COVID-19 Results Briefing

United States of America

March 31, 2021

This document contains summary information on the latest projections from the IHME model on COVID-19 in the US. The model was run on March 31, 2021 with data through March 29, 2021.

Daily cases are increasing, and daily deaths have remained largely constant. In some states, most notably Michigan, a large surge is underway. Given steady relaxation of social distancing mandates and steady increases in mobility (combined with the spread of B.1.1.7), a repeat of the Michigan pattern in many other states is a distinct possibility. In our reference scenario, we see daily deaths remaining constant until early May. But given that increases in mobility have been faster than we expected, our worse scenario – where daily deaths increase until mid-May – remains very possible.

The experience in Europe should serve as a warning of the risks implied by the B.1.1.7 variant. Europe has had a much stronger set of mandates in place than the US, but has seen steady increases in daily cases and slower increases in daily deaths. Three factors may explain why increases in US cases have been less dramatic than in Europe thus far: 1) later spread of B.1.1.7 after the peak of seasonality, 2) higher vaccination rates, and 3) higher mask use. The gap between our worse scenario and our reference scenario, which is driven by slightly faster increases in mobility and faster declines in mask use, highlights how relatively small changes in behavior can have a profound impact on deaths in the near term.

Although we remain reasonably confident that case and death numbers will be lower in the summer, a very wide range of outcomes over the next two months is possible. These outcomes depend on the behavioral response in terms of vaccine confidence, mask wearing, and avoidance of situations that pose a high-risk for transmission. The declines in vaccine confidence over the last two weeks is also a disturbing trend, particularly since the main strategies to manage the current reversal in transmission are accelerating vaccination scale-up, maintaining mask use levels, and avoiding early re-opening.

Current situation

- Daily reported cases in the last week increased to 58,600 per day on average compared to 54,600 the week before (Figure 1).
- Daily deaths in the last week decreased to 940 per day on average compared to 1,000 the week before (Figure 2). This makes COVID-19 the number 2 cause of death in the US this week (Table 1).
- The daily death rate is greater than 4 per million in Georgia, Kentucky, Massachusetts, and Ohio (Figure 3).
- We estimated that 21% of people in the US have been infected as of March 29 (Figure 4).

- Effective R, computed using cases, hospitalizations, and deaths, is greater than 1 in 28 states (Figure 5).
- The infection-detection rate is close to 50% (Figure 6).
- Variant spread, estimated on the basis of sequence data and expected scale-up of more highly transmissible variants after the last available sequence data, is shown in Figure 7. B.1.1.7 is likely the overwhelmingly dominant variant in Minnesota and Michigan. It also likely accounts for the majority of new infections in most states of the Northeast. The escape variant P.1 is now accounting for some transmission in the Southeast.

Trends in drivers of transmission

- States continue to lift mandates (Table 2). Specifically, Arizona, District of Columbia, Maine, Pennsylvania, and Vermont have lifted some mandates. Compared to Europe, which also has a B.1.1.7-driven surge, the continued re-opening in the US is remarkable.
- Mobility continues to increase, steadily reaching 13% lower than the pre-COVID-19 baseline (Figure 9). Mobility was near baseline (within 10%) in 26 states. Mobility was lower than 30% of baseline in the District of Columbia.
- As of March 29, we estimated that 74% of people always wore a mask when leaving their home (Figure 11). Mask use was lower than 50% in South Dakota and Wyoming.
- There were 387 diagnostic tests per 100,000 people on March 29 (Figure 13).
- In the US, 70.2% of people say they would accept or would probably accept a vaccine for COVID-19. This is down by 1.5 percentage points from last week, continuing a decline in vaccine confidence that began two weeks ago. The fraction of the population who are open to receiving a COVID-19 vaccine ranges from 53% in Alaska to 90% in the District of Columbia (Figure 16).
- In our current reference scenario, we expect that 186 million will be vaccinated by July 1 (Figure 17), which is down slightly from last week's estimate.

Projections

- In our **reference scenario**, which represents what we think is most likely to happen, our model projects 609,000 cumulative deaths on July 1. This represents 61,000 additional deaths from March 29 to July 1 (Figure 18). Daily deaths are expected to begin declining in early May and decline to below 250 per day by July 1 (Figure 19).
- If **universal mask coverage (95%)** were attained in the next week, our model projects 11,000 fewer cumulative deaths compared to the reference scenario on July 1 (Figure 18).
- Under our **worse scenario**, our model projects 651,000 cumulative deaths on July 1 (Figure 18). This represents 42,000 more deaths than in the reference scenario. Daily deaths in the worse scenario increase to a peak in mid-May. Given the rapid relaxation of mandates and rise in mobility, the worse scenario is quite likely.

- By July 1, we project that 50,800 lives will be saved by the projected vaccine rollout. This does not include the lives saved through vaccination that has already occurred.
- Daily infections in the reference scenario begin declining the second week of April. In the worse scenario, daily infections increase until late April and then decline.
- Figure 21 compares our reference scenario forecasts to other publicly archived models. The CDC ensemble has a slight increase in daily deaths. The USC model suggests steady increases through to July 1. Los Alamos National Labs and the MIT model have steady declines over the next six weeks.
- At some point from March through July 1, 18 states will have high or extreme stress on hospital beds (Figure 22). At some point from March through July 1, 2 states will have high or extreme stress on ICU capacity (Figure 23).

Model updates

In previous weeks, we captured the relationship between past transmission intensity and variant spread by including invasion rates for both the non-escape (B.1.1.7) and escape (B.1.351 and P.1) variants as covariates in our regression model, alongside other predictors like mask usage and mobility data. This week we have removed the variants from our regression model and incorporated them mechanistically into our fit of transmission intensity to past infections. The mechanistic model allows us to track infections due to the increased transmission intensity of the escape variants from infections due to natural- and vaccine-immunity breakthrough.

Limited evidence from the Novavax and AstraZeneca placebo arms suggests cross-variant immunity between escape variants and ancestral variants is between 0 and 30%. The spread of B.1.351 in South Africa and P.1 in Amazonas, Brazil, provides further data on the implied level of cross-variant immunity and increased transmissibility of these escape variants. To capture the uncertainty around both cross-variant immunity and escape variant transmissibility, we explored over 1,100 combinations of cross-variant immunity from natural infection, increased transmission intensity of the non-escape variants, and increased transmission of the escape variants, and selected a joint distribution of these three parameters that best matches the invasion rates of B.1.351 in South Africa and P.1 in Amazonas, Brazil.

We sampled the transmission intensity increase of B.1.1.7 relative to ancestral-type SARS-CoV-2 uniformly from a 30% increase to a 50% increase. The proportion of people previously infected with ancestral-type virus who are immune to the escape variants is sampled uniformly between 0.0 and 0.6. Finally, the transmission intensity increase of the escape variants relative to the increase in transmission intensity of B.1.1.7 is sampled from a normal distribution centered at 0.5 with a standard deviation of 0.13. This encodes our assumptions about how B.1.1.7 and the escape variants will compete as they show up in the same location. In absolute terms, this puts the transmission intensity of the escape variants in the range of 5%–16% when cross-variant immunity is 0.0 and 16%–28% when cross-variant immunity is 0.6. Our results this week incorporate this range of uncertainty in these critical parameters governing the impact of the escape variants.

In general, to determine the timing of initial invasion of a variant of concern (VOC) into a new location, we consider multiple data sources. For the US in particular, we use both the GISAID database and CDC data on confirmed and suspected VOC cases. In the presence of limited data, we use either a cutoff of five VOC sequences in the GISAID database or 25 suspected or confirmed VOC cases in the CDC database to indicate that local transmission is ongoing. One example of this is our identification of local transmission of P.1 in Florida due to the 42 suspected or confirmed VOC cases reported to the CDC database. However, as we gain more data, we take a more data-driven approach by fitting a model to the fraction of all GISAID sequences in a location that are a particular VOC. This data is taken as the gold standard, and the results of this model can override the simpler decision based on thresholds of sequences or cases. A practical application of this approach is the removal of B.1.351 local transmission from the US. There are more than five B.1.351 sequences in the GISAID database as well as more than 25 confirmed or suspected B.1.351 cases in the CDC database for a number of states in the US. However, the fraction of all sequences in the GISAID database that are B.1.351 has decreased in these states over time and is currently at 0% in all but North Carolina. This indicates that while B.1.351 infections have been detected in these states, we do not yet have strong evidence that these infections have led to the rapid invasion we have seen by VOCs in other settings. Of course, as new data are acquired, this situation will be re-evaluated on a state-by-state basis.

