Informe de resultados de COVID-19

México

22 de diciembre de 2021

Este documento contiene información resumida sobre las últimas proyecciones del modelo IHME sobre COVID-19 en México. El modelo se ejecutó el 21 de diciembre de 2021, con datos hasta el 13 de diciembre de 2021. En este comunicado, hemos revisado sustancialmente nuestro modelo para reflejar tanto la aparición de la variante Omicron, la disminución de la infección adquirida y la inmunidad adquirida por la vacuna y la matriz de inmunidad entre las variantes. Nuestro escenario de referencia sugiere que durante los próximos dos meses 70% de la población en México probablemente se infectará con Omicron. Debido a una fracción mucho mayor de infecciones asintomáticas (probablemente más del 90%) y, por lo tanto, una tasa de detección de infecciones más baja, esperamos que los casos diagnosticados aumenten a un pico de 20,430 al día para el 3 de febrero de 2022. Con base en los datos de Sudáfrica, el Reino Unido, Dinamarca y Noruega, esperamos que la tasa de hospitalización por infección de Omicron en comparación con Delta sea un 90-96% más baja. A pesar de que la tasa de Infección-hospitalización es más baja, algunos hospitales posiblemente se verán sometidos a una mayor presión que durante el último aumento del invierno. Del mismo modo, según los datos disponibles, esperamos que la tasa de mortalidad por infección sea un 97-99% más baja que para Delta. Un gran número de infecciones y hospitalizaciones moderadas aún pueden traducirse en 32 mil muertes adicionales en los próximos 4 meses.

¿Cuáles son las respuestas de política disponibles? Hemos incluido en este comunicado cuatro nuevos escenarios: a) aumento del uso de mascarillas al 80%; b) aumento de la entrega de la vacuna de la tercera dosis a todos los que han recibido 2 dosis, c) mejoría en contra del rechazo a la vacuna y d) Alta severidad de Omicron. Dada la velocidad de propagación global de Omicron y el tiempo de duplicación muy corto para la transmisión, las estrategias que tendrán un impacto importante en el marco de tiempo son aumentar el uso de mascarillas de alta calidad como N95 o equivalente y una expansión más rápida de terceras dosis de vacunación con intervalos más cortos desde las dos primeras dosis hasta la tercera dosis. Dada la rápida difusión y el IHR e IFR muy reducidos, no creemos que el cierre de escuelas primarias o secundarias sea apropiado. Los bloqueos más agresivos para controlar la transmisión pueden reducir la presión sobre algunos sistemas hospitalarios, pero tendrán un costo económico y social considerable. Dado que es probable que los programas de detección masiva no se realicen en asintomáticos, la detección en el lugar de trabajo y los protocolos sobre el tiempo que las personas deben permanecer alejadas del trabajo pueden necesitar modificarse, de lo contrario, puede haber un impacto considerable en algunos empleadores y en algunas cadenas de suministro. Las tasas de transmisión extremadamente altas y los casos notificados también pueden significar que el rastreo de contactos puede ser ineficaz y potencialmente un desperdicio de recursos.

Las personas pueden actuar para protegerse vacunándose si aún no lo han hecho y recibiendo una tercera vacuna tan pronto como sean elegibles. Las personas con un riesgo elevado debido a la edad o las comorbilidades que deseen reducir su riesgo de hospitalización o muerte deben usar una máscara, preferiblemente una máscara de alta calidad, como una máscara N95, y evitar situaciones en las que la transmisión sea más probable, como cualquier reunión en el interior o reunión al aire libre donde el distanciamiento no es posible. Las personas que no están vacunadas o que nunca han sido infectadas también deben estar particularmente preocupadas.

Con altas tasas de infección y las presiones proyectadas en algunos hospitales, las tasas de hospitalización deben usarse como una métrica para impulsar la política a nivel local. El sistema médico ya está agotado y parte del personal médico puede infectarse y tener que aislarse, la fuerza laboral puede verse afectada aún más. Existen enormes variaciones en la capacidad de los hospitales para expandirse para cumplir con el aumento y se necesitan métricas locales.

Situación actual

• Las infecciones diarias en la última semana aumentaron a 246,700 por día en promedio en comparación con 123,400 la semana anterior (Figura 1.1). El censo hospitalario diario en la última semana (hasta el 13 de diciembre) disminuyó a 820 por día en promedio en comparación con 830 la semana anterior.

• Los casos notificados diariamente en la última semana aumentaron a 3,000 por día en promedio en comparación con 2,600 la semana anterior (Figura 2.1).

• Las muertes reportadas por COVID-19 en la última semana disminuyeron a 150 por día en promedio en comparación con 150 la semana anterior (Figura 3.1).

• El total de muertes por COVID-19 en la última semana disminuyó a 200 por día en promedio en comparación con 200 la semana anterior (Figura 3.1). Esto convierte al COVID-19 en la cuarta causa de muerte en México esta semana (Tabla 1). Las muertes diarias totales estimadas por COVID-19 en la última semana fueron 1.3 veces mayores que el número de muertes reportadas.

• La tasa diaria de muertes reportadas por COVID-19 es superior a 4 por millón en Baja California, Sonora y Chihuahua. (Figura 4.1).

• La tasa diaria de muertes totales por COVID-19 es superior a 4 por millón en Baja California, Sonora, Chihuahua y Aguascalientes. (Figura 4.2).

• Estimamos que el 66% de las personas en México se han infectado al menos una vez hasta el 13 de diciembre (Figura 6.1). La R efectiva, calculada utilizando casos, hospitalizaciones y muertes, es mayor que 1 en todos los estados del país. (Figura 7.1).

• La tasa de detección de infecciones en México fue cercana al 4% el 13 de diciembre (Figura 8.1).

• Con base en el GISAID y varias bases de datos nacionales, combinado con nuestro modelo de dispersión de variantes, estimamos la prevalencia actual de variantes de interés (Figura 9.1-Figura 9.5). Estimamos que la variante Alpha está circulando en 0 estados, que la variante Beta está circulando en 0 estados, que la variante Delta está circulando en 32 estados, que la variante Gamma está circulando en 0 estados y que la variante Omicron está circulando en 32 estados.

Tendencias en los impulsores de la transmisión

• La movilidad la semana pasada fue un 19% más alta que la línea de base anterior a COVID-19 (Figura 11.1). En ningún estado la movilidad fue inferior al 30% de la línea de base.

• Al 13 de diciembre, en la Encuesta de Tendencias e Impacto de COVID-19, el 78% de las personas informan que siempre usaban una máscara al salir de casa en comparación con el 78% de la semana pasada (Figura 13.1).

• Se realizaron 12 pruebas de diagnóstico por cada 100,000 personas el 13 de diciembre (Figura 15.1).

• Al 13 de diciembre, 4 estados han alcanzado el 70% o más de la población que ha recibido al menos una dosis de vacuna y 0 estados han alcanzado el 70% o más de la población que está completamente vacunada (Figura 17.1). El 63% de las personas en México ha recibido al menos una dosis de vacuna y el 48% está completamente vacunada.

• En México, 92.1% de la población de 12 años o más dice que aceptaría o probablemente aceptaría una vacuna para COVID-19. Tenga en cuenta que la aceptación de la vacuna se calcula utilizando datos de encuestas de la población mayor de 18 años. Esto es un 0.6 puntos porcentuales más que la semana pasada. La proporción de la población que está dispuesta a recibir la vacuna COVID-19 oscila entre el 80% en Chiapas y el 99% en la Ciudad de México (Figura 19.1).

• En nuestro escenario de referencia actual, esperamos que 85.4 millones de personas estén vacunadas con al menos una dosis para el 1 de abril (Figura 20.1). Esperamos que el 62% de la población esté completamente vacunada para el 1 de abril.

Proyecciones

Infecciones

• Las infecciones diarias estimadas en el escenario de referencia, que representa lo que creemos que es más probable que suceda, aumentarán a 1,148,240 para el 22 de enero de 2022 (Figura 21.1).

• Las infecciones diarias estimadas en el escenario de alta gravedad de Omicron aumentarán a 1,149,080 para el 22 de enero de 2022 (Figura 21.1).

• Las infecciones diarias estimadas en el escenario de cobertura de mascarilla del 80% aumentarán a 1,112,900 para el 21 de enero de 2022 (Figura 21.1).

• Las infecciones diarias estimadas en el tercer escenario de dosis aumentarán a 1,016,810 para el 22 de enero de 2022 (Figura 21.1).

• Las infecciones diarias estimadas en el escenario de rechazo reducido a la vacuna aumentarán a 1,148,240 para el 22 de enero de 2022 (Figura 21.1).

Casos

• Los casos diarios en el escenario de referencia subirán a 20,430 para el 3 de febrero de 2022 (Figura 21.2).

• Los casos diarios en el escenario de alta severidad de Omicron aumentarán a 20,430 para el 3 de febrero de 2022 (Figura 21.2).

• Los casos diarios en el escenario de cobertura de mascarilla del 80% aumentarán a 20,020 para el 3 de febrero de 2022 (Figura 21.2).

• Los casos diarios en el escenario de colocación de la tercera dosis aumentarán a 17,630 para el 3 de febrero de 2022 (Figura 21.2).

• Los casos diarios en el escenario de rechazo reducido a la vacuna aumentarán a 20,430 para el 3 de febrero de 2022 (Figura 21.2).

Hospitalizaciones

• El censo hospitalario diario en el escenario de referencia aumentará a 3,170 al 17 de febrero de 2022 (Figura 21.3).

• El censo hospitalario diario en el escenario de alta gravedad de Omicron aumentará a 5,580 para el 19 de febrero de 2022 (Figura 21.3).

• El censo hospitalario diario en el escenario de cobertura de mascarilla del 80% aumentará a 3,080 para el 16 de febrero de 2022 (Figura 21.3).

• El censo hospitalario diario en el tercer escenario de dosis aumentará a 2,490 para el 15 de febrero de 2022 (Figura 21.3).

• El censo hospitalario diario en el escenario de rechazo reducido a la vacuna aumentará a 3,170 para el 17 de febrero de 2022 (Figura 21.3).

Muertes

• En nuestro escenario de referencia, nuestro modelo proyecta 432,000 muertes acumuladas reportadas por COVID-19 el 1 de abril. Esto representa 24,000 muertes adicionales del 13 de diciembre al 1 de abril. Las muertes por COVID-19 reportadas diariamente en el escenario de referencia aumentarán a 300 en febrero 10, 2022 (Figura 21.4).

• Bajo nuestro escenario de referencia, nuestro modelo proyecta 581,000 muertes totales acumuladas debido a COVID-19 el 1 de abril. Esto representa 32,000 muertes adicionales del 13 de diciembre al 1 de abril (Figura 24.2).

• En nuestro escenario de alta severidad de Omicron, nuestro modelo proyecta 451,000 muertes acumuladas reportadas debido a COVID-19 el 1 de abril. Esto representa 43,000 muertes adicionales del 13 de diciembre al 1 de abril. Muertes por COVID-19 reportadas diariamente en el escenario de alta severidad de Omicron aumentará a 600 para el 16 de febrero de 2022 (Figura 21.4).

• En nuestro escenario de cobertura de 80% con mascarilla, nuestro modelo proyecta 432,000 muertes acumuladas reportadas por COVID-19 el 1 de abril. Esto representa 23,000 muertes adicionales del 13 de diciembre al 1 de abril. Muertes por COVID-19 reportadas diariamente en el escenario de cobertura de 80% con mascarilla aumentará a 290 para el 9 de febrero de 2022 (Figura 21.4).

• En nuestro tercer escenario de dosis, nuestro modelo proyecta 426,000 muertes acumuladas reportadas debido a COVID-19 el 1 de abril. Esto representa 18,000 muertes adicionales del 13 de diciembre al 1 de abril. Las muertes por COVID-19 reportadas diariamente en el tercer escenario de dosis aumentarán a 220 para el 5 de febrero de 2022 (Figura 21.4).

• En nuestro escenario de rechazo reducido a la vacuna, nuestro modelo proyecta 432,000 muertes acumuladas reportadas debido a COVID-19 el 1 de abril. Esto representa 24,000 muertes adicionales desde el 13 de diciembre al 1 de abril. Las muertes por COVID-19 reportadas diariamente en el escenario de vacilación reducida a la vacuna aumentarán a 300 para el 10 de febrero de 2022 (Figura 21.4).

• La Figura 22.1 compara nuestros pronósticos de escenarios de referencia con otros modelos archivados públicamente. Los pronósticos son muy divergentes.

• En algún momento, desde diciembre hasta el 1 de abril, 1 estado tendrá una presión alta o extrema en las camas de hospital (Figura 23.1). En algún momento, desde diciembre hasta el 1 de abril, un estado tendrá una presión alta o extrema en la capacidad de la unidad de cuidados intensivos (UCI) (Figura 24.1).

