An estimate of the transmissibility and severity of SARS-CoV-2 variant B.1.1.7-N501Y in South East England

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Summary

We fitted a two-strain model of SARS-CoV-2 transmission to observed hospital admissions, hospital bed occupancy, deaths, PCR prevalence, seroprevalence, and frequency of the novel SARS-CoV-2 variant B.1.1.7-N501Y in the South East, East of England, and London regions of England. We estimate that the novel variant is 56% (95% credible interval across three NHS England regions 50-74%) more transmissible than other circulating strains of SARS-CoV-2. We did not find strong evidence that the novel variant is more or less severe than other strains. Nevertheless, the increase in transmissibility is likely to lead to a large increase in incidence, with peak hospitalisations and deaths far higher than was observed in April, even with pre-Christmas levels of restrictions (Tiers) in place. A lockdown of similar severity to the that undertaken in November is unlikely to reduce the reproduction number to less than 1. Preliminary results suggest that adding school closure should be sufficient to reduce R to less than 1. Large resurgences of the virus are likely following easement of a third lockdown. Projections are less certain for those regions which have currently identified few cases with the new variant. Preliminary results of a vaccination programme – based on Pfizer-type efficacy and very rapid roll-out – suggest that it can help reduce cases and deaths significantly and that vaccinating the elderly first (60+ years) then working down through the age groups may be more effective than vaccinating the elderly first then working up through the age groups. Further work on these strategies is, however, needed
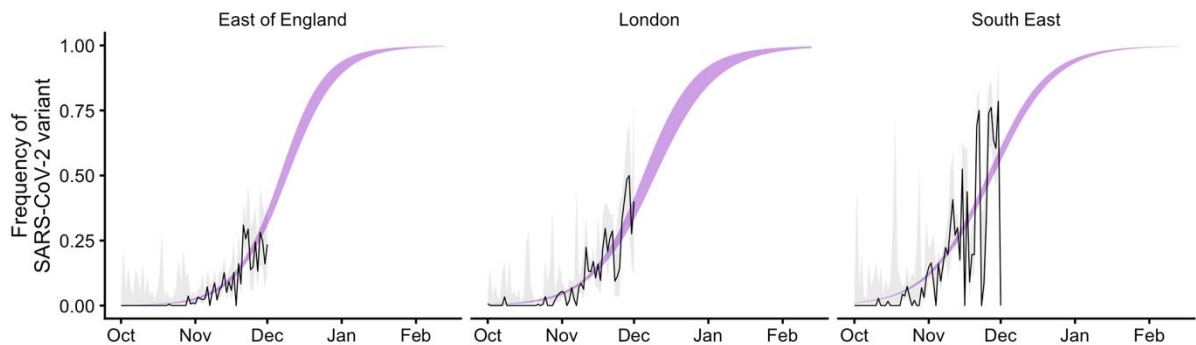
Results

Figure 1. Model fit to observed frequency of B.1.1.7-N501Y in COG-UK data. The black lines and grey shaded regions show the frequency of the variant in COG-UK data, with sequencing reads localised to the three NHS regions by longitude and latitude. We truncated the data at December 1 because of less complete data after this point. The purple shaded regions show the model fit for the relative frequency of the variant strain. In all regions the variant is predicted to reach ca. 98% frequency by mid-January, although in reality clusters of other strains are likely to persist for longer than this.
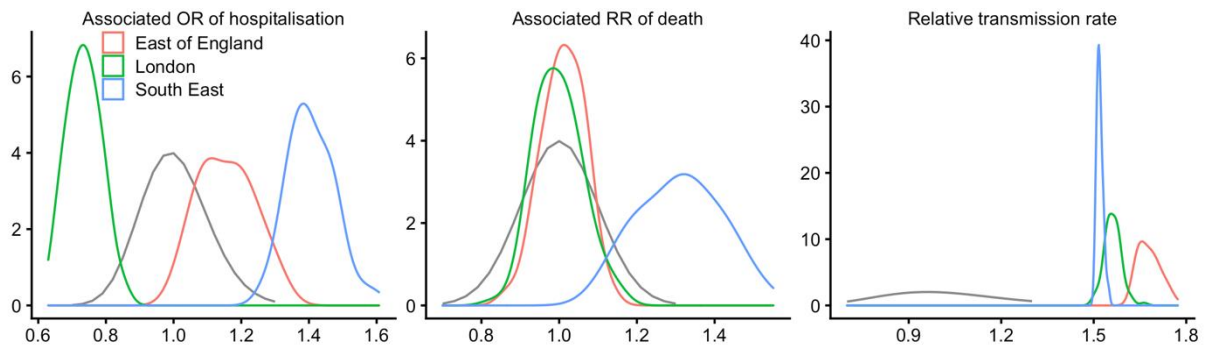

Figure 2. Relative transmission rate, odds ratio of hospitalisation associated with B.1.1.7-N501Y, and relative risk of death associated with B.1.1.7-N501Y. Grey lines show the prior distributions for these inferred parameters. For the severity estimates (relative risk of death and odds ratio of hospitalisation), the average effect close to 1 and divergent impact in different regions may suggest there is little effect on hospitalisations and deaths. Since the strain has emerged only recently, it may be disproportionately represented in younger or older individuals, which complicates estimating the severity due to the strong age gradient in hospitalisation and death due to COVID-19. Note that in the South East, both RR of death and OR of hospitalisation are higher. However, this region also shows the lowest apparent growth rate of the strain. This may indicate that the growth rate of the strain has been underestimated in the South East by the model, and so severity estimates are pulled up artificially as a result.
