COVID-19 Results Briefing

India

May 5, 2021

This document contains summary information on the latest projections from the IHME model on COVID-19 in India. The model was run on May 5, 2021, with case and death data through May 2, 2021, and covariate data through May 3, 2021.

COVID-19 was the leading cause of death in India last week by a big margin, responsible for 2.5 times more deaths than the second-leading cause. India currently has the highest number of daily COVID-19 cases and deaths of any country in the world. After the declining trend in the number of daily COVID-19 cases and deaths in India from September 2020 to mid-February 2021, there has been a sharp reversal of this trend with a dramatic rise in April and early May. Last week, the daily COVID-19 cases were about four times and the daily COVID-19 deaths three times the numbers in the previous peak in September 2020. The daily cases increased by 16% and the daily deaths by 40% last week in India compared with the week before. Without drastic measures to bolster the health system to deal with this onslaught, decrease social mixing, and increase effective face mask use, the situation currently looks quite grim for India. IHME's reference scenario forecasts 1,496,000 COVID-19 deaths in India by September 1, 2021.

Current situation

- Daily reported cases in the last week increased to 370,900 per day on average compared to 319,700 the week before (Figure 1).
- The estimated daily deaths in the last week increased to 10,500 per day on average compared to 7,500 the week before (Figure 2).[1] This makes COVID-19 the number one cause of death in India this week (Table 1).
- The daily death rate is greater than 4 per million in 22 states and union territories (Figure 3).
- We estimated that 41% of people in India have been infected as of May 3 (Figure 5).
- Effective R, computed using cases, hospitalizations, and deaths, is greater than 1 in 26 states and union territories (Figure 6).
- The infection-detection rate in India was close to 4% on May 3 (Figure 7).

Trends in drivers of transmission

- Mobility last week was 48% lower than the pre-COVID-19 baseline (Figure 10). Mobility was near baseline (within 10%) in no states or union territories. Mobility was lower than 30% of baseline in 27 states and union territories (Figure 11).
- There were 152 diagnostic tests per 100,000 people on May 3 (Figure 14).

- In India, 82% of people say they would accept or would probably accept a vaccine for COVID-19. This is up by 1.3 percentage points from last week. The fraction of the population who are open to receiving a COVID-19 vaccine ranges from 60% in Tamil Nadu to 88% in Odisha (Figure 18).
- In our current reference scenario, we expect that 778 million will be vaccinated by September 1 (Figure 19).

Projections

- In our **reference scenario**, which represents what we think is most likely to happen, our model projects 1,496,000 cumulative deaths on September 1, 2021. This represents 842,000 additional deaths from May 3 to September 1 (Figure 20). Daily deaths will peak at 15,430 on May 17, 2021 (Figure 21). These estimates are based in part on seroprevalence surveys.
- If **universal mask coverage (95%)** were attained in the next week, our model projects 101,000 fewer cumulative deaths compared to the reference scenario on September 1, 2021 (Figure 20).
- Under our **worse scenario**, our model projects 1,735,000 cumulative deaths on September 1, 2021, an additional 239,000 deaths compared to our reference scenario (Figure 20).
- By September 1, we project that 143,400 lives will be saved by the projected vaccine rollout.
- Figure 23 compares our reference scenario forecasts to other publicly archived models. Forecasts are widely divergent.

[1] For information on the calculation of total mortality due to COVID-19 to account for under-reporting of deaths, please refer to the following methods description: http://www.healthdata.org/special-analysis/estimation-excess-mortality-due-covid-19-and-scalars-reported-covid-19-deaths

Model updates

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

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

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

Figure 1. Reported daily COVID-19 cases

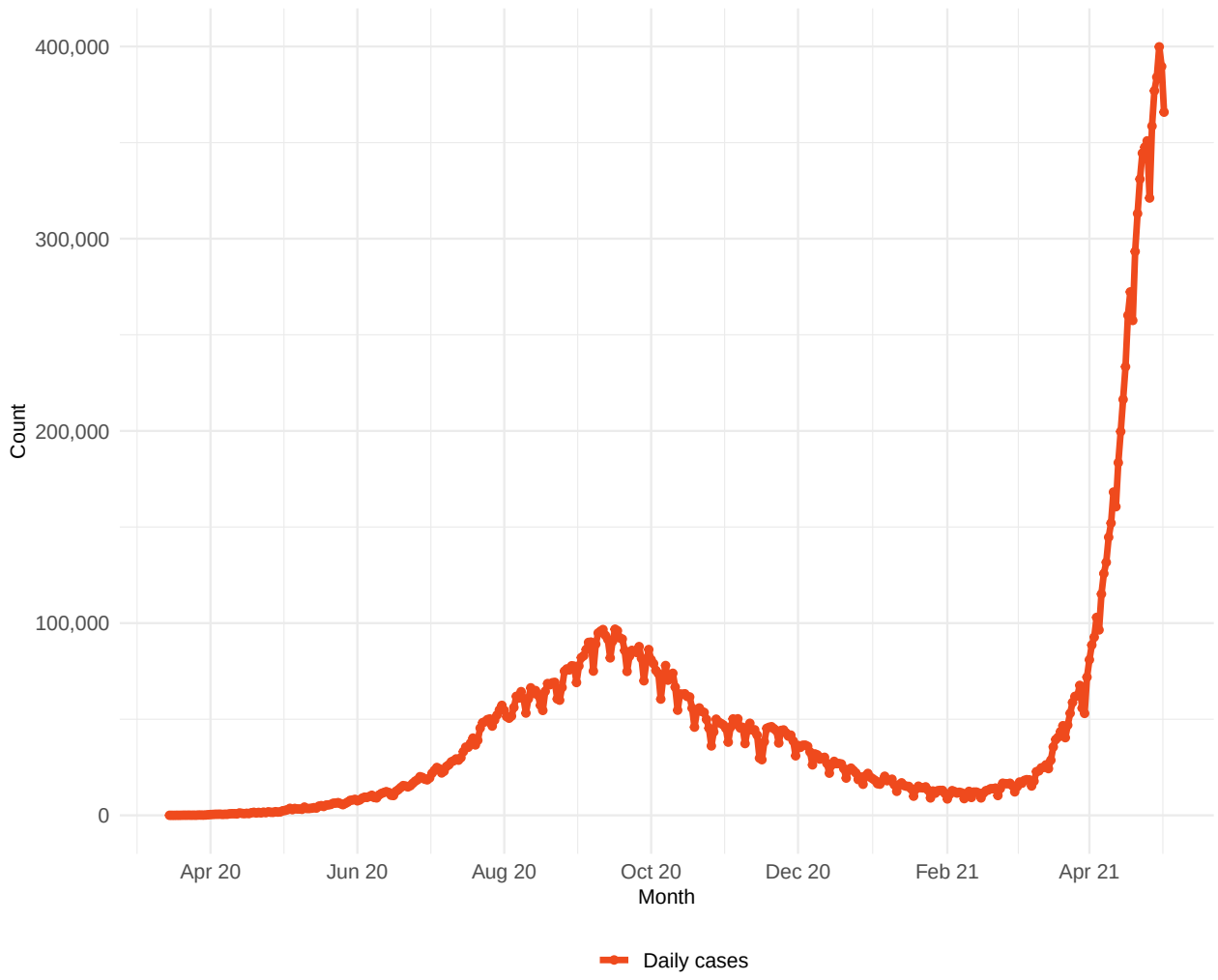


Table 1. Ranking of COVID-19 among the leading causes of mortality this week, assuming uniform deaths of non-COVID causes throughout the year

Cause name	Weekly deaths	Ranking
COVID-19	73,585	1
Ischemic heart disease	29,214	2
Chronic obstructive pulmonary disease	17,278	3
Stroke	13,444	4
Diarrheal diseases	12,160	5
Neonatal disorders	8,423	6
Lower respiratory infections	8,340	7
Tuberculosis	8,128	8
Diabetes mellitus	5,252	9
Cirrhosis and other chronic liver diseases	5,193	10