Figure 1. Reported daily COVID-19 cases

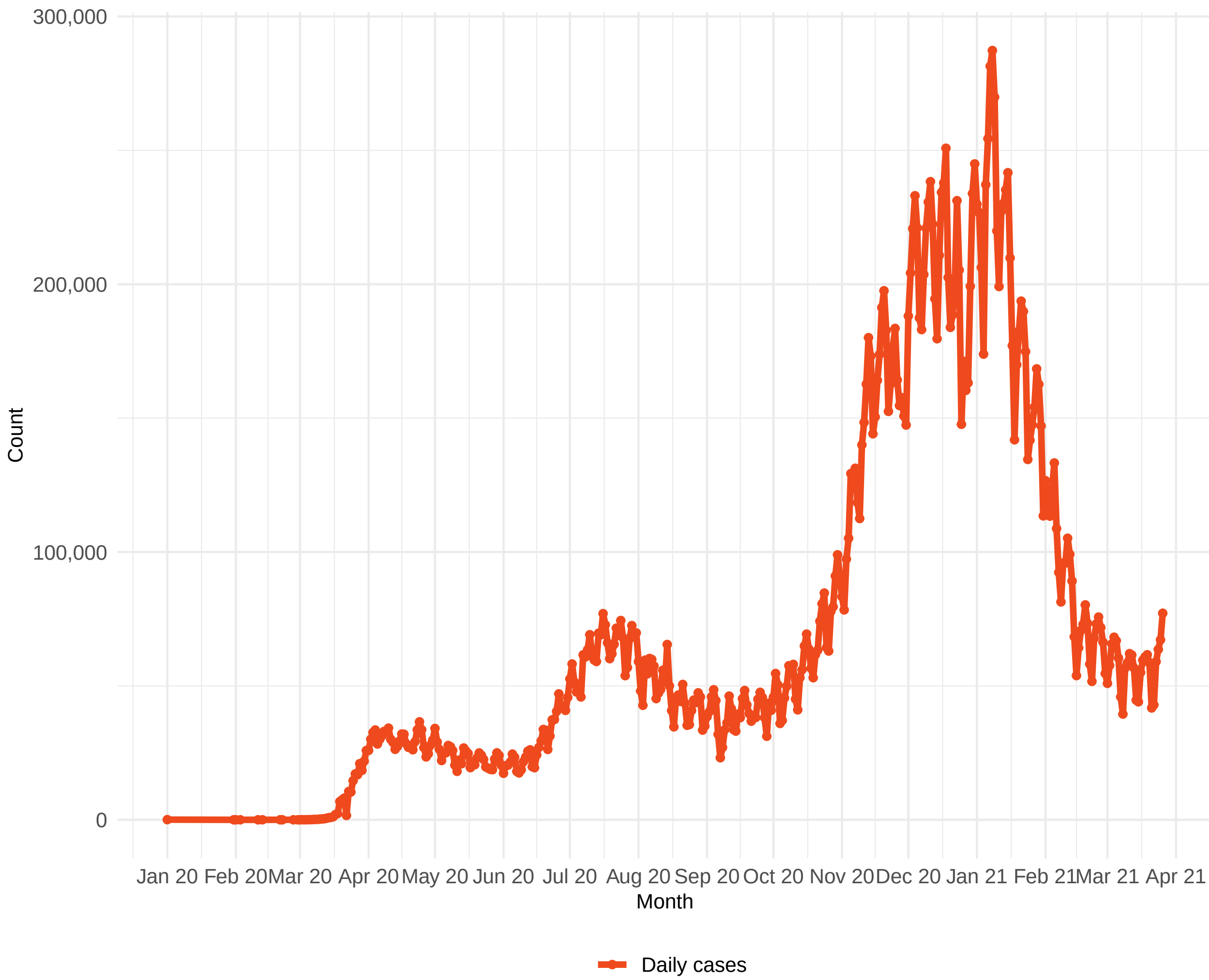


Table 1. Ranking of COVID-19 among the leading causes of mortality this week, assuming uniform deaths of non-COVID causes throughout the year

Cause name	Weekly deaths	Ranking
Ischemic heart disease	10,724	1
COVID-19	6,593	2
Tracheal, bronchus, and lung cancer	3,965	3
Chronic obstructive pulmonary disease	3,766	4
Stroke	3,643	5
Alzheimer's disease and other dementias	2,768	6
Chronic kidney disease	2,057	7
Colon and rectum cancer	1,616	8
Lower respiratory infections	1,575	9
Diabetes mellitus	1,495	10

Figure 2. Reported daily COVID-19 deaths

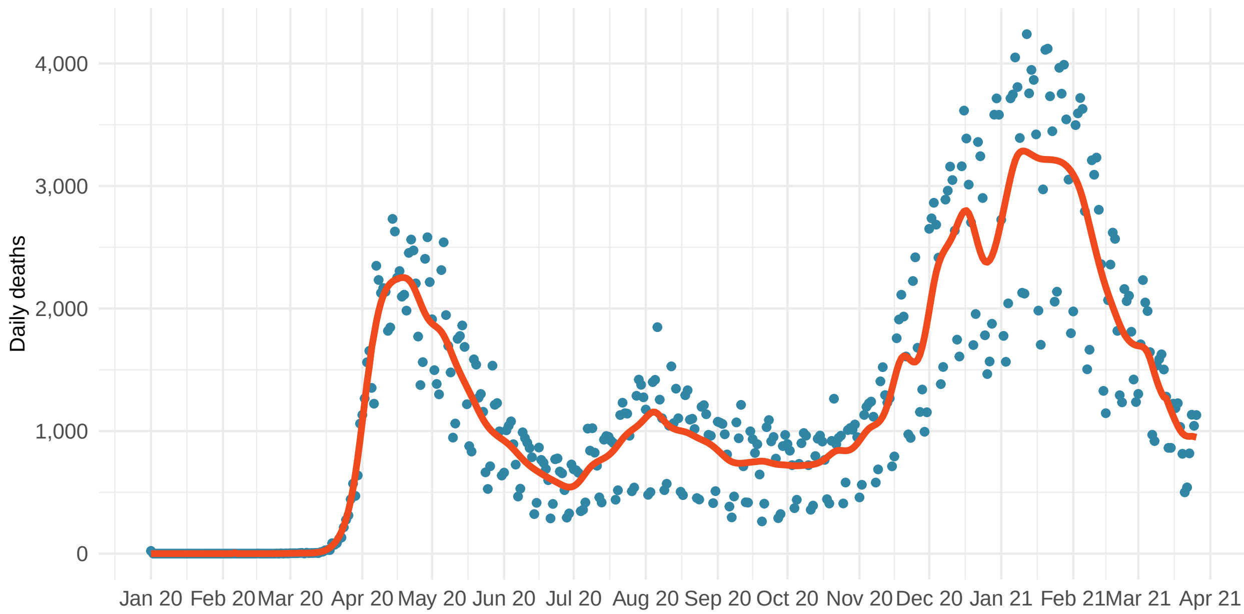


Figure 3. Daily COVID-19 death rate per 1 million on March 29, 2021

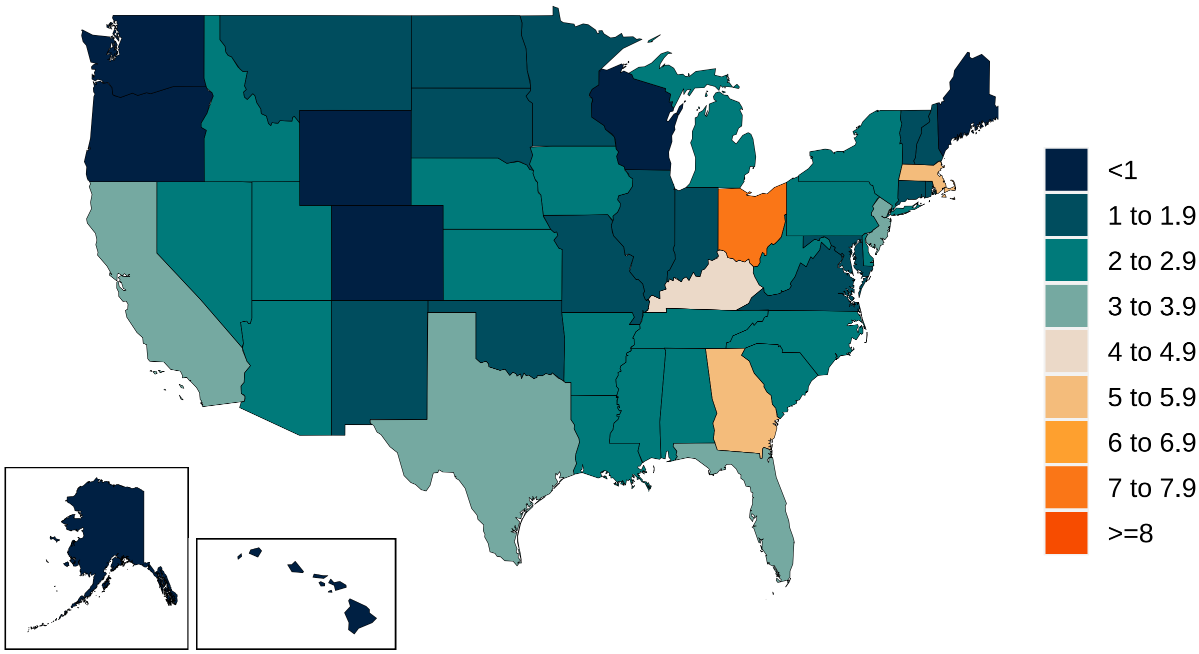


Figure 4. Estimated percent of the population infected with COVID-19 on March 29, 2021

