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

Purpose:

1. This paper outlines the available scientific evidence base around <u>behavioural and social interventions</u> (previously referred to as <u>non-pharmaceutical interventions</u>) 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 advises that a combination of individual home isolation of symptomatic cases, household isolation and social distancing of the over 70s[1] could have a positive effect on: delaying the onset of the peak; reducing the number of cases during the peak; and reducing the total number of cases. 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 well understood by the public and have been enacted in other countries. Modelling suggests as compliance drops so does impact, but there is no major inflexion point at which a drop in compliance leads to a disproportionate drop in effect.

5. Applying these interventions could be helpful in containing an epidemic to some degree or changing the shape of the epidemiological curve, see figure 1, potentially 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;
    2. Delaying the peak so it occurs when the NHS is out of Winter pressures;
    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; and
    4. Reducing the total number of deaths by limiting the number of cases in vulnerable groups.

6. Any intervention would need to be Government policy for a significant duration (2-3 months) in order to see the benefit, as removing and/or relaxing the intervention too early could result in a new outbreak and potentially extend transmission of the virus into Winter 2020. However, the timescale for this are uncertain and would need to be kept under review to provide confidence that these are in place to sufficiently cover the peak of the outbreak.

7. SAGE advises that measures relating to individual and household isolation will likely need to be enacted within the next two weeks to be fully effective, and those concerning social distancing of the elderly and vulnerable 2-3 weeks after this. However, the triggers for individual and household isolation could be met earlier depending on the progress of the outbreak in the UK. CMO, GCSA and PHE will review case numbers daily to advise further on the meeting of any trigger points.

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[1] To be discussed and agreed by SAGE on 10 March as a change from over 65's

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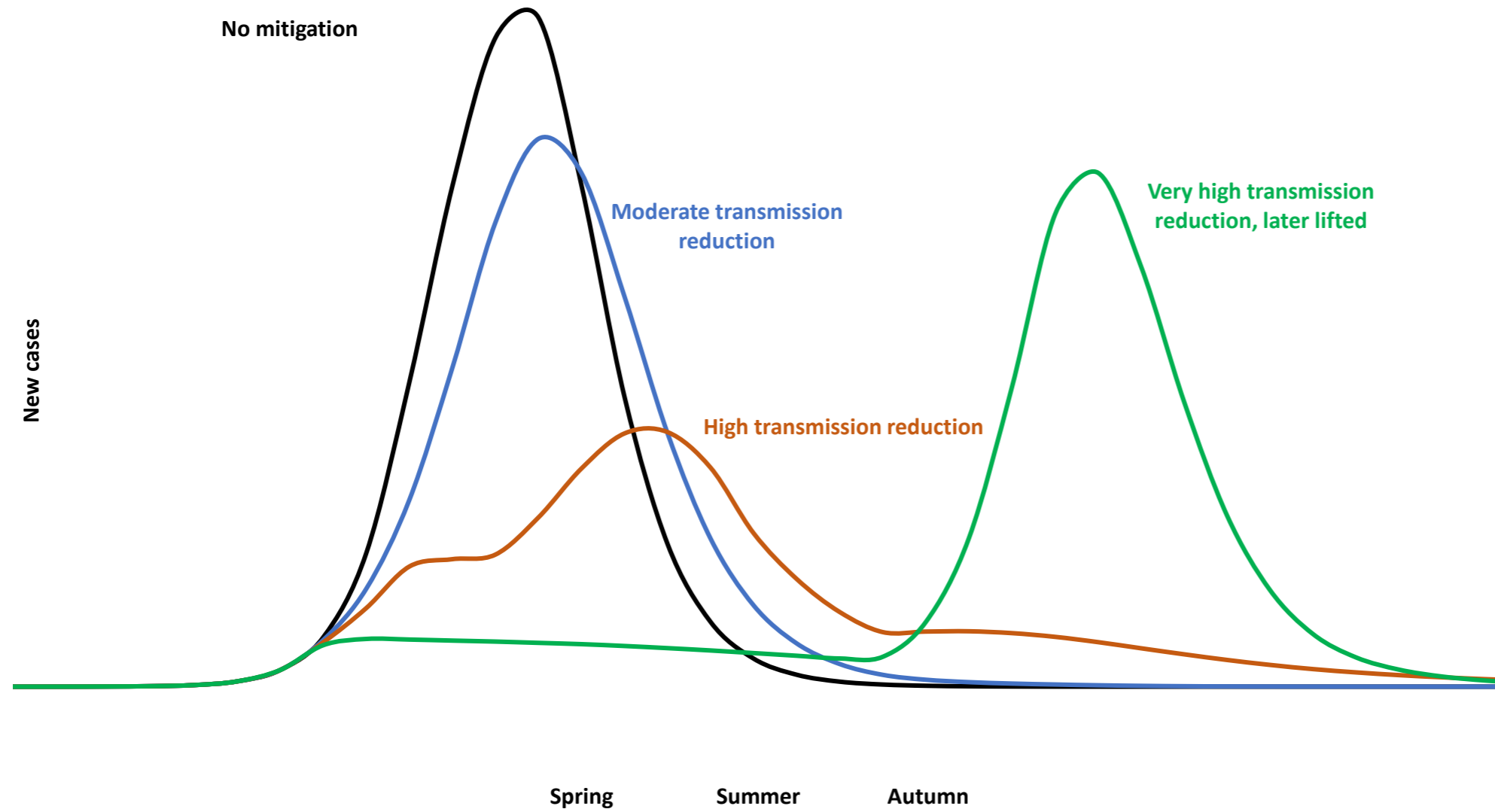
Please note: The scale and timings of the epidemic curves in this diagram are illustrative only, but their patterns are robust.

