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

Date: 22nd July 2020

SIGNED OFF BY SPI-M CO-CHAIRS ON BEHALF OF SPI-M-O

Summary

1. It is highly likely that the overall reproduction number, **R**, in the UK has been below 1 in recent weeks. SPI-M-O's best estimate for **the UK is that R remains between 0.7 and 0.9** as has been the case for the past seven weeks.

2. The **growth rate** records how quickly the number of infections is changing per day. SPI-M-O's consensus estimate is that **the growth rate in the UK is between -4% and -1% per day**.

3. Estimates of R and the growth rates per day are less reliable and less useful in determining the state of the epidemic when disease incidence is low or where there is significant variability in the population, for example, local outbreaks. Both are average measures and will smooth over outbreaks at small spatial scales or over short periods of time.

4. **Care should be taken when interpreting the R and growth rate estimates for Scotland, Wales, Northern Ireland, East of England, London, North West, South East and South West.** This is because these estimates are based on low case numbers and / or dominated by clustered outbreaks and are insufficiently robust to inform policy decisions.

5. As prevalence of infection falls, national and regional forecasts become less meaningful and it becomes increasingly important to monitor the level of transmission at a local level to detect and respond to local outbreaks.

6. As prevalence of SARS-CoV-2 in the UK is currently low, the possibility that false positives are inflating estimates of incidence should be considered. This is relevant for surveys using PCR tests, such as the ONS swabbing survey and Real-time Assessment of Community Transmission (REACT) study. Analysis of household clustering by the ONS suggests that their results are not dominated by these false positives. SPI-M-O will continue to investigate this issue over the coming weeks and make any necessary adjustments to its modelling, if required.

Reproduction number

7. The reproduction number is the average number of secondary infections produced by a single infected individual. R is an average over time, geographies and communities. Whilst it varies in different geographies and settings of the population, separating transmission within and between these sub-populations increases uncertainty.

8. Uncertainty in R increases as the number of infections decreases. SPI-M-O's agreed national estimates of R are summarised in **Table 1** and **Figures 1 and 2**. SPI-M-O's best estimate for **the UK is that R remains between 0.7 and 0.9**. The previous three consensus estimates of R have been included to show the trend in the estimates.

9. **Any changes in transmission patterns that may have occurred in the last two to three weeks will not yet be reflected in the epidemiological data, nor therefore in SPI-M-O's estimates of R**.

Growth rates

10. For small daily changes, the growth rate is approximately the proportion by which the number of infections increases or decreases per day, i.e. the rate at which an epidemic is growing or shrinking[1].

11. SPI-M-O's consensus estimate is that the epidemic is slowly shrinking in the UK, with a growth rate each day that can be interpreted as **-4% and -1% per day**. SPI-M-O's agreed national estimates of growth rate are summarised in **Table 1**.

12. Rounding and differences between the models used in the combination approach account for differences between estimates of R and growth rates. Such variation highlights the importance of applying judgement when using these metrics rather than relying solely on their values.

13. At a UK and England level, models that use case and emergency call data, both of which are expected to be leading indicators for changes in transmission, are currently giving slightly higher estimates of the growth rate than those based on deaths, a lagged indicator.

[1] The growth rate λ, is the exponent of the exponential curve $y = e^{\lambda t}$, where y is the number of new infections, and t is time, given in days. It is approximately the change per day (so λ=-0.04 corresponds to a 4% decline in cases per day).

This trend is not so clearly repeated at regional level, where there is more variation across the estimates produced by different models.

Regional variation

14. Estimates of R at regional levels are subject to the same difficulties in interpretation as national estimates, and these are amplified due to the smaller numbers of cases. Publishing several estimates increases the statistical chance that one of them is high by chance. SPI-M-O does not have confidence that regional R estimates are sufficiently robust to inform regional policy decisions.

15. Consensus estimates for the regional growth rates per day in England are also given in **Table 1** and **Figure 3**. For completeness, consensus regional estimates of R for England are given in **Table 1** and **Figure 4**, some of the ranges of R include 1.

Reliability of R and growth rates

16. R becomes an unreliable measure for informing policy when case numbers fall to low levels, there is variability in estimates from different data streams, or there is a high degree of variability in transmission, for example, due to a localised outbreak.

