# FREQUENTLY ASKED QUESTIONS: Minnesota COVID-19 Modeling

THIRD ROUND OF QUESTIONS (V.3) – 5/18/20

## What information from the Minnesota COVID-19 modeling is shared with the public?

The modeling effort consists of building a model structure that seeks to describe the likely transmission dynamics of the SARS-CoV-2 pathogen, identifying parameters or assumptions from outbreaks to mathematically represent these dynamics. We bring relevant data to the model to make it meaningful for and reflective of disease progression in Minnesota. Within the model, the research team has also implemented a set of scenarios to educate state leaders and the public about the potential path of the disease in the state and explore the relative impacts on a range of outcomes – mortality, peak ICU/ventilator demand, timing of peak infections.

The research teams at the University of Minnesota and the Minnesota Department of Health (MDH) are committed to transparency in our work. To date, we have released summary slide decks, technical documentation, programming code for the model (version 3.0), an infographic, and a document that addresses frequently asked questions. All of this information is available on the [Minnesota COVID-19 Modeling (mn.gov/covid19/data/modeling)](mn.gov/covid19/data/modeling) webpage. It represents the summation of all completed work to date.

## How many scenarios have you run? Are all of these results available to the public?

When preparing summary slides for briefings, a subset of scenarios are generally shown to keep the amount of information being presented at a digestible level. However, all scenarios modeled are available in either presentation slide decks or as appendices to this document. This information is on the [Minnesota COVID-19 Modeling (mn.gov/covid19/data/modeling)](mn.gov/covid19/data/modeling) webpage. Although there is an infinite number of potential scenarios to model, at this point every scenario has been made publicly available.

## Who decides which scenarios are run with the model? How is this decision made?

Model scenarios represent hypothetical strategies that are either actively under consideration by state leaders or represent a range of alternatives. Modeled scenarios were designed to educate state leaders about the relative impact of a set of alternative options in mitigation – physical distancing, treatment, testing – on outcomes. Scenarios are not recommendations, nor do they represent precise forecasts.

Since the initial development of the MN COVID-19 model, scenarios were designed by the research team, informed by MDH leadership, or requested by the Governor's Office. Public discussion related to disease progression and modeling across the nation have also contributed to the selection and design of scenarios.

## How does the model take into account that there has been a concentration of COVID-19 deaths in congregate living facilities? Can the model predict where these are likely to occur in the future?

Compartmental models such as the Minnesota COVID-19 model are not well suited to predicting hotspots or their impact. In part to moderate the effects of hot spots on mortality prediction, version 3.0 takes into account deaths that occur outside of hospital settings. Specifically, the model includes an estimated parameter for the probability that individuals aged 70 years and older die at home or in a congregate living facility. The model's prediction for the percentage of cumulative deaths occurring outside of health care settings is in line with observed data (69.7% vs. 65.0% through April 25).

## Can the model tell us what will happen in the fall if we have either a mild or severe influenza season?

As described in [COVID-19: The CIDRAP Viewpoint (www.cidrap.umn.edu/sites/default/files/public/downloads/cidrap-covid19-viewpoint-part1_0.pdf)](www.cidrap.umn.edu/sites/default/files/public/downloads/cidrap-covid19-viewpoint-part1_0.pdf), the epidemic could play out in a number of different ways, depending in part on mitigation measures, a potential seasonal pattern, shifts in acquired immunity or transmission characteristics related to mutation of the pathogen.

Currently modeled scenarios do not show a fall resurgence or peaks and valleys because they assume a permanent return to no-mitigation measures. This would allow the virus to run its course through the remaining susceptible population over the summer (with the potential to overwhelm the health care system).

Future scenarios examining potential intermittent mitigation efforts in response to signs of an accelerating infection would likely extend the predicted duration of the epidemic. In such scenarios, the impact of a mild or severe influenza season in the fall could be incorporated in the form of decreased hospital capacity due to occupancy by influenza patients. At this point, however, there is little data to predict how that might play out.

