

COVID-19 Results Briefing

The United States of America

December 22, 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 December 22, 2020, with data through December 20, 2020.

National daily cases and deaths continue to increase. Despite the national increase, a number of states in the Midwest have flat or declining cases and hospitalizations. Given the magnitude of the epidemic and stress on hospital systems, relatively few states have reacted with the imposition of a package of mandates. In this week's models, we have revised downward our expected number of vaccinations by April 1 by nearly 25% due to likely delays in the approval of the Astra-Zeneca vaccine. Daily deaths are expected to rise into mid-January and then begin declining if state governments impose mandates on gatherings, bar and restaurant openings, and other major locations for transmission. Daily deaths in the absence of concerted government action can reach over 5,000 by mid-February. Despite increased mask wearing, reaching 74% in the US, expanding mask wearing to 95% represents an opportunity to reduce the death toll by April 1 by 49,000.

Current situation

- Daily reported cases in the last week increased to 206,300 per day on average compared to 207,400 the week before (Figure 1).
- Daily deaths in the last week increased to 2,580 per day on average compared to 2,350 the week before (Figure 2). This makes COVID-19 the number 1 cause of death in the US this week (Table 1).
- Effective R, computed using cases, hospitalizations, and deaths, is greater than 1 in 31 states (Figure 3). Many states in the Midwest now have an effective R less than 1.
- We estimated that 18% of people in the US have been infected as of December 20 (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, there have been few changes in mandates at the state level (Table 2).
- Mobility last week was 24% lower than the pre-COVID-19 baseline (Figure 8), representing an increase over the last week. Mobility was near baseline (within 10%) in Alabama, Mississippi, Nebraska, South Dakota, and Wyoming. Mobility was lower than 30% of baseline in 12 states.



- More detailed analysis of cellphone visits to specific types of locations show that restaurant, bar, and department store visits are down compared to the two weeks immediately after Thanksgiving (Figure 8).
- As of December 20, we estimated that 74% of people always wore a mask when leaving their home, unchanged from last week (Figure 9). Mask use was lower than 50% in no locations.
- There were 461 diagnostic tests per 100,000 people on December 20 (Figure 10).
- In the US, 49.8% of people say they would accept a vaccine for COVID-19, and 26.3% say they are unsure if they would accept one. The fraction of the population who are open to receiving a COVID-19 vaccine ("yes" and "unsure" responses) ranges from 66% in Mississippi to 83% in Virginia (Figure 12).
- We expect that 72 million people will be vaccinated by April 1 (Figure 13). With faster scale-up, the number vaccinated could reach 128 million people. These estimated numbers of vaccinations are substantially lower than last week's estimates because of expected delays in the approval of the AstraZeneca vaccine.

Projections

- In our **reference scenario**, which represents what we think is most likely to happen, our model projects 567,000 cumulative deaths on April 1, 2021. This represents 252,000 additional deaths from December 20 to April 1 (Figure 14). Daily deaths will peak at 3,890 on January 11, 2021 (Figure 15).
- By April 1, 2021, we project that 33,200 lives will be saved by the projected vaccine rollout. If rapid rollout of vaccine is achieved, 45,000 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 54,000 lives (Figure 14).
- If **universal mask coverage (95%)** were attained in the next week, our model projects 49,000 fewer cumulative deaths compared to the reference scenario on April 1, 2021 (Figure 14).
- Under our **mandates easing scenario**, our model projects 731,000 cumulative deaths on April 1, 2021 (Figure 14).
- We estimate that 47.2% of people will still be susceptible on April 1, 2021 (Figure 17).
- The reference scenario assumes that 49 states will re-impose mandates by April 1, 2021 (Figure 18).
- Figure 21 compares our reference scenario forecasts to other publicly archived models. All the forecasts except that of Los Alamos National Labs suggest a decline in daily deaths starting at least by mid-January.
- At some point from December through April 1, 47 states will have high or extreme stress on hospital beds (Figure 22). At some point from December through April 1, 48 states will have high or extreme stress on ICU capacity (Figure 23).



Model updates

Methods have not been changed in this week's update. However, vaccination scale-up has been modified to reflect the revised timing of expected approvals and new purchase agreements announced for the Pfizer, Moderna, and AstraZeneca vaccines in the EU, Mexico, China, and Malaysia.



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	18,062	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 December 09, 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 December 20, 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 December 20, 2020



Critical drivers

 Table 2. Current mandate implementation













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 December 20, 2020







AAACCODDFGH % of 2019 mean 1.2+ (1,1.2] (0.8,1] (0.6,0.8] (0.4,0.6] (0.2,0.4] (0,0.2]

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 December 20, 2020







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

Figure 10b. COVID-19 diagnostic tests per 100,000 people on December 16, 2020















Figure 13. The number of people who receive any vaccine and those that are immune accounting for efficacy, loss to follow up for 2 dose vaccines, and a 28 day delay between first dose and immunity for 2 dose vaccines.



Solid lines represent the total vaccine doses, dashed lines represent effective vaccination



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 April 01, 2021 for six scenarios

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







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

Figure 17. Susceptible population, accounting for infections and people immune through vaccination





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 April 01, 2021

Figure 20. Daily COVID-19 deaths per million forecasted on April 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 available 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*.



All hospital beds

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*.



Intensive care unit beds



Cause name	Annual deaths	Ranking
Ischemic heart disease	557,600	1
COVID-19	350,716	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 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).



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.