

## Epidemiology Modelling Review Group: consensus statement on COVID-19

Date: 10 November 2021

## Introduction

The UK Health Security Agency (UKHSA) Epidemiology Modelling Review Group (EMRG) shares this consensus statement on COVID-19 with acknowledgment to SPI-M-O, who have developed and shared modelling methodologies and contribute model outputs to these combined estimates.

All probability statements are in line with the framework given in Annexe A.

# Summary

- UKHSA's best estimate for R in England is between 0.8 and 1.0. R is estimated to be between 0.8 and 1.0 for Wales, 0.9 and 1.1 for Scotland, and 0.8 and 1.0 for Northern Ireland (Figure 1). These estimates are based on models<sup>1</sup> fit to data available up to 8 November 2021, including hospitalisations, deaths, testing, wastewater samples and longitudinal studies.
- 2. Combined estimates<sup>2</sup> show that the incidence<sup>3</sup> is between 49,000 and 85,000 new infections per day in England.

### Incidence and prevalence

- 3. During its most recent week (ending 30 October), the ONS COVID-19 Infection Survey estimates<sup>4</sup> that an average of 925,400 people had COVID-19 in the community in England (95% credible interval 875,200 to 975,100). The survey does not include people in care homes, hospitals or prisons. Estimates from across the 4 nations of the UK are:
- England 925,400 (95% credible interval 875,200 to 975,100)
- Scotland 62,100 (95% credible interval 50,000 to 74,500)
- Wales 64,900 (95% credible interval 52,700 to 78,200)
- Northern Ireland 24,700 (95% credible interval 18,000 to 32,400)

<sup>&</sup>lt;sup>1</sup> Model estimates are required as quantities such as the Reproduction Number (R) are not directly observable. Instead, a variety of independently produced models are used to interpret the data and estimate R.

<sup>&</sup>lt;sup>2</sup> Different nations and regions may use different sets of models for these estimates; hence caution should be applied in drawing direct comparisons. For example, fewer models produce estimates for Wales and Northern Ireland.

<sup>&</sup>lt;sup>3</sup> The number of new infections per day.

<sup>&</sup>lt;sup>4</sup> These estimates can be subject to revision as further information is available and modelled.

### Growth rate and reproduction number

For small daily changes, the growth rate is approximately the proportion by which the number of infections increases or decreases per day, that is, the speed at which an epidemic is growing or shrinking.<sup>5</sup>

- 4. The EMRG's consensus estimates for the growth rates in the 4 nations are (90% credible interval):
- England is between -3% to +1% per day,
- Wales is between -3% to +1% per day,
- Scotland is between -2% to +1% per day, and
- Northern Ireland is between -3% to +1% per day

National estimates of growth rates are summarised in Figure 2.

- 5. The reproduction number (R) is the average number of secondary infections produced by a single infected individual; it is an average over time, geographies, viral variants, and communities.
- UKHSA's best estimate for R in England is between 0.8 and 1.0. R is estimated to be between 0.8 and 1.0 for Wales, 0.9 and 1.1 for Scotland, and 0.8 and 1.0 for Northern Ireland. UKHSA's agreed national and regional R estimates are summarised in <u>Table 1</u>, <u>Table 2</u>, <u>Figure 1</u>, and <u>Figure 3</u>. These are based on the latest data available up to 8 November 2021<sup>6</sup>.
- 7. R is an indicator that lags changes in transmission by 2 to 3 weeks<sup>7</sup>, due to the time required for changes to be seen in data streams.
- 8. This inherent lag means that recent fluctuations should not be expected to be consistent with these estimates, and estimates may not represent transmission trends now.
- 9. Estimates of R and the growth rates per day become less useful in determining the state of the epidemic when there is a high degree of immunity in the population. Particular care should be taken when interpreting these estimates.

<sup>&</sup>lt;sup>5</sup> Further Technical Information on the growth rate can be found in Plus Magazine: <u>The growth rate of COVID-19</u> <u>plus.maths.org.</u>

<sup>&</sup>lt;sup>6</sup> Different models fit to different windows of time using different methodologies, hence not all models will fit up to this precise date.