## What types of data or other information used in the modeling will need to be updated as we learn more?

There is considerable remaining uncertainty about the pathogen, how it is transmitted in the population, and how it affects individuals in the short and long term. Examples of the data that will benefit modeling fall into three categories:

- Health care data: For patients whose infection requires medical care, we are interested in updated information about the length of hospital stays, the requirement for and duration of medical ventilation, availability and utilization of other treatment, and mortality.
- Case and testing data: We are interested in learning more from Minnesota data, as well as from scientific publications, how asymptomatic and mild patients contribute to spread of the disease, what share of the overall infected population they represent, and to what extent infected patients acquire, maintain, and benefit from immunity.
- Scientific data about the pathogen: Particularly concerning longer-term trends, we are interested in learning more about possible variation in the transmissibility of the pathogen across seasons, and to what extent the fatality rate may change, perhaps because of ongoing mutation.

These types of data, whether they are derived from health care settings, through testing, or through scientific investigations across different outbreak locations, will help shape the model to produce closer (though still simplified) abstractions of the real world as we interact with this novel virus.

## The parameter description seems to be indicating that 41% of infections are asymptomatic. Is that accurate?

The 41% value that we present reflects the proportion of infections that are either truly asymptomatic – they never exhibit any of the symptoms associated with COVID-19 – or are mild. The assumption is these people never require COVID-19 related hospitalization (as opposed to symptomatic infections facing a risk of hospitalization). This parameter was estimated by calibrating the model to observed COVID-19 hospitalizations and deaths in Minnesota. The value was varied in the uncertainty analysis, which contributes to the uncertainty ranges presented around model outcomes.

## Why are the projected numbers for ICU demand and mortality higher for Scenario 5 (V.2) compared to Scenario 4 (V.2)?

The projected numbers for Scenarios 4 and 5 are in SARS-CoV-2 (COVID-19) Modeling (Version 2.0), April 10, 2020 – updated April 28, 2020 (mn.gov/covid19/assets/MNmodel_PPT_FINAL%204.10.20_revised%2020200501_tcm1148-430665.pdf) for Version 2.0 of the model, which was updated on April 28. Scenario 4 included a Stay-at-Home order in place through May 8, and Scenario 5 extended the Stay-at-Home order through May 31. The main difference in the projections from these two scenarios was the delay of the infection and ICU demand peaks for Scenario 5. The estimated values for total ICU demand and deaths did not differ materially. Though the point estimates varied somewhat, showing higher values for some of the outcomes, they were within the uncertainty ranges of each other. A more direct comparison of the mean values from the probabilistic sensitivity analysis samples for Scenarios 4 and 5 – the slide deck displays the base case outcomes with a mean value for Scenario 5 – show no difference in estimated deaths or top ICU demand as shown below:

| V2.0 Scenario | Hypothetical end date for Stay at Home order | Weeks until infection peak | Weeks until ICU capacity reached | Top ICU demand | Mortality through March 22, 2021 |
|---|---|---|---|---|---|
| **Scenario 4** | May 8, 2020 | 16 weeks (July13) | 16 weeks (July 13) | 3,700 | 22,000 |
| **Scenario 5** | May 31, 2020 | 20 weeks (August 10) | 19 weeks (August 3) | 3,700 | 22,000 |

# Appendix A: Scenarios Modeled with V.3 through May 13, 2020

**Scenario 1: unmitigated**
Weeks until peak: 7 (6 to 7)
Weeks until ICU capacity reached: 4 (4 to 4)
Top ICU demand: 4,991 (2,761 to 6,928)
Mortality: 57,035 (31,036 to 79,580)
End of May Mortality: 42,032 (24,736 to 53908)
Proportion Infected: 87.5% (87.4% to 87.5%)

**Scenario 5: stay-at-home until May 18**
Weeks until peak: 14 (13 to 14)
Weeks until ICU capacity reached: 14 (13 to 15)
Top ICU demand: 3,397 (1,875 to 5,039)
Mortality: 29,030 (15,726 to 43,868)
End of May Mortality: 1,441 (1,082 to 1,554)
Proportion Infected: 79.9% (79.0% to 80.4%)

**Scenario 5a: stay-at-home until May 18 with worst case testing**
Weeks until peak: 14 (13 to 15)
Weeks until ICU capacity reached: 14 (13 to 15)
Top ICU demand: 3,150 (1,719 to 4,644)
Mortality: 26,914 (14,804 to 40,608)
End of May Mortality: 1,430 (1,069 to 1,543)
Proportion Infected: 77.8% (77.1% to 78.9%)

