COVID-19 Results Briefing

Brazil

May 21, 2021

This document contains summary information on the latest projections from the IHME model on COVID-19 in Brazil. The model was run on May 19, 2021 with data through May 17, 2021.

Current situation

- Daily reported cases in the last week decreased to 58,300 per day on average compared to 59,100 the week before (Figure 1).
- Daily deaths in the last week decreased to 2,600 per day on average compared to 2,900 the week before (Figure 2). This makes COVID-19 the number 1 cause of death in Brazil this week (Table 1).
- The daily death rate is greater than 4 per million in 27 states (Figure 3).
- We estimated that 35% of people in Brazil have been infected as of May 17 (Figure 5).
- Effective R, computed using cases, hospitalizations, and deaths, is greater than 1 in 19 states (Figure 6).
- The infection detection rate in Brazil is close to 28% on May 17 (Figure 7).

Trends in drivers of transmission

- Mobility last week was 20% lower than the pre-COVID-19 baseline (Figure 10). Mobility was near baseline (within 10%) in Acre, Amapá, Maranhão, Pará, and Rondônia. Mobility was lower than 30% of baseline in Sergipe.
- As of May 17 we estimated that 68% of people always wore a mask when leaving their home compared to 68% last week (Figure 12). Mask use was lower than 50% in no states.
- There were 62 diagnostic tests per 100,000 people on May 17 (Figure 14).
- In Brazil 90.8% of people say they would accept or would probably accept a vaccine for COVID-19. This is up by 0.2 percentage points from last week. The fraction of the population who are open to receiving a COVID-19 vaccine ranges from 76% in Roraima to 93% in São Paulo (Figure 18).
- In our current reference scenario, we expect that 153.46 million people will be vaccinated by September 1 (Figure 19).

Projections

- In our **reference scenario**, which represents what we think is most likely to happen, our model projects 847,000 cumulative deaths on September 1, 2021. This represents 212,000 additional deaths from May 17 to September 1 (Figure 20). Daily deaths are expected to decline steadily until September 1 (Figure 21).
- If **universal mask coverage (95%)** were attained in the next week, our model projects 53,000 fewer cumulative deaths compared to the reference scenario on September 1, 2021 (Figure 20).
- Under our **worse scenario**, our model projects 959,000 cumulative deaths on September 1, 2021, an additional 112,000 deaths compared to our reference scenario (Figure 20).
- By September 1, we project that 92,500 lives will be saved by the projected vaccine rollout.
- Figure 23 compares our reference scenario forecasts to other publicly archived models. Forecasts are widely divergent.
- At some point from May through September 1, 16 states will have high or extreme stress on hospital beds (Figure 24). At some point from May through September 1, 25 states will have high or extreme stress on ICU capacity (Figure 25).

Model updates

In the IHME estimation of COVID-19 infections, hospitalizations, and deaths to date, we have used officially reported COVID-19 deaths for nearly all locations. As of the week of May 3rd, we have switched to a new approach that relies on the estimation of total mortality due to COVID-19. There are several reasons that have led us to adopt this new approach. These reasons include the fact that testing capacity varies markedly across countries and within countries over time, which means that the reported COVID-19 deaths as a proportion of all deaths due to COVID-19 also vary markedly across countries and within countries over time. In addition, in many high-income countries, deaths from COVID-19 in older individuals, especially in long-term care facilities, went unrecorded in the first few months of the pandemic. In other countries, such as Ecuador, Peru, and the Russian Federation, the discrepancy between reported deaths and analyses of death rates compared to expected death rates, sometimes referred to as "excess mortality," suggests that the total COVID-19 death rate is many multiples larger than official reports. Estimating the total COVID-19 death rate is important both for modeling the transmission dynamics of the disease to make better forecasts, and also for understanding the drivers of larger and smaller epidemics across different countries.

Our approach to estimating the total COVID-19 death rate is based on measurement of the excess death rate during the pandemic week by week compared to what would have been expected based on past trends and seasonality. However, the excess death rate does not equal the total COVID-19 death rate. Excess mortality is influenced by six drivers of all-cause mortality that relate to the pandemic and the social distancing mandates that came with the pandemic. These six drivers are: a) the total COVID-19 death rate, that is, all deaths directly related to COVID-19 infection; b) the increase in mortality due to needed health care being delayed or deferred during the pandemic; c) the increase in mortality due to increases in mental health disorders including depression, increased alcohol use, and increased opioid use; d) the reduction in mortality due to decreases in injuries because of general reductions in mobility associated with social distancing mandates; e) the reductions in mortality due to reduced transmission of other viruses, most notably influenza, respiratory syncytial virus, and measles; and f) the reductions in mortality due to some chronic conditions, such as cardiovascular disease and chronic respiratory disease, that occur when frail individuals who would have died from these conditions died earlier from COVID-19 instead. To correctly estimate the total COVID-19 mortality, we need to take into account all six of these drivers of change in mortality that have happened since the onset of the pandemic.

Our analysis follows four key steps. First, for all locations where weekly or monthly all-cause mortality has been reported since the start of the pandemic, we estimate how much mortality increased compared to the expected death rate. In other words, we estimate excess mortality in all locations with sufficient data. Second, based on a range of studies and consideration of other evidence, we estimate the fraction of excess mortality that is from total COVID-19 deaths as opposed to the five other drivers that influence excess mortality. Third, we build a statistical model that predicts the weekly ratio of total COVID-19 deaths to reported COVID-19 deaths based on covariates and spatial effects. Fourth, we use this statistical relationship to predict the ratio of total to reported COVID-19 deaths in places without data on total COVID-19 deaths and then multiply the reported COVID-19 deaths by this ratio to generate estimates of total COVID-19 deaths for all locations.

Figure 1. Reported daily COVID-19 cases

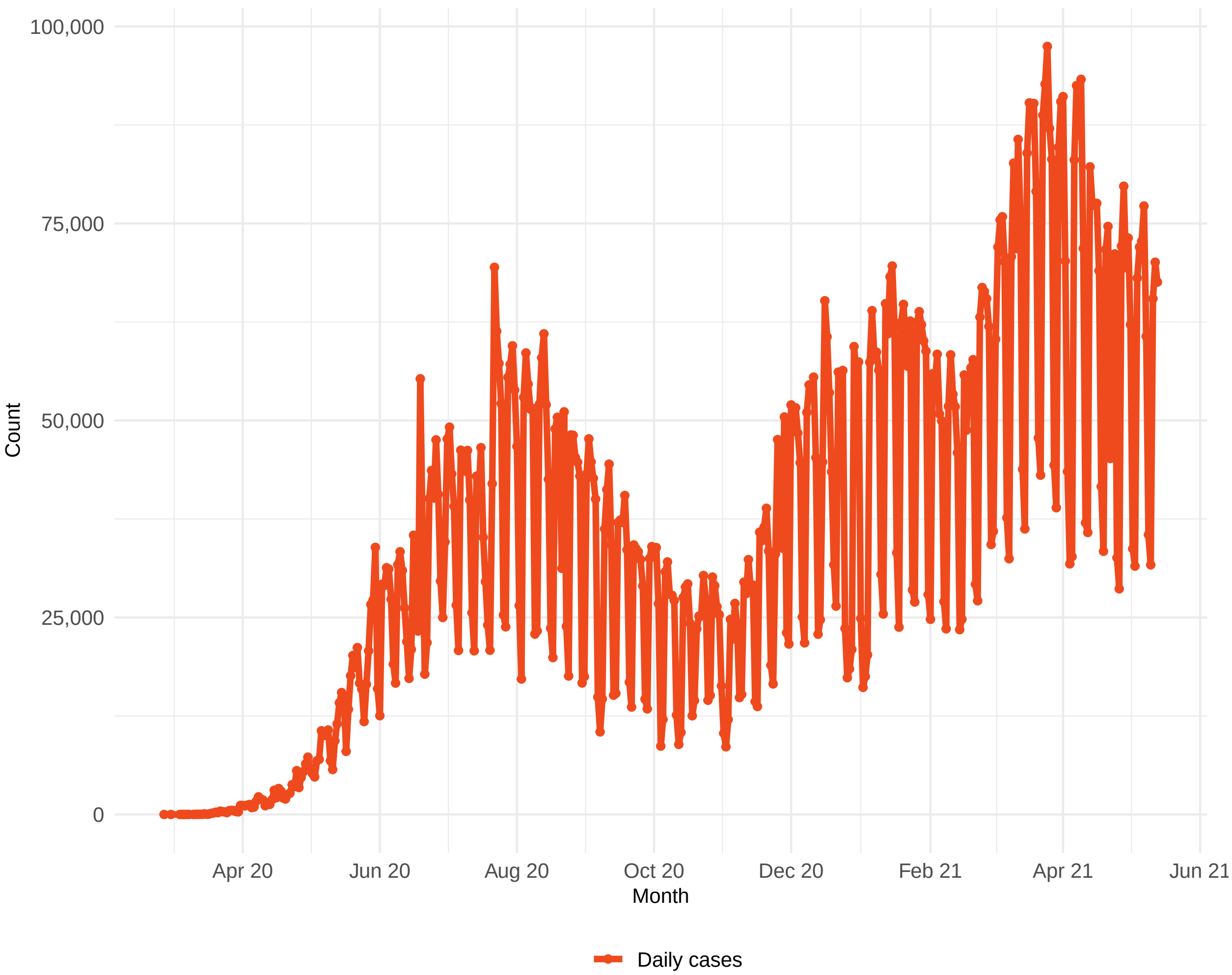


Table 1. Ranking of COVID-19 among the leading causes of mortality this week, assuming uniform deaths of non-COVID causes throughout the year

Cause name	Weekly deaths	Ranking
COVID-19	18,042	1
Ischemic heart disease	3,293	2
Stroke	2,519	3
Lower respiratory infections	1,705	4
Chronic obstructive pulmonary disease	1,321	5
Interpersonal violence	1,267	6
Diabetes mellitus	1,257	7
Alzheimer's disease and other dementias	1,050	8
Road injuries	856	9
Chronic kidney disease	814	10

Figure 2. Smoothed trend estimate of reported daily COVID-19 deaths (blue) and total daily COVID-19 deaths (orange).