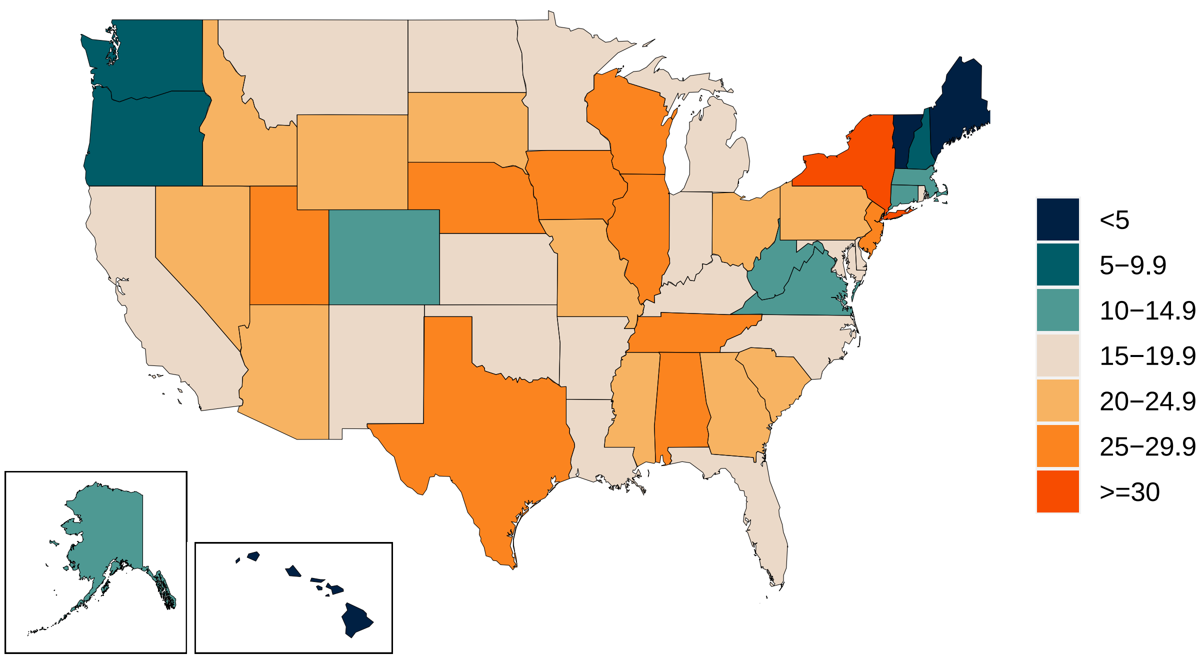


Figure 5. Mean effective R on March 18, 2021. The estimate of effective R is based on the combined analysis of deaths, case reporting, and hospitalizations where available. Current reported cases reflect infections 11-13 days prior, so estimates of effective R can only be made for the recent past. Effective R less than 1 means that transmission should decline, all other things being held the same.

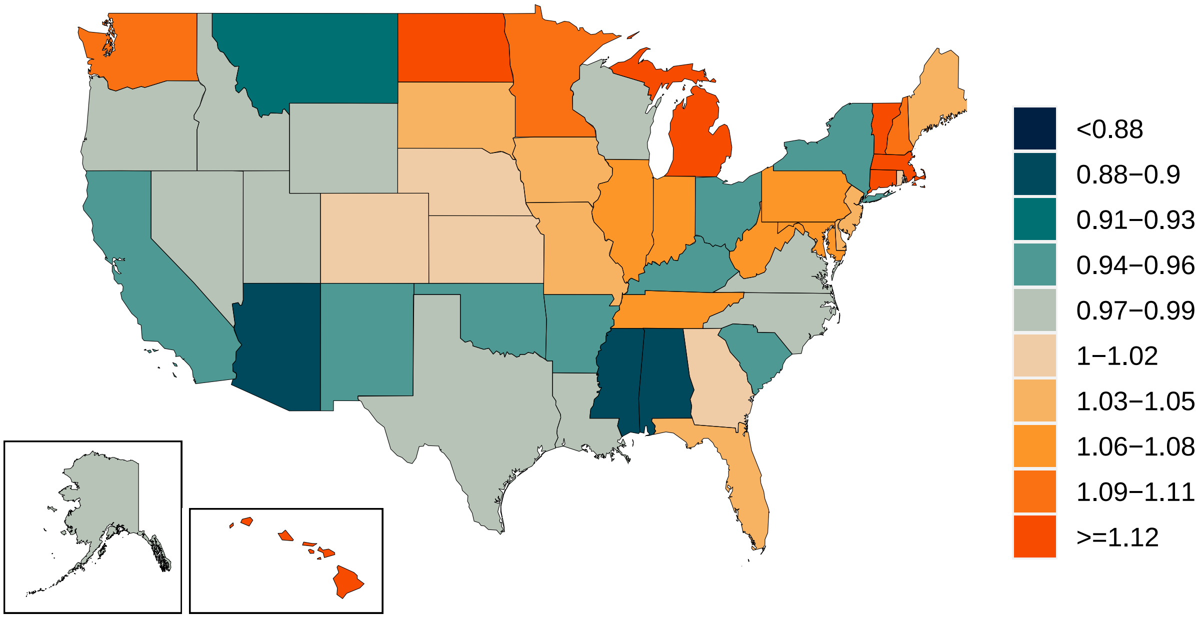
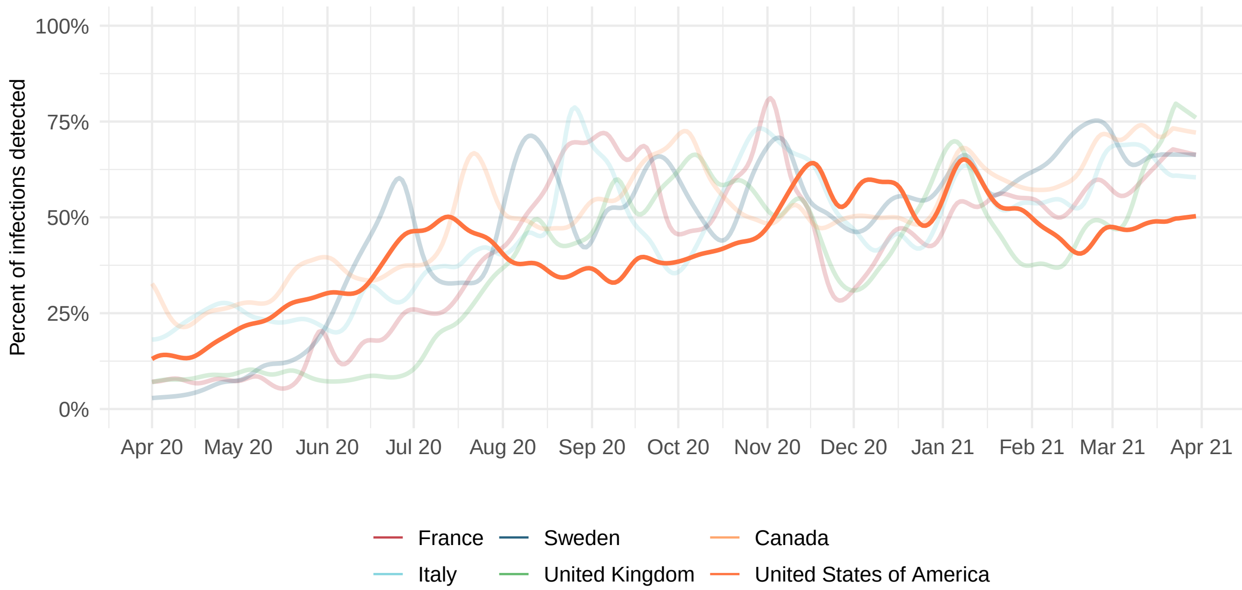


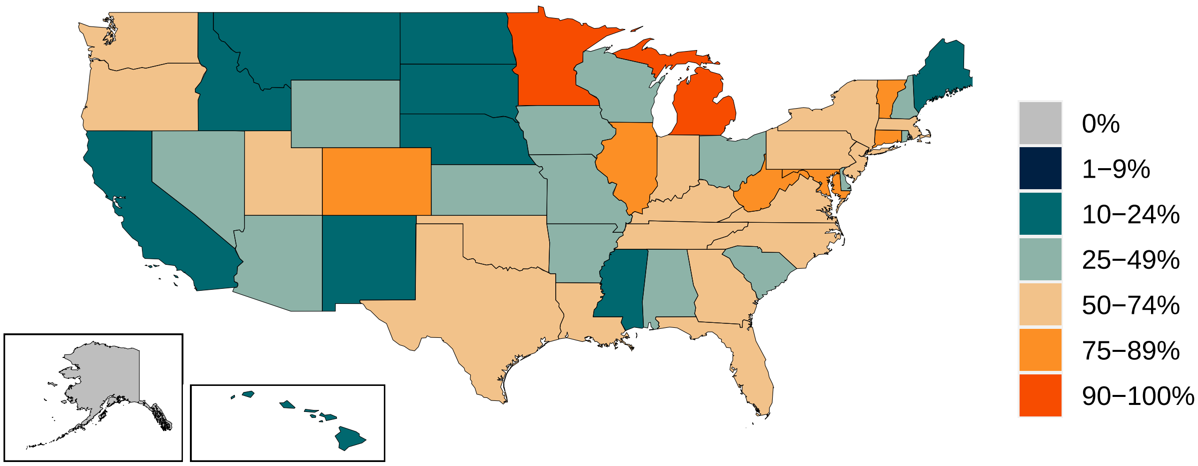
Figure 6. Percent of COVID-19 infections detected. This is estimated as the ratio of reported daily COVID-19 cases to estimated daily COVID-19 infections based on the SEIR disease transmission model.



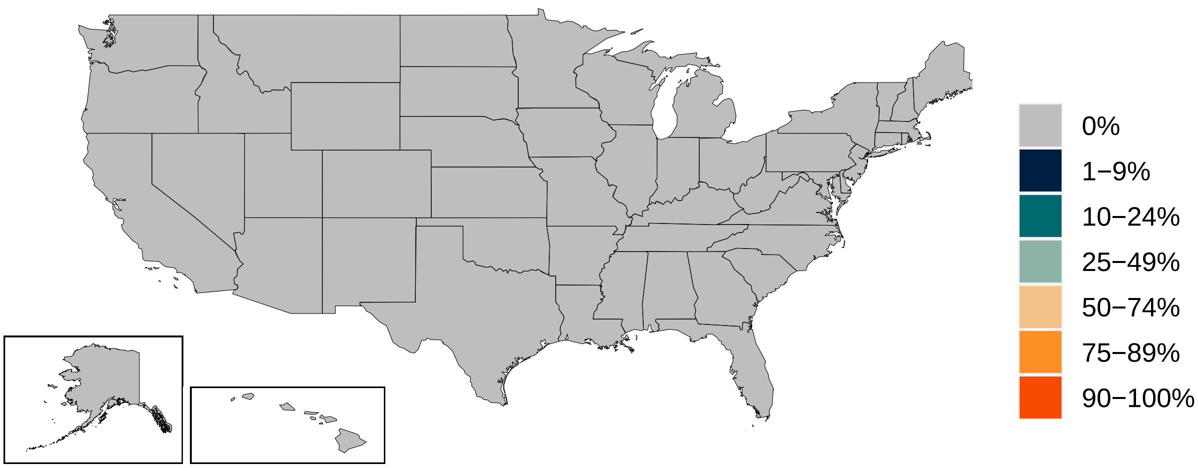
*Due to measurement errors in cases and testing rates, the infection to detection rate (IDR) can exceed 100% at particular points in time.

