Mathematician on the front lines of Colorado's coronavirus response

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A sign announces the closure of an ice cream shop in Denver at the height of the coronavirus pandemic in April. Credit: Andrew Sorensen/CU Boulder

At the start of 2020, David Bortz, like most Coloradans, didn't know what a coronavirus was. For the last few months, tracking this virus is practically his full-time job.

Bortz, an associate professor in the Department of Applied Mathematics at CU Boulder, is a mathematical biologist—a numbers man who uses complex equations, or mathematical models, to tackle some of the trickiest questions in the life sciences.

Today, he's a member of Colorado's COVID-19 Modeling Team.

Think of it as the state's epidemiological dream team. It's made up of researchers from across Colorado who have been assembled to try to get ahead of the pandemic. They include scientists from CU Denver, CU School of Medicine, the Colorado School of Public Health and Colorado State University.

"The scientific community in Colorado, and worldwide, has redirected an enormous amount of resources to tackle this crisis," Bortz said.

The modeling team has been working long hours to give public health officials in Colorado timely guidance on how various measures might slow or accelerate the spread of the virus. The group uses mathematical and statistical modeling to answer questions like: would loosening social distancing restrictions today put a new strain on hospital intensive care units across the state in a few weeks?

Bortz said that the modeling team is now facing a new challenge: studying how the state might continue to reopen businesses, and what the ramifications could be.

Bortz spoke to CU Boulder Today about what it's like to suddenly be a mathematician in the public spotlight, and why epidemiological models are important public health tools—despite some uncertainties.

People seem to be paying attention to models more than ever before. What is that like for someone in your field?

It's exciting to be a part of a research team where mathematical modeling and analysis have such a central role in both policymaking and

public discourse. Simultaneously, however, there's obviously a lot of pressure to make sure we get it right. Which means the team has been working non-stop for the last few months.

You're focusing now on something called an SEIR model. How does that work?

SEIR models belong to a mathematical epidemiology framework that divides a population into people who are susceptible (S) to a disease, exposed (E), infectious (I) and recovered (R). The mathematical modeling can help to answer questions like: How fast does an individual who is susceptible become exposed? How fast does an individual who is infected become recovered on average? And so on.

How do you ensure that these sorts of tools are reliable for informing public health decisions?

As researchers have studied this class of equations for about 100 years, we have a really good understanding of the core mathematics as well as how uncertainty propagates from case counts to uncertainty in ventilator needs. It's similar to how we think about hurricane forecasting.

In any weather prediction, there is going to be uncertainty from meteorological measurements as well as different predictions from the different computational models being used. The overall result of this variation is that meteorologists provide a cone of uncertainty that allows them to predict that, for example, a hurricane will land somewhere between northern Florida and South Carolina.

So we may not know exactly how strong the winds will be, but we know enough to say it's time to evacuate?

Exactly. In the case of COVID-19, if we had let the virus go unchecked, we may not know the death rate perfectly, but a likely outcome would have been that the disease would have been fatal for 1% or more of the U.S. population. Projecting further into the future, we also know that if we completely release social distancing recommendations too early, there's going to be a noticeable second peak in the epidemic.

What kinds of questions are you and your colleagues focusing on now?

How do you open up restaurants? What restrictions are needed to open up bars? And by what date, and how do those choices influence the economy? Do you ask people to wear masks when they're hiking or biking or just when they're out on the street and going to the grocery store? Those are the sorts of questions that need evidence-based answers because of the real and widespread impact these choices have on public health and the economy.

It really does seem like we're in the moment of a movie when the team comes together to turn back disaster.

It's humbling, and I'm honored to be a part of this team of world-class researchers providing guidance to the State Epidemiologist and the Governor. However, the real superheroes are the people on the front lines of the pandemic. I can make predictions about the needed reduction in the infection rate, but it's the actions by the medical professionals, essential workers and everyone who follows the public health recommendations that really result in turning back this disaster.

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