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

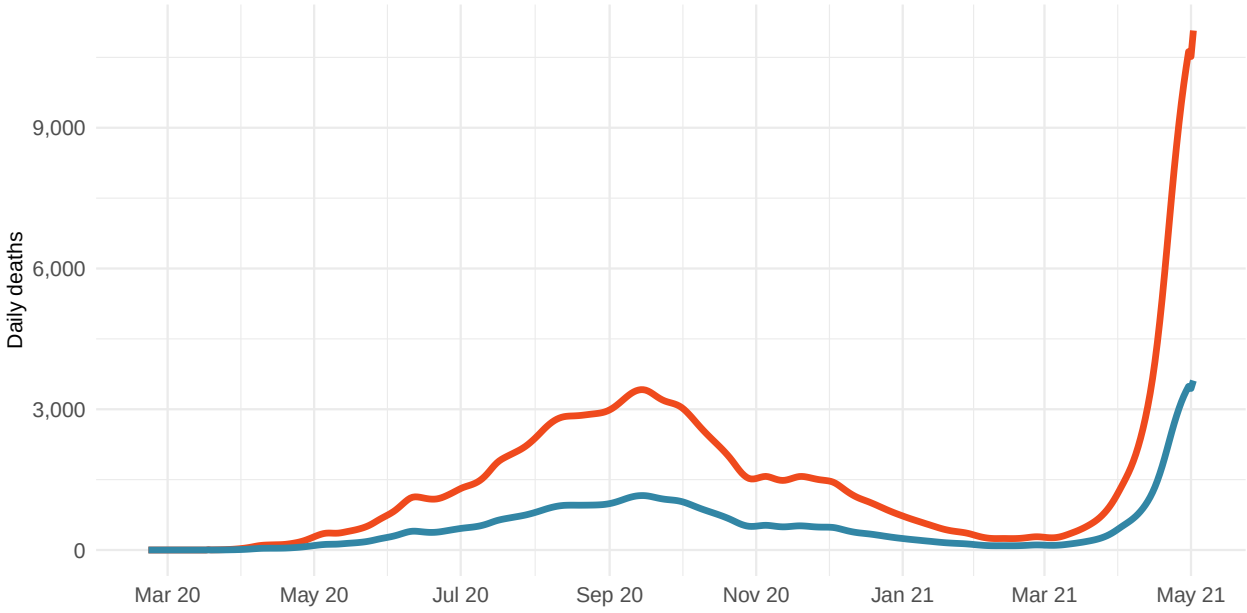


Figure 3. Daily COVID-19 death rate per 1 million on May 03, 2021

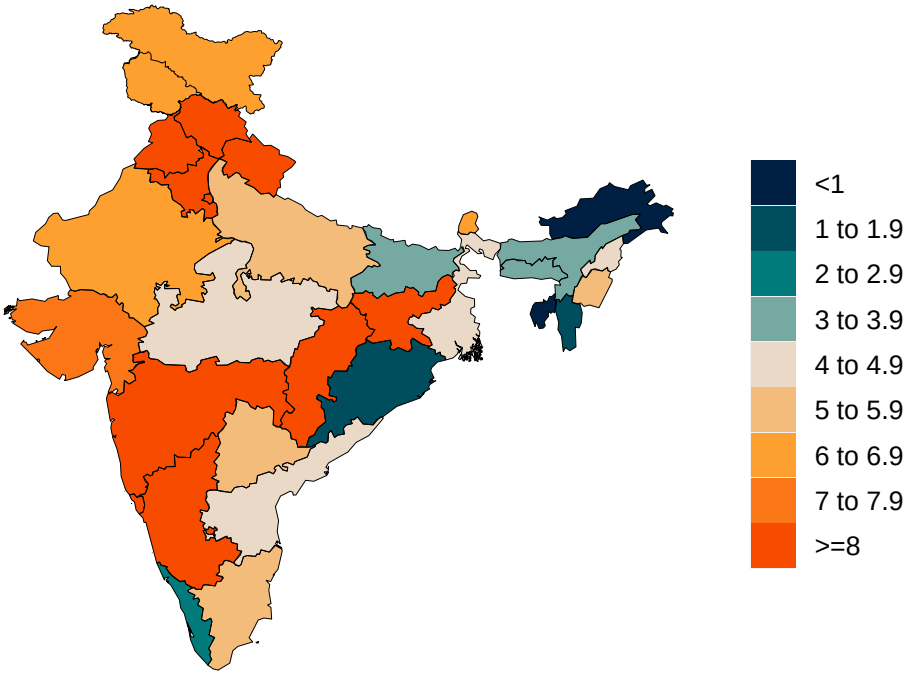


Figure 4. Cumulative COVID-19 deaths per 100,000 on May 03, 2021

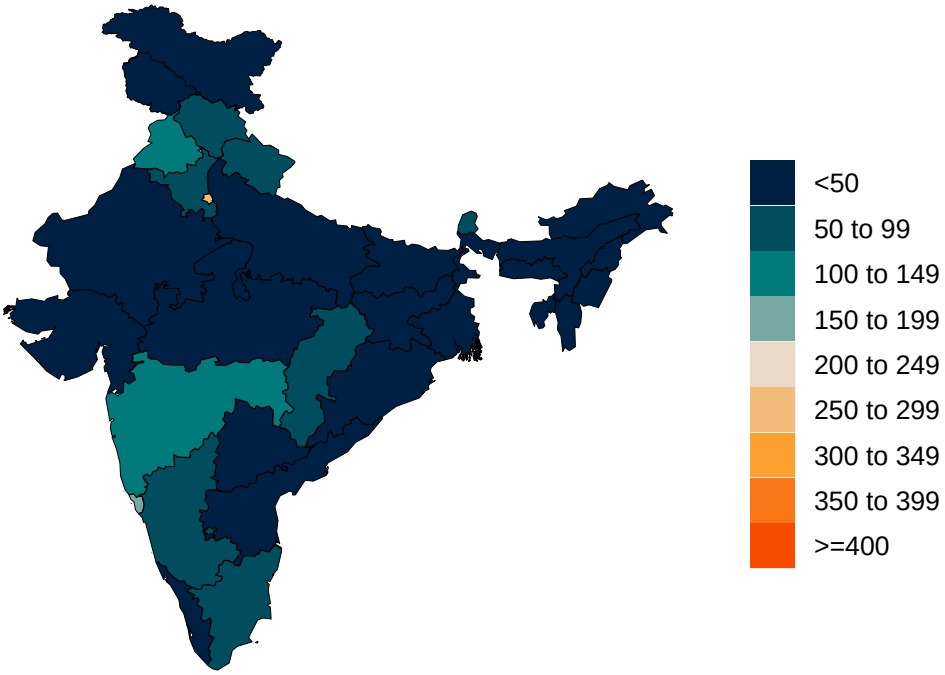


Figure 5. Estimated percent of the population infected with COVID-19 on May 03, 2021

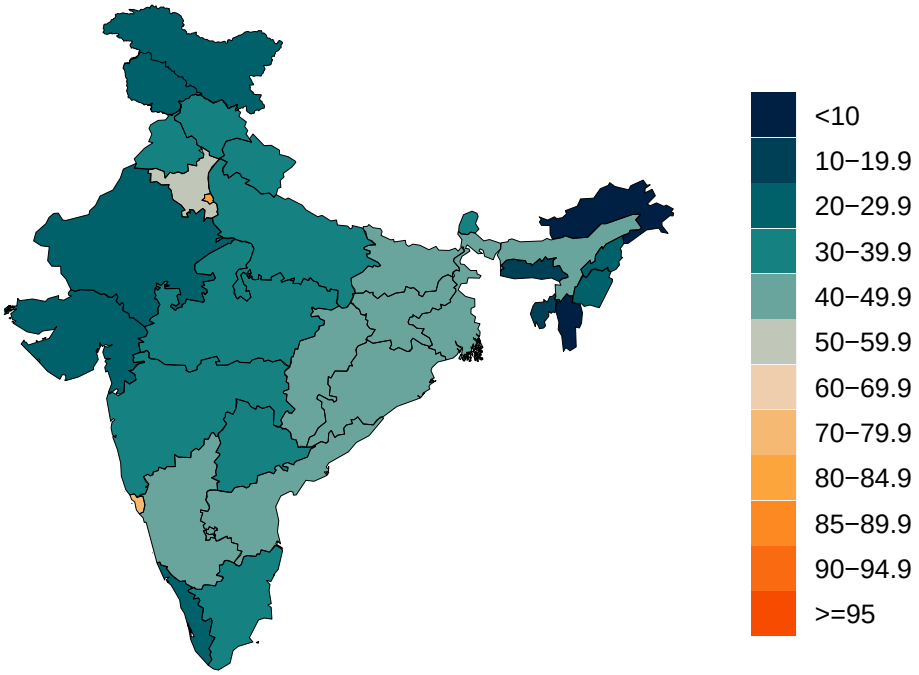


Figure 6. Mean effective R on April 22, 2021. The estimate of effective R is based on the combined analysis of deaths, case reporting, and hospitalizations where available. Current reported cases reflect infections 11-13 days prior, so estimates of effective R can only be made for the recent past. Effective R less than 1 means that transmission should decline, all other things being held the same.