17. SPI-M-O's view is that **care should be taken when interpreting the R and growth rate estimates for: Scotland, Wales, Northern Ireland, East of England, London, North West, South East and the South West.** This is because these estimates are based on low case numbers and / or clustered outbreaks.

Incidence

18. The relationship between infection, symptoms, swab positivity, hospitalisation, and death is becoming clearer, but uncertainties remain in estimating the number of new daily infections.

19. Combined estimates from four SPI-M models give a 90% confidence interval of **2,000 – 5,000 new infections per day** in England.

20. Data from the ONS swabbing survey for the most recent week of the study (13 to 19 July) estimates that an average of 27,700 people were positive for SARS-CoV-2 in the community in England (confidence interval 18,500 to 39,900). The study also estimates that during the same week, there were **2,800 new infections per day, with a confidence interval of 1,500 to 5,500**. Although the ONS survey can directly estimate incidence, it is based on a very small number of positive tests.

False positive and false negative test results

21. As the prevalence of a disease declines in a population, the positive predictive value[2] (PPV) of a test also declines, with particularly severe effects as prevalence approaches zero. This means that even if a test has very high specificity, positive results could be dominated by false positives when prevalence is low.

22. The prevalence of SARS-CoV-2 in the UK is currently low enough that surveys using PCR tests, such as the ONS swabbing survey and Real-time Assessment of Community Transmission (REACT) study, may be overestimating the level of incidence due to false positive results. Analysis of household clustering by the ONS suggests that their results are not dominated by these false positives.

23. To give a sense of scale, Figures 5 and 6 display the results from a simple modelling approach investigating the impact that different sensitivity and specificity levels can have on prevalence and growth rate estimates. In these examples, the true level of prevalence is assumed to be 0.1%. As shown in Figure 5, even a very small imperfection in specificity means false positive results could lead to a significant overestimate of prevalence. In contrast, poor sensitivity could lead to an underestimate, but this effect is more subtle.

24. Furthermore, when prevalence is very low, false positive results would make the trajectory over time appears to be flatter than it actually is, so estimates of growth rate using this data will suggest a growth rate is closer to zero than it is (same for both positive and negative growth). Poor sensitivity exacerbates this effect. A similar effect is likely to be seen in R estimates.

25. There are also likely to be a significant number of false negative results in such tests, particularly when self-administered. SPI-M-O will continue to investigate this issue over the coming weeks and make any necessary adjustments to its modelling, if required.

[2] Positive predictive value (PPV) - the probability, given a positive test result, that an individual really has the disease.

Figure 5: The effect of false positive and false negative results on estimated prevalence