<sup>&</sup>lt;sup>7</sup> Different data-streams and different models are expected to be lagged in their estimates by different amounts when compared with the true underlying epidemiological situation. This is due to multiple lags such as reporting and delays in the infection processes. However, the consensus combination generally reflects a 2-week lag.

Nation	R	Daily growth rate	Doubling time <sup>8</sup>			
England	0.8 to 1.0	-3% to +1%	-26 days to flat			
Wales	0.8 to 1.0	-3% to +1%	-27 days to flat			
Scotland	0.9 to 1.1	-2% to +1%	-39 days to flat			
Northern Ireland	0.8 to 1.0	-3% to +1%	-25 days to flat			

Table 1. Combined estimates of R values growth rates and doubling times in the 4nations of the UK (90% credible interval)

## Table 2. Combined estimates of R values growth rates and doubling times in the NHSEngland regions (90% credible interval)

NHS England region	R	Daily growth rate	Doubling time <sup>8</sup>			
England	0.8 to 1.0	-3% to +1%	-26 days to flat			
London	0.8 to 1.0	-4% to +1%	-20 days to flat			
East of England	0.8 to 1.0	-5% to +0%	-16 days to flat			
Midlands	0.8 to 1.0	-4% to +1%	-18 days to flat			
North East & Yorkshire	0.8 to 1.0	-5% to +0%	-17 days to flat			
North West	0.8 to 1.0	-4% to +1%	-17 days to flat			
South East	0.8 to 1.0	-5% to +1%	-16 days to flat			
South West	0.7 to 1.0	-5% to +1%	-14 days to flat			

<sup>&</sup>lt;sup>8</sup> Any estimates with a halving or doubling time of more than 40 days have been described as flat. Negative values of doubling time indicate a halving time (the time expected for cases to fall by 50%). Doubling time here is calculated using the growth rate.

### Annexe A. PHIA framework of language for discussing probabilities

The yardstick splits the probability scale into 7 ranges from remote chance (0 to 5% probability) to almost certain (95% to 100% probability).

Remote (	Chance	Highly U	nlikely	Unli	kely	Realis	tic Possibility		Likely / Probable		Highl	/ Likely	Almos	t Certain
0%	5%	10%	20%	25%	35%	40%	50%	55%		75%	80%	90%	95%	100%

## Acknowledgements

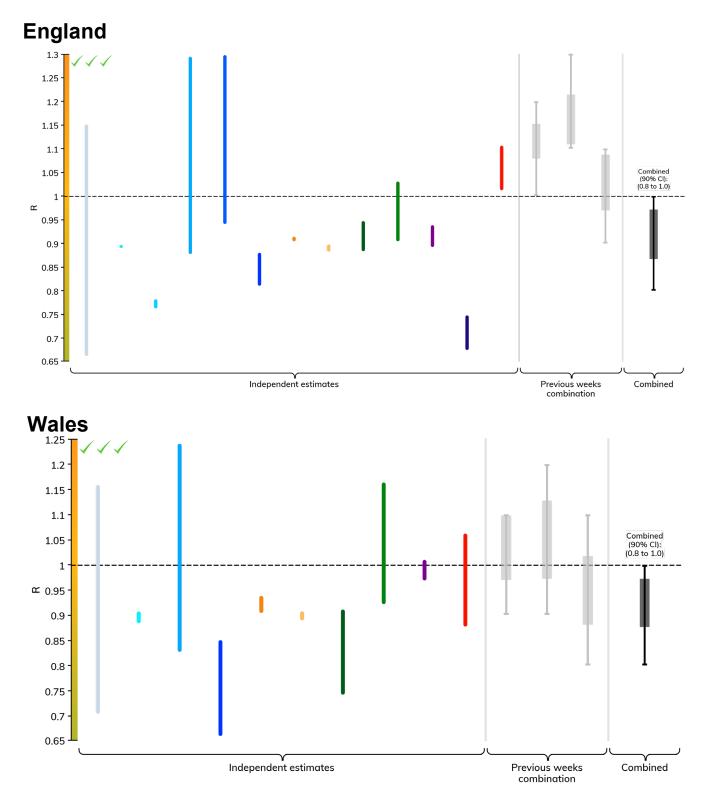
UKHSA takes responsibility for this consensus statement and its contents. However, UKHSA would like to acknowledge the work of SPI-M-O and academic partners in developing methodologies and sharing these, as well as continuing to contribute model outputs to the combined estimates. These estimates include contribution from LSHTM (<u>1</u>, <u>2</u>), Imperial College London (<u>3</u>, <u>8</u>), University of Warwick (<u>4</u>, <u>5</u>), University of Exeter and University of Bristol (<u>6</u>), Lancaster University (<u>7</u>), University of Manchester and University of Cambridge (<u>9</u>). UKHSA would also like to thank the European Bioinformatics Institute (<u>10</u>), University of Oxford (<u>11</u>, <u>12</u>), University of Liverpool (<u>13</u>), and the Institute of Disease Modeling (<u>14</u>) for contributing model outputs. UKHSA also acknowledges the work developing combination estimates from Defence and Science Technology Laboratory (<u>15</u>). UKHSA also thanks and acknowledges the support and collaboration of the SPI-M-O Secretariat and co-Chairs, as well as colleagues across the 4 nations.