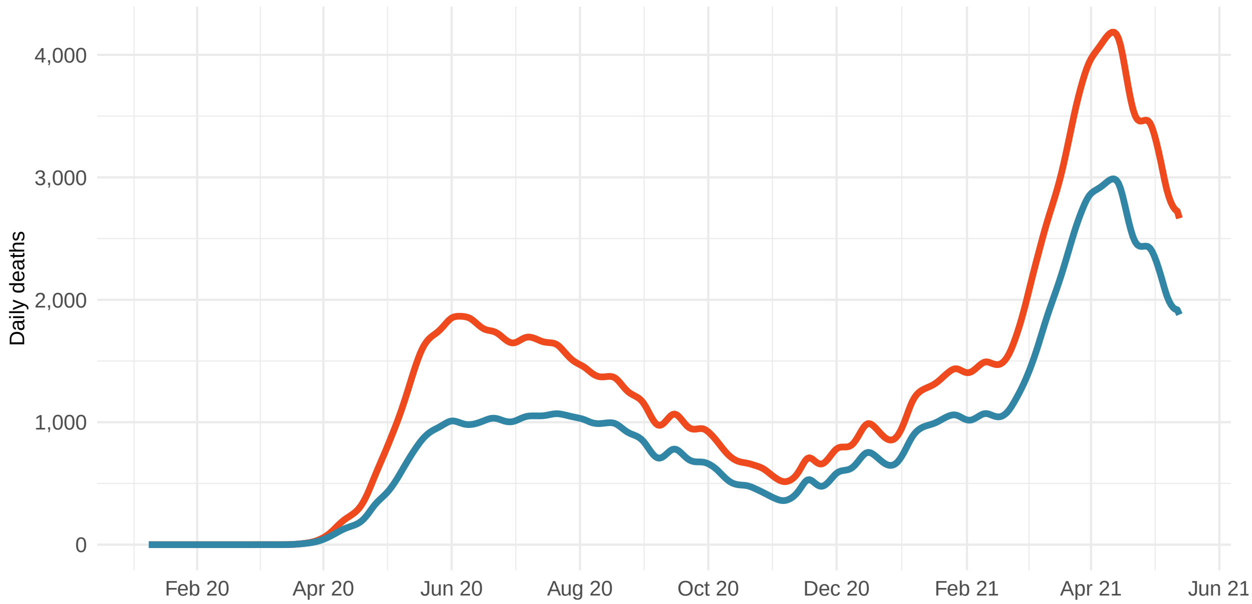


Figure 3. Daily COVID-19 death rate per 1 million on May 17, 2021

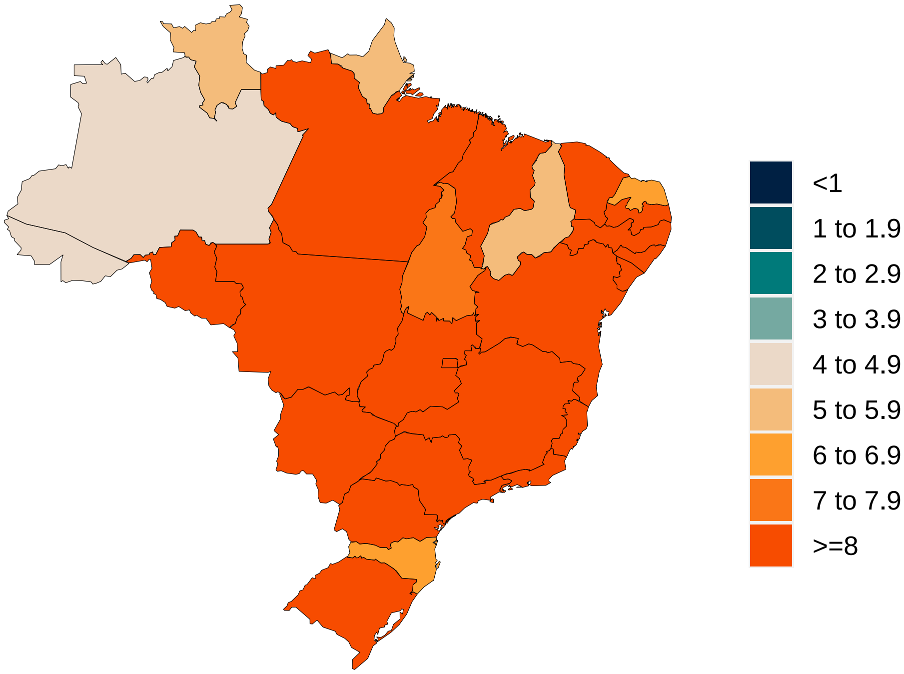


Figure 4. Cumulative COVID-19 deaths per 100,000 on May 17, 2021

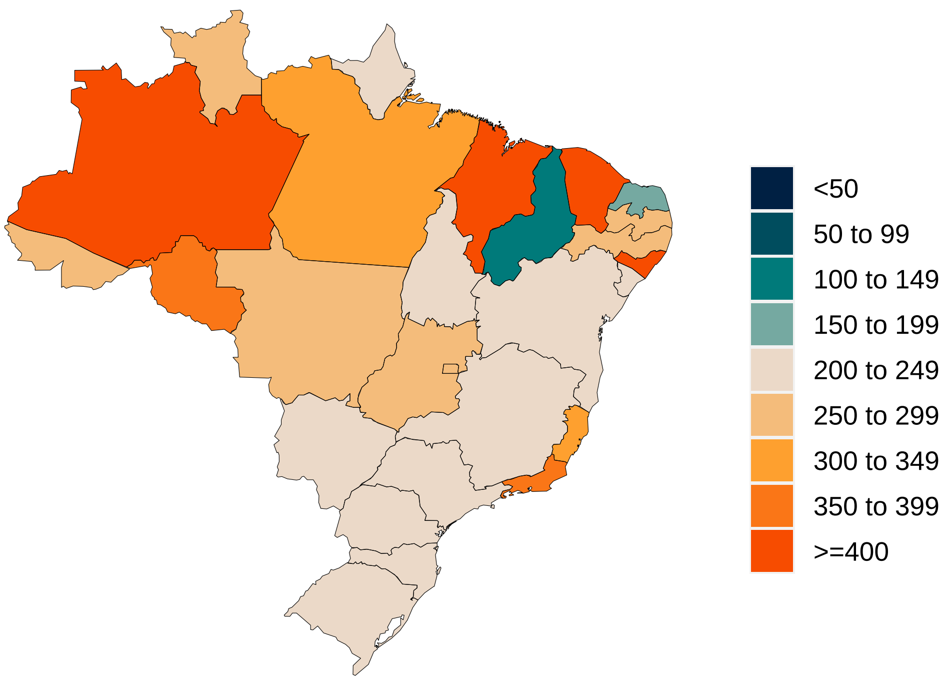


Figure 5. Estimated percent of the population infected with COVID-19 on May 17, 2021

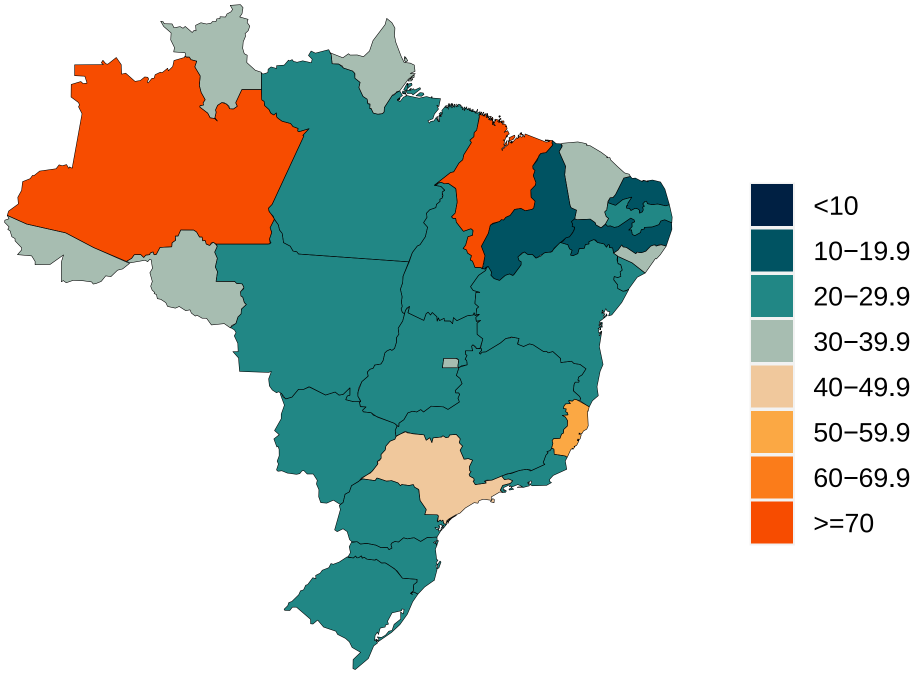


Figure 6. Mean effective R on May 06, 2021. The estimate of effective R is based on the combined analysis of deaths, case reporting, and hospitalizations where available. Current reported cases reflect infections 11-13 days prior, so estimates of effective R can only be made for the recent past. Effective R less than 1 means that transmission should decline, all other things being held the same.