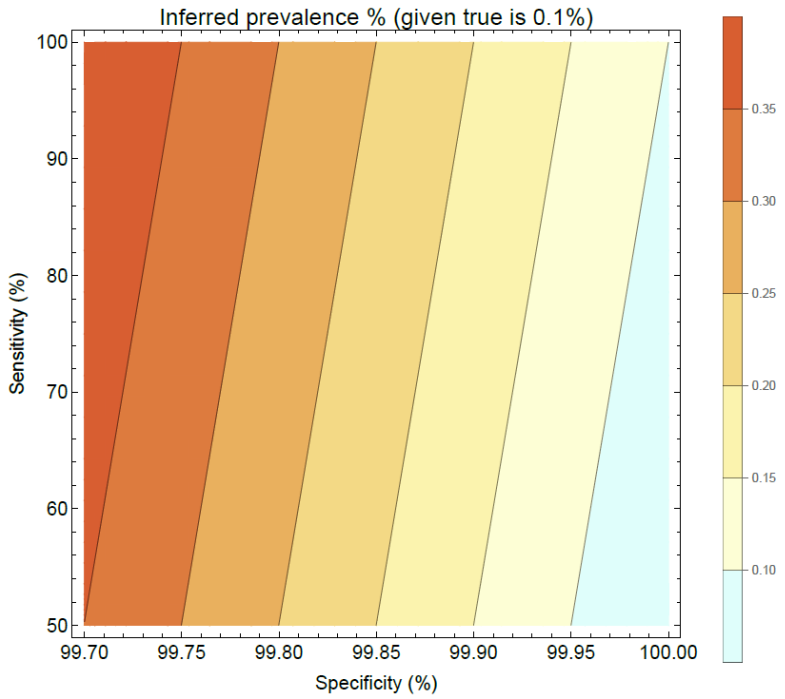
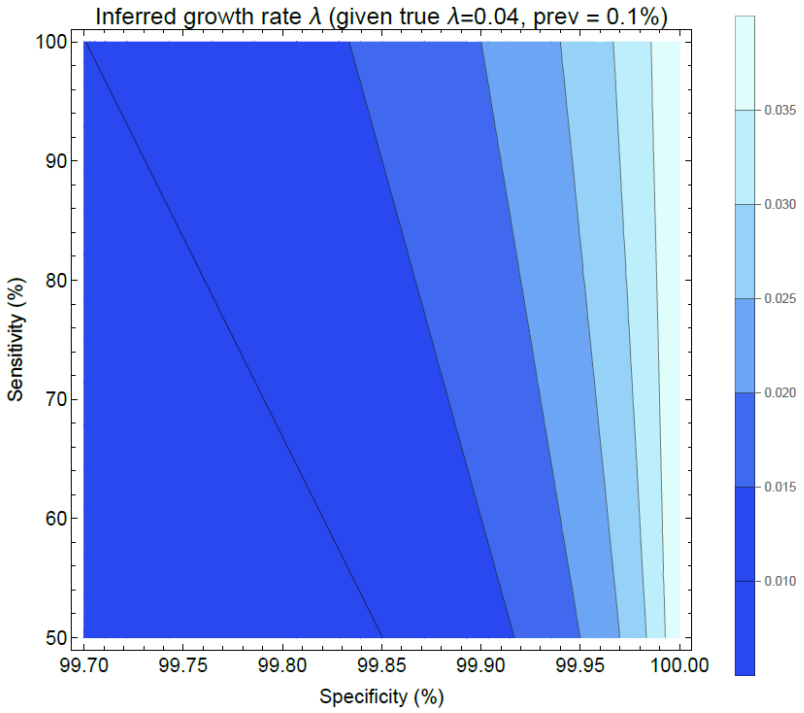


Figure 6: The effect of false positive and false negative results on growth rate estimates



Annex: PHIA framework of language for discussing probabilities

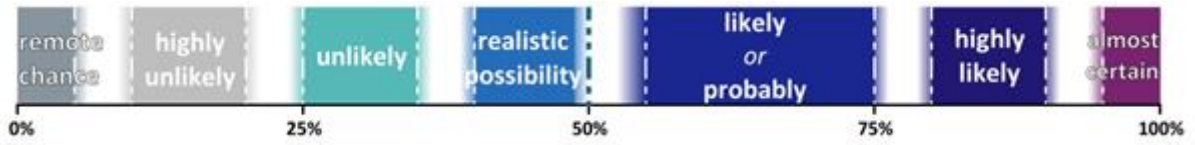


Table 1: Combined estimate of R and the growth rate in the UK, four nations, and NHS England regions (90% confidence interval)

Nation	R	Growth rate per day
England	0.8 – 1.0	-4% to 0%
Scotland*	0.6 – 0.9	-8% to -2%
Wales*	0.6 – 0.9	-5% to -2%
Northern Ireland*	0.3 – 1.1	-11% to -4%
UK	**0.7 – 0.9**	**-4% to -1%**

NHS England region	R	Growth rate per day
East of England*	0.8 – 1.0	-3% to +2%
London*	0.8 – 1.0	-5% to +1%
Midlands	0.7 – 1.0	-5% to 0%
North East and Yorkshire	0.8 – 1.0	-4% to 0%
North West*	0.7 – 1.0	-5% to -1%
South East*	0.8 – 1.0	-3% to +1%
South West*	0.7 – 1.0	-5% to +2%

*Care should be taken when interpreting these estimates as they are based on low incidence and/or clustered outbreaks within this area.

Figure 1: SPI-M groups' estimates of median R in the UK, including 90% confidence intervals. Bars represent different independent estimates. The grey shaded area represents the combined numerical range and the black bar is the combined range after rounding to 1 decimal place.

