COVID-19 Results Briefing

India

October 21, 2022

This document contains summary information on the latest projections from the IHME model on COVID-19 in India. The model was run on October 21, 2022, with data through October 18, 2022.

The Omicron variant surge that hit India in early 2022 has subsided with a generally decreasing trend in the number of reported COVID-19 cases and deaths. Continuing measures are needed to keep the health system ready to deal with potential surges of COVID-19 and reach the vulnerable in the population who have not been vaccinated. IHME's reference scenario forecasts 3.7 million total deaths due to COVID-19 in India by February 1, 2023. An important component of successful management of COVID-19 in India is timely reporting of genomic sequencing of an adequate number of samples of the virus from across the country, and assessing the efficacy of the available vaccines against the variants of the virus.

Current situation

- Daily infections in the last week increased to 3,031,000 per day on average compared to 2,703,000 the week before (Figure 1.1).
- Daily reported cases in the last week increased to 2,700 per day on average compared to 2,500 the week before (Figure 2.1).
- Daily hospital census in the last week (through October 18) increased to 15,000 per day on average compared to 14,000 the week before (Figure 1.1).
- Reported deaths due to COVID-19 in the last week decreased to 13 per day on average compared to 16 the week before (Figure 3.1).
- The estimated total deaths due to COVID-19 in the last week decreased to 59 per day on average compared to 70 the week before (Figure 3.1). This makes COVID-19 the number 60 cause of death in India this week (Table 1). Estimated total daily deaths due to COVID-19 in the past week were 4.6 times larger than the reported number of deaths.
- The daily rate of reported deaths due to COVID-19 is greater than 4 per million in no states and union territories (Figure 4.1).
- The daily rate of total deaths due to COVID-19 is greater than 4 per million in no states and union territories (Figure 4.2).
- We estimate that 92% of people in India have been infected at least once as of October 17 (Figure 6.1). Effective R, computed using cases, hospitalizations, and deaths, is greater than 1 in 24 states and union territories (Figure 7.1).
Based on the GISAID and various national databases, combined with our variant spread model, we estimate the current prevalence of variants of concern (Figures 9.1-9.6). We estimate that the BA.1/BA.2 variants are circulating in 35 states and union territories, that the BA.5 variant is circulating in 35 states and union territories, that the Delta variant is circulating in 31 states and union territories, that the Alpha variant is circulating in one state or union territory, that the Gamma variant is circulating in one state or union territory, and that the Beta variant is circulating in no states and union territories.

Trends in drivers of transmission

As of October 17, 16 states and union territories have reached 70% or more of the population who have received at least one vaccine dose, and 11 states and union territories have reached 70% or more of the population who are fully vaccinated (Figures 12.1 and 12.2). 69% of people in India have received at least one vaccine dose, and 64% are fully vaccinated.

In our current reference scenario, we expect that 954 million people will be vaccinated with at least one dose by February 1 (Figure 14.1). We expect that 64% of the population will be fully vaccinated by February 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:

- Vaccines are distributed at the expected pace. Brand- and variant-specific vaccine efficacy is updated using the latest available information from peer-reviewed publications and other reports.
- Future mask use will decline to 50% of the minimum level it reached between January 1, 2021, and May 1, 2022. This decline begins after the last observed data point in each location and transitions linearly to the minimum over a period of six weeks.
- Mobility increases as vaccine coverage increases.
- 80% of those who are fully vaccinated (two doses for most vaccines, or one dose for Johnson & Johnson) receive an additional dose six months after becoming fully vaccinated, and 80% of those who receive an additional dose receive a second additional dose six months later.
- Antiviral utilization for COVID-19 risk prevention has reached 80% in high-risk populations and 50% in low-risk populations between March 1, 2022, and June 1, 2022. This applies in high-income countries, but not low- and middle-income countries, and this rollout assumption follows a similar pattern to global vaccine rollouts.

