Digital 'virus' helps researchers map potential spread

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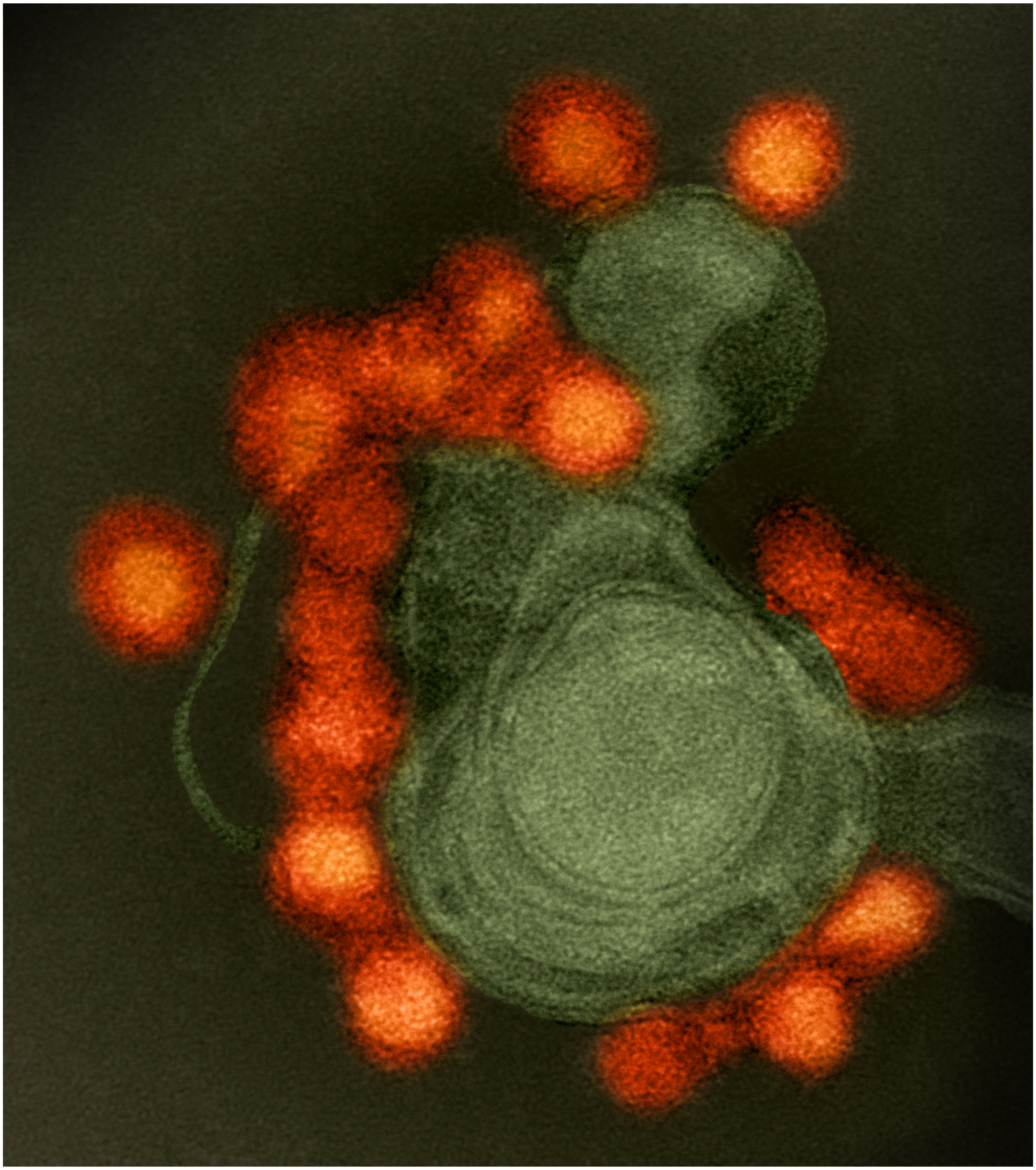

Transmission electron microscope image of negative-stained, Fortaleza-strain Zika virus (red), isolated from a microcephaly case in Brazil. The virus is associated with cellular membranes in the center. Credit: NIAID

As governments around the world wrestle with questions about how and when to reopen their economies, they must rely on predictions or weeks-old data to make informed decisions.

A Cornell researcher is among a team of engineers, statisticians and computer and data scientists who have developed a potential solution: a digital "virus" that could piggyback on contact-tracing apps and spread from smartphone to smartphone in real time.

This would allow policymakers to gauge the impact of various social distancing measures without waiting two weeks or longer to learn how coronavirus has actually spread, said Shane Henderson, professor of operations research and information engineering and a co-author of "Safe Blues: A Method for Estimation and Control in the Fight Against COVID-19."

"Our challenge is that the information on how this epidemic is progressing is always delayed," said Henderson. "The information we have today about how many people are infected is out of date straightaway, because there's an incubation period while you're waiting for the virus to be secured in a host. And so we don't learn anything about these people until they become symptomatic, no matter how much estimating we do. Safe Blues is an attempt to close the gap between our current state of knowledge and what's really going on."

The method protects individuals' privacy because the data is aggregated, the researchers said.

The developers hope Safe Blues can be added to existing contact-tracing apps, which aim to collect personalized data about users' potential contacts. Unlike contact tracing, which requires widespread participation to be effective, Safe Blues would require only about 10% of a given population to carry it in order to make accurate predictions.

Safe Blues works by sending out periodic pings from smartphones equipped with Bluetooth. Through the strength of the Bluetooth signal, the tool can assess the proximity of other phones, as well as how long they remain near each other. One phone, carrying several strains of the Safe Blues virus, then communicates with a nearby phone and randomly transmits a strain of the virus—just as a human host might.

The data is sent to a central server, which then uses statistical machine learning and artificial intelligence models to predict how COVID-19 will spread.

"We don't know the true properties of COVID-19 or how it spreads, so we're putting out these different strains to figure out from the data which one matches the spread of the true disease," Henderson said. "We do have some legitimate data on the true spread of the disease, so we can figure out which combination of strains best matches that. And then we use that best combination to help policymakers determine how they're doing."

The estimates it produces could not only help evaluate social distancing measures, but improve predictions of infection among asymptomatic people.

"If we inject these Safe Blues strains into the contact-tracing apps, we can watch how these strains evolve over the next 10 days, and if we see those strains start to take off, then we know we have a problem," Henderson said. "We can make predictions based on what we see; if it's out of control, we can send that information to the policymakers and maybe they could clamp down with stronger social distancing."

More information: Safe Blues: A Method for Estimation and Control in the Fight Against COVID-19: safeblues.org/

Provided by Cornell University