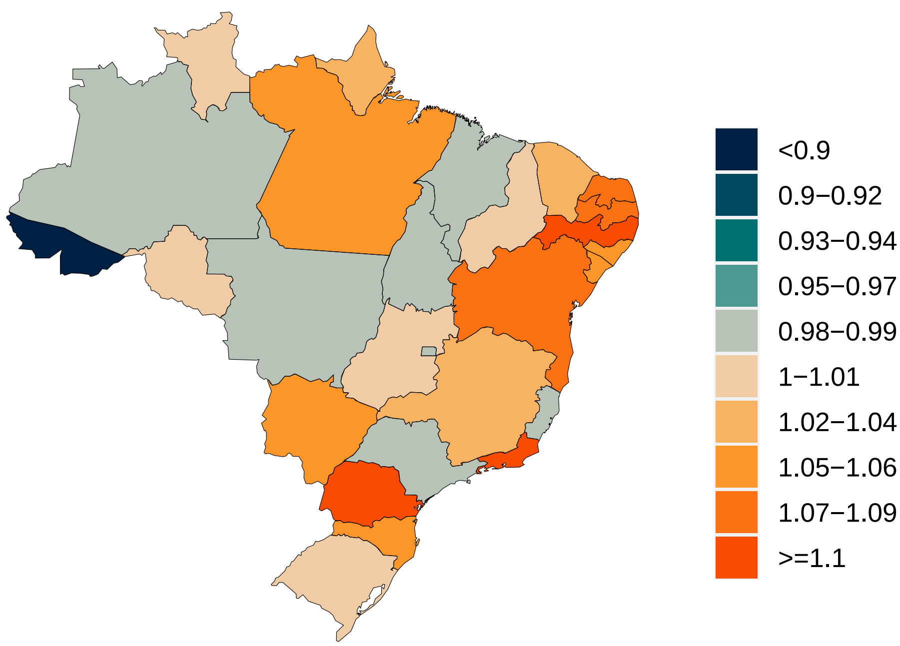


Figure 7. Percent of COVID-19 infections detected. This is estimated as the ratio of reported daily COVID-19 cases to estimated daily COVID-19 infections based on the SEIR disease transmission model.

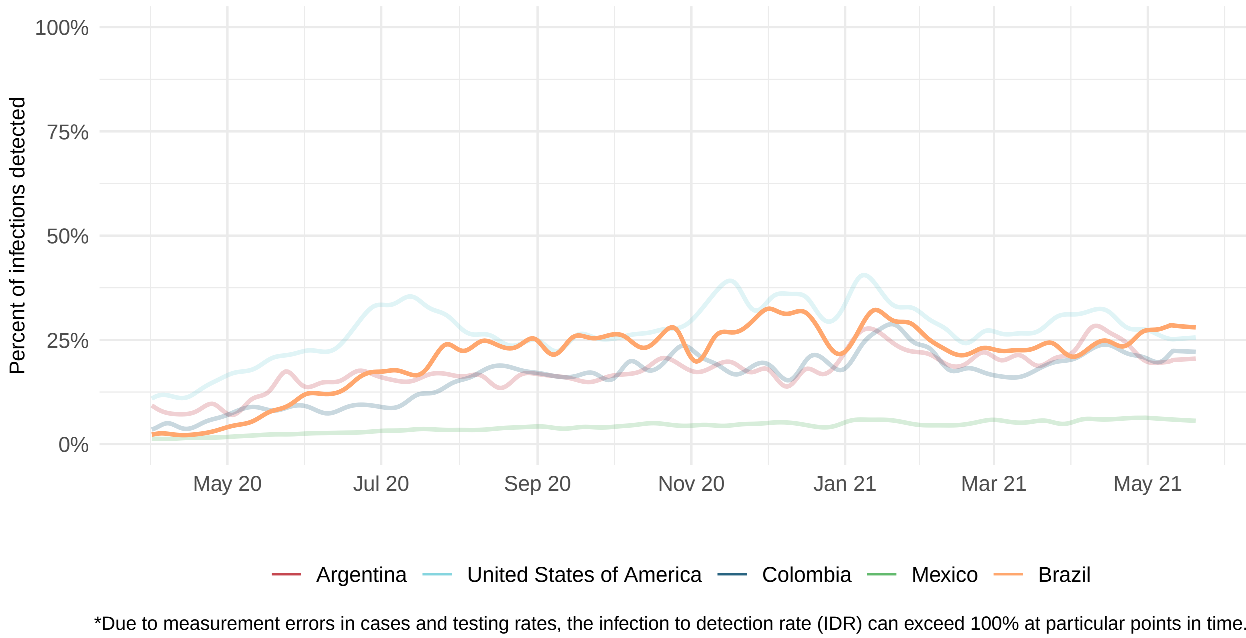
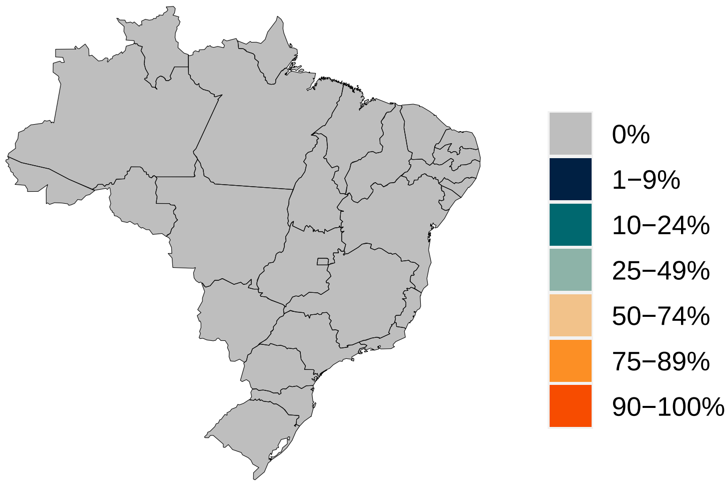
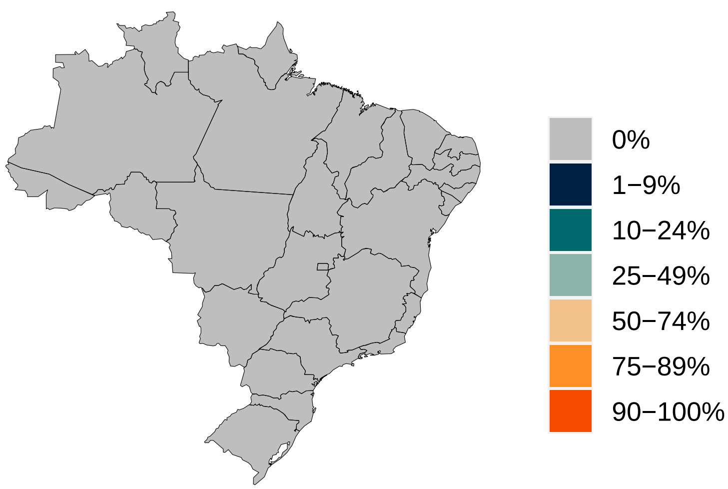


Figure 8. Estimated percent of circulating SARS-CoV-2 for 3 primary variants on May 17, 2021.

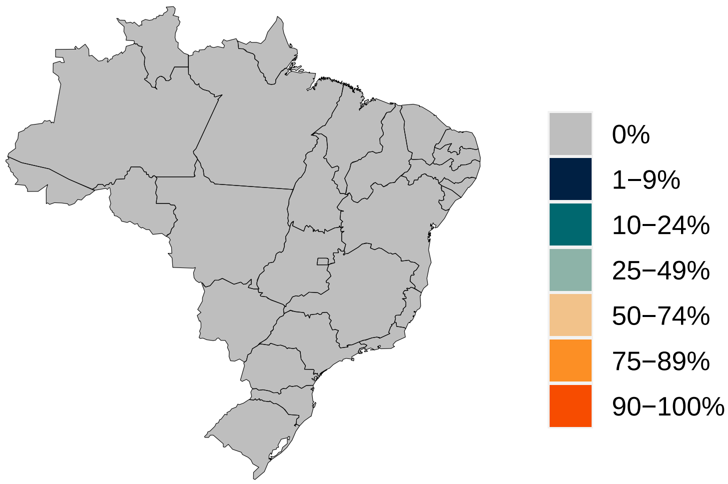
A. Estimated percent B.1.1.7 variant



B. Estimated percent B.1.351 variant



C. Estimated percent B.1.617 variant



D. Estimated percent P.1 or P.3 variant

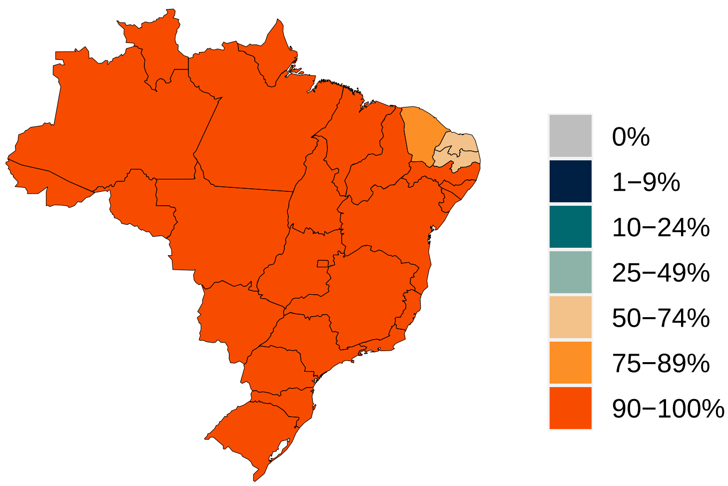
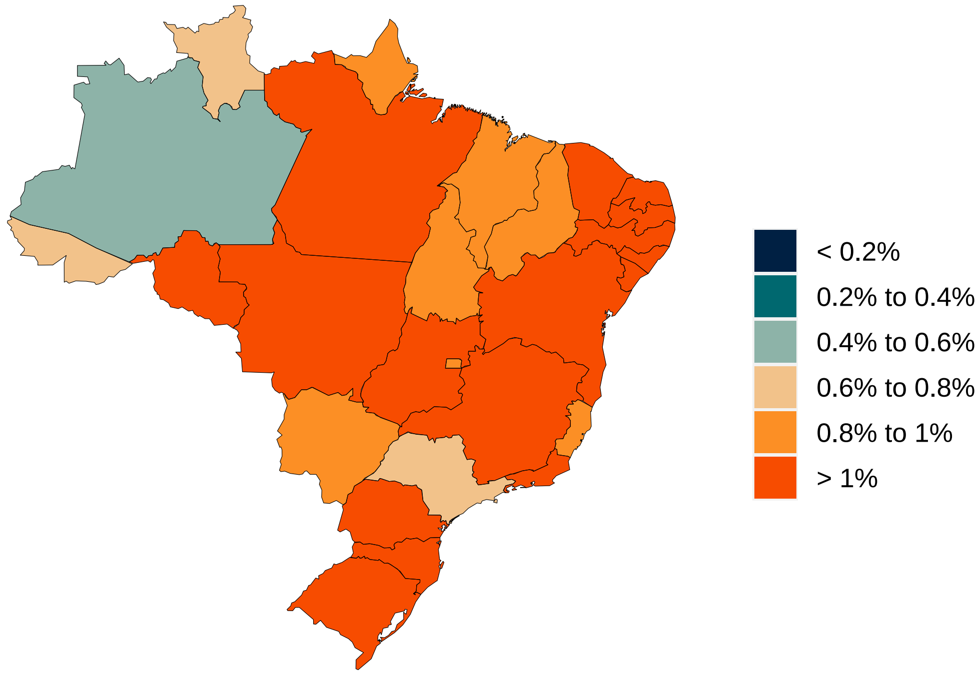


