Biocomplexity researchers working with health officials to predict COVID-19 spread

March 3 2020, by Fariss Samarrai

UVA biocomplexity researchers are working to predict the spread of coronavirus infection across the world. Credit: Dan Addison, University Communications

The novel coronavirus COVID-19 epidemic is growing rapidly and already affecting 65 countries. South Korea has seen an explosive growth

in confirmed cases, partially attributable to large-scale testing and identification of cases. Italy and Iran are seeing increasing cases, and infections are spilling into neighboring countries and nations connected by international travel.

Where will this go next, and how can nations and individuals respond?

A team of researchers at the University of Virginia Biocomplexity Institute, using powerful computing resources for studying and understanding the spread of infectious diseases, are working on the problem in consultation with federal and state government health agencies.

Madhav Marathe, a professor of computer science and biocomplexity, and a division director at UVA's Biocomplexity Institute, discusses the situation for readers of UVA Today.

Q. The coronavirus epidemic is nearing the point of pandemic. What can be done to bring this under control?

A. The severity and the extent cannot be predicted with certainty at this stage. While there is reason to be cautiously optimistic about the improving situation within China, the spread elsewhere is of great concern.

We need concerted global efforts to mitigate the effects and spread of COVID-19 by producing and supplying enough protective equipment and gear, such as face masks and gloves; quickly developing vaccines and antivirals; and developing strategies for distributing personnel and scarce resources, such as ventilators.

To control this epidemic, the global community will also need to bank on non-pharmaceutical measures, such as social distancing, effective isolation and quarantine. Canceling flights to and from infected countries might help initially, but is unlikely to be of much use once a pandemic takes hold.

One of the most important things to focus on is communicating the risk of pandemic to the public, maintaining calm and controlling the spread of rumors and misinformation. We also must ensure that disease perception does not lead to discriminatory behavior, as such actions will lead to reduced transparency and possibly increased infection rates.

We must implement measures in a humane manner, based on scientific evidence, and, to the extent possible, aimed toward minimizing disruptions to daily routines and economies. Countries must step up their diagnostic capabilities and share resources and know-how.

On a personal level, individuals must not panic, but should prepare for possible disruptions to daily life. Make yourself aware, and follow the advice of trustworthy sources. Hand hygiene and other healthy habits suggested that work for influenza prevention will definitely help regarding COVID-19.

Q. What do you expect to happen in the U.S. and elsewhere in the coming weeks and over the long term?

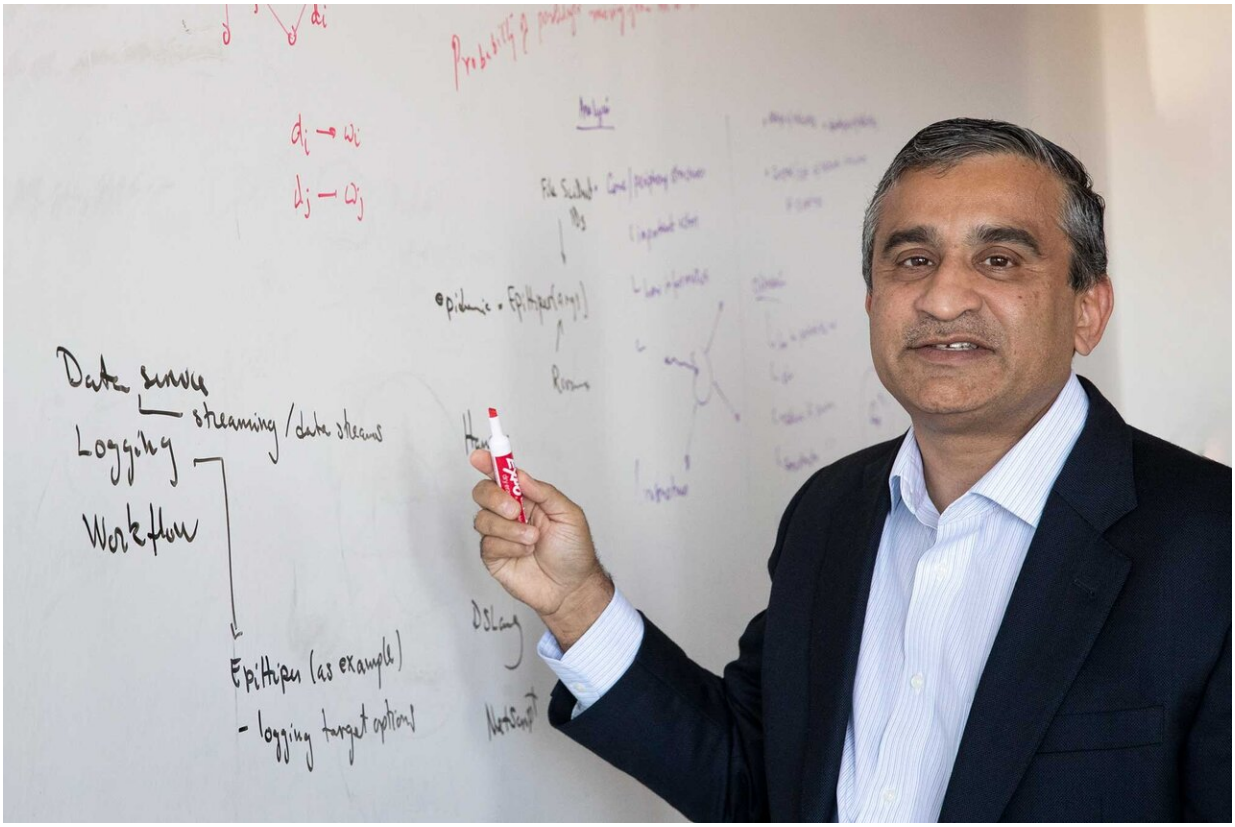
A. The U.S. reported its first confirmed case of travel-related COVID-19 on Jan. 21 in a patient who had traveled to Wuhan, China. Five weeks later, we now have about 90 cases (as of this article's publication date), which include repatriated/evacuated patients and four cases of community infections, two of which resulted in death.