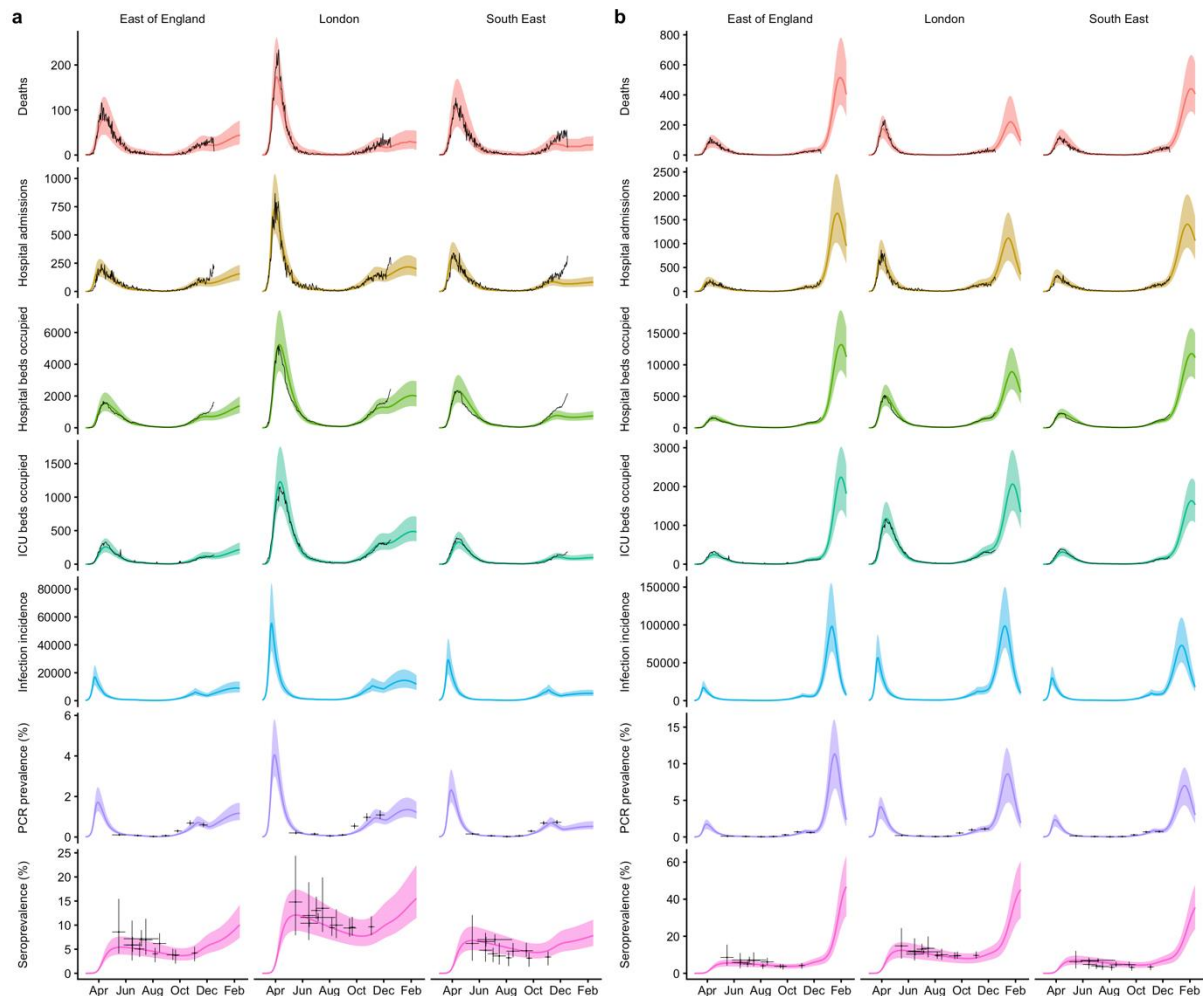
Figure 3. Model fits to deaths, hospital admissions, hospital bed occupancy, ICU bed occupancy, daily incidence (absolute number) of new infections, PCR prevalence of active infection, and seroprevalence with and without introducing the B.1.1.7 N501Y variant. **(a)** Model fit without introducing the variant strain. Note how the model is unable to capture the rise in hospital admissions in these three regions. **(b)** Model fit with the second strain introduced. The magnitude of the first wave is exceeded on all metrics by mid-January. **Note that this projection assumes that no additional control measures are brought in, and mobility patterns remain the same as they were during the week ending December 15, 2020.** Since stronger measures have already been introduced in the three regions since that time, the actual peak under a "status quo" scenario may be lower than illustrated here. We do not capture reactive social distancing or any further policy changes in this figure. Details of the model fit to all regions is given in the Appendix.

