COVID-19 Results Briefing

Brazil

December 22, 2021

This document contains summary information on the latest projections from the IHME model on COVID-19 in Brazil. The model was run on December 21, 2021, with data through December 13, 2021.

Current situation

- Daily infections in the last week increased to 70,900 per day on average compared to 57,200 the week before (Figure 1.1). Daily hospital census in the last week (through December 13) increased to 2,200 per day on average compared to 2,000 the week before.
- Daily reported cases in the last week increased to 11,200 per day on average compared to 11,000 the week before (Figure 2.1).
- Reported deaths due to COVID-19 in the last week decreased to 240 per day on average compared to 260 the week before (Figure 3.1).
- Total deaths due to COVID-19 in the last week decreased to 250 per day on average compared to 270 the week before (Figure 3.1). This makes COVID-19 the number 3 cause of death in Brazil this week (Table 1). Estimated total daily deaths due to COVID-19 in the past week were 1 times larger than the reported number of deaths.
- No locations had daily reported COVID-19 death rates greater than 4 per million (Figure 4.1).
- No locations had daily total COVID-19 death rates greater than 4 per million (Figure 4.2).
- We estimate that 46% of people in Brazil have been infected at least once as of December 13 (Figure 6.1). Effective R, computed using cases, hospitalizations, and deaths, is greater than 1 in 24 states. (Figure 7.1).
- The infection-detection rate in Brazil was close to 22% on December 13 (Figure 8.1).
- Based on the GISAID and various national databases, combined with our variant spread model, we estimate the current prevalence of variants of concern (Figure 9.1-Figure 9.5). We estimate that the Alpha variant is circulating in 0 states, that the Beta variant is circulating in 0 states, that the Delta variant is circulating in 27 states, that the Gamma variant is circulating in 0 states and that the Omicron variant is circulating in 27 states.

Trends in drivers of transmission

- Mobility last week was 11% higher than the pre-COVID-19 baseline (Figure 11.1). Mobility was lower than 30% of baseline in no locations.
- As of December 13, in the COVID-19 Trends and Impact Survey, 57% of people self-report that they always wore a mask when leaving their home compared to 57% last week (Figure 13.1).
- There were 61 diagnostic tests per 100,000 people on December 13 (Figure 15.1).
- As of December 13, 10 states have reached 70% or more of the population who have received at least one vaccine dose and 3 states have reached 70% or more of the population who are fully vaccinated (Figure 17.1). 72% of people in Brazil have received at least one vaccine dose and 62% are fully vaccinated.
- In Brazil, 92% of the population that is 12 years and older say they would accept or would probably accept a vaccine for COVID-19. Note that vaccine acceptance is calculated using survey data from the 18+ population. This is down by 0.1 percentage points from last week. The proportion of the population who are open to receiving a COVID-19 vaccine ranges from 80% in Amapá to 100% in São Paulo (Figure 19.1).
- In our current reference scenario, we expect that 156.8 million people will be vaccinated with at least one dose by April 1 (Figure 20.1). We expect that 69% of the population will be fully vaccinated by April 1.
Projections

Infections
- Daily estimated infections in the reference scenario, which represents what we think is most likely to happen, will rise to 1,331,430 by February 16, 2022 (Figure 21.1).
- Daily estimated infections in the high severity of Omicron scenario will rise to 1,331,370 by February 16, 2022 (Figure 21.1).
- Daily estimated infections in the 80% mask coverage scenario will rise to 944,180 by February 24, 2022 (Figure 21.1).
- Daily estimated infections in the third dose scenario will rise to 992,770 by February 13, 2022 (Figure 21.1).
- Daily estimated infections in the reduced vaccine hesitancy scenario will rise to 1,330,330 by February 16, 2022 (Figure 21.1).

Cases
- Daily cases in the reference scenario will rise to 93,790 by March 6, 2022 (Figure 21.2).
- Daily cases in the high severity of Omicron scenario will rise to 93,790 by March 6, 2022 (Figure 21.2).
- Daily cases in the 80% mask coverage scenario will rise to 62,360 by March 18, 2022 (Figure 21.2).
- Daily cases in the third dose scenario will rise to 66,890 by March 4, 2022 (Figure 21.2).
- Daily cases in the reduced vaccine hesitancy scenario will rise to 93,640 by March 6, 2022 (Figure 21.2).

