COVID-19 Results Briefing: the United States of America

November 12, 2020

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 November 11, 2020.

Daily cases are increasing at an accelerating rate with deaths increasing, but at a slower rate. Given the experience in Europe, we expect that the increase in deaths will soon begin to match the increase in cases. The fall/winter surge is evident in nearly all states at this point. We have seen convincing evidence from hospital studies of individual patients and population-level measurements, that the infection-fatality rate (IFR) has declined 30% since April due to improved treatment. Our forecasts include this reduced IFR. Despite this, we expect 439,000 cumulative deaths by March 1 and a peak of daily deaths in mid-January at 2,200 a day. Although mask use has increased to 67%, further increases to 95% could save a further 68,000 lives by March 1.

Current situation

- Daily reported cases in the last week increased to 79,900 per day on average compared to 67,000 the week before (Figure 1).
- Daily deaths in the last week increased to 910 per day on average compared to 830 the week before (Figure 2). This makes COVID-19 the number 2 cause of death in the United States of America this week (Table 1).
- Effective R, computed using cases, hospitalizations, and deaths, is greater than 1 in 23 states (Figure 3). The states with the greatest increase in transmission are Arizona, Nevada, and New York.
- We estimated that 12% of people in the United States of America have been infected as of November 9. Among states, this ranged from 1% in Vermont to 24% in New Jersey (Figure 4).
- The daily death rate is greater than 4 per million in Arkansas, Idaho, Illinois, Indiana, Iowa, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Mexico, North Dakota, South Dakota, Tennessee, Wisconsin, and Wyoming (Figure 6).

Trends in drivers of transmission

- Mobility last week was 24% lower than the baseline mobility (average of the period January 1 – March 1, 2020; Figure 8). Mobility was near baseline (within 10%) in Alabama, Iowa, Mississippi, and Oklahoma. Mobility was lower than 30% of baseline in California, Hawaii, Maryland, Massachusetts, New Jersey, New Mexico, New York, and the District of Columbia.
- National mask use remains at 67% (Figure 9). Mask use was lower than 50% in Idaho, South Dakota, and Wyoming.
- There were 320 diagnostic tests per 100,000 people on November 9 (Figure 10).

Projections

- In our **reference scenario**, which represents what we think is most likely to happen, we expect daily deaths to reach 2,200 in mid-January and slowly decline to 1,750 on March 1 (Figure 13). In our reference scenario, we expect daily infections to reach 325,000 by early January (Figure 14).
- Cumulative deaths in the reference scenario reach 439,000 on March 1 (Figure 12). In the reference scenario, 33 states have to re-impose broad-reaching social distancing mandates, otherwise the cumulative death toll could reach 587,000 deaths by March 1.
- If **universal mask coverage** (95%) were attained in the next week, our model projects 68,000 lives could be saved by March 1, 2021.
- Figure 18 compares our forecasts to other publicly archived forecasts. The Los Alamos National Labs model still shows a decline in the next 6 weeks, but this is dramatically slower than forecasts they have made over the last 8 weeks. Imperial still shows a minimal increase from a level that is well below what has already been seen in the last week. The MIT (Delphi) model shows an increase reaching 1,000 deaths a day in late November, and further increasing to 1,250 a day in late December. The USC (SIKJalpha) model shows a surge equal to ours through to the second week of December, but then a dramatic decline.
- Predicted demand for hospital beds and intensive care unit (ICU) beds is compared to reported capacity in Figures 19 and 20. Eleven states are expected to have extreme stress on general hospital beds sometime in December through February. A further 25 states will have high stress in that same period. These levels of demand may lead to cutting back on elective procedures during this period. Stress on ICU capacity despite improvements in treatment will be extreme in 20 states.

Model updates

We have substantially revised the infection-fatality rate (IFR) used in the model. To date, we had used an IFR that was derived from an analysis of population-representative antibody surveys where we disaggregated prevalence by age and matched COVID-19 death rates. The age-specific IFR from this analysis was assumed to be the same across locations and time.

We have now accumulated considerable empirical evidence that suggests that 1) the IFR has been declining since March/April due to improvements in the clinical management of patients, and 2) the IFR varies as a function of the level of obesity in a community.
The evidence supporting these observations includes:

- An analysis of detailed clinical records of more than 15,000 individuals from a COVID-19 registry organized by the American Heart Association. This registry covers patients in more than 150 hospitals. Our analysis suggests that after controlling for age, sex, comorbidities, and disease severity at admission, the hospital-fatality rate has declined by about 30% since March/April.

- An analysis of more than 250,000 individuals admitted to hospitals in Brazil with COVID-19 shows that after controlling for age, sex, obesity, and oxygenation at admission, the hospital-fatality rate has declined by about 30% since March/April.
- An analysis of age-standardized IFRs from more than 300 surveys also suggests that the population-level trends in the IFR are consistent with a 30% decline since March/April. These data also suggest that the prevalence of obesity at the population level is associated with a higher IFR and that the magnitude of the effect is similar to that found in the individual-level analysis.

Based on these empirical findings, we have switched to a new estimated IFR. The new IFR varies over time (declining since March/April by approximately 0.19% per day until the beginning of September), varies across locations as a function of obesity prevalence, and varies across locations (as before) as a function of the population distribution by age. The implication of lower IFRs over time is that for a given number of observed deaths there are more cumulative infections.

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.

Current situation

Figure 1. Reported daily COVID-19 cases

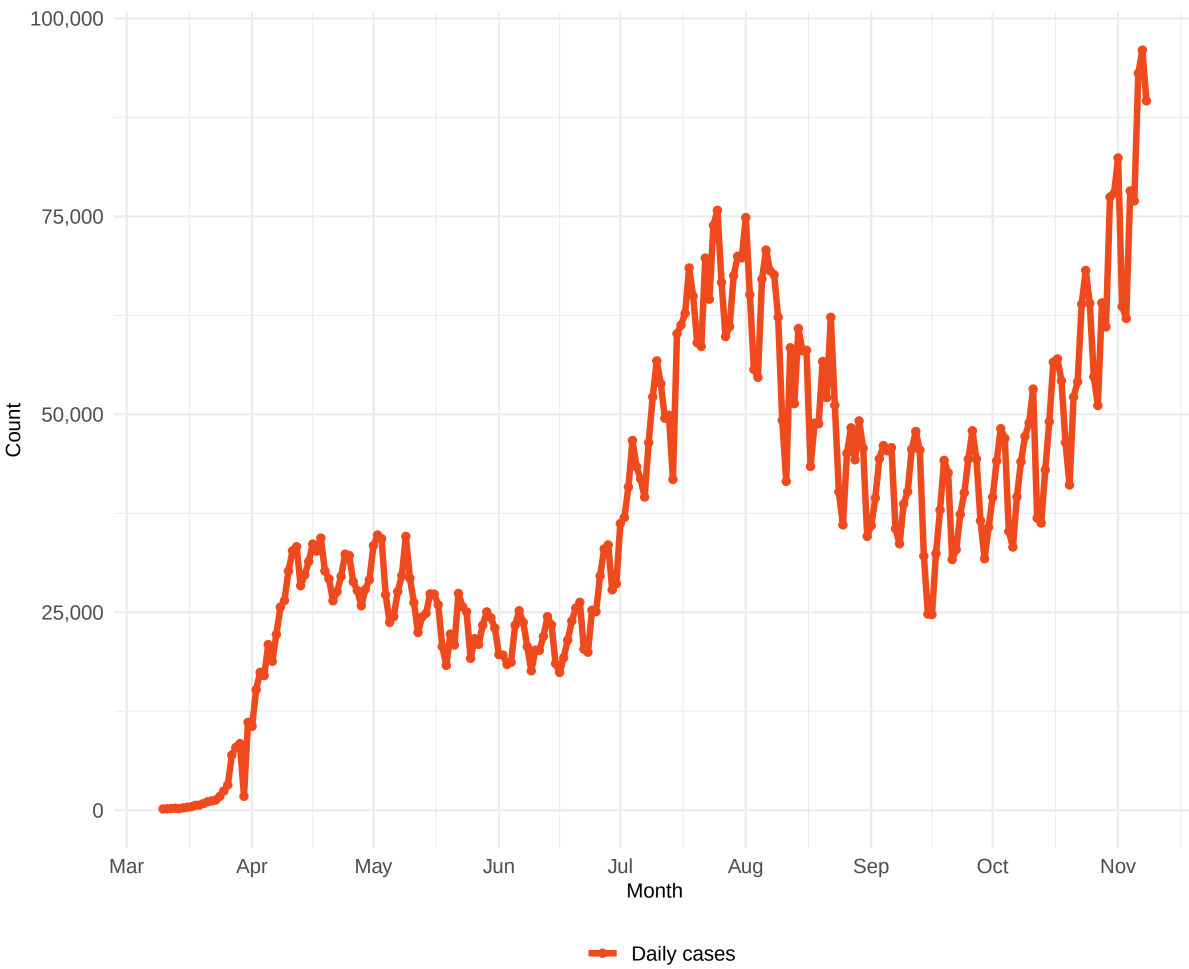


Table 1. Ranking of COVID-19 among the leading causes of mortality this week, assuming uniform deaths of non-COVID causes throughout the year

Cause name	Weekly deaths	Ranking
Ischemic heart disease	10,724	1
COVID-19	6,447	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.