Projections

Using a previously described analysis (https://cmmid.github.io/topics/covid19/uk-tiers-2nd-lockdown.html), we simulated the impact of introducing a four-week lockdown starting on December 20 in these three regions. The lockdown was parameterised to match the stringency of the second national lockdown in England (Nov 5–Dec 1, 2020) (**Fig 5**) or to match the stringency of the firebreak in Wales (Oct 2020) (**Fig 6**), as measured by changes to Google Mobility indices for these periods. We also examined keeping schools open versus keeping schools closed during these lockdowns.
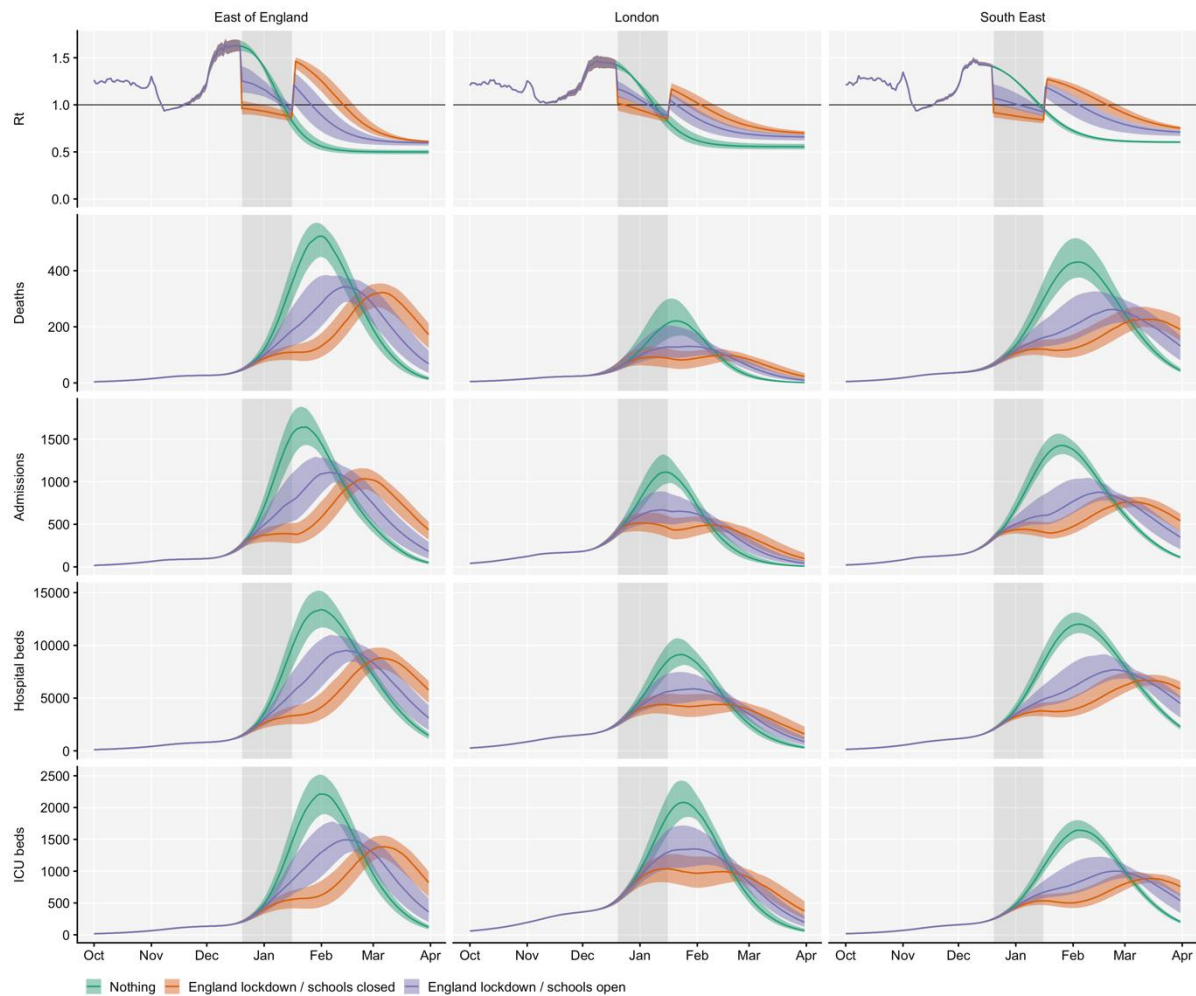
Figure 4. Impact of a four-week lockdown similar to the second national lockdown in England, with or without schools closed, compared to the status quo as of the week ending December 15, 2020.
