Situation Report for COVID-19: Brazil, 2022-12-25

Download the report for Brazil, 2022-12-25 here. This report presents two analyses. One using reported COVID-19 related deaths another using positive excess-mortality (December 2019 onwards) as the underlying number of COVID-19 deaths. These numbers are calculated by comparing current mortality to historic trends. These data are then used to back-calculate an 'inferred number of COVID-19 infections' using mathematical modelling techniques (see Methods for further details) to estimate the number of people that have been infected and to make short-term projections for future healthcare needs. Not all countries are able to provide timely estimates of excess mortality, so estimates from the The Economist Excess Deaths Model are harnessed to fill in these gaps. Data on reported deaths and cases are from the COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University. These are updated daily and whilst there may be a short delay, they are generally consistent with Ministry reports.

Epidemiological Situation

Total Reported Cases	Total Reported Deaths	Total Estimated Excess Mortality
36,112,777	692,735	845,326

Dominant Variants of Concern

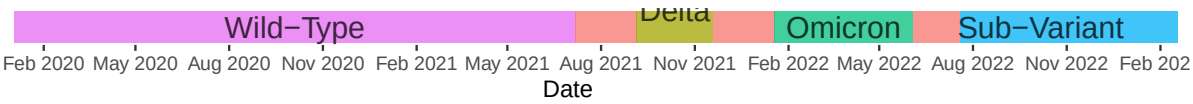

Figure 1: **Timings of the modelled variants.**

This report adjusts for the Delta, Omicron, Omicron Sub-Variant variants. The timings of which are shown in Figure 1. These dates are based upon reported sequencing data from NextStrain and GISAID. For countries with a limited number of recent sequences, these dates are inferred from global or regional trends and should be interpreted with caution.

The figure below shows the cumulative reported deaths as a function of the time since the 10th death was reported. Dashed lines show the expected trajectory for different doubling times of the epidemic. For example, with a doubling time of 3 days, if there are currently a total of 20 deaths reported, we would expect there to be 40 deaths in total reported in 3 days-time, 80 deaths in 6 days-time, 160 deaths in 9 days-time etc. For most epidemics, in the absence of interventions, we expect a doubling time of 3-4 days for this disease.