The 80% mask use scenario makes all the same assumptions as the reference scenario but assumes all locations reach 80% mask use within seven days. If a location currently has higher than 80% use, mask use remains at the current level.
The antiviral access scenario makes all the same assumptions as the reference scenario but assumes globally distributed antivirals and extends coverage to all low- and middle-income countries between August 15, 2022, and September 15, 2022.

Cases

- Daily estimated cases in the reference scenario will rise to 11,330 by November 13, 2022 (Figure 16.2).
- Daily estimated cases in the 80% mask use scenario will rise to 8,800 by November 13, 2022 (Figure 16.2).
- Daily estimated cases in the antiviral access scenario will rise to 11,330 by November 13, 2022 (Figure 16.2).

Deaths

- In our reference scenario, our model projects 534,000 cumulative reported deaths due to COVID-19 on February 1. This represents 3,300 additional deaths from October 17 to February 1. Daily reported COVID-19 deaths in the reference scenario will rise to 40 by November 25, 2022 (Figure 16.4).
- Under our reference scenario, our model projects 3,720,000 cumulative total deaths due to COVID-19 on February 1. This represents 19,000 additional deaths from October 17 to February 1 (Figure 16.5).
- In our 80% mask use scenario, our model projects 533,000 cumulative reported deaths due to COVID-19 on February 1. This represents 2,600 additional deaths from October 17 to February 1. Daily reported COVID-19 deaths in the 80% mask use scenario will rise to 40 by November 15, 2022 (Figure 16.4).
- In our antiviral access scenario, our model projects 533,000 cumulative reported deaths due to COVID-19 on February 1. This represents 2,700 additional deaths from October 17 to February 1. Daily reported COVID-19 deaths in the antiviral access scenario will rise to 40 by November 25, 2022 (Figure 16.4).
- Figure 17.1 compares our reference scenario forecasts to other publicly archived models. Forecasts are widely divergent.
Model updates

Revisions to transmission covariates

The covariates for transmission intensity have been revised to replace our mobility index with an index that more directly measures policy mandates in individual locations and to remove the level of testing entirely as a model covariate. The decision to replace mobility with a mandate index is driven both by the sunsetting of the data products we use to derive mobility as well as by a desire to more directly relate policy measures to changes in transmission. The new mandate index is described below. Testing was removed because it has not been a predictive covariate since the beginning of the pandemic. The early hypothesis was that testing and contact tracing would be policy mechanisms for pandemic control. Instead, we found that during much of the pandemic, testing levels were mostly uncorrelated with transmission. In the post-Omicron era, much of the testing is done with at-home kits and is not registered with any reporting agency, so it has become a generally unreliable measure.

Mandate variable

To model the overall intensity of non-pharmaceutical interventions (NPIs) implemented over time, we developed a database of 17 NPI variables. Each binary NPI variable represents instances of when a government mandated an intervention aimed at altering population behavior to reduce transmission of SARS-CoV-2 (e.g., closure of primary schools or a mandate that gatherings of large numbers of people are restricted). These data were collated for 220 countries and 206 subnational units from November 2019 to present using news reports, press releases, and local collaborators and ministries of public health as sources. To summarize overall mandate intensity, we created an NPI index in a two-step process. We first created sub-indices for primary and secondary education, gatherings, and stay-at-home orders by averaging the statuses of the individual mandates in those groups. We then averaged the sub-indices with the remaining individual mandates to produce a measure of overall mandate intensity over time across our 17 NPI variables on a scale of 0 to 1.

