COVID-19 Results Briefing

The United States of America

January 22, 2021

This document contains summary information on the latest projections from the IHME model on COVID-19 in the United States of America. The model was run on January 21, 2021, with data through January 19, 2021.

The trends in hospitalizations, which are much less affected by holiday-related reporting disruptions, suggest that the epidemic is at its peak. Five states still have effective R greater than 1, but most of these are very close to the peak, including California. Seasonality and increasing vaccination rates should lead to slow declines in the daily death rates in the coming weeks and months. Our forecasts, however, do not take into account the potential spread of Variant B.1.1.7, first identified in the UK, or Variant B.1.351, first identified in South Africa, which could extend the fall/winter surge into late spring if they spread in the US. We do not expect the US to reach a level of herd immunity that would prevent a third wave next winter. This is because a quarter of Americans state they will not take the vaccine and a further quarter state they are unsure. In addition, we do not have clear evidence on how much vaccination stops transmission as opposed to preventing severe disease and death. Scale-up of vaccination does mean, however, that the number of deaths in a third wave, if it occurs, would be greatly reduced. Key strategies for both managing the end of this fall/winter surge and mitigating the risk of new variants continue to include emphasizing expanding mask use from 76% to 95%, encouraging social distancing through appropriate mandates, and accelerating vaccination.

Current situation

- Daily reported cases in the last week decreased to 211,600 per day on average compared to 243,500 the week before (Figure 1).
- Daily deaths in the last week increased to 3,240 per day on average compared to 3,160 the week before (Figure 2). COVID-19 continues to be the number 1 cause of death in the US this week (Table 1).
- Effective R, computed using estimates of daily infections from cases divided by the infection detection rate, hospital admissions divided by the infection hospitalization rate, and deaths divided by the infection-fatality rate with the appropriate lags for each, is greater than 1 in only five states: California, South Carolina, Virginia, Vermont, and Maine (Figure 3).
- We estimated that 17% of people in the US have been infected as of January 19 (Figure 4).
- The daily death rate is greater than 4 per million in 46 states (Figure 6).

Trends in drivers of transmission

- In the last week, mandates have remained constant (Table 2).

- Mobility last week was 31% lower than the pre-COVID-19 baseline (Figure 8). Mobility was near baseline (within 10%) in South Dakota and Wyoming. Mobility was lower than 30% of baseline in in 22 states.
- As of January 19, we estimated that 76% of people always wore a mask when leaving their home (Figure 9). In all states mask use was over 50%.
- There were 398 diagnostic tests per 100,000 people on January 19 (Figure 10).
- In the US, 50.8% of people say they would accept a vaccine for COVID-19 and 25.5% say they are unsure if they would accept one. The fraction of the population who are open to receiving a COVID-19 vaccine ranges from 68% in Mississippi to 85% in the District of Columbia (Figure 12).
- We expect that 157 million people will be vaccinated by May 1 (Figure 13). With faster scale-up, the number vaccinated could reach 178 million people.

Projections

- In our **reference scenario**, which represents what we think is most likely to happen, our model projects 569,000 cumulative deaths on May 1, 2021. This represents 168,000 additional deaths from January 19 to May 1 (Figure 14). Daily deaths will likely stay relatively stable around 3,250 deaths per day on average until early February (Figure 15).
- By May 1, 2021, we project that 42,800 lives will be saved by the projected vaccine rollout. If rapid rollout of vaccine is achieved, 52,400 lives will be saved compared to a no-vaccine scenario. As compared to a no-vaccine scenario, rapid rollout targeting high-risk individuals only could save 59,800 lives (Figure 14).
- If **universal mask coverage (95%)** were attained in the next week, our model projects 22,000 fewer cumulative deaths compared to the reference scenario on May 1, 2021 (Figure 14).
- Under our **mandates easing scenario**, our model projects 621,000 cumulative deaths on May 1, 2021 (Figure 14).
- By May 1 in the reference scenario we expect 36% to be immune. The impact of vaccination on immunity levels is based on the assumption that vaccination effectiveness in blocking transmission is 50% of vaccine effectiveness in preventing severe disease (Figure 17).
- Figure 21 compares our reference scenario forecasts to other publicly archived models. All models except the Los Alamos National Labs model are converging on forecasts that suggest declining daily death tolls reaching less than a 1,000 per day sometime between late March and late April.
- At some point from January through May 1, 40 states will have high or extreme stress on hospital beds (Figure 22). At some point from January through May 1, 46 states will have high or extreme stress on ICU capacity (Figure 23).

Model updates

This week we have fully revised the way we estimate past daily infections in a modeling framework that leverages data from seroprevalence surveys, daily cases, daily deaths, and, where available, daily hospitalizations. We have not revised the way our projections are being made. The changes introduced affect the part of our model that estimates infections from the beginning of the pandemic to the present day.

This new approach to estimating infections in the past has several advantages. First, it puts more emphasis on the recent trend in cases and hospitalizations than our previous approach. Second, it is more robust to reporting lags in any one of the three main indicators. Third, for locations with small populations, by synthesizing data on all three indicators (cases, deaths, and hospitalizations), the results are less sensitive to fluctuations due to chance or measurement error in any one of the indicators. Fourth, our new approach leverages the information collected through seroprevalence surveys to validate the estimates of daily infections.

Why did we change our approach?

Our COVID-19 forecast model depends on estimating daily infections and effective R since March 2020 for each location. We estimate the relationship between daily infections to date and covariates (such as mobility, mask use, testing per capita, and social distancing mandates) and use that relationship to forecast effective R in the future. Up until this week's release, our method for estimating daily infections in the past was anchored on daily deaths because in the first months of the pandemic, there was less measurement error in daily deaths than in daily cases. Over the past two months, and particularly over various holiday periods across the world, there has been clear evidence of significant delays in reporting of cases and deaths. These reporting lags result in artificial dips and then artificial surges due to catch-up reporting. In contrast, in places where daily hospital admissions for COVID-19 are reported in a timely manner such as the US HHS, daily hospital admissions have not exhibited large reporting lags. Throughout the pandemic, we have also seen that the trend measured through daily hospitalizations has been much less affected by the availability of testing than the trend observed in cases.

More details on the new approach

We use 884 seroprevalence surveys which provide information on the proportion of a population that has SARS-COV2 antibodies in their blood, and we relate them to estimates of cumulative cases, hospitalizations, and deaths for the same time period in these populations to derive measurements of three quantities of interest: 1) the infection detection rate (IDR), 2) the infection hospitalization rate (IHR) and 3) the infection-fatality rate (IFR). Because the IHR and the IFR are strongly related to age, we analyze the age-standardized IHR and IFR. For each of the three measures, we have developed predictive models so that we can have estimates for all locations, not just those that have seroprevalence surveys.

- IDR: The key covariate in this model is testing rates per capita. This model also includes location random effects, so the IDR is tuned to the available data for each location. Overall, the data suggest the IDR has increased across all locations from very low levels, as low as 1%, at the beginning of the pandemic to much higher levels, exceeding over 50% in some high-income

settings. The model also includes corrections for seroprevalence surveys that may be biased compared to the general population such as blood donors.

- IHR: The IHR varies considerably across countries and states or regions within a country, likely reflecting variation in clinical practice. We have tested and found that there isn't a consistent relationship between the IHR and time, indicating that while clinical practice varies across locations, there has not been a substantial shift in the IHR over time within each location. The model also includes corrections for seroprevalence surveys that may be biased compared to the general population such as blood donors.
- IFR: As noted in previous briefs, the age-standardized IFR has changed over time and is highly correlated with population levels of obesity. The final model includes time, obesity prevalence, corrections for potentially biased sources of seroprevalence, and location random effects.

Our new approach includes three main steps.

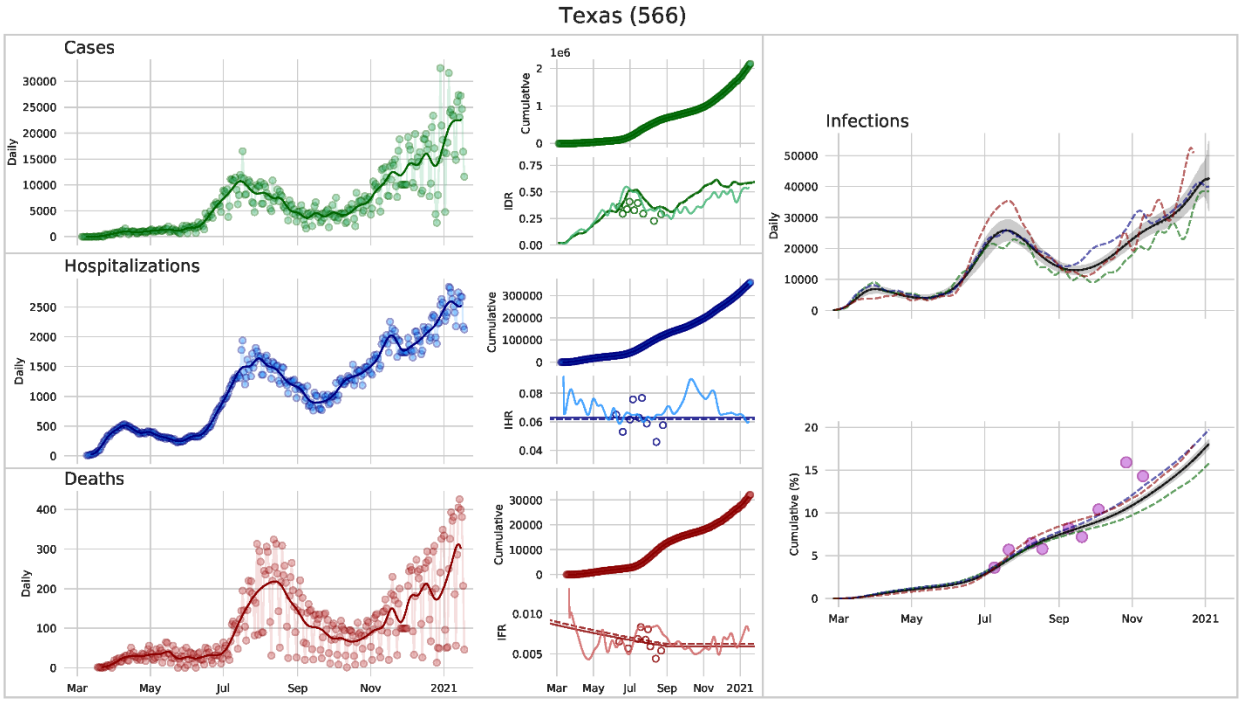
First, we produce three distinct time series of infections per day:

- Using cases: To estimate infections per day, we convert the smoothed time series of cases per day by the IDR and shift it back 11 days. This way we capture the lag between the time of infection and being diagnosed as a case.
- Using hospitalizations: We divide the smoothed time series of hospitalizations per day by the IHR and shift everything back by 11 days.
- Using deaths: We divide the smoothed time series of deaths per day by the IFR. These are shifted back by 24 days.

Second, we pool the three time series to generate our best estimate of the trend in infections per day from March to the present.

Third, we compare the calculated the cumulative infections from the four series of infections per day (based on cases, hospitalizations, and deaths and the final pooled estimate) to the available seroprevalence data; given the methods employed, on average they match the seroprevalence data.

To explore this visually, the approach is summarized in a plot like the one shown below for each location. The left-hand side shows daily cases in green, hospital admissions in blue, and deaths in red. As mentioned above, a smoothed line is fit to each of these time series. In the middle column of figures, the estimated IDR is shown in green, the IHR in blue, and the IFR in red. The graphs also show data from seroprevalence surveys, when available. The right-hand side graphs show infections. The top right graph shows the three estimated time series of infections per day (based on cases, hospitalizations, and deaths, respectively), and the black line shows the pooled estimate with uncertainty. The bottom right plot shows the estimated cumulative infections based on each time series, and the black line shows the estimated cumulative infections based on the pooled estimate. The purple dots represent the seroprevalence data, where available.