Actualizaciones de modelos

En esta actualización, hemos revisado sustancialmente nuestro modelo para tener en cuenta explícitamente varios factores importantes que tienen una profunda influencia en la probable trayectoria de la epidemia en los próximos meses. Primero, el modelo rastrea las infecciones de diferentes variantes por separado, incluidas las ancestrales, Alfa, Beta, Gamma, Delta, Omicron y otras. En segundo lugar, tenemos en cuenta que la inmunidad derivada de infecciones y de vacunas disminuye con el tiempo. La inmunidad que previene la infección se debilita más rápidamente que la inmunidad que previene la hospitalización y la muerte, por lo que derivamos curvas decrecientes separadas para la infección y para la hospitalización y la muerte. Basándonos en un análisis sistemático de estudios publicados, informes y estudios archivados, obtenemos curvas decrecientes específicas de la vacuna. En tercer lugar, la infección con diferentes variantes de COVID-19 puede conferir una protección diferente para cada variante del modelo. La matriz de inmunidad de variante cruzada nos permite tener en cuenta el mayor escape inmune visto con Omicron. En tercer lugar, modelamos explícitamente la administración de una tercera dosis de vacuna (y una

segunda dosis para los receptores de J&J). En cuarto lugar, el modelo de distribución variante se basa ahora tanto en la distribución espacial como en los patrones del tráfico aéreo. El apéndice técnico proporciona detalles de la estructura del modelo y el análisis de como disminuye la inmunidad.

El impulsor crítico de nuestras previsiones en los próximos meses es la propagación de la variante Omicron. Las suposiciones críticas sobre la variante Omicron se basan en nuestro análisis de todos los datos de laboratorio disponibles sobre la eficacia de la vacuna, los estudios de efectividad de la vacuna con pruebas negativas en Sudáfrica y el Reino Unido, los datos a nivel de población sobre la positividad de la PCR en muestras representativas de la población y los datos detectados casos, hospitalizaciones y muertes en Sudáfrica, el Reino Unido, Dinamarca y Noruega. Más detalles sobre este análisis se encuentran en el apéndice técnico. Los supuestos clave que influyen sustancialmente en los pronósticos incluyen los siguientes: Primero, una infección previa brinda entre un 40% y un 60% de protección contra la infección por Omicron. En segundo lugar, la eficacia de la vacuna para prevenir la infección se reduce aproximadamente en un 50% en comparación con la eficacia contra la variante Delta, y la eficacia de la vacuna para prevenir la hospitalización y la muerte se reduce en un 25% en comparación con la eficacia contra la variante Delta. En tercer lugar, se supone que la fracción asintomática aumenta de cerca del 40% al 90% -95%; esta fracción influye en las estimaciones futuras de la tasa de detección de infecciones. En cuarto lugar, se estima que la tasa de infección-hospitalización para Omicron es entre un 90% y un 96% más baja que para la variante Delta. En quinto lugar, se estima que la tasa de mortalidad por infección de Omicron es entre un 97% y un 99% más baja que la de Delta.

COVID-19 Results Briefing

Mexico

December 22, 2021

This document contains summary information on the latest projections from the IHME model on COVID-19 in Mexico. The model was run on December 21, 2021, with data through December 13, 2021. In this release, we have substantially revised our model to reflect both the emergence of the Omicron variant, waning infection-acquired and vaccine-acquired immunity, and the matrix of immunity across variants. Our reference scenario suggests that over the next two months, 70% of the population will likely be infected with Omicron. Because of a much greater fraction of asymptomatic infections (likely over 90%) and thus a lower infection-detection rate, we expect diagnosed cases will increase to a peak of 20,430 for February 3, 2022. Based on the data from South Africa, the United Kingdom, Denmark and Norway, we expect that the infection-hospitalization rate (IHR) for Omicron compared to Delta will be 90-96% lower. Despite the lower IHR, some hospitals will potentially be under greater pressure than during the last winter surge. Likewise, based on the available data, we expect the infection-fatality rate (IFR) will be 97-99% lower than for Delta. Huge numbers of infections, and moderate hospitalizations may still translate into 32,000 deaths in the coming four months.

What are the policy responses that are available? We have included in this release scenarios of increasing mask use to 80%, increasing third dose vaccine delivery to all that have had two doses, and making progress against vaccine hesitancy. Given the speed of the global spread of Omicron and the very short doubling time for Omicron transmission, the strategies that will make a major impact in the time frame are increasing high quality mask use such N95 or equivalent and more rapid expansion of third doses of vaccination with shorter intervals from the first two doses to the third dose. Given the rapid spread and much reduced IHR and IFR, we do not believe elementary or secondary school closures are appropriate. More aggressive lockdowns to control transmission may reduce the pressure on some hospital systems but will come at considerable economic and social cost. Given that screening programs are likely to show many asymptomatic cases, workplace screening and protocols on how long individuals need to stay away from work may need to be modified otherwise there may be a considerable impact on some employers and on some supply chains. Extremely high rates of transmission and reported cases may also mean that contact tracing may be ineffective and potentially a waste of resources.

Individuals can act to protect themselves by getting vaccinated if not already vaccinated and getting a third dose as soon as they are eligible. Individuals at any elevated risk due to age or comorbidities who wish to reduce their risk of hospitalization or death should wear a mask, preferably a high-quality mask such as an N95 mask, and avoid situations where transmission is more likely such as any indoor gathering or outdoor gathering where distancing is not possible. Individuals who are not vaccinated or have never been infected should also be particularly concerned.

With high infection rates and the projected stress on some hospitals, hospitalization rates should be used as a metric to drive policy at the local level. The medical system is already exhausted and some medical staff may get infected and have to isolate, the work force may be impacted even more. There are huge variations in the capacity of hospitals to expand to meet the surge and local metrics are needed.

Current situation

- Daily infections in the last week increased to 246,700 per day on average compared to 123,400 the week before (Figure 1.1). Daily hospital census in the last week (through December 13) decreased to 820 per day on average compared to 830 the week before.
- Daily reported cases in the last week increased to 3,000 per day on average compared to 2,600 the week before (Figure 2.1).
- Reported deaths due to COVID-19 in the last week decreased to 150 per day on average, about the same as the week before (Figure 3.1).
- Total deaths due to COVID-19 in the last week decreased to 200 per day on average, about the same as the week before (Figure 3.1). This makes COVID-19 the number 4 cause of death in Mexico this week (Table 1). Estimated total daily deaths due to COVID-19 in the past week were 1.3 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 three states. (Figure 4.1).
- The daily rate of total COVID-19 deaths is greater than 4 per million in four states. (Figure 4.2).
- We estimate that 66% of people in Mexico 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 32 states. (Figure 7.1).
- The infection-detection rate in Mexico was close to 4% 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 32 states, that the Gamma variant is circulating in 0 states and that the Omicron variant is circulating in 32 states.

Trends in drivers of transmission

- Mobility last week was 19% 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, 78% of people self-report that they always wore a mask when leaving their home, about the same as last week (Figure 13.1).

- There were 12 diagnostic tests per 100,000 people on December 13 (Figure 15.1).
- As of December 13, four states have reached 70% or more of the population who have received at least one vaccine dose and 0 states have reached 70% or more of the population who are fully vaccinated (Figure 17.1). 63% of people in Mexico have received at least one vaccine dose and 48% are fully vaccinated.
- In Mexico, 92.1% 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 up by 0.6 percentage points from last week. The proportion of the population who are open to receiving a COVID-19 vaccine ranges from 80% in Chiapas to 99% in Mexico City (Figure 19.1).
- In our current reference scenario, we expect that 85.4 million people will be vaccinated with at least one dose by April 1 (Figure 20.1). We expect that 62% 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 1,148,240 by January 22, 2022 (Figure 21.1).
- Daily estimated infections in the **high severity of Omicron scenario** will rise to 1,149,080 by January 22, 2022 (Figure 21.1).
- Daily estimated infections in the **80% mask coverage scenario** will rise to 1,112,900 by January 21, 2022 (Figure 21.1).
- Daily estimated infections in the **third dose scenario** will rise to 1,016,810 by January 22, 2022 (Figure 21.1).
- Daily estimated infections in the **reduced vaccine hesitancy scenario** will rise to 1,148,240 by January 22, 2022 (Figure 21.1).

Cases

- Daily cases in the **reference scenario** will rise to 20,430 by February 3, 2022 (Figure 21.2).
- Daily cases in the **high severity of Omicron scenario** will rise to 20,430 by February 3, 2022 (Figure 21.2).
- Daily cases in the **80% mask coverage scenario** will rise to 20,020 by February 3, 2022 (Figure 21.2).
- Daily cases in the **third dose scenario** will rise to 17,630 by February 3, 2022 (Figure 21.2).
- Daily cases in the **reduced vaccine hesitancy scenario** will rise to 20,430 by February 3, 2022 (Figure 21.2).

Hospitalizations

- Daily hospital census in the **reference scenario** will rise to 3,170 by February 17, 2022 (Figure 21.3).
- Daily hospital census in the **high severity of Omicron scenario** will rise to 5,580 by February 19, 2022 (Figure 21.3).
- Daily hospital census in the **80% mask coverage scenario** will rise to 3,080 by February 16, 2022 (Figure 21.3).
- Daily hospital census in the **third dose scenario** will rise to 2,490 by February 15, 2022 (Figure 21.3).
- Daily hospital census in the **reduced vaccine hesitancy scenario** will rise to 3,170 by February 17, 2022 (Figure 21.3).

Deaths

- In our **reference scenario**, our model projects 432,000 cumulative reported deaths due to COVID-19 on April 1. This represents 24,000 additional deaths from December 13 to April 1. Daily reported COVID-19 deaths in the **reference scenario** will rise to 300 by February 10, 2022 (Figure 21.4).
- Under our **reference scenario**, our model projects 581,000 cumulative total deaths due to COVID-19 on April 1. This represents 32,000 additional deaths from December 13 to April 1 (Figure 24.2).
- In our **high severity of Omicron scenario**, our model projects 451,000 cumulative reported deaths due to COVID-19 on April 1. This represents 43,000 additional deaths from December 13 to April 1. Daily reported COVID-19 deaths in the **high severity of Omicron scenario** will rise to 600 by February 16, 2022 (Figure 21.4).
- In our **80% mask coverage scenario**, our model projects 432,000 cumulative reported deaths due to COVID-19 on April 1. This represents 23,000 additional deaths from December 13 to April 1. Daily reported COVID-19 deaths in the **80% mask coverage scenario** will rise to 290 by February 9, 2022 (Figure 21.4).
- In our **third dose scenario**, our model projects 426,000 cumulative reported deaths due to COVID-19 on April 1. This represents 18,000 additional deaths from December 13 to April 1. Daily reported COVID-19 deaths in the **third dose scenario** will rise to 220 by February 5, 2022 (Figure 21.4).
- In our **reduced vaccine hesitancy scenario**, our model projects 432,000 cumulative reported deaths due to COVID-19 on April 1. This represents 24,000 additional deaths from December 13 to April 1. Daily reported COVID-19 deaths in the **reduced vaccine hesitancy scenario** will rise to 300 by February 10, 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, one state will have high or extreme stress on hospital beds (Figure 23.1). At some point from December through April 1, one state 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 explicitly 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 critical driver of our forecasts in the next months is the spread of the Omicron variant. Critical assumptions about the Omicron variant are based on our analysis of all the available lab data on vaccine efficacy, test-negative vaccine effectiveness studies in South Africa and the UK, population-level data on PCR positivity in representative samples of the population, and detected cases, hospitalization, and deaths in South Africa, the UK, Denmark, and Norway. More details on this analysis are in the technical appendix. 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

