Medium: (low confidence) Potential to identify clusters in venues and to enable contact tracing between those who are not known to the case. Effectiveness has not been evaluated, but a framework for some of the measures that should be considered has been recommended[xxxvi].	Very low: (high confidence) Ad-hoc and quite limited due to data remaining on individual's phones and only a small proportion of people routinely using check-in[xxxvii,xxxviii]. For collecting contact details, very little is collected, and this is patchy. Unlikely to be as effective as QR codes unless there is an outbreak and it is used in local contact tracing. Workplace or education setting data is likely to be more complete than public and social settings.	Require everyone attending a venue either to scan QR code or provide verified contact data. Requirement until recently has been that only one person in a group has to check in (this has changed) Some people have phones that can't use the NHS COVID-19 app. This is likely to be greater in areas of higher prevalence and greater social deprivation. Providing guidance on how and why to collect and how to store contact details.
Genomic sequencing	Relatively limited impact on rapidly stopping transmission to date, but the introduction of surge testing may change	Highest whilst prevalence is low but drops as prevalence increases (and clusters/outbreaks merge). Sequencing of	Reduce time lag between case identification and sequencing. PCR testing for specific variants

	this. Very valuable in identifying reasons for changes in regional/national trends and informing the need for larger scale interventions. Very valuable in understanding modes of transmission.	positive cases does not impact transmission directly, but indirectly through subsequent targeting of other measures such as surge testing and case isolation.	may reduce the delay between case detection and variant identification but limitations should be considered, e.g. identifies only known variants, may require additional sample material.
Face coverings	High (medium confidence): Potential for high effectiveness as a source control and reasonable effectiveness as protection to the wearer. Mitigates all transmission routes. Theoretical effectiveness for a good quality face covering is likely to be around 50-90% for smaller aerosols and greater for large droplets. The potential effectiveness is hard to reach as it is highly dependent on quality and fit and compliance with wearing.[xxxix]	Medium (medium confidence): Effectiveness is hard to measure, but a number of large-scale studies and reviews from data in other countries suggest impacts on transmission typically in 6-15% range, but potentially up to 45%[xl]. These lower values reflect real world differences in quality and wearing of face coverings, including some who do not wear them. Effectiveness is likely to be very heterogeneous depending on the setting and individuals.	Maintaining emphasis on quality and fit of face covering, as well as the reasoning why they are effective. Raising awareness of and enforcing quality standards for face coverings sold to the public, for example through the BSI kitemark.[xli] Provision of free coverings in public spaces where they are required to address financial barriers. Clear guidance on when face masks/coverings need to be worn, why, and under what circumstances they may be removed.
Physical distancing	High: (medium-high confidence) Close range transmission likely to be highest individual exposure risk, so explicit measures to address are likely to be beneficial. Effects of distance are evident in contact tracing data and other sources This is evident in contact tracing data which shows the risk of direct contact (<1m) is double that at 1-2m. Distancing	Medium[xlii]:(low-medium confidence) Application of distancing is generally good, but variable in some settings. Evidence from HSE inspections suggests social distancing is the most common issue in workplaces[xliii,xliv]. Some recent data suggests risk at 1m is not significantly higher than 2m where people are passive and face coverings are worn[xlv]. However,	If advice on distancing changes it is important to have clear messaging around what 1m+ really means for both public and workplaces. Important to be clear about what measures constitutes the "+". To be effective additional measures need to consider the route of transmission that distancing

	has also acted to reduce the overall number of people in many settings which reduces population transmission risk.	1m may be more risky compared to 2m in settings where people are active, loud or are not wearing face coverings.	mitigates and ensure this is managed in an alternative way.
Perspex screens	Low (low confidence): Likely to have some benefits in preventing droplet transmission in places where people have to have close (<1.5m) face-to-face interaction. Possible they may also act to remind people to maintain distance. Despite their widespread usage there is no good evidence of effectiveness for any diseases. There is some mechanistic evidence that they can block airflows and so may increase risk of airborne transmission.	Low (low confidence): Many screens currently deployed are likely to be ineffective as they are not positioned in a location to provide any benefit. There is currently very little consideration of airflows when positioning screens.	Research to measure the benefits and negative impacts of screens to provide clearer guidance on when and where they should or should not be used. Wider promotion of screens is not likely to have any additional benefits and could cause harms if they are used in place of other measures (e.g. face coverings).