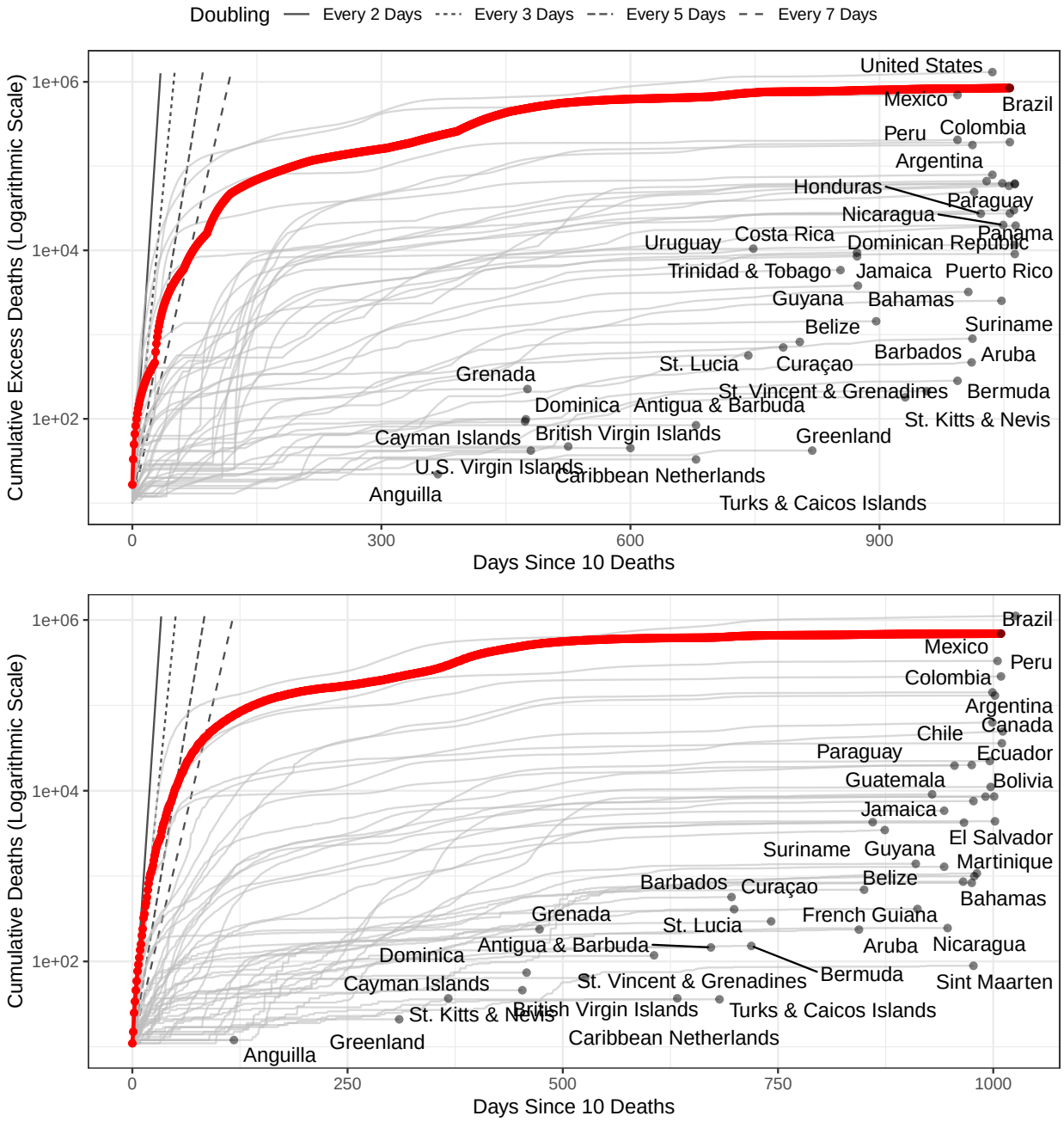

Figure 2: **Cumulative Deaths since 10 deaths.** Country not shown if fewer than 10 deaths.

COVID-19 Transmission Modelling

The figure below shows the estimated number of people infected over the past 4 weeks. The bar charts show, for comparison, the number of reported cases. We estimate that there has been a total of 2,546,732 (95% CI: 2,264,065-2,829,400) (Excess Mortality) or 1,624,046 (95% CI: 1,430,632-1,817,461) (Reported Deaths) infections over the past 4 weeks. The right-hand plot shows these data on a different scale as the estimated infections are likely to be much larger than the reported cases. **Importantly**, the estimated infections includes both asymptomatic and mild cases that would not necessarily be identified through surveillance. Consequently, the estimated infections are likely to be significantly higher than the reported cases in all countries (see our FAQ for further explanation of these differences and why the reported cases and estimated infections are unlikely to match).