# References

- Abbott, Hellewell and others '<u>Estimating the time-varying reproduction number of SARS-CoV-2 using national and subnational case counts</u>'. Wellcome Open Research, 8 December 2020
- 2. Sherratt and others. '<u>National and Subnational estimates for the United Kingdom</u>'
- 3. Knock and others. '<u>Key epidemiological drivers and impact of interventions in the 2020</u> <u>SARS-CoV-2 epidemic in England</u>'. Science Translational Medicine, 14 July 2021
- 4. Keeling and others. '<u>Predictions of COVID-19 dynamics in the UK: Short-term forecasting</u> and analysis of potential exit strategies. PLOS Computational Biology, 22 January 2021
- 5. Keeling and others. '<u>Fitting to the UK Covid-19 outbreak, short-term forecasts and estimating the reproductive number</u>.' MedRxiv: 29 September 2020
- Challen and others. 'Estimates of regional infectivity of COVID-19 in the United Kingdom following imposition of social distancing measures.' Philosophical Transactions of the Royal Society B: 31 May 2021
- 7. Jewell and others. '<u>Bayesian stochastic model-based forecasting for spatial COVID-19 risk</u> in England Technical Concept Note.' Github: 22 September 2020
- 8. Cori and others. <u>'A New Framework and Software to Estimate Time-Varying Reproduction</u> <u>Numbers During Epidemics</u>.' American Journal of Epidemiology: 1 November 2013
- Birrell and others. '<u>Real-time Nowcasting and Forecasting of COVID-19 Dynamics in</u> <u>England: the first wave?</u>' Philosophical Transactions of the Royal Society B: Biological Sciences, 31 May 2021
- 10. Vöhringer and others <u>Genomic reconstruction of the SARS-CoV-2 epidemic across</u> England from September 2020 to May 2021. MedRxiv, 26 May 2021
- 11. Teh and others. 'Efficient Bayesian Inference of Instantaneous Reproduction Numbers at Fine Spatial Scales, with an Application to Mapping and Nowcasting the Covid-19 Epidemic in British Local Authorities.' LocalCovid.info: 19 April 2021
- 12. Panovska-Griffiths and others. <u>Modelling the impact of reopening schools in early 2021 in</u> <u>the presence of the new SARS-CoV-2 variant amd with the roll out of vaccination against</u> <u>COVID-19</u>. MedRxiv: 9 February 2021
- 13. Moore and Phillips. 'Liverpool Covid Model: Model Overview.' Github: 10 March 2021
- 14. Kerr and others. '<u>Covasim: an agent-based model of COVID-19 dynamics and interventions.</u>' MedRxiv: 1 April 2021
- 15. Maishman and others. '<u>Statistical methods used to combine the effective reproduction</u> <u>number, R(t), and other related measures of COVID-19 in the UK.</u>' arXiv preprint, 3 March 2021