<table>
<thead>
<tr>
<th>Group</th>
<th>Description of individual NPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educational 1</td>
<td>Primary schools are closed.</td>
</tr>
<tr>
<td>2</td>
<td>Secondary and middle schools are closed.</td>
</tr>
<tr>
<td>3</td>
<td>Higher educational institutions (e.g., universities) are closed.</td>
</tr>
<tr>
<td>Travel</td>
<td>4 A country has closed all of its borders.</td>
</tr>
<tr>
<td>Gathering</td>
<td>5 Gatherings of 100 to 250 people are prohibited.</td>
</tr>
<tr>
<td>6</td>
<td>Gatherings of 50 to 100 people are prohibited.</td>
</tr>
<tr>
<td>7</td>
<td>Gatherings of 25 to 50 people are prohibited.</td>
</tr>
<tr>
<td>8</td>
<td>Gatherings of 10 to 25 people are prohibited.</td>
</tr>
<tr>
<td>9</td>
<td>Gatherings of 6 to 10 people are prohibited.</td>
</tr>
<tr>
<td>10</td>
<td>Citizens are instructed to remain in their homes. Only essential travel is permitted.</td>
</tr>
<tr>
<td>Business</td>
<td>11 Dining establishments are closed for dining in, but delivery admissible.</td>
</tr>
<tr>
<td>12</td>
<td>Businesses selling alcoholic beverages in social setting, such as bars and nightclubs, are closed.</td>
</tr>
<tr>
<td>13</td>
<td>Retail establishments which are deemed non-essential are closed. Grocery and gas stations remain open.</td>
</tr>
<tr>
<td>14</td>
<td>Workplaces where it is not essential for workers to be physically present are closed.</td>
</tr>
<tr>
<td>15</td>
<td>Establishments for leisure activities, such as gyms and pools, are closed.</td>
</tr>
<tr>
<td>Curfew</td>
<td>16 Non-essential businesses are required to close before a specified time each day.</td>
</tr>
<tr>
<td>17</td>
<td>Residents are required to remain in their homes after a specified time each day.</td>
</tr>
</tbody>
</table>

Revised invasion dates

Invasion dates for all variants in all locations have been revised to better reflect the actual waves of transmission indicated by spikes in cases, deaths, and admissions. Previously, we used sequencing data from the GISAID database to decide when a new variant of SARS-CoV-2 began local transmission in a location (the "invasion
date” for the variant). Unfortunately, the results suggested by the sequencing data often led to invasion timings that did not make sense when compared with reported cases, deaths, and hospital admissions in a location. Both the capture and reporting of sequencing data are subject to several kinds of bias. Because we have no mechanism to review the underlying data sources collated by GISAID and ensure those biases are properly accounted for, we have decided to use it as a confirmatory source instead of the primary arbiter of when a variant enters a location. New invasion dates were selected to match peak timings in reported cases, deaths, and hospital admissions and to reflect the invasion speeds reported in other literature and confirmed in our own analyses in earlier model development.

Below is an example diagnostic used in this analysis. On the right are plots of the total number of GISAID sequences in Louisiana and the proportion of those sequences of each variant (with a smoothing model applied). The purple vertical lines on the plots indicate the invasion dates suggested by our GISAID-driven model. In this example, we see the Alpha variant invade just prior to a decline in reported cases, deaths, and admissions, which is implausible, and we also see the Delta variant arriving too far ahead of the surge in cases, deaths, and admissions. This location was revised to remove the Alpha variant entirely and to shift the invasion of the Delta variant forward by about a month.

The effects of these shifts were examined after the model was run to confirm that surges in the reported measures accurately reflect the variants we believe to be responsible using diagnostics like those below that attribute infections and the reported cases, deaths, and hospital admissions to particular variants.
Figure 1.1: Daily COVID-19 hospital census and estimated infections

Figure 2.1: Reported daily COVID-19 cases, moving average
Table 1: Ranking of total deaths due to COVID-19 among the leading causes of mortality this week, assuming uniform deaths of non-COVID causes throughout the year

<table>
<thead>
<tr>
<th>Cause name</th>
<th>Weekly deaths</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ischemic heart disease</td>
<td>29,214</td>
<td>1</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>17,278</td>
<td>2</td>
</tr>
<tr>
<td>Stroke</td>
<td>13,444</td>
<td>3</td>
</tr>
<tr>
<td>Diarrheal diseases</td>
<td>12,160</td>
<td>4</td>
</tr>
<tr>
<td>Neonatal disorders</td>
<td>8,423</td>
<td>5</td>
</tr>
<tr>
<td>Lower respiratory infections</td>
<td>8,340</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>8,128</td>
<td>7</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>5,252</td>
<td>8</td>
</tr>
<tr>
<td>Cirrhosis and other chronic liver diseases</td>
<td>5,193</td>
<td>9</td>
</tr>
<tr>
<td>Falls</td>
<td>4,494</td>
<td>10</td>
</tr>
<tr>
<td>COVID-19</td>
<td>416</td>
<td>60</td>
</tr>
</tbody>
</table>