Hospitalizations
- Daily hospital census in the reference scenario will rise to 8,010 by March 18, 2022 (Figure 21.3).
- Daily hospital census in the high severity of Omicron scenario will rise to 14,440 by March 21, 2022 (Figure 21.3).
- Daily hospital census in the 80% mask coverage scenario will rise to 5,220 by March 27, 2022 (Figure 21.3).
- Daily hospital census in the third dose scenario will rise to 4,830 by March 14, 2022 (Figure 21.3).
- Daily hospital census in the reduced vaccine hesitancy scenario will rise to 7,990 by March 18, 2022 (Figure 21.3).

Deaths
- In our reference scenario, our model projects 660,000 cumulative reported deaths due to COVID-19 on April 1. This represents 41,000 additional deaths from December 13 to April 1. Daily reported COVID-19 deaths in the reference scenario will rise to 490 by March 7, 2022 (Figure 21.4).
- Under our reference scenario, our model projects 682,000 cumulative total deaths due to COVID-19 on April 1. This represents 43,000 additional deaths from December 13 to April 1 (Figure 24.2).
- In our high severity of Omicron scenario, our model projects 686,000 cumulative reported deaths due to COVID-19 on April 1. This represents 67,000 additional deaths from December 13 to April 1. Daily reported COVID-19 deaths in the high severity of Omicron scenario will rise to 1,030 by March 17, 2022 (Figure 21.4).
- In our 80% mask coverage scenario, our model projects 649,000 cumulative reported deaths due to COVID-19 on April 1. This represents 29,000 additional deaths from December 13 to April 1. Daily reported COVID-19 deaths in the 80% mask coverage scenario will rise to 290 by March 13, 2022 (Figure 21.4).
- In our third dose scenario, our model projects 645,000 cumulative reported deaths due to COVID-19 on April 1. This represents 26,000 additional deaths from December 13 to April 1. Daily reported COVID-19 deaths in the third dose scenario will rise to 280 by February 26, 2022 (Figure 21.4).
• In our **reduced vaccine hesitancy scenario**, our model projects 660,000 cumulative reported deaths due to COVID-19 on April 1. This represents 41,000 additional deaths from December 13 to April 1. Daily reported COVID-19 deaths in the **reduced vaccine hesitancy scenario** will rise to 480 by March 7, 2022 (Figure 21.4).

• Figure 22.1 compares our reference scenario forecasts to other publicly archived models. Forecasts are widely divergent.

• At some point from December through April 1, 1 state will have high or extreme stress on hospital beds (Figure 23.1). At some point from December through April 1, 15 states will have high or extreme stress on intensive care unit (ICU) capacity (Figure 24.1).
Model updates

In this update, we have substantially revised our model to explicitly account for several important factors that have a profound influence on the likely trajectory of the epidemic in the coming months. First, the model tracks infections from different variants separately, including ancestral, Alpha, Beta, Gamma, Delta, Omicron, and other. Second, we take into account that infection-derived and vaccine-derived immunity wanes over time. Immunity that prevents infection wanes more quickly than immunity preventing hospitalization and death, so we derive separate waning curves for infection and for hospitalization and death. Based on a systematic analysis of published studies, reports, and archived studies, we derive vaccine-specific waning curves. Third, infection with different COVID-19 variants can confer different protection for each variant in the model. The matrix of cross-variant immunity allows us to take into account the greater immune escape seen with Omicron. Third, we explicit model the delivery of a third dose of vaccine (and second dose for J&J recipients). Fourth, the variant spread model is now based on both spatial spread and patterns of airline traffic. The technical appendix provides details of the model structure and the analysis of waning immunity. The key assumptions that substantially influence the forecasts include the following: First, prior infection provides 40% to 60% protection against infection with Omicron. Second, vaccine effectiveness in preventing infection is reduced by approximately 50% compared to the efficacy against the Delta variant, and vaccine effectiveness in preventing hospitalization and death is reduced by 25% compared to the efficacy against the Delta variant. Third, the fraction asymptomatic is assumed to increase from near 40% to 90%–95%; this fraction influences the future estimates of the infection-detection rate. Fourth, the infection-hospitalization rate for Omicron is estimated to be 90%–96% lower than for Delta variant. Fifth, the infection-fatality rate for Omicron is estimated to be 97%–99% lower than for Delta.
Figure 1.1. Daily COVID-19 hospital census and estimated infections

![Graph showing daily COVID-19 hospital census and estimated infections from January 2020 to January 2022]