Figure 9. Infection fatality ratio on May 17, 2021. This is estimated as the ratio of COVID-19 deaths to infections based on the SEIR disease transmission model.



Critical drivers

Table 2. Current mandate implementation

	All nonessential businesses closed	Any businesses restricted	Any gatherings restricted	Mask use	School closure	Stay home order	Travel limits
Acre	No mandate	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate	No mandate
Alagoas	Mandate in place	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Amapá	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate (lifted this week)	No mandate
Amazonas	Mandate in place	Mandate in place	Mandate in place	Mandate in place	Mandate in place	Mandate in place	Mandate in place
Bahia	No mandate	No mandate	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Ceará	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate
Distrito Federal	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Espírito Santo	Mandate in place	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Goiás	No mandate	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate	No mandate
Maranhão	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Mato Grosso	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate (lifted this week)	No mandate
Mato Grosso do Sul	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Minas Gerais	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Paraná	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Paraíba	No mandate	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate	No mandate
Pará	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Pernambuco	No mandate	Mandate in place	No mandate	Mandate in place	Mandate in place	No mandate	No mandate
Piaui	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Rio Grande do Norte	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Rio Grande do Sul	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Rio de Janeiro	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate (lifted this week)	No mandate
Rondônia	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Roraima	Mandate in place	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Santa Catarina	No mandate	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate	No mandate
Sergipe	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
São Paulo	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Tocantins	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate	No mandate

Mandate in place
Mandate in place (imposed this week)
No mandate
No mandate (lifted this week)

*Not all locations are measured at the subnational level.

Figure 10. Trend in mobility as measured through smartphone app use compared to January 2020 baseline

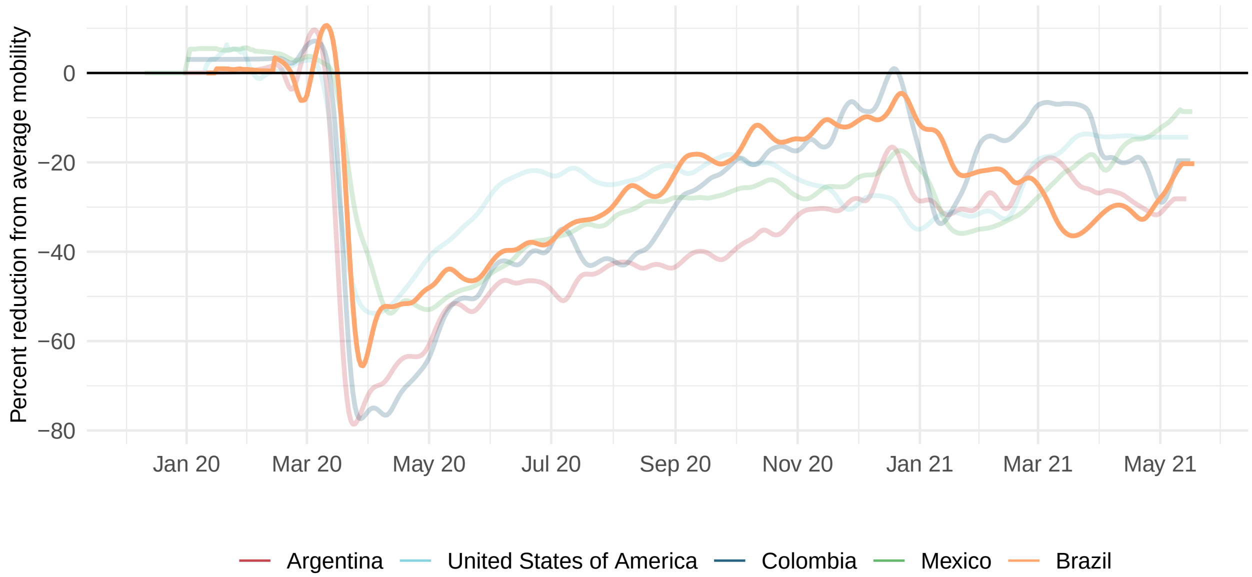


Figure 11. Mobility level as measured through smartphone app use compared to January 2020 baseline (percent) on May 17, 2021

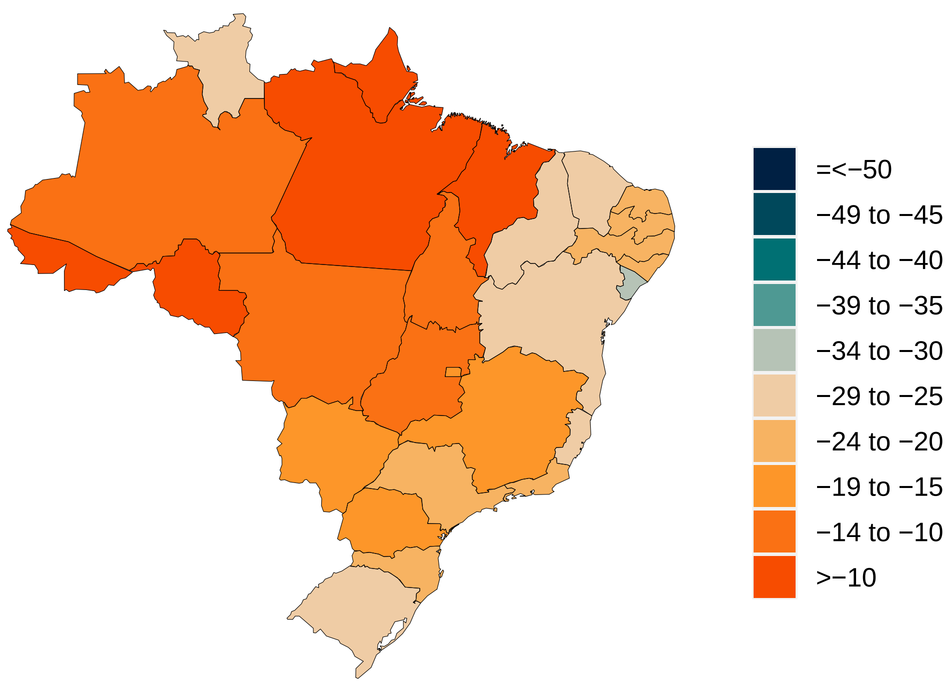


Figure 12. Trend in the proportion of the population reporting always wearing a mask when leaving home

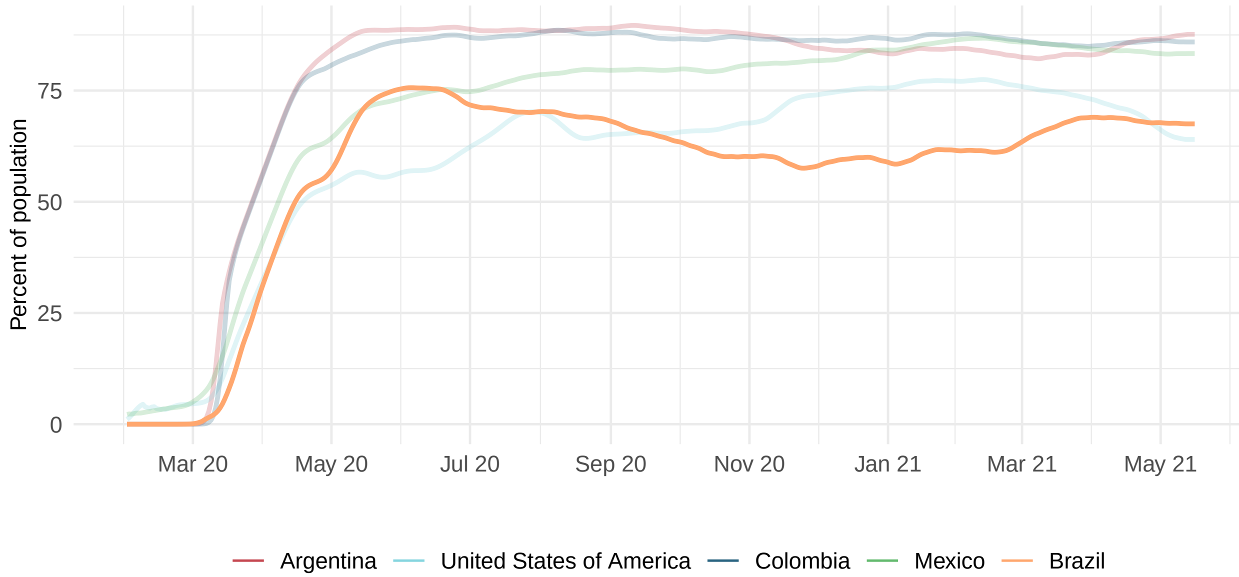


Figure 13. Proportion of the population reporting always wearing a mask when leaving home on May 17, 2021

