### **Media summary**

The reproduction number (Rt) is the average number of infections caused by each infected person. This represents how quickly an epidemic spreads and has become policy-relevant during the Covid-19 pandemic. As it is difficult to measure the true number of infections, researchers use other indicators, e.g. tested cases, hospital admissions, or deaths, to estimate Rt. However, these cases may not represent average transmission in the whole population (for example, those who die are likely to be older). We explored Rt estimates from three data sources of Covid-19 cases across English regions and found that each is influenced differently by testing rates and the average age of cases. This means we should consider the data used to estimate Rt before making conclusions about transmission in the general population.

### **Data accessibility**

The code that supports the findings of this study is available on Github (DOI: 10.5281/zenodo.4029075). Other sources of data were derived from the following resources available in the public domain.

* Sherratt K, Abbott S. 2020 Rt comparison by data source in the UK. Zenodo. (doi:10.5281/zenodo.4029075)
* Office for National Statistics. 2020 Number of deaths in care homes notified to the Care Quality Commission, England.
* Public Health England. 2020 National COVID-19 surveillance reports. GOV.UK. See https://www.gov.uk/government/publications/national-covid-19-surveillance-reports.
* Office for National Statistics. 2020 Estimates of the population for the UK, England and Wales, Scotland and Northern Ireland. See https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/populationestimatesforukenglandandwalesscotlandandnorthernireland.
* Xu B et al. 2020 Epidemiological data from the COVID-19 outbreak, real-time case information. Sci Data 7, 106.
* The Health Foundation. 2020 COVID-19 policy tracker. See https://www.health.org.uk/news-and-comment/charts-and-infographics/covid-19-policy-tracker.
* Public Health England, NHSX. 2020 Coronavirus (COVID-19) in the UK. See <https://coronavirus.data.gov.uk/about-data>.

Data not yet available in the public domain included the delay from onset to death for a sample of Covid-19 positive cases in England. However, in the main code base for this paper we have included a table of summary statistics of the bootstrapped sample of these data ([DOI: 10.5281/zenodo.4029075](https://doi.org/10.5281/zenodo.4029075)).

**Author contributions**

Conceptualisation: SA, KS; methodology: SA, KS; data curation: KS; formal analysis: KS; writing - original draft: KS, SA; writing - review & editing: SA, SF, MJ, SRM, JH, JDM, NB, CMMID Covid-19 working group; supervision: SF