Potential impact of behavioural and social interventions on an epidemic of Covid-19 in the UK

Purpose:

1. This outlines the available scientific evidence base around the behavioural and social interventions (previously referred to as non-pharmaceutical interventions) that could be applied as part of the HMG response to a UK epidemic of Covid-19, including the expected impacts on the spread of the virus and public behaviours. The note does not cover economic, operational or policy considerations.

2. SAGE has not provided a recommendation of which interventions, or package of interventions, that Government may choose to apply. Any decision must consider the impacts these interventions may have on society, on individuals, the workforce and businesses, and the operation of Government and public services.

Background:

3. In the event of a severe epidemic, the NHS will be unable to meet all demands placed on it. In the reasonable worst-case scenario, demand on beds is likely to overtake supply well before the peak is reached.

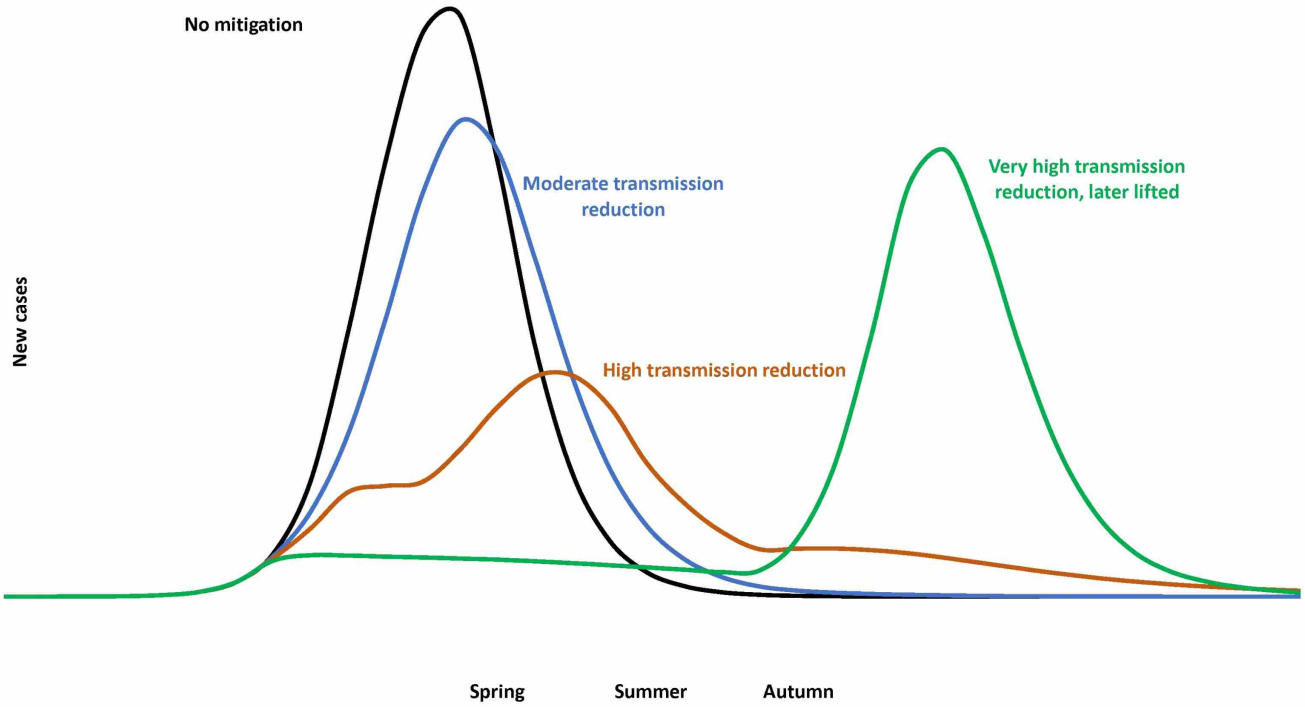
4. There are a range of behavioural and social interventions which are evidenced as having been effective in responding to historic epidemics. These interventions are also well understood by the public and have been enacted in other countries.

5. Applying these interventions could be helpful in containing an epidemic to some degree or changing the shape of the epicurve, see figure 1, making the response of the NHS and other sectors more sustainable. The objectives of these interventions could be to:
    1. Contain the outbreak so that it does not become an epidemic (note – this may not be fully achievable);
    2. Delaying the peak so it occurs when the NHS is out of Winter pressures; and
    3. Reducing the size of and/or extending the peak so that the response by the NHS and other sectors can be maintained more sustainably.

6. Any intervention would need to be Government policy for a significant duration in order to see the benefit, as removing and/or relaxing the intervention before this could result in further peaks and potentially extend transmission of the virus into Winter 2020.

7. SAGE will consider the points below in further detail on 5 March:
    - Optimal combination of interventions to achieve the objectives above,
    - Optimal point to enact these interventions,
    - Duration that these interventions should be in place to achieve the objectives above.