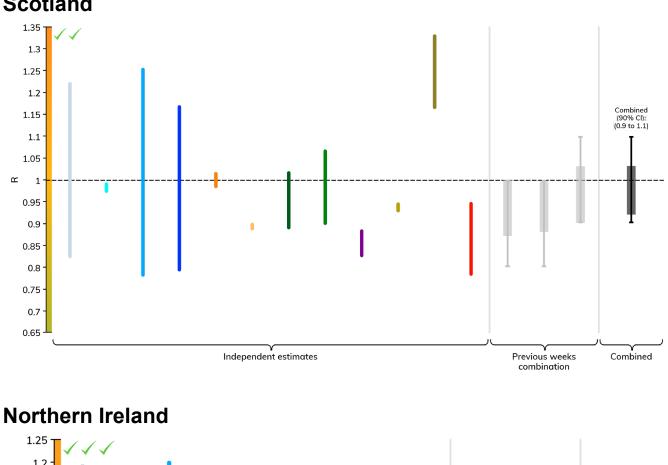
#### Figure 1a. Estimates of R in the 4 nations of the UK (90% credible intervals)

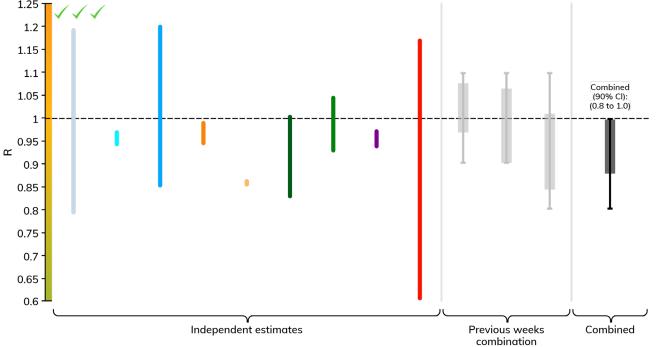
Bars represent different independent estimates. The grey shaded areas represent the combined numerical range and the black bars are the combined range after rounding outwards to one decimal place.



#### Figure 1b. Estimates of R in the 4 nations of the UK (90% credible 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 outwards to one decimal place.



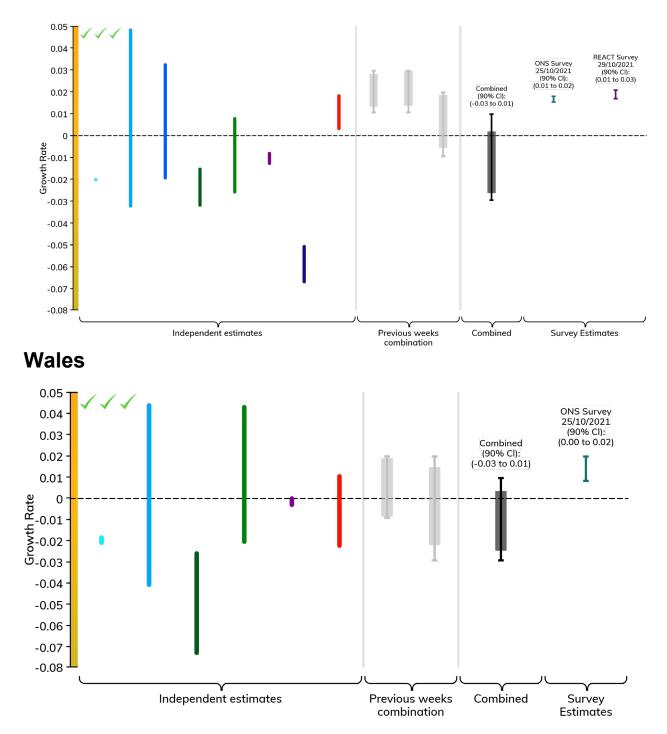


#### Scotland

## Figure 2a. Estimates of the growth rate in NHS England nations, including 90% credible intervals

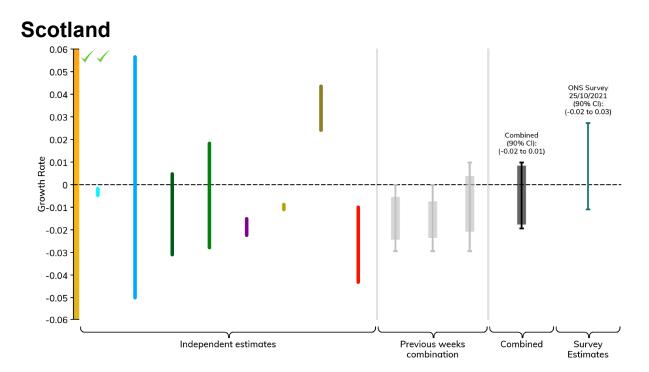
Bars represent different independent estimates. The grey shaded areas represent the combined numerical range and the black bars are the combined range after rounding outwards to the nearest per cent.