Texas (566)
Cases
Daily
Cumulative
1e6
IDR
Hospitalizations
Daily
Cumulative
IHR
Deaths
Daily
Cumulative
IFR
Mar
May
Jul
Sep
Nov
2021
Infections
Daily
Cumulative (%)

Current situation

Figure 1. Reported daily COVID-19 cases

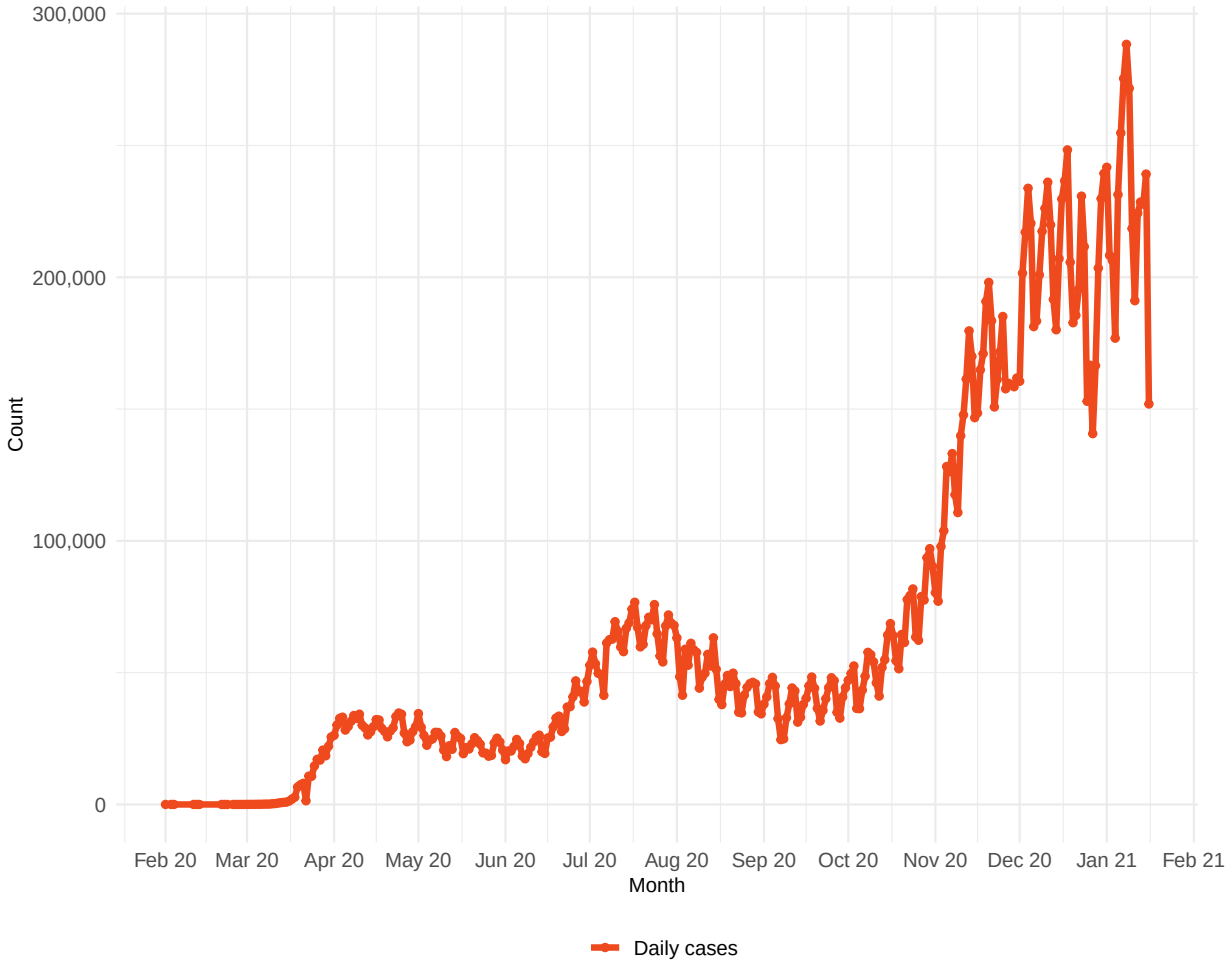


Table 1. Ranking of COVID-19 among the leading causes of mortality this week, assuming uniform deaths of non-COVID causes throughout the year

Cause name	Weekly deaths	Ranking
COVID-19	22,658	1
Ischemic heart disease	10,724	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 2a. Reported daily COVID-19 deaths

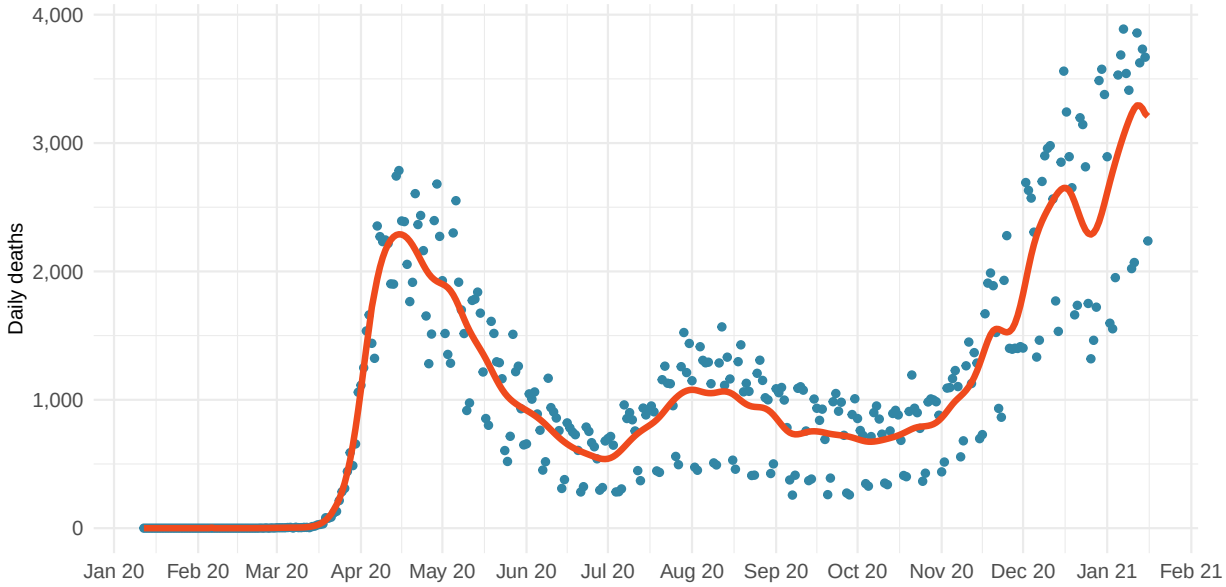


Figure 2b. Estimated cumulative deaths by age group

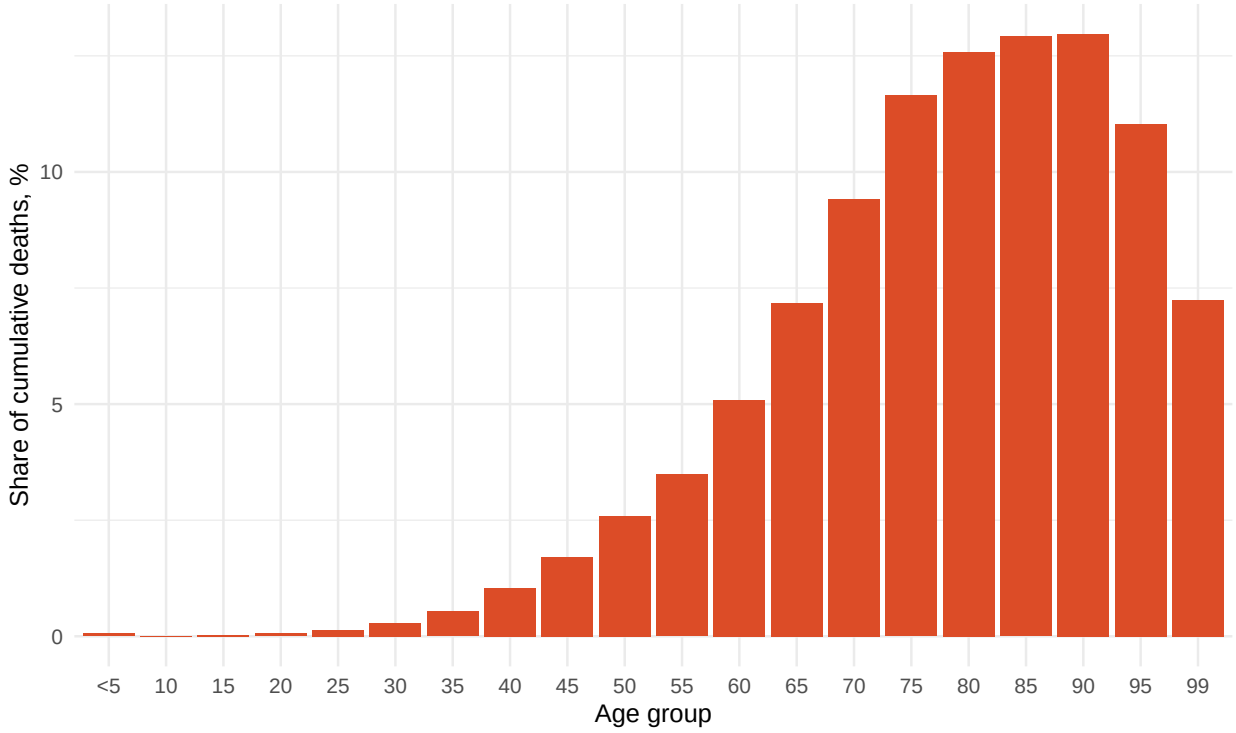


Figure 3. Mean effective R on January 08, 2021. The estimate of effective R is based on the combined analysis of deaths, case reporting, and hospitalizations where available. Current reported cases reflect infections 11-13 days prior, so estimates of effective R can only be made for the recent past. Effective R less than 1 means that transmission should decline, all other things being held the same.

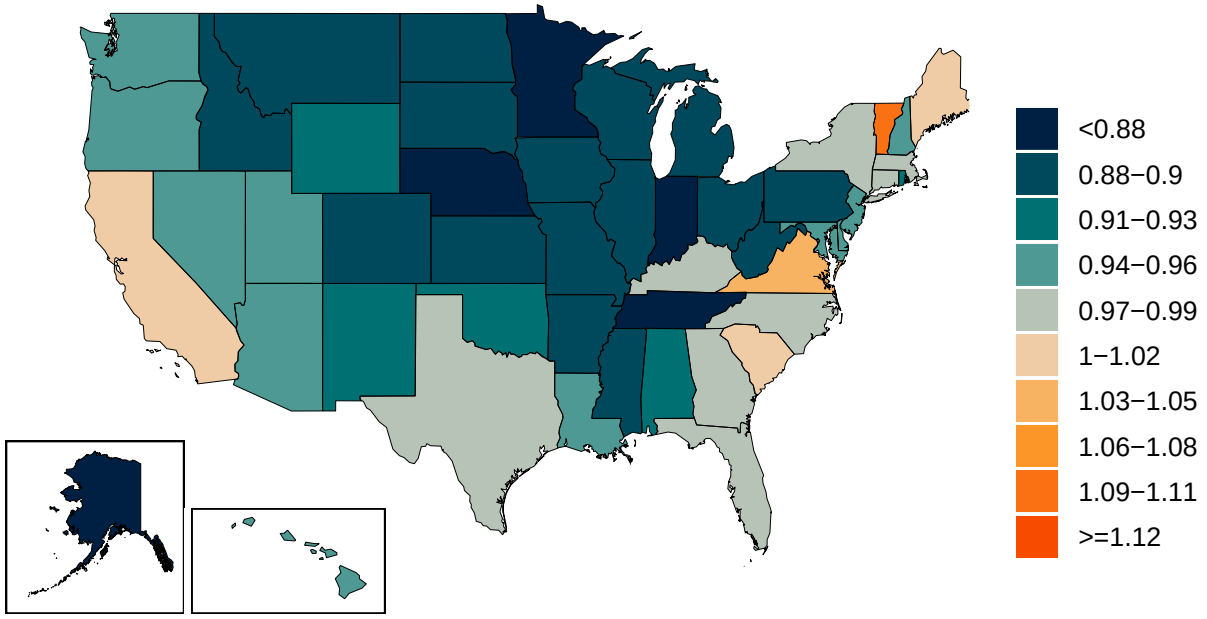


Figure 4. Estimated percent of the population infected with COVID-19 on January 19, 2021