Figure 2.1. Reported daily COVID-19 cases, moving average

![Graph showing reported daily COVID-19 cases from February 2020 to December 2021, with a moving average line]

covid19.healthdata.org  Institute for Health Metrics and Evaluation
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>3,293</td>
<td>1</td>
</tr>
<tr>
<td>Stroke</td>
<td>2,519</td>
<td>2</td>
</tr>
<tr>
<td>COVID-19</td>
<td>1,765</td>
<td>3</td>
</tr>
<tr>
<td>Lower respiratory infections</td>
<td>1,705</td>
<td>4</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>1,321</td>
<td>5</td>
</tr>
<tr>
<td>Interpersonal violence</td>
<td>1,267</td>
<td>6</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1,257</td>
<td>7</td>
</tr>
<tr>
<td>Alzheimer’s disease and other dementias</td>
<td>1,050</td>
<td>8</td>
</tr>
<tr>
<td>Road injuries</td>
<td>856</td>
<td>9</td>
</tr>
<tr>
<td>Chronic kidney disease</td>
<td>814</td>
<td>10</td>
</tr>
</tbody>
</table>

Figure 3.1. Smoothed trend estimate of reported daily COVID-19 deaths (blue) and total daily deaths due to COVID-19 (orange)
Daily COVID-19 death rate per 1 million on December 13, 2021

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 December 13, 2021

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 December 13, 2021

**Figure 7.1.** Mean effective R on December 2, 2021. 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.
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Estimated percent of circulating SARS-CoV-2 for primary variant families on December 13, 2021

Figure 9.1 Estimated percent Alpha variant

Figure 9.2 Estimated percent Beta variant
Figure 9.3 Estimated percent Delta variant

Figure 9.4 Estimated percent Gamma variant
Figure 9.5 Estimated percent Omicron variant
Figure 10.1. Infection-fatality rate on December 13, 2021. This is estimated as the ratio of COVID-19 deaths to estimated daily COVID-19 infections.
## Critical drivers

**Table 2. Current mandate implementation**

<table>
<thead>
<tr>
<th>Primary school closure</th>
<th>Secondary school closure</th>
<th>Entry restrictions for some non-residents</th>
<th>Entry restrictions for all non-residents</th>
<th>Curfew for businesses</th>
<th>Individual curfew</th>
<th>Gathering limit: 6 indoor, 10 outdoor</th>
<th>Gathering limit: 10 indoor, 25 outdoor</th>
<th>Gathering limit: 25 indoor, 50 outdoor</th>
<th>Gathering limit: 50 indoor, 100 outdoor</th>
<th>Gathering limit: 100 indoor, 250 outdoor</th>
<th>Restaurants closed</th>
<th>Bars closed</th>
<th>Restaurants / bars closed</th>
<th>Restaurants / bars curbside only</th>
<th>Gyms, pools, other leisure closed</th>
<th>Non-essential retail closed</th>
<th>Non-essential workplace closed</th>
<th>Stay home order</th>
<th>Stay home fine</th>
<th>Mask mandate</th>
<th>Mask mandate fine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>Brazil</td>
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</tbody>
</table>
Figure 11.1. Trend in mobility as measured through smartphone app use, compared to January 2020 baseline
Figure 12.1. Mobility level as measured through smartphone app use, compared to January 2020 baseline (percent) on December 13, 2021
Figure 13.1. Trend in the proportion of the population reporting always wearing a mask when leaving home

Figure 14.1. Proportion of the population reporting always wearing a mask when leaving home on December 13, 2021
Figure 15.1. Trend in COVID-19 diagnostic tests per 100,000 people