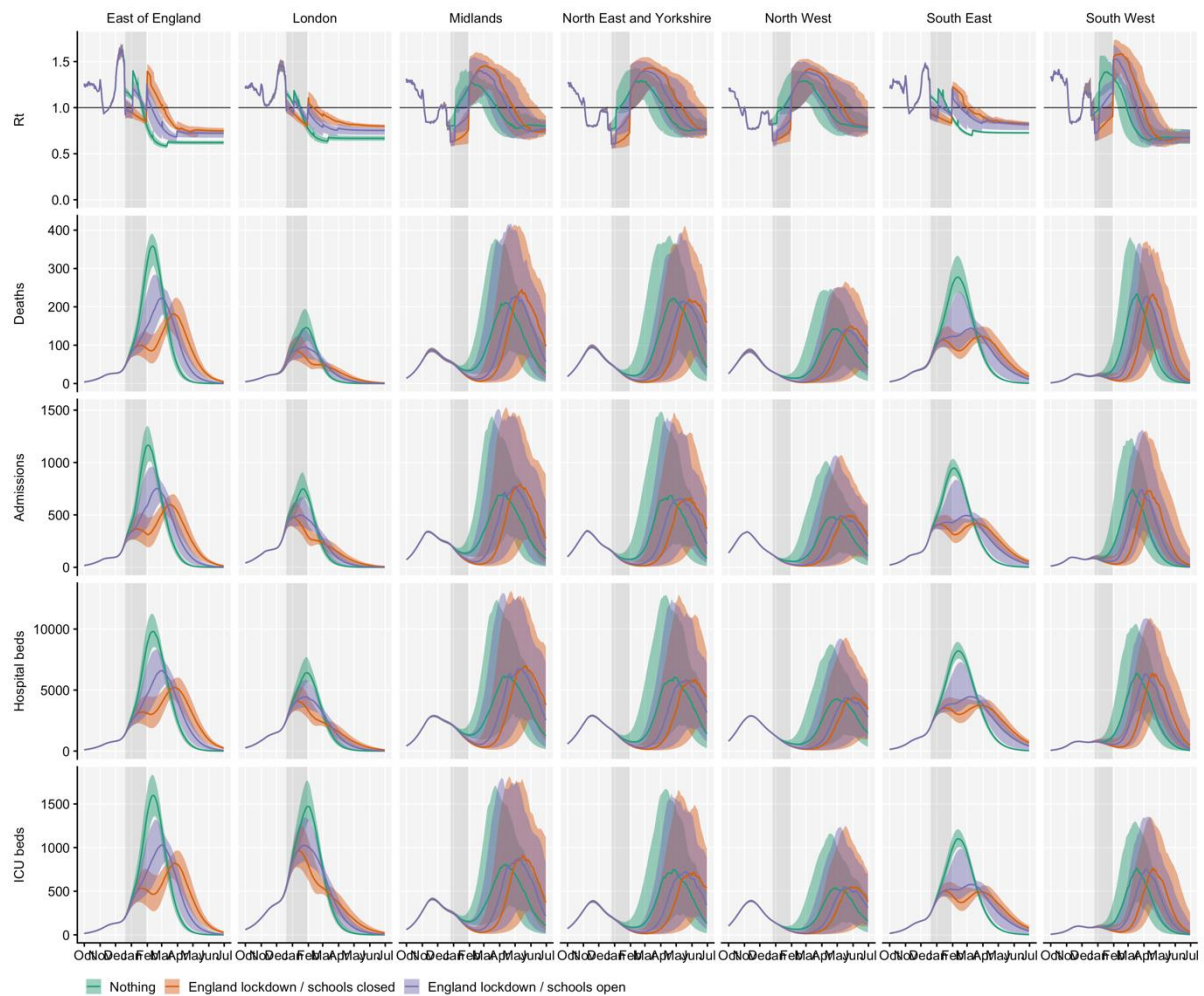
Figure 5: projections for a 4 week November-type lockdown with/without school closures in each of the different regions. Lockdown starts at the beginning of January. For the four regions in which there are few data on the new variant, projections are based on drawing from normal distributions with the same mean and variance for the 3 key parameters (increase in R, odds ratio of hospitalisation and relative risk of death as estimated from data from the other three regions (see Figure 2).