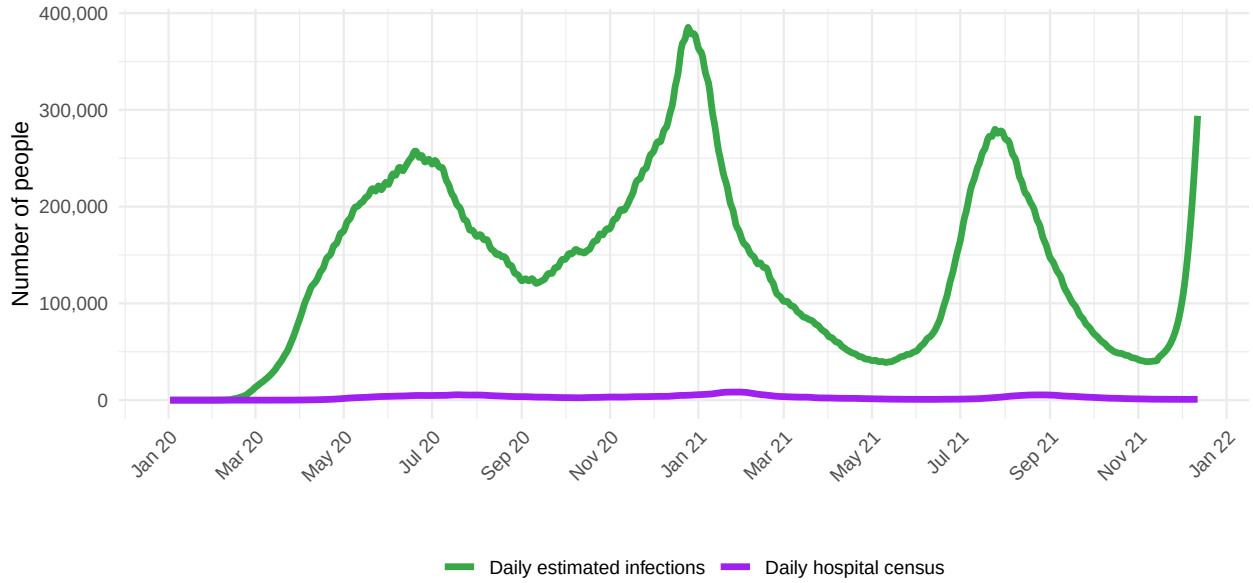


Figure 2.1. Reported daily COVID-19 cases, moving average

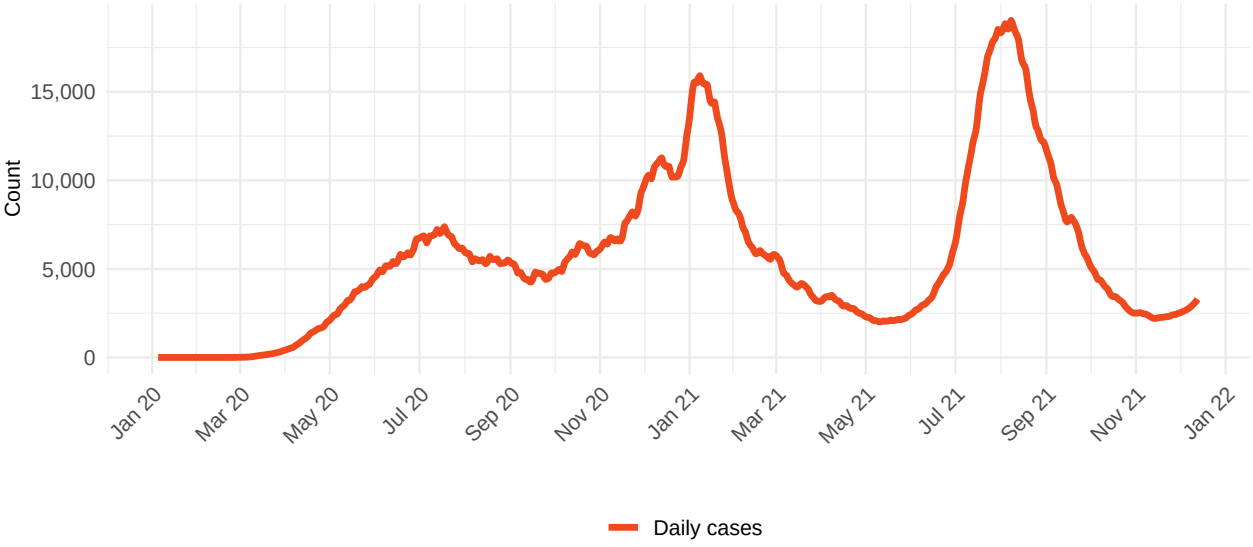
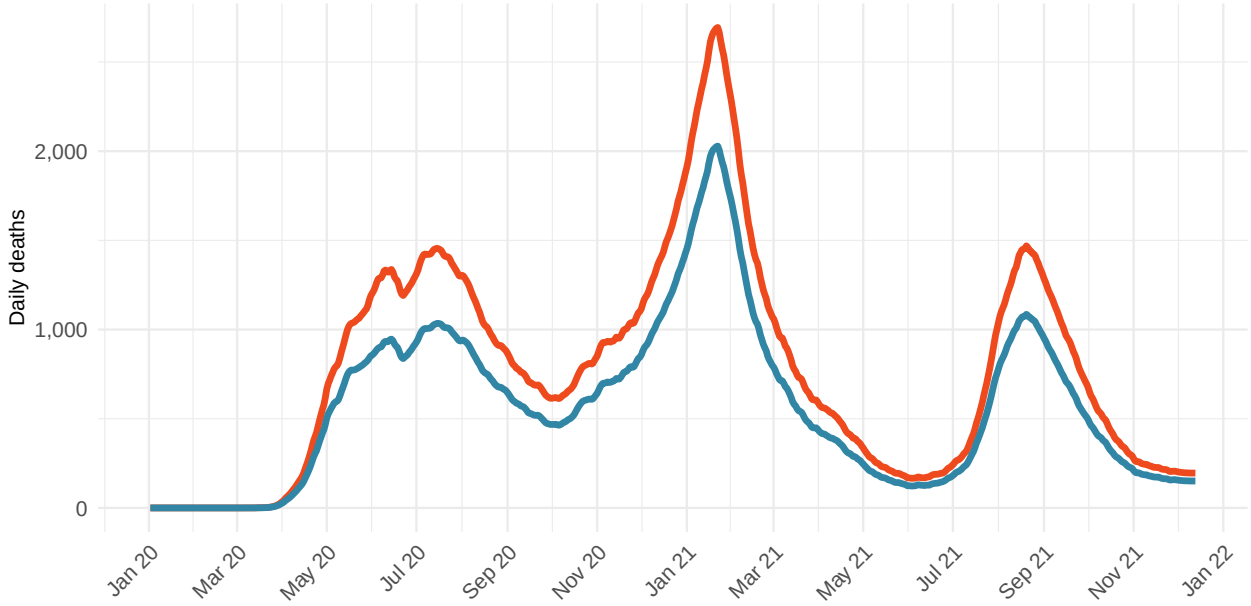


Table 1. Ranking of total deaths due to COVID-19 among the leading causes of mortality this week, assuming uniform deaths of non-COVID causes throughout the year

Cause name	Weekly deaths	Ranking
Ischemic heart disease	2,044	1
Diabetes mellitus	1,420	2
Chronic kidney disease	1,395	3
COVID-19	1,370	4
Cirrhosis and other chronic liver diseases	891	5
Stroke	729	6
Chronic obstructive pulmonary disease	630	7
Interpersonal violence	590	8
Alzheimer's disease and other dementias	455	9
Lower respiratory infections	434	10

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

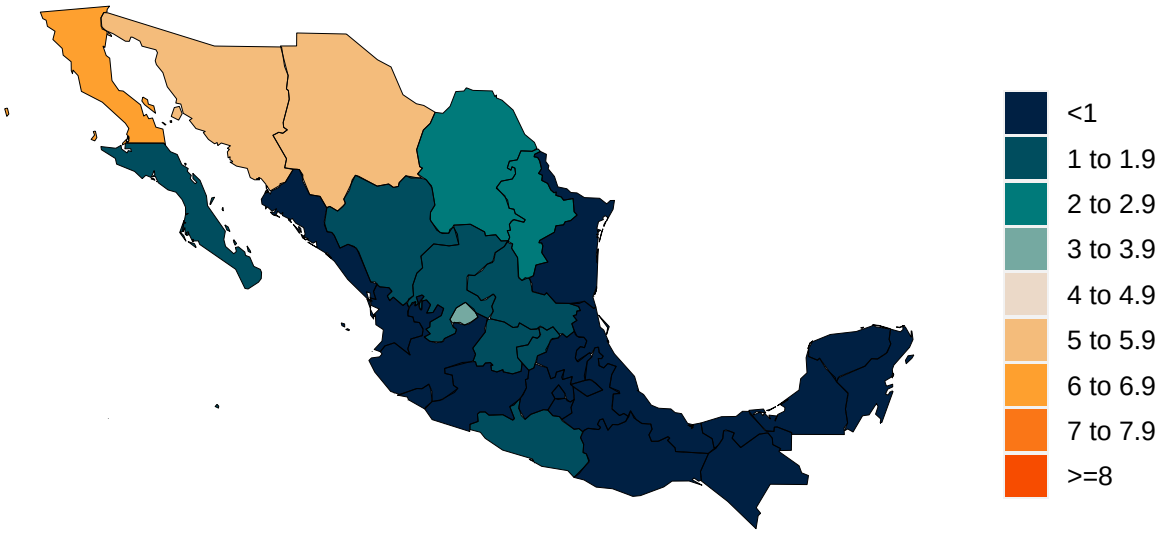
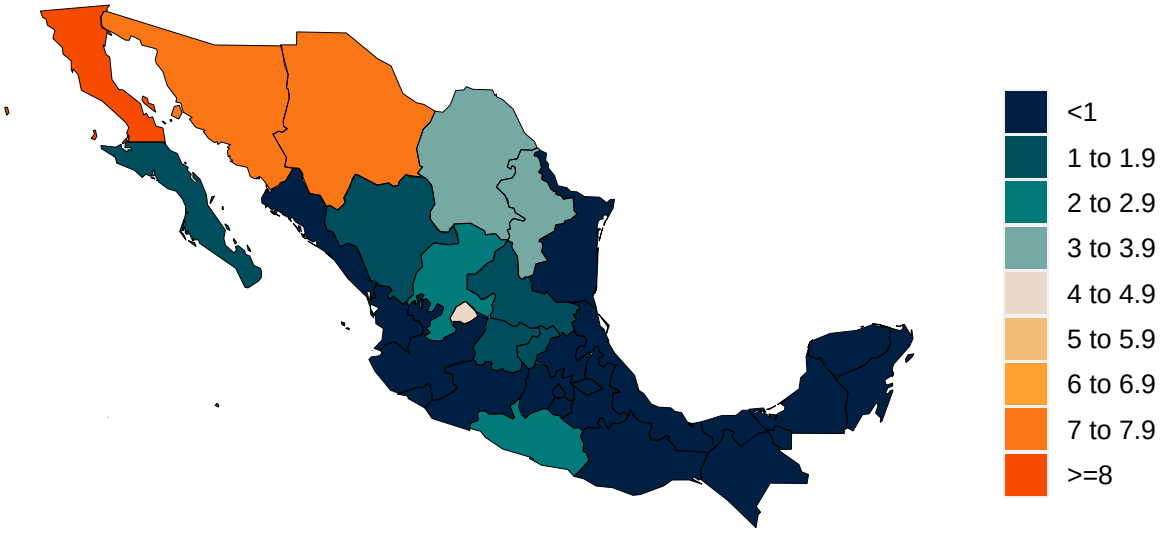


