CORONAVIRUS

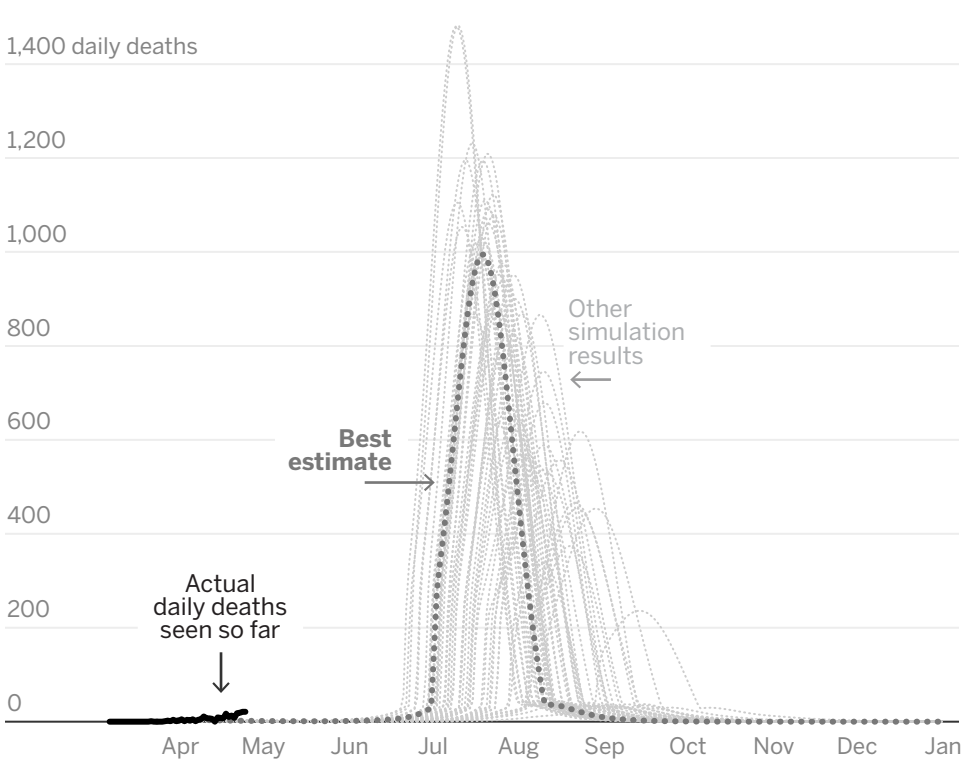
WHY MINNESOTA'S COVID-19 MODELS ARE SO DIFFERENT

By MICHAEL COREY and C.J. SINNER • Star Tribune staff

If Minnesotans were still having dinner parties, the hottest topics might be sourdough bread and epidemiological models. Complex disease models, while perhaps previously a niche interest, are far from abstract these days — they're a major reason many of us are stuck at home and whole sectors of the economy are shut down. And we turn to models because we all want concrete answers about when life can go back to normal. Unfortunately, the models don't seem to agree. At all. How can scientists looking at the same data come up with such different estimates? And who's right? We talked with members of both the Minnesota and Washington modeling teams and other epidemiologists to sort out the science.