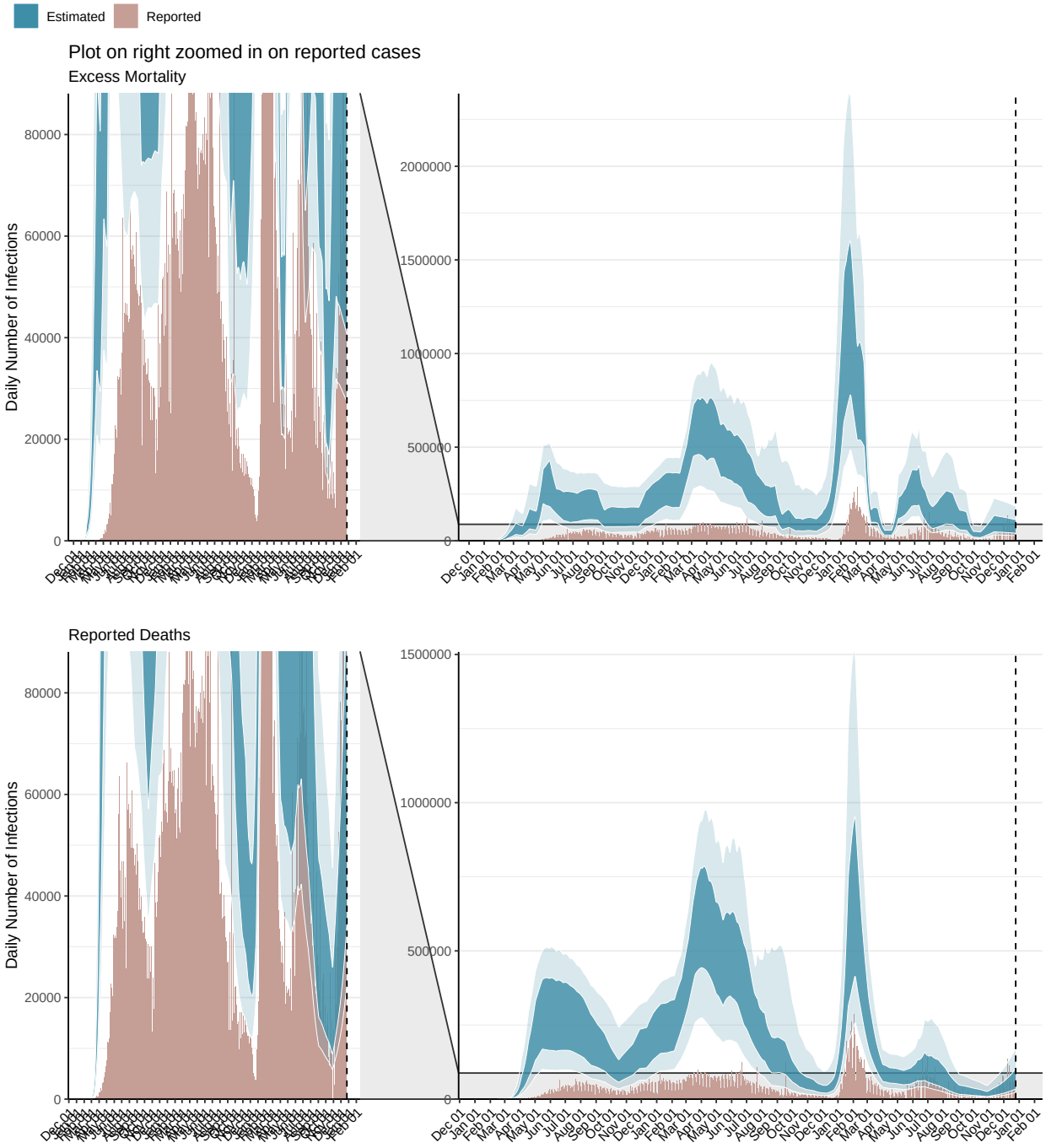

Figure 3: **Daily number of infections estimated by fitting to the current total of deaths.** Reported cases are shown in red. Model estimated infections are shown in blue (dark blue 50% interquartile range, light blue 95% quantile). The dashed line shows the current day.

By fitting to the time series of deaths, we are able to estimate a time-varying reproduction number, R_{eff}. R_{eff} is the the average number of secondary infections caused by a single infected person at a given time. If R_{eff} is above 1, the rate of transmission is increasing and the number of new infections is increasing. R_{eff} is assumed to change proportionally to mobility. By fitting our model to excess mortality we aim to account for under-ascertainment of COVID-19 related deaths (please see our FAQ section for more information about this approach).

For sub-national estimates of R_t, and further analysis of Brazil, please see Report 21

