Minnesota COVID-19 Modeling

FREQUENTLY ASKED QUESTIONS

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What is the Minnesota COVID-19 Model?

An interdisciplinary team at the University of Minnesota has been working with the Minnesota Department of Health to use available evidence on COVID-19 to estimate the trajectory of the disease in Minnesota using a SEIR (susceptible, exposed, infected, recovered) framework. This model aims to understand how the COIVD-19 epidemic will evolve in Minnesota and how different social distancing policies may impact it. The model accounts for state-specific demographics and the prevalence of underlying health conditions, and is calibrated to recently observed Minnesota COVID-19 mortality data. The model was developed to help inform the state's policy and operational responses. Details on the structure of the model, assumptions, and the underlying data are available at Coronavirus Disease in Minnesota (mn.gov/covid19).

What does the model tell us and what does it not tell us?

Mathematical models are not crystal balls. They cannot tell us what will happen in the future. Instead they provide a range of plausible outcomes given what is presently known about disease natural history and the state of the epidemic. Given the novelty of this virus, our understanding of these things is incomplete. Model outputs are therefore associated with considerable uncertainty. These uncertainties can be estimated and included in presentations of model results. The Minnesota model uses data from other states and countries where community spread started earlier to project estimates of daily COVID-19 case counts, intensive care unit (ICU) bed occupancy, and deaths in Minnesota. The model tells us *approximately* when the peak of the epidemic is expected to occur, what the expected magnitude of the peak is, and when the required number of ICU beds could be expected to exceed the state's capacity.

What have we learned from the model so far?

Select results from the Minnesota model have become available from the first two versions of the model. At a high level, the model results show that social distancing strategies similar to what has been recommended are expected to postpone the timing of the peak in infections and ICU admissions due to COVID-19.

Why did we develop the Minnesota COVID-19 Model?

When new diseases emerge, policy-makers, business leaders, and public health officials must make decisions under conditions of uncertainty. The newness and severity of this disease means that decision makers do not yet know the best way to control this epidemic. By combining available data on how the virus causes disease (what epidemiologists call “natural history”) with mathematical equations, researchers can create models to forecast key outcomes such as the number of critical cases or deaths. The ability to forecast will, however, depend on the quality and availability of data. For a new disease like COVID-19, much remains unknown or uncertain. To address this, models can produce results that reflect this uncertainty.

How are state officials using this model?

The Minnesota Department of Health is using the model to simulate different hypothetical social distancing measures to predict their impact on the timing and reduction of COVID-19 cases and deaths in the state. Modeling the number of people who have the disease each week helps to establish the approximate window of time from when mitigation strategies were implemented until the point at which the state’s health care systems might become overloaded by COVID-19 cases, assuming current levels of resource availability. Governor Walz and other state leaders use results from this model to inform response strategies, such as the stay-at-home order, and plans for increased health care capacity.

Why don’t we see a flattening of the curve with mitigation strategies?

Social distancing is an effective tool for reducing transmission but it cannot stop it. Flattening the curve would require *prolonged* social distancing over the course of many months. Currently the model compares relatively short social distancing measures. For this reason, differences across modeled scenarios appear as a delay in the epidemic peak but not a flattening of it.

Where did model parameter estimates come from?

In a model, parameters are the values that reflect assumptions about the speed and probability with which people progress through various states (from susceptible to infected, for example). Values for this model are informed by published reports using data from early outbreaks in China, Europe, and the U.S. They are also carefully vetted to consider data quality and relevance to Minnesota. Where multiple plausible estimates are available, they inform the range of uncertainty around that estimate. These studies represent the most complete data to date on the clinical characteristics, risk factors, and outcomes of COVID-19 cases. A full list of model parameters with sources can be found in the model technical documentation available at [Minnesota COVID-19 Modeling (mn.gov/covid19/data/modeling.jsp)](mn.gov/covid19/data/modeling.jsp).

It is a common practice to update models as new evidence becomes available to ensure model inputs are drawn from the most up-to-date information on similar populations. The second version of Minnesota’s COVID-19 model updated the following parameters in light of newly available data: the transmissibility of the virus (higher), the average length of COVID-19 related hospitalizations (lower), and the proportion of infected individuals requiring hospitalization (lower).

How are data on Minnesota's confirmed cases used in the model?

Information about confirmed cases in Minnesota are used to calibrate the model to ensure that it reproduces case counts similar to what was reported in the first 20 days of the state's epidemic. The estimate of the percentage of infections that are detected (confirmed cases) was adjusted until the model reproduced daily death counts that were similar to actual death counts. This process established an estimate for the prevalence of undetected infections on the first day of the model simulation – a parameter that cannot be directly observed. It increased estimates of the *total* number of infections in the state by a factor of approximately 10.

Why do results from the Minnesota COVID-19 model differ from other models?

The conceptual approach, assumptions, and parameter estimates will all affect outcomes of each particular model. In addition, models can differ in timescales. Unlike other shorter-term models, the Minnesota model describes the potential course of the epidemic for a full year.

Divergent results from different models is not unexpected. However it is important to clarify the particular model features that explain these differences. The Institute for Health Metrics and Evaluation (IHME) model, for example, predicts far fewer cases and deaths for Minnesota. This is due to several reasons. First, the IHME model assumes far more restrictive social distancing measures implemented for significantly longer periods of time. It also projects outcomes over the course of four months as opposed to a full year as with the Minnesota model. Finally, it does not explicitly account for the elevated risk of illness and death from COVID-19 associated with underlying health conditions.

MDH has referred to the second version or iteration of the Minnesota model. Will there be future versions, and if so, what will be different?

It is common practice to refresh models when new data become available. As with the second version, subsequent versions will continue to incorporate the most up-to-date information about COVID-19 in Minnesota, the U.S., and across the globe. We will adjust model parameters appropriately based on new data. Updates will impact model output and ultimately reduce uncertainty.

Moving forward, the model structure and output may also be modified to better meet the needs of policy makers and other decision-makers. For example, we may add features to allow users to compare the timing of certain mitigation strategies, to account for geographic variation, and to incorporate the potential effects of enhanced access to antibody testing.

What do the ranges in the model results mean?

The ranges are uncertainty intervals around model outcomes. The intervals produced by this model give a range of results that might be expected given the uncertainty around parameter values used.

When can I get the model results in a more user-friendly format?

Other modeling teams have made available graphic user interfaces from which users can vary model parameters to assess how they might affect outcomes such as mortality and ICU demand. Our research team has nearly completed building such a dynamic interface for the Minnesota model. When the Minnesota model interface is sufficiently robust to quickly produce results and generate validated output, we will make it available to the public along with the underlying code. We hope this release will occur in April.

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