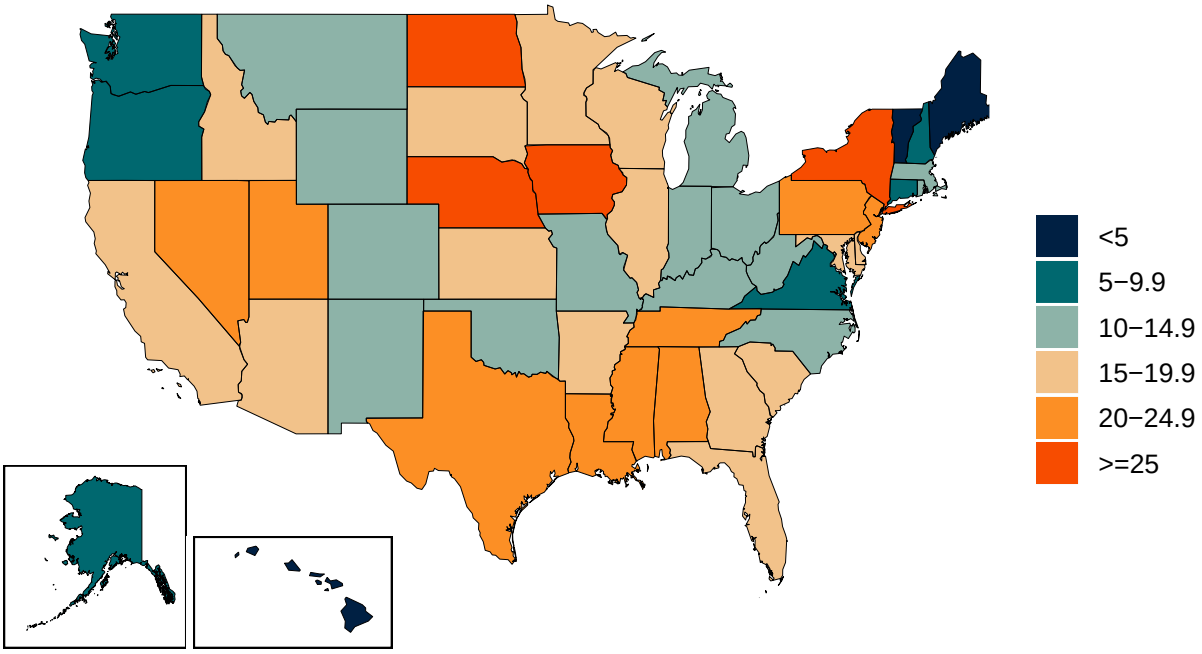


Figure 5. Percent of COVID-19 infections detected. This is estimated as the ratio of reported daily COVID-19 cases to estimated daily COVID-19 infections based on the SEIR disease transmission model.

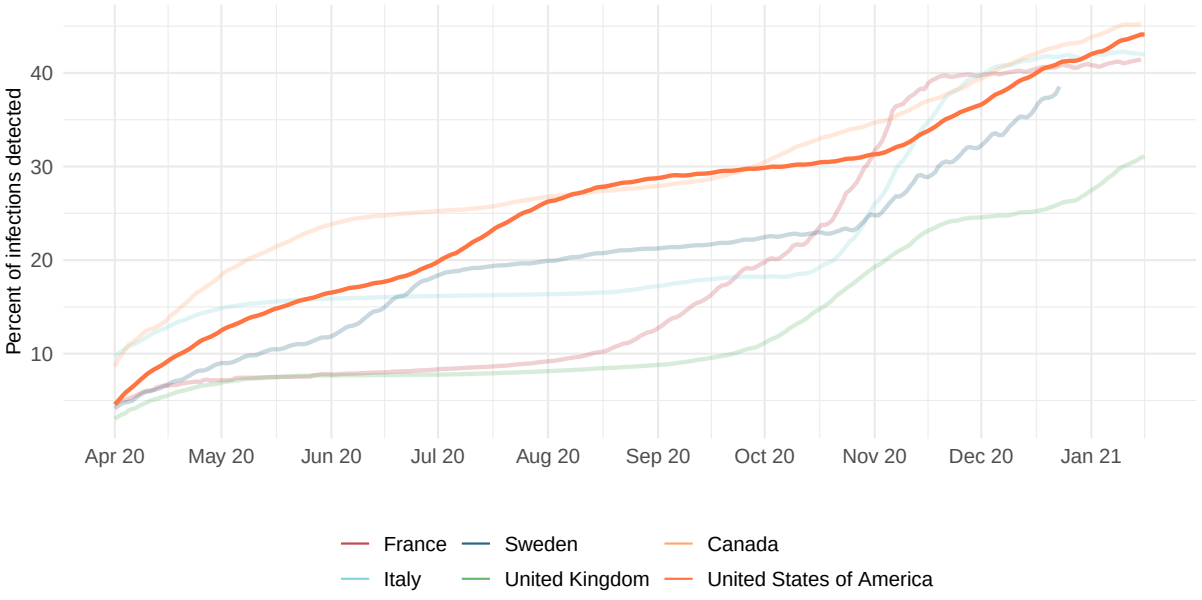
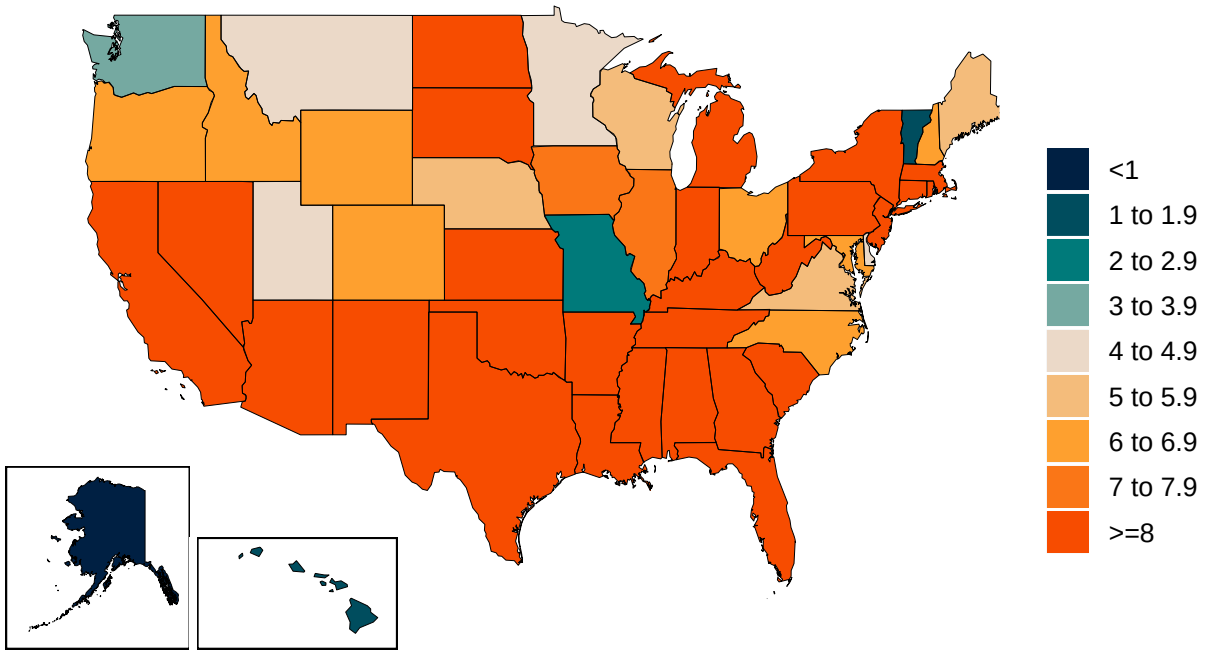


Figure 6. Daily COVID-19 death rate per 1 million on January 19, 2021



Critical drivers

Table 2. Current mandate implementation

Figure 7. Total number of social distancing mandates (including mask use)

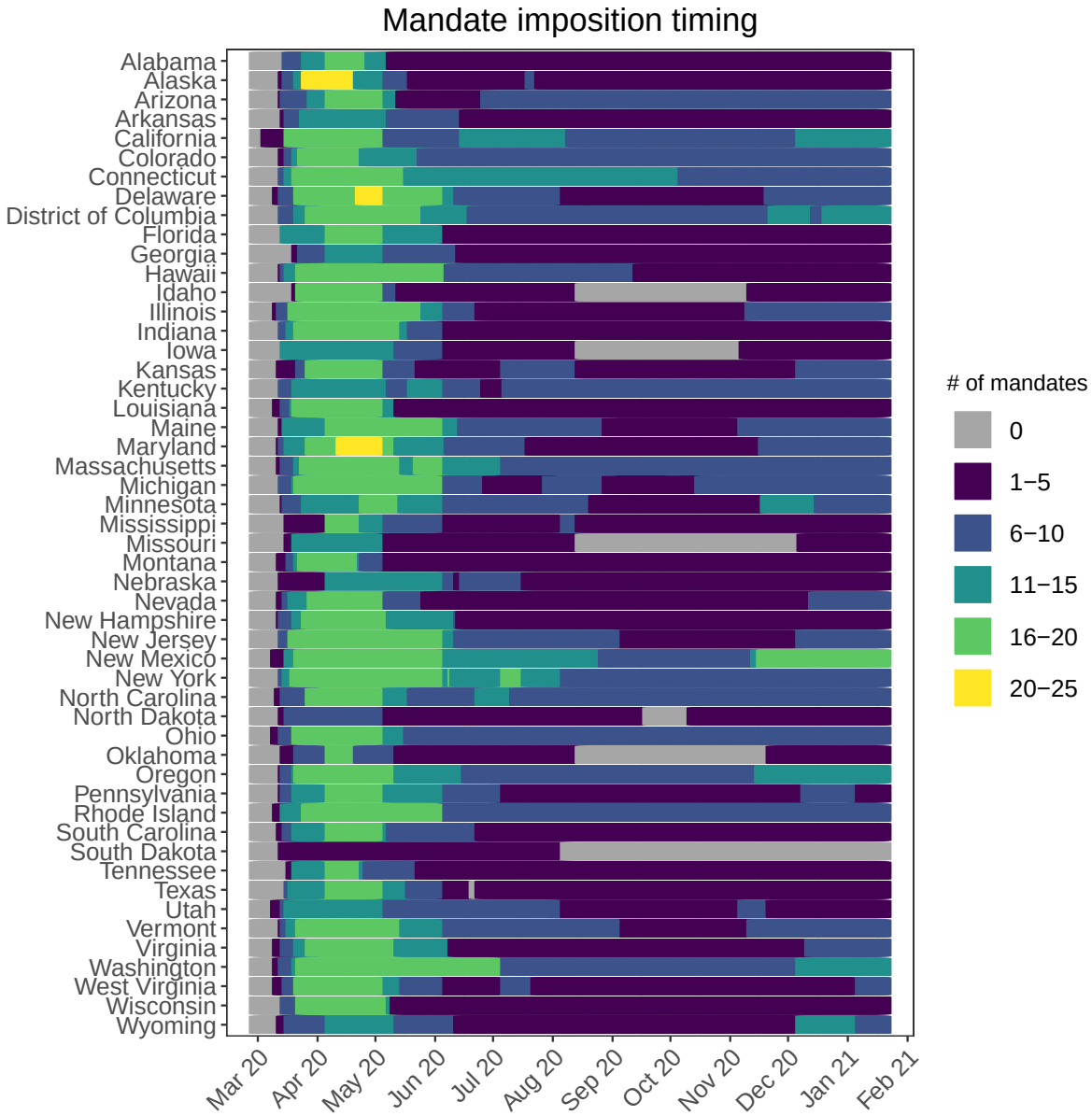


Figure 8a. Trend in mobility as measured through smartphone app use compared to January 2020 baseline