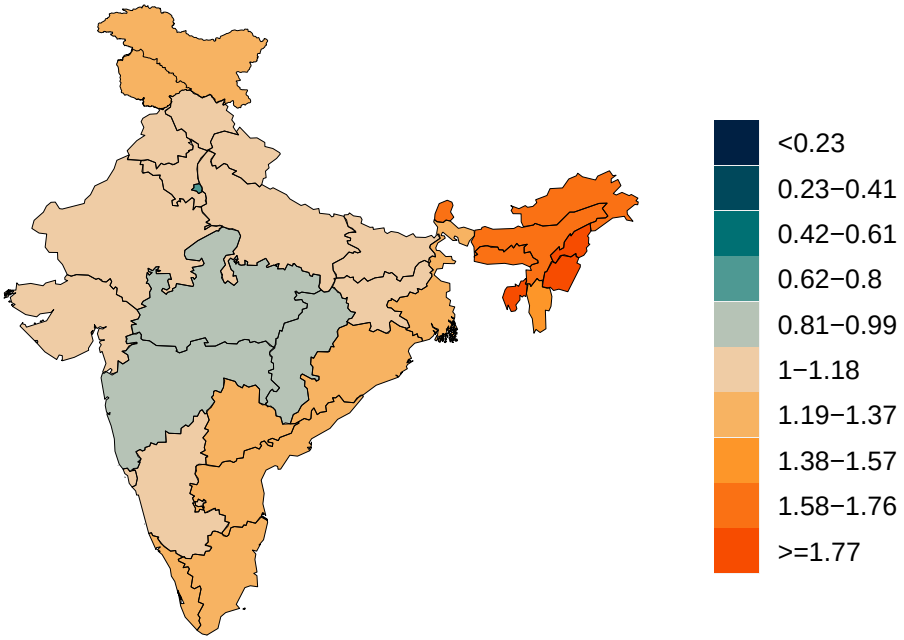
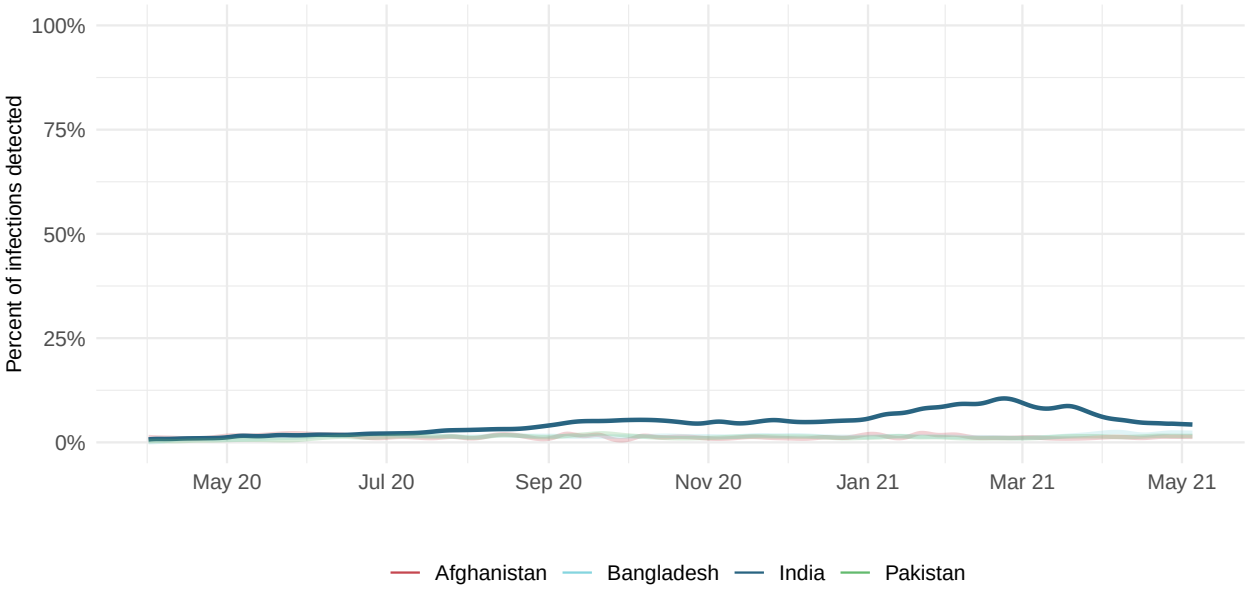


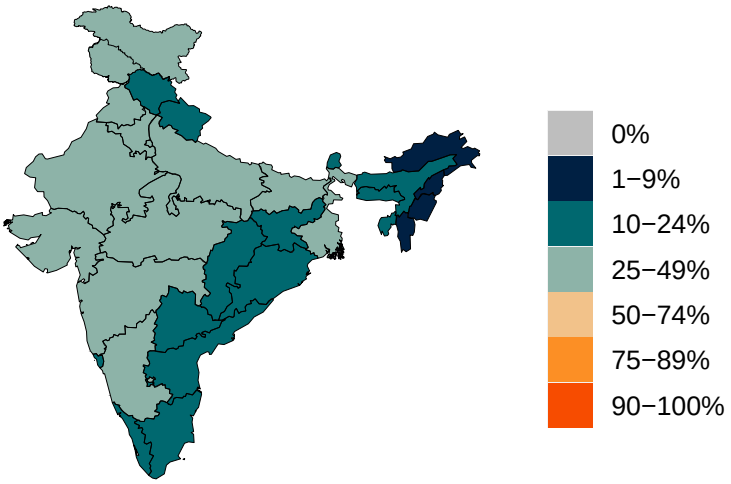
Figure 7. Percent of COVID-19 infections detected. This is estimated as the ratio of reported daily COVID-19 cases to estimated daily COVID-19 infections based on the SEIR disease transmission model.



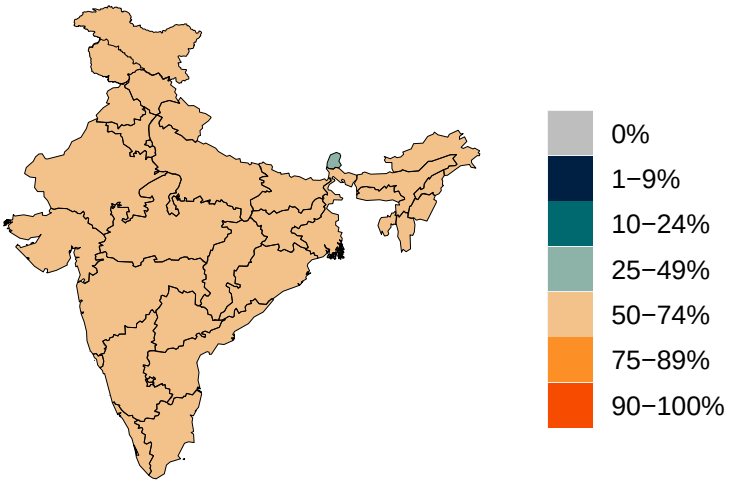
*Due to measurement errors in cases and testing rates, the infection to detection rate (IDR) can exceed 100% at particular points in time.