Illustrative impact of behavioural and social interventions lasting several months on a reasonable worst-case epidemic (Figure 1)



Key

The reasonable worst-case scenario, with no mitigating measures, would likely peak during April-May, with a high peak incidence.

Behavioural and social interventions which moderately reduce transmission are unlikely to greatly reduce the total number of cases but could reduce and slightly delay the peak. This scenario may also arise from behavioural changes without government intervention.

Behavioural and social interventions which further reduce transmission could delay and reduce the peak still further.

Very stringent behavioural and social interventions could have a similar scale of impact to Hong Kong and prevent a major epidemic. However, when lifted, a large epidemic would likely follow. Depending how long they were in place, this could peak in autumn.

Please note: The scale and timings of the epidemic curves in this diagram are illustrative only, but their patterns are robust.

Impact of behavioural and social interventions that have taken place elsewhere

8. Preventing an epidemic requires the reproduction number (the average number of people a person will infect) to be reduced below 1 and maintained there.

9. Modelling suggests that the stringent interventions introduced in Wuhan from 23 January (quarantine and movement restrictions) may have reduced the reproduction number to below one. However, there are differing views across the scientific community about whether other factors were involved in this. There is also speculation that the approach taken in Wuhan, to apply stringent regulations which have been rapidly lifted, may result in a second larger peak.

10. Hong Kong and Singapore are undertaking extensive contact tracing as well as a raft of social distancing measures such as school closures and self-isolation, but not to the same level of stringency as seen in Wuhan. There is also anecdotal evidence of extensive self-isolation by the general population. The roughly linear increase in the number of cases in Hong Kong and Singapore suggest that this approach has held the reproduction number around 1.

General conclusions on the impact of behavioural and social interventions during the reasonable worst-case scenario (Table 1, 2)

7. **All the results below are based on a reasonable worst-case scenario.**

8. Any of the measures listed below could potentially flatten and extend the peak of the epidemic. This would prolong the outbreak, but the lower maximum case numbers would reduce pressures on the NHS and other sectors. However, it should be noted that even without Government intervention, public behavioural change will have some (potentially very significant) effect.

9. A combination of these measures is expected to have a greater impact: implementing a subset of measures would be ideal. Whilst this would have a more moderate impact it would be much less likely to result in a second wave. In comparison combining stringent social distancing measures, school closures and quarantining cases, as a long-term policy, may have a similar impact to that seen in Hong Kong or Singapore, but this could result in a large second epidemic wave once the measures were lifted.

10. The timing of the interventions would be critical. It will not be possible to time their starting date optimally or identify the areas which will be most impacted first. There is therefore no case to be made to bring in interventions on a local level. However, monitoring will enable analysis of whether to ramp up interventions or lift them.

11. These interventions assume high levels of compliance over long periods of time. This may be unachievable in the UK population and uptake of these measures is likely to vary across groups, possibly leading to variation in outbreak intensities across different communities.

12. Our best assessment is that single interventions of the type considered below could reduce the peak NHS bead demand by somewhere in the range of 15-30%.

13. Any estimates of the potential impact of different combinations of measures are driven by several assumptions and are subject to great uncertainty. Enacting a policy, for 13 weeks, of home isolation of cases with stringent social distancing of either all groups, or of the elderly, could be expected to reduce the total number of deaths by around a third, and the peak demand for hospital beds, critical care beds and deaths by 50-65%.

14. It should be noted that whatever the reduction in peak NHS bed demand achieved by these interventions, in the reasonable worst-case scenario demand will still greatly exceed supply.

Table 1: Potential impact of behavioural and social interventions on a Covid-19 epidemic in the UK