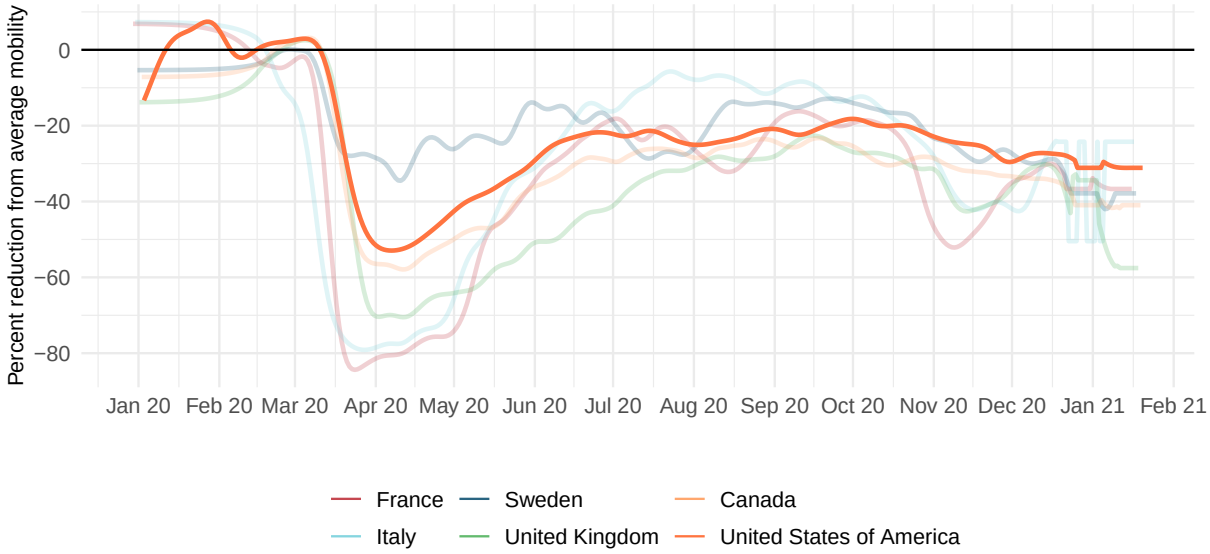


Figure 8b. Mobility level as measured through smartphone app use compared to January 2020 baseline (percent) on January 19, 2021

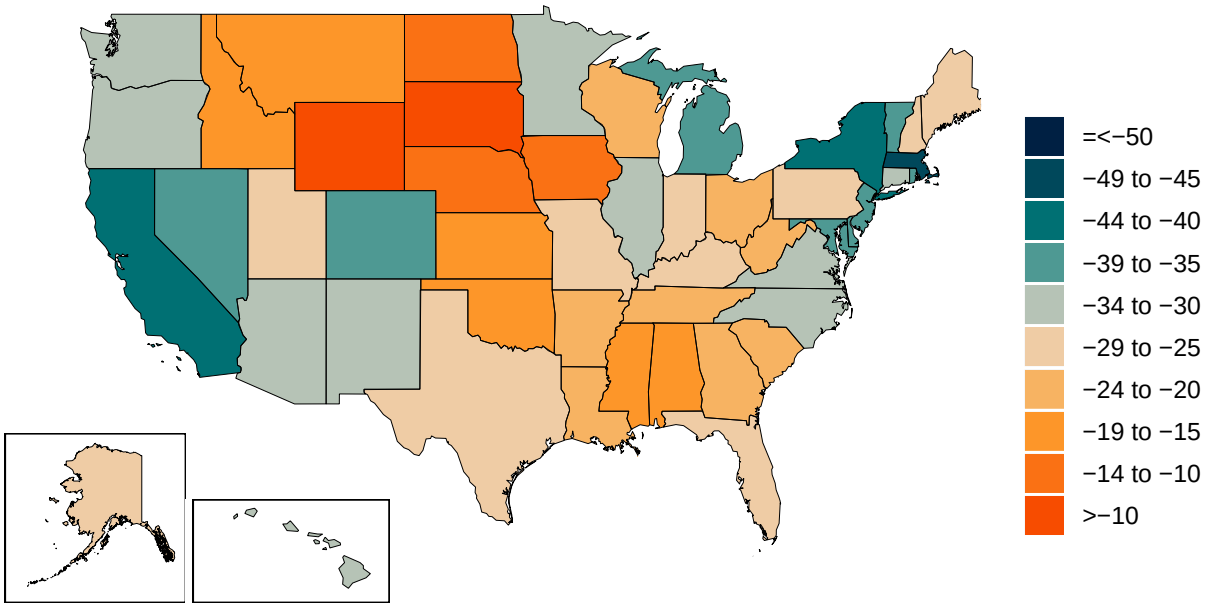


Figure 8c. Trend in visits to restaurants as measured through cell phone data compared to 2019 average

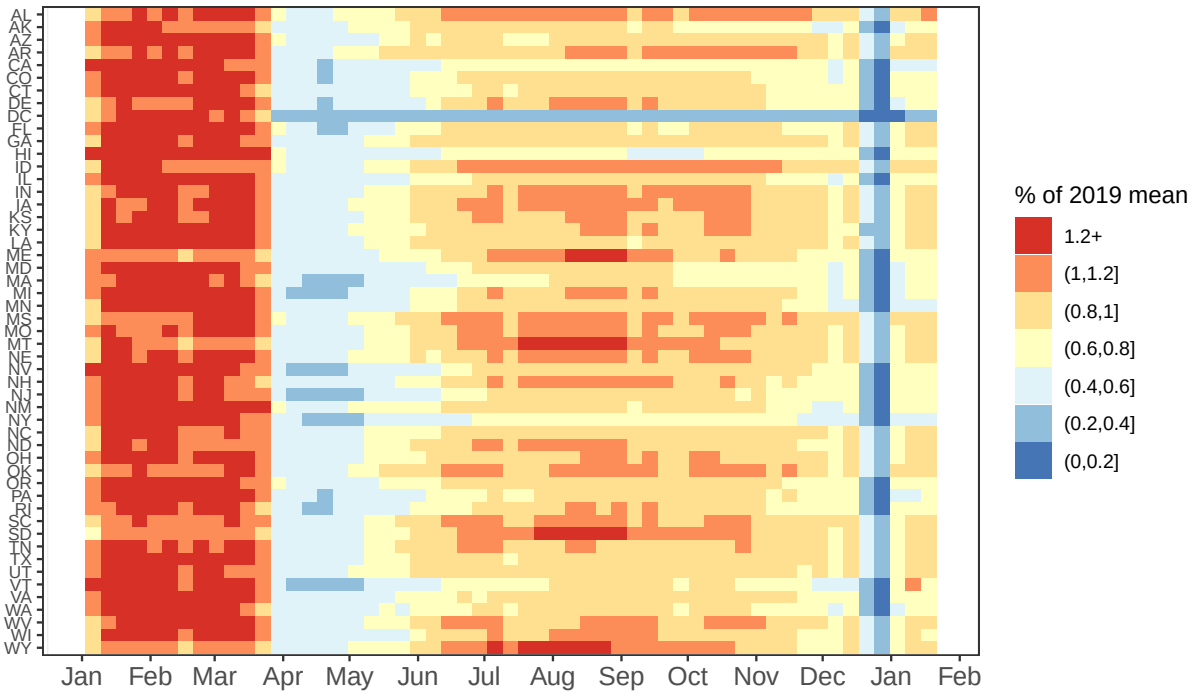


Figure 8d. Trend in visits to bars as measured through cell phone data compared to 2019 average

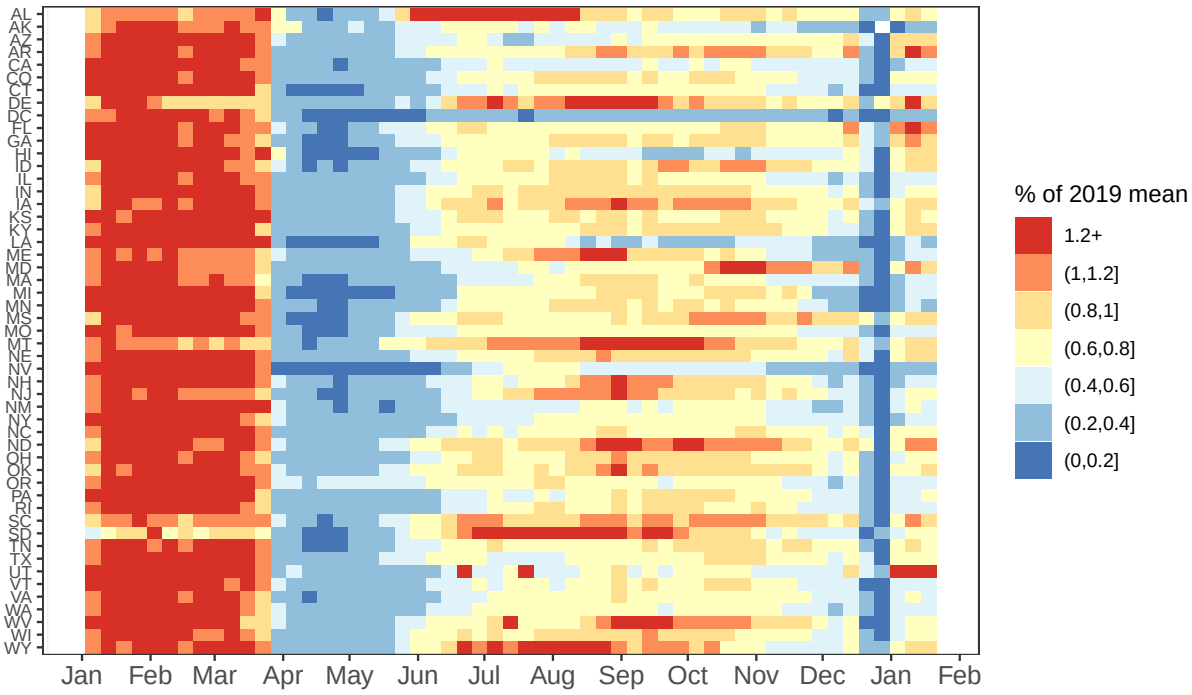


Figure 8e. Trend in visits to elementary & secondary schools as measured through cell phone data compared to 2019 average

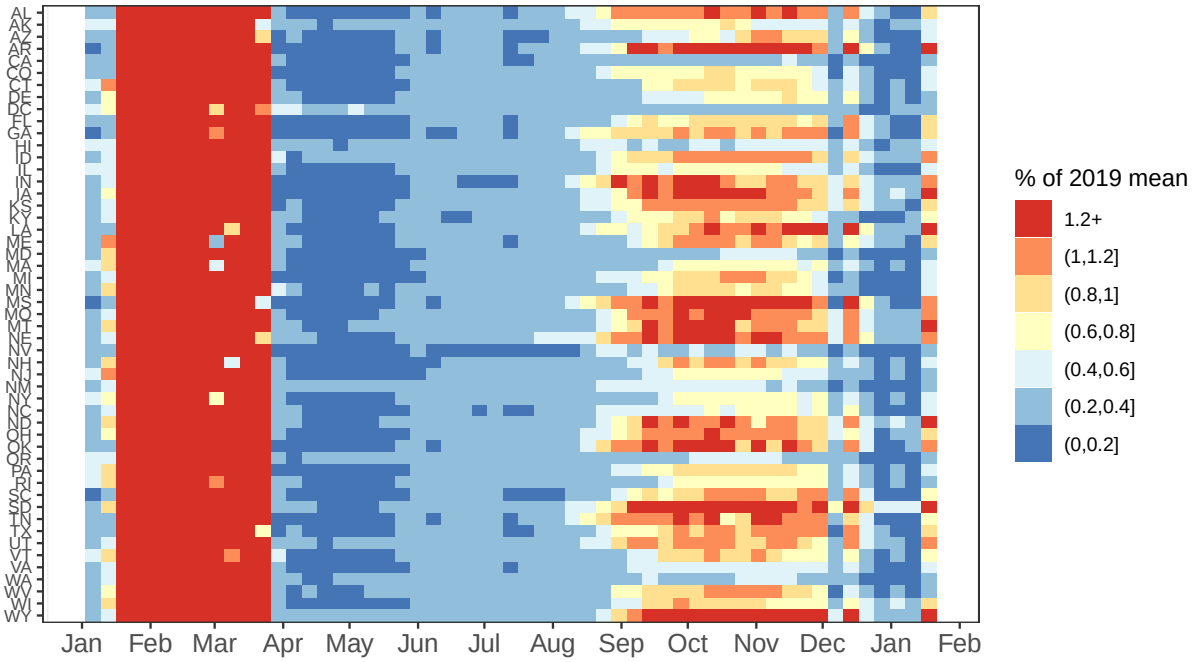


Figure 8f. Trend in visits to department stores as measured through cell phone data compared to 2019 average