Impact of behavioural and social interventions that have taken place elsewhere

8. Preventing or reducing an epidemic requires the reproduction number (the average number of people one individual will infect) to fall below 1 and be 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 subsequent 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 & 3)

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

12. Any of the measures listed below could, on their own, potentially flatten and extend the peak of the epidemic by some degree. 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.

13. 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.

14. 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. Local or regional implementation could produce a similar effect to a national implementation and would mean a shorter duration of intervention. Monitoring will be essential to enable analysis of whether to ramp up interventions or lift them. As the epidemic develops, the peak number of cases in each county will occur at different times. Modelling suggest this will be spread over around a 4 week period. As such national interventions, if enacted, would be in place earlier in the epidemiological curve in some areas than others.

15. These interventions assume compliance levels of 50% or more 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. Overall policy effectiveness of home isolation and whole household isolation shows a linear dependence on the assumed compliance with case isolation. A reduction in compliance of 20% in home isolation and whole household isolation measures, when combined with social distancing for vulnerable groups would only lead to a modest reduction in the effect (around 5% in the peak bed demand and total deaths).

Table 1: Assumptions underlying behavioural and social interventions on a Covid-19 epidemic in the UK

To note: Modelling has been based on these assumptions. It is critical that details of any policy are not driven by these modelling assumptions alone. Interventions can be remodelled with revised assumptions once these have been decided in consultation with departments.

OFFICIAL: Potential impact of behavioural and social interventions on a Covid-19 epidemic in the UK – 9 March 2020

Intervention	Stopping large events such as concerts and sports	Closure of schools	Home isolation of symptomatic cases	Whole household isolation	Social distancing	Social distancing for the elderly (modelled for 65+, 70+, 80+)
Assumptions	Includes, in order of significance, closing cinemas, night clubs, sporting fixtures, places of worship and theatre. Does not include closing bars and restaurants.	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.	Symptomatic cases withdraw to the home for 14 days*. *(Models using 7 days deliver comparable results.)	Following identification of a symptomatic case in the household, all other members withdraw for 14 days after the onset of symptoms of the first ill individual. I.e. the 14-day window does not restart if another individual in the household becomes ill within this window. Based on 14-day incubation period, but a plausible assumption of what policy should be, not necessarily optimal policy. Household is based on the ONS definition	Cessation of all activities outside household (including social contact between different households) bar essentials and attending school and work.	Cessation of all activities outside the household for the (including social contact between different households) bar the essentials and attending school and work. *(Models using 65+, and 70+ deliver comparable results.)
Compliance	N/A – SPI-M consensus view of all evidence	100%	70% of symptomatic cases	50% of households	All households	75% compliance.
Duration of policy measure	8-13 weeks	8-13 weeks	8-13 weeks	8-13 weeks	8-13 weeks	17 weeks
Workplace/ school contacts	None	No change	Of those who isolate, reduced to 0	Of those who isolate, reduced to 0	Workplace contact rates reduced by 25%. School contact rates are unchanged.	Workplace/school contacts are reduced by 50%.
Household contacts	None	Increase by 50%.	Household contacts unchanged.	Household contacts double in households which comply.	Household contact increase by 25%.	Those who comply increase household contacts by 25%.
Contacts outside of work/school	Contact rates outside the home are only reduced by c. 5%.	Contacts that are neither in the home nor at work increase by 25%	Contacts that are neither in the home nor at work decrease by 75% among the compliant.	Contacts that are neither in the home nor at work decrease by 75% among the compliant.	Contacts that are neither in the home nor at work decrease by 75% among the compliant.	Contacts that are neither in the home nor at work decrease by 75% among the compliant.
Timing			Within 1-2 weeks of date at top of this table.	Within 1-2 weeks of date at top of this table.		Roughly 2 weeks after enactment of home isolation + whole household isolation.