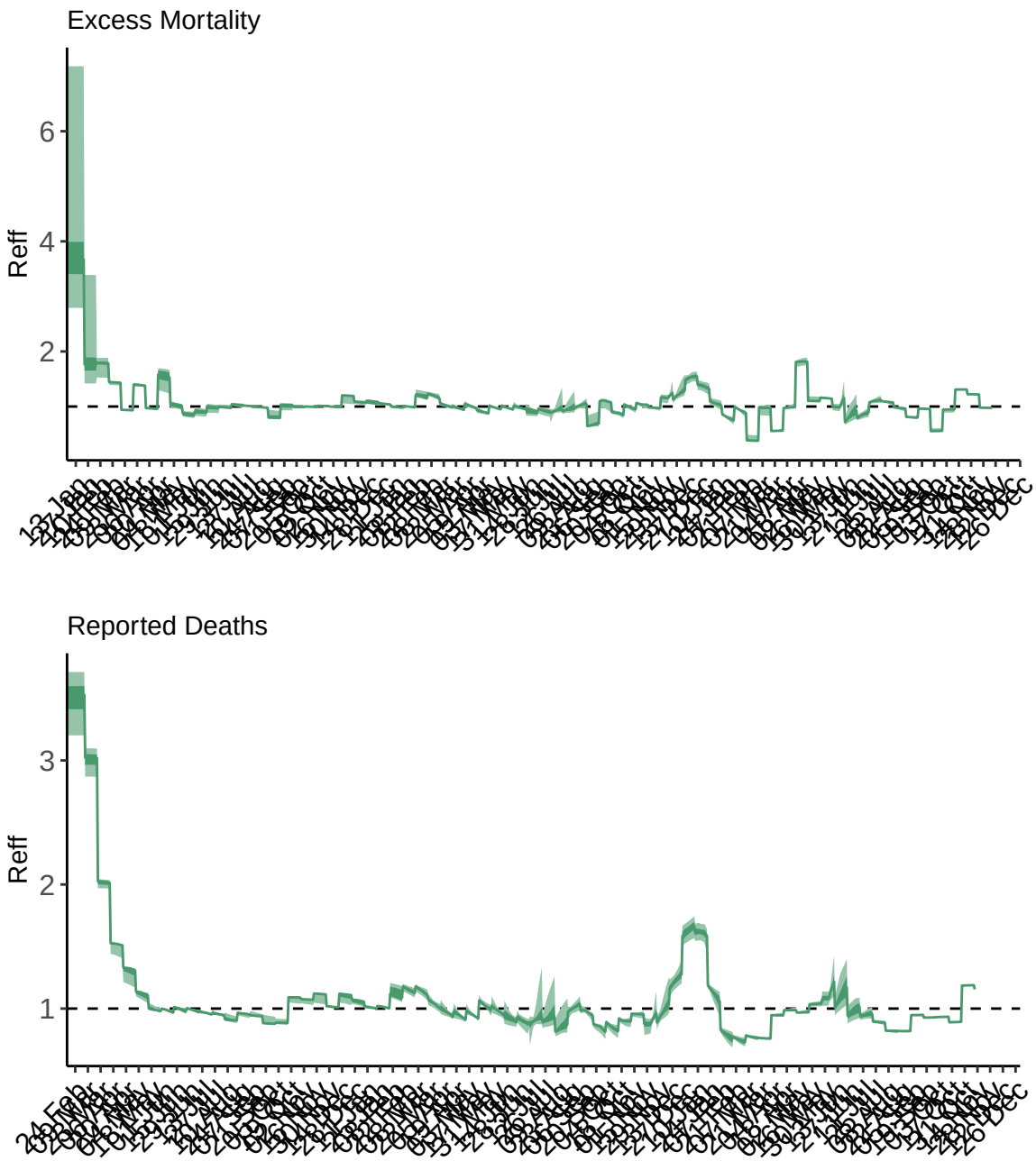

Figure 4: **Time-varying effective reproduction number,** R_{eff}**.** R_{eff} (**green**) is the average number of secondary infections caused by a single infected person at time equal to t. A horizonatal dashed line is shown at $R_{eff} = 1$. $R_{eff} < 1$ indicates a slowing epidemic in which new infections are not increasing. $R_{eff} > 1$ indicates a growing epidemic in which new infections are increasing over time. Dark green shows the 50% CI and light green shows the 95% CI

Using the model fit, we can forecast the expected trajectory for cumulative deaths assuming the transmission level, represented by the final R_t value stays the same over the next 28 days. **N.B. Brazil is forecast to be close to or surpassing our best estimates for healthcare capacity in the next 28 days.** Estimates of deaths in the next 28 days may be inaccurate due to our working assumptions for mortality in individuals who do not receive appropriate treatment. See our methods for more information.