Figure 7. Percent of circulating SARS-CoV-2 for 3 primary variants on March 29, 2021.

A. Percent B.1.1.7 variant



B. Percent B.1.351 variant



C. Percent P1 variant

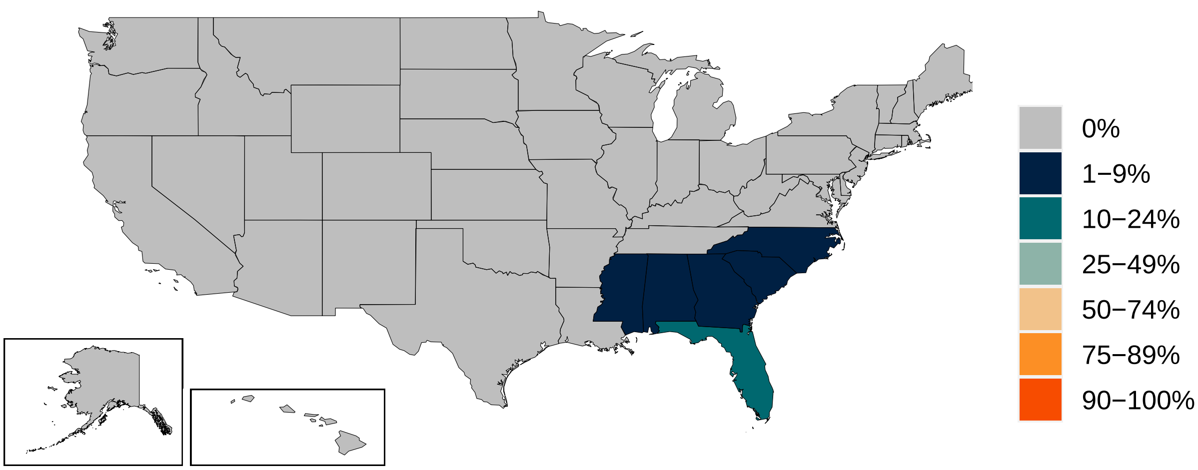
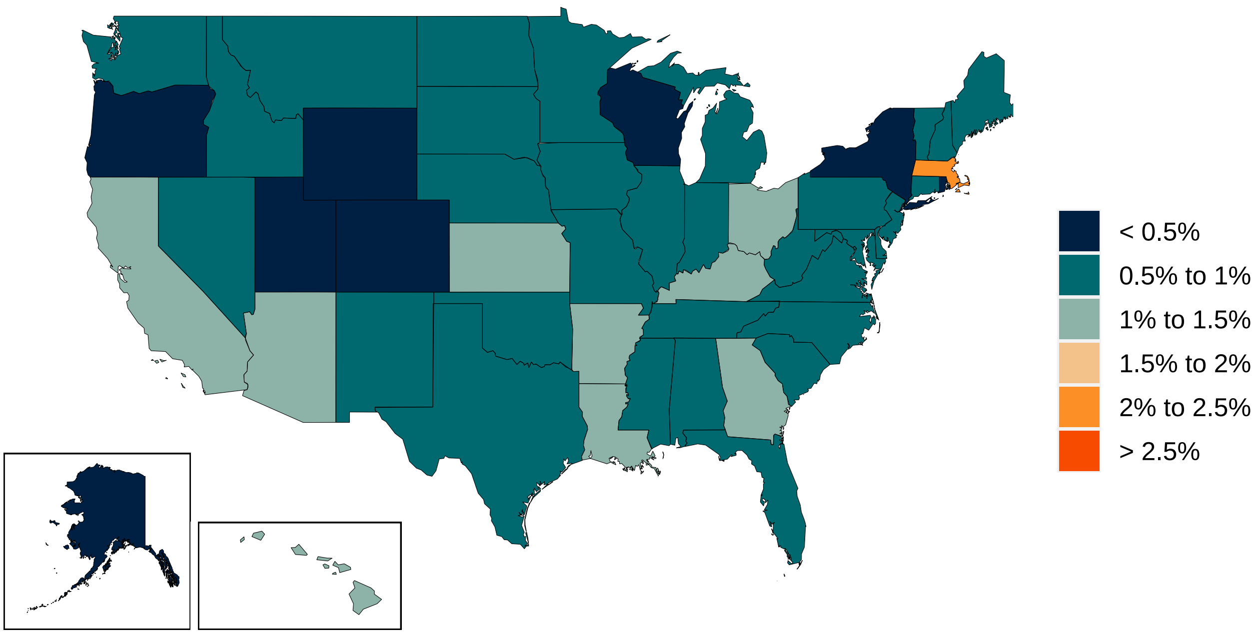


Figure 8. Infection fatality ratio on March 29, 2021. This is estimated as the ratio of COVID-19 deaths to infections based on the SEIR disease transmission model.



Critical drivers

Table 2. Current mandate implementation

*Not all locations are measured at the subnational level.

Figure 9. Trend in mobility as measured through smartphone app use compared to January 2020 baseline

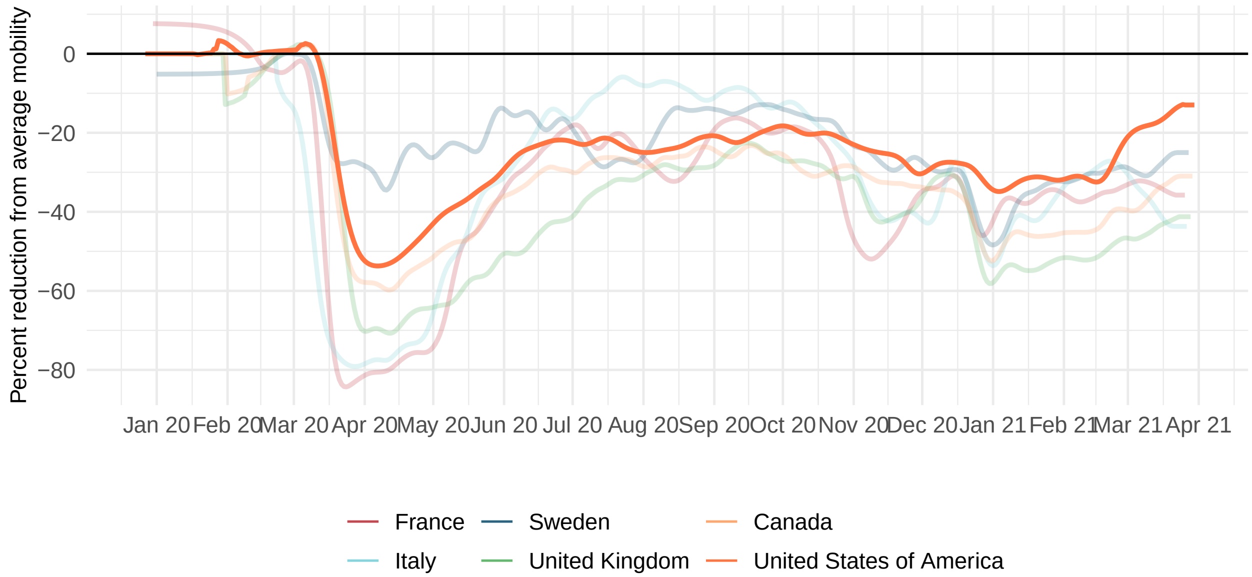


Figure 10. Mobility level as measured through smartphone app use compared to January 2020 baseline (percent) on March 29, 2021

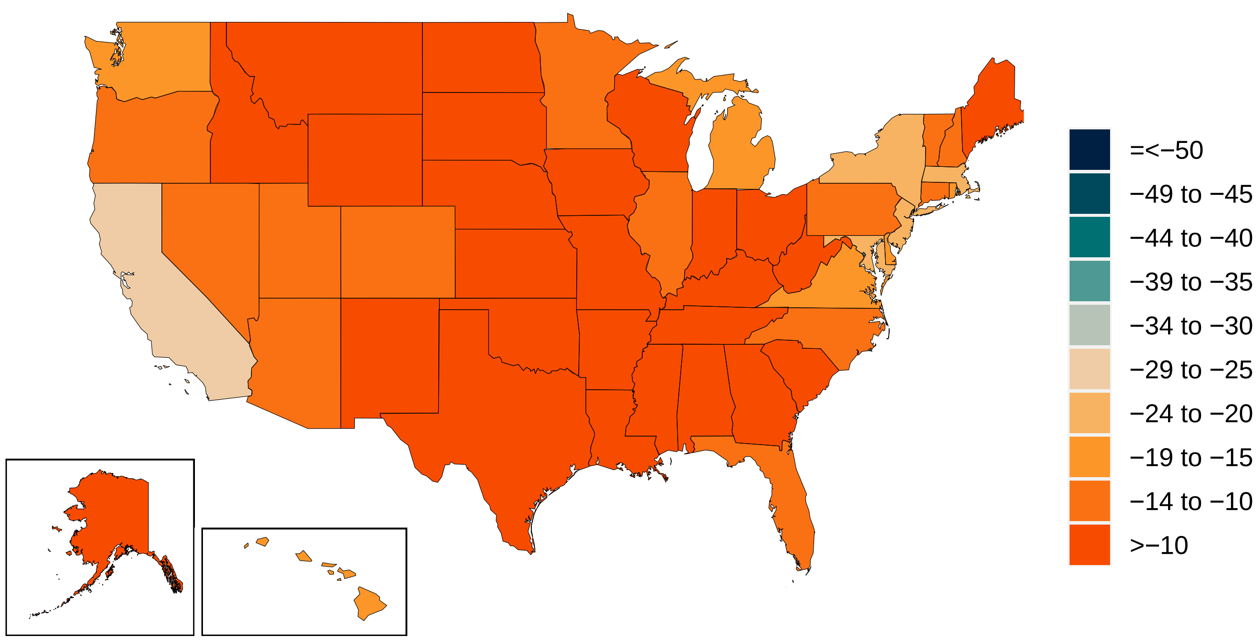


Figure 11. Trend in the proportion of the population reporting always wearing a mask when leaving home

