New model leveraging flu data generates highly accurate prediction of COVID-19 spread

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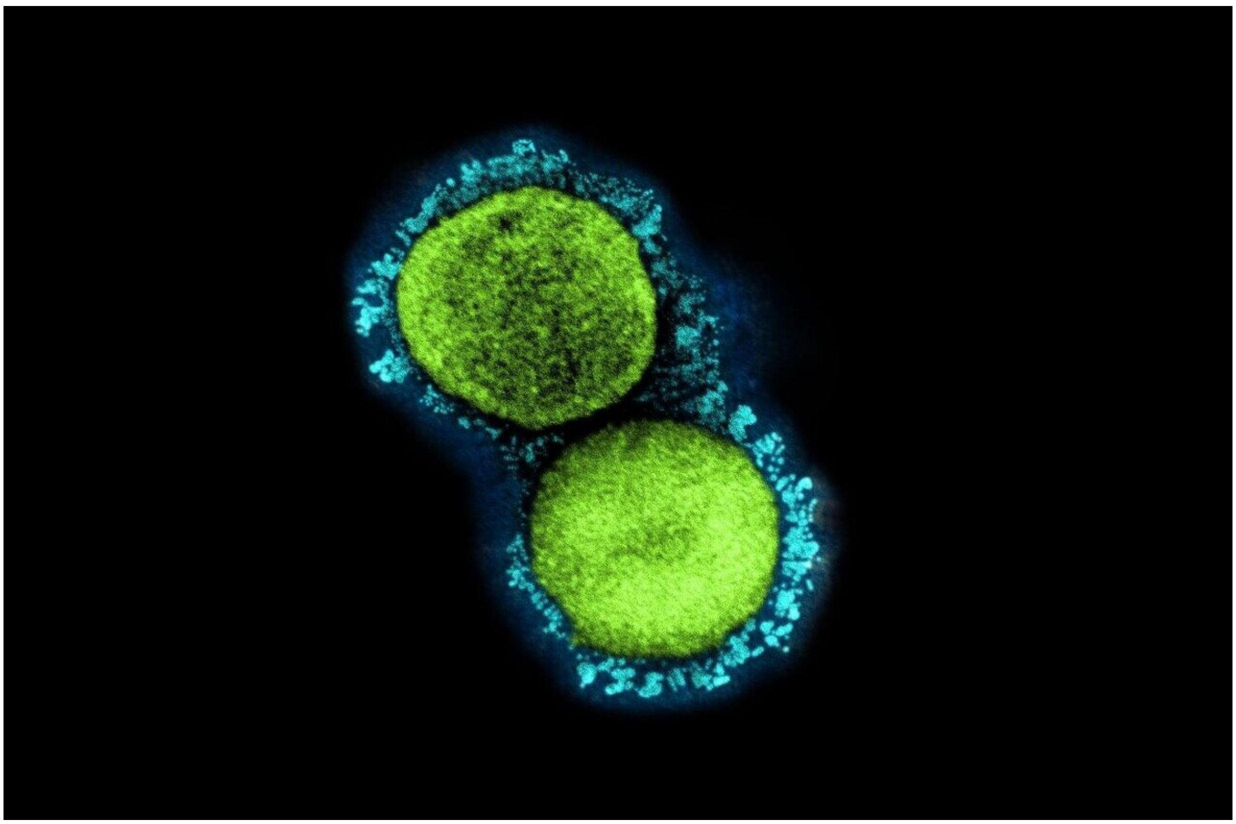

A transmission electron micrograph of SARS-CoV-2 virus particles (UK B.1.1.7 variant), isolated from a patient sample and cultivated in cell culture. Credit: NIAID

COVID-19 is not the flu. The disease caused by the novel SARS-CoV-2 virus is more transmissible, and deadlier, than most influenza epidemics we've encountered in our lifetimes, and scientists and physicians are still learning new things about the disease and its long-term effects. But COVID-19 and the flu do have a few things in common—they are both caused by viruses that primarily infect the upper respiratory system, and both are spread by droplets, fomites and contact.

