To predict flu's spread, modelers turn to weather forecasts

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Srinivasan Venkatramanan, right, and Brian Lewis are working with AccuWeather to understand weather and flu outbreak patterns. Credit: Dan Addison, University Communications

Are influenza outbreaks and weather patterns connected? Researchers have long known that flu season occurs in the colder months, and that infection rates drop dramatically as the weather warms. But why? And could weather forecasting help predict where and when the flu will surge or fall off?

Researchers at the University of Virginia's Biocomplexity Institute are working with weather forecasters at AccuWeather to see if a closer correlation between weather and flu outbreaks can be determined, and if such correlations can help predict when and where the flu will show up, how virulent it will be, and when it will peak and wane. Their work may even apply to outbreaks of other pathogens such as coronavirus.

AccuWeather produces a weekly flu report on its health site, using Biocomplexity Institute researchers as sources.

"AccuWeather's experts focus on forecasting weather, while we are working to better forecast infectious disease outbreaks," said Bryan Lewis, a Biocomplexity Institute researcher who designs computer models to predict the spread of several infectious diseases, including the flu. "But predicting the severity of the flu season is a huge challenge because there are a multitude of unknown variables that affect how a season plays out."

Flu season begins most years in October in the Northern Hemisphere, it generally peaks between December and February, and continues into March and sometimes as late as May, Lewis said. This may be because people tend to congregate inside during cold weather, coughing and sneezing in offices, classrooms and cars, passing viruses amongst each other.

Additionally, lab studies show that the flu virus survives longer outside of the human body in the generally drier air of winter. For these reasons, researchers believe they may be able to predict flu infection patterns partly based on winter weather patterns through a season.

But flu infection rates are dynamic, ever-changing, always morphing, just like the weather.

Lewis points out, however, that weather forecasting, always an imprecise science—once iffy at best, and often flat-out wrong—increasingly (by means of more data sources and better big data analytics) is spot-on correct, at least for several days out.

But forecasting the flu is a science still in its toddler phase.

"We're a few decades behind the weather forecasters," Lewis said. "But we're streamlining our data pipeline and improving our techniques, with the goal to become very good at this."

According to the Centers for Disease Control, so far this season about 26 million people in the U.S. have been sickened with the flu, about 250,000 have been hospitalized and 14,000 have died (this, by the way, far surpasses the currently 73,000 coronavirus cases worldwide and 1,900 deaths from that disease).

This flu season is proving to be an "oddball" Lewis said, as "not all flu seasons are created equal."

Normally, the "A" strain of influenza shows up first—in the late fall and during the winter—followed by the "B" strain in late winter to early spring. This year, the B strain appeared first, while the A strain now is making a strong showing. This reversal threw a curveball into the data mix, and Lewis and his colleagues are trying to understand it as they factor the data into their models.

"One reason it is difficult to predict a flu season is because we are using data that spans both space—such as regions—and time periods," said Srinivasan Venkatramanan, a research scientist at the Biocomplexity Institute. "And what we know, or think we know, is affected by the behavioral changes of people who are responding to an outbreak, such as closing down schools, staying away from work and getting vaccinated. There are so many variables in real time to factor in, so many nuances to interpret, all of them affecting the future, and therefore the outcome. We're working to sort out how these variables come into play, and learning from our mistakes."

Flu forecasters are always working behind the curve. Data, which is gathered from a variety of sources—state health departments, the Centers for Disease Control, sales of medications—is usually about two weeks old. So, the very material with which modelers are making their forecasts is based on what's already happened, not on what is happening at the very moment. If the data shows that people are rushing out to buy cold medicines, or are Googling the symptoms of the flu, that possibly means they already are sick. They might even be recovering.

Venkatramanan said that as modelers take into consideration a multitude of influencing factors that affect their results, they become better at identifying problems in data collection and analysis that have resulted in forecasting failures. But much of it is a matter of human interpretation—part art, part science—just as weather forecasters must interpret the different projections of a hurricane's path when several computer models point to different routes.

"We're looking to tie in weather data with search trends to see if we can get better at predicting where the flu will show up next, how many people may be infected, and how serious the infection could be," Venkatramanan said. "It's challenging work, but we are getting better at it, the goal being to ever improve our ability to forecast the spread of infectious disease."

In the meantime, there are ways to avoid getting the flu. "Get vaccinated each year, wash your hands often, avoid people who are sick when possible, and get plenty of sleep," Lewis said. "These are proven ways to reduce exposure and susceptibility. And if you do get sick, be nice to yourself and your co-workers or classmates—stay home and get better."

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