Table 2: 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	Whole household isolation	Social distancing	Social distancing for those over 65	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 In the 70+ scenario, this effectively drops 5% to 15-35%. In the 80+ this drops to 5-15%[2]
			X			X	Unlikely to contain an outbreak on its own	2-3 week delay to peak	45-55% reduction in peak hospital bed demand.	30-45% reduction in deaths.
			X	X		X	Unlikely to contain an outbreak on its own	2-3 week delay to peak	50-70% reduction in peak hospital bed demand. Greater when started earlier or younger ages are included	35-50% reduction in deaths. Smaller impact on total cases. Relatively little difference between 65+ and 70+ scenarios, but effects of interventions are lower when applied to 80+
Confidence	Very low confidence	High confidence	Low confidence	Medium confidence	Medium confidence	High confidence	This confidence 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.			

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[2] Numbers still to be reviewed by SAGE.

Table 3: Behavioural science considerations for each potential intervention

	Stopping large events such as concerts and sports	Closure of schools	Home isolation of symptomatic cases	Whole household isolation	Social distancing	Social distancing for those over 65	Public attitudes & support	Likely compliance	Barriers / facilitators / communication issues
Interventions activated	X						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]	If events are cancelled, compliance will be high. However, displacement is also possible (e.g. football supporters congregating away from stadiums to watch matches).	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.
		X					70-90% of parents from closed schools supported the policy across 6 studies in previous incidents [4].	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.	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.
			X				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.	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.	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.
				X			Not aware of any data for household isolation.	Not aware of any data for households of cases. Reasonable to assume a lower adherence in non-symptomatic household members.	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.
					X		16% avoiding shaking hands. 65% expect it will take months to contain the virus [1,2].	Likely high, initially, for many social activities. People actively changed their greetings during H1N1: 11%	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.

							For H1N1, ~50% agreed that avoiding large crowds would be effective in preventing spread of swine flu, with ~20% unsure [8].	avoided hugging or kissing distant acquaintances, 10% avoided shaking hands with family or friends or distant acquaintances [9].	Encouraging replacement behaviours and alternative social activities may reduce dissatisfaction (e.g. remote interactions).
						X	Not aware of any data.	Unclear. Complicated with 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.	Risk of stigma and resentment in categorising individuals by age. Important to frame 'cocooning' as those more vulnerable or at risk.
			X			X	Most specifically targeted strategy with easy to understand rationale, and therefore likely to be most acceptable to public.	Symptomatic isolation: adherence of 50% to 90% (trending to the higher end) seen in previous incidents (SARS, MERS, H1N1).	Symptomatic isolation: adherence likely to be improved if seen as expected and respected. Requires good financial support, clarity of messaging, support from community, and appeals to altruism / civic duty. At-risk group isolation: Likely to be generally supported. Older adults and those with chronic illness currently feel more worried (older adults) and more at risk (chronic illness). 73% of over 65s and 69% of those with long-term medical conditions agree that "keeping away from crowded places generally" is effective in reducing spread. At-risk group isolation: Targeting advice carefully (rather than blanket "over 65yrs") may improve adherence and reduce tension with if some continue to work (e.g. medics, MPs). At-risk group isolation: Guidance needed to address how this should work if an at-risk individual lives in a household with others who are not at-risk and not isolating. At-risk group isolation: Concern over increased isolation/injury at home for those who live alone (e.g. trips and falls). Suggest a community support/buddy system or possibly local authority level system to check on physical/mental health at regular intervals.
			X	X		X	Similar issues for previous option, but also including, for household isolation:	Unknown adherence	Unequal impact on poorer households (loss of income, higher household bills, loss of access to free school meals and other support) Need for higher level of social and psychological support for households Risk that being unable to adhere to every rule, leads to lower attempts to adhere to all rules. A degree of pragmatism may be required in messaging.

References:

Tables 1 and 2: SPI-M underlying data and assumptions:

- 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 3: 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

[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