The next few weeks are crucial, and projections will depend on how many undetected community transmissions have occurred, and how we ramp up diagnostics across the country. As evidence points to sustained transmission within the U.S., we should be mindful that this is happening with the backdrop of an ongoing, though waning, influenza season. Current levels of influenza-like illness—6% outpatient visits nationally in the week ending Feb. 15—might make detection difficult because clinicians will have to determine which cases are flu and which are COVID-19. The extent and timeline of an epidemic in the U.S., and the number of severe cases, will depend on how early we detect and isolate the confirmed COVID-19 cases.

If there is a silver lining to this epidemic, it is the rapidity with which the academic community across the globe has rallied to uncover the unknowns about COVID-19. While researchers and physicians in China have been forthright in publishing results of clinical investigations and genomic sequencing, researchers across the world have built on this work and are sharing information to estimate disease parameters and undetected cases and undertaking vaccine and therapeutics development.

Q. The common flu this season has sickened and killed many more people in the U.S. than has coronavirus worldwide. Why is this new pathogen so feared?

A. While the seasonal flu is known to have a mortality rate of less than 0.1%, current estimates of COVID-19 case mortality seem to be around 1-2%, making it closer to that of the pandemic influenza of 1918. However, this case mortality rate varies by age, taking a harder toll on the older segments of the population than on the young. Unlike influenza, our immune system has never seen COVID-19, so most individuals are susceptible to contracting the disease if exposed.



Madhav Marathe, a division director at the Biocomplexity Institute, is a professor of computer science and biocomplexity. Credit: University of Virginia

This high fatality rate, combined with the virus's demonstrated ability to rapidly cause a large number of infections, is a significant concern for public health officials.

False rumors about the origin of the disease have further amplified people's fears. And currently we simply do not understand the virus very well. Even basic questions still need to be answered, such as exactly how the disease spreads, the circumstances under which an infected individual becomes critically ill, the incubation period, and how long a person can be infected and shedding the virus before becoming

symptomatic. The unusually long incubation period—on average around five days, but apparently reaching up to 14 days—and the likelihood of asymptomatic transmission make it difficult to detect, and hence contain, the spread of this virus.

Scientists are working hard to develop and test new vaccines and antivirals, and are investigating currently available drugs to see if they can be modified for treatment of this infection, but it will take some time to develop effective pharmaceutical interventions.

Given that this epidemic has occurred during an active flu season also causes concern that a substantial number of coronavirus cases might not have been detected.

At this time, social interventions, such as quarantines, are the only available means to control the spread of this disease. The tremendous efforts in China, in Hubei province and others, provides an example of how these kinds of interventions may be effective.

Q. What is the Biocomplexity Institute doing to help government agencies plan and respond?

A. The Biocomplexity Institute is actively working with a number of scientists worldwide to support planning and response efforts by federal, local and international health authorities. We have longstanding technical expertise, having actively supported the federal government during major epidemics since 2005, including various flu outbreaks, MERS, Ebola and Zika.

Our technical approach is unique, blending expertise in artificial intelligence, high-performance computing, network science and epidemic science to study large-scale infectious disease problems.

As COVID-19 approaches pandemic level, we have begun analyzing a number of counter-factual or what-if scenarios and the possible effects of various social interventions on the future spread of the disease—the when, where and intensity.

We are working to determine efficient ways to estimate and allocate scarce medical resources, such as ventilators, masks and gloves, and are creating decision support tools and dashboards to help the general public and health care authorities improve situation assessments.

We also are using our computer expertise and artificial intelligence capabilities to develop epidemic dynamics simulations and decision-support tools for planning and response. Much of this involves curating, synthesizing, wrangling and organizing data for use by the larger academic community to further develop models and decision-support tools.

In considering global spread, we are looking at the importation risk to different countries based on airline traffic, and estimating the impact of airline suspensions in delaying the emergence of cases around the world. This work highlights the vulnerability of different countries, and could help step up diagnostic capabilities in high-risk countries. Through our dashboards, we have curated multiple data sources to provide global and detailed perspectives into the confirmed cases.

I am incredibly proud of our team; these folks are working tirelessly to support real-time outbreak science to help policymakers and health authorities make sound decisions in a dynamic environment. This way of doing science is not common and our team provides a unique capability.

Q. What can individuals do to protect themselves and others from the coronavirus?

A. First and foremost, individuals must prepare and not panic. People should listen to updates and advice from local health authorities and federal agencies such as the Centers for Disease Control.

Follow the same rules of hygiene that we use to prevent influenza, such as hand-washing and curtailing non-essential social interactions. Since the virus seems to have higher mortality in the senior population, plan now on how to take care of older relatives.

Most importantly, don't act on rumors or spread them. Misinformation and disinformation are rampant and social media has made matters worse. To curb the spread of misinformation and panic, please identify and follow trusted non-partisan sources. Public health websites provide good information on current situations and preparedness efforts.

Provided by University of Virginia

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