

Note added for publication

This paper contains estimates of the reproduction number (R) for the UK, four nations and NHS England regions. Please note that estimates for the four nations and regions are from individual modelling groups, and not agreed consensus estimates 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. Estimates of R for Scotland, Wales, Northern Ireland and NHSE England regions are subject to greater uncertainty given the lower number of cases and increased variation.

Different modelling groups use different data sources to estimate R using complex mathematical models that simulate the spread of infections. Some may even use all these sources of information to adjust their models to better reflect the real-world situation. There is uncertainty in all these data sources, which is why R estimates can vary between different models, and why we do not rely on one model; evidence is considered, discussed and R is presented as a range.

Given wide uncertainty ranges, it should not be concluded from estimates in this paper that R is higher or lower in different regions or nations.

This paper also contains separate estimates of R in the community and in hospitals; these are not agreed SAGE estimates. Outbreaks in hospitals and care homes cannot be considered in isolation as they are interlinked with the epidemic in the community.

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

Date: 4th May 2020

Summary

1. SPI-M-O's consensus is that the overall reproduction number, R_t , is under 1. It is lower in the community than overall. If there are three interlocking epidemics running and seeding each other, then each one has its own R_t (i.e. R_t in the community, hospitals and care homes) and there is one R_t for all 3 epidemics combined (overall R_t). Estimates of R_t in the community range from 0.5-0.9. This difference, and the uncertainty in these estimates, are due to the large but unknown number of hospital-acquired cases and infections in health and care workers. As a result, estimates of R_t are highly variable.

Reproduction number

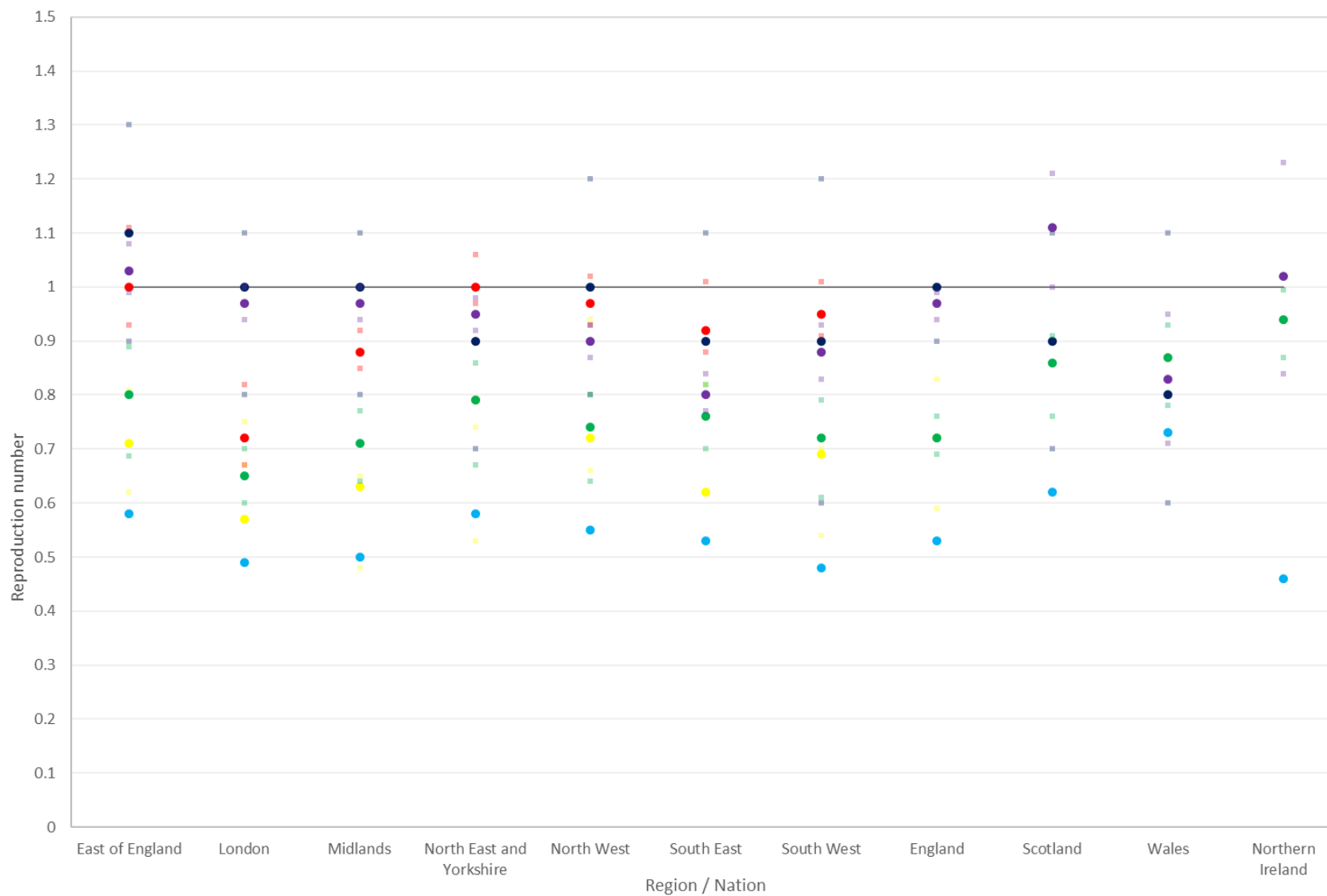
2. The reproduction number (R_t) is the average number of secondary infections produced by a single infected individual.
3. There are four measures of R_t which are particularly relevant to the current situation: an overall R_t , R_t in the community, R_t in care homes, and R_t in hospitals. Each of these may vary in different parts of the country, communities and subsections of the population.
4. Estimates of R_t are sensitive to differences in modelling methodology and can never be precisely determined. SPI-M-O's approach is for different modelling groups to independently estimate R_t to reflect this inherent uncertainty.