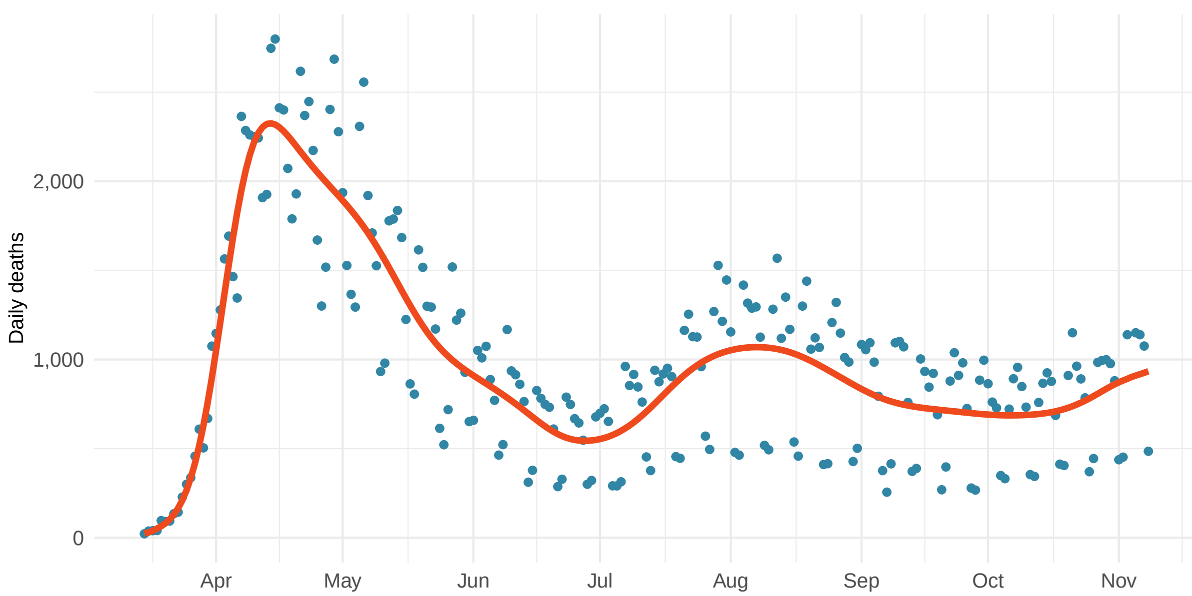


Figure 2b. Estimated cumulative deaths by age group

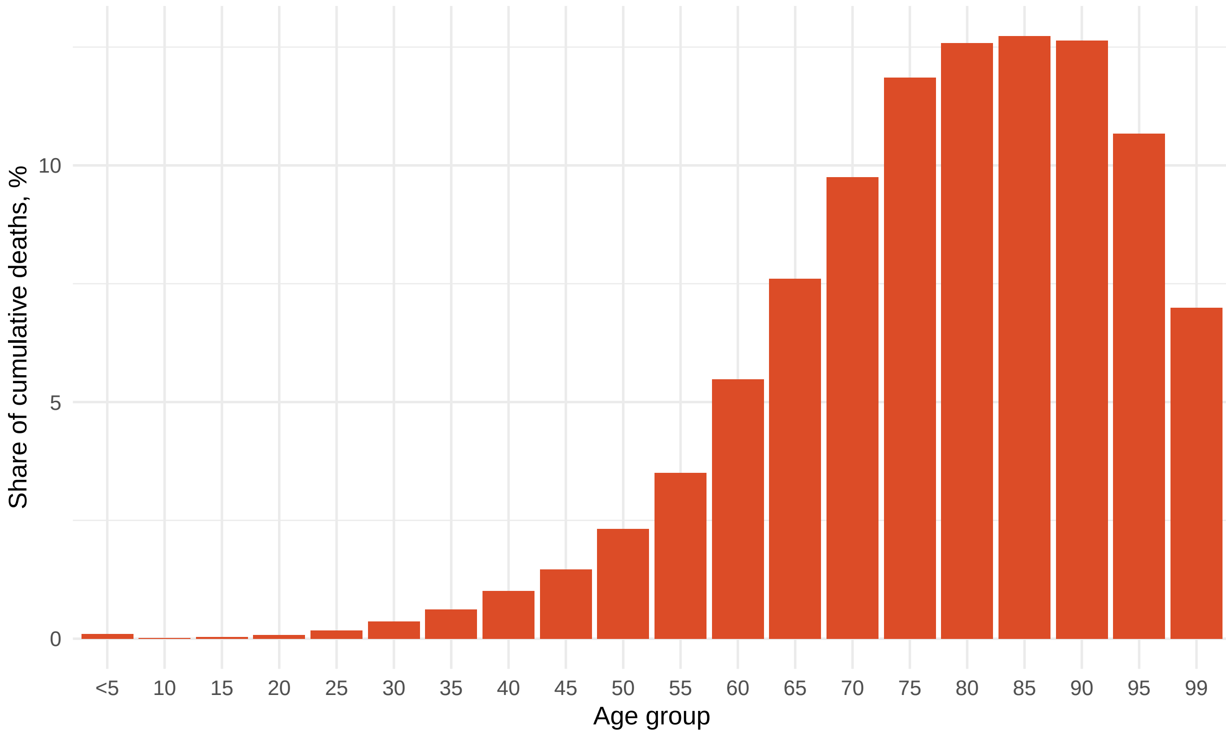


Figure 3. Mean effective R on October 29, 2020. The estimate of effective R is based on the combined analysis of deaths, case reporting and hospitalizations where available. Current reported cases reflect infections 11-13 days prior so estimates of effective R can only be made for the recent past. Effective R less than 1 means that transmission should decline all other things being held the same.

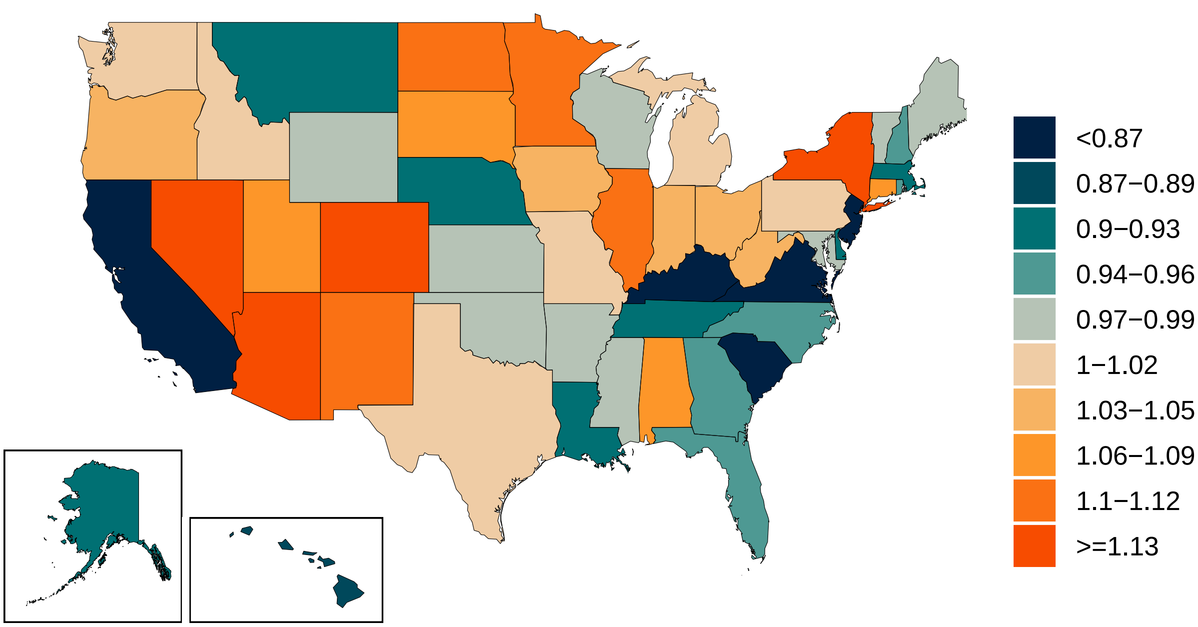


Figure 4. Estimated percent of the population infected with COVID-19 on November 09, 2020

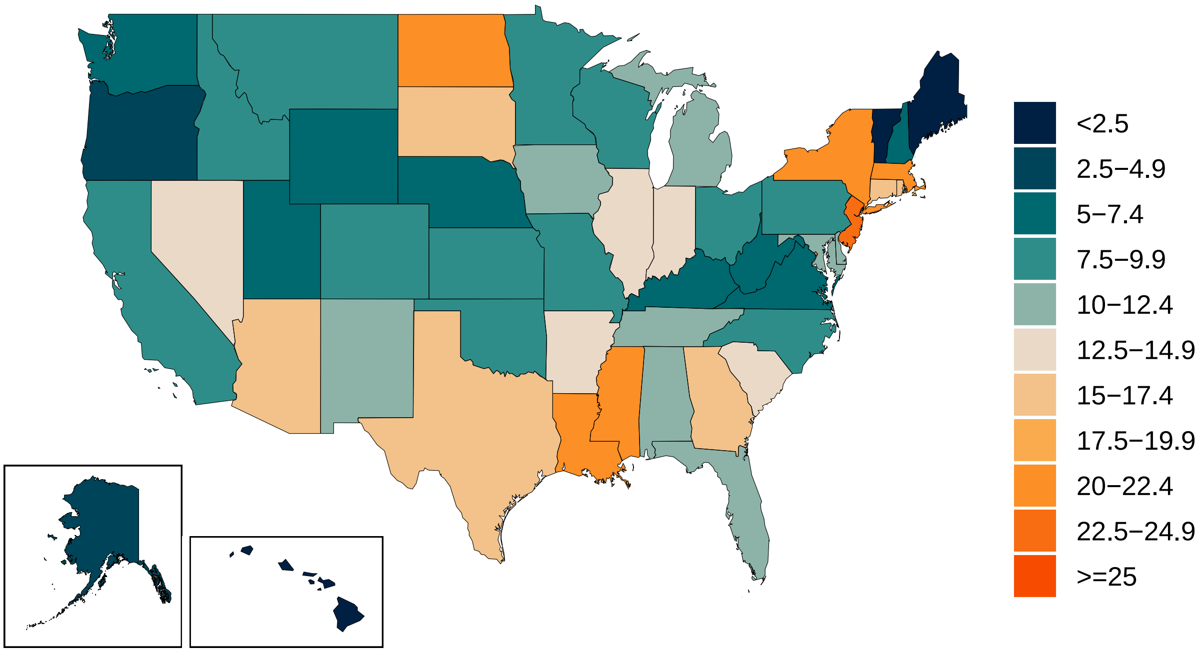


Figure 5. Percent of COVID-19 infections detected. This is estimated as the ratio of reported daily COVID-19 cases to estimated daily COVID-19 infections based on the SEIR disease transmission model.