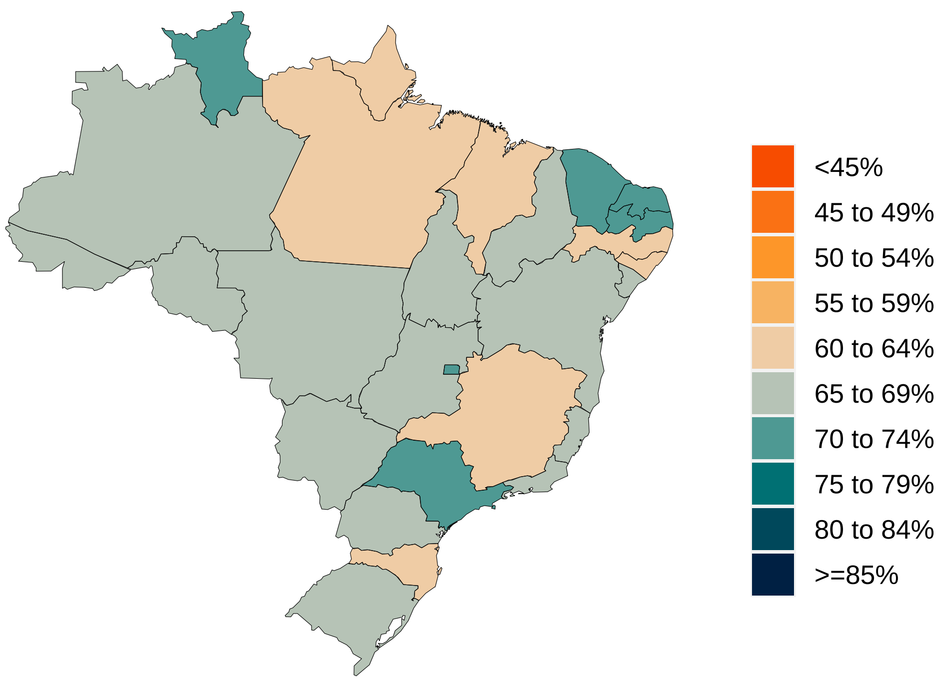


Figure 14. Trend in COVID-19 diagnostic tests per 100,000 people

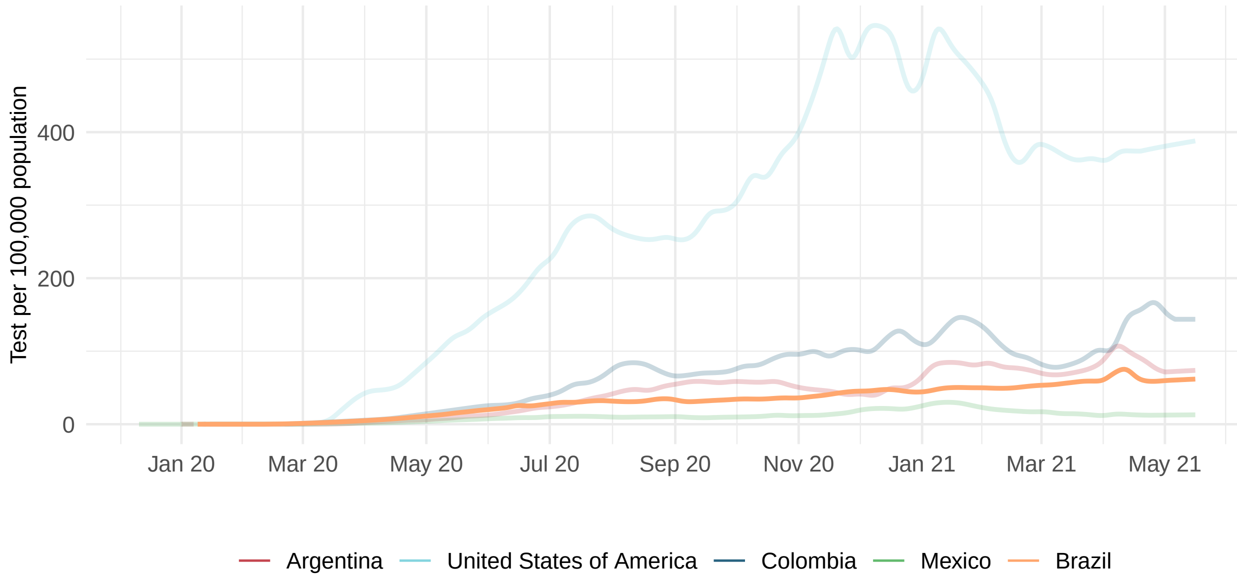


Figure 15. COVID-19 diagnostic tests per 100,000 people on May 06, 2021

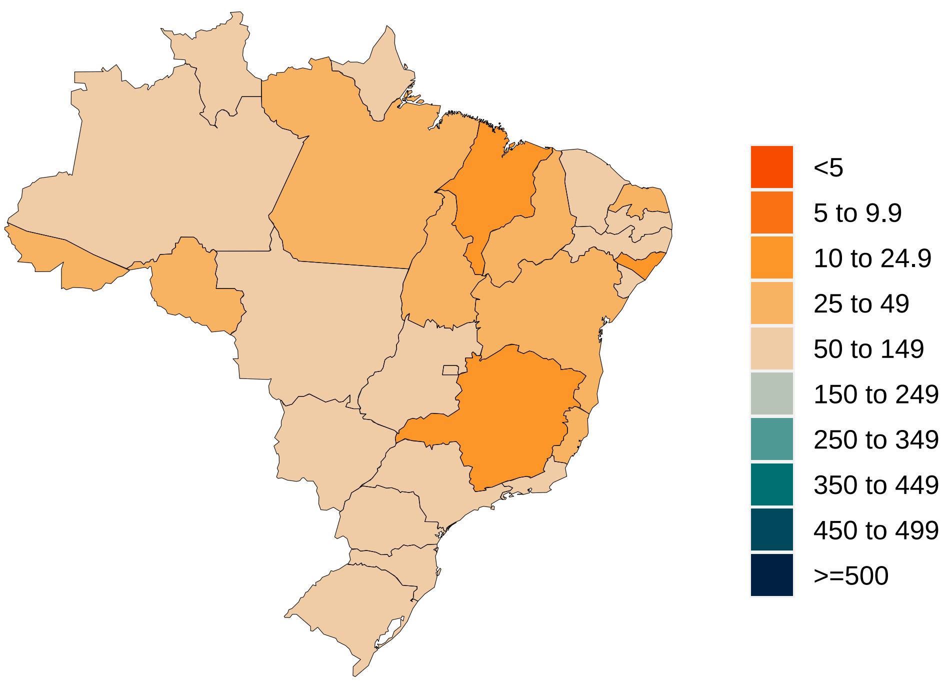


Figure 16. Increase in the risk of death due to pneumonia on February 1 compared to August 1

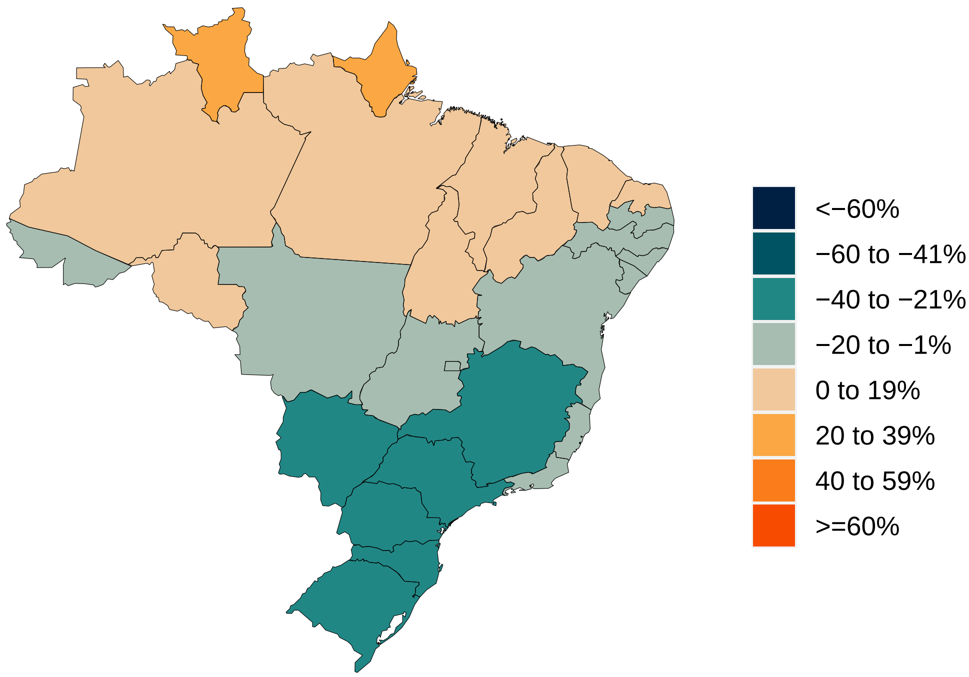


Table 3. The SEIR model uses variant-specific estimates of vaccine efficacy at preventing symptomatic disease and at preventing infection. We use data from clinical trials directly, where available, and make estimates otherwise. More information can be found on our website (http://www.healthdata.org/node/8584).