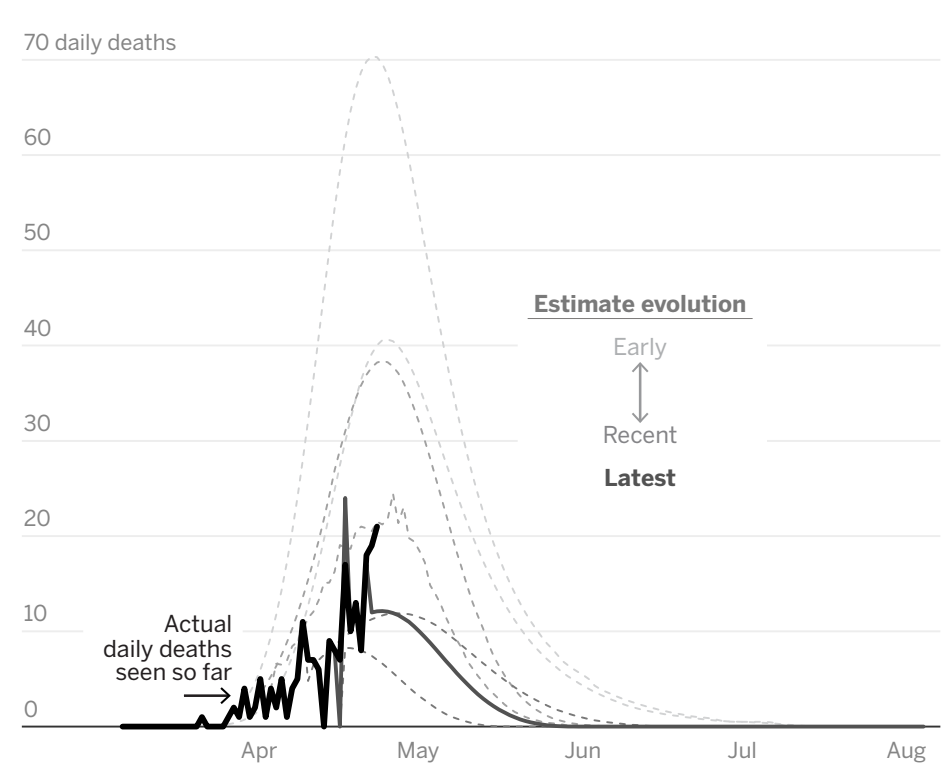
THE MINNESOTA MODEL

Commissioned by Minnesota's Department of Health and designed by University of Minnesota researchers, it suggests the state could see 22,000 deaths over six months even with stay-at-home orders in place into early May.



THE WASHINGTON MODEL

Favored by the White House and produced by the Institute for Health Metrics and Evaluation at the University of Washington, this model points to only 360 deaths in Minnesota.



WHERE THE MODELS AGREE

Social distancing: Relaxing social distancing guidelines too soon — even if expanded testing is in place — would likely lead to a pronounced spike in cases and deaths.

ICU beds and ventilators: Exceeding the state's maximum capacity of ICU beds and ventilators could lead to many more deaths that otherwise could have been avoided.

Rolling changes: Both are trying to figure out how coronavirus works on the fly and have made major changes in their projections as our knowledge of the virus grows.

Deaths, not cases: Both assume real-world data on deaths are more useful than estimates of cases to ground predictions because there hasn't been sufficient testing.

So why do the models project such different death totals and ICU demands? There are three big reasons

DIFFERENCE NO. 1

They make different assumptions about social distancing

The University of Minnesota model includes several scenarios, each reflecting a different social distancing strategy. None of those scenarios matches exactly what Gov. Tim Walz has implemented, but the closest one looks like this:

• Minnesotans stay home for six weeks, until May 8. (Walz's stay-at-home order ends May 4.)

• Elderly and other "vulnerable" people would stay home into August, when the model estimates deaths will be past their peak.

• Everyone would continue some social distancing through May 30.

In the Minnesota-built models, the vast majority of infections and deaths here occur in a second, much bigger peak in mid-July, after extreme social distancing measures have been relaxed.

The Washington model projects only a single peak in deaths, a scenario they say is possible as long as governments don't relax social distancing until officials can isolate every single case through contact tracing.

They even project a date that could happen: after May 31, though if social distancing is relaxed too early, a second spike would also appear.

DIFFERENCE NO. 2

Minnesota's model assumes we wouldn't lock down again

The high death tolls projected in the Minnesota model's second peak come with a big "if." These scenarios assume that even in the face of horrific daily death totals — 1,000 a day at the top of the curve — that state officials would not reinstitute stay-at-home orders.

"Are we going to do that? Maybe, maybe not. We think it's important to emphasize the consequences of not doing that," said Dr. Eva Enns, a researcher helping design the model.

If the governor intervened quickly in case of a renewed spike, the state could flatten the curve again and potentially avoid many deaths.