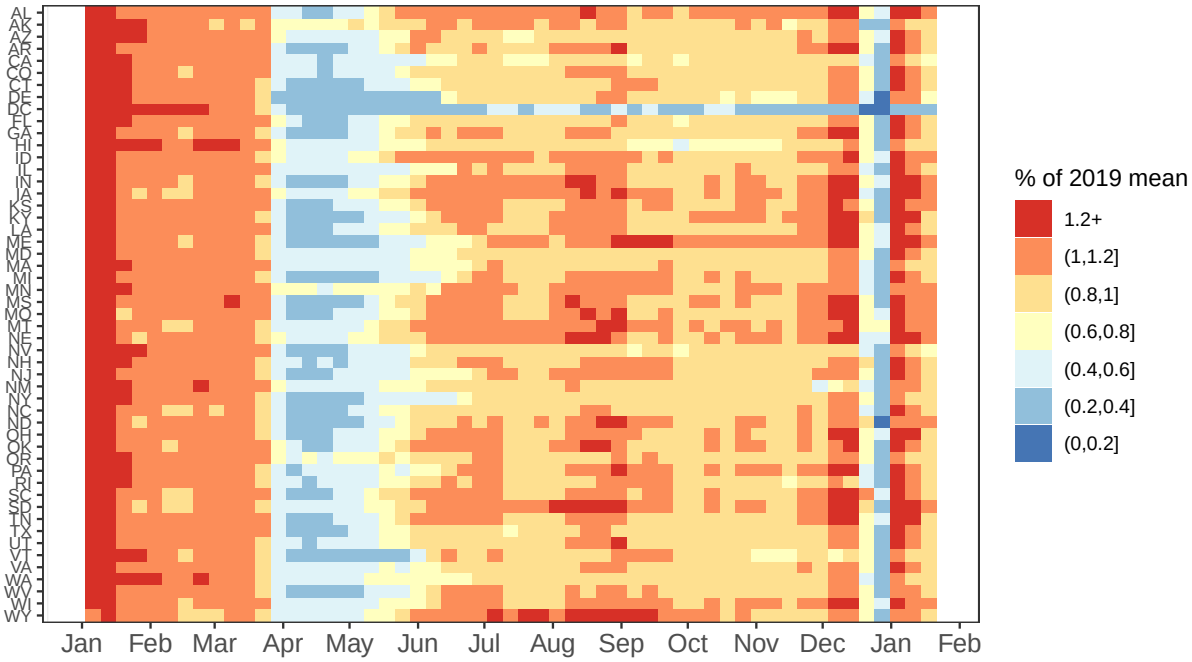


Figure 9a. Trend in the proportion of the population reporting always wearing a mask when leaving home

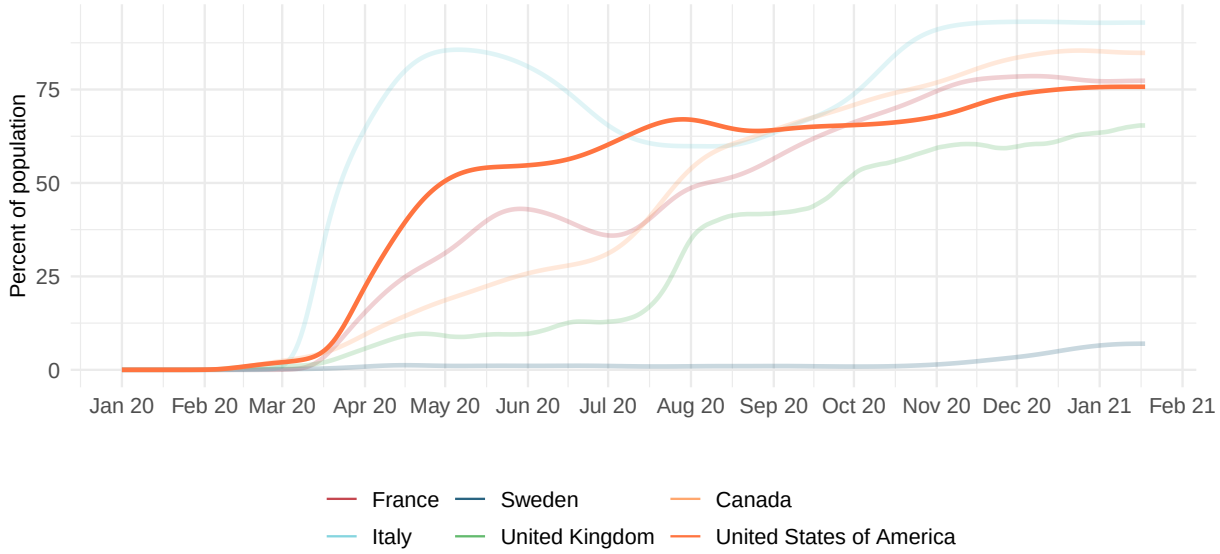


Figure 9b. Proportion of the population reporting always wearing a mask when leaving home on January 19, 2021

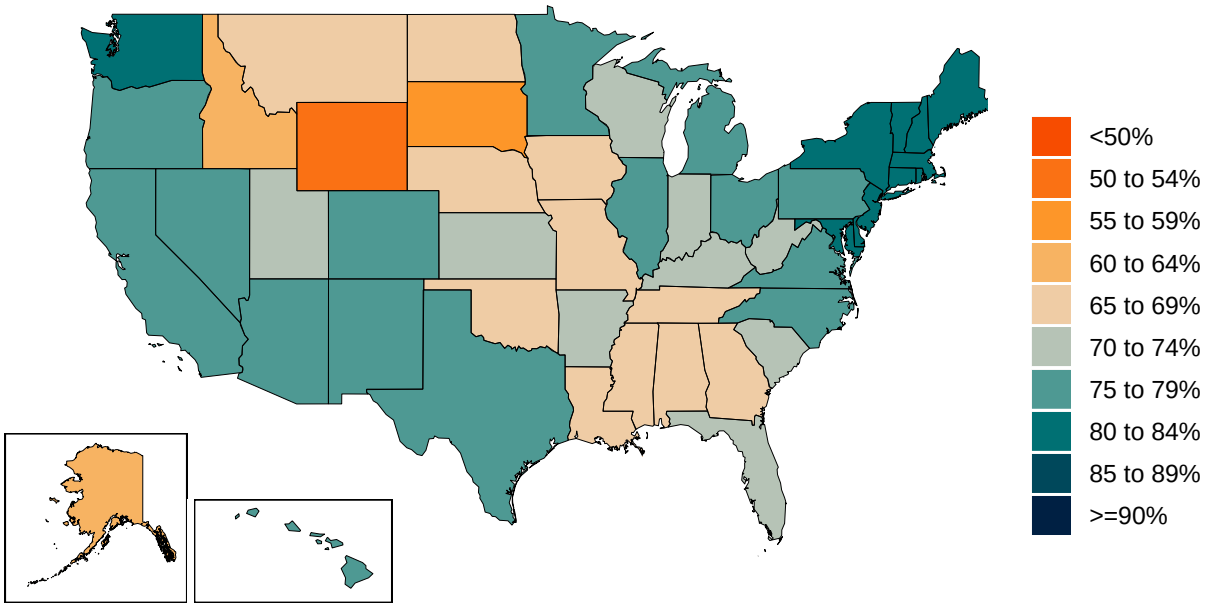


Figure 10a. Trend in COVID-19 diagnostic tests per 100,000 people

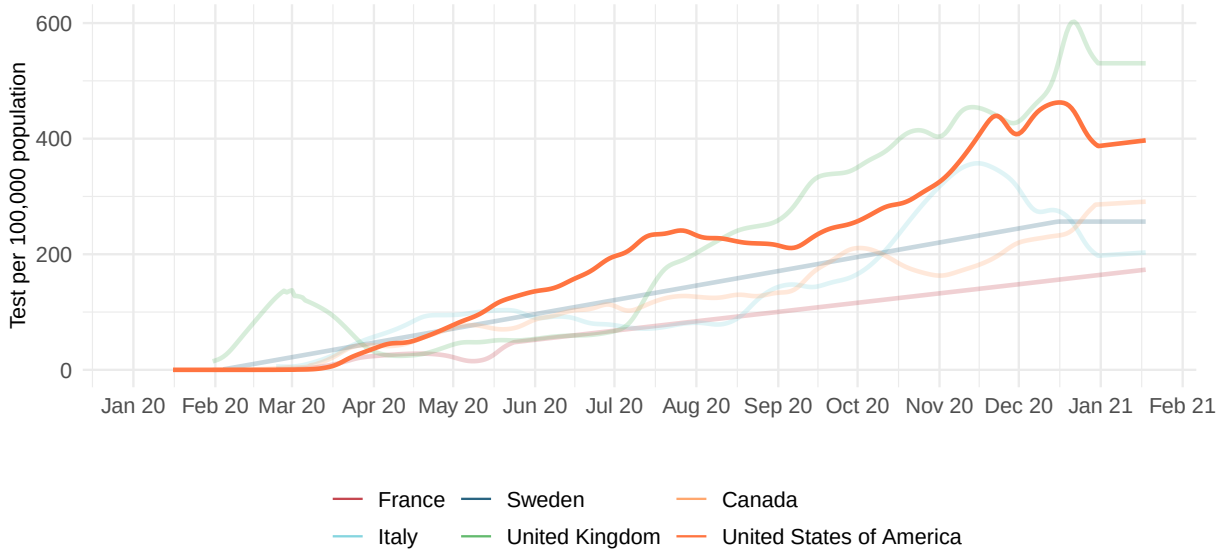


Figure 10b. COVID-19 diagnostic tests per 100,000 people on December 31, 2020

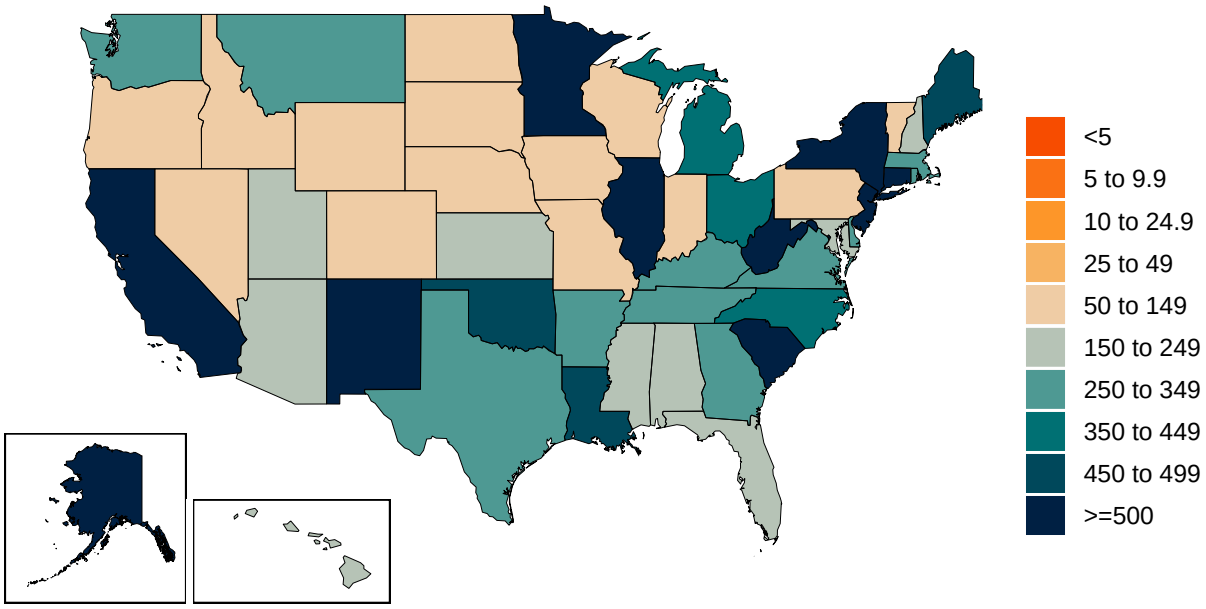


Figure 11. Increase in the risk of death due to pneumonia on February 1 2020 compared to August 1 2020