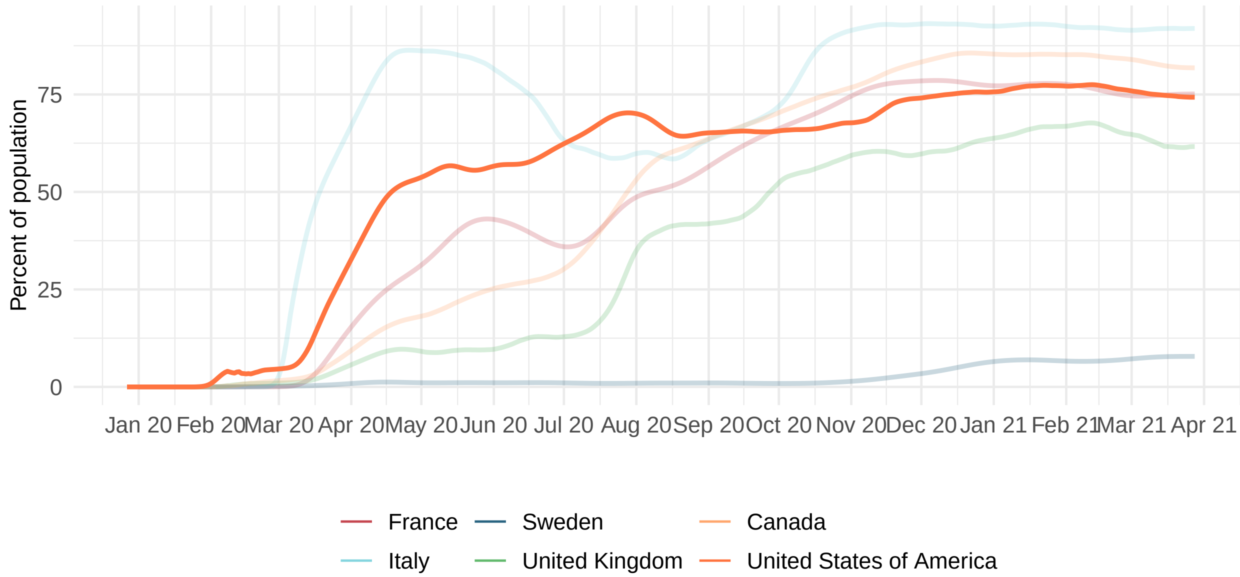


Figure 12. Proportion of the population reporting always wearing a mask when leaving home on March 29, 2021

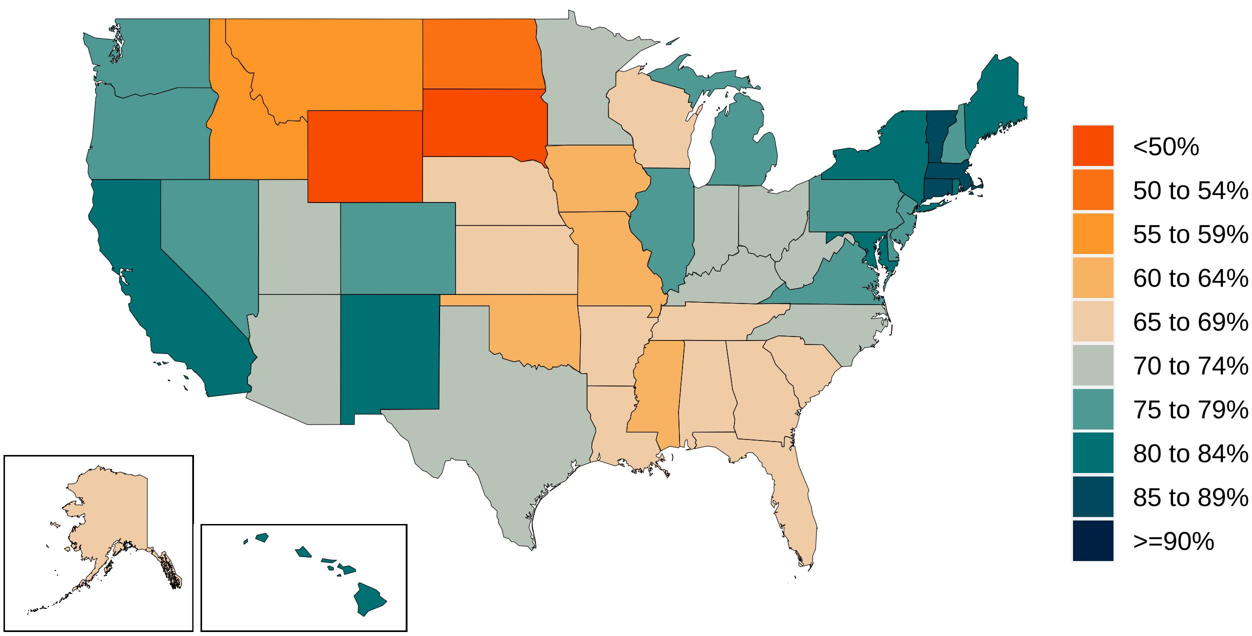


Figure 13. Trend in COVID-19 diagnostic tests per 100,000 people

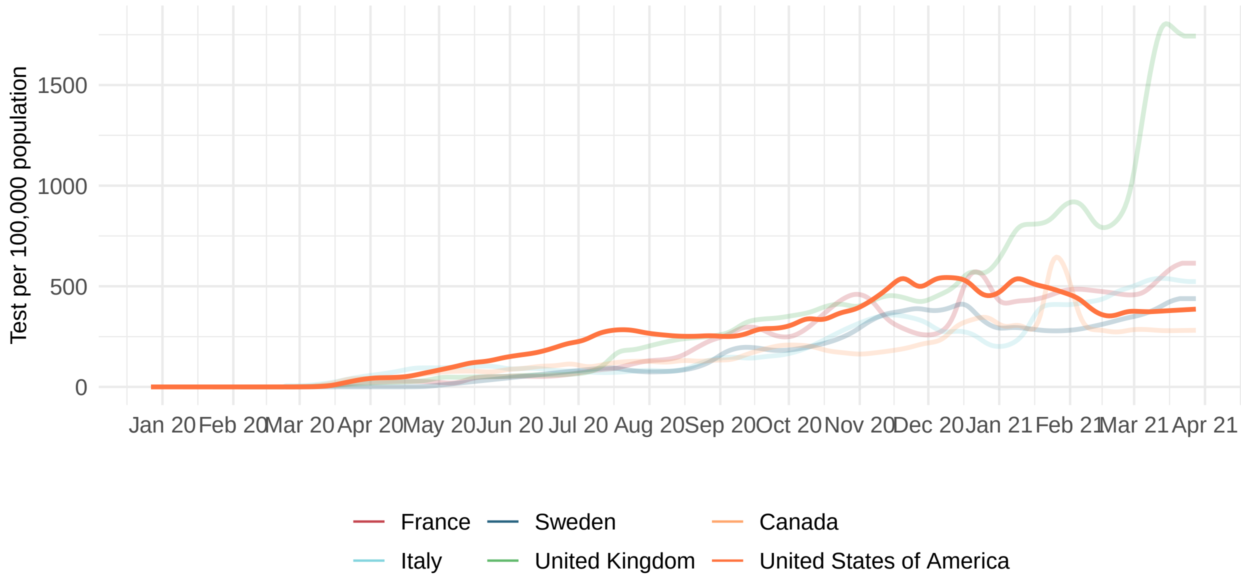


Figure 14. COVID-19 diagnostic tests per 100,000 people on March 08, 2021

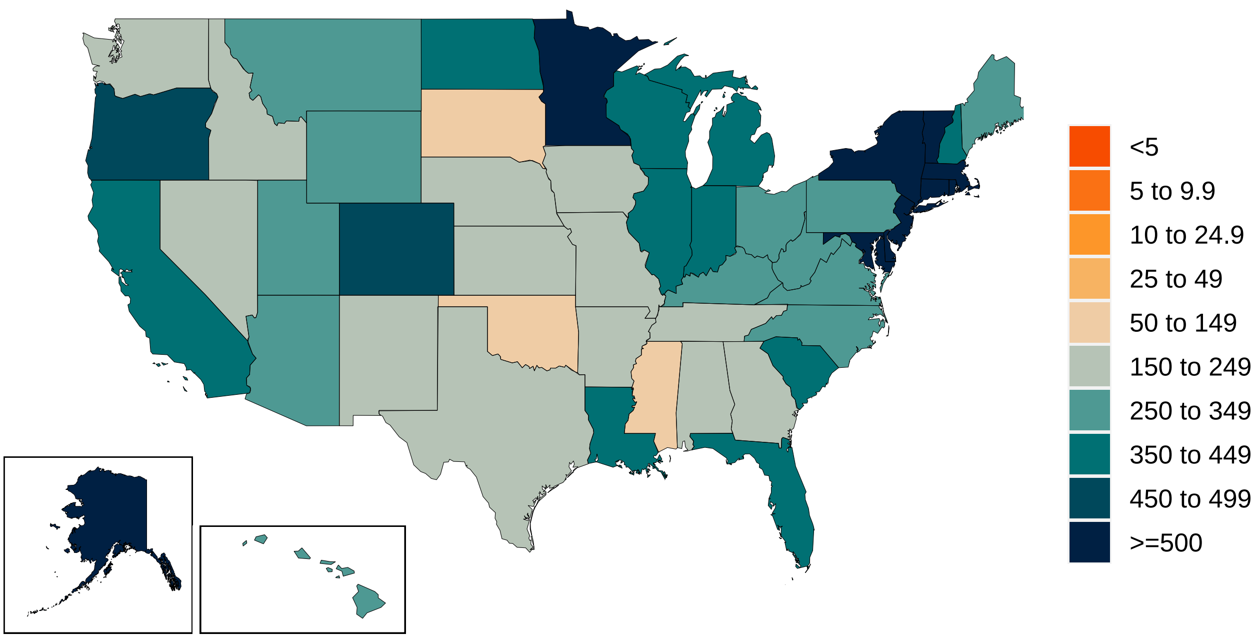


Figure 15. Increase in the risk of death due to pneumonia on February 1 2020 compared to August 1 2020