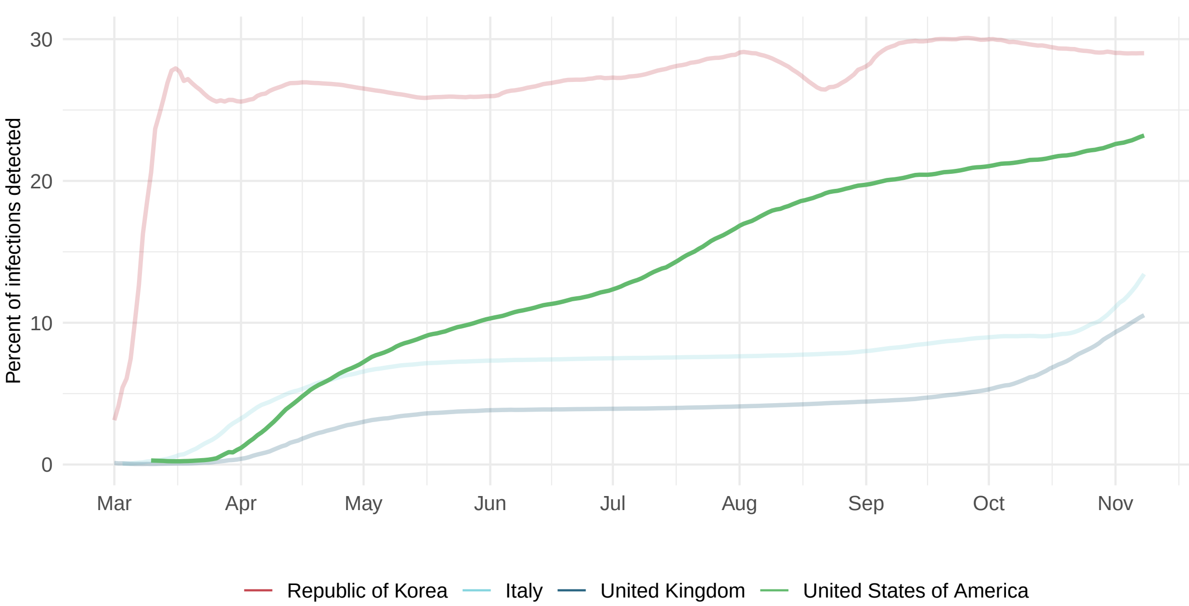
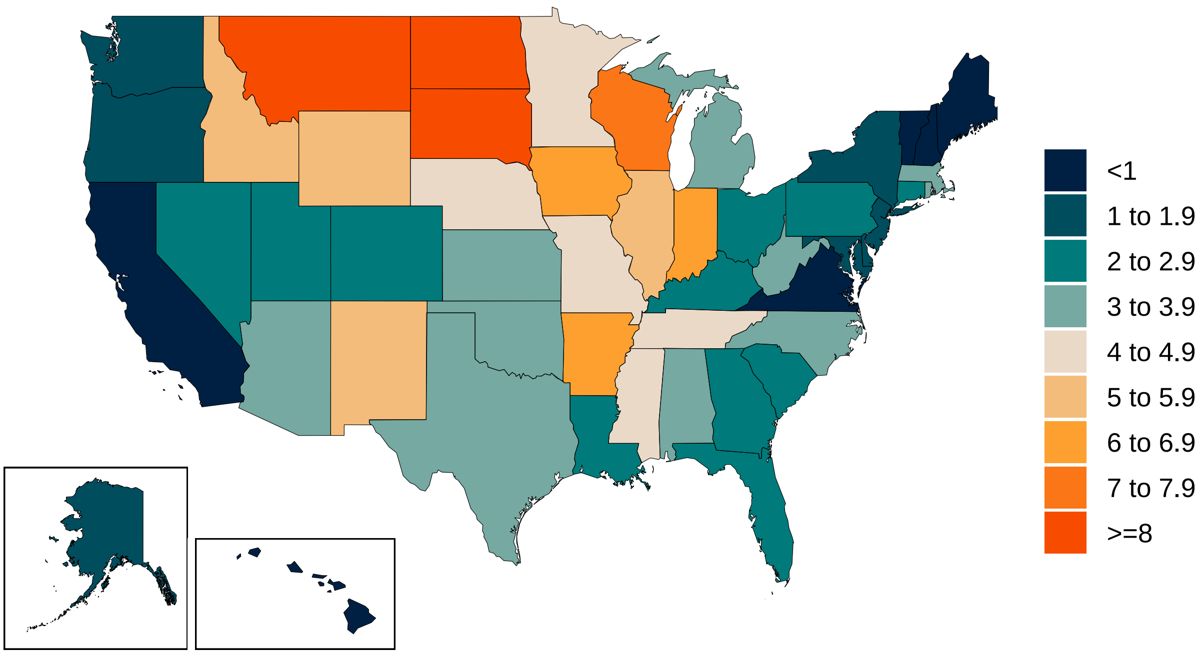


Figure 6. Daily COVID-19 death rate per 1 million on November 09, 2020



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
Alabama	No mandate	No mandate	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Alaska	No mandate	No mandate	No mandate	No mandate	Mandate in place	No mandate	Mandate in place
Arizona	No mandate	Mandate in place	Mandate in place	No mandate	Mandate in place	No mandate	No mandate
Arkansas	No mandate	Mandate in place	No mandate	Mandate in place	No mandate	No mandate	No mandate
California	Mandate in place	Mandate in place	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate
Colorado	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Connecticut	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Delaware	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
District of Columbia	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Florida	No mandate	No mandate	No mandate	No mandate	Mandate in place	No mandate	No mandate
Georgia	No mandate	Mandate in place	Mandate in place	No mandate	Mandate in place	Mandate in place	No mandate
Hawaii	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Idaho	No mandate	No mandate	No mandate	No mandate	Mandate in place	No mandate	No mandate
Illinois	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Indiana	No mandate	No mandate	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Iowa	No mandate	No mandate	No mandate	No mandate	Mandate in place	No mandate	No mandate
Kansas	No mandate	No mandate	No mandate	Mandate in place	Mandate in place	No mandate	No mandate
Kentucky	No mandate	No mandate	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Louisiana	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Maine	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Maryland	No mandate	Mandate in place	No mandate	Mandate in place	Mandate in place	No mandate	No mandate
Massachusetts	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Michigan	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Minnesota	No mandate	No mandate	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Mississippi	No mandate	No mandate	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Missouri	No mandate	No mandate	No mandate	No mandate	Mandate in place	No mandate	No mandate
Montana	No mandate	No mandate	No mandate	Mandate in place	Mandate in place	No mandate	No mandate
Nebraska	No mandate	No mandate	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Nevada	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
New Hampshire	No mandate	No mandate	Mandate in place	No mandate	Mandate in place	No mandate	No mandate
New Jersey	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
New Mexico	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
New York	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
North Carolina	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
North Dakota	No mandate	Mandate in place	No mandate	No mandate	Mandate in place	No mandate	No mandate
Ohio	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Oklahoma	No mandate	No mandate	No mandate	No mandate	Mandate in place	No mandate	No mandate
Oregon	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Pennsylvania	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Rhode Island	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
South Carolina	No mandate	No mandate	Mandate in place	No mandate	Mandate in place	No mandate	No mandate
South Dakota	No mandate	No mandate	No mandate	No mandate	Mandate in place	No mandate	No mandate
Tennessee	No mandate	Mandate in place	Mandate in place	No mandate	Mandate in place	No mandate	No mandate
Texas	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Utah	No mandate	Mandate in place	No mandate	Mandate in place	Mandate in place	No mandate	No mandate
Vermont	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Virginia	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Washington	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
West Virginia	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Wisconsin	No mandate	Mandate in place	Mandate in place	Mandate in place	Mandate in place	No mandate	No mandate
Wyoming	No mandate	No mandate	Mandate in place	No mandate	Mandate in place	No mandate	No mandate