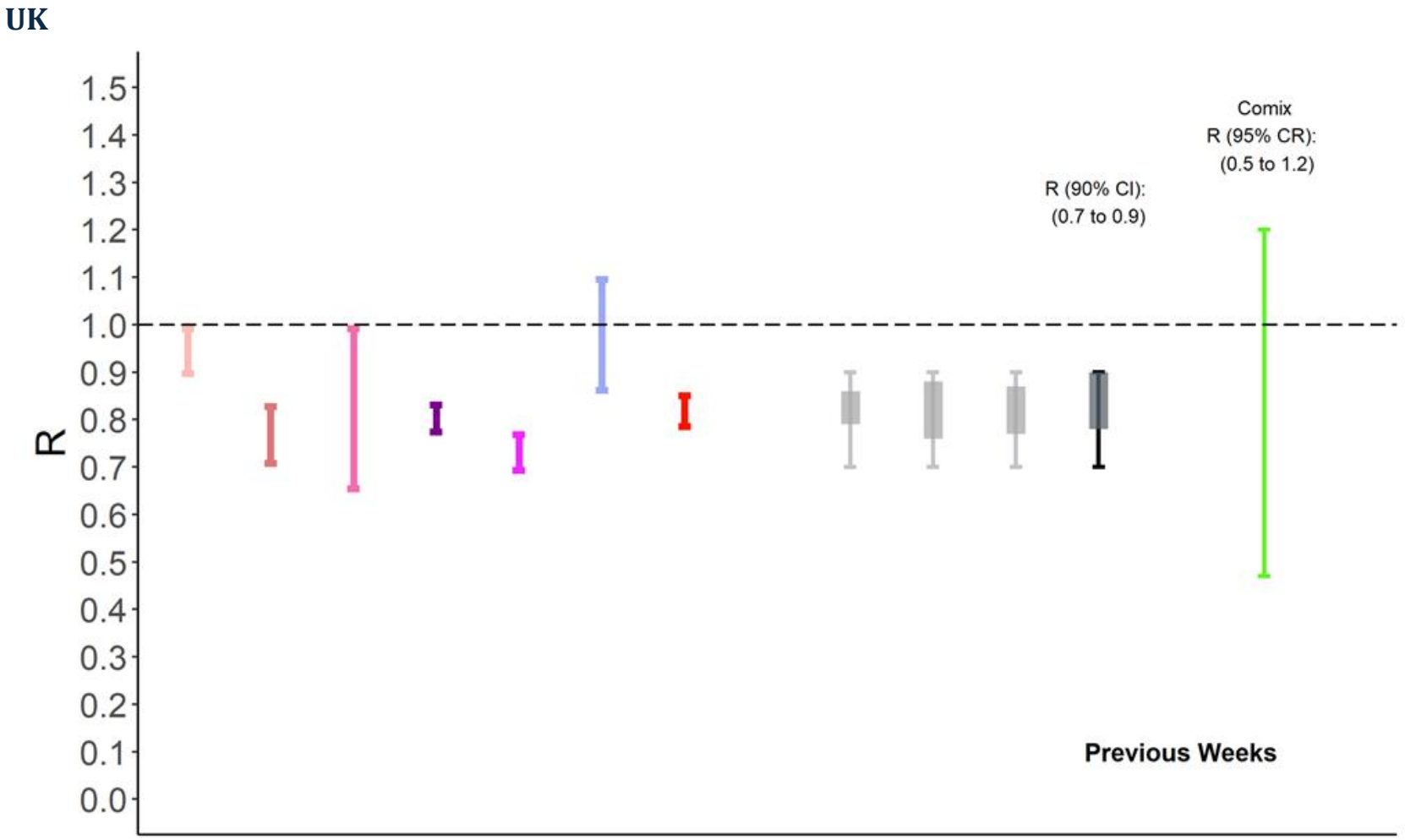


Figure 2: SPI-M groups estimates of median R in the four nations of the UK, including 90% confidence intervals. Bars represent different independent estimates. The grey shaded areas represent the combined numerical range and the black bars are the combined range after rounding to 1 decimal place.