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[ii] SAGE 76 https://www.gov.uk/government/publications/sage-76-minutes-coronavirus-covid-19-response-14-january-2021/sage-76-minutes-coronavirus-covid-19-response-14-january-2021

[iii] SAGE 77 https://www.gov.uk/government/publications/sage-77-minutes-coronavirus-covid-19-response-21-january-2021/sage-77-minutes-coronavirus-covid-19-response-21-january-2021

[iv] SAGE 76 https://www.gov.uk/government/publications/sage-76-minutes-coronavirus-covid-19-response-14-january-2021/sage-76-minutes-coronavirus-covid-19-response-14-january-2021

[v] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/933225/S0824_SARS-CoV-2_Transmission_routes_and_environments.pdf

[vi] https://www.gov.uk/government/publications/the-r-m-model-technical-annex

[vii] https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandwellbeing/bulletins/coronavirusandselfisolationaftertestingpositiveinengland/8to13march2021

[viii] https://www.bmj.com/content/372/bmj.n608

[ix] SAGE 71 https://www.gov.uk/government/publications/sage-71-minutes-coronavirus-covid-19-response-3-december-2020

[x] https://www.gov.uk/government/publications/sage-83-minutes-coronavirus-covid-19-response-11-march-2021/sage-83-minutes-coronavirus-covid-19-response-11-march-2021

[xi] https://www.gov.uk/government/publications/spi-m-o-statement-on-daily-contact-testing-3-march-2021

[xii] https://www.gov.uk/government/publications/emgspi-bspi-m-reducing-within-and-between-household-transmission-in-light-of-new-variant-sars-cov-2-14-january-2021

[xiii] https://www.gov.uk/government/publications/emgspi-bspi-m-reducing-within-and-between-household-transmission-in-light-of-new-variant-sars-cov-2-14-january-2021

[xiv] SAGE 83 Not yet published

[xv] https://www.gov.uk/government/publications/phe-factors-contributing-to-risk-of-sars-cov2-transmission-in-various-settings-26-november-2020

[xvi]https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/bulletins/coronavirusandselfisolationafterbeingincontactwithapositivecaseinengland/1marchto6march2021

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[xviii] SAGE 71 - https://www.gov.uk/government/publications/sage-71-minutes-coronavirus-covid-19-response-3-december-2020/sage-71-minutes-coronavirus-covid-19-response-3-december-2020

[xix] SAGE 70 - https://www.gov.uk/government/publications/sage-70-minutes-coronavirus-covid-19-response-26-november-2020/sage-70-minutes-coronavirus-covid-19-response-26-november-2020

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[xxi] https://www.medrxiv.org/content/10.1101/2021.01.13.21249563v2.full-text

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[xxiii] https://www.nature.com/articles/d41586-021-00332-4

[xxiv] https://www.liverpool.ac.uk/media/livacuk/coronavirus/Liverpool,Community,Testing,Pilot,Interim,Evaluation.pdf

[xxv] SAGE 70 – Negative Test Certificates and Mass Testing SAGE 70 minutes: Coronavirus (COVID-19) response, 26 November 2020 - GOV.UK (www.gov.uk)

[xxvi] SAGE 72 – SPI-B Certification Paper – Not yet published

[xxvii] SAGE 79 – NERVTAG Certification Immunity Advice – Not yet published

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[xxix] https://www.medrxiv.org/content/10.1101/2021.03.30.21254333v1

[xxx] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/965094/s1100-covid-19-risk-by-occupation-workplace.pdf

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[xxxii] https://www.gov.uk/government/publications/emg-role-of-ventilation-in-controlling-sars-cov-2-transmission-30-september-2020

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