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

A. Estimated percent B.1.1.7 variant



B. Estimated percent B.1.351 or B.1.617 variant



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

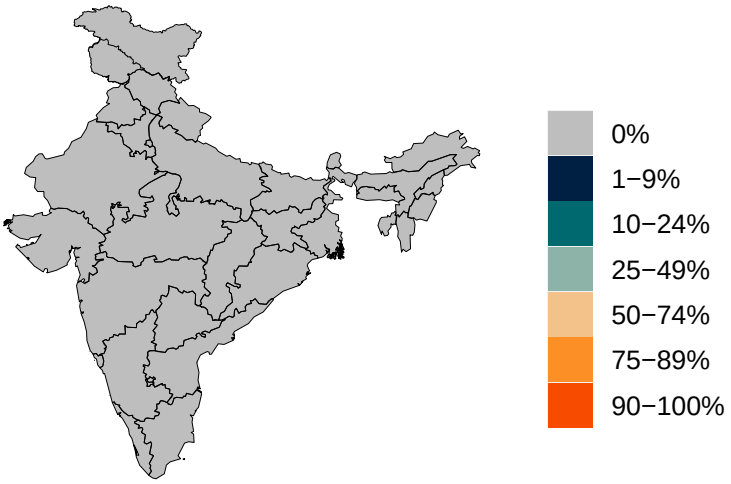
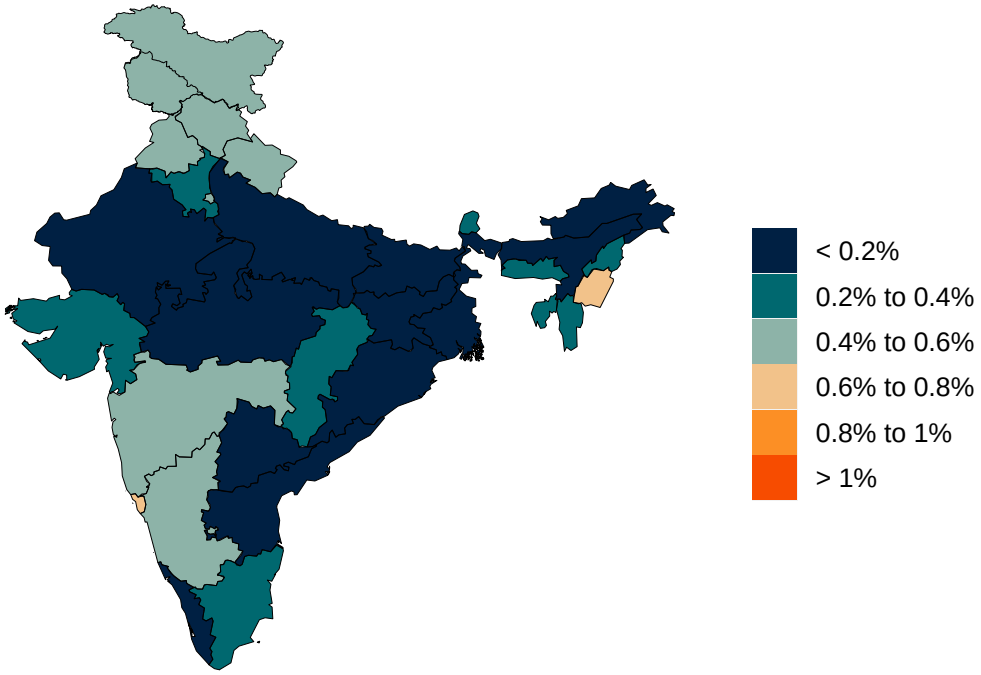
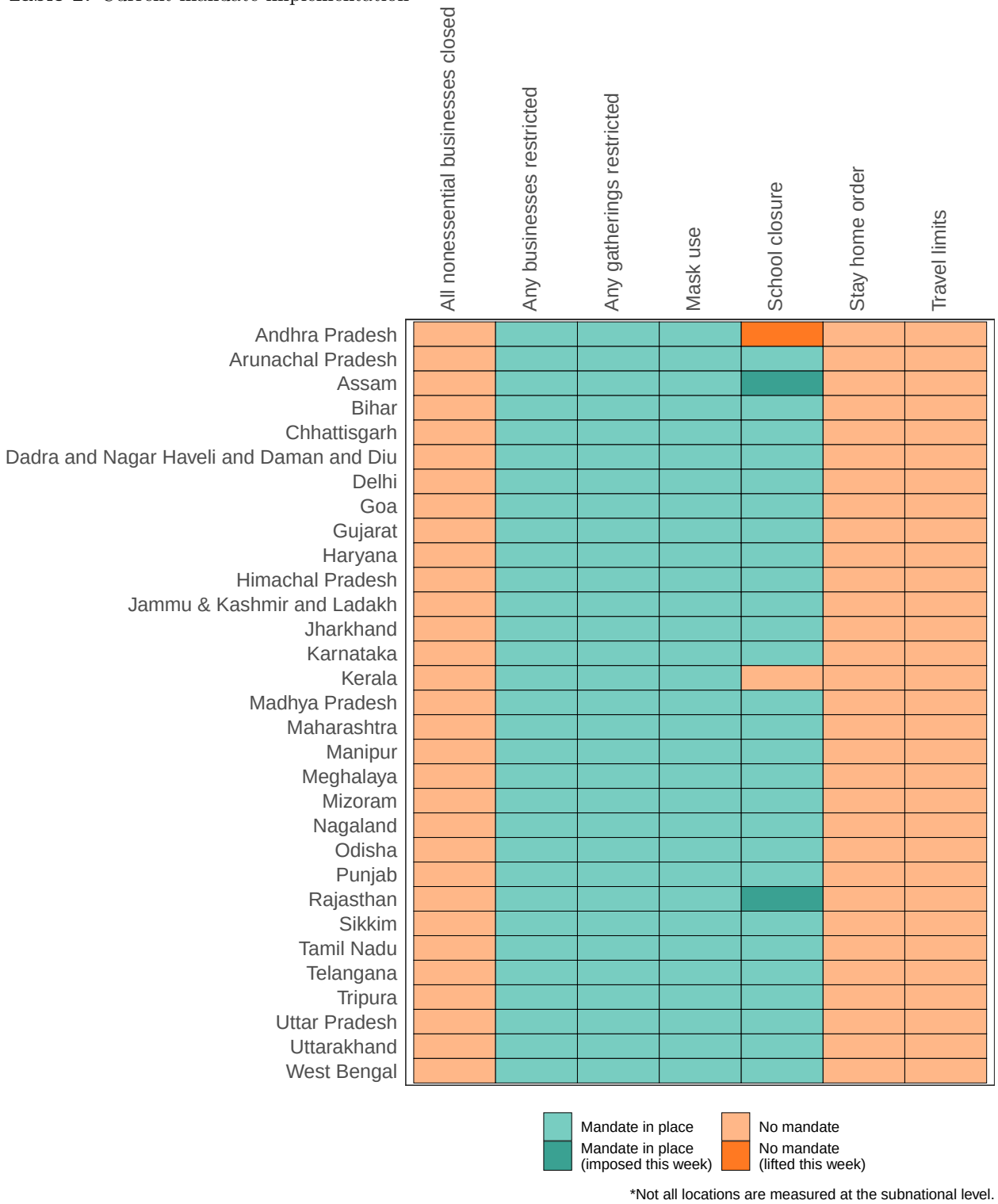


Figure 9. Infection fatality ratio on May 03, 2021. This is estimated as the ratio of COVID-19 deaths to infections based on the SEIR disease transmission model.



Critical drivers

Table 2. Current mandate implementation



*Not all locations are measured at the subnational level.

