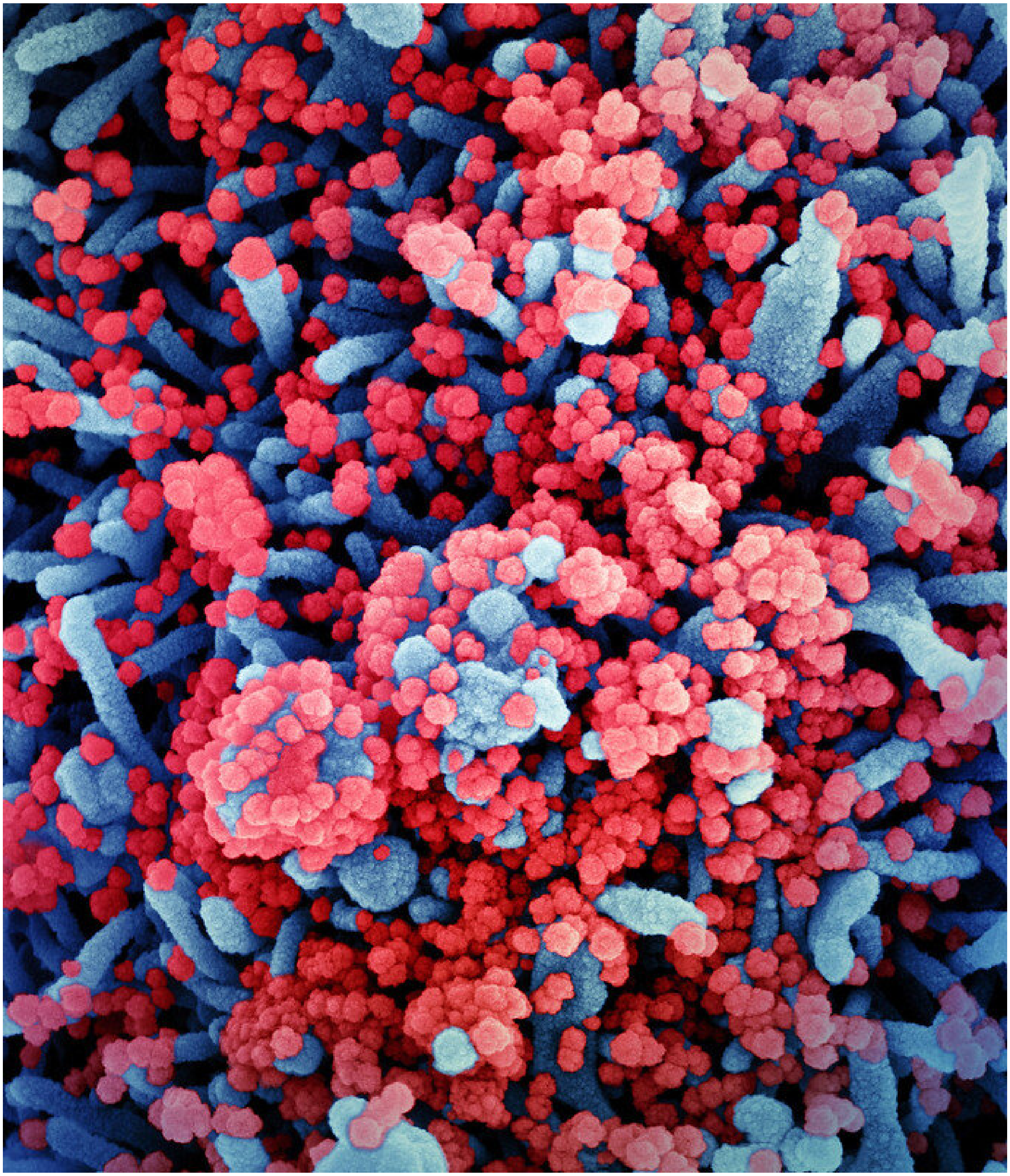
Early warning system fills in gaps in infectious disease surveillance

January 11 2021



Colorized scanning electron micrograph of a cell (blue) heavily infected with SARS-CoV-2 virus particles (red), isolated from a patient sample. Image captured at the NIAID Integrated Research Facility (IRF) in Fort Detrick, Maryland. Credit: NIAID

Researchers at Columbia University Mailman School of Public Health developed an infectious disease early warning system that includes areas lacking health clinics participating in infectious disease surveillance. The approach compensates for existing gaps by optimally assigning surveillance sites that support better observation and prediction of the spread of an outbreak, including to areas remaining without surveillance. Details are published in the journal *Nature Communications.*

The research team, including Jeffrey Shaman and Sen Pei, have been at the forefront of forecasting and analyzing the spread of COVID-19. Their highly cited paper in the journal *Science Advances* estimated the number of lives saved had physical distancing and other measures taken effect one week earlier. They have also led the development of methods to forecast other infectious diseases, including seasonal influenza.

The new early warning system optimizes the selection of surveillance sites then applies a computer model to data from these sites in order to forecast the geographic spread of influenza, including to rural areas lacking surveillance. The researchers say their method would be effective for other respiratory outbreaks, including human metapneumovirus and seasonal coronavirus, which have similar transmission routes. It can also be modified to work with other diseases.

"Our goal was to design a way to provide a cost-effective early warning system so public health officials can quickly respond to outbreaks and prevent further spread," says first author Sen Pei, Ph.D., associate research scientist in the Department of Environmental Health Sciences at the Columbia Mailman School. "Our method can be used to support development of a more robust surveillance system and to identify where to set up or improve surveillance."

"Too often infectious outbreaks spread undetected due to gaps in surveillance at the community level. These gaps have contributed to tragic and unnecessary illness and loss of life, as we have seen over the past year," says senior author Jeffrey Shaman, Ph.D., a professor in the Department of Environmental Health Sciences at the Columbia Mailman School. "Our method can help fill these gaps to prevent these unwanted outcomes, and provide guidance on where to invest in greater surveillance."

The researchers validated their approach using historical data, demonstrating its ability to forecast the spread of past outbreaks at the state and county levels. At state level, they used real-world data in 35 states from the U.S. Armed Forces Health Surveillance Branch (AFHSB), for influenza during nine seasons (2008-2009 to 2016-2017), and human metapneumovirus and seasonal coronavirus during four seasons (2013-2014 to 2016-2017). At the county level, they validated their method using a model-generated (virtual) outbreak since there are no historical data available in the majority of counties. The method they developed can generate more accurate near-term forecasts than alternative methods tested by the researchers, such as those that prioritize locations with large populations or use a random selection.

According to U.S. Centers for Disease Control and Prevention, the U.S. Influenza Surveillance System collects data from participating outpatient healthcare clinics in all U.S. states, Puerto Rico, the District of Columbia, and the U.S. Virgin Islands—but not in every U.S. county. Participation of healthcare providers is voluntary, and may change over time. Each week, approximately 3,000 providers report data to CDC on the total number of patients seen for any reason and the number of those patients with influenza-like illness.

More information: Sen Pei et al, Optimizing respiratory virus surveillance networks using uncertainty propagation, *Nature*

Communications (2021). DOI: 10.1038/s41467-020-20399-3

Provided by Columbia University's Mailman School of Public Health