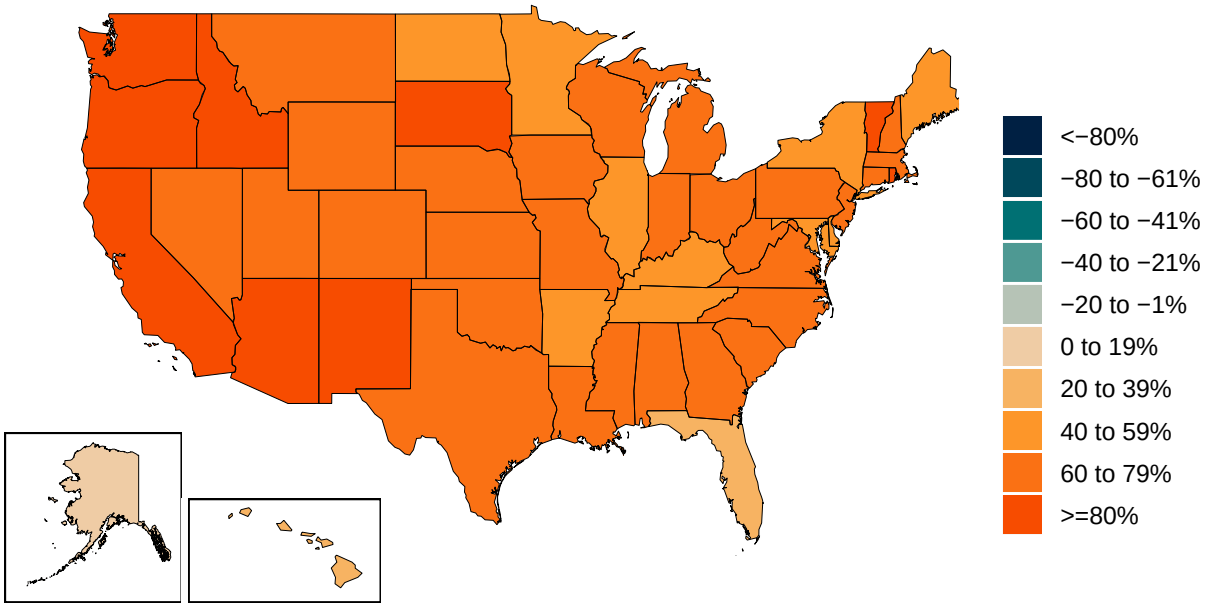


Figure 12. This figure shows the estimated proportion of the adult (18+) population that is open to receiving a COVID-19 vaccine based on Facebook survey responses (yes and unsure).

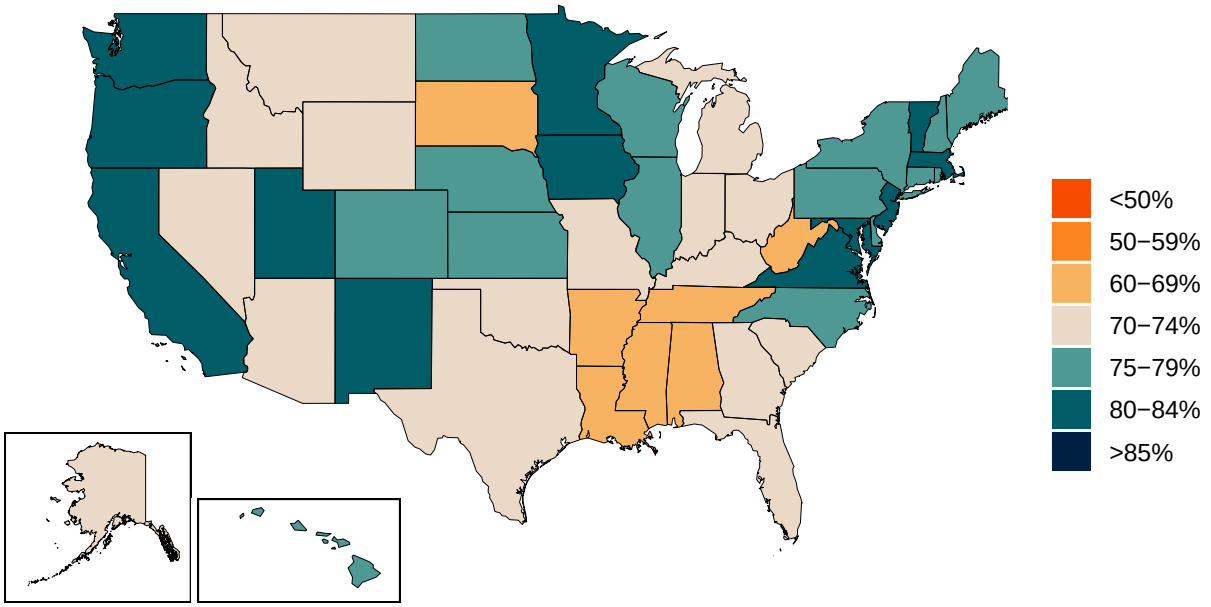
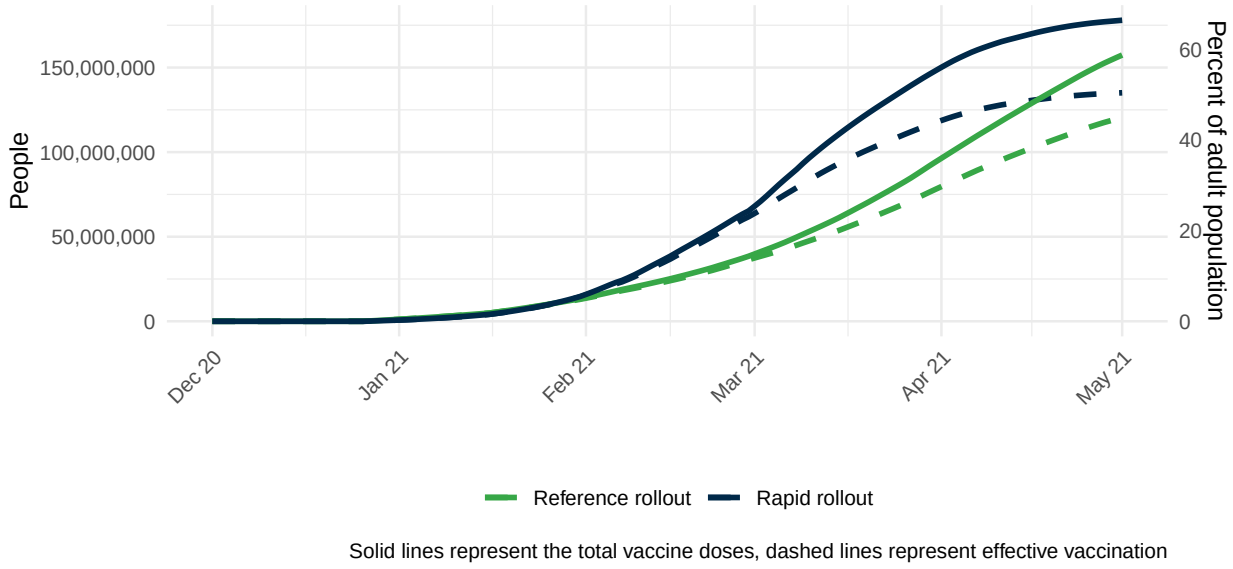


Figure 13. The number of people who receive any vaccine and those who are immune, accounting for efficacy, loss to follow up for two-dose vaccines, partial immunity after one dose, and immunity after two doses.



Projections and scenarios

We produce six scenarios when projecting COVID-19. The reference scenario is our forecast of what we think is most likely to happen. We assume that if the daily mortality rate from COVID-19 reaches 8 per million, social distancing (SD) mandates will be re-imposed. The mandate easing scenario is what would happen if governments continue to ease social distancing mandates with no re-imposition. The universal mask mandate scenario is what would happen if mask use increased immediately to 95% and social distancing mandates were re-imposed at 8 deaths per million. These three scenarios assume our reference vaccine delivery scale up where vaccine delivery will scale to full capacity over 90 days.

The rapid vaccine rollout scenario assumes that vaccine distribution will scale up to full delivery capacity in half the time as the reference delivery scenario and that the maximum doses that can be delivered per day is twice as much as the reference delivery scenario. The rapid vaccine rollout to high-risk populations scenario is the same but high-risk populations are vaccinated before essential workers or other adults. The no vaccine scenario is the same as our reference scenario but with no vaccine use.