Figure 4.2 Daily total COVID-19 death rate per 1 million



Cumulative COVID-19 deaths per 100,000 on December 13, 2021

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

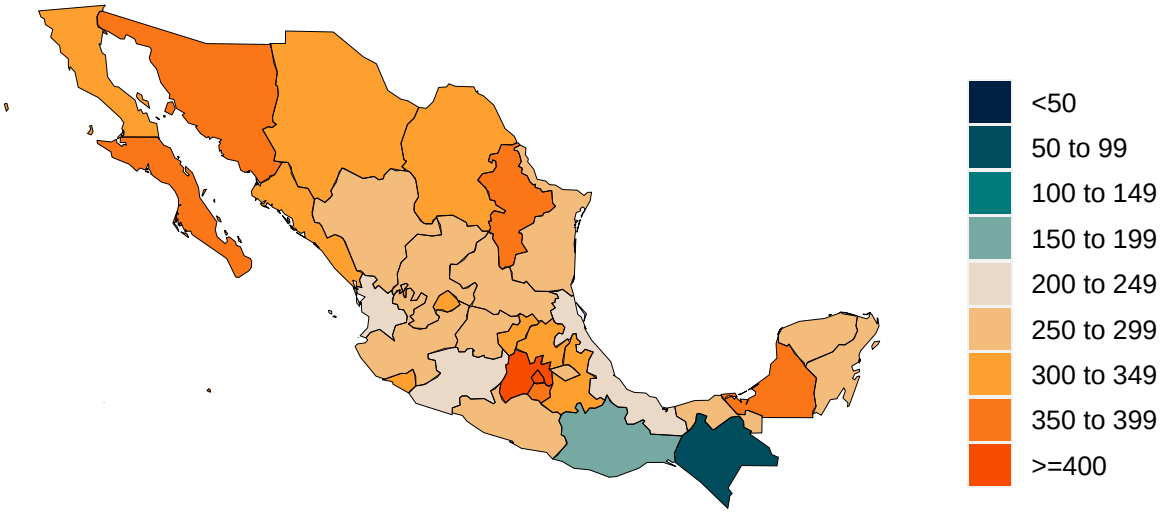


Figure 5.2 Total cumulative COVID-19 deaths per 100,000

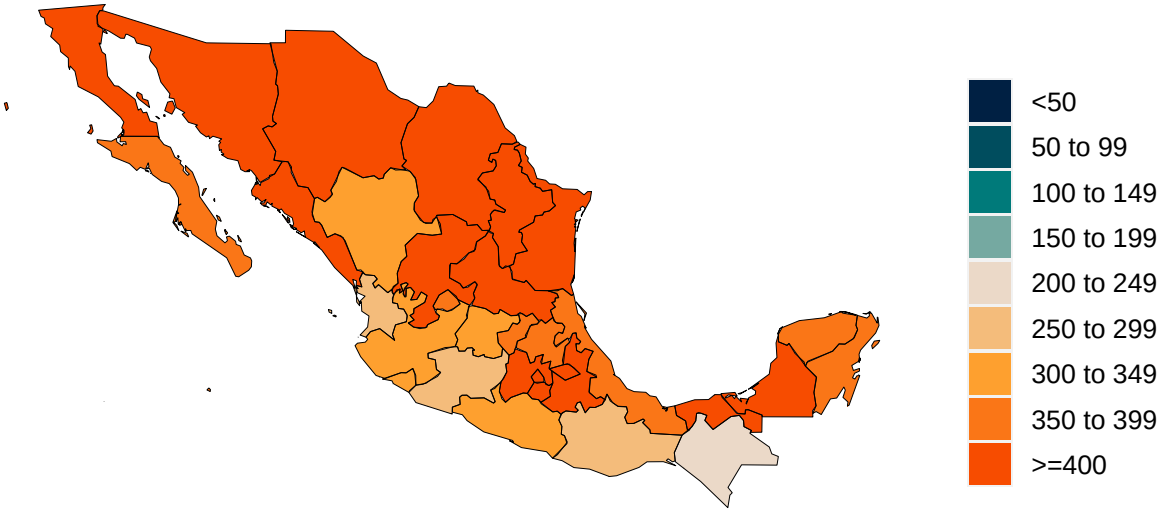


Figure 6.1. Estimated percent of the population infected with COVID-19 on December 13, 2021

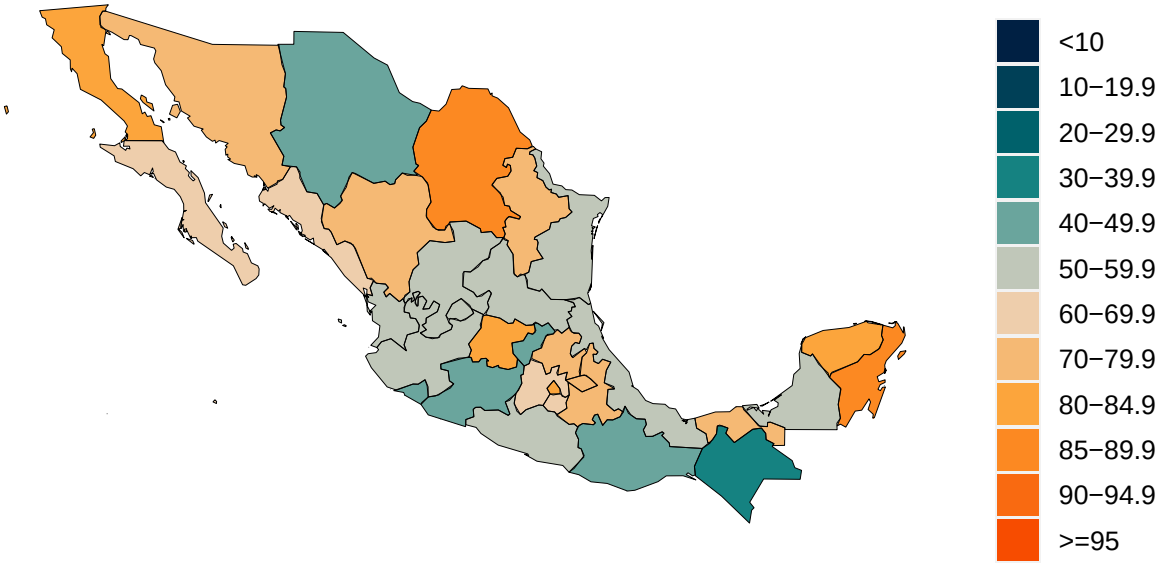


Figure 7.1. Mean effective R on December 2, 2021. Effective R less than 1 means that transmission should decline, all other things being held the same. The estimate of effective R is based on the combined analysis of deaths, case reporting, and hospitalizations where available. Current reported cases reflect infections 11-13 days prior, so estimates of effective R can only be made for the recent past.

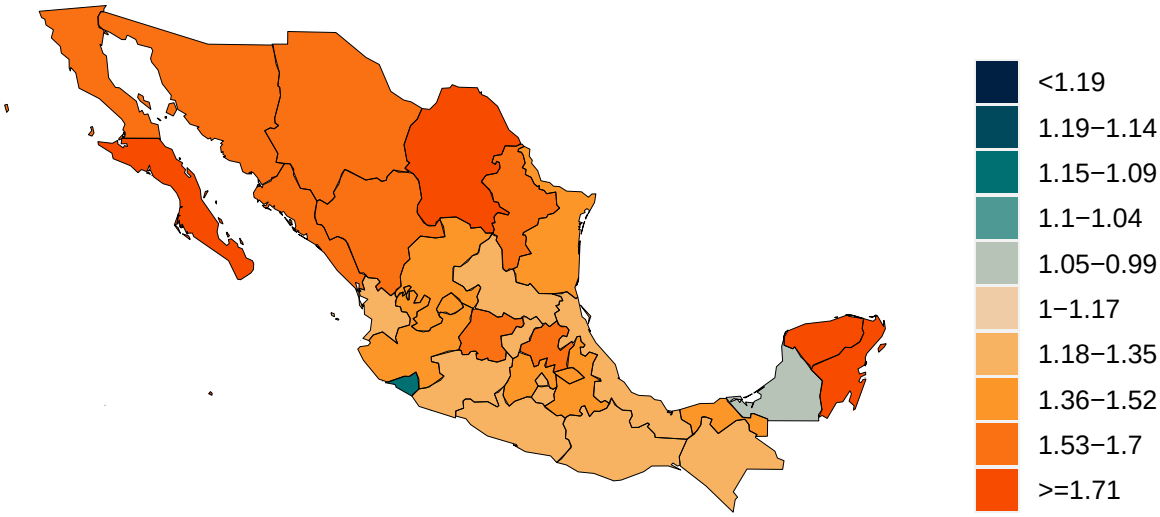
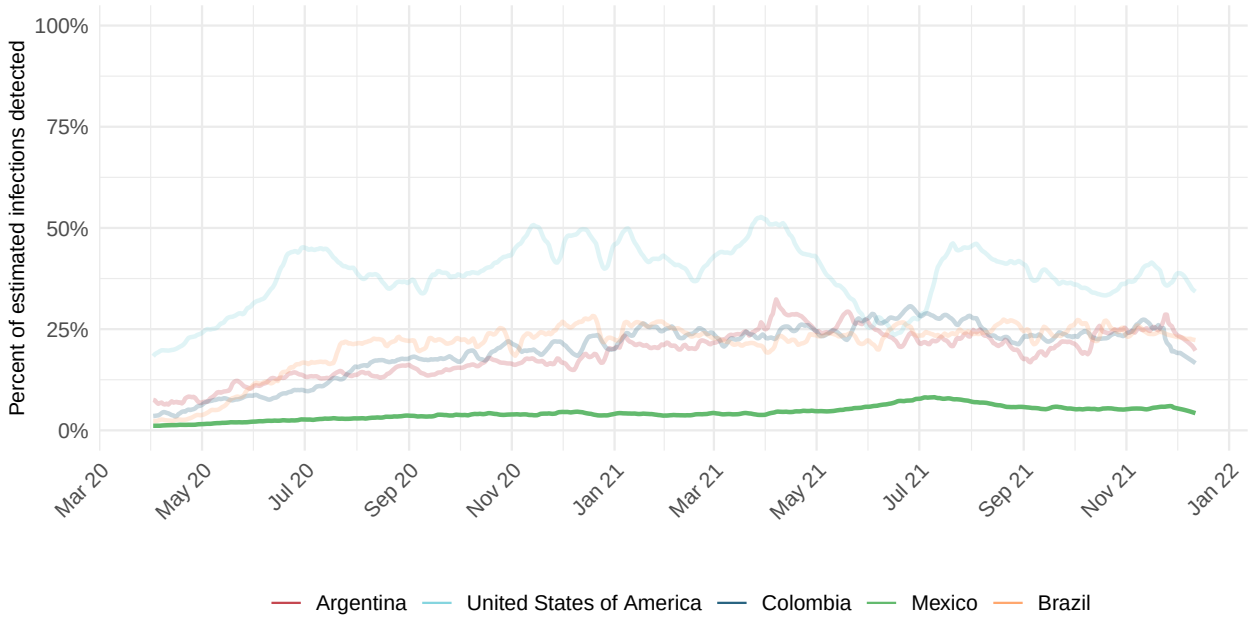


Figure 8.1. Percent of estimated COVID-19 infections detected. This is estimated as the ratio of reported daily COVID-19 cases to estimated daily COVID-19 infections based on the SEIR disease transmission model. Due to measurement errors in cases and testing rates, the infection-detection rate can exceed 100% at particular points in time.



Estimated percent of circulating SARS-CoV-2 for primary variant families on December 13, 2021

Figure 9.1 Estimated percent Alpha variant

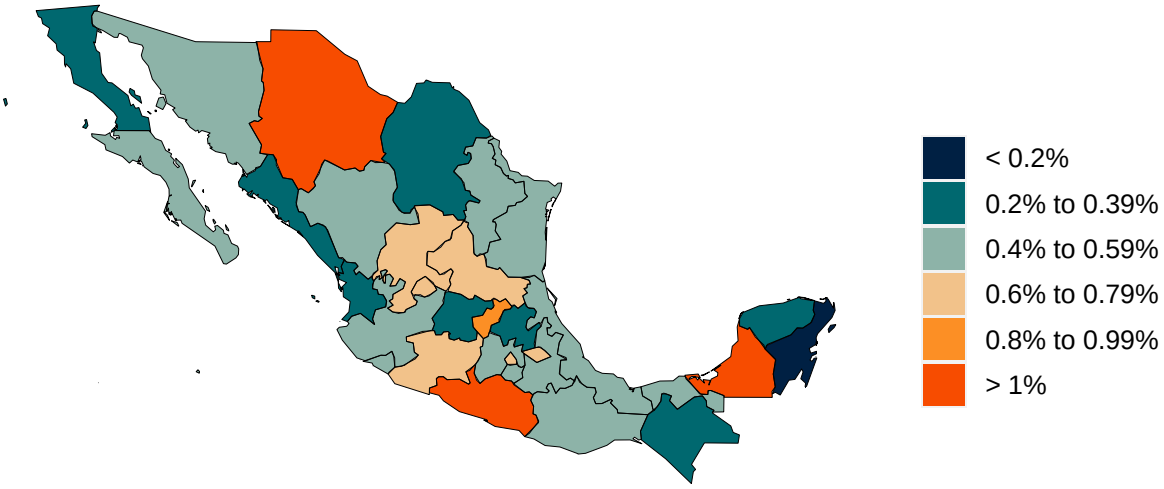
Figure 9.2 Estimated percent Beta variant