#### England

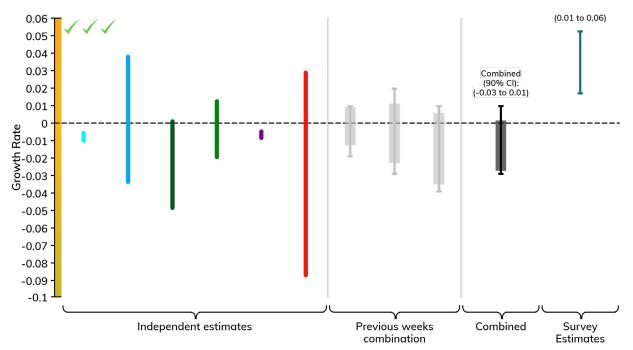


### Figure 2b. Estimates of the growth rate in NHS England nations, including 90% credible intervals

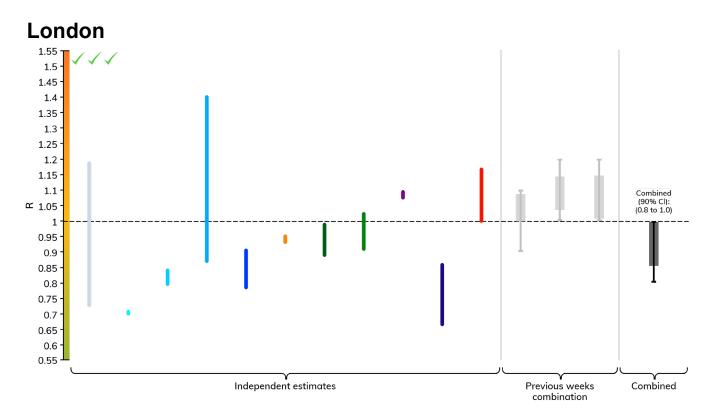
Bars represent different independent estimates. The grey shaded areas represent the combined numerical range and the black bars are the combined range after rounding outwards to the nearest per cent.



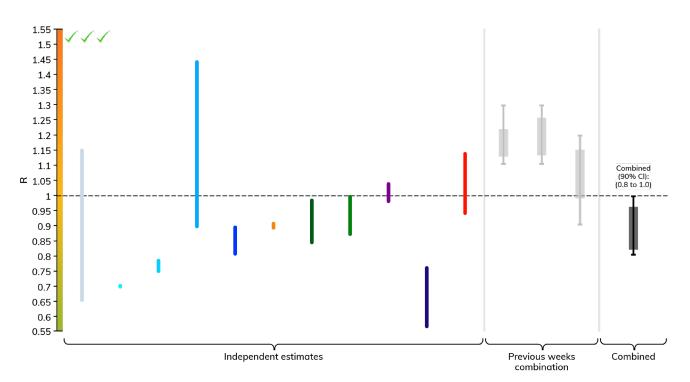
#### **Northern Ireland**



**Figure 3a. Estimates of R in the NHS England regions, including 90% credible 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 outwards to one decimal place.