Figure 3.1: Smoothed trend estimate of daily COVID-19 deaths
Daily COVID-19 death rate per 1 million on October 17, 2022

Figure 4.1: Daily reported COVID-19 death rate per 1 million

Figure 4.2: Daily total COVID-19 death rate per 1 million
Cumulative COVID-19 deaths per 100,000 on October 17, 2022

Figure 5.1: Reported cumulative COVID-19 deaths per 100,000

Figure 5.2: Total cumulative COVID-19 deaths per 100,000
Figure 6.1: Estimated percent of the population infected with COVID-19 on October 17, 2022

Figure 7.1: Mean effective R on October 6, 2022. Effective R less than 1 means that transmission should decline, all other things being held the same. 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.
Figure 8.1: Percent of estimated 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-detection rate can exceed 100% at particular points in time.
Estimated percent of circulating SARS-CoV-2 for primary variant families on October 17, 2022

Figure 9.1: Estimated percent of new infections that are Alpha variant

Figure 9.2: Estimated percent of new infections that are Beta variant
Figure 9.3: Estimated percent of new infections that are Delta variant

Figure 9.4: Estimated percent of new infections that are Gamma variant
Figure 9.5: Estimated percent of new infections that are BA.1/BA.2 variant

Figure 9.6: Estimated percent of new infections that are BA.5 variant
Figure 10.1: Infection-fatality rate on October 17, 2022. This is estimated as the ratio of COVID-19 deaths to estimated daily COVID-19 infections.
Critical drivers

Table 2: Current mandate implementation

- Primary school closure
- Secondary school closure
- Higher school closure
- Entry restrictions for some non-residents
- Entry restrictions for all non-residents
- Individual movements restricted
- Curfew for businesses
- Individual curfew
- Gathering limit: 6 indoor, 10 outdoor
- Gathering limit: 10 indoor, 25 outdoor
- Gathering limit: 25 indoor, 50 outdoor
- Gathering limit: 50 indoor, 100 outdoor
- Gathering limit: 100 indoor, 250 outdoor
- Restaurants closed
- Bars closed
- Restaurants / bars closed
- Restaurants / bars curbside only
- Gyms, pools, other leisure closed
- Non-essential retail closed
- Non-essential retail curbside only
- Non-essential workplaces closed
- Stay home order
- Stay home fine
- Mask mandate
- Mask mandate fine

Mandate in place
Mandate in place (imposed this week)
Mandate in place (updated from previous reporting)
No mandate
No mandate (lifted this week)
No mandate (updated from previous reporting)
Figure 11.1: Trend in the proportion of the population reporting always wearing a mask when leaving home
Table 3: Estimates of vaccine effectiveness for specific vaccines used in the model at preventing severe disease and infection. We use data from clinical trials directly, where available, and make estimates otherwise. More information can be found on our website.