Mandate in place No mandate

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

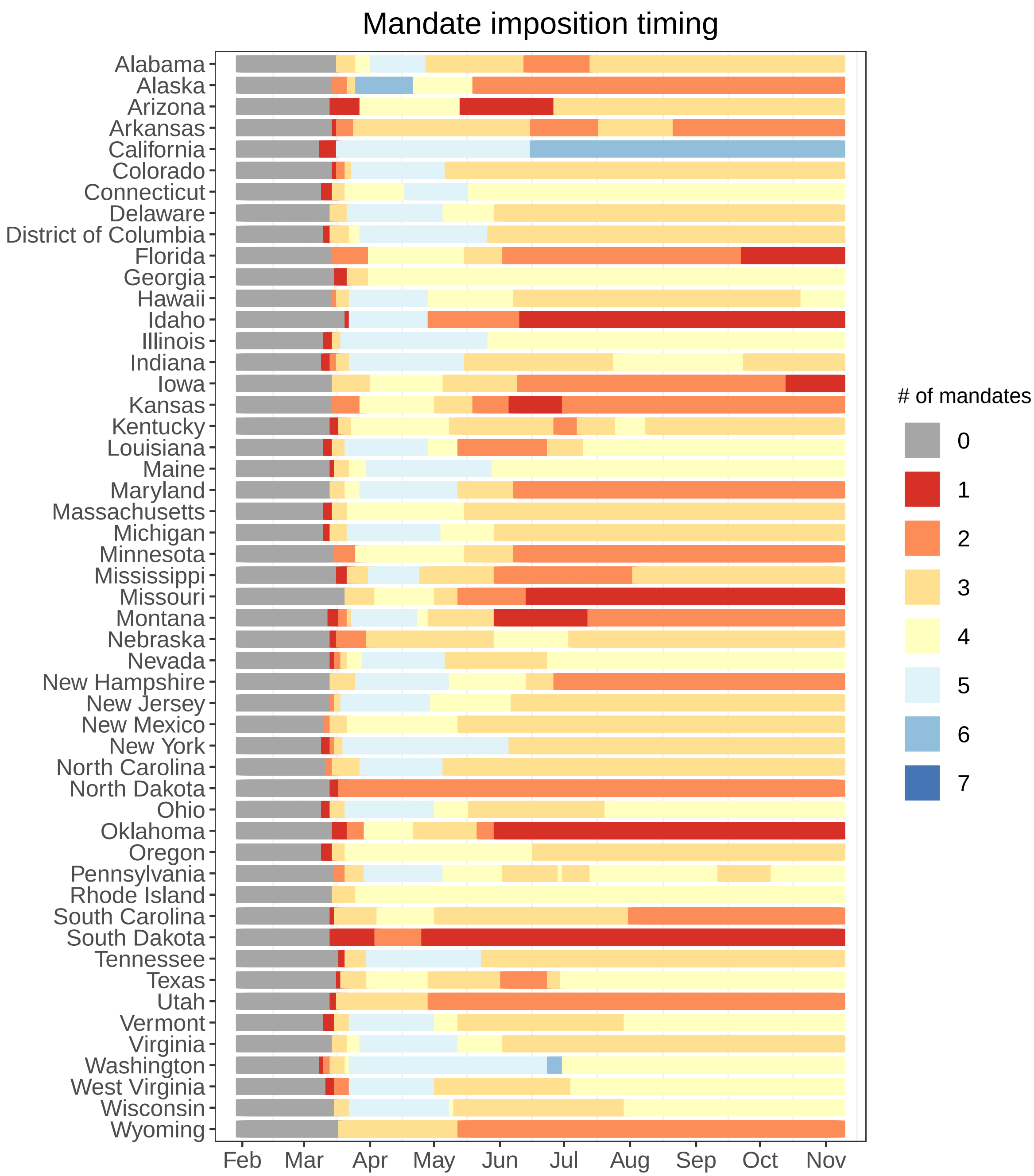


Figure 8a. Trend in mobility as measured through smartphone app use compared to January 2020 baseline

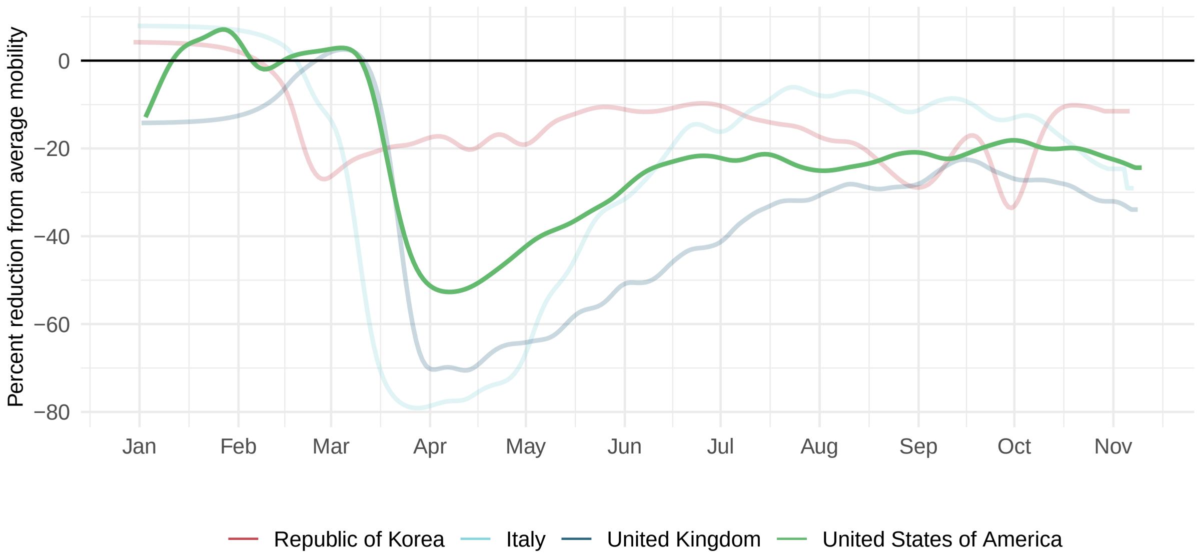


Figure 8b. Mobility level as measured through smartphone app use compared to January 2020 baseline (percent) on November 09, 2020

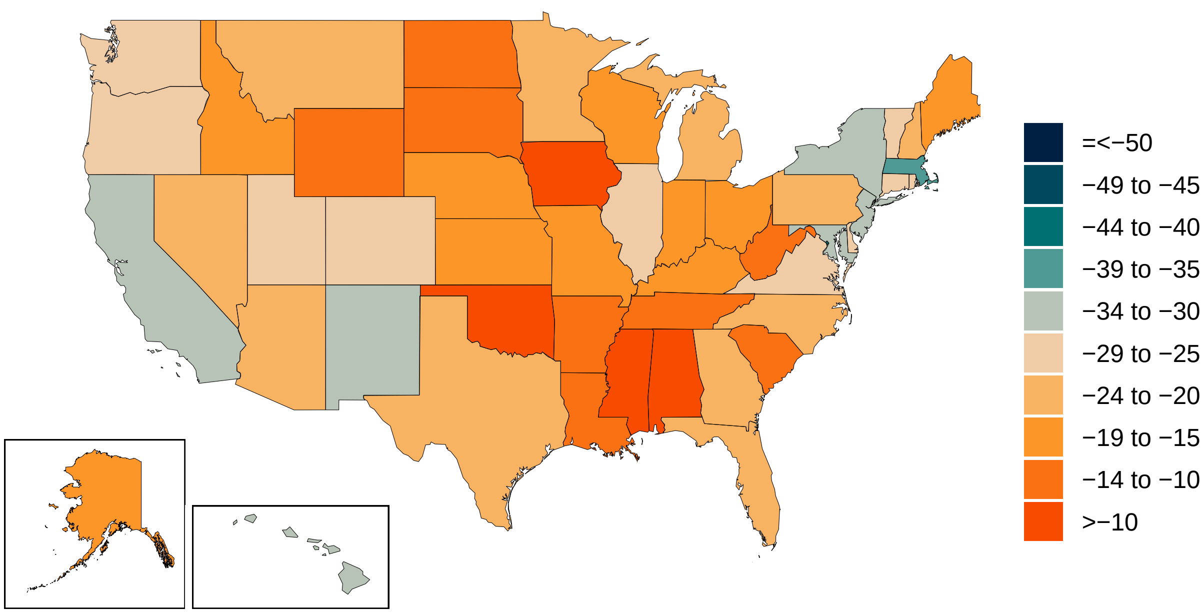


Figure 9a. Trend in the proportion of the population reporting always wearing a mask when leaving home

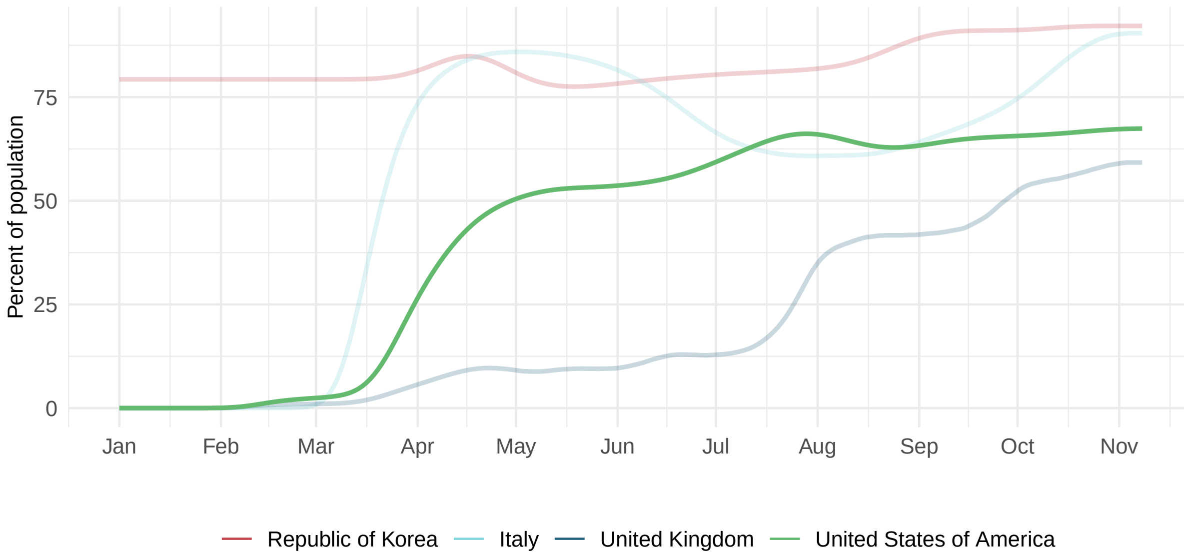


Figure 9b. Proportion of the population reporting always wearing a mask when leaving home on November 09, 2020