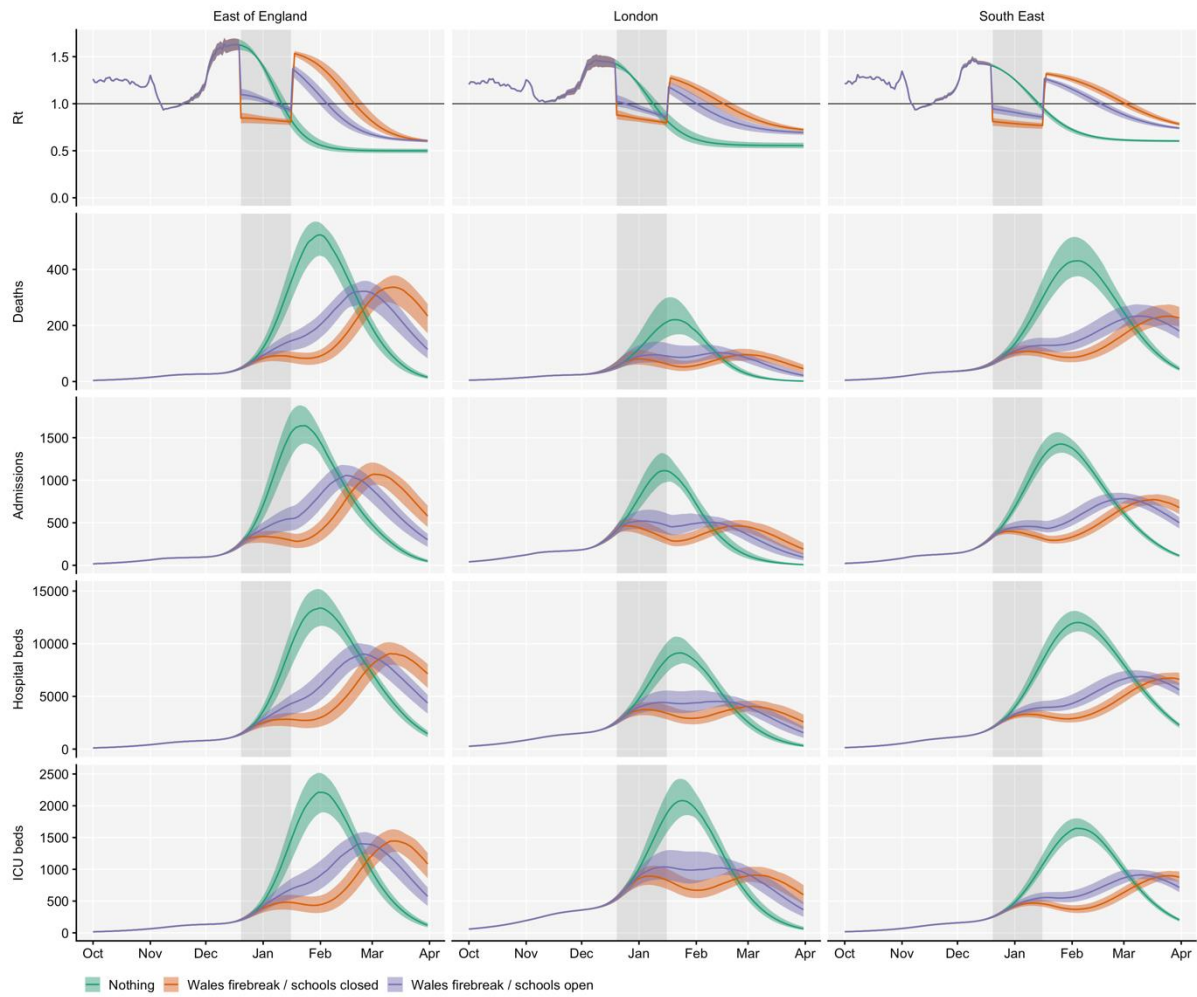
Figure 6. Impact of a four-week lockdown similar to the firebreak in Wales, with or without schools closed, compared to the status quo as of the week ending December 15, 2020.
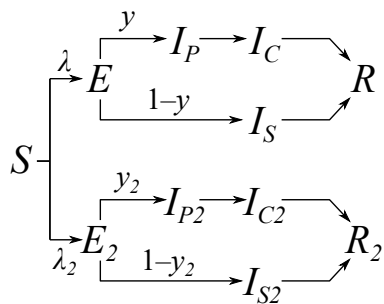

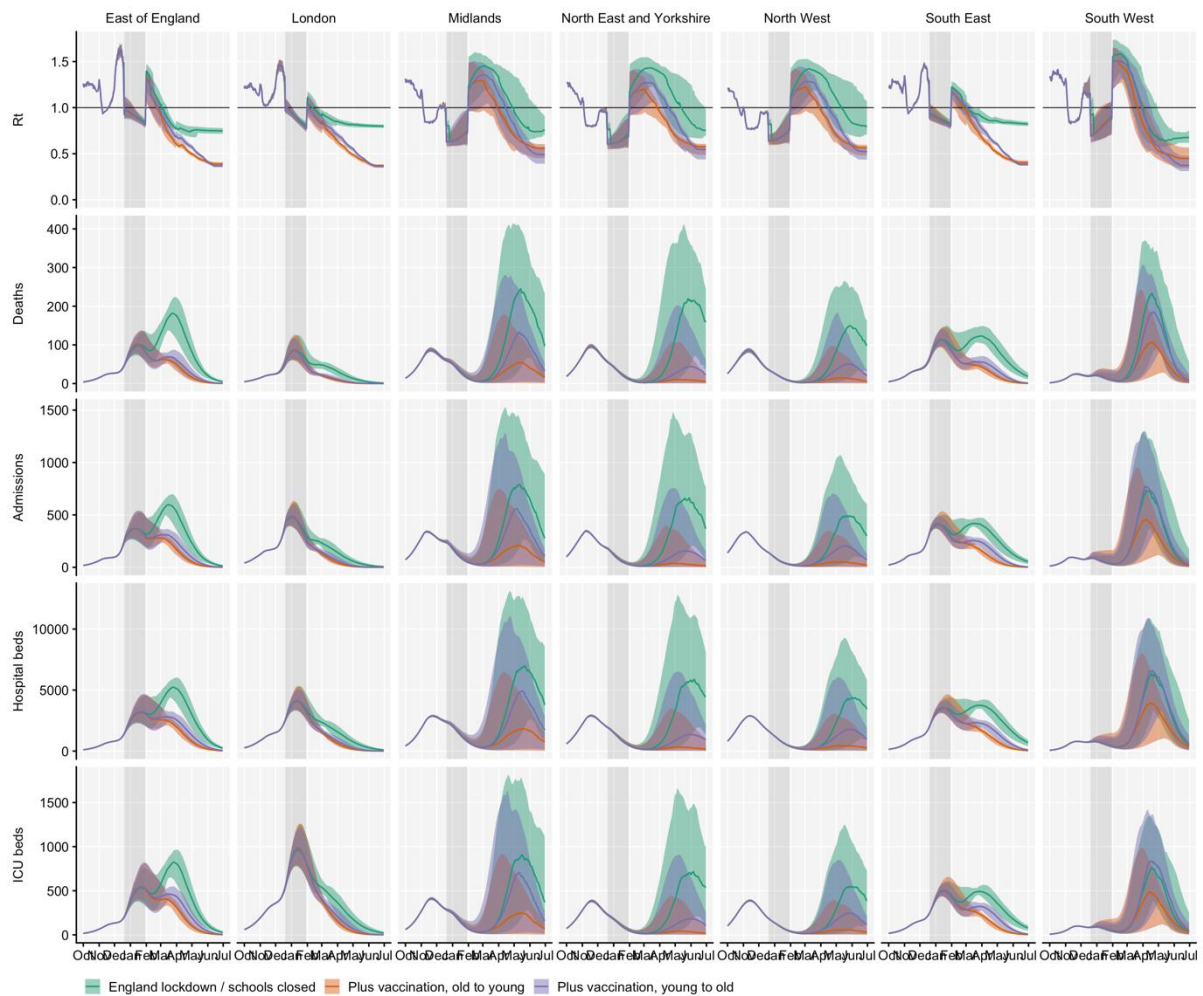**Figure 7.** Diagram of the two-strain model.