	Stopping large events such as concerts and sports	Closure of schools	Home isolation of symptomatic cases when enacted early * (policy would be applied for 13 weeks)	Whole household isolation when enacted early * (policy would be applied for 13 weeks)	Social distancing when enacted early * (policy would be applied for 13 weeks)	Social distancing for those over 65, when enacted early * (policy would be applied for 13 weeks)	Potential effectiveness in containing an outbreak	Potential effectiveness in delaying an outbreak	Potential effectiveness in reducing the peak of an outbreak	Potential effectiveness in reducing total number of cases and deaths, excluding excess deaths caused by lack of NHS capacity
Interventions activated	X						None	Very little on their own	Very little on their own	Very little on their own
		X					Unlikely to contain an outbreak on its own	No more than 3 weeks delay to peak and possibly much less	If children have similar role in transmission as in pan flu, c.10%-20% reduction in peak hospital demand with closures of 8-12 weeks.	Modest impact (<5%)
			X				Unlikely to contain an outbreak on its own	2-3 weeks delay to peak	Reduction in peak incidence of maybe 20% (uncertainty range at least 15-25%)	Modest impact (<5%)
				X			Unlikely to contain an outbreak on its own	2-3 weeks delay to peak	Reduction in peak incidence of maybe 25% (uncertainty range of at least 20-30%)	Modest impact (<10%)
					X		Unlikely to contain an outbreak on its own, though likely to have a larger impact than each of the other measures	3-5 weeks delay to peak	Substantial reduction in peak, may be up to 50–60%	Around 20-25% of deaths
						X	Will not contain an outbreak on its own	Negligible impact	Reduction in peak of total number of cases, but c. 25–35% reduction in deaths and demand for hospital beds and critical care beds	Up to 5% of cases, but 20-35% of deaths
Assumptions	Includes, in order of significance, closing cinemas, night clubs, sporting fixtures, places of worship and theatre. Does not include closing bars and restaurants. Assumes contact rates outside the home are only reduced by c 5%	Schools completely close nationally and children do not gather in other group settings. Children play an important role in transmission but lower than seasonal flu.	65% of symptomatic cases withdraw to the home for at least 7 days or until the resolution of symptoms (current PHE advice is 14 days), reducing non-household contacts by 75%. Household contacts unchanged.	Following identification of a symptomatic case in the household, all other members withdraw for 14 days. Household contacts double, all contact outside the household reduced by 75%. 50% of households are assumed to comply.	All households reduce contacts outside the household and school/workplace by 75%. School contact rates are unchanged. Workplace contact rates reduced by 25%. Household contact increase by 25%.	75% compliance. Those who comply increase household contacts by 25% but reduce other contacts by 75%.	-	-	-	-
Confidence **	Very low confidence	High confidence	Low confidence	Medium confidence	Medium confidence	High confidence				

* Data is based on interventions such as home isolation for symptomatic cases, household isolation, social distancing and social distancing for over 65s being activated for 13 weeks. However, individuals or households who are self-isolating will do this for a duration set by recommended guidelines. For example, current PHE guidelines is that this is for 14 days for symptomatic cases.

Social distancing (column yellow and green) implies cessation of all activities outside the household (including social contact between different households) bar the essentials and attending school and work.

**This is an assessment of how effective this intervention will be at limiting transmission of Covid-19 in the UK, if all the underlying assumptions are correct and if there is compliance. This is not an indication of the likely level of compliance.

Table 2: Behavioural science considerations for each potential intervention

	Stopping large events such as concerts and sport	Closure of schools	Home isolation of symptomatic cases when enacted early (policy would be applied for 13 weeks)	Whole household isolation when enacted early (policy would be applied for 13 weeks)	Social distancing when enacted early (policy would be applied for 13 weeks)	Social distancing for those over 65 when enacted early (policy would be applied for 13 weeks)
Public attitudes & support	Some degree of distancing is likely to be broadly supported by the public, at least initially i.e. cessation of sporting activities, music festivals. Attitudes may change as duration increases. 62% already expect major sporting events will be jeopardized. 21% currently avoiding large gatherings [1,2]	70-90% of parents from closed schools supported the policy across 6 studies in previous incidents [4].	Easiest measure to explain and justify to the public. 84% in UK currently support mandatory quarantine [2]. 87% of those quarantined during H1N1 considered it useful and 73% justified.	Not aware of any data for household isolation.	16% avoiding shaking hands. 65% expect it will take months to contain the virus [1,2]. For H1N1, ~50% agreed that avoiding large crowds would be effective in preventing spread of swine flu, with ~20% unsure [8].	Not aware of any data.
Likely compliance	If events are cancelled, compliance will be high. However, displacement is also possible (e.g. football supporters congregating away from stadiums to watch matches).	Two studies report contact rates in pupils are reduced by 55 to 65% [4]. Likely to be higher with good communication and with high risk perceptions. Longer duration closures may reduce compliance.	Adherence of ~50% to 90% in previous outbreaks, tending more to the higher end [3]. This is among those actively contacted by health services. Adherence among self-diagnosed people likely to be lower.	Not aware of any data for households of cases. Reasonable to assume a lower adherence in non-symptomatic household members.	Likely high, initially, for many social activities. People actively changed their greetings during H1N1: 11% avoided hugging or kissing distant acquaintances, 10% avoided shaking hands with family or friends or distant acquaintances [9].	Unclear. Complicated by households with both vulnerable and non-vulnerable members. At present [10]: 6% of older people leave their house once a week or less. 17% of older people have less than weekly contact with family, friends and neighbours. 11% have less than monthly contact.
Barriers / facilitators / communication issues	Important to stress legitimacy of /reasoning for interventions such as long-term suspension of mass gatherings to reduce dissatisfaction. Particularly important as time goes on.	Clear messaging about the purpose of school closures needed to prevent children continuing to mix. Current parental perception is that schools close to facilitate "deep cleaning" [7]. Those in lower socio-economic groups may be most impacted by disruption from school closure, e.g. more reliant on free school meals or unable to rearrange work to provide childcare. Allowing school premises to remain open to provide some community services, while sending most children home, may mitigate this.	Important to reinforce guidance on who should isolate, when, and for how long to prevent ambiguity reducing adherence, e.g. when symptoms are mild. Targeted support during isolation may promote compliance. This requires understanding of what the key stressors are and when they appear. This applies also to household quarantine. Unclear if "isolation" is clearest term to use. Requires evidence. Concerns likely to arise about impact on others within the household. In some occupations (esp. healthcare workers) it is the norm that people continue to work when unwell. Important to make it socially unacceptable to attend work/school if unwell. Messaging on isolation could be more powerful if framed as both an act of protecting oneself, as well as protecting others.	Resistance & non-compliance will be greater if impacts are inequitable. For those on low incomes, loss of income means inability to pay for food, heating, lighting, internet. This can be addressed by guaranteeing supplies during quarantine periods (e.g. agreements to waive online delivery charges). Ensuring supplies flow to households is essential. A desire to help among the wider community (e.g. taking on chores, delivering supplies) could be encouraged and scaffolded to support quarantined households. There is a risk of stigma, so isolation should be portrayed as an act of altruistic civic duty. Clear guidance required to outline the cycle of isolation, what to do if you live with a vulnerable person, and what to do if a member of the household becomes severely unwell. Variable compliance, due to variable capacity to comply may lead to dissatisfaction, e.g. essential work commitments, economic precarity and caring responsibilities outside of the home.	Where possible, businesses should encourage employees to work from home. Frustration may arise in those unable to reduce social contact in their work. Guidance will be needed to mitigate this. Encouraging replacement behaviours and alternative social activities may reduce dissatisfaction (e.g. remote interactions).	Risk of stigma and resentment in categorising individuals by age. Important to frame 'cocooning' as those more vulnerable or at risk.