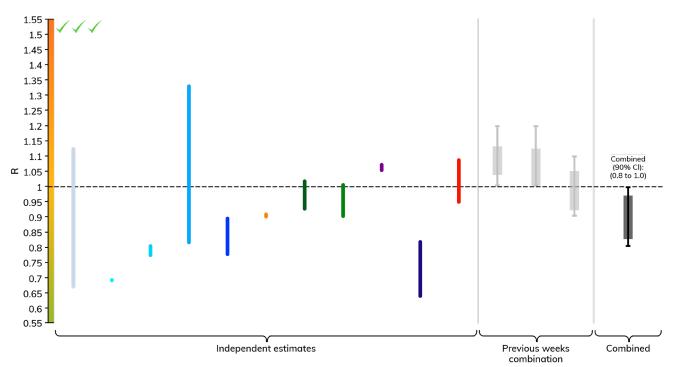


#### East of England

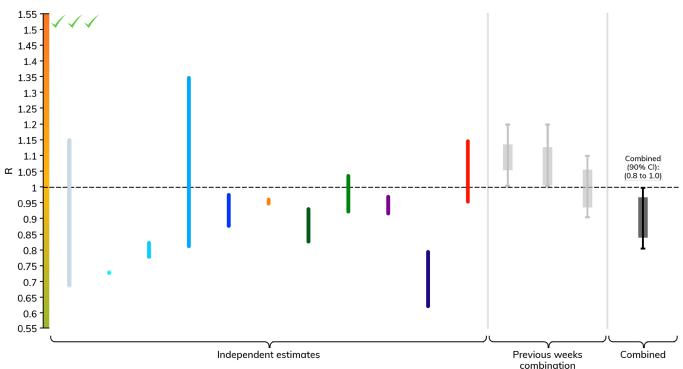


**Figure 3b. Estimates of R in the NHS England regions, including 90% credible intervals** Bars represent different independent estimates. The grey shaded areas represent the combined numerical range and the black bars are the combined range after rounding outwards to one decimal place.

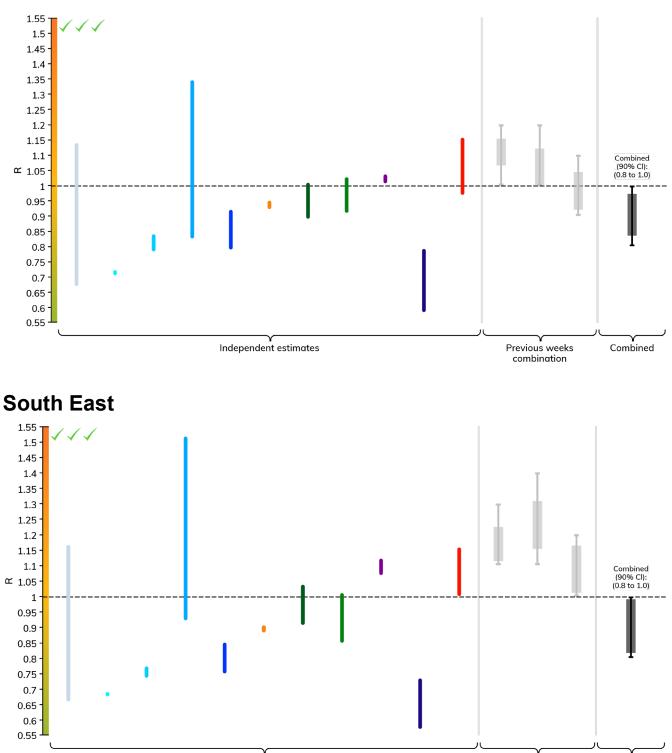
#### Midlands



#### North East and Yorkshire



**Figure 3c. Estimates of R in the NHS England regions, including 90% credible 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 outwards to one decimal place.



#### **North West**

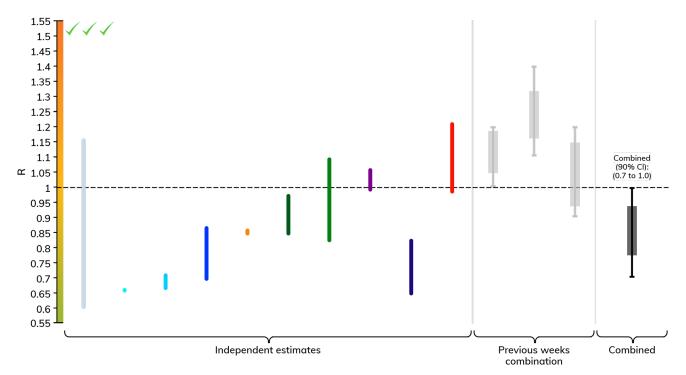
Independent estimates

Previous weeks combination

Combined

**Figure 3d. Estimates of R in the NHS England regions, including 90% credible 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 outwards to one decimal place.

#### **South West**



## About the UK Health Security Agency

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