Figure 16.1. COVID-19 diagnostic tests per 100,000 people on December 13, 2021
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</td>
<td>Severe</td>
<td>Severe</td>
<td>Severe</td>
<td>Severe</td>
<td>Severe</td>
</tr>
<tr>
<td></td>
<td>disease</td>
<td>infection</td>
<td>disease</td>
<td>infection</td>
<td>disease</td>
<td>infection</td>
</tr>
<tr>
<td>AstraZeneca</td>
<td>94%</td>
<td>63%</td>
<td>94%</td>
<td>63%</td>
<td>94%</td>
<td>69%</td>
</tr>
<tr>
<td>CanSino</td>
<td>66%</td>
<td>62%</td>
<td>66%</td>
<td>62%</td>
<td>64%</td>
<td>61%</td>
</tr>
<tr>
<td>CoronaVac</td>
<td>50%</td>
<td>41%</td>
<td>50%</td>
<td>47%</td>
<td>49%</td>
<td>46%</td>
</tr>
<tr>
<td>Covaxin</td>
<td>78%</td>
<td>73%</td>
<td>78%</td>
<td>73%</td>
<td>76%</td>
<td>72%</td>
</tr>
<tr>
<td>Johnson &amp; Johnson</td>
<td>86%</td>
<td>72%</td>
<td>86%</td>
<td>72%</td>
<td>76%</td>
<td>64%</td>
</tr>
<tr>
<td>Moderna</td>
<td>97%</td>
<td>92%</td>
<td>97%</td>
<td>92%</td>
<td>97%</td>
<td>91%</td>
</tr>
<tr>
<td>Novavax</td>
<td>80%</td>
<td>83%</td>
<td>89%</td>
<td>83%</td>
<td>86%</td>
<td>82%</td>
</tr>
<tr>
<td>Pfizer/BioNTech</td>
<td>95%</td>
<td>86%</td>
<td>95%</td>
<td>86%</td>
<td>95%</td>
<td>84%</td>
</tr>
<tr>
<td>Sinopharm</td>
<td>73%</td>
<td>68%</td>
<td>73%</td>
<td>68%</td>
<td>71%</td>
<td>67%</td>
</tr>
<tr>
<td>Sputnik-V</td>
<td>92%</td>
<td>86%</td>
<td>92%</td>
<td>86%</td>
<td>89%</td>
<td>85%</td>
</tr>
<tr>
<td>Other vaccines</td>
<td>75%</td>
<td>70%</td>
<td>75%</td>
<td>70%</td>
<td>73%</td>
<td>69%</td>
</tr>
<tr>
<td>Other vaccines (mRNA)</td>
<td>91%</td>
<td>86%</td>
<td>91%</td>
<td>86%</td>
<td>88%</td>
<td>85%</td>
</tr>
</tbody>
</table>
Percent of the population having received at least one dose (17.1) and fully vaccinated against SARS-CoV-2 (17.2) by December 13, 2021

Figure 17.1 Percent of the population having received one dose of a COVID-19 vaccine

Figure 17.2 Percent of the population fully vaccinated against SARS-CoV-2
Figure 18.1. Trend in the estimated proportion of the population that is 12 years and older that has been vaccinated or would probably or definitely receive the COVID-19 vaccine if available. Note that vaccine acceptance is calculated using survey data from the 18+ population.

Figure 19.1. Estimated proportion of the population that is 12 years and older that has been vaccinated or would probably or definitely receive the COVID-19 vaccine if available. Note that vaccine acceptance is calculated using survey data from the 18+ population.
Figure 20.1. Percent of people who receive at least one dose of a COVID-19 vaccine and those who are fully vaccinated.
Projections and scenarios

We produce five 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 is the mean of mask use over the last 7 days.
- Mobility increases as vaccine coverage increases.
- Omicron variant spreads according to our flight and local spread model.
- 80% of those who have had two doses of vaccine (or one dose for Johnson & Johnson) receive a third dose at 6 months after their second dose.

The high severity of Omicron scenario modifies the reference scenario assumption in two ways: * The infection-hospitalization ratio for Omicron is 2.3 times as high as compared to the reference scenario. * The infection-fatality rate is 4.6 times as high as compared to the reference scenario.

The 80% mask use scenario makes all the same assumptions as the reference scenario but assumes all locations reach 80% mask use within 7 days. If a location currently has higher than 80% use, mask use remains at the current level.

The third dose scenario is the same as the reference scenario but assumes that 100% of those who have received two doses of vaccine will get a third dose at 6 months.

The reduced vaccine hesitancy scenario assumes that those in each location who respond on surveys that they probably will not receive a vaccine are persuaded or mandated to receive a vaccine.
**Figure 21.1.** Daily COVID-19 infections until April 01, 2022 for five scenarios

**Figure 21.2.** Daily COVID-19 reported cases until April 01, 2022 for five scenarios
Figure 24.2. Daily COVID-19 hospital census until April 01, 2022 for five scenarios

Figure 24.3 Reported daily COVID-19 deaths per 100,000
Figure 24.4 Total daily COVID-19 deaths per 100,000

- Reference scenario
- High severity of Omicron
- Third dose
- 80% mask use
- Reduced vaccine hesitancy

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Figure 22.1. 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: Delphi from the Massachusetts Institute of Technology (Delphi) [December 21, 2021], Imperial College London (Imperial) [December 5, 2021], the SI-KJalpha model from the University of Southern California (SIKJalpha) [December 19, 2021]. Daily deaths from other modeling groups are smoothed to remove inconsistencies with rounding. Regional values are aggregates from available locations in that region.
Figure 23.1. 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 20% or greater is considered extreme stress.
Figure 24.1. 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 60% or greater is considered extreme stress.
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.