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

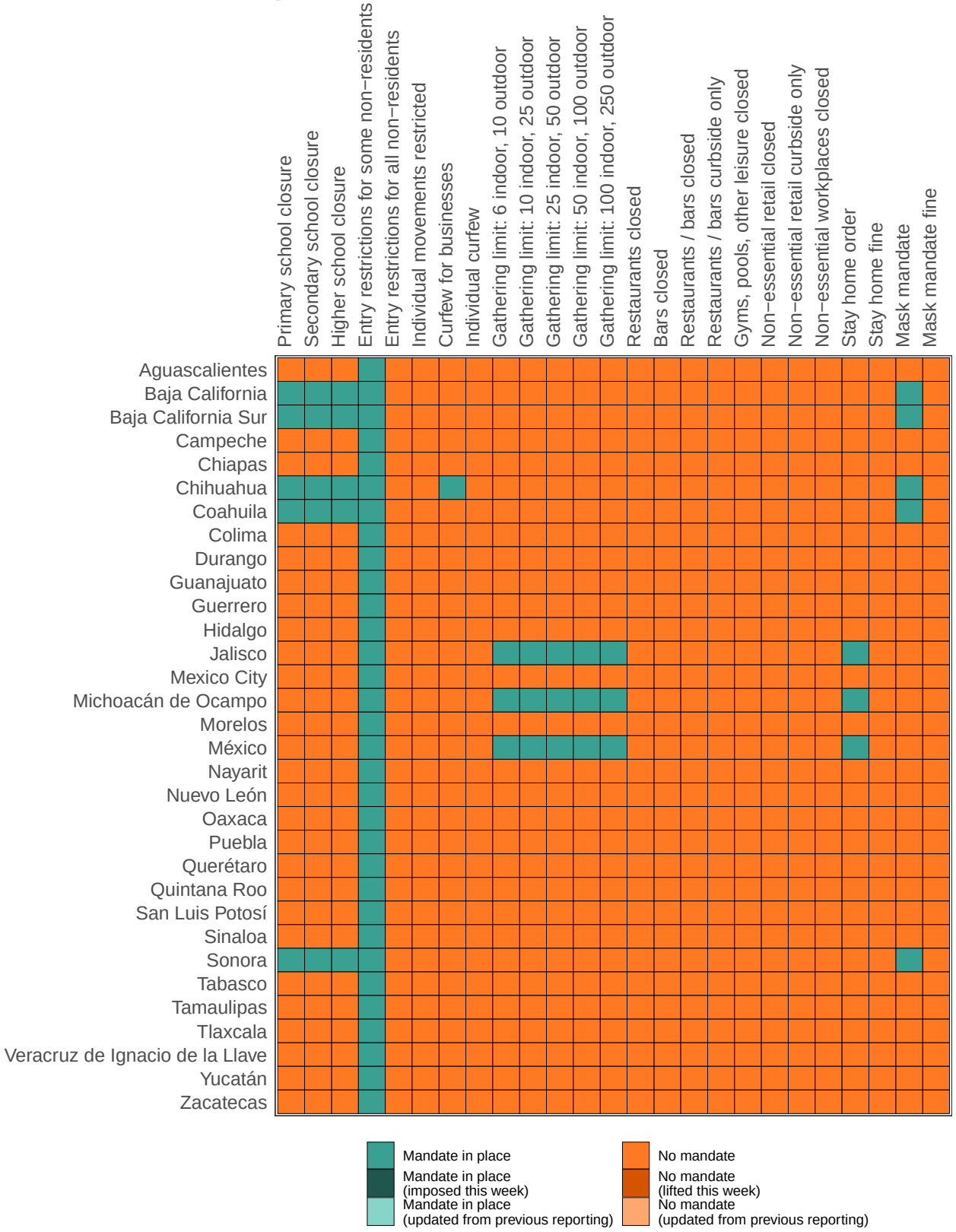


Figure 11.1. Trend in mobility as measured through smartphone app use, compared to January 2020 baseline

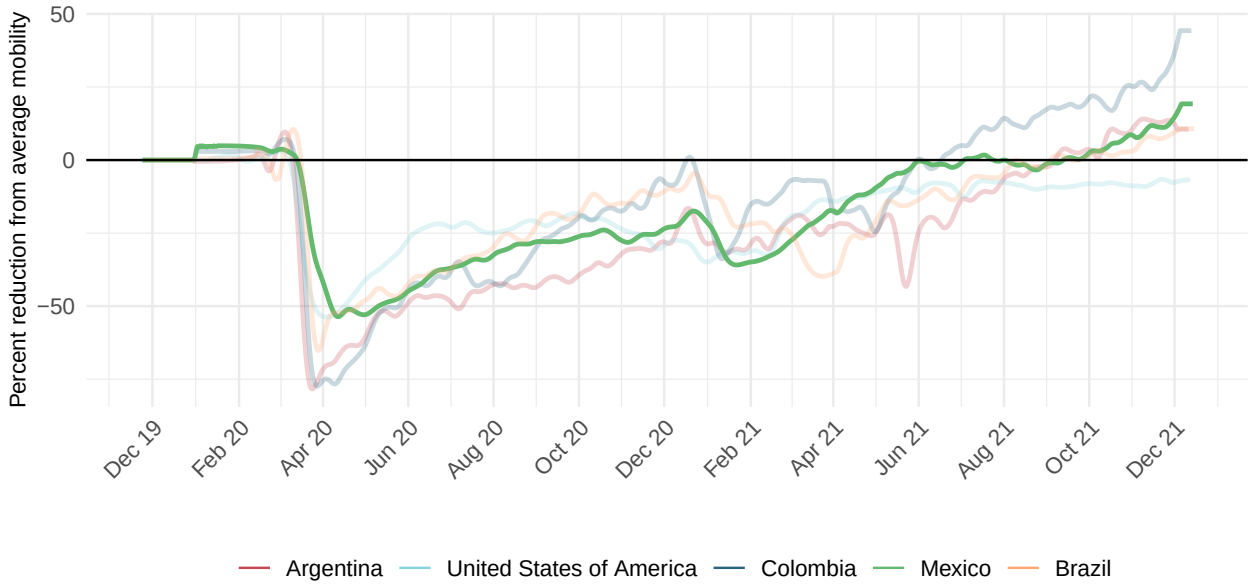


Figure 12.1. Mobility level as measured through smartphone app use, compared to January 2020 baseline (percent) on December 13, 2021

Figure 13.1. Trend in the proportion of the population reporting always wearing a mask when leaving home

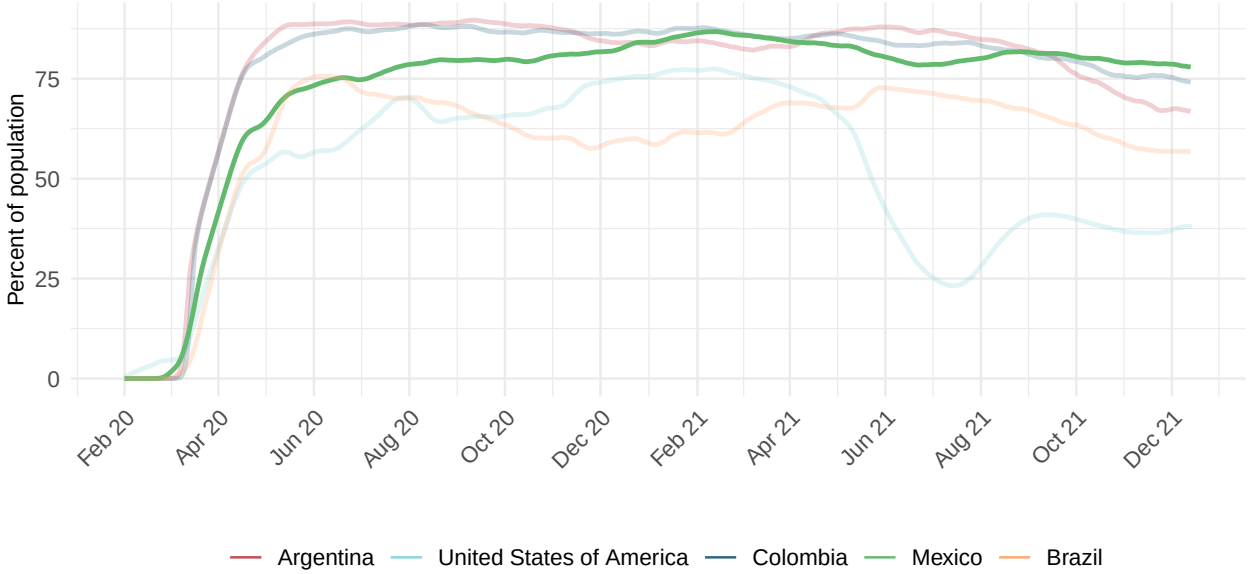


Figure 14.1. Proportion of the population reporting always wearing a mask when leaving home on December 13, 2021

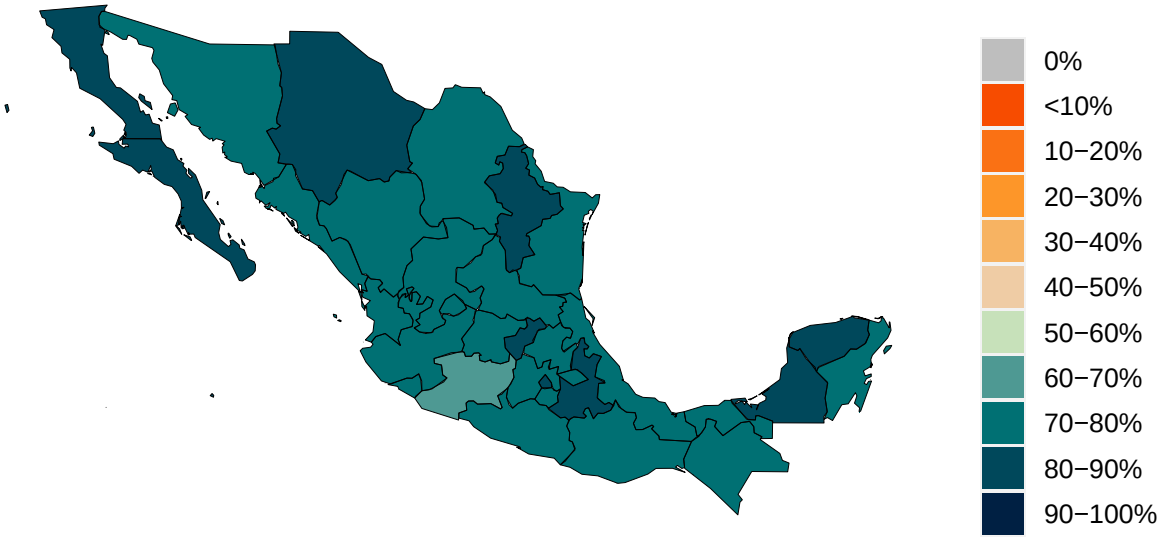


Figure 15.1. Trend in COVID-19 diagnostic tests per 100,000 people

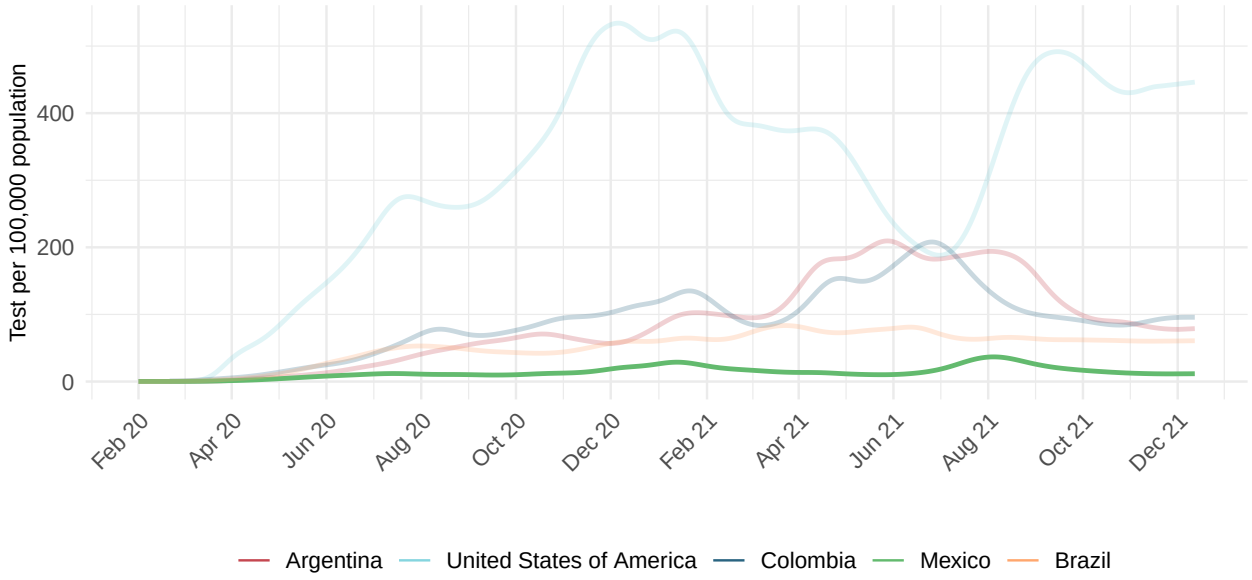


Figure 16.1. COVID-19 diagnostic tests per 100,000 people on December 13, 2021

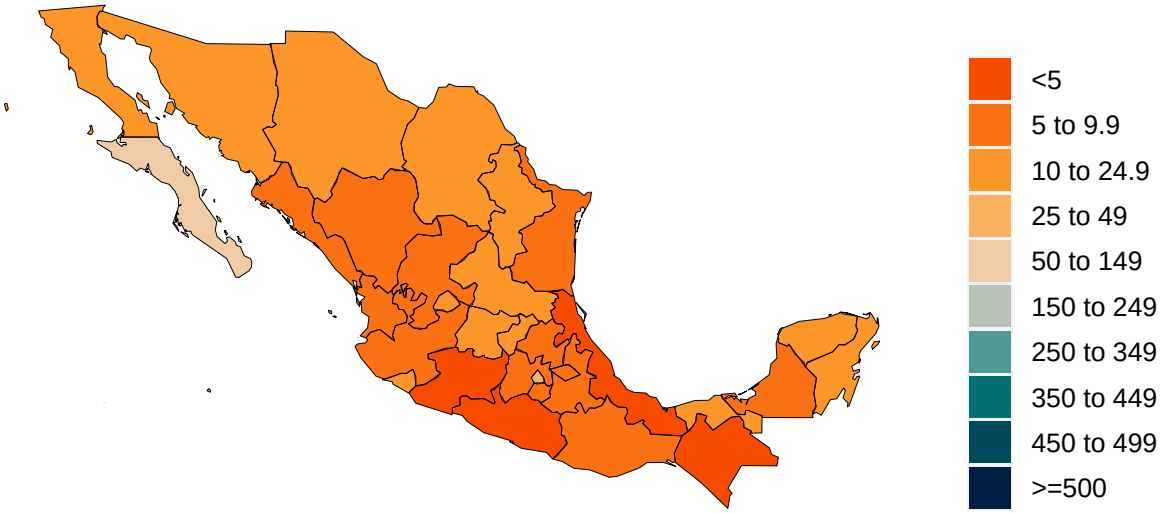


Table 3. Estimates of vaccine effectiveness for specific vaccines used in the model at preventing severe disease and infection. We use data from clinical trials directly, where available, and make estimates otherwise. More information can be found on our website.