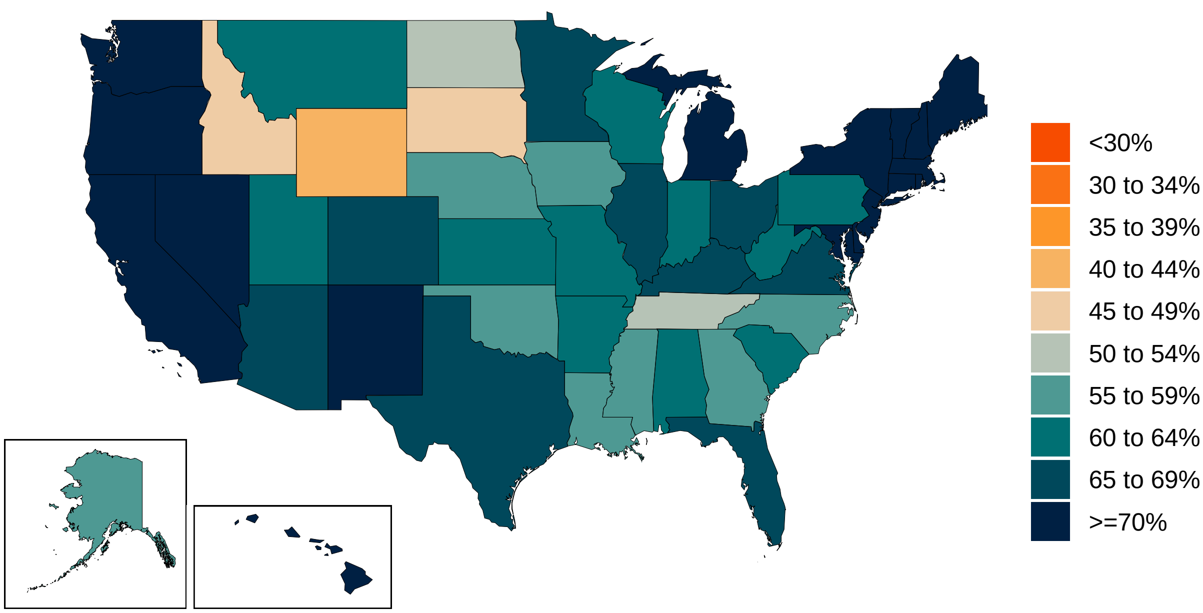


Figure 10a. Trend in COVID-19 diagnostic tests per 100,000 people

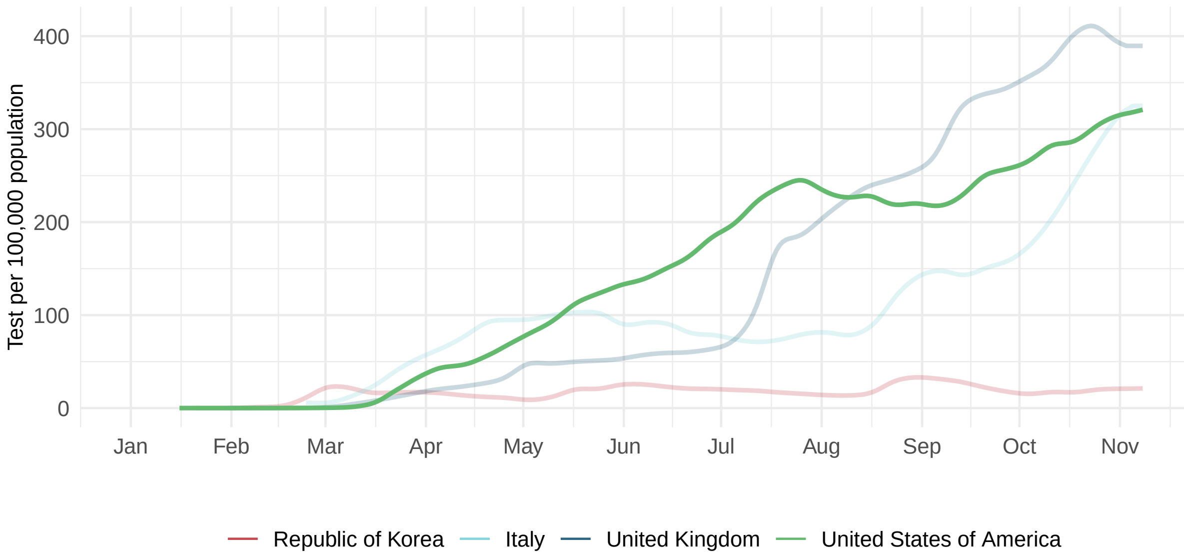


Figure 10b. COVID-19 diagnostic tests per 100,000 people on November 06, 2020

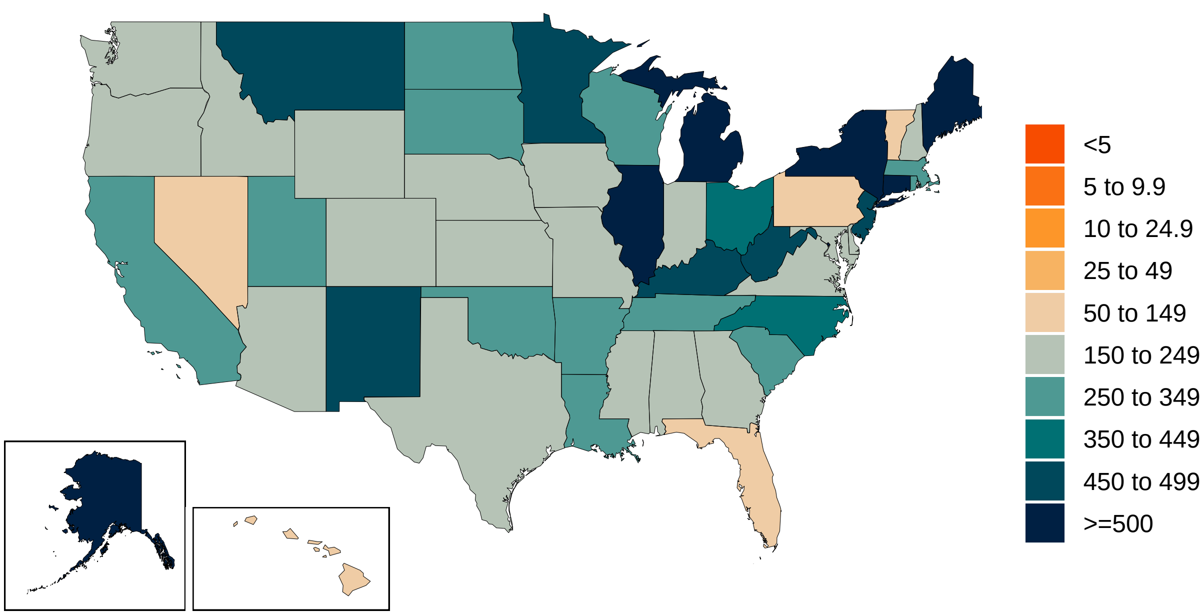
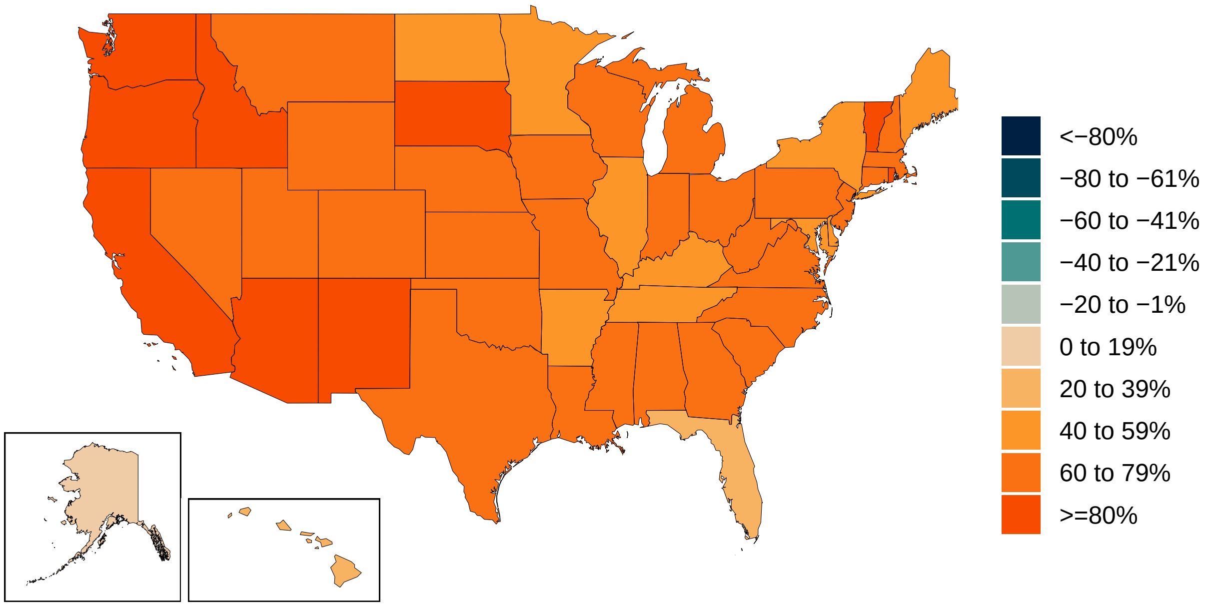


Figure 11. Increase in the risk of death due to pneumonia on February 1 compared to August 1



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. 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.