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

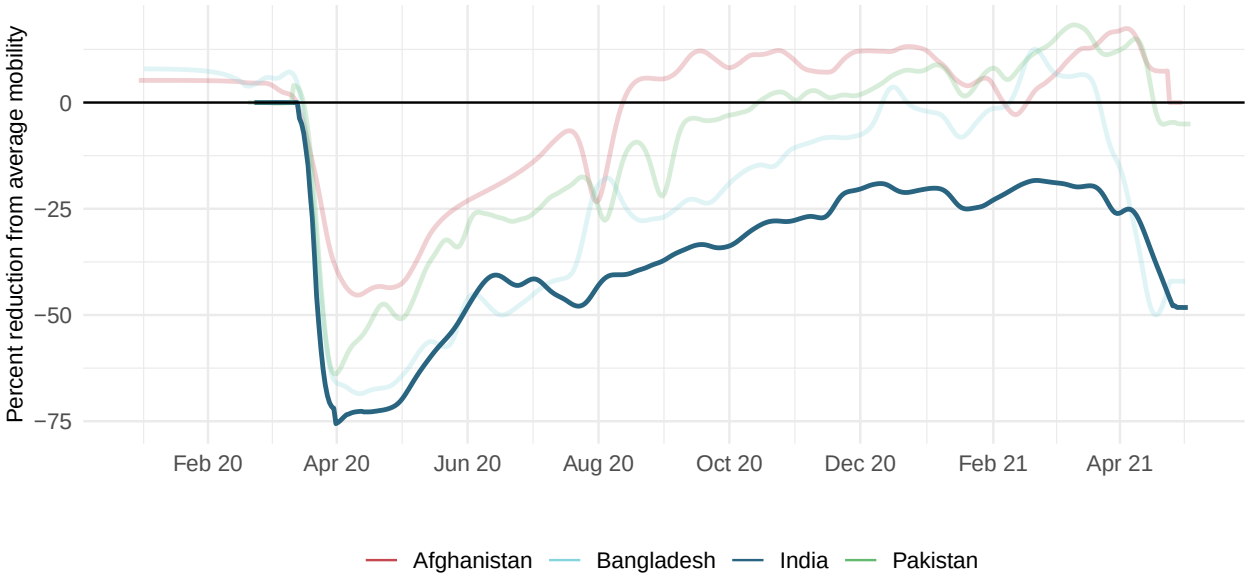


Figure 11. Mobility level as measured through smartphone app use compared to January 2020 baseline (percent) on May 03, 2021

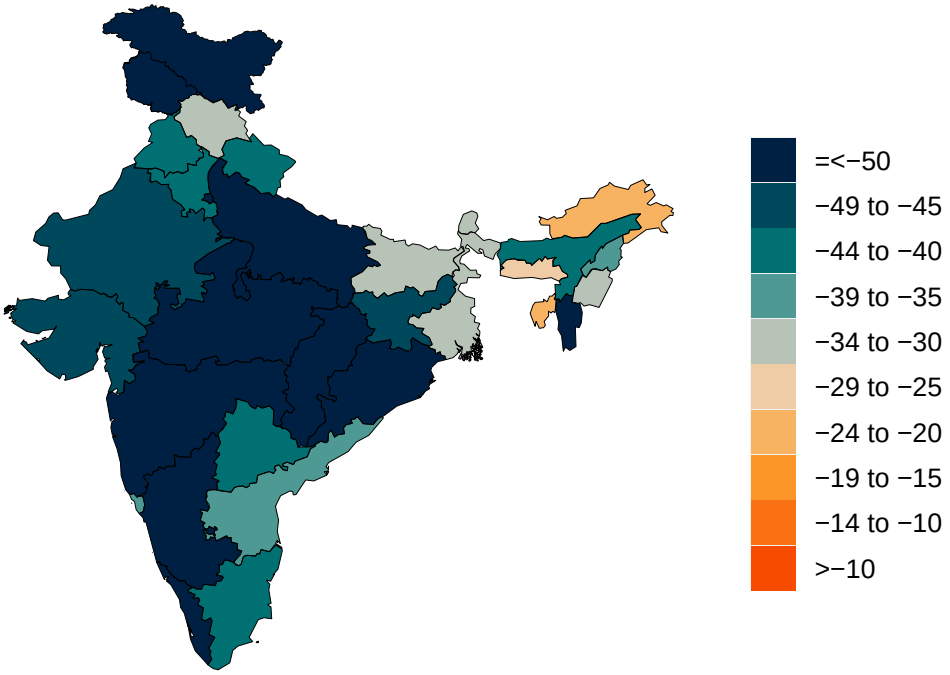


Figure 12. Trend in the proportion of the population reporting always wearing a mask when leaving home

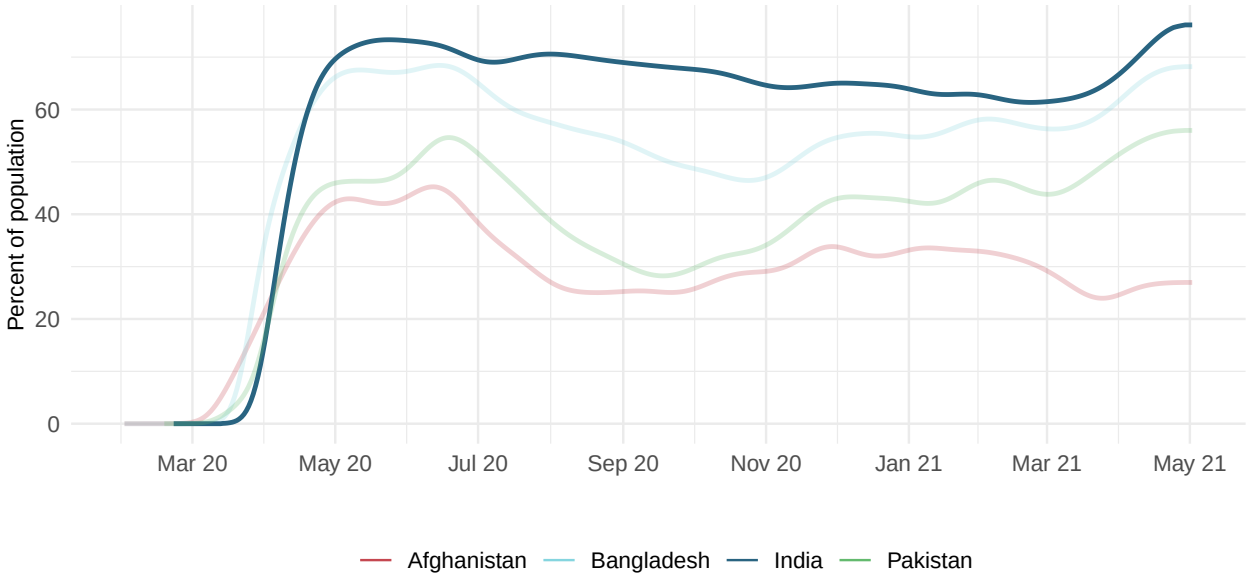


Figure 13. Proportion of the population reporting always wearing a mask when leaving home on May 03, 2021