**Scenario 5b: stay-at-home until May 18 with best case testing**
Weeks until peak: 14 (13 to 15)
Weeks until ICU capacity reached: 15 (14 to 15)
Top ICU demand: 2,766 (1,440 to 3,866)
Mortality: 23,338 (13,152 to 33,216)
End of May Mortality: 1,422 (1,060 to 1,535)
Proportion Infected: 74.2% (71.9% to 76.4%)

**Scenario 6: stay-at-home until May 31**
Weeks until peak: 15 (14 to 16)
Weeks until ICU capacity reached: 15 (14 to 16)
Top ICU demand: 3,006 (1,577 to 4,739)
Mortality: 28,231 (15,834 to 43,152)
End of May Mortality: 1,388 (988 to 1,494)
Proportion Infected: 78.7% (77.9% to 80.3%)

**Scenario 6a: stay-at-home until May 31 with worst case testing**
Weeks until peak: 16 (15 to 16)
Weeks until ICU capacity reached: 16 (15 to 17)
Top ICU demand: 2,790 (1,427 to 4,371)
Mortality: 25,915 (14,687 to 39,576)
End of May Mortality: 1,380 (983 to 1,486)
Proportion Infected: 76.9% (75.8% to 78.5%)

**Scenario 6b: stay-at-home until May 31 with best case testing**
Weeks until peak: 16 (15 to 17)
Weeks until ICU capacity reached: 17 (16 to 18)
Top ICU demand: 2,444 (1,223 to 3,667)
Mortality: 22,589 (12,903 to 32,012)
End of May Mortality: 1,375 (980 to 1,481)
Proportion Infected: 73.3% (70.8 to 75.7%)

**Scenario 7: CDC guidelines**
Weeks until peak: 15 (13 to 26)
Weeks until ICU capacity reached: NA (24 to 27)
Top ICU demand: 1,034 (547 to 2,520)
Mortality: 26294 (14,617 to 37,269)
End of May Mortality: 1,388 (988, 1,494)
Proportion Infected: 71.0% (69.3% to 76.5%)

**Scenario 8: CDC guidelines plus medical advancement**
Weeks until peak: 15 (13 to 26)
Weeks until ICU capacity reached: NA (25 to 26)
Top ICU demand: 1,034 (480 to 1,822)
Mortality: 25,392 (14,044 to 35,179)
End of May Mortality: 1,388 (988 to 1,494)
Proportion Infected: 71.0% (69.3% to 76.5%)

**Scenario 99: IHME assumptions & time horizon (first wave only)**
Weeks until peak: 5 (5 to 5)
Weeks until ICU capacity reached: NA (NA, NA)
Top ICU demand: 116 (93 to 121)
Mortality: 636 (544 to 666)
End of May Mortality: 614 (528 to 643)
Proportion Infected: 2.7% (1.8% to 4.4%)

Notes:

- Models 5 and 6 assumes a 3-week of physical mitigation followed the stay-at-home order and ongoing recommendation for physical distancing by the most vulnerable Minnesotans, those 60 years and older..
- Testing options represent hypothetical scenarios that are roughly aligned with evidence concerning sensitivity and the range of testing anticipated:
  - Best: 95% sensitivity, 20K daily tests
  - Worst: 70% sensitivity, 10K daily test
- Models 7 and 8 rely on: Opening Up America Again, White House/CDC, slide deck. It varies by assumes downward trajectory of hospitalizations for 14 days, instead of cases, following the peak (or through Sept. 7, 2020); [Opening Up America Again (www.whitehouse.gov/openingamerica) 5/8/2020, 11:43 p.m.].
- The treatment option in model 8 (Remdisivir), was applied only to hospitalized patients. Using available evidence [NIH Clinical Trial Shows Remdesivir Accelerates Recovery from Advanced COVID-19 (www.niaid.nih.gov/news-events/nih-clinical-trial-shows-remdesivir-accelerates-recovery-advanced-covid-19)], we assume 30% reduction in length of stay and mortality.
- The IHME model scenario aims to replicate the model conditions developed by the Institute for Health Metrics and Evaluation at the University of Washington, including assuming contact conditions reduction of 95% (mitigation strategies) continued forever (4-month time horizon). Percent reduction was calibrated to near 0 daily deaths by June 2; [COVID-19 Projections: Minnesota (www.covid19.healthdata.org/united-states-of-america/minnesota) 5/8/2020, 11:56 p.m.].

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