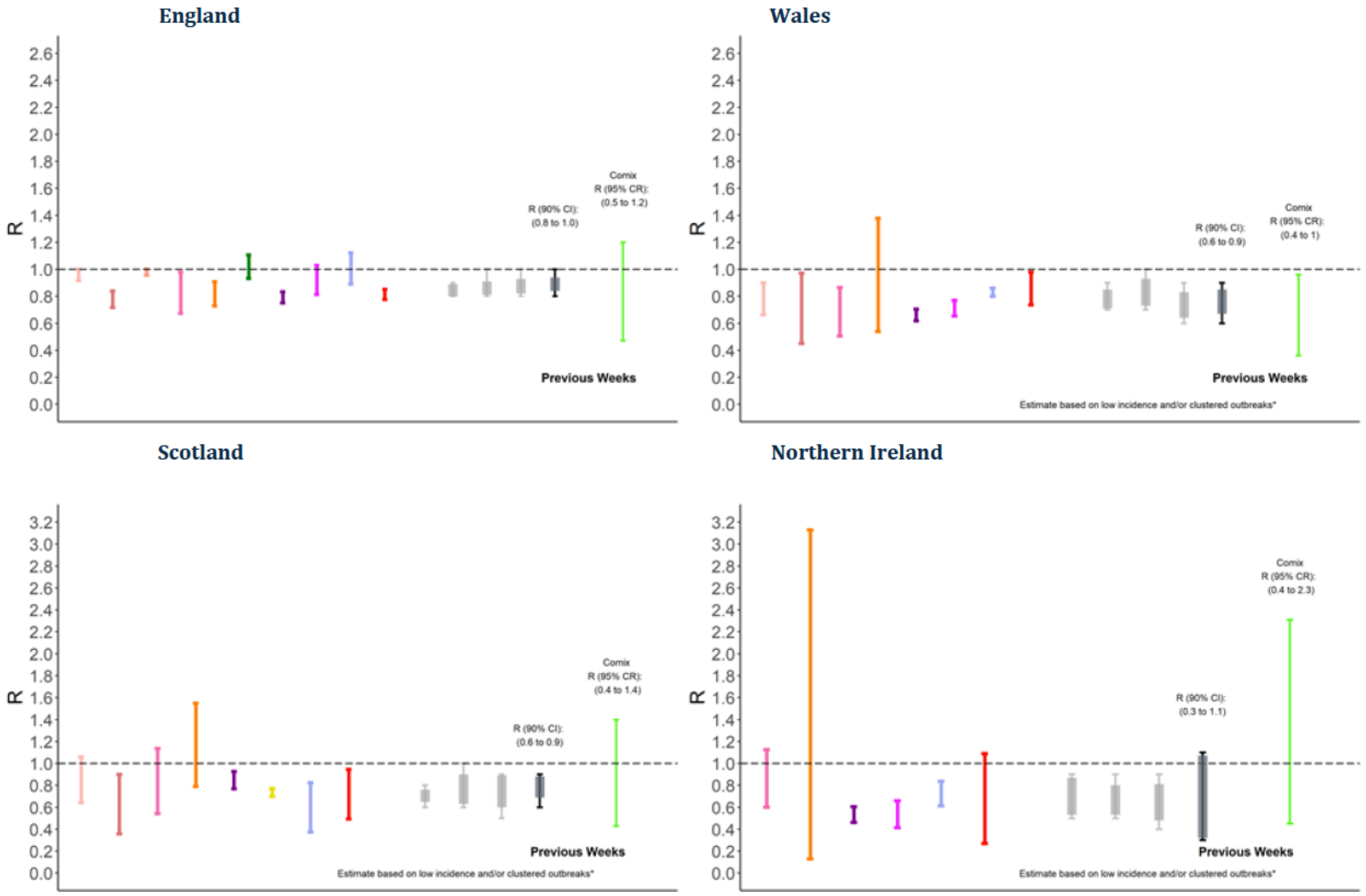


Figure 3: SPI-M groups estimates of the growth rate in NHS England regions, including 90% confidence intervals. Bars represent different modelling groups. The grey shaded areas represent the combined numerical range and the black bars are the combined range after rounding to 2 decimal places.