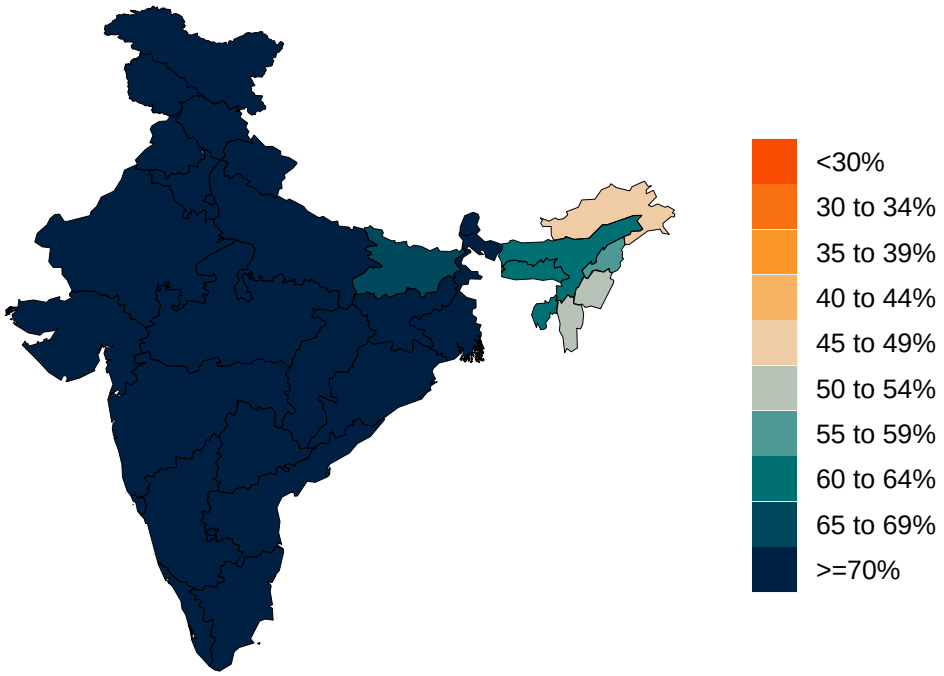


Figure 14. Trend in COVID-19 diagnostic tests per 100,000 people

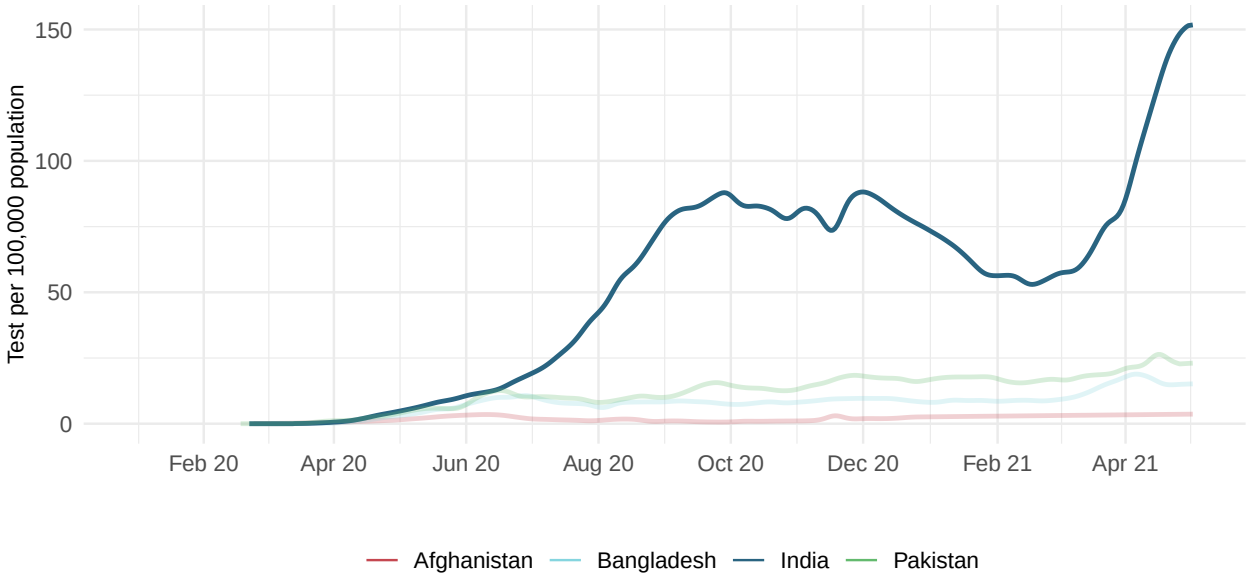


Figure 15. COVID-19 diagnostic tests per 100,000 people on April 30, 2021

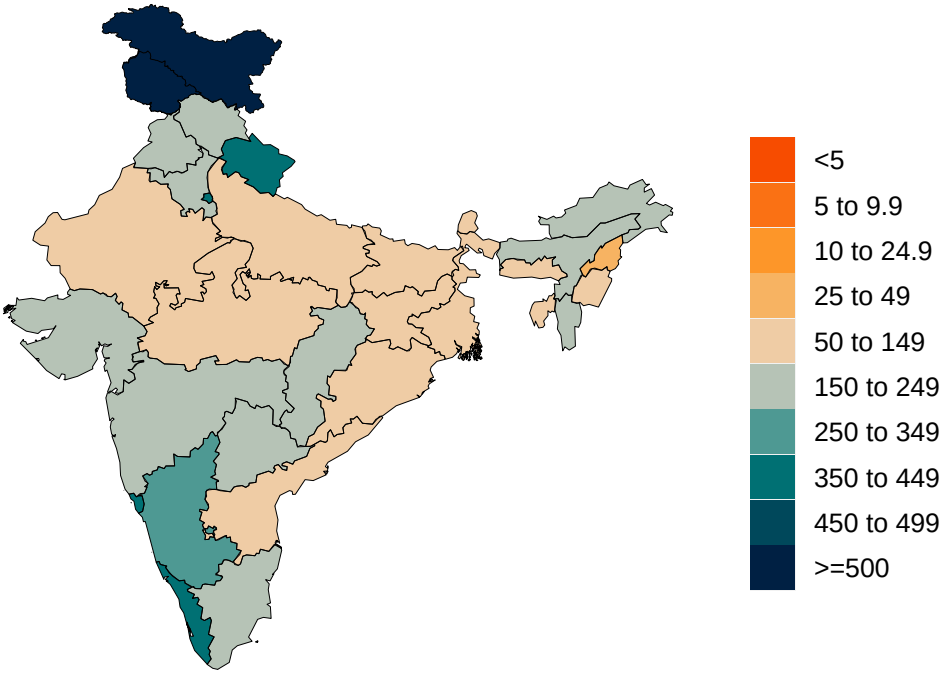


Figure 16. Increase in the risk of death due to pneumonia on February 1 2020 compared to August 1 2020

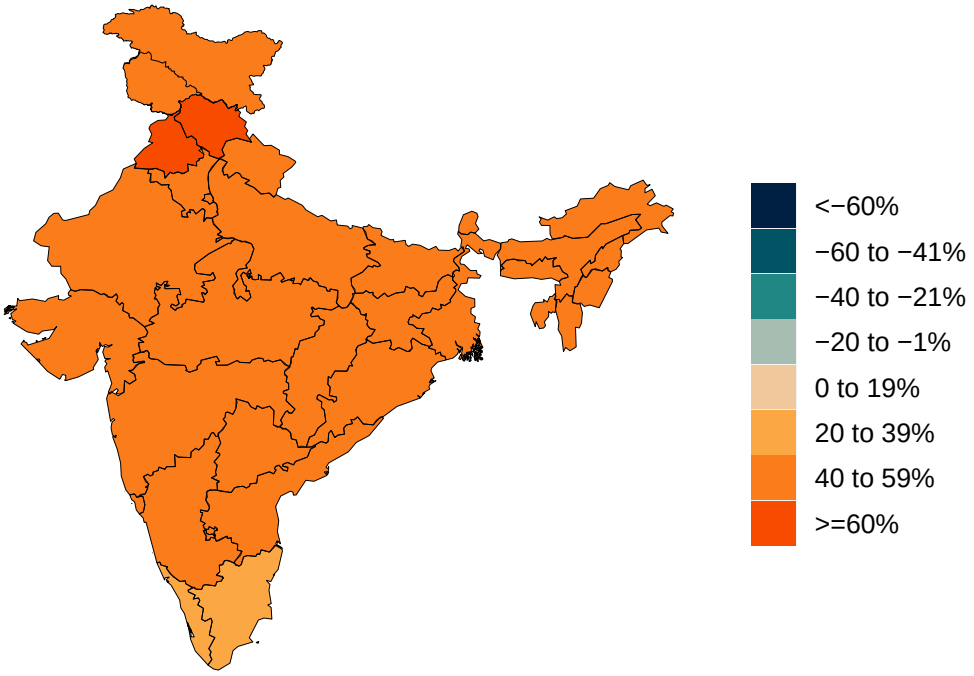


Table 3. The SEIR model uses variant-specific estimates of vaccine efficacy at preventing symptomatic disease and at preventing infection. We use data from clinical trials directly, where available, and make estimates otherwise. More information can be found on our website (http://www.healthdata.org/node/8584).