Figure 14. Cumulative COVID-19 deaths until May 01, 2021 for six scenarios

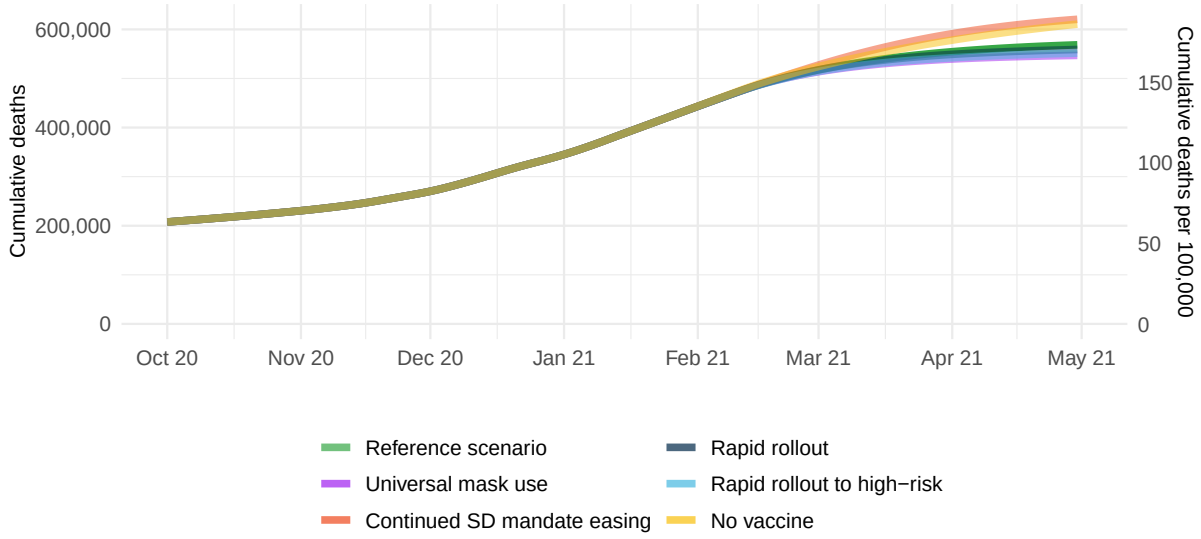


Figure 15. Daily COVID-19 deaths until May 01, 2021 for six scenarios

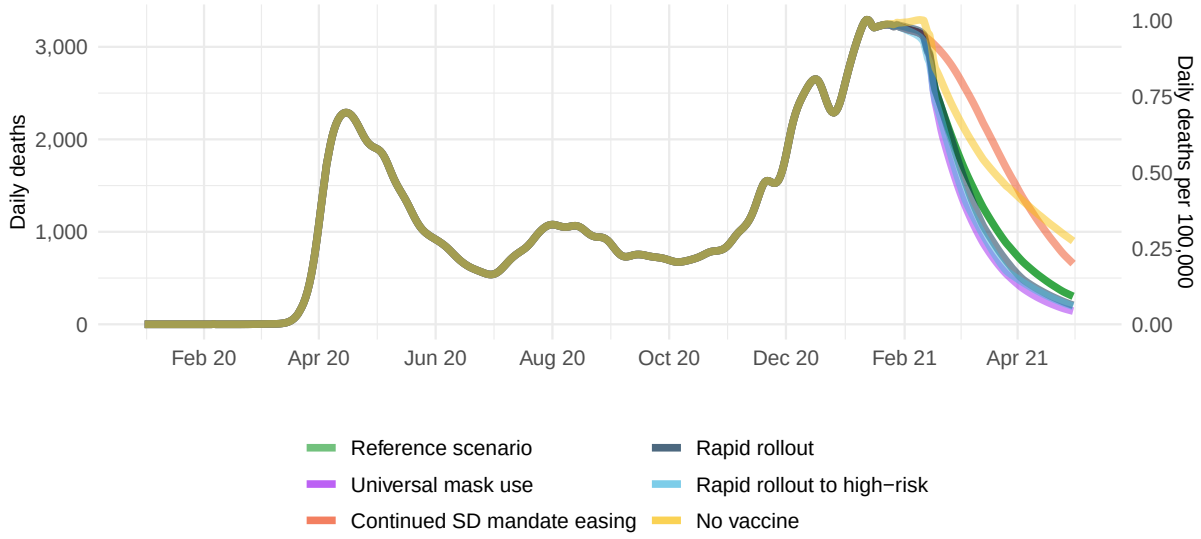


Figure 16. Daily COVID-19 infections until May 01, 2021 for six scenarios

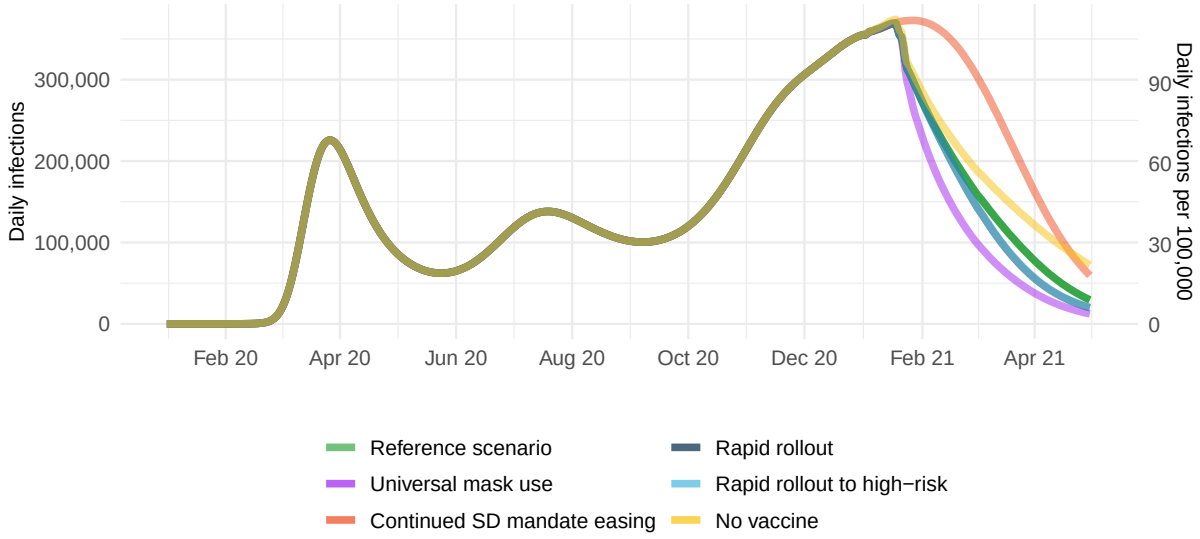


Figure 17. Estimated percentage immune based on cumulative infections and vaccinations. We assume that vaccine impact on transmission is 50% of the vaccine effectiveness for severe disease

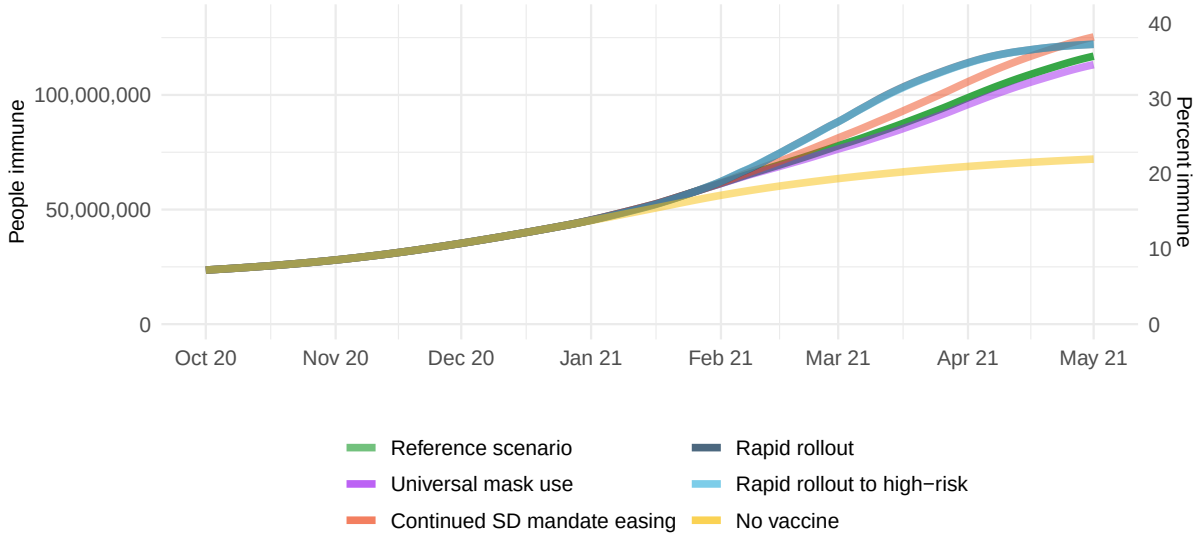


Figure 18. Month of assumed mandate re-implementation. (Month when daily death rate passes 8 per million, when reference scenario model assumes mandates will be re-imposed.)

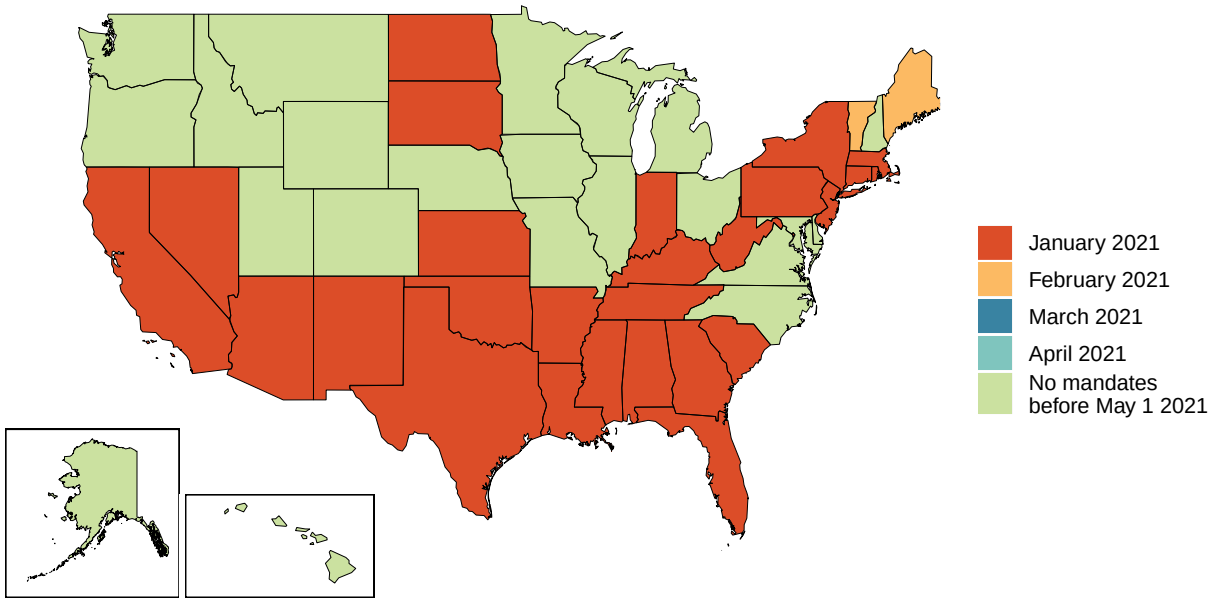


Figure 19. Forecasted percent infected with COVID-19 on May 01, 2021

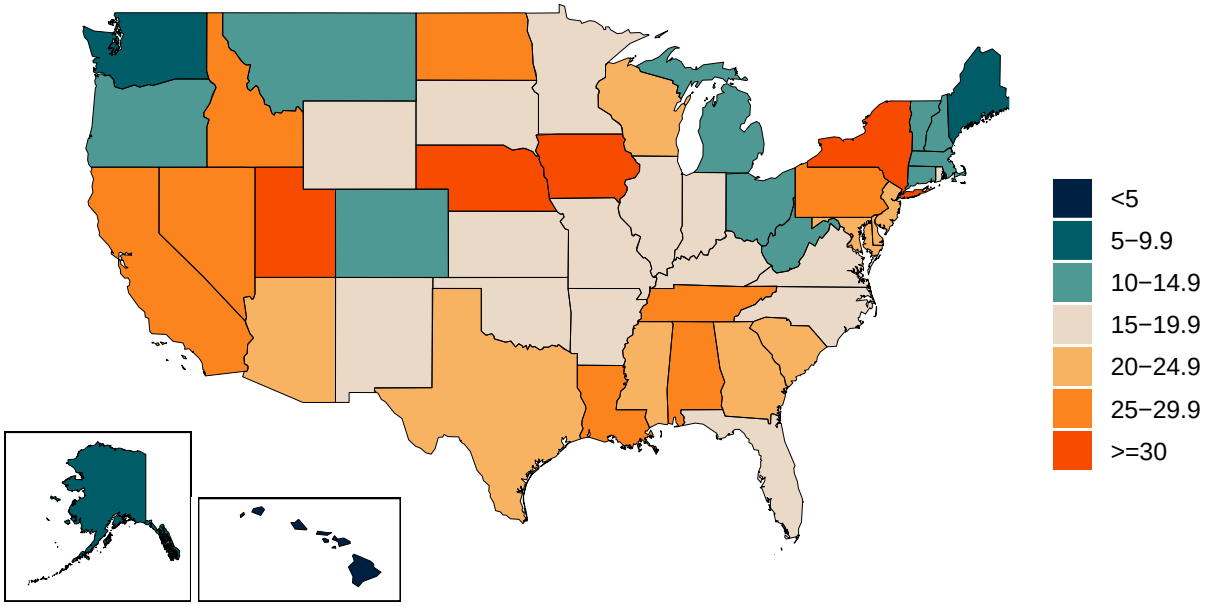


Figure 20. Daily COVID-19 deaths per million forecasted on May 01, 2021 in the reference scenario

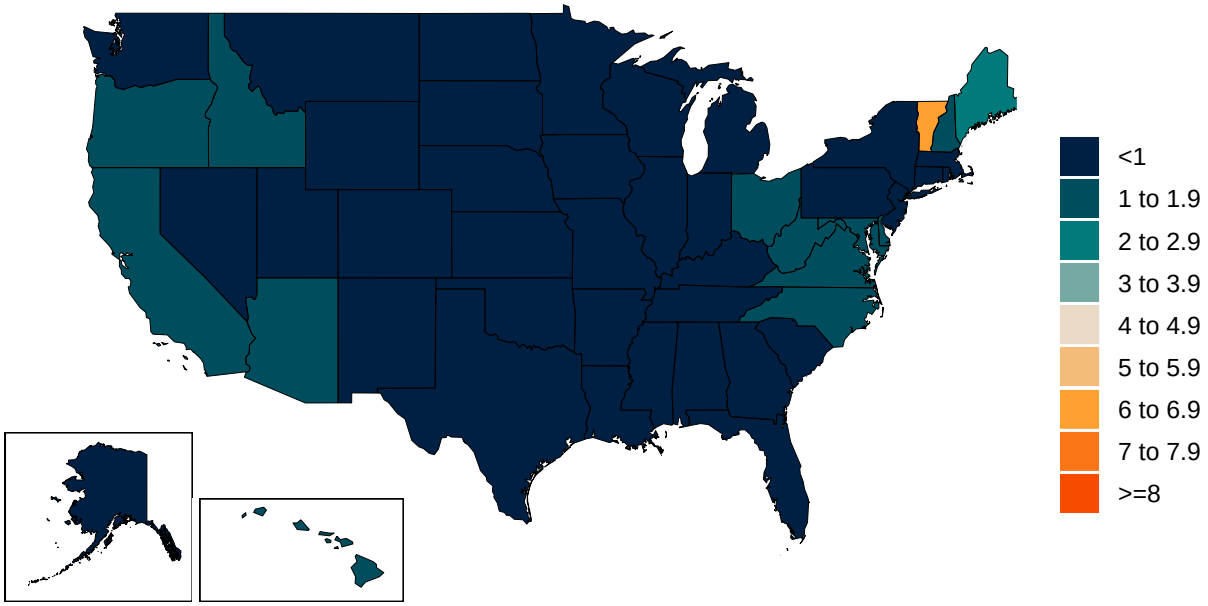


Figure 21. Comparison of reference model projections with other COVID modeling groups. For this comparison, we are including projections of daily COVID-19 deaths from other modeling groups when available: Delphi from the Massachussets Institute of Technology (Delphi; https://www.covidanalytics.io/home), Imperial College London (Imperial; https://www.covidsim.org), The Los Alamos National Laboratory (LANL; https://covid-19.bsvgateway.org/), 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 availble locations in that region.