Figure 12. Cumulative COVID-19 deaths until March 01, 2021 for three scenarios.

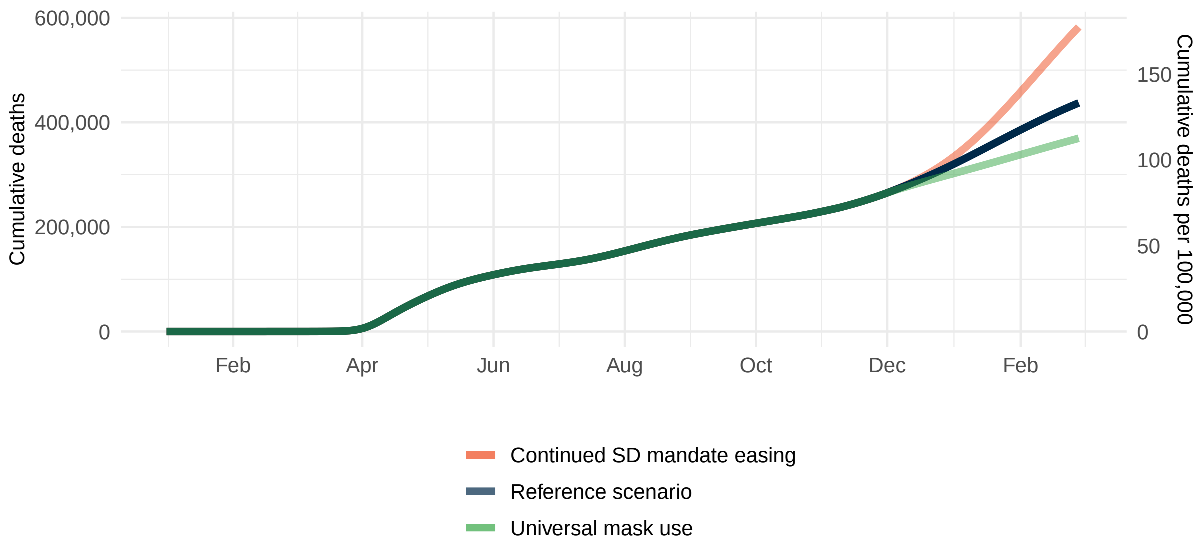


Fig 13. Daily COVID-19 deaths until March 01, 2021 for three scenarios.

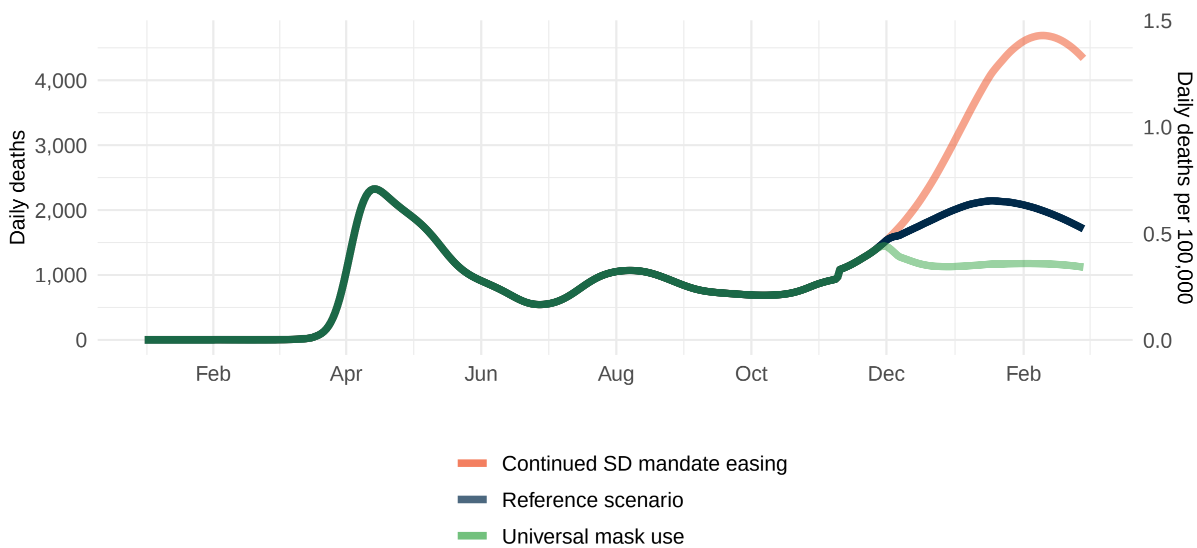


Fig 14. Daily COVID-19 infections until March 01, 2021 for three scenarios.

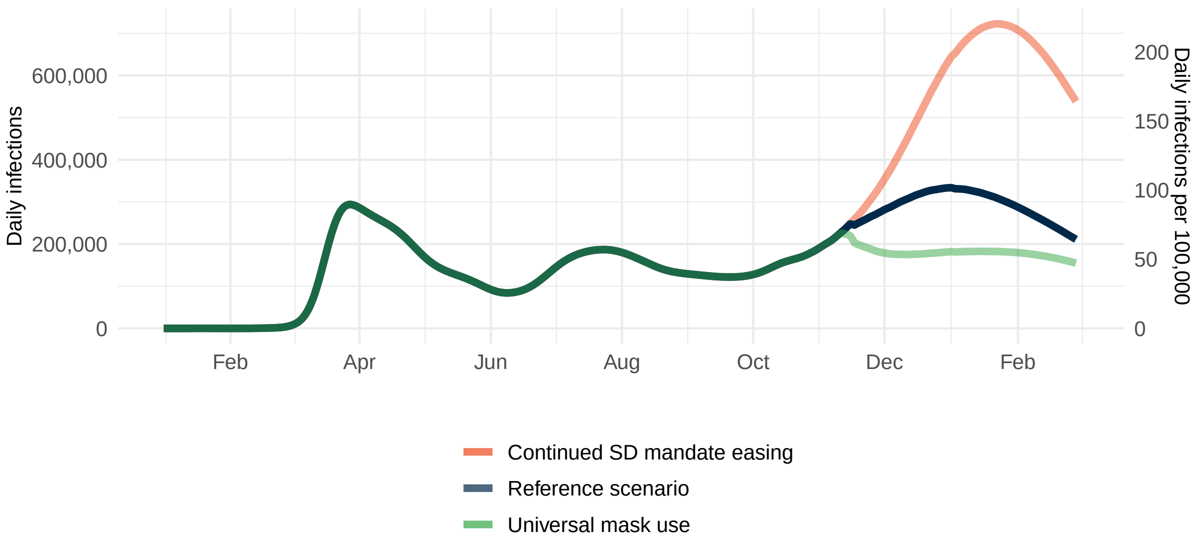


Fig 15. Month of assumed mandate re-implementation. (Month when daily death rate passes 8 per million, when reference scenario model assumes mandates will be re-imposed.)