	Effectiveness at preventing											
	Ancestral		Alpha		Beta		Gamma		Delta		Omicron	
Vaccine	Severe disease	Infection	Severe disease	Infection	Severe disease	Infection	Severe disease	Infection	Severe disease	Infection	Severe disease	Infection
AstraZeneca	94%	63%	94%	63%	94%	69%	94%	69%	94%	69%	71%	36%
CanSino	66%	62%	66%	62%	64%	61%	64%	61%	64%	61%	48%	32%
CoronaVac	50%	47%	50%	47%	49%	46%	49%	46%	49%	46%	37%	24%
Covaxin	78%	73%	78%	73%	76%	72%	76%	72%	76%	72%	57%	38%
Johnson & Johnson	86%	72%	86%	72%	76%	64%	76%	64%	76%	64%	57%	33%
Moderna	97%	92%	97%	92%	97%	91%	97%	91%	97%	91%	73%	48%
Novavax	89%	83%	89%	83%	86%	82%	86%	82%	86%	82%	65%	43%
Pfizer/BioNTech	95%	86%	95%	86%	95%	84%	95%	84%	95%	84%	72%	44%
Sinopharm	73%	68%	73%	68%	71%	67%	71%	67%	71%	67%	53%	35%
Sputnik-V	92%	86%	92%	86%	89%	85%	89%	85%	89%	85%	67%	44%
Other vaccines	75%	70%	75%	70%	73%	69%	73%	69%	73%	69%	55%	36%
Other vaccines (mRNA)	91%	86%	91%	86%	88%	85%	88%	85%	88%	85%	67%	45%

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

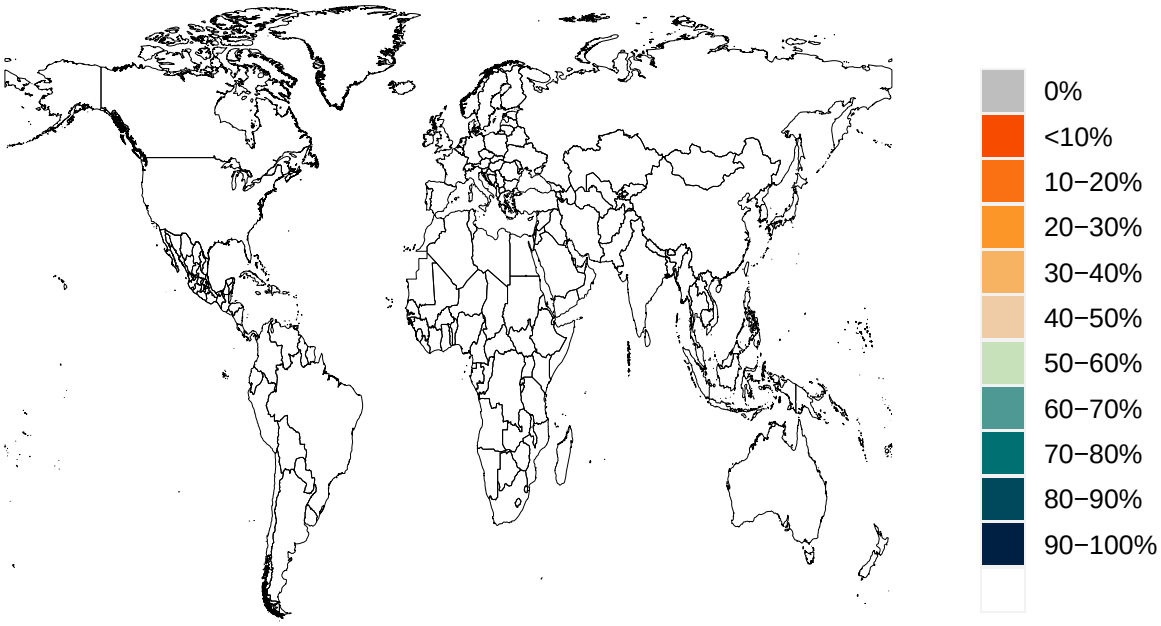


Figure 17.2 Percent of the population fully vaccinated against SARS-CoV-2

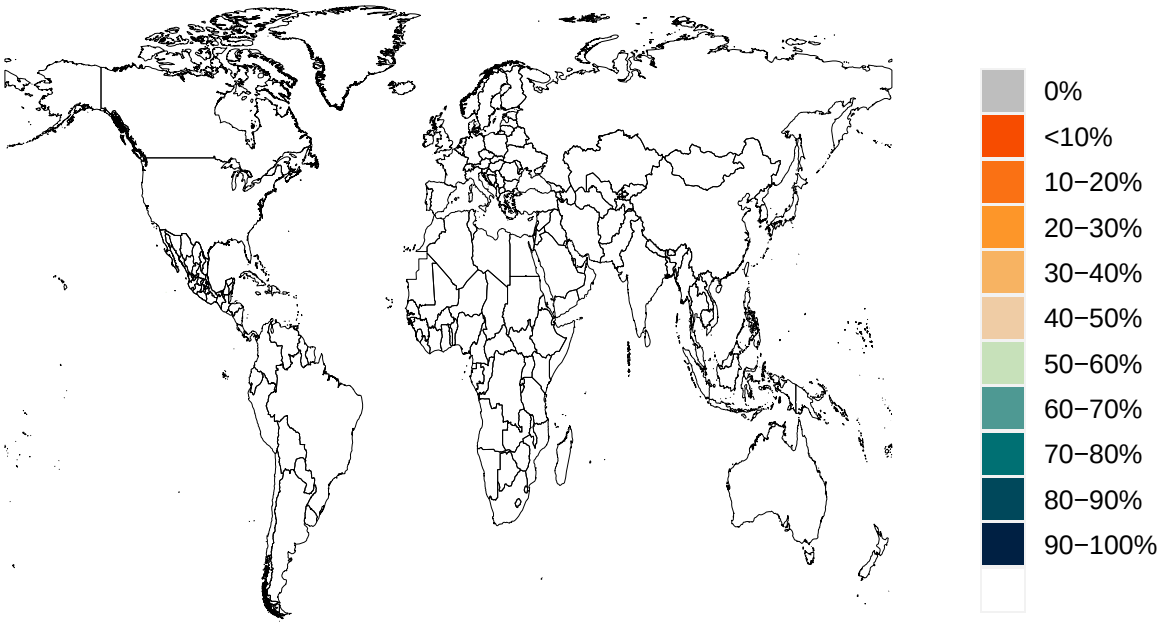


Figure 18.1. Trend in the estimated proportion of the population that is 12 years and older that has been vaccinated or would probably or definitely receive the COVID-19 vaccine if available. Note that vaccine acceptance is calculated using survey data from the 18+ population.

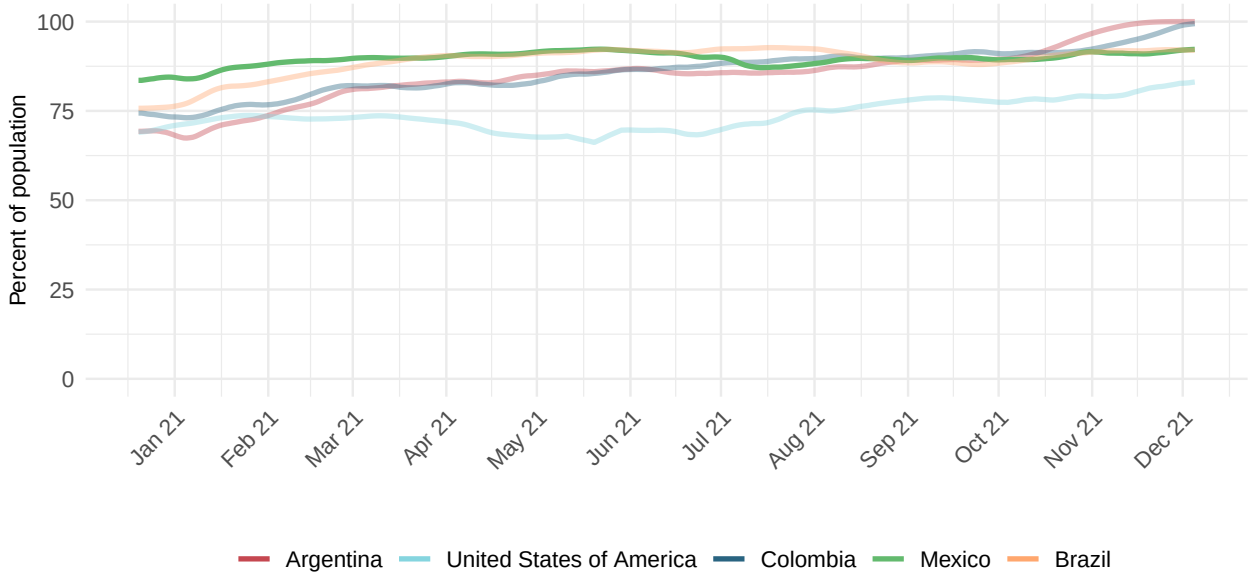


Figure 19.1. Estimated proportion of the population that is 12 years and older that has been vaccinated or would probably or definitely receive the COVID-19 vaccine if available. Note that vaccine acceptance is calculated using survey data from the 18+ population.