Figure 8: Potential impact of vaccination using Pfizer-type vaccine (60% protection against infection, 95% protection against disease). A rapid roll-out of vaccination is assumed (2 million doses per week). Vaccines are first given to the elderly (over 60 years of age) until 85% coverage is reached, and then rolled out either in 5 year decrements of age (55-59, 50-54, etc, orange) or 5 year increments in age (10-14, 15-19, etc, purple) and compared with a no-vaccination scenario (green) in which a lockdown with schools closed is implemented during January.
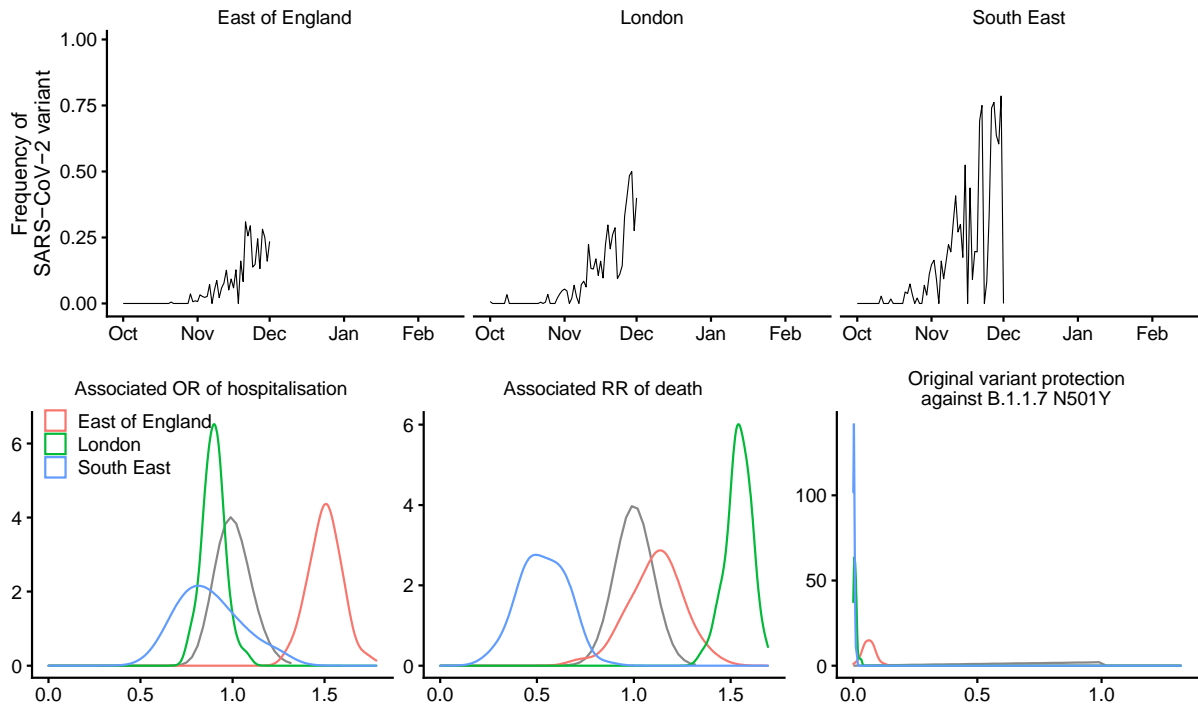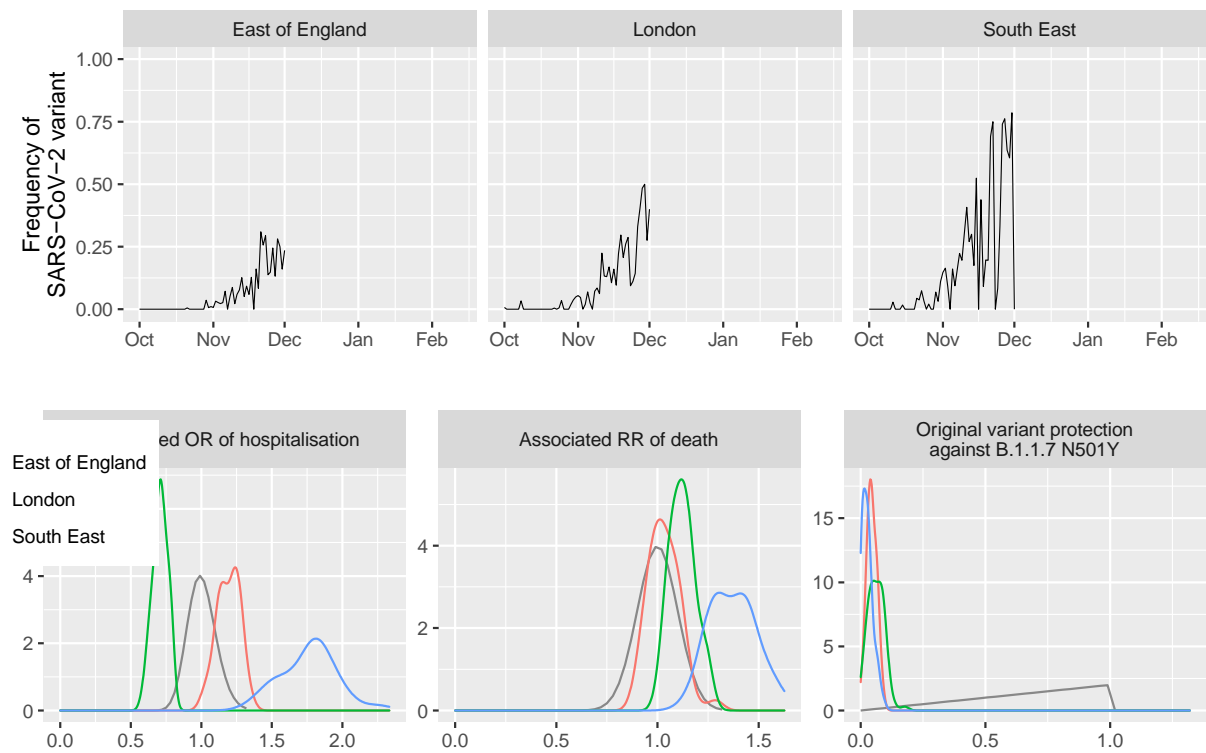