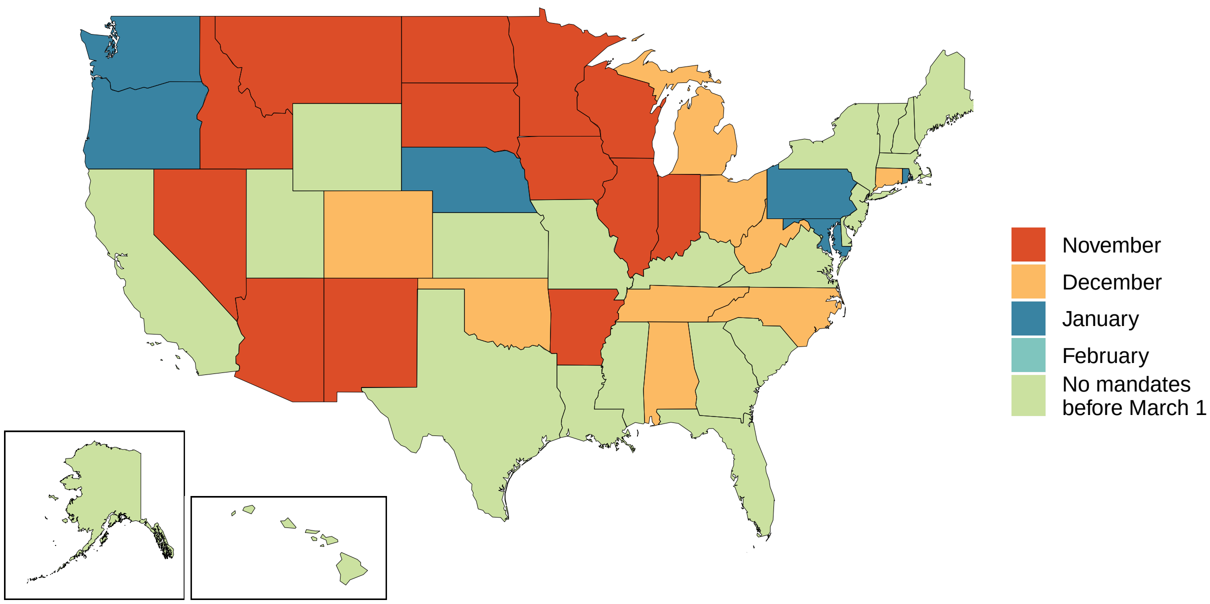


Figure 16. Forecasted percent infected with COVID-19 on March 01, 2021

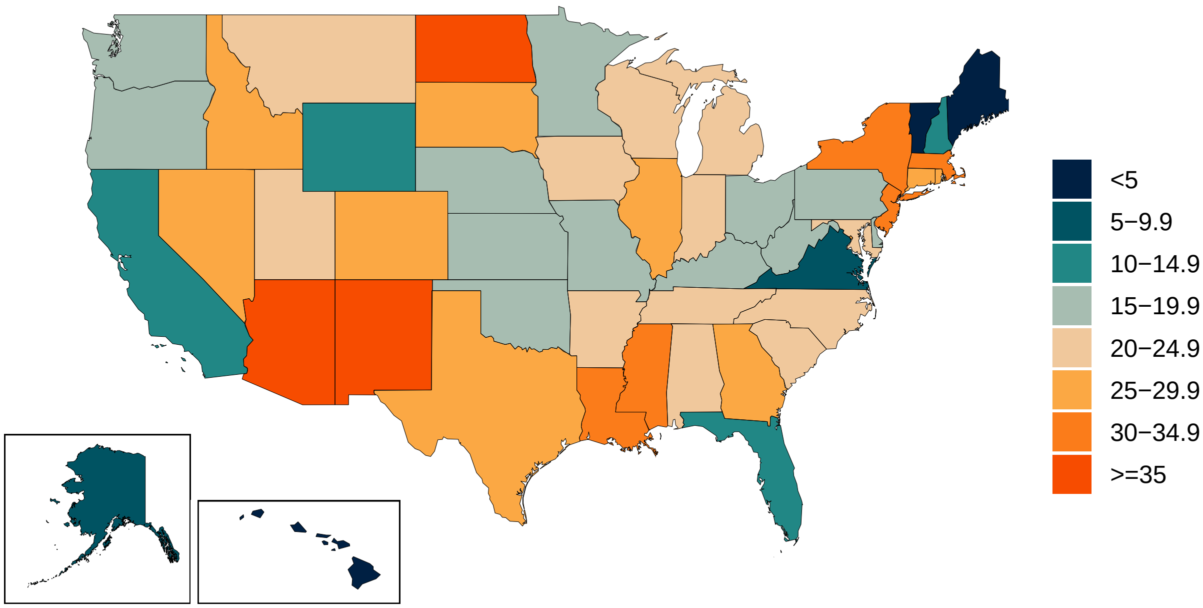


Figure 17. Daily COVID-19 deaths per million forecasted on March 01, 2021 in the reference scenario

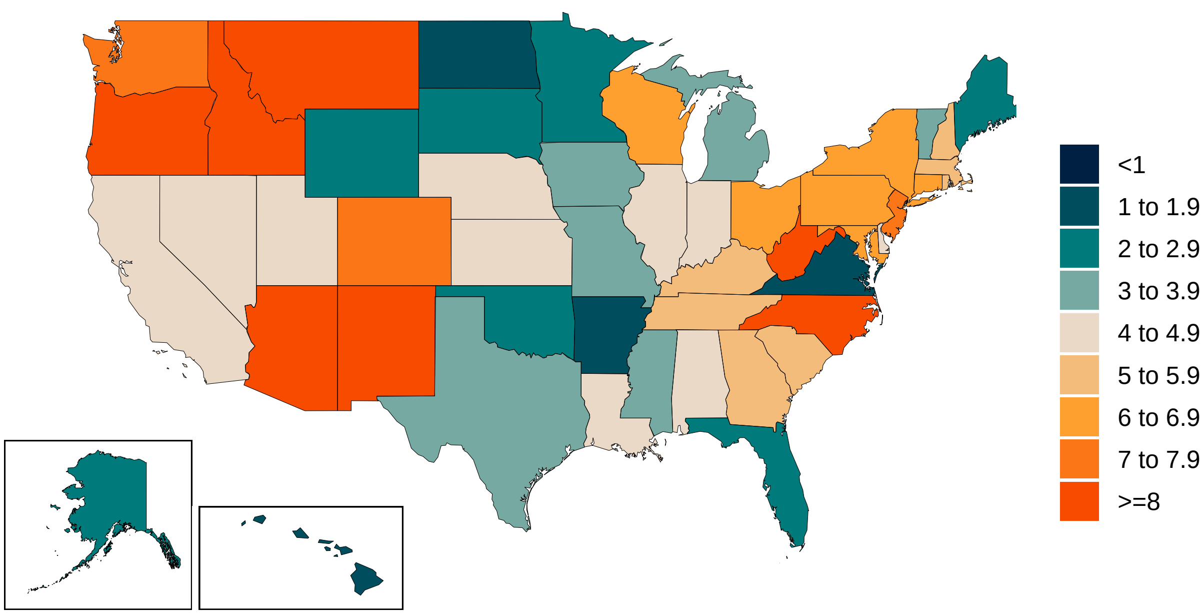


Figure 18. Comparison of reference model projections with other COVID modeling groups. For this comparison, we are including projections of daily COVID-19 deaths from other modeling groups when available: Delphi from the Massachussets Institute of Technology (Delphi; https://www.covidanalytics.io/home), 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.

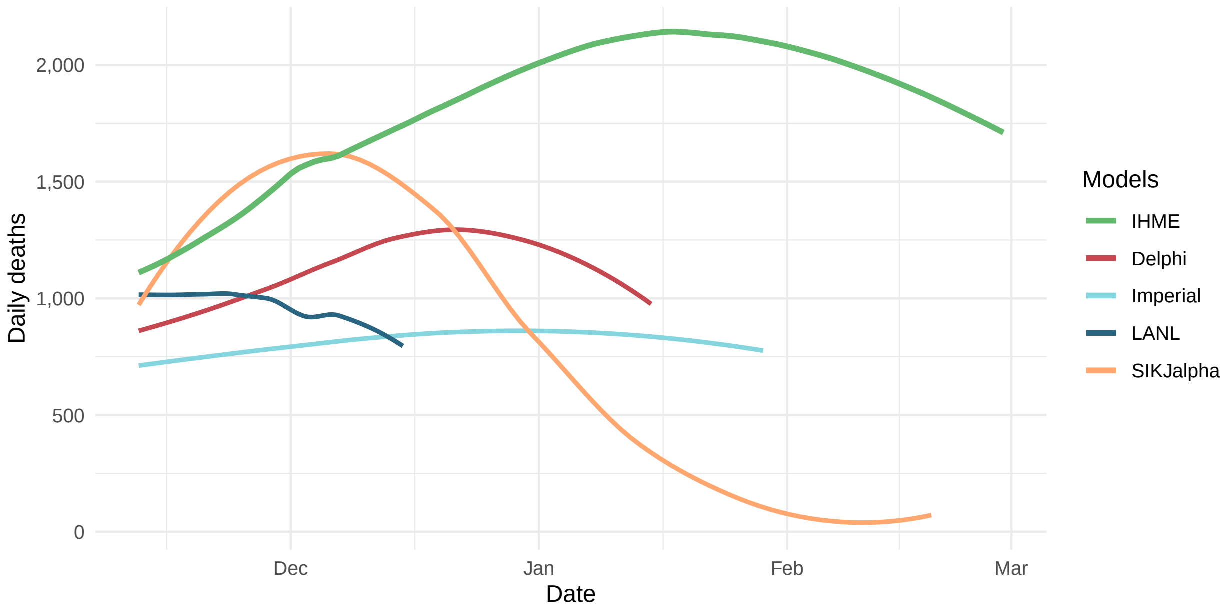


Figure 19. The estimated inpatient hospital usage is shown over time. The percent of hospital beds occupied by COVID-19 patients is color coded based on observed quantiles of the maximum proportion of beds occupied by COVID-19 patients. Less than 5% is considered *low stress*, 5-9% is considered *moderate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