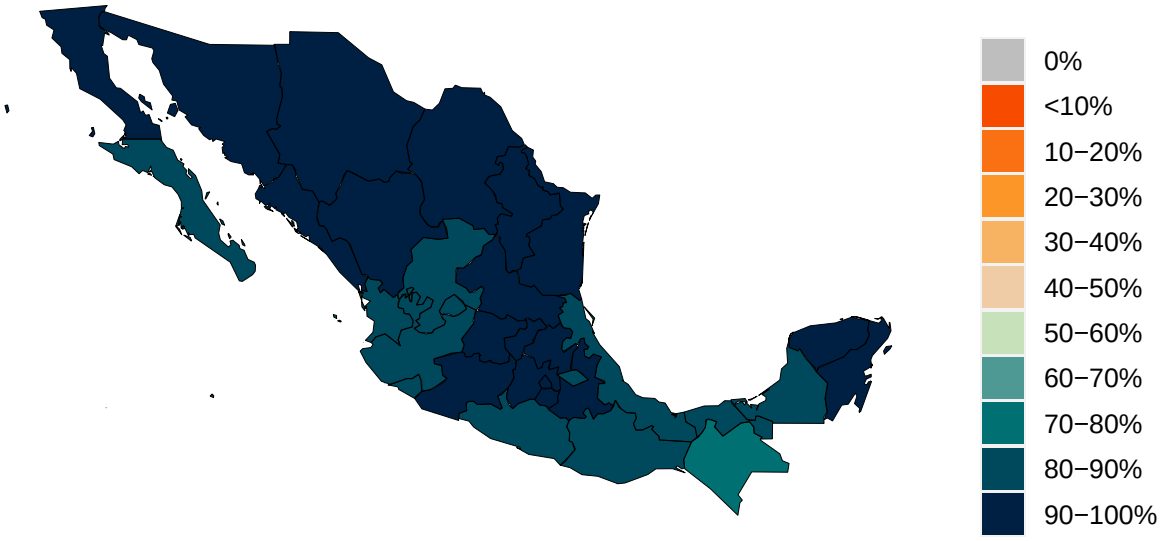
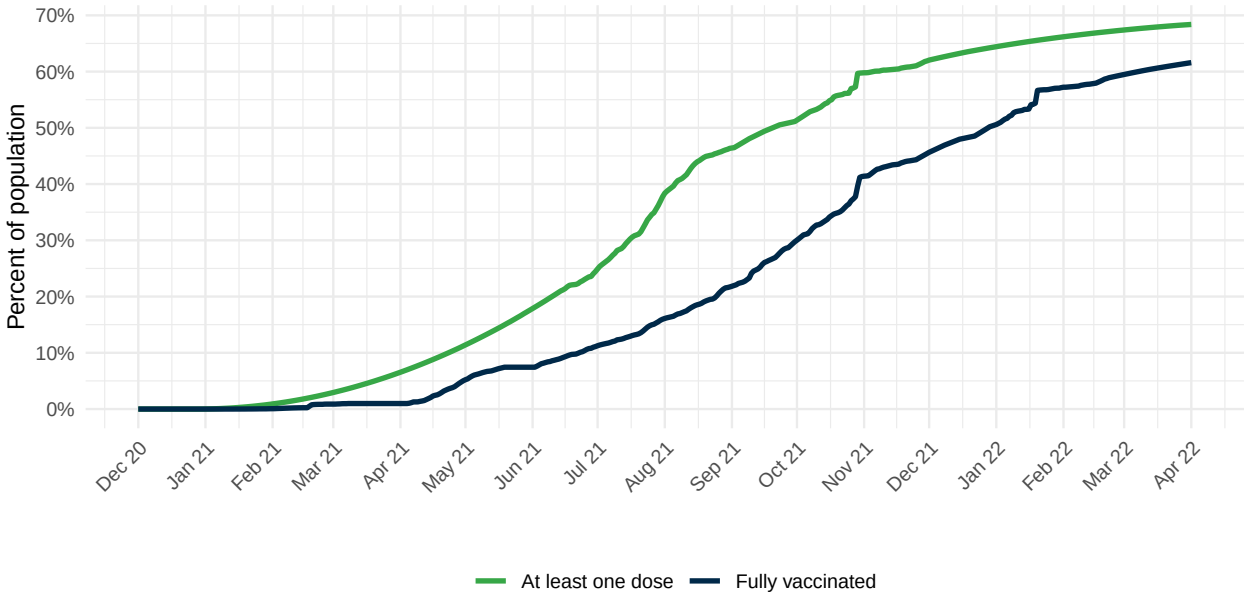


Figure 20.1. Percent of people who receive at least one dose of a COVID-19 vaccine and those who are fully vaccinated



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

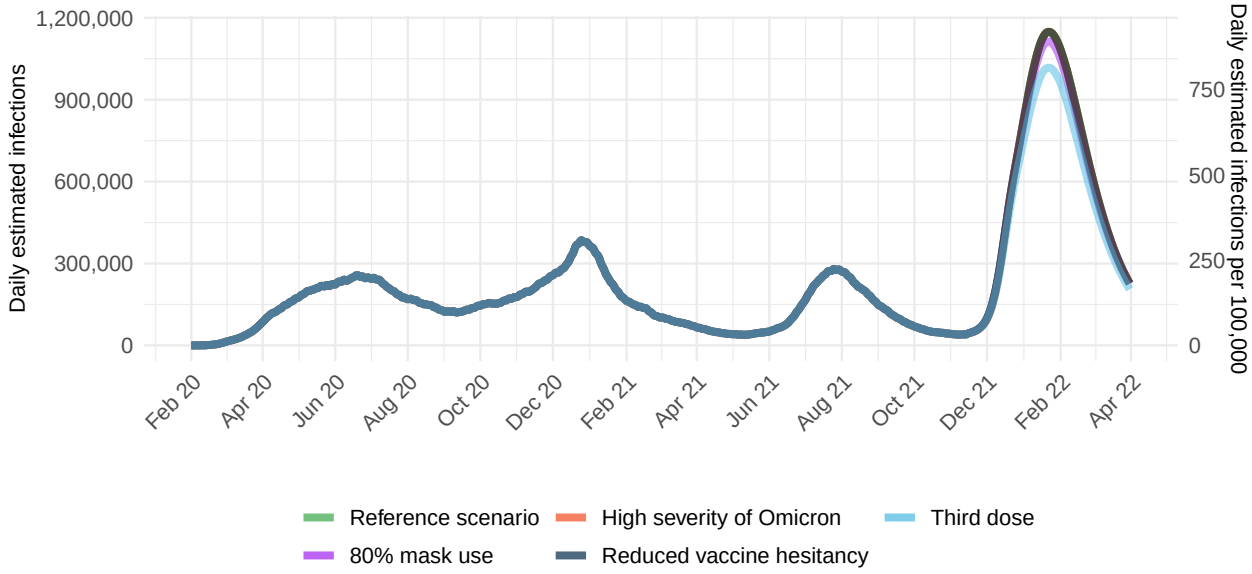


Figure 21.2. Daily COVID-19 reported cases until April 01, 2022 for five scenarios

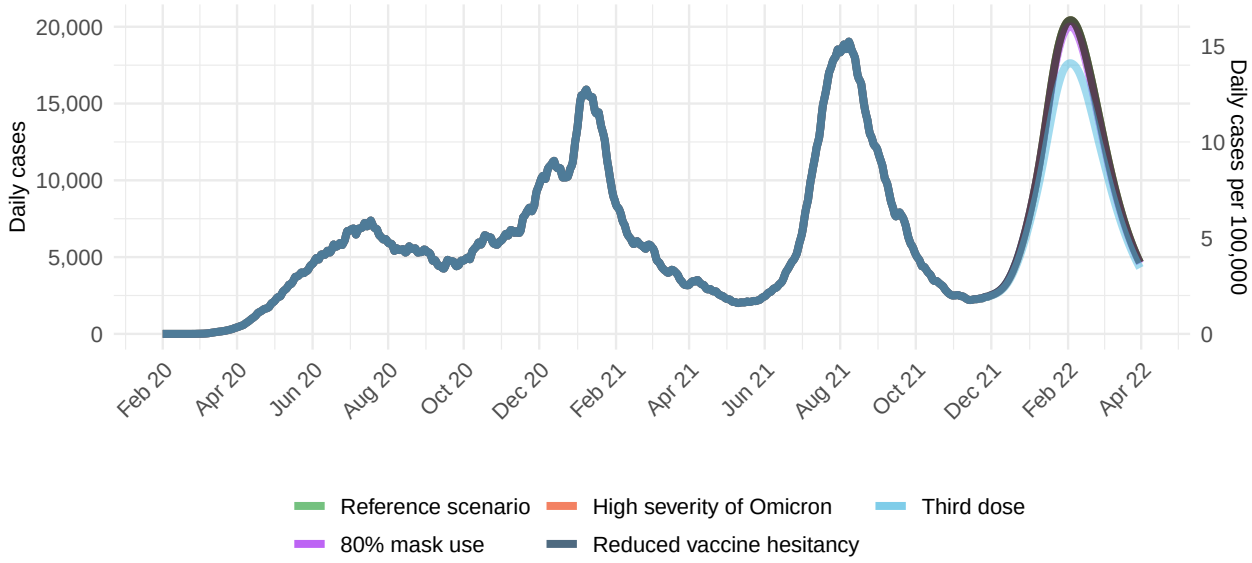


Figure 24.2. Daily COVID-19 hospital census until April 01, 2022 for five scenarios

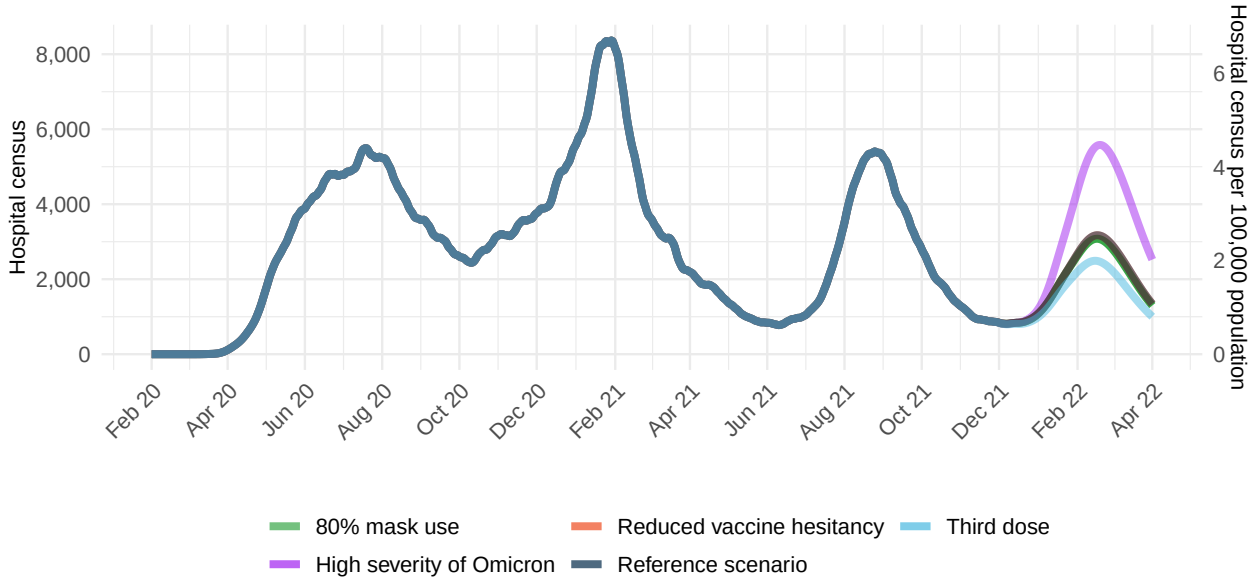


Figure 24.3 Reported daily COVID-19 deaths per 100,000

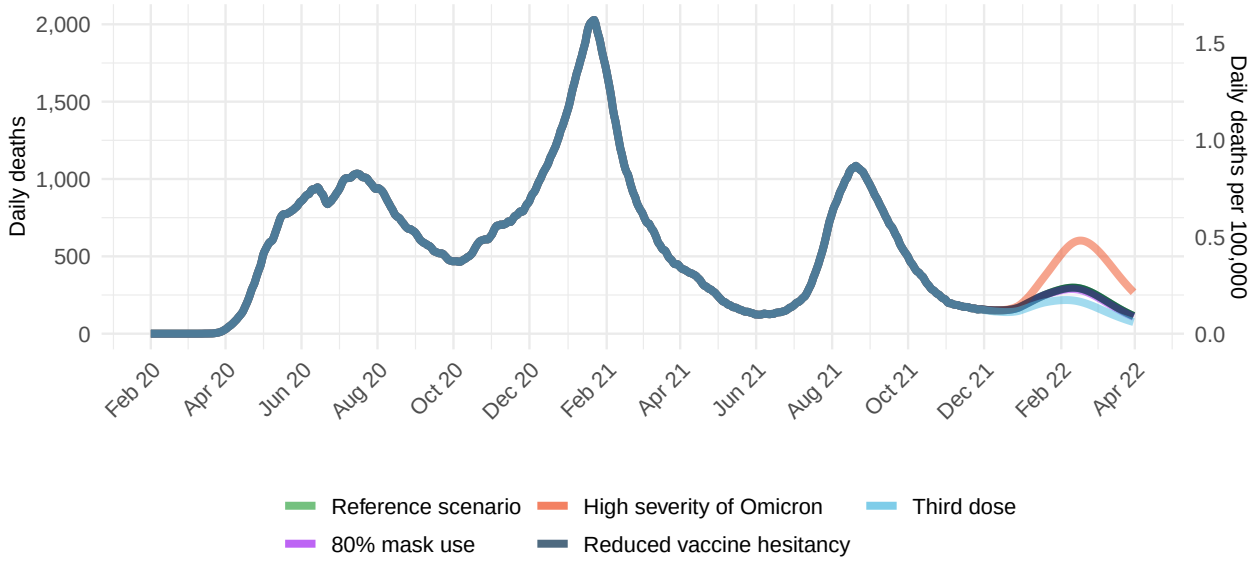


Figure 24.4 Total daily COVID-19 deaths per 100,000

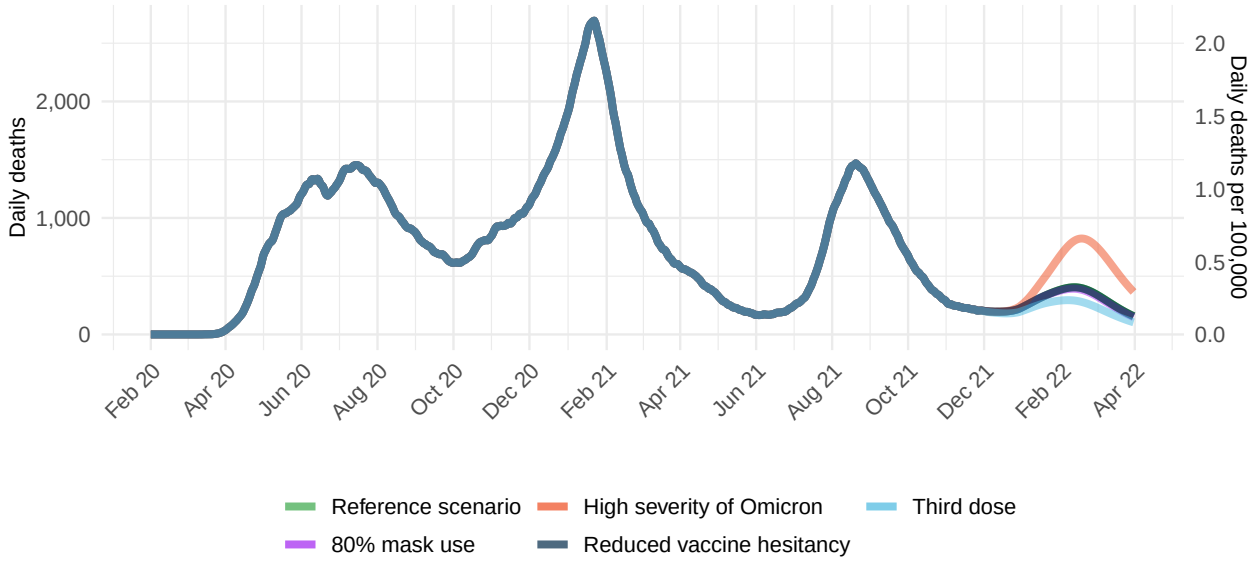


Figure 22.1. Comparison of reference model projections with other COVID modeling groups. For this comparison, we are including projections of daily COVID-19 deaths from other modeling groups when available, last model update in brackets: Delphi from the Massachusetts Institute of Technology (Delphi) [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.