Vaccine	Efficacy at preventing disease: D614G & B.1.1.7	Efficacy at preventing infection: D614G & B.1.1.7	Efficacy at preventing disease: B.1.351, B.1.617, & P.1	Efficacy at preventing infection: B.1.351, B.1.617, & P.1
AstraZeneca	74%	52%	10%	9%
CoronaVac	50%	44%	38%	33%
Covaxin	78%	69%	59%	52%
Janssen	72%	72%	64%	56%
Moderna	94%	89%	79%	75%
Novavax	89%	79%	49%	43%
Pfizer/BioNTech	91%	86%	76%	72%
Sinopharm	73%	65%	55%	49%
Sputnik-V	92%	81%	70%	61%
Tianjin CanSino	66%	58%	50%	44%
Other vaccines	75%	66%	57%	50%
Other vaccines (mRNA)	91%	86%	76%	72%

Figure 17. Trend in the estimated proportion of the adult (18+) population that have been vaccinated or is open to receiving a COVID-19 vaccine based on Facebook survey responses (yes and yes, probably).

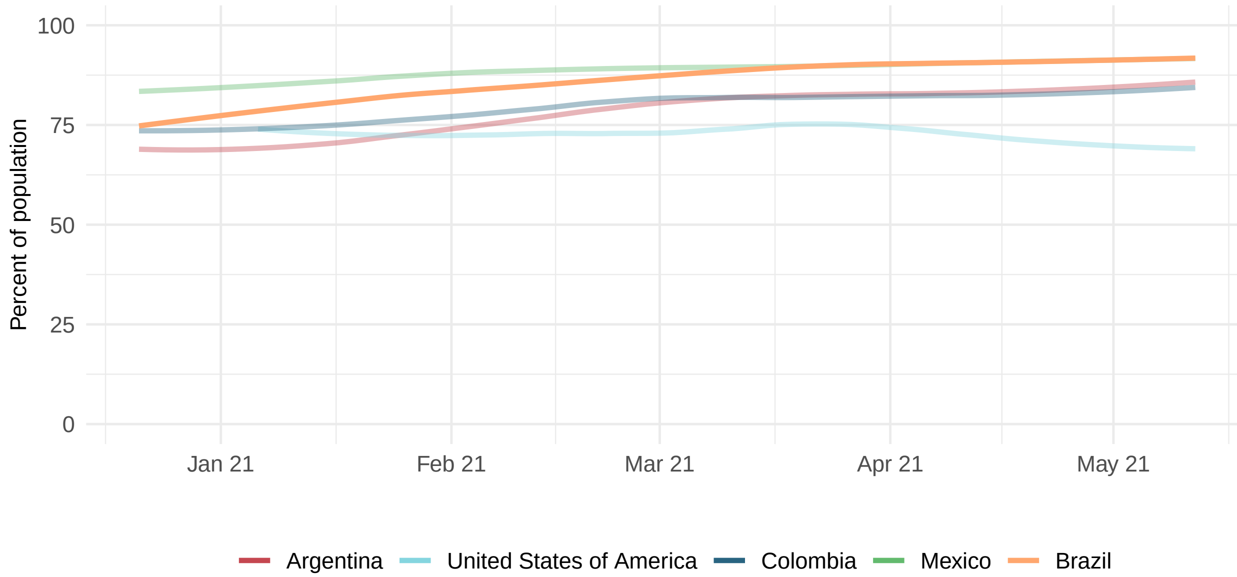


Figure 18. This figure shows the estimated proportion of the adult (18+) population that has been vaccinated or is open to receiving a COVID-19 vaccine based on Facebook survey responses (yes and yes, probably).

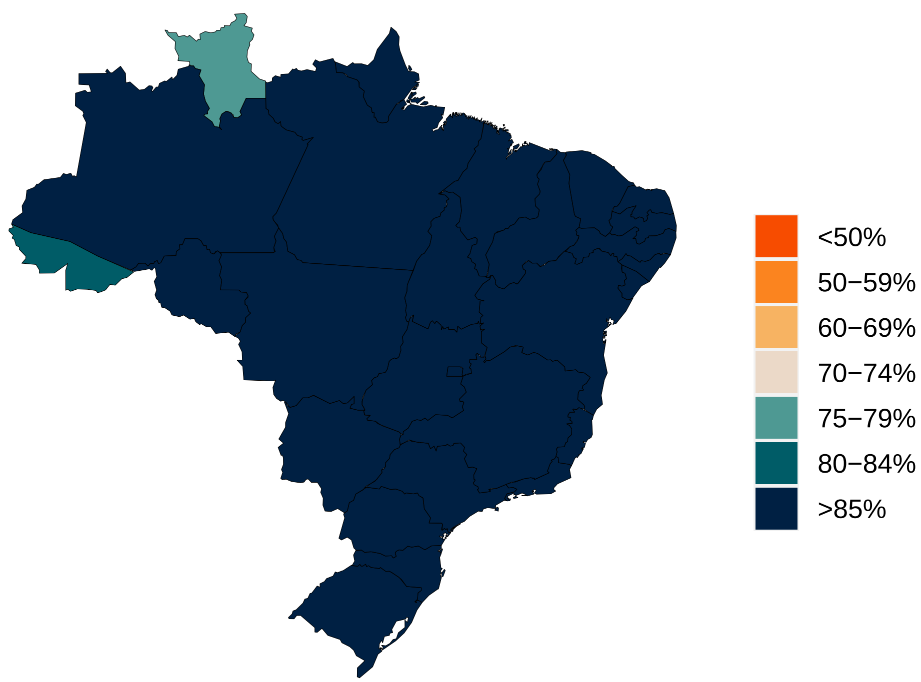
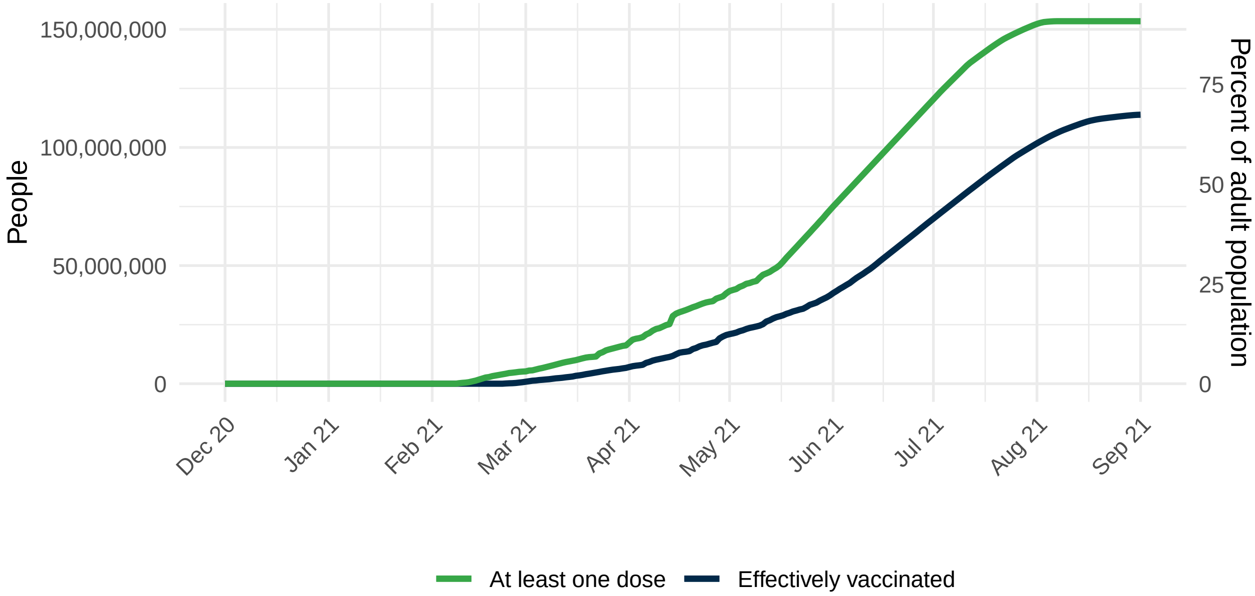


Figure 19. The number of people who receive any vaccine and those who are effectively vaccinated and protected against disease, accounting for efficacy, loss to follow up for two-dose vaccines, partial immunity after one dose, and immunity after two doses.



Projections and scenarios

We produce three scenarios when projecting COVID-19. The **reference scenario** is our forecast of what we think is most likely to happen:

- Vaccines are distributed at the expected pace.
- Governments adapt their response by re-imposing social distancing mandates for 6 weeks whenever daily deaths reach 8 per million, unless a location has already spent at least 7 of the last 14 days with daily deaths above this rate and not yet re-imposed social distancing mandates. In this case, the scenario assumes that mandates are re-imposed when daily deaths reach 15 per million.
- Variants B.1.1.7 (first identified in the UK), B.1.351 (first identified in South Africa), and P1 (first identified in Brazil) continue to spread from locations with (a) more than 5 sequenced variants, and (b) reports of community transmission, to adjacent locations following the speed of variant scale-up observed in the regions of the UK.
- In one-quarter of those vaccinated, mobility increases toward pre-COVID-19 levels.

The **worse scenario** modifies the reference scenario assumptions in three ways:

- First, it assumes that variants B.1.351 or P1 begin to spread within 3 weeks in adjacent locations that do not already have B.1.351 or P1 community transmission.
- Second, it assumes that all those vaccinated increase their mobility toward pre-COVID-19 levels.
- Third, it assumes that among those vaccinated, mask use starts to decline exponentially one month after completed vaccination.

The **universal masks scenario** makes all the same assumptions as the reference scenario but also assumes 95% of the population wear masks in public in every location.