For Ishanu Chattopadhyay, Ph.D., it therefore made sense to consider whether or not these similarities could be used to help predict the spread of COVID-19. Chattopadhyay, a professor of medicine at the University of Chicago, and his postdoctoral scholar Yi Huang, Ph.D., drew on their previous experience modeling epidemics and expertise in machine learning to analyze years of past influenza epidemics. The new risk measure they developed—denoted as the Universal Influenza-like Transmission (UnIT) score—has proven to be better at predicting weekly case count forecasts than the best models currently described. The work was published October 14 in *PLoS Computational Biology.*

"Even before COVID-19, we were working on modeling pandemics in general," said Chattopadhyay, senior author on the paper. "There are multiple challenges presented by a pandemic. One is thinking about how a new strain emerges, and how the virus came to be—and the other is predicting the case counts. It's very important to understand where the disease came from, but once it's a pandemic, it's important to be able to predict how it's going to move through the population and through cities in order to develop public health policies."

Chattopadhyay and Huang jumped at the chance to use their skills to help model the pandemic nationwide, and when they looked at the existing models, they noticed a glaring absence.

"Almost every approach you could think of was already being used," said

Chattopadhyay. "But one of the things it seemed like people should be looking at, but hadn't, was: Is there a similarity between COVID-19 and seasonal influenza trends? These are different diseases, but there are similarities in how they are transmitted. One indication of this is how the measures we took to curb the spread of COVID-19 also curbed the spread of the flu. So, the question is, can we actually use patterns of how flu spreads in the U.S. to inform this modeling of how COVID-19 spreads?"

The researchers used 10 years of data on influenza hospitalizations nationwide to examine week-to-week trends in patients with the flu, allowing them to determine where infection clusters began and how they spread across the country each year. Using this data, they were able to produce the UnIT score. Combined with other variables known to be important in the spread of diseases like COVID-19, such as demographic details within a community, the model produced forecasting results that were more accurate on average than any of the other models listed on the CDC modeling hub.

"Our model is relatively simple, with far fewer variables than many of the other models being used to predict case counts and deaths. And yet we beat out those other, more complicated models on average over the entire pandemic timeline," said first author Huang, now an associate research scientist at Brookhaven National Laboratory. "This shows us that we can learn something valuable from things we already know, like influenza epidemics, and can combine that knowledge of history with principles in statistics to come up with a new and meaningful way to predict something truly unknown."

The results are important not just for understanding the ongoing COVID-19 pandemic, but can be extended to help predict future pandemics.

"If we see such accuracy here, then any respiratory illness that spreads in this manner—any similar pandemics we see in the future, we can probably apply this same tool," said Chattopadhyay. "With expanding populations and environmental changes leading to more animal/human contact, many experts think that pandemic events like this may become more common. It's important to be able to model how epidemics spread and what their path will look like, particularly when we are implementing interventions like vaccines and social distancing. Being able to extract information from the data we already have is incredibly useful—it makes us more prepared for the next pandemic."

The algorithm developed by the research team has been shared on the CDC COVID-19 Forecast Hub, where it can be accessed by other scientists and is used as part of the CDC's prediction modeling for COVID-19. The researchers hope that future research can incorporate global data trends to determine whether COVID-19 trends are similar around the world, or if there are differences based on population and climate.

The study, "Universal Risk Phenotype Of US Counties For Flu-like Transmission To Improve County-specific COVID-19 Incidence Forecasts," was supported in part by the Defense Sciences Office of the Defense Advanced Research Projects Agency.

More information: Universal Risk Phenotype Of US Counties For Flu-like Transmission To Improve County-specific COVID-19 Incidence Forecasts, *PLoS Computational Biology* (2021). journals.plos.org/ploscompbiol … journal.pcbi.1009363

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