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%	6%
CoronaVac	50%	43%	38%	25%
Janssen	72%	72%	64%	42%
Moderna	94%	85%	72%	47%
Novavax	89%	77%	49%	32%
Pfizer/BioNTech	91%	86%	69%	45%
Sinopharm	73%	63%	56%	36%
Sputnik-V	92%	80%	70%	45%
Tianjin CanSino	66%	57%	50%	32%
Other vaccines	75%	65%	57%	37%
Other vaccines (mRNA)	95%	83%	72%	47%

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

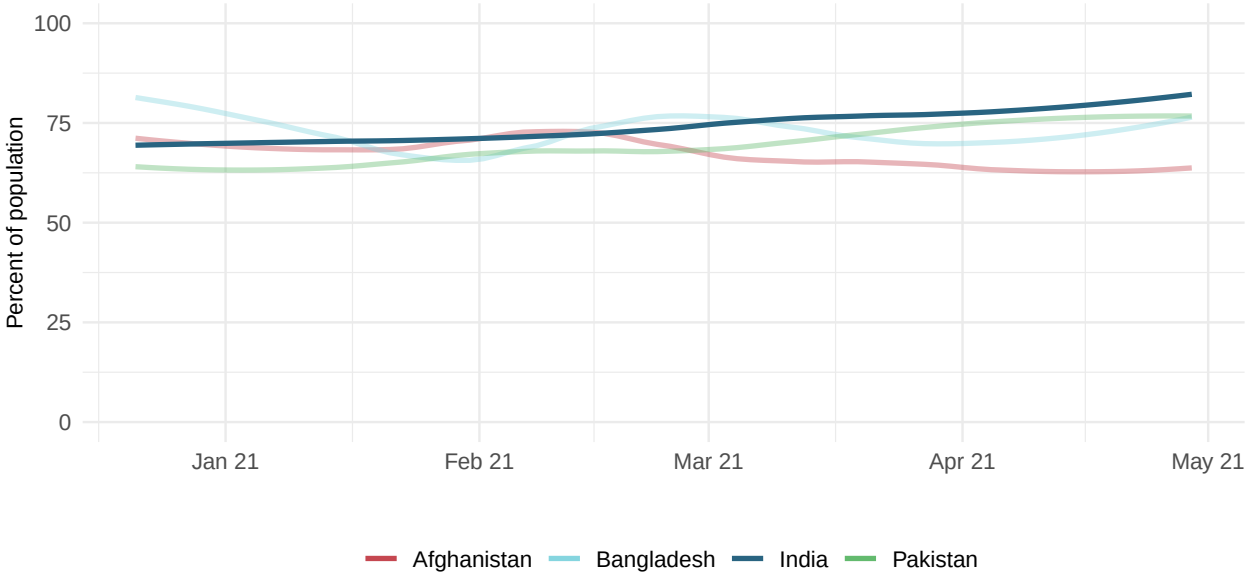


Figure 18. This figure shows the estimated proportion of the adult (18+) population that has been vaccinated or is open to receiving a COVID-19 vaccine based on Facebook survey responses (yes and yes, probably).

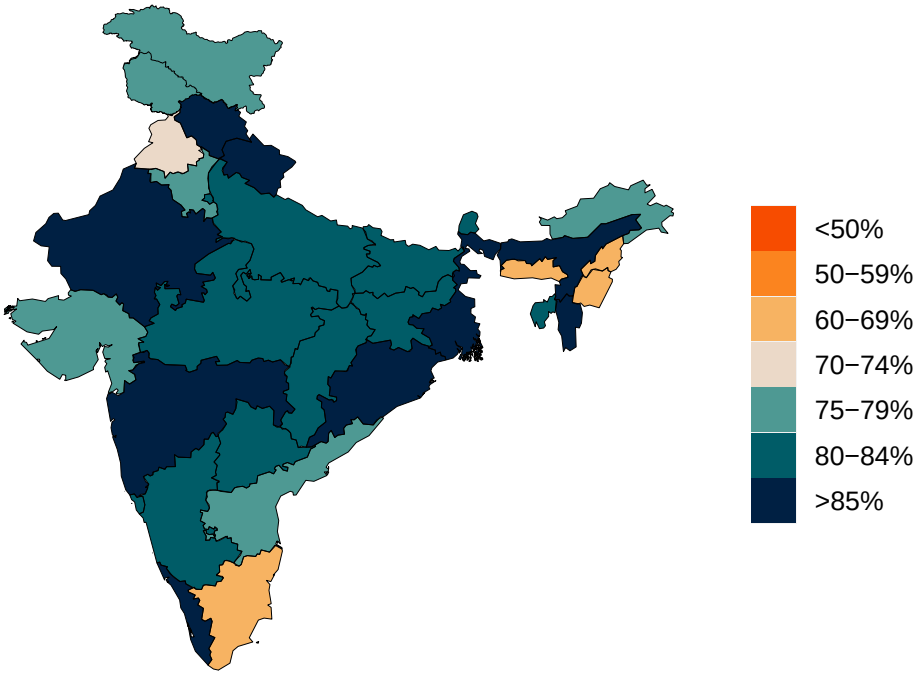
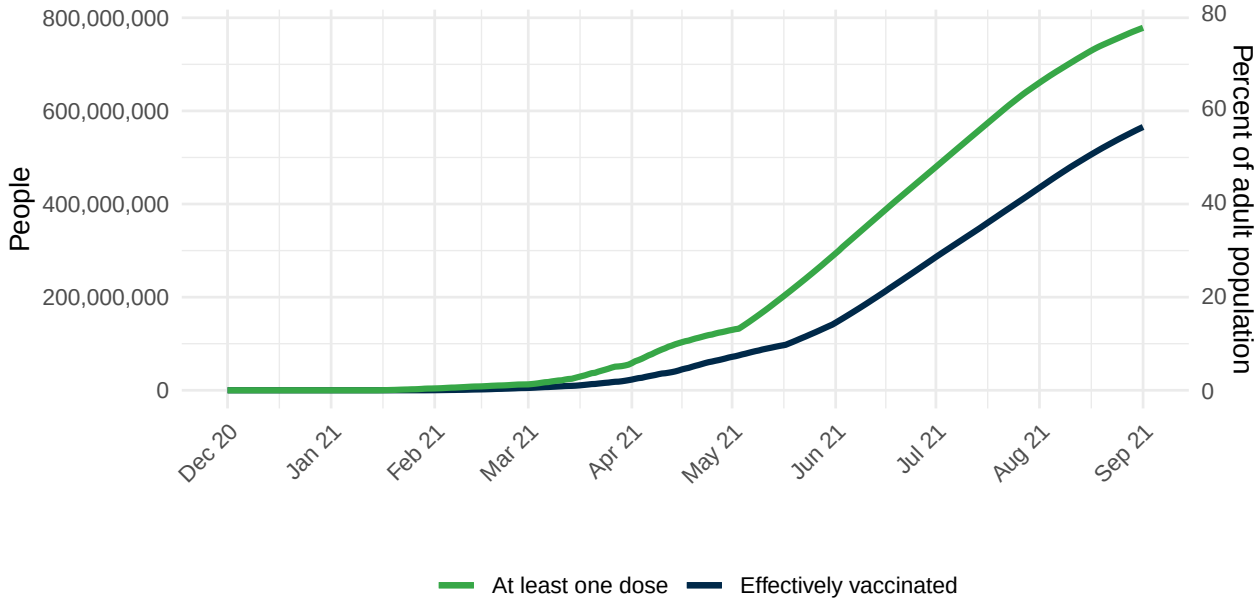


Figure 19. The number of people who receive any vaccine and those who are effectively vaccinated and protected against disease, accounting for efficacy, loss to follow up for two-dose vaccines, partial immunity after one dose, and immunity after two doses.