Figure 20. Cumulative COVID-19 deaths until September 01, 2021 for three scenarios

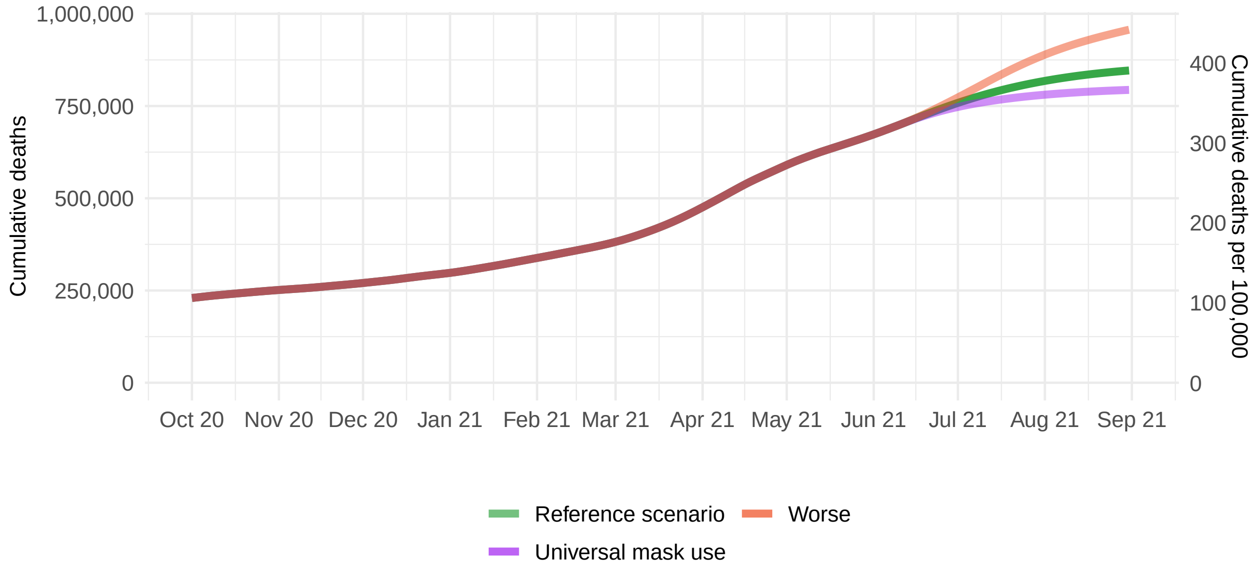


Figure 21. Daily COVID-19 deaths until September 01, 2021 for three scenarios,

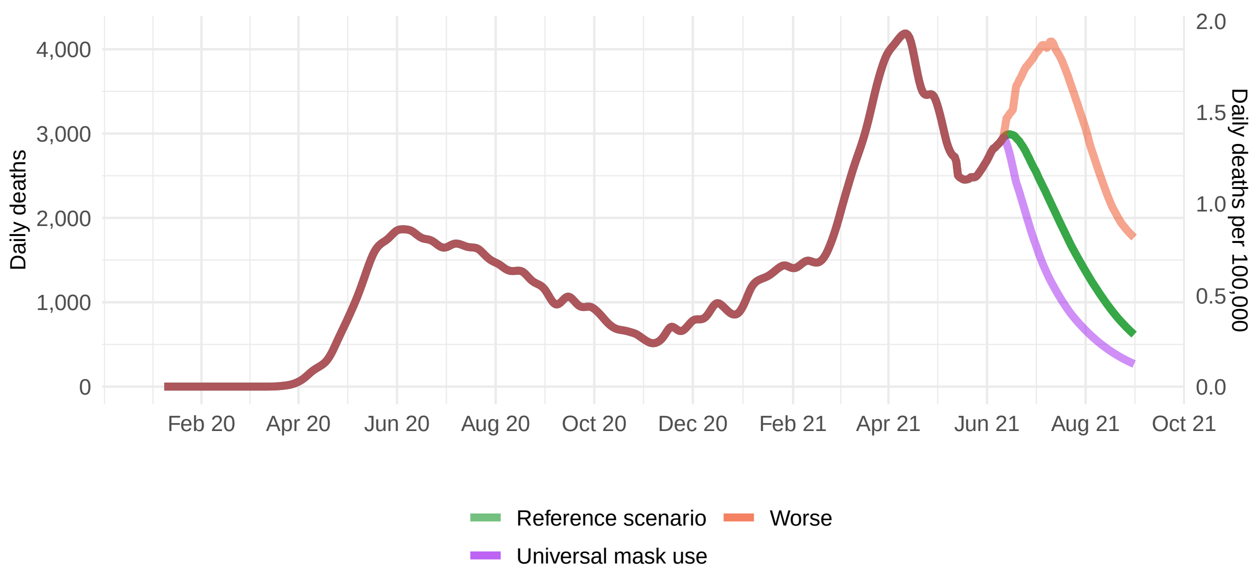


Figure 22. Daily COVID-19 infections until September 01, 2021 for three scenarios.

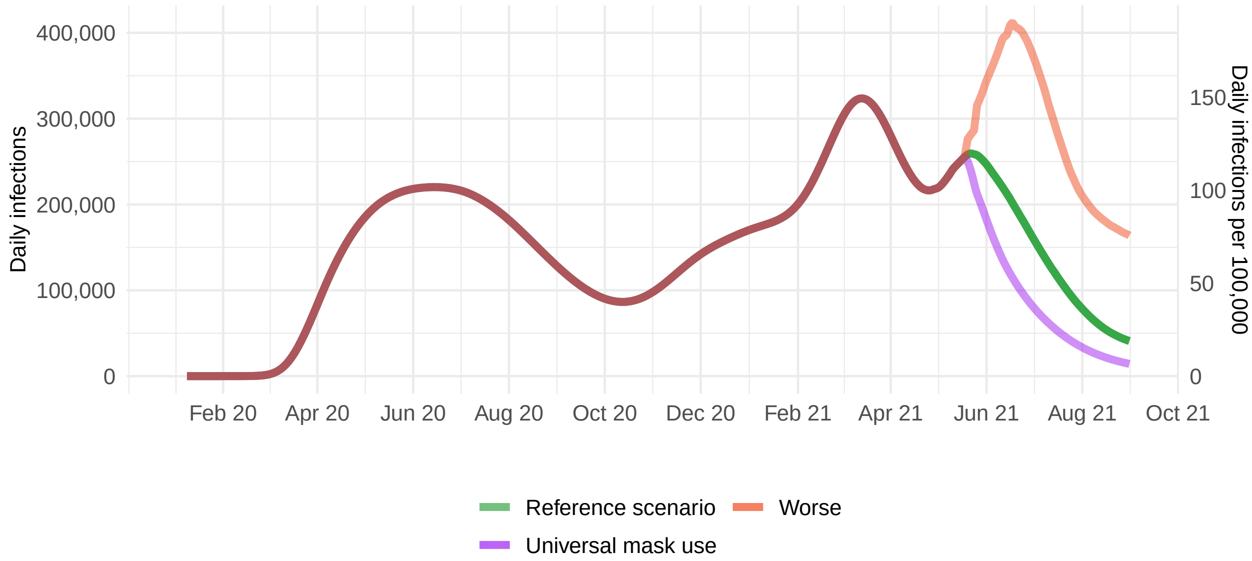


Figure 23. Comparison of reference model projections with other COVID modeling groups. For this comparison, we are including projections of daily COVID-19 deaths from other modeling groups when available: Delphi from the Massachussets Institute of Technology (Delphi; https://www.covidanalytics.io/home), Imperial College London (Imperial; https://www.covidsim.org), The Los Alamos National Laboratory (LANL; https://covid-19.bsvgateway.org/), and the SI-KJalpha model from the University of Southern California (SIKJalpha; https://github.com/scc-usc/ReCOVER-COVID-19). Daily deaths from other modeling groups are smoothed to remove inconsistencies with rounding. Regional values are aggregates from available locations in that region.

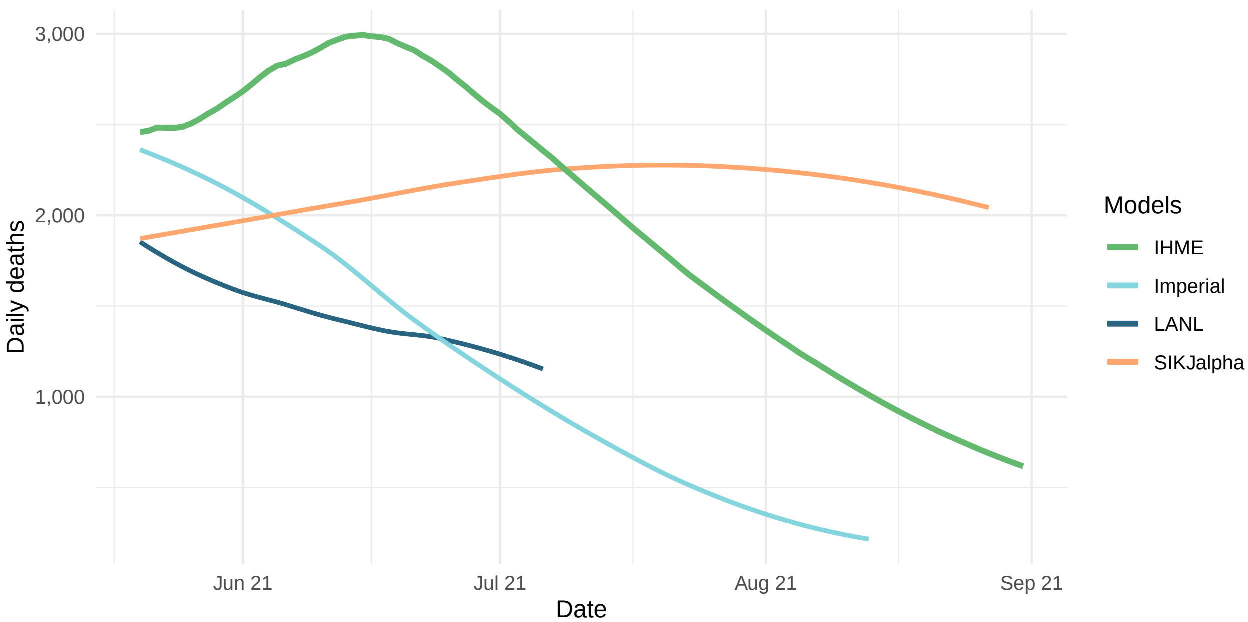


Figure 24. The estimated inpatient hospital usage is shown over time. The percent of hospital beds occupied by COVID-19 patients is color coded based on observed quantiles of the maximum proportion of beds occupied by COVID-19 patients. Less than 5% is considered *low stress*, 5-9% is considered *moderate stress*, 10-19% is considered *high stress*, and greater than 20% is considered *extreme stress*.