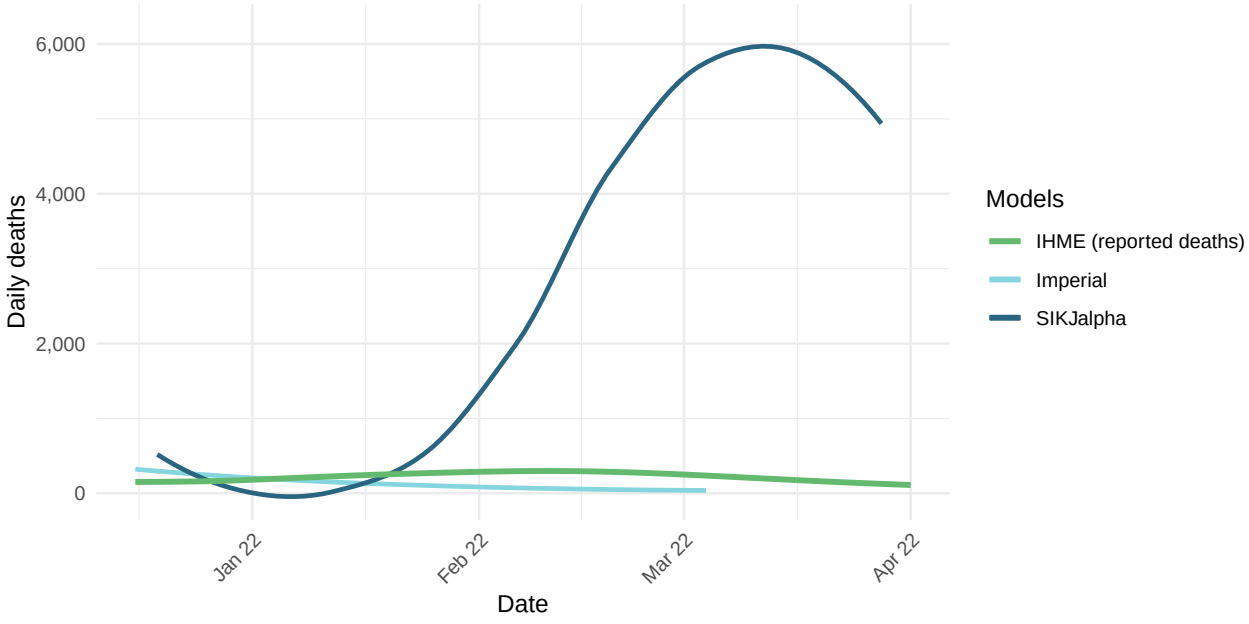


Figure 23.1. The estimated inpatient hospital usage is shown over time. The percent of hospital beds occupied by COVID-19 patients is color-coded based on observed quantiles of the maximum proportion of beds occupied by COVID-19 patients. Less than 5% is considered *low stress*, 5-9% is considered *moderate stress*, 10-19% is considered *high stress*, and 20% or greater is considered *extreme stress*.

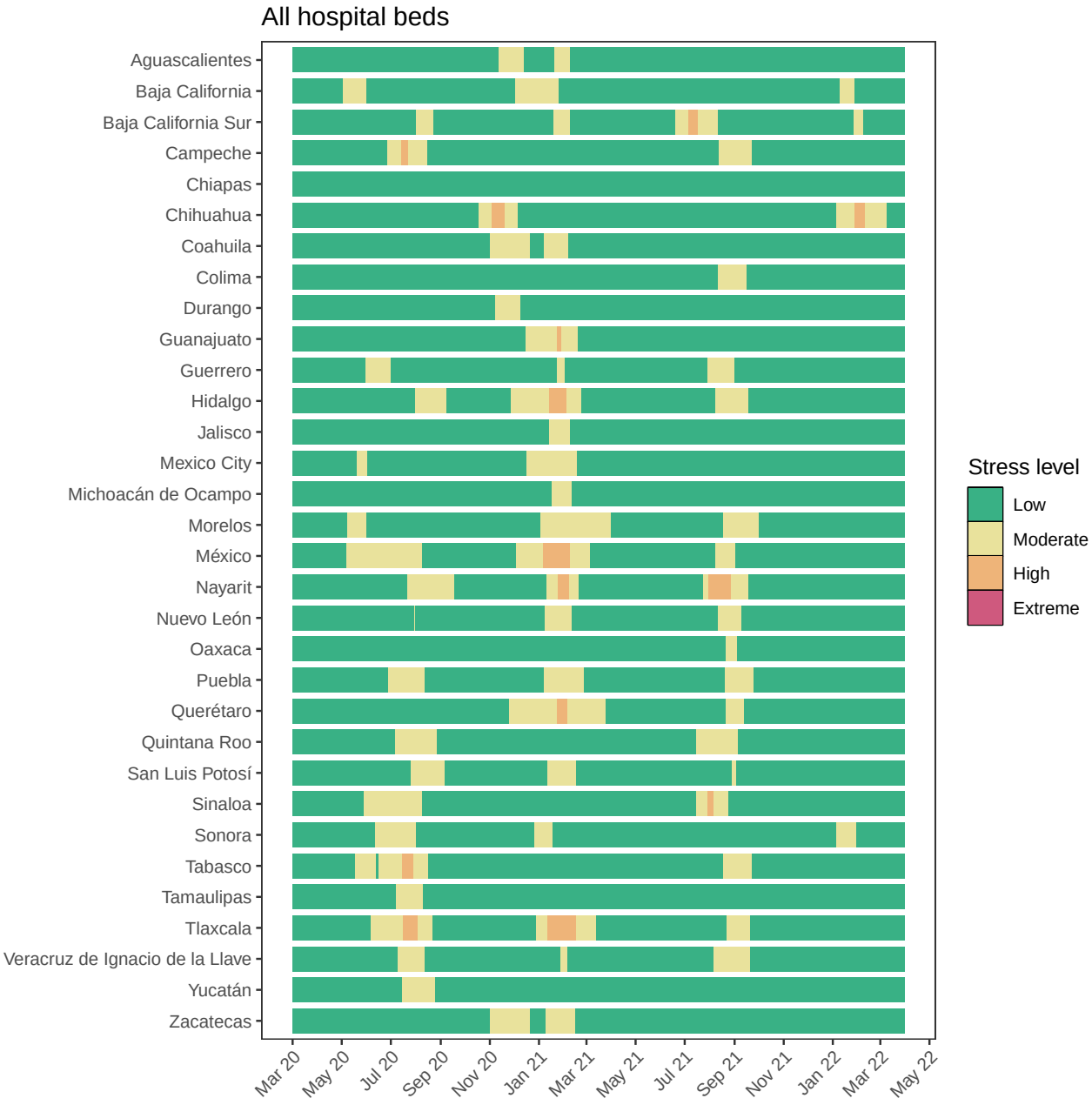
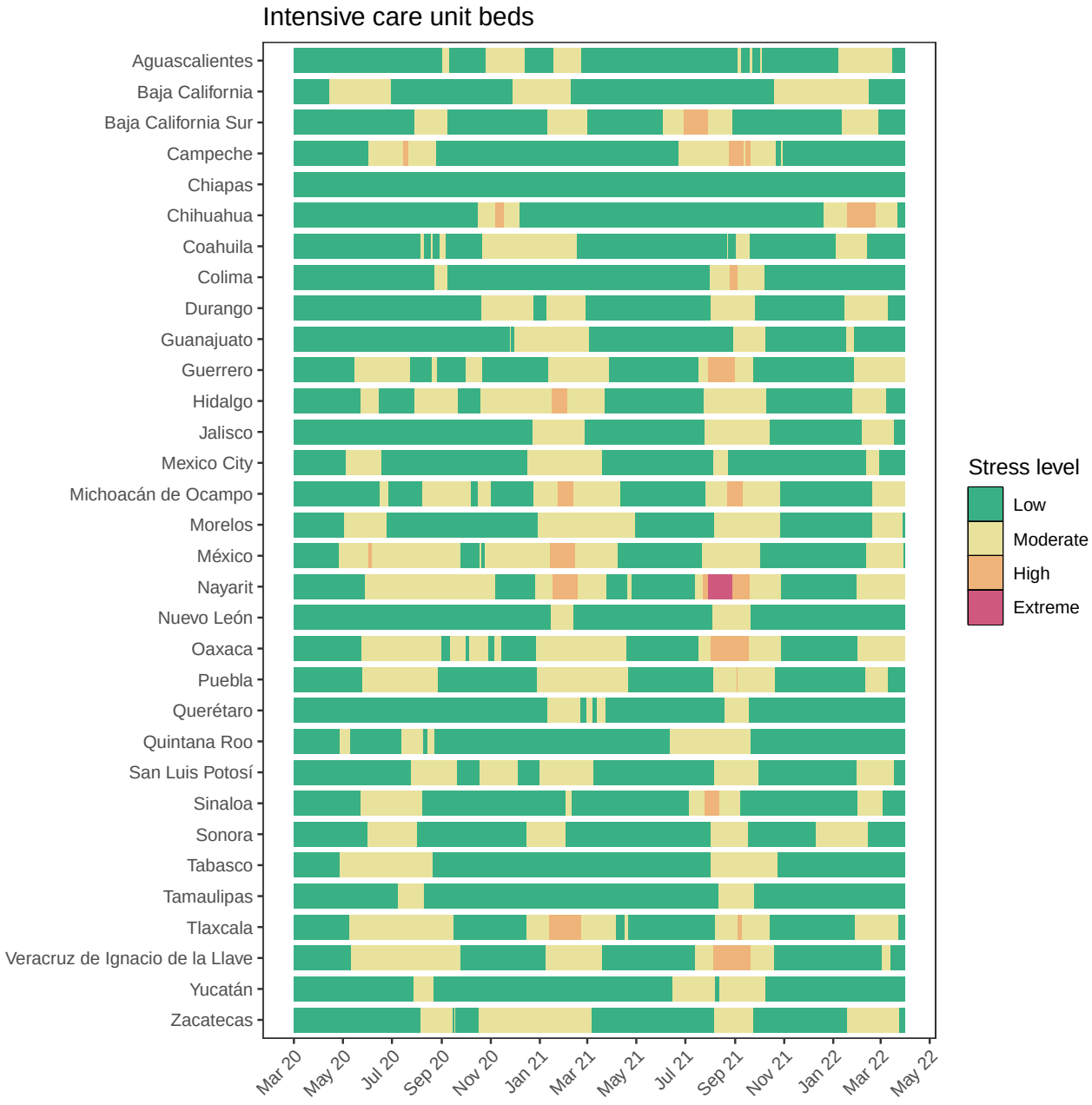


Figure 24.1. The estimated intensive care unit (ICU) usage is shown over time. The percent of ICU beds occupied by COVID-19 patients is color-coded based on observed quantiles of the maximum proportion of ICU beds occupied by COVID-19 patients. Less than 10% is considered *low stress*, 10-29% is considered *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.

Questions? Requests? Feedback? Please contact us at https://www.healthdata.org/covid/contact-us.