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Ancestral</th>
<th>Alpha</th>
<th>Beta</th>
<th>Gamma</th>
<th>Delta</th>
<th>Omicron</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Severe disease</td>
<td>Infection</td>
<td>Severe disease</td>
<td>Infection</td>
<td>Severe disease</td>
<td>Infection</td>
</tr>
<tr>
<td>AstraZeneca</td>
<td>94%</td>
<td>63%</td>
<td>94%</td>
<td>63%</td>
<td>0.9400000</td>
<td>69%</td>
</tr>
<tr>
<td>CanSino</td>
<td>66%</td>
<td>62%</td>
<td>66%</td>
<td>62%</td>
<td>0.6408140</td>
<td>61%</td>
</tr>
<tr>
<td>CoronaVac</td>
<td>50%</td>
<td>47%</td>
<td>50%</td>
<td>47%</td>
<td>0.4854651</td>
<td>46%</td>
</tr>
<tr>
<td>Covaxin</td>
<td>78%</td>
<td>73%</td>
<td>78%</td>
<td>73%</td>
<td>0.7573256</td>
<td>72%</td>
</tr>
<tr>
<td>Johnson &amp; Johnson</td>
<td>86%</td>
<td>72%</td>
<td>86%</td>
<td>72%</td>
<td>0.7600000</td>
<td>64%</td>
</tr>
<tr>
<td>Moderna</td>
<td>97%</td>
<td>92%</td>
<td>97%</td>
<td>92%</td>
<td>0.9700000</td>
<td>91%</td>
</tr>
<tr>
<td>Novavax</td>
<td>89%</td>
<td>83%</td>
<td>89%</td>
<td>83%</td>
<td>0.8641279</td>
<td>82%</td>
</tr>
<tr>
<td>Pfizer/BioNTech</td>
<td>95%</td>
<td>86%</td>
<td>95%</td>
<td>86%</td>
<td>0.9500000</td>
<td>84%</td>
</tr>
<tr>
<td>Sinopharm</td>
<td>73%</td>
<td>68%</td>
<td>73%</td>
<td>68%</td>
<td>0.7087791</td>
<td>67%</td>
</tr>
<tr>
<td>Sputnik-V</td>
<td>92%</td>
<td>86%</td>
<td>92%</td>
<td>86%</td>
<td>0.8932558</td>
<td>85%</td>
</tr>
<tr>
<td>Other vaccines</td>
<td>75%</td>
<td>70%</td>
<td>75%</td>
<td>70%</td>
<td>0.7281977</td>
<td>69%</td>
</tr>
<tr>
<td>Other vaccines (mRNA)</td>
<td>91%</td>
<td>86%</td>
<td>91%</td>
<td>86%</td>
<td>0.8835465</td>
<td>85%</td>
</tr>
</tbody>
</table>
Percent of the population having received at least one dose (12.1) and fully vaccinated against SARS-CoV-2 (12.2) by October 17, 2022

Figure 12.1: Percent of the population having received one dose of a COVID-19 vaccine

Figure 12.2: Percent of the population fully vaccinated against SARS-CoV-2
Figure 13.1: Estimated proportion of the total population that is not vaccinated but willing to be vaccinated as of June 24, 2022
Figure 14.1: Percent of people who receive at least one dose of a COVID-19 vaccine and those who are fully vaccinated

Figure 15.1: Percent of people who are immune to Delta, BA.1/BA.2 or BA.5. Immunity is based on protection due to prior vaccination and infection(s). Moreover, variant-specific immunity is also based on variant-variant specific protection.
Projections and scenarios

Figure 16.1: Daily COVID-19 infections until February 01, 2023 for three scenarios

Figure 16.2: Daily COVID-19 reported cases until February 01, 2023 for three scenarios
Figure 16.3: Daily COVID-19 hospital census until February 01, 2023 for three scenarios

- **Reference**
- **Antiviral access**
- **80% mask use**
Figure 16.4: Reported daily COVID-19 deaths per 100,000
Figure 16.5: Total daily COVID-19 deaths per 100,000

- Reference
- Antiviral access
- 80% mask use
Figure 17.1: 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, last model update in brackets: the SI-KJalpha model from the University of Southern California (SIKJalpha) [October 21, 2022]. Regional values are aggregates from available locations in that region.
More information

Data sources:

Mask use and vaccine confidence data are from the The Delphi Group at Carnegie Mellon University and University of Maryland COVID-19 Trends and Impact Surveys, in partnership with Facebook. Mask use data are also from Premise, the Kaiser Family Foundation, and the YouGov COVID-19 Behaviour Tracker survey.

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.

To download our most recent results, visit our Data downloads page.