References:

Table 1: SPI-M results based on:

- SPI-M-O modelling consensus on school closures and supporting paper collated by Julia Gog, 19th February 2020
- SPI-M-O meeting, 26th February 2020
- Imperial College paper "Potential effect of behavioural and social interventions on a COVID-19 epidemic". That assumes:
- National policies triggered by national weekly symptomatic disease incidence triggers of 100 or 300 cases per 100,000 of population per week.
- 90% of symptomatic disease can be detected (e.g. via a community-based surveillance system such as FluSurvey).
- R_0 between 2.0 and 2.4.

Table 2: SPI-B underlying data:

Where possible, we have restricted our reviews to those of actual behaviour in analogous situations, with a preference for UK data.

[1] Ipsos MORI. Coronavirus: Opinion and reaction. Results for a multi-country poll, UK findings (Feb 19, 2020) [data collection Feb 14-15, n=~1,000]

[2] Ipsos MORI. Coronavirus: Opinion and reaction. Results for a multi-country poll, UK findings (Feb 12, 2020) [data collection Feb 7-9, n=1,000]

[3] Webster RK, Brooks SK, Smith LE, Woodland L, Wessely S, Rubin GJ. How to improve adherence with quarantine: Rapid review of the evidence. Public Health (under review)

[4] Brooks SK, Smith LE, Webster RK, Weston D, Woodland L, Hall I, Rubin GJ. The impact of unplanned school closure on children's social contact: Rapid evidence review. Eurosurveillance (under review)

[5] Brooks SK, Webster RK, Smith LE, Woodland L, Wessely S, Greenberg N, Rubin GJ. The psychological impact of quarantine and how to reduce it: Rapid review of the evidence. Lancet 2020, https://doi.org/10.1016/S0140-6736(20)30460-8

[6] Webster RK, Lieu R, Karimullina K, Hall I, Amlot R, Rubin GJ. A systematic review of infectious illness presenteeism: Prevalence, reasons and risk factors. BMC Public Health, 2019, 19:799

[7] Department of Health and Social Care focus groups, conducted mid-February (conta[Name Redacted]@dhsc.gov.uk).

[8] Rubin GJ, Potts HWW, Michie S. The impact of communications about swine flu (influenza A HINIv) on public responses to the outbreak: Results from 36 national telephone surveys in the UK. Health Technology Assessment. 2010;14(34):183-266 doi:10.3310/hta14340-03.

[9] SteelFisher GK, Blendon RJ, Ward JR, Rapoport R, Kahn EB, Kohl KS. Public response to the 2009 influenza A H1N1 pandemic: a polling study in five countries. Lancet Infect Dis. 2012;12(11):845-50.

[10] https://www.ageuk.org.uk/globalassets/age-uk/documents/reports-and-publications/reports-and-briefings/health--wellbeing/rb_june15_lonelines_in_later_life_evidence_review.pdf