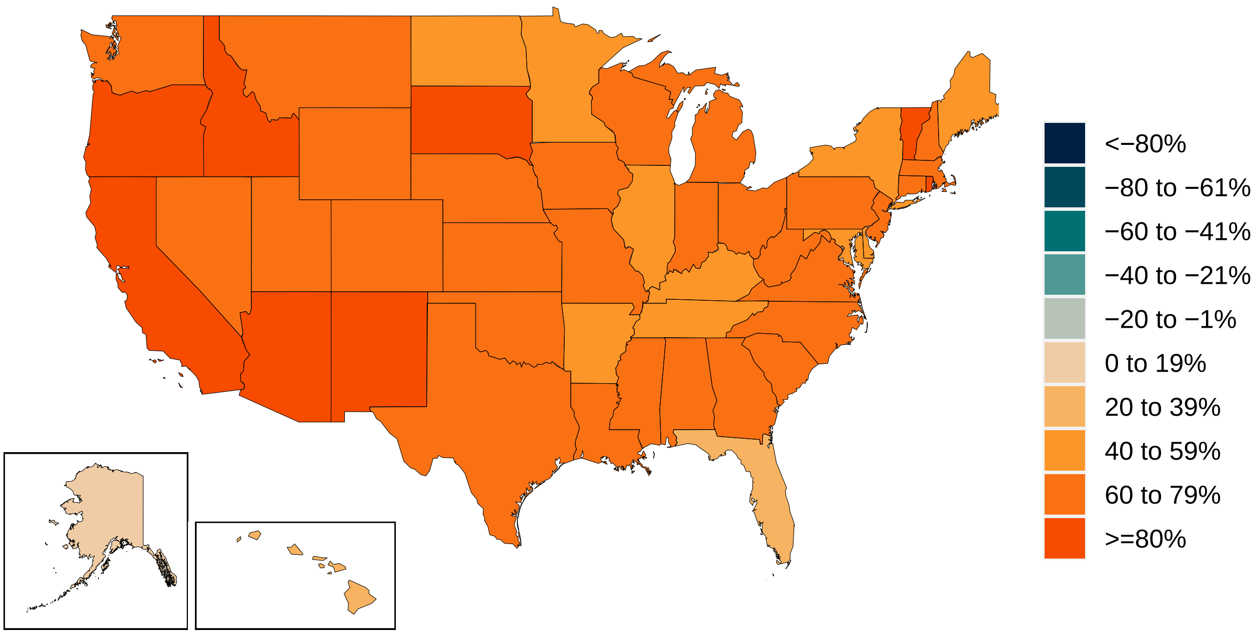


Table 3. The SEIR model uses variant-specific estimates of vaccine efficacy at preventing symptomatic disease and at preventing infection. We use data from clinical trials directly, where available, and make estimates otherwise. More information can be found on our website (http://www.healthdata.org/node/8584).

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 & P.1	Efficacy at preventing infection: B.1.351 & P.1
AstraZeneca	75%	52%	10%	7%
CanSinoBio	66%	57%	50%	44%
CoronaVac	50%	43%	38%	33%
Johnson & Johnson	72%	72%	64%	56%
Moderna	94%	85%	72%	62%
Novavax	89%	77%	49%	43%
Pfizer/BioNTech	95%	86%	72%	63%
Sinopharm	73%	63%	56%	48%
Sputnik V	92%	80%	70%	61%
Other mRNA vaccines	95%	83%	72%	63%
All other vaccines	75%	65%	57%	50%

Figure 16. This figure shows the estimated proportion of the adult (18+) population that is open to receiving a COVID-19 vaccine based on Facebook survey responses (yes and yes, probably).

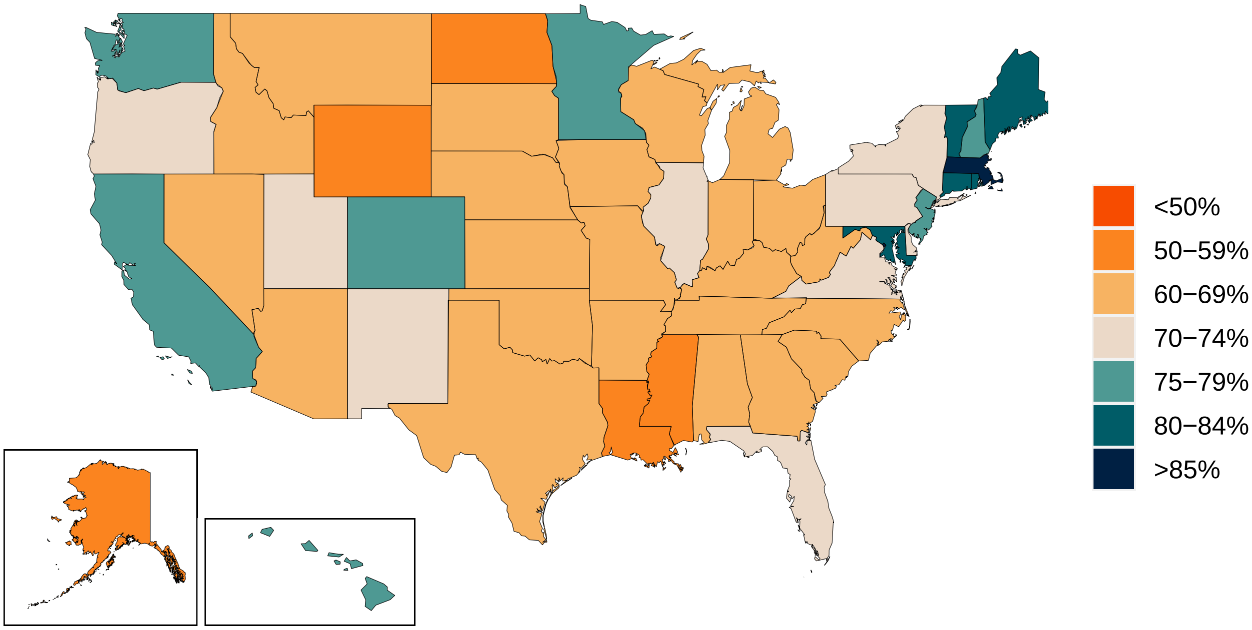
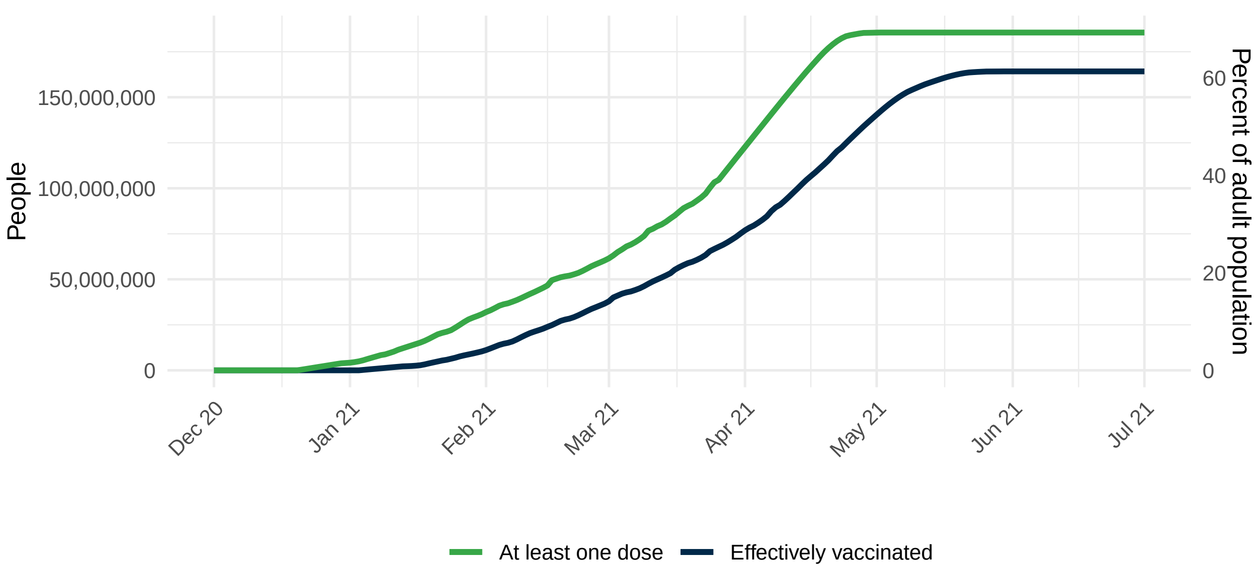


Figure 17. The number of people who receive any vaccine and those who are effectively vaccinated and protected against disease, accounting for efficacy, loss to follow up for two-dose vaccines, partial immunity after one dose, and immunity after two doses.