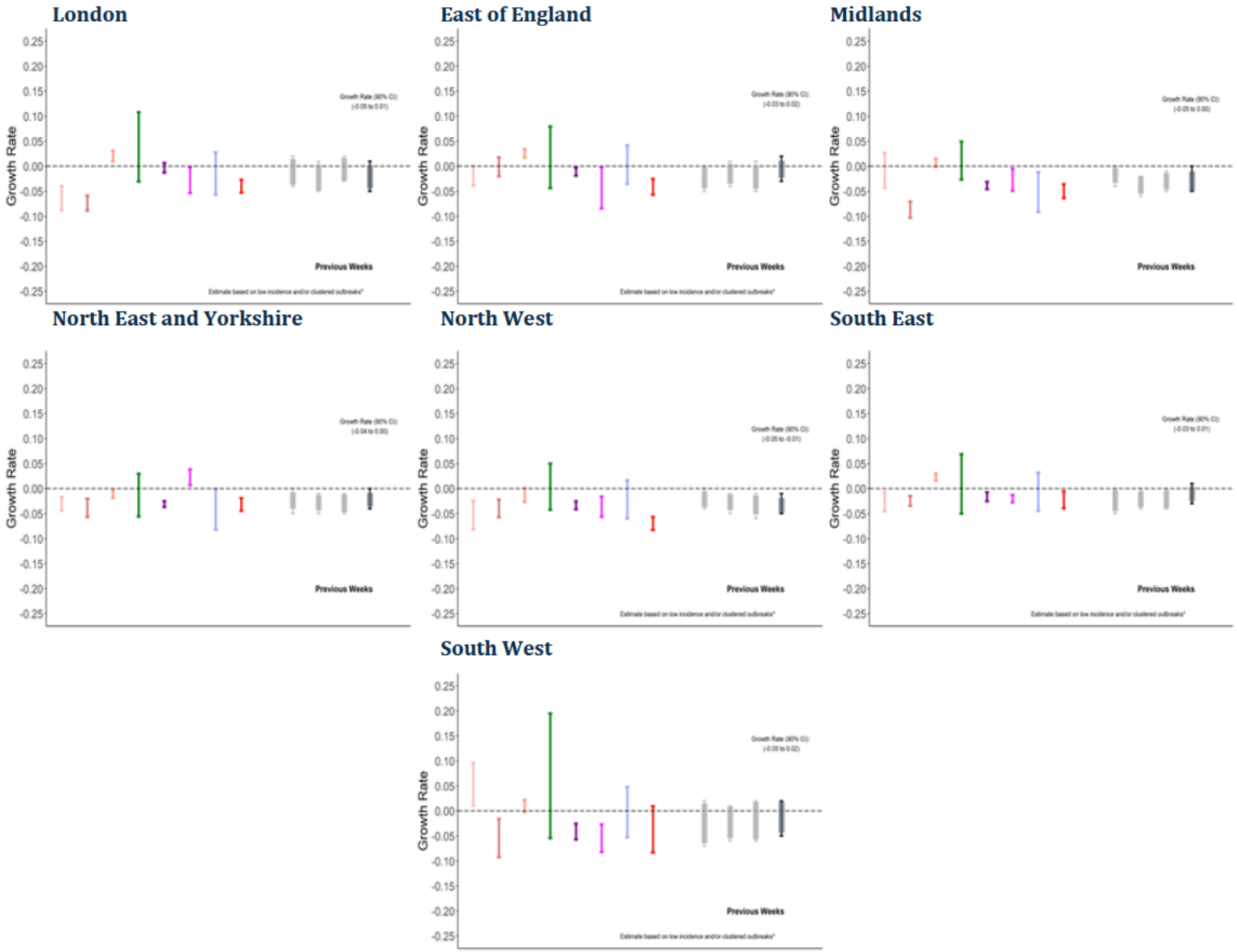


Figure 4: SPI-M groups estimates of median R in the NHS England regions, including 90% confidence intervals. Bars represent different independent estimates. The grey shaded areas represent the combined numerical range and the black bars are the combined range after rounding to 1 decimal place.