5. The interacting epidemics in the community, hospitals and care homes are very hard to unpick without information on the route of infection for each case, resulting in differences between estimates which are based on hospital data or deaths. Whilst new hospital admissions have been falling for a while, in recent days the rate of decline has slowed and appears to be flattening in some regions. It is not clear why this is, but it could reflect on-going hospital transmission.
6. SPI-M modelling groups' estimates of R_t in different regions and nations of the UK vary but are consistent in estimating that overall R is below 1. These are summarised in Table 1 and Figure 1 below.

Table 1. Estimates of overall UK reproduction number from 6 different groups in SPI-M

Nation / Region	Group1	Group 2	Group 3	Group 4	Group 5	Group 6
East of England	1.03 (0.99-1.08)	1.1 (0.9-1.3)	1.00 (0.93-1.11)	0.58	0.71 (0.62-0.81)	0.80 (0.69-0.89)
London	0.97 (0.94-1)	1 (0.8-1.1)	0.72 (0.67-0.82)	0.49	0.57 (0.67-0.75)	0.65 (0.6-0.7)
Midlands	0.97 (0.94-1)	1 (0.8-1.1)	0.88 (0.85-0.92)	0.50	0.63 (0.48-0.65)	0.71 (0.64-0.77)
North East and Yorkshire	0.95 (0.92-0.98)	0.9 (0.7-1)	1.00 (0.97-1.06)	0.58	0.79 (0.53-0.74)	0.79 (0.67-0.86)
North West	0.90 (0.87-0.93)	1 (0.8-1.2)	0.97 (0.93-1.02)	0.55	0.72 (0.66-0.94)	0.74 (0.64-0.8)
South East	0.80 (0.77-0.84)	0.9 (0.8-1.1)	0.92 (0.88-1.01)	0.53	0.62 (0.62-0.82)	0.76 (0.7-0.82)
South West	0.88 (0.83-0.93)	0.9 (0.6-1.2)	0.95 (0.91-1.01)	0.48	0.69 (0.54-0.7)	0.72 (0.61-0.79)
England	0.97 (0.94-0.99)	1 (0.9-1)		0.53	0.72 (0.59-0.83)	0.72 (0.69-0.76)
Scotland	1.11 (1-1.21)	0.9 (0.7-1.1)		0.62		0.86 (0.76-0.91)
Wales	0.83 (0.71-0.95)	0.8 (0.6-1.1)		0.73		0.87 (0.78-0.93)
Northern Ireland	1.02 (0.84-1.23)			0.46		0.94 (0.87-1.00)

Figure 1. SPI-M groups estimates of median R_t by region / nation, including 95% confidence intervals, where colours represent different modelling groups.



7. Hospital-acquired infections are estimated to make up more than 10% of new and newly diagnosed cases of COVID-19 in hospital, with extremely high variation between hospitals. NHS England data show 10-15% of new and newly confirmed hospital cases come from care homes, and it is estimated that a further 2-5% are from health and care workers. This implies that a minimum of 25% of new hospital cases are not arriving from the community. This is likely to be an underestimate as it does not include people who acquire COVID-19 in hospital, leave, and are then re-admitted, or people who acquire infection in outpatient departments. Nor does it account for infections spread in the community by healthcare workers.
8. R_t in hospital is hard to determine, as it has to be estimated from statistical analysis of hospital admission data, which requires several assumptions to be made. SPI-M-O's consensus view of R_t in hospitals is 0.1-0.5. This implies that hospitals cannot sustain epidemics separately from community spread but is consistent with long drawn out epidemics indistinguishable from a plateau.
9. It is not possible to define R_t in care homes currently as a significant proportion of new cases in those environments are introduced from the community, hospitals, and possibly other care homes. The trend in deaths in care homes since 10th April has not shown strong evidence of either increasing or decreasing. It is possible that health and care workers may be vectors for transmission between the care sector, the NHS, and the community.
10. R_t within the community is therefore lower than in the country overall. SPI-M-O's consensus view is that R_t in the community is well below 1 and likely significantly lower than the overall R_t in the population. The likely range is 0.5-0.9.
11. We have independent data sources that informs our estimates of R_t in the community. There is a purpose-designed contact survey (COMix), the KCL ZOE app, and 111/999 calls. These measures support the view that R_t in the community is ~ 0.5.

Prevalence and incidence of COVID-19

12. The current number of new infections per day remains uncertain. Emerging community swabbing data collected between 26th and 30th April suggested that 179,000 people (confidence interval 78,000 to 358,000) would have swabbed positive with SARS-CoV-2 on 3rd May. However, since an individual would swab positive for about 10 days, a rough estimate of the number of people who newly swabbed positive (i.e. daily incidence) on 3rd May is ~10% of that, so ~18,000.

13. Preliminary results from these swabbing surveys support the view that a significant proportion (~30%) of infections in the UK are directly associated with health and social care workers.
14. Central estimates from different members of SPI-M-O for the incidence of infection (including those with no symptoms) range from 10,000-40,000 new infections per day. Uncertainty in this range is predominantly due to different assumptions on the proportion of infections which are asymptomatic. Further community swabbing data will go a long way to settling this central uncertainty.