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.
- People who receive vaccines stop wearing masks three months after they have been fully vaccinated.

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 people who receive vaccines stop wearing masks one month after they have been fully vaccinated.

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 18. Cumulative COVID-19 deaths until July 01, 2021 for three scenarios

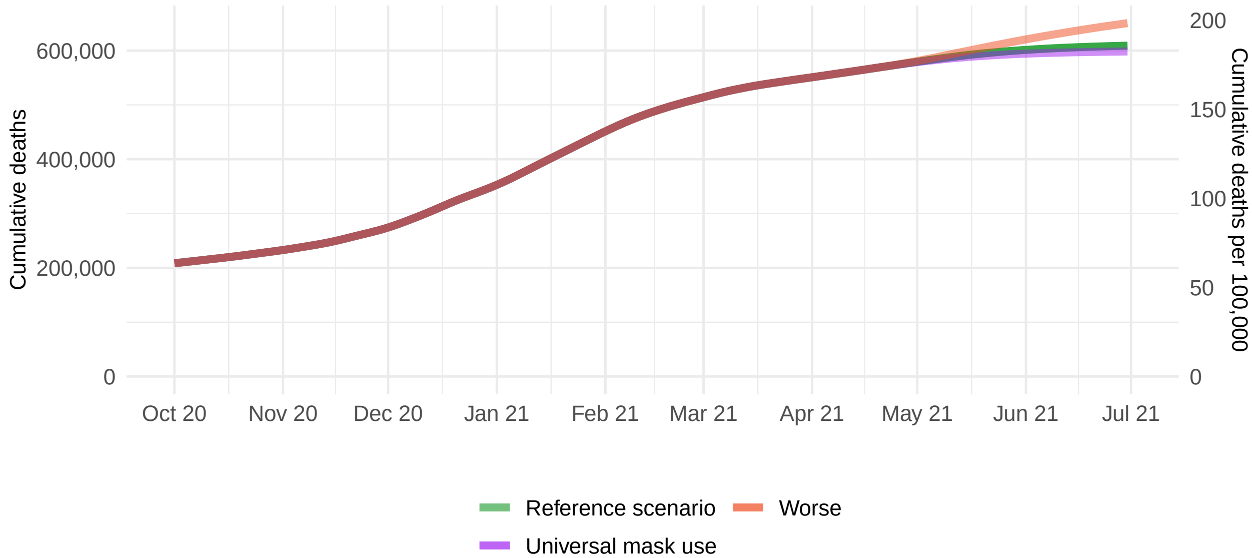


Figure 19. Daily COVID-19 deaths until July 01, 2021 for three scenarios

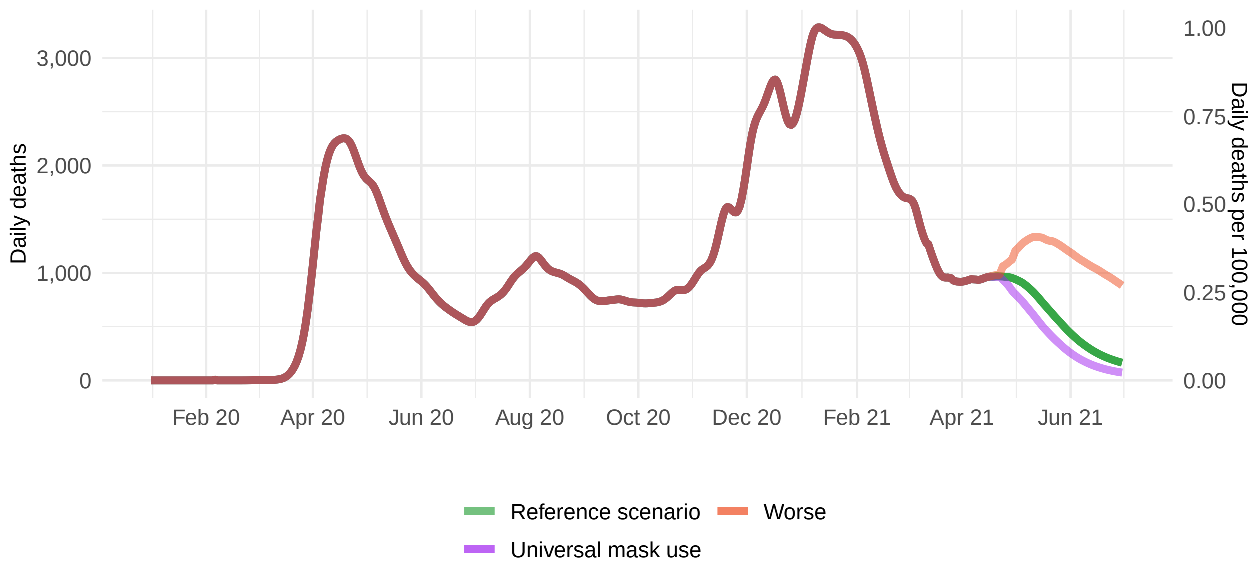


Figure 20. Daily COVID-19 infections until July 01, 2021 for three scenarios

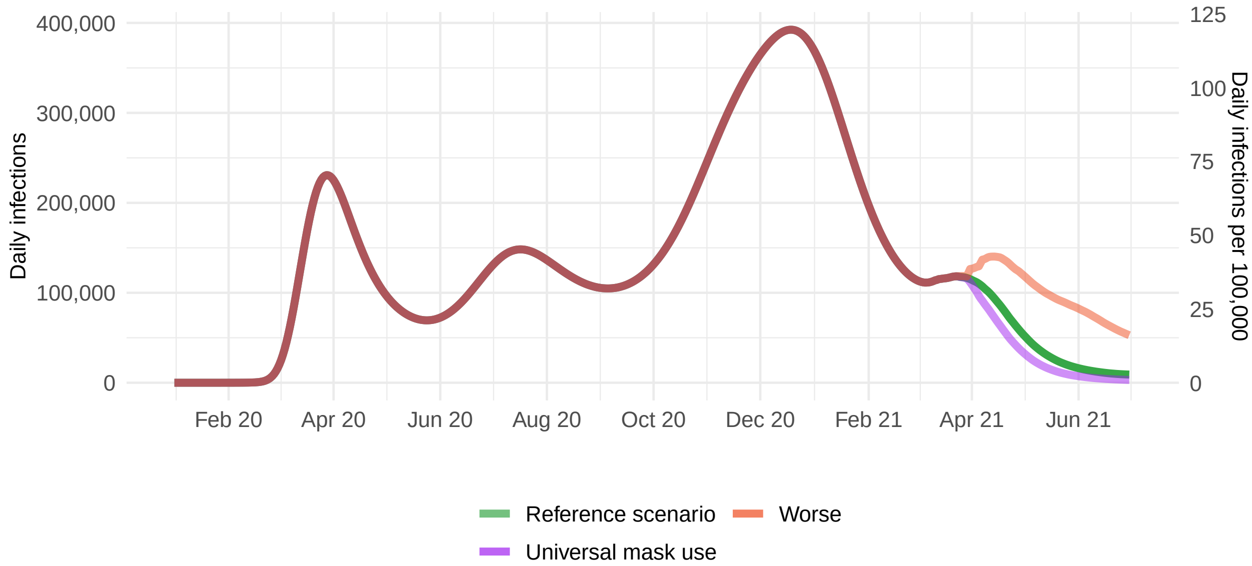


Figure 21. Comparison of reference model projections with other COVID modeling groups. For this comparison, we are including projections of daily COVID-19 deaths from other modeling groups when available: Delphi from the Massachussets Institute of Technology (Delphi; https://www.covidanalytics.io/home), Imperial College London (Imperial; https://www.covidsim.org), The Los Alamos National Laboratory (LANL; https://covid-19.bsvgateway.org/), the SI-KJalpha model from the University of Southern California (SIKJalpha; https://github.com/scc-usc/ReCOVER-COVID-19), and the CDC Ensemble Model (CDC; https://www.cdc.gov/coronavirus/2019-ncov/covid-data/forecasting-us.html#ensembleforecast.) Daily deaths from other modeling groups are smoothed to remove inconsistencies with rounding. Regional values are aggregates from availble locations in that region.