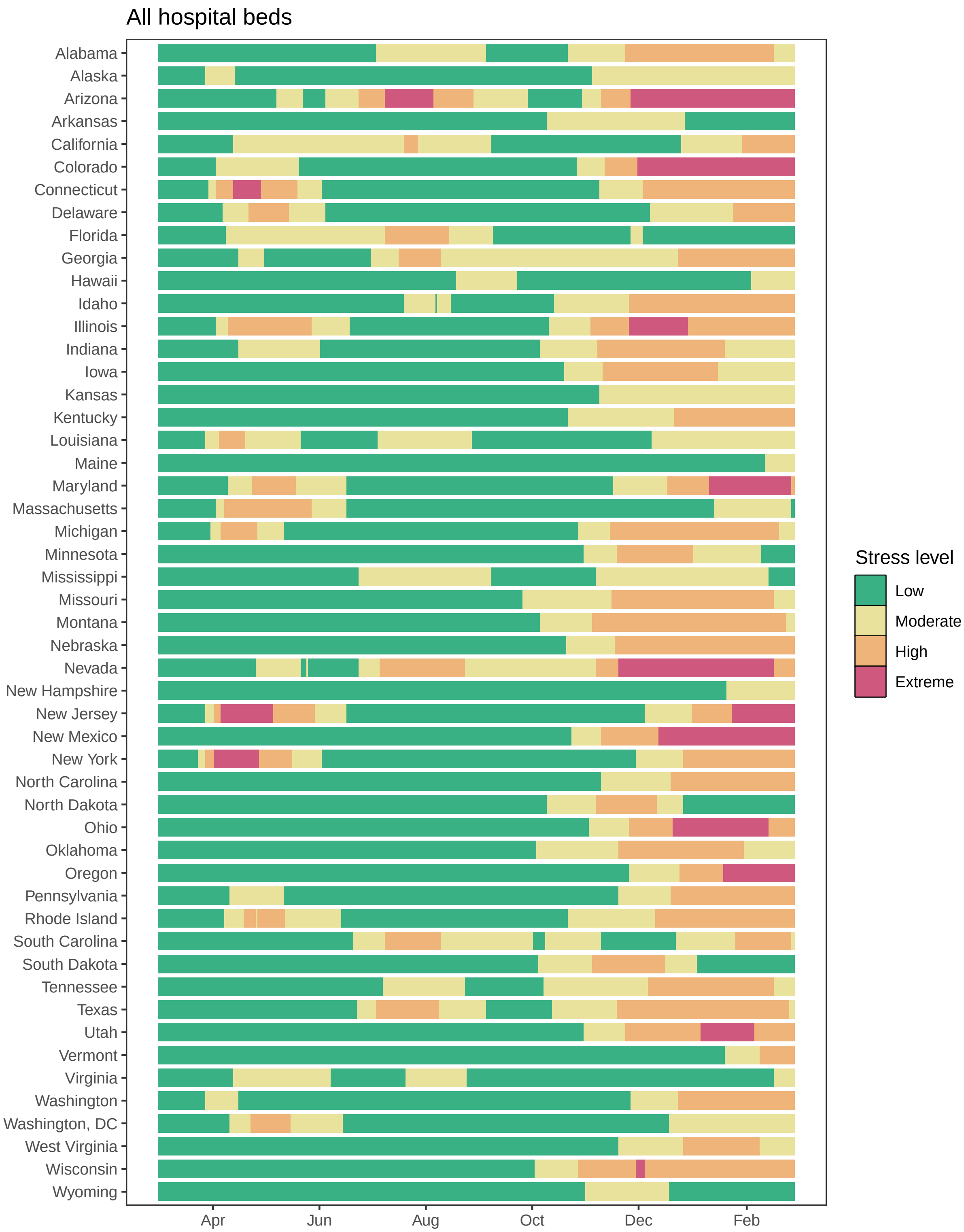


Figure 20. The estimated intensive care unit (ICU) usage is shown over time. The percent of ICU beds occupied by COVID-19 patients is color coded based on observed quantiles of the maximum proportion of ICU beds occupied by COVID-19 patients. Less than 10% is considered *low stress*, 10-29% is considered *moderate stress*, 30-59% is considered *high stress* and greater than 60% is considered *extreme stress.*

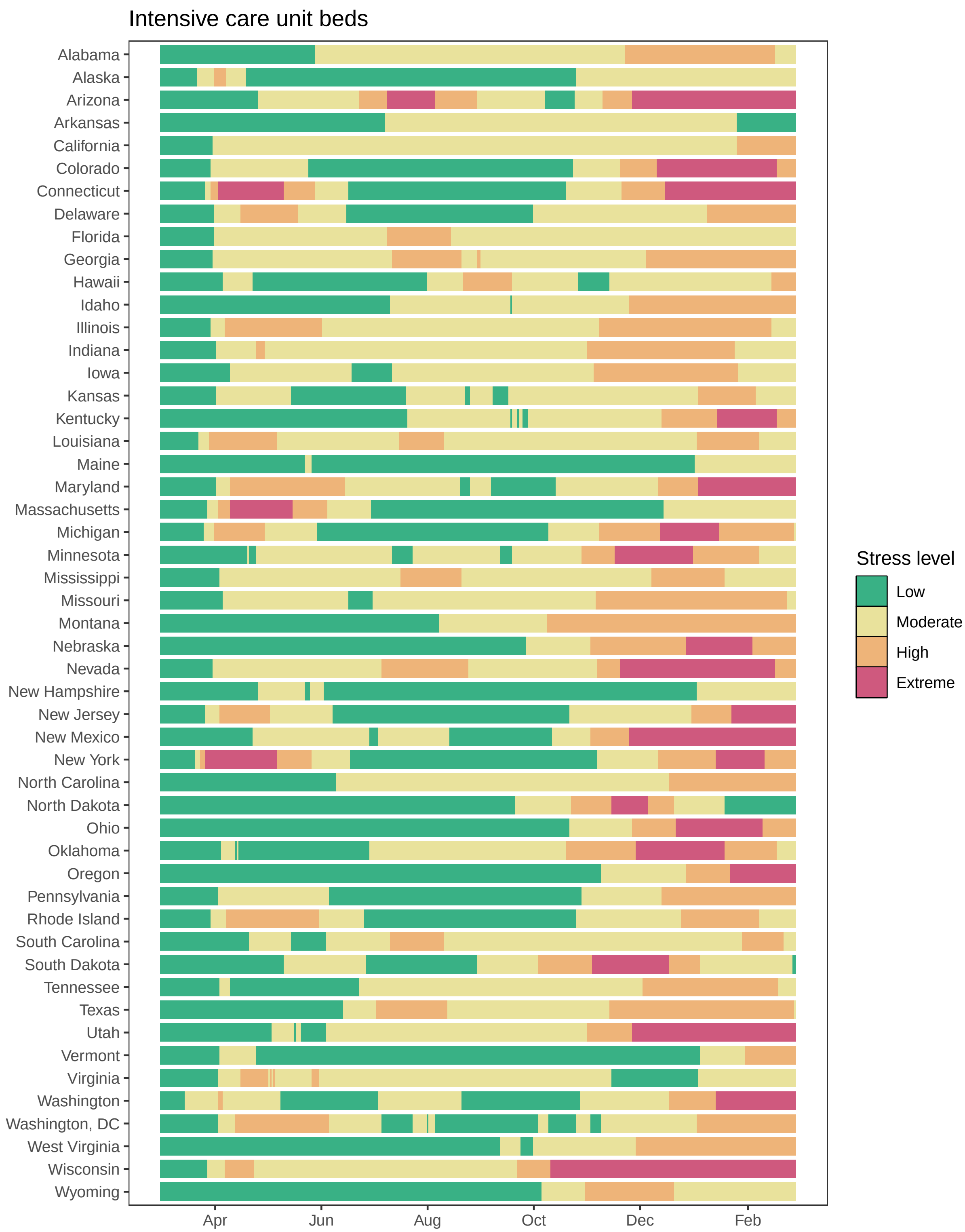


Table 3. Ranking of COVID-19 among the leading causes of mortality in the full year 2020. Deaths from COVID-19 are projections of cumulative deaths on Jan 1, 2021 from the reference scenario. Deaths from other causes are from the Global Burden of Disease study 2019 (rounded to the nearest 100).

Cause name	Annual deaths	Ranking
Ischemic heart disease	557,600	1
COVID-19	320,404	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

Table 4. Table of the number of deaths at varying levels of the cumulative percent of the population that is infected with COVID-19. The infection fatality rate can be used to figure out how many people may eventually die from COVID-19 before a community arrives at herd immunity. Since we do not know the level at which herd immunity may be reached for COVID-19, the table below shows the total number of deaths that would be expected in the United States of America for various levels of herd immunity. These estimates assume that there does not exist an effective vaccine and that no significant improvements in treatment will be made. We estimated that the all age infection fatality ratio of of November 11, 2020 in the United States of America was 0.6%.

Cumulative incidence	Deaths
30%	560,000
35%	654,000
40%	747,000
45%	841,000
50%	934,000
55%	1,027,000
60%	1,121,000
65%	1,214,000
70%	1,308,000
75%	1,401,000
80%	1,494,000
85%	1,588,000
90%	1,681,000
95%	1,774,000

Recognition and thanks

Mask data sources:

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.

A note of thanks:

We would like to extend a special thanks to the Pan American Health Organization (PAHO) for key data sources; our partners and collaborators in Argentina, Brazil, Bolivia, Chile, Colombia, Cuba, the Dominican Republic, Ecuador, Egypt, Honduras, Israel, Japan, Malaysia, Mexico, Moldova, Panama, Peru, the Philippines, Russia, Serbia, South Korea, Turkey, and Ukraine for their support and expert advice; and to the tireless data collection and collation efforts of individuals and institutions throughout the world.

In addition, we wish to express our gratitude for efforts to collect social distancing policy information in Latin America to University of Miami Institute for Advanced Study of the Americas (Felicia Knaul, Michael Touchton), with data published here: http://observcovid.miami.edu/; Fundación Mexicana para la Salud (Héctor Arreola-Ornelas) with support from the GDS Services International: Tómatelo a Pecho A.C.; and Centro de Investigaciones en Ciencias de la Salud, Universidad Anáhuac (Héctor Arreola-Ornelas); Lab on Research, Ethics, Aging and Community-Health at Tufts University (REACH Lab) and the University of Miami Institute for Advanced Study of the Americas (Thalia Porteny).

Further, IHME is grateful to the Microsoft AI for Health program for their support in hosting our COVID-19 data visualizations on the Azure Cloud. We would like to also extend a warm thank you to the many others who have made our COVID-19 estimation efforts possible.