In fact, a series of on-again, off-again stay-at-home policies was the recommendation of a coronavirus paper by scientists at Imperial College, London.

With this strategy, the U.K.-based researchers predicted a series of ongoing, smaller peaks rather than one giant second peak.

Such a policy would prevent Minnesota from reaching "herd immunity" for a long time. It could also mean repeatedly disrupting lives and the economy until a vaccine is available.

DIFFERENCE NO. 3

The models themselves work differently from each other

The Minnesota model starts by trying to mathematically represent how the infection works, then checks that against what has actually happened. This "SEIR" model groups people into phases of the disease: Susceptible, Exposed, Infected and Recovered.

To do this, modelers must make correct assumptions about how many people an infected person will come into contact with, how likely it is each one of those people will be infected, how likely that person is to be hospitalized and how deadly the disease is for those who catch it.

The Minnesota team has touted their model as the only one with inputs customized to the age, racial and health demographics of Minnesotans. This should allow them to make Minnesota-specific projections.

The Washington model compares the number of deaths in an area so far with the number and timing of those deaths to outbreaks in other places, assuming the "shape of the curve" will match.

WHO'S RIGHT?

Which to trust? Neither team likes the other's approach

The words "models are not a crystal ball" were uttered by nearly every epidemiologist we spoke with, sometimes more than once.

"We can't know which one, if either, will be right, because that's predicting the future, which we just cannot do as humans," said Dr. Maria Sundaram, an epidemiologist at Emory University. "We can just make an educated guess."

(Sundaram earned her Ph.D. at Minnesota but isn't on the Minnesota team.)

Still, both modeling teams defended their chosen approach and had concerns about others.

The Minnesota team joins a large cadre of scientists who believe the Washington model is too optimistic.

"I don't know if it's really all that insightful," said Stefan Gildemeister, a health economist supervising the effort for the Minnesota Department of Health. "The notion that they are assuming deep isolation, that there's testing capability that just doesn't exist at the moment, and they're kind of ignoring the fact that the virus will continue to perpetrate, is just not very helpful."

Gildemeister said the virus isn't likely to go quietly.

"I hope folks are really thoughtful before they open up on the basis of the [Washington] evidence," Gildemeister said. "Lives are at stake. To say we're done with a curve in various jurisdictions, that is incredibly dangerous."

Sundaram said the Washington model could be a best-case scenario.

"That maybe is a strong assumption to make, that we do everything right the first time around," Sundaram said.

Sundaram said the Washington model is right that contact tracing would be needed for containment of a second wave without the help of a vaccine, but that many places in the U.S. aren't there yet.

Dr. Theo Vos, an epidemiologist on the Washington team, said he wasn't familiar with the Minnesota model specifically, but said that generally, SEIR models like Minnesota's haven't performed well.

"You've seen a number of examples predicting that within no time, millions and millions of deaths would occur," Vos said. "That has not happened."

To Vos, starting with theory when so much about coronavirus is murky could lead to wild projections. He said the Washington model's anchoring to observed data make it more reliable.

"I think we're lower than most of those models, but we're much closer to actual observations," he said.

Gildemeister said the Minnesota model has been designed to avoid out-of-control overprediction.

While the Washington team is updating its projections often, it takes longer to develop each version of the Minnesota model, so in the short term, it can appear to be out of sync with reality. That's a bad sign, Vos said.

"If a model does poorly at predicting in the short term, then I would have much less faith in the long-term predictions," he said. But speed is not the only consideration, Sundaram said. "There's absolutely a trade off between having an answer quickly and having an answer that's the most accurate possible answer."

The frequency of updates is also related to each model's goals, Gildemeister said. The Minnesota model tries to predict which social distancing measures would save the most lives, rather than making precise forecasts, he said.

And the Minnesota modelers say Washington's frequent updates imply to casual observers that their predictions have always been spot on.

Recent updates to the Washington model have included significant changes in its Minnesota projections, including predicting we had passed our peak before later pushing it back.

No matter what, Gildemeister said it's just too early to render a verdict.

"You don't grade halfway through a test," he said, "and I feel we're not even a third of the way into this test."