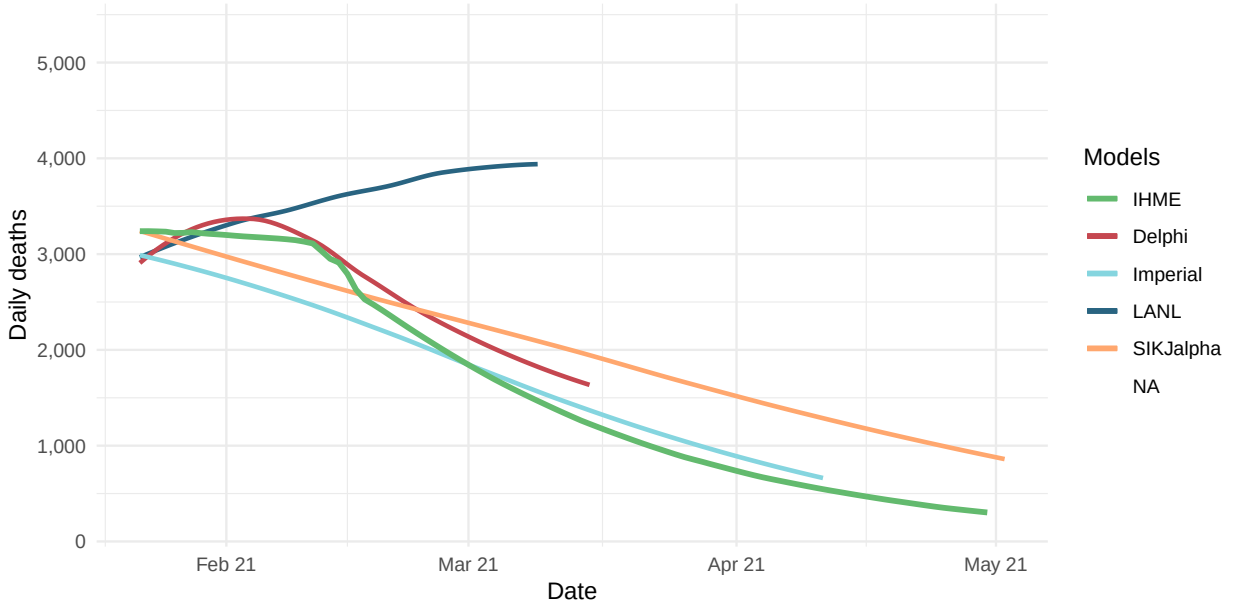


Figure 22. The estimated inpatient hospital usage is shown over time. The percent of hospital beds occupied by COVID-19 patients is color coded based on observed quantiles of the maximum proportion of beds occupied by COVID-19 patients. Less than 5% is considered *low stress*, 5-9% is considered *moderate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

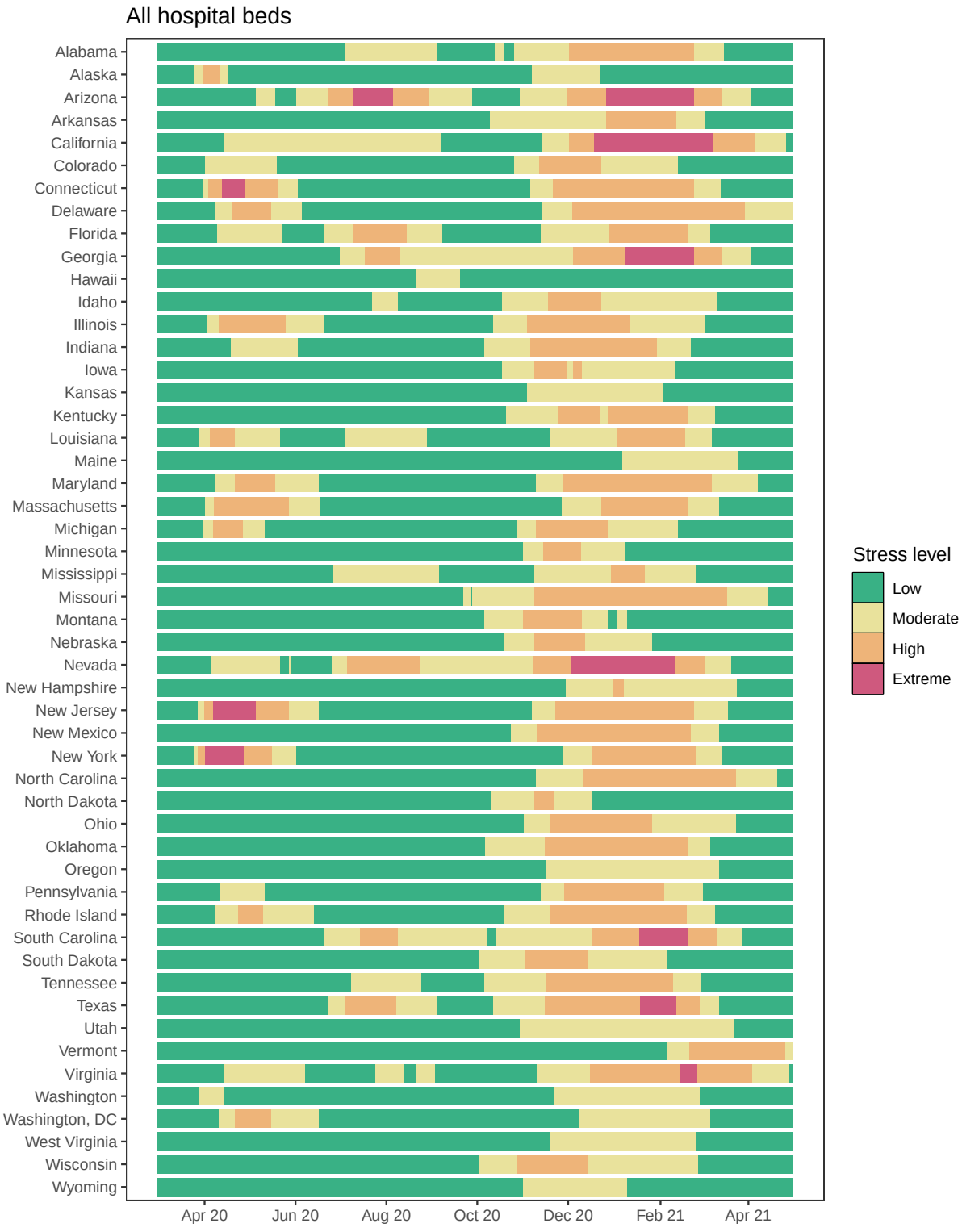


Figure 23. The estimated intensive care unit (ICU) usage is shown over time. The percent of ICU beds occupied by COVID-19 patients is color coded based on observed quantiles of the maximum proportion of ICU beds occupied by COVID-19 patients. Less than 10% is considered *low stress*, 10-29% is considered *moderate stress*, 30-59% is considered *high stress*, and greater than 60% is considered *extreme stress*.

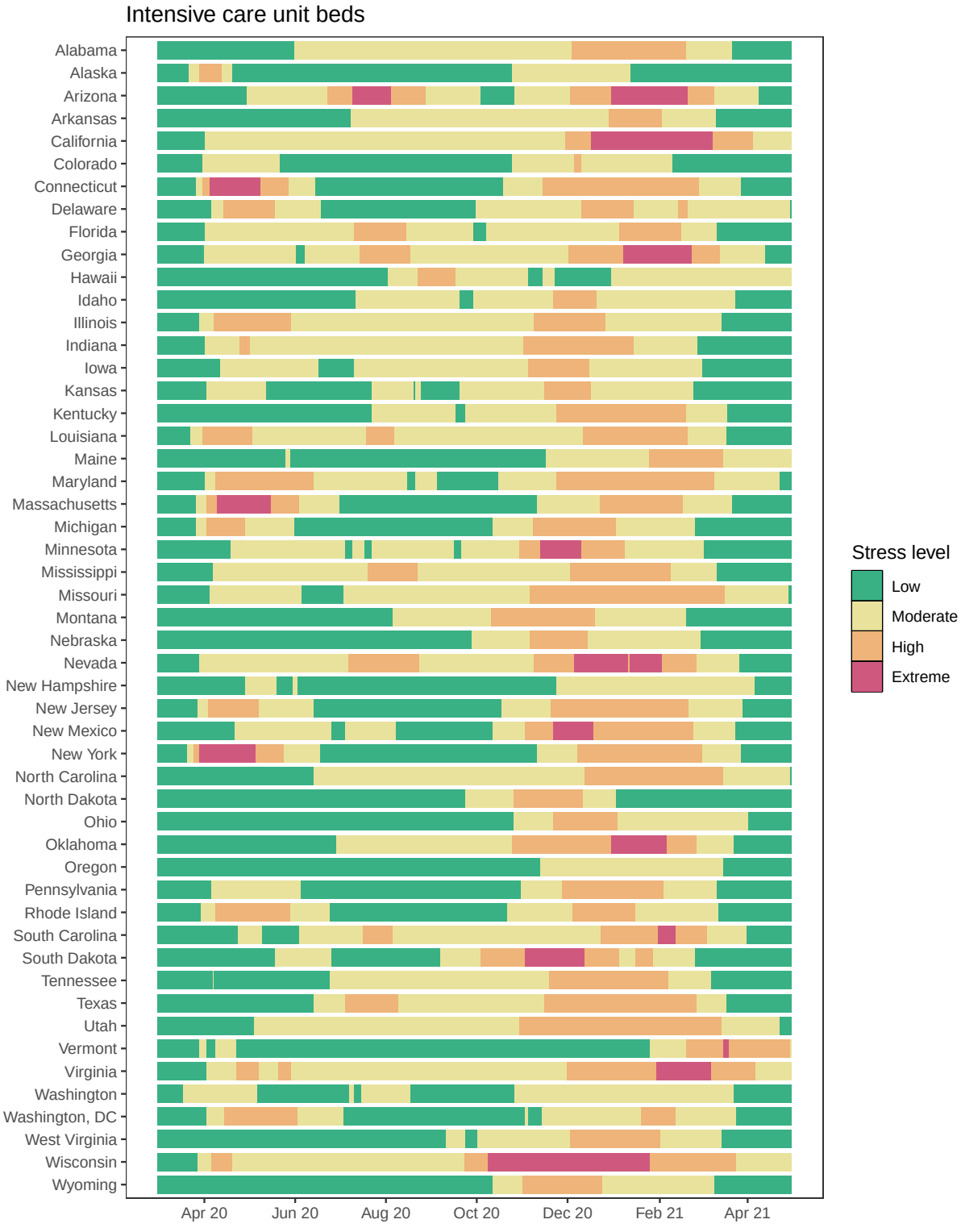


Table 3. Ranking of COVID-19 among the leading causes of mortality in the full year 2020. Deaths from COVID-19 are projections of cumulative deaths on Jan 1, 2021 from the reference scenario. Deaths from other causes are from the Global Burden of Disease study 2019 (rounded to the nearest 100).

Cause name	Annual deaths	Ranking
Ischemic heart disease	557,600	1
COVID-19	345,211	2
Tracheal, bronchus, and lung cancer	206,200	3
Chronic obstructive pulmonary disease	195,800	4
Stroke	189,500	5
Alzheimer's disease and other dementias	143,900	6
Chronic kidney disease	107,000	7
Colon and rectum cancer	84,000	8
Lower respiratory infections	81,900	9
Diabetes mellitus	77,700	10

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/).

Data on vaccine candidates, stages of development, manufacturing capacity, and pre-purchasing agreements are primarily from Linksbridge and supplemented by Duke University.

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.