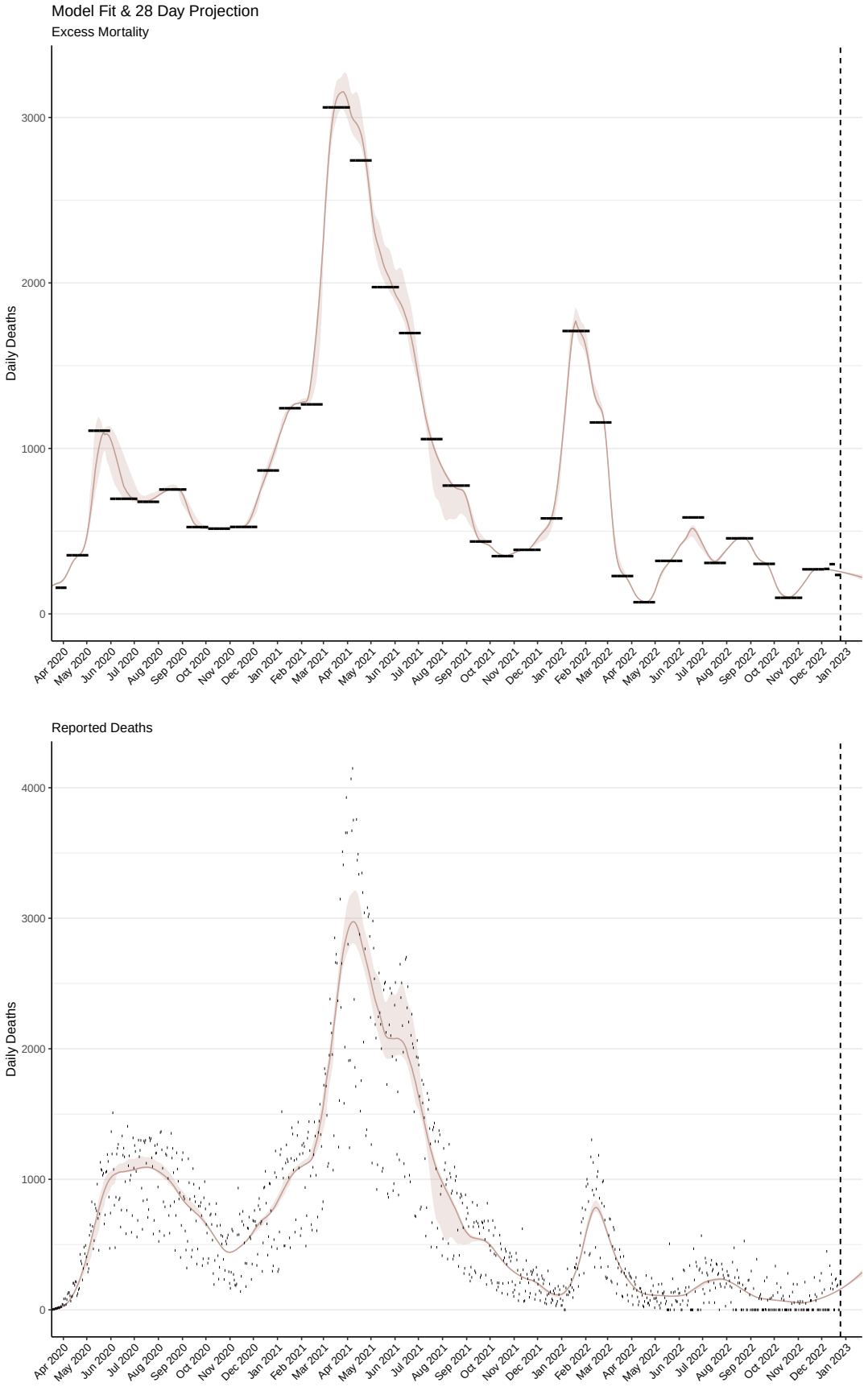

Figure 5: **Estimated daily deaths.** Projected deaths assuming the current level of interventions are maintained are shown in red (median and 95% quantile). Excess mortality is plotted in black. Includes a forecast of the next 28 days.

Short-term Epidemic Scenario

The following scenario does not account for future VoC and assumes the current VoC (based on sequence data) remains dominant.

We include a short-term projections of healthcare demand, new infections, and detected infections given that the R_t number does not change.

We estimate that over the next 4 weeks demand for hospital beds will change from 4,693 (95% CI: 4,034-5,352) (Excess Mortality) or 3,079 (95% CI: 2,646-3,511) (Reported Deaths) patients requiring treatment with high-pressure oxygen at the current date to 3,972 (95% CI: 3,435-4,510) (Excess Mortality) or 5,372 (95% CI: 4,660-6,083) (Reported Deaths) hospital beds being required on 2023-01-22 if no further interventions are introduced (Scenario 1). Similarly, we estimate that over the next 4 weeks demand for critical care (ICU) beds will change from 1,846 (95% CI: 1,635-2,058) (Excess Mortality) or 1,185 (95% CI: 1,051-1,319) (Reported Deaths) patients requiring treatment with mechanical ventilation at the current date to 1,574 (95% CI: 1,405-1,743) (Excess Mortality) or 2,087 (95% CI: 1,876-2,298) (Reported Deaths) by 2023-01-22. These projections are dependant on the chosen age-dependant hospitalisation rates (see Methods). **N.B. This scenario is unlikely to show significant differences for the first week since there is a delay of approximately 10 days between infection and hospital admission. Consequently, the effectiveness of a change in policy is likely to be better captured by hospital admission data approximately 2 weeks after the policy change is implemented.**

