Note added for publication

This paper contains estimates of R for some regions of the UK. Please note that these are illustrative examples from a single modelling group, and not an agreed consensus estimate from SAGE.

R is an average value that can vary in different parts of the country, communities, and subsections of the population. It cannot be measured directly so there is always some uncertainty around its exact value. Regional estimates are subject to greater uncertainty given the lower number of cases and increased variation.

SPI-M-O: Consensus Statement on COVID-19

Date: 27th April 2020

Reproduction number and halving time

1. The reproduction number (R_t) is the average number of secondary infections produced by a single infected individual. The critical issue is whether R_t is greater than one. The last SPI-M consensus view from 13th April states that the reproduction number in the community was highly likely to be less than 1, with a plausible range of 0.5 to 1.

2. Current estimates of R_t in the community from different modelling groups range from 0.6 to 0.9. Admissions to hospital are falling at a different rate to deaths, resulting in some of the variation.

3. As the current estimates show that R_t is less than 1, the halving time (time it takes to the number of new infections to halve in size) is a more appropriate measure than doubling time. This is acutely sensitive to the value of R_t and the data and assumptions used to infer infection numbers, halving time in hospitals in England are of the order of 16 days.

4. The reproduction number is dependent on the characteristics of the population so may be different in different groupings within the UK. Current estimates from different modelling groups show relatively minor variations across the regions of England (from R=0.5-0.7 in London compared with R=0.6-0.8 in the East of England).

UK Incidence

5. The current number of new infections per day remains uncertain and will not be estimated precisely until results of community testing surveys are available. A plausible estimate is order of 10,000s of new infections per day.

Implications for reviewing current social distancing measures

6. The fact that R is below 1 implies that there could be some relaxation of measures without causing exponential growth in cases. The fundamental challenge, however, is that the

unmitigated reproduction number was around 2.7-3; reducing it to its current level has required a reduction in transmission of approximately 80%. To successfully keep R below 1 means that any relaxation of measures cannot increase transmission by more than 10-15% of its original level.

7. Bald calculations of a numerical relationship between relaxation of different measures and changes in R over-stretch the natural and behavioural science available to us now. This is a new infection, and we have a limited amount of information about how it spreads in which contexts. Some kinds of uncertainty will resolve over the next few months: how rapid and effective contact tracing is; the proportion of transmission that happens in asymptomatically infected people and those who are pre-symptomatic; the role of children in transmission; but others will always be hard to predict - and chief amongst those is how people will behave in the future in response to a threat they have never encountered before. As a result, whilst individual modelling groups can hypothesise on specific scenarios, it is not possible to be sure that any specific set of policy changes will result in R remaining below 1. SPI-M cannot say with consensus, which combination of useful policy changes will result in R remaining below 1. We can,however, share principles about infection control in populations that can be used to design sensible, evidence driven interventions.

8. Case isolation, household quarantine and app-based tracing, even with very high uptake levels, without some level of social distancing will not be sufficient to keep R below 1 on their own.

9. With very good adherence to a highly effective system, an approach to contact tracing that rapidly identifies then quarantines the vast majority of cases and a large number of their contacts could plausibly reduce the unmitigated reproduction number by no more than 60% (i.e. from R=3 to R>1.2). Unless incidence of COVID-19 is very low, this would result in an extremely high number of people being in quarantine at any one time

10. A successful contact tracing strategy would require around 80% of non-household contacts of symptomatic cases to be traced and isolated rapidly, i.e. within two days of symptom onset for the index case. This would require around 30 contacts to be traced per symptomatic case. App-based tracing will only detect a contact if both parties have the app active, so (under the simplest assumptions of clustering) the proportion of contacts it could detect is proportionate to the square of the population using it. Once children and those without smartphones are considered, even if a very high proportions of people used an app that had almost perfect contact tracing abilities, less than half of contacts are likely to be detected through the app.

11. High adherence case isolation, household quarantine and very high-quality contact tracing will almost certainly not reduce R below 1 without some social distancing measures remaining in place. Such measures could include limiting the number of contacts outside the home to below 5.

12. The impacts of various partial school opening options are being considered separately by another SAGE subgroup and data on the role of children in transmission and their susceptibility and infectivity are still accruing. There are currently different views in SPI-M on the impacts of reopening schools on R_t.

13. Relaxing social distancing only for those not living with anyone over 45, or a similar population segmentation measure, would need unrealistically high levels of adherence and stringency to be successful and so is unlikely to prevent significant transmission in the higher risk group. This could occur either during the time when the higher risk population is being protected, or in a second wave after their restrictions are relaxed.

High and low incidence scenarios

14. A policy of maintaining R below 1 with incidence that is high but not in excess of ICU capacity would give little time to re-impose more stringent measures if it becomes clear that R has increased above 1. Such a scenario would be heavily reliant of shielding of vulnerable groups and possibly varying social distancing for different subgroups of the population, based on their risk.

15. Maintaining a high incidence scenario could allow measures to be progressively relaxed as population immunity developed. It would, however, take around one year to allow all measures to be removed using such an approach, even if all infections resulted in an effective, long-lasting immune response. Such a policy would result in tens of thousands of direct deaths from COVID-19 and it is unlikely that significant levels of population immunity could be achieved by autumn without ICU being overwhelmed. Deaths from non-COVID-19 causes due to displaced health service activity are likely to be higher in a high incidence scenario than a low incidence scenario.

16. It is possible that more complex strategies combining segmentation and shielding could have the potential of greater de-coupling of the epidemic between settings, such as between care homes and the community. More work is required on this for a SPI-M consensus to be reached on what strategies might achieve this. SPI-M remains concerned that not enough is being done to protect those who are known to be at high risk of death if infected with COVID-19.

17. A low incidence scenario would still require risk-based variation in social distancing measures and careful shielding of parts of the population, although this would not need be as aggressive or have as high adherence rates necessary for a high incidence scenario.

Annex: SAGE framework of language for discussing probabilities