Appendix:

Exploration of alternative hypotheses
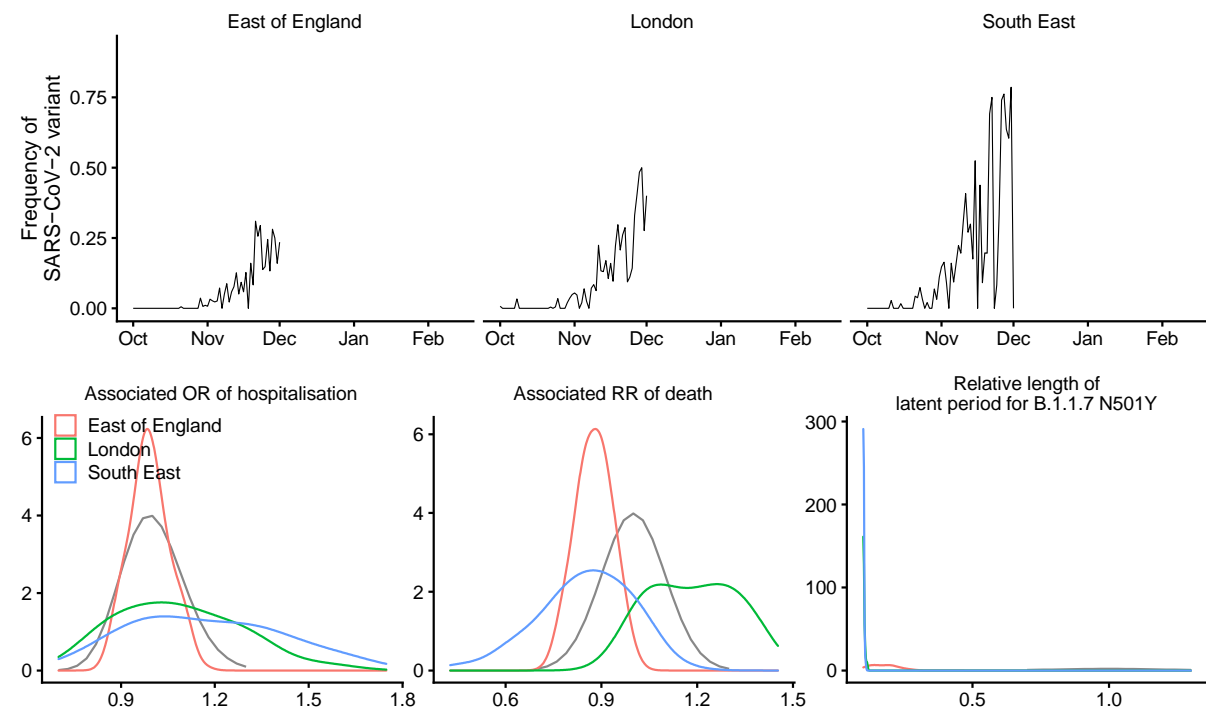
Hypothesis 1, increased R
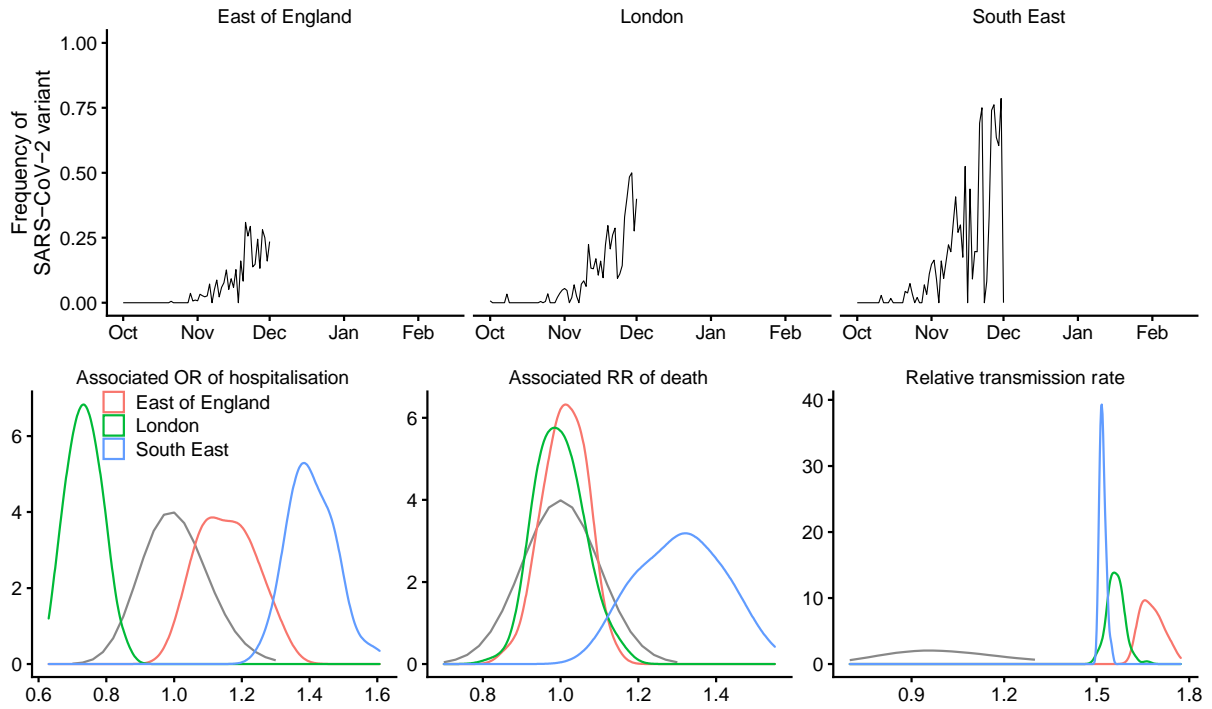
Hypothesis 2, immune escape

Hypothesis 3, immune escape + higher susceptibility in children

Hypothesis 4, shorter latent period

Overall fit to all NHS regions