Projections and scenarios

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

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

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

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

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

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

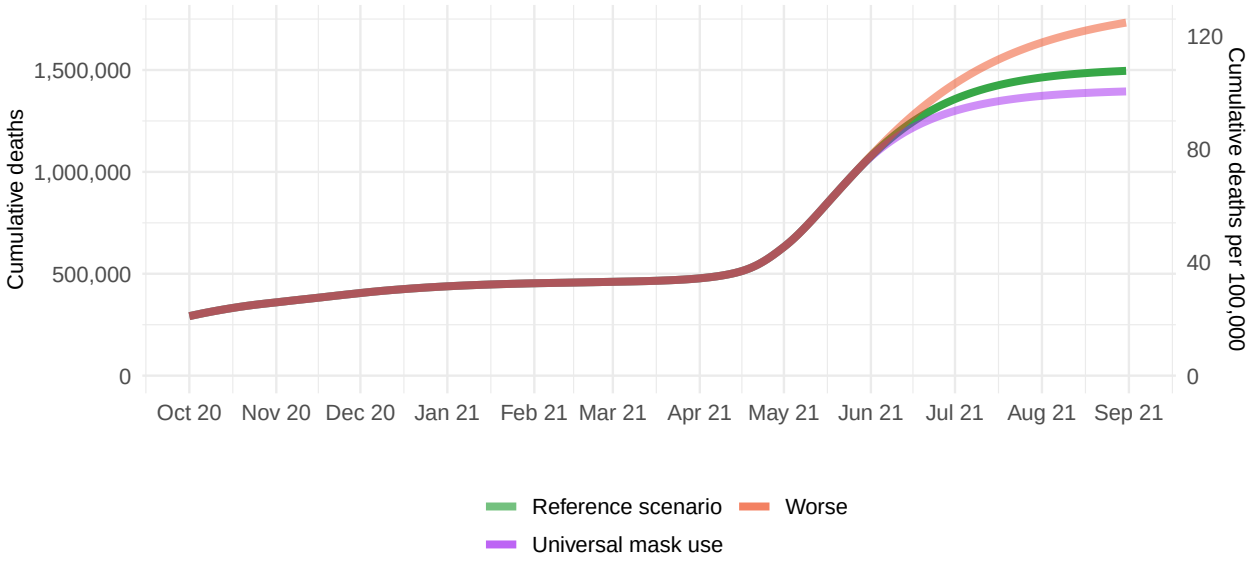


Figure 21. Daily COVID-19 deaths until September 01, 2021 for three scenarios,

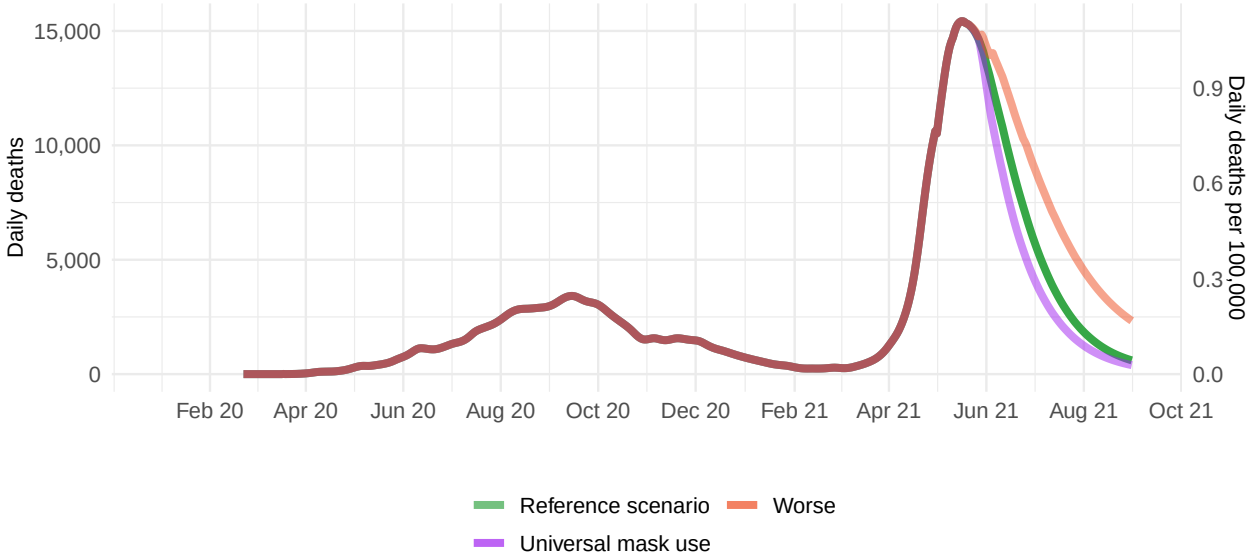


Figure 22. Daily COVID-19 infections until September 01, 2021 for three scenarios.

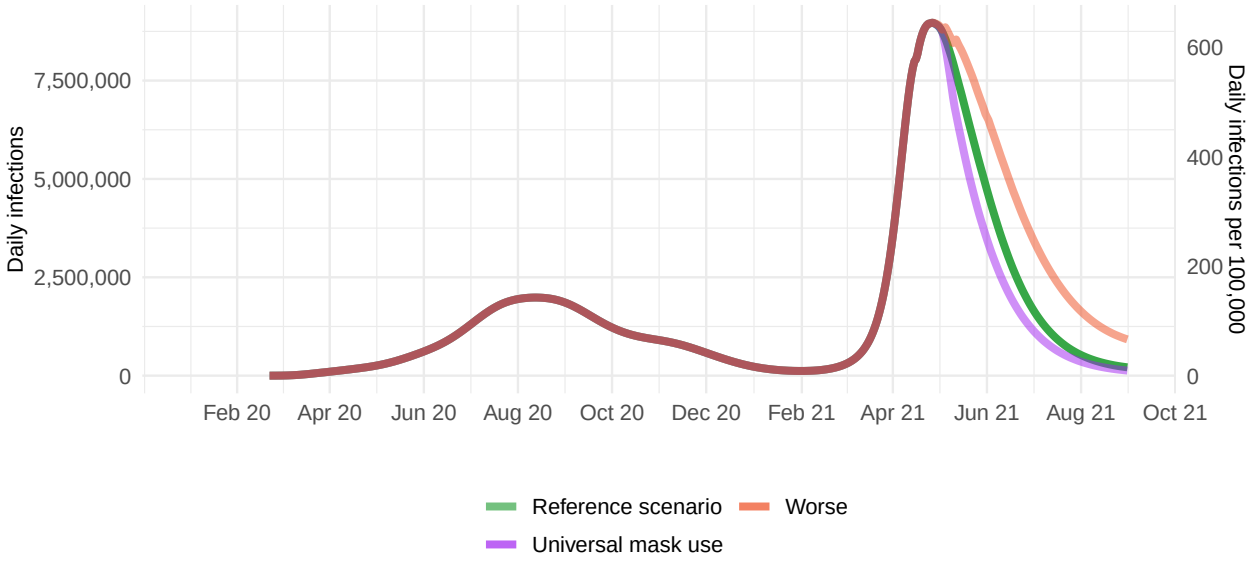
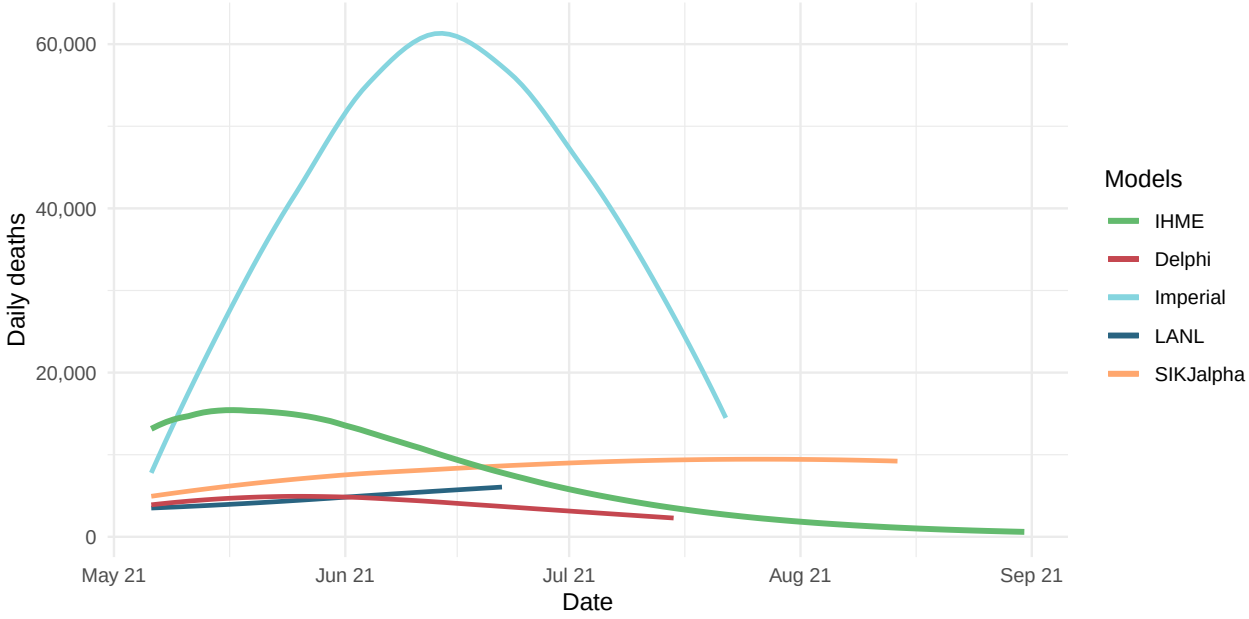


Figure 23. Comparison of reference model projections with other COVID modeling groups. For this comparison, we are including projections of daily COVID-19 deaths from other modeling groups when available: Delphi from the Massachussets Institute of Technology (Delphi; https://www.covidanalytics.io/home),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



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.