The impact of each scenario has a more immediate effect on the daily number of infections. The figure below shows the impact of each scenario on the estimated daily incidence of new infections. We estimate that if the underlying R_t of the virus remains the same the daily number of infections will change from 84,804 (95% CI: 75,577-94,031) (Excess Mortality) or 76,301 (95% CI: 67,422-85,180) (Reported Deaths) at the current date to 70,191 (95% CI: 63,015-77,368) (Excess Mortality) or 126,147 (95% CI: 113,181-139,113) (Reported Deaths) by 2023-01-22.

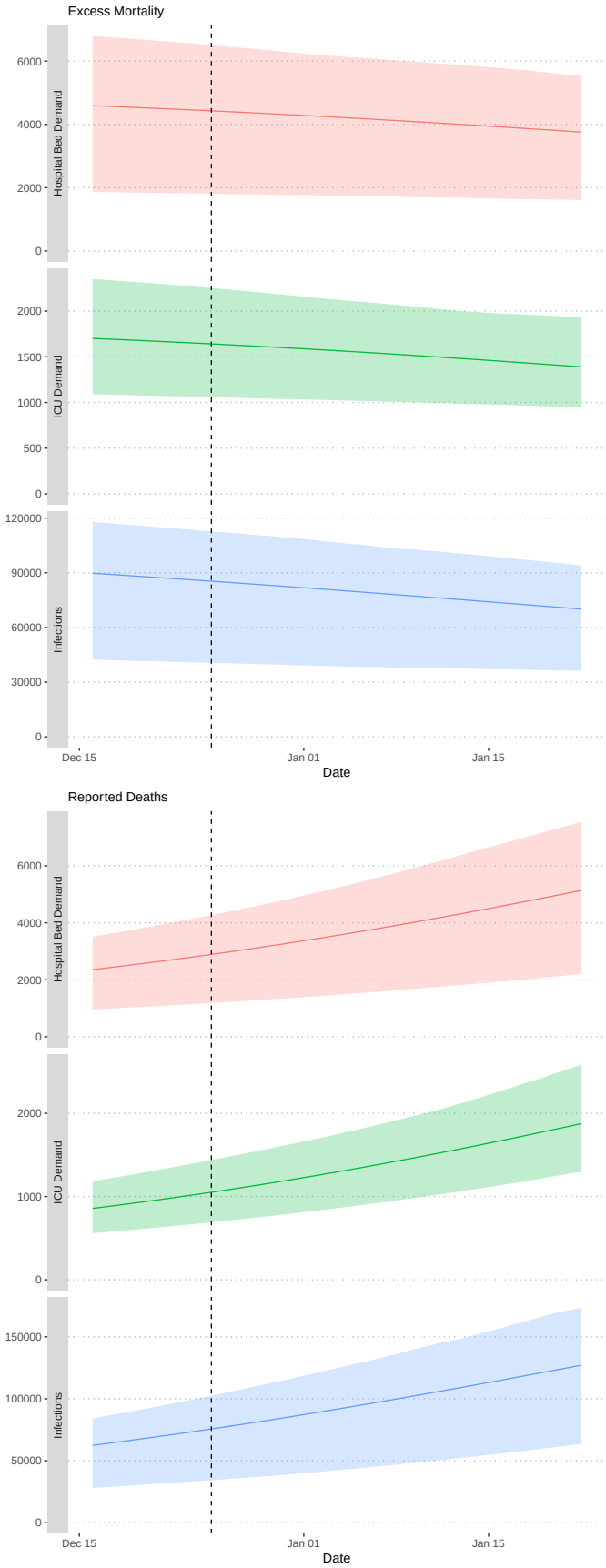

Figure 6: **Scenario projection for the next 28 days.** Individuals needing an ICU bed are assumed to need mechanical ventilation. **