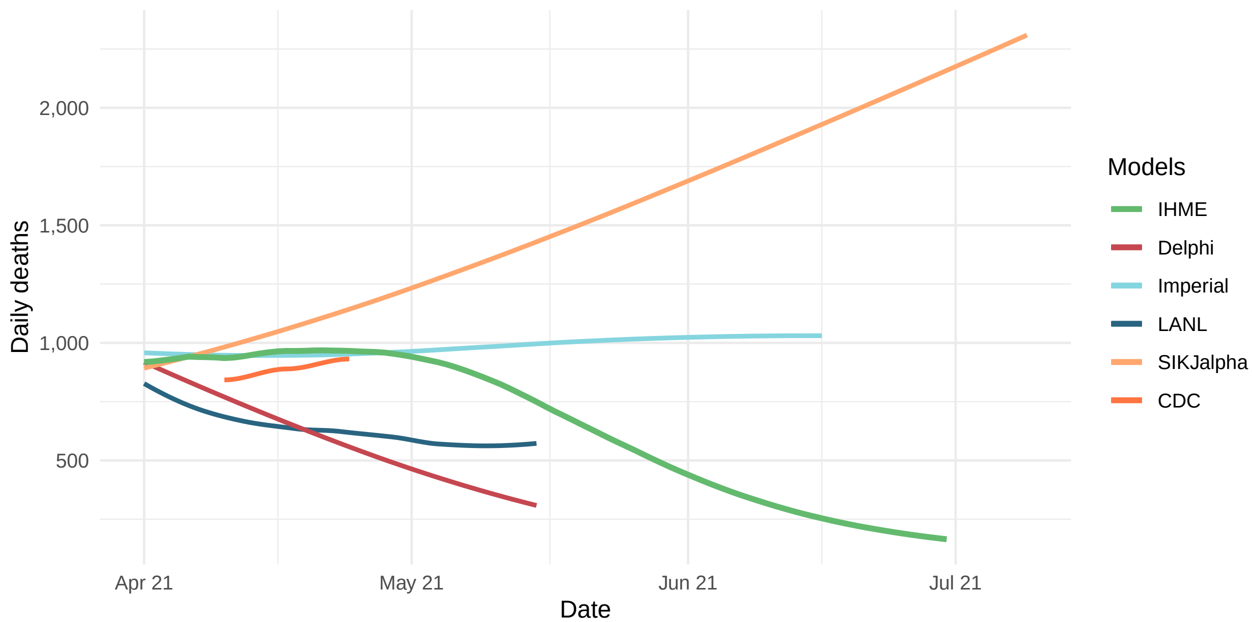


Figure 22. The estimated inpatient hospital usage is shown over time. The percent of hospital beds occupied by COVID-19 patients is color coded based on observed quantiles of the maximum proportion of beds occupied by COVID-19 patients. Less than 5% is considered *low stress*, 5-9% is considered *moderate stress*, 10-19% is considered *high stress*, and greater than 20% is considered *extreme stress*.

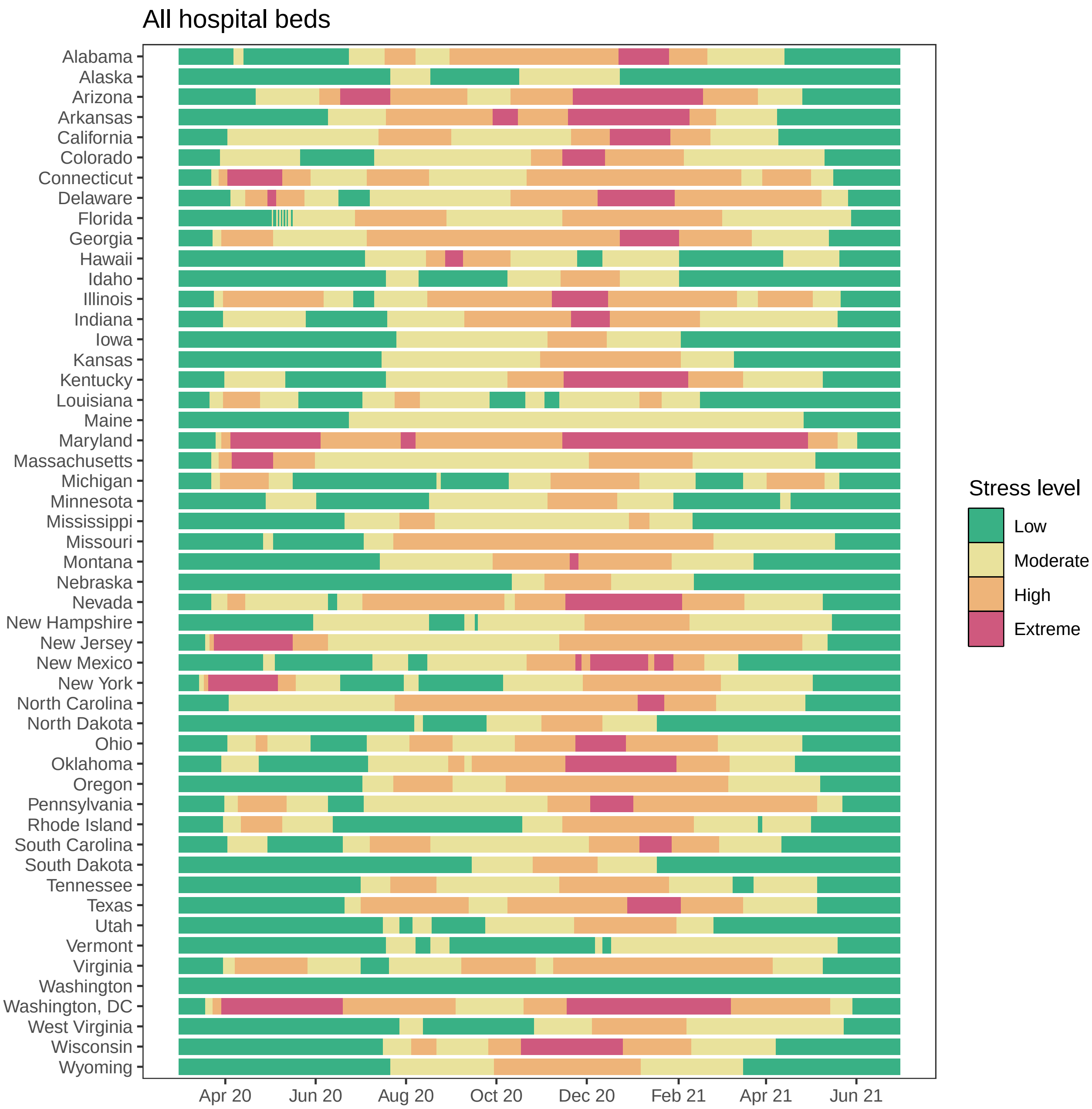
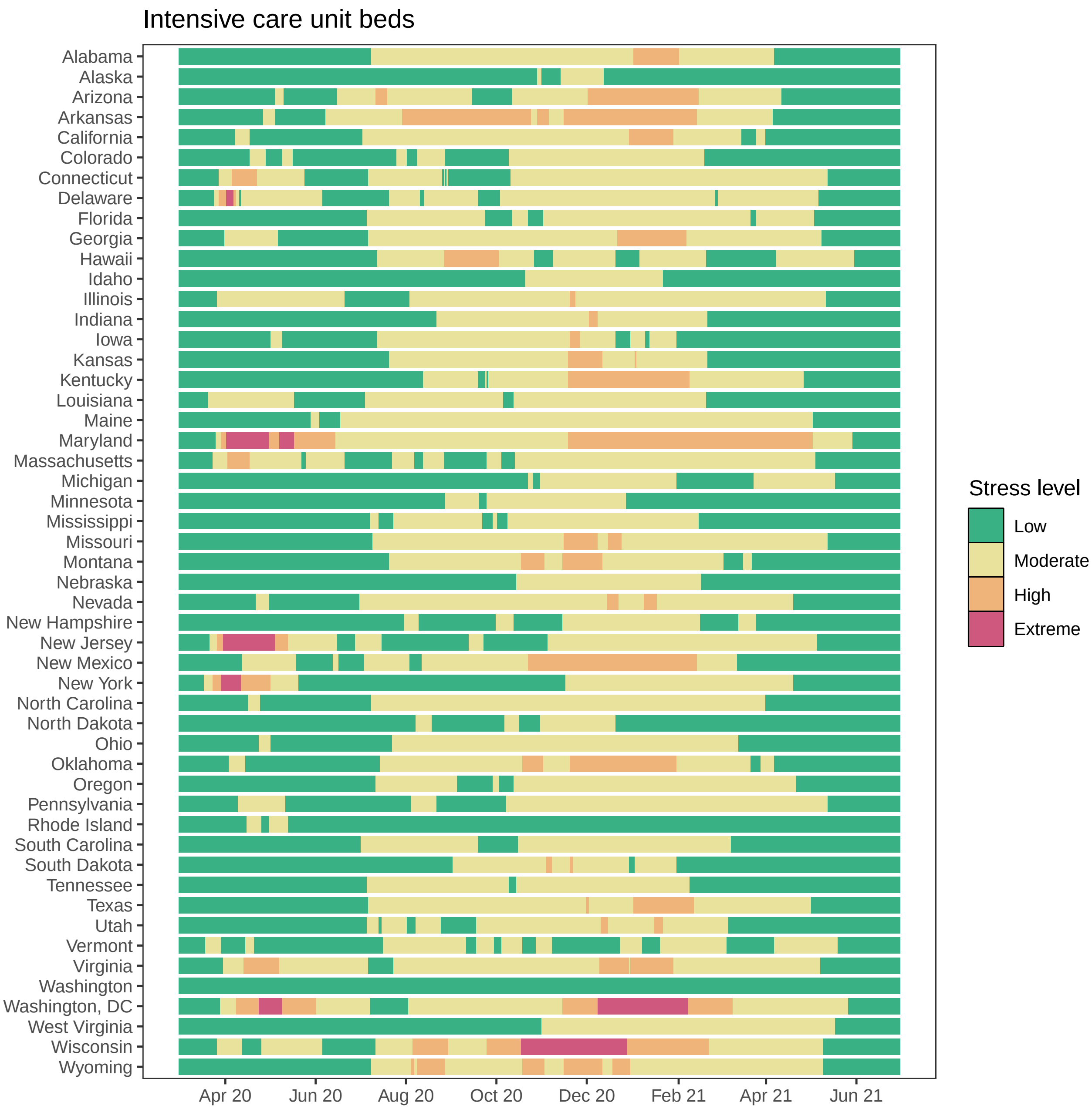


Figure 23. The estimated intensive care unit (ICU) usage is shown over time. The percent of ICU beds occupied by COVID-19 patients is color coded based on observed quantiles of the maximum proportion of ICU beds occupied by COVID-19 patients. Less than 10% is considered *low stress*, 10-29% is considered *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.