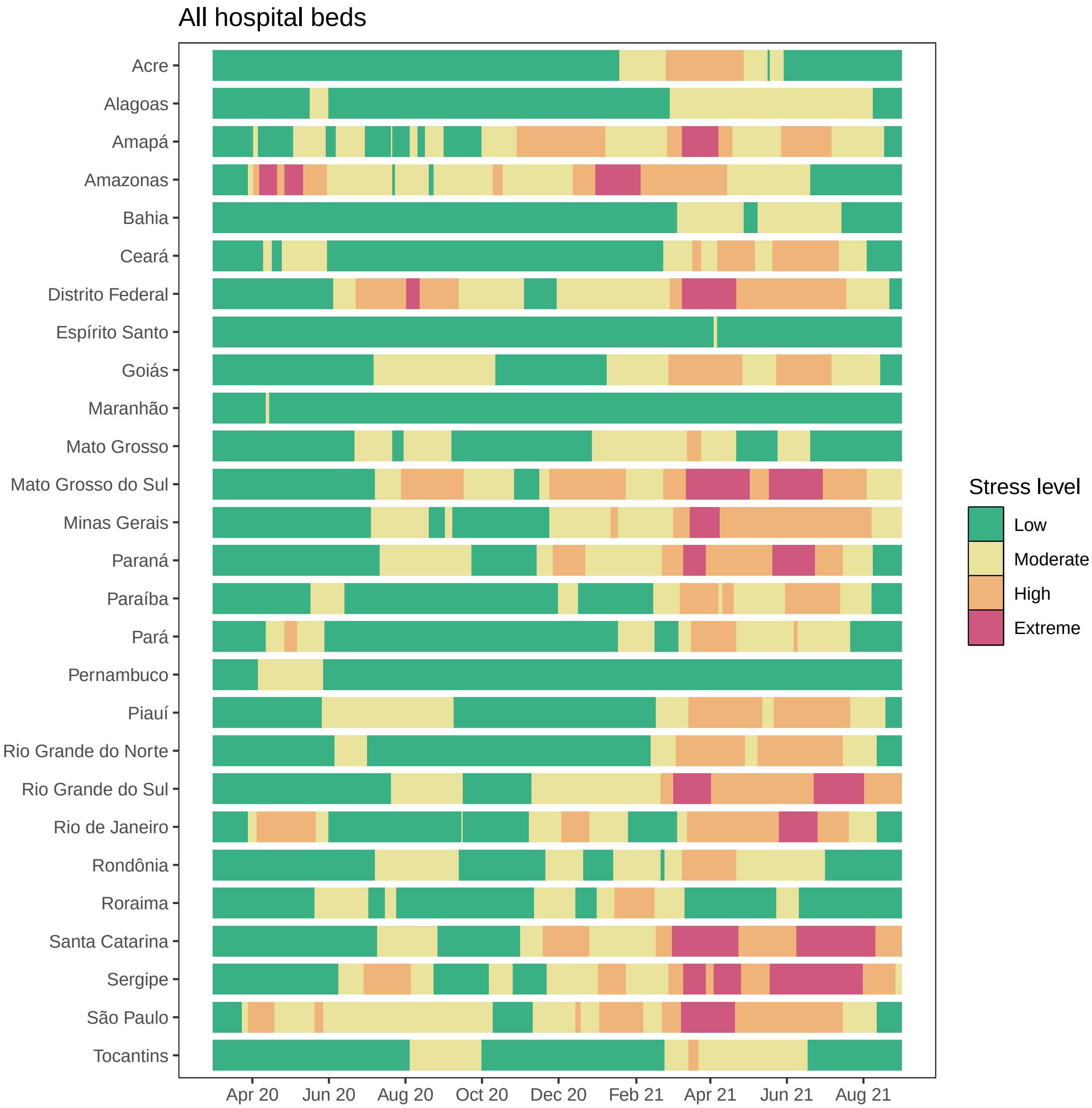
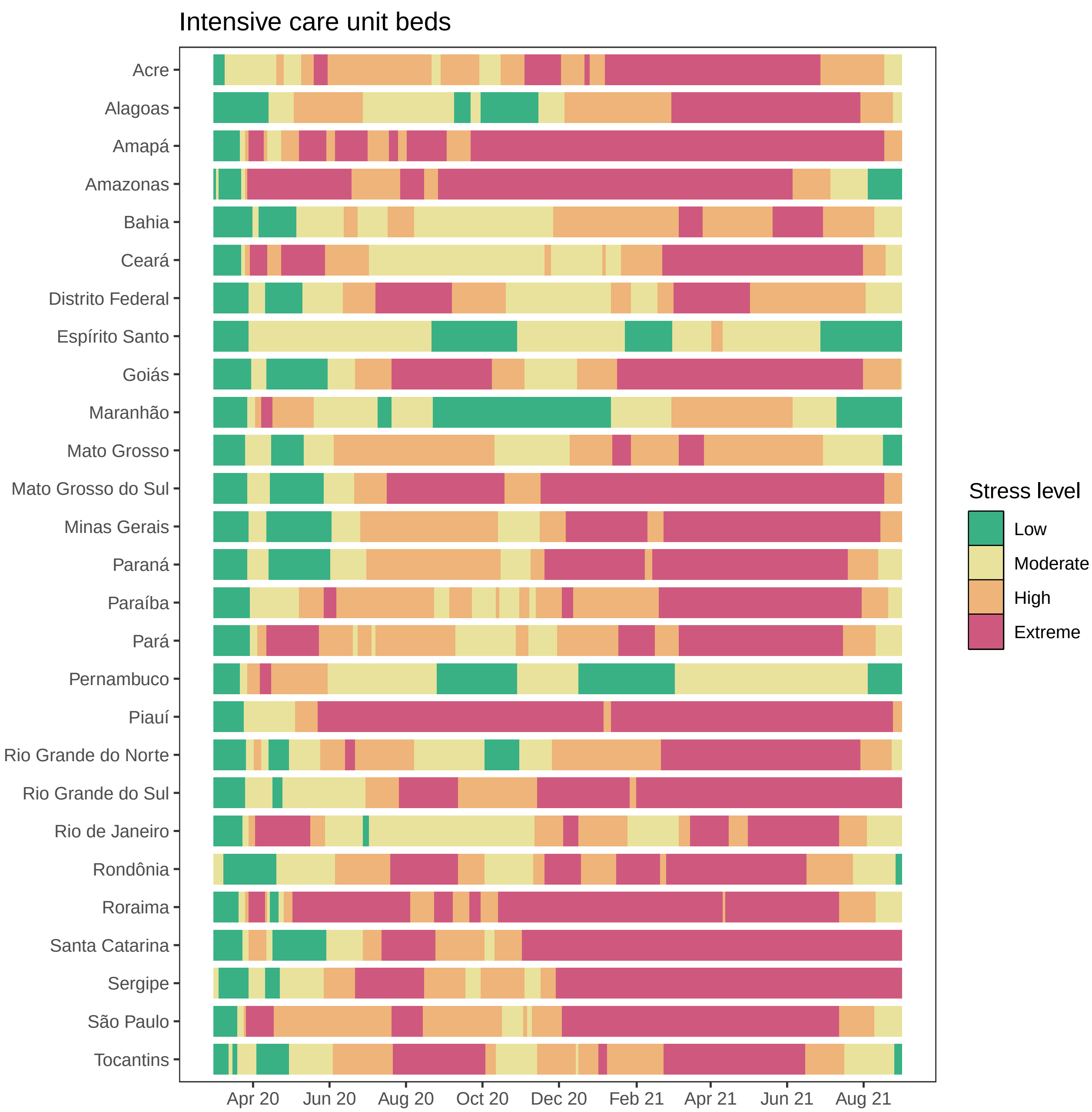


Figure 25. The estimated intensive care unit (ICU) usage is shown over time. The percent of ICU beds occupied by COVID-19 patients is color coded based on observed quantiles of the maximum proportion of ICU beds occupied by COVID-19 patients. Less than 10% is considered *low stress*, 10-29% is considered *moderate stress*, 30-59% is considered *high stress*, and greater than 60% is considered *extreme stress*.



More information

Data sources:

Mask use data sources include Premise; Facebook Global Symptom Survey (This research is based on survey results from University of Maryland Social Data Science Center) and the Facebook United States Symptom Survey (in collaboration with Carnegie Mellon University); Kaiser Family Foundation; YouGov COVID-19 Behaviour Tracker survey.

Vaccine hesitancy data are from the COVID-19 Beliefs, Behaviors, and Norms Study, a survey conducted on Facebook by the Massachusetts Institute of Technology (https://covidsurvey.mit.edu/).

Vaccine hesitancy data are from the Facebook Global Symptom Survey (This research is based on survey results from University of Maryland Social Data Science Center), the Facebook United States Symptom Survey (in collaboration with Carnegie Mellon University), and from the Facebook COVID-19 Beliefs, Behaviors, and Norms Study conducted by the Massachusetts Institute of Technology.

Genetic sequence and metadata are primarily from the GISAID Initiative. Further details available on the COVID-19 model FAQ page.

A note of thanks:

We wish to warmly acknowledge the support of these and others who have made our COVID-19 estimation efforts possible.

More information:

For all COVID-19 resources at IHME, visit http://www.healthdata.org/covid.

Questions? Requests? Feedback? Please contact us at https://www.healthdata.org/covid/contact-us.