New research uncovers pattern in global flu outbreaks

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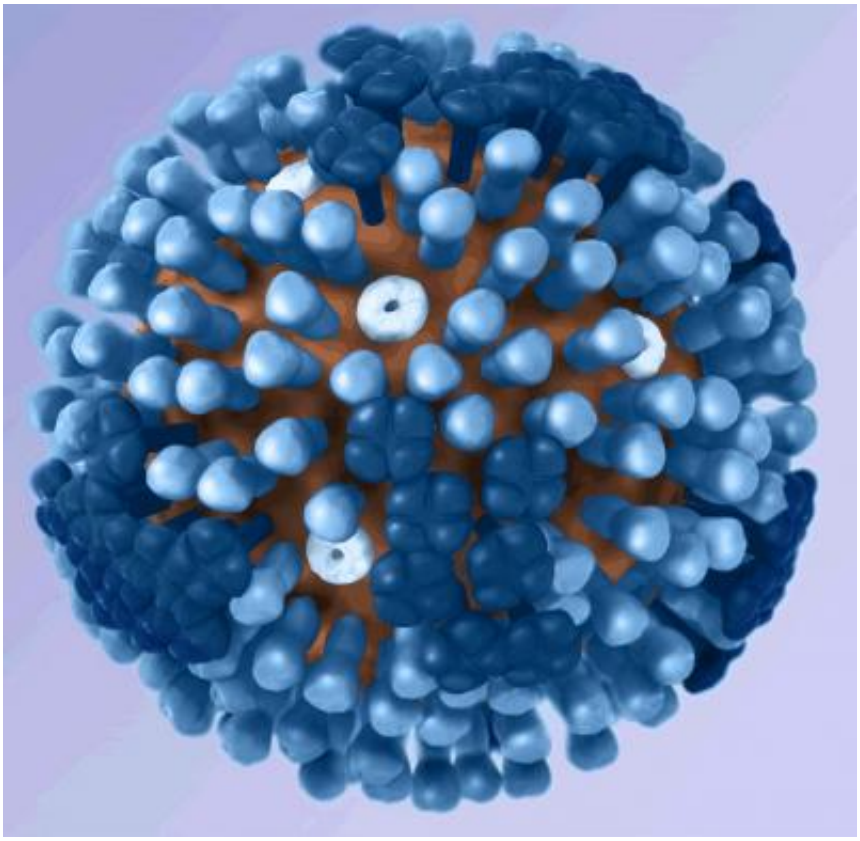

A 3-D image of a flu virus. Credit: Center for Disease Control

As cold winter weather approaches, millions of people look for remedies to avoid the flu. Yet influenza outbreaks equally affect those living in warm, tropical regions where there is no direct link to seasonal temperature changes. This lack of a seasonal connection between flu

outbreaks in tropical and temperate climates has made studying the environmental factors that drive the flu challenging.

In a new study, a Scripps Institution of Oceanography at the University of California San Diego-led research team found that a key environmental driver - humidity - links flu outbreaks across the globe and that temperature mediates this effect.

Using the empirical dynamic modeling (EDM) approach developed by Scripps ecologist George Sugihara and colleagues, the scientists analyzed nearly 20 years of global influenza data from the World Health Organization's Global Health Atlas to uncover a positive association between flu outbreaks, absolute humidity, which is the amount of moisture in the air, and temperature across all latitudes. The study, led by Scripps postdoctoral researcher Ethan Deyle, found a critical temperature window of 70-75 degrees Fahrenheit (21-24 degrees Celsius). Humidity levels above and below the temperature window become a key factor in the spread of the virus.

According to the researchers, "with further laboratory testing, these population-level results could help set the stage for public health initiatives such as placing humidifiers in schools and hospitals during cold, dry, temperate winters and in the tropics, perhaps using dehumidifiers or air conditioners set above 75° F to dry air in public buildings." The study's findings were published on Oct. 31 in the early online edition of the journal *Proceedings of the National Academy of Sciences*.

"The analysis allowed us to see what environmental factors were driving influenza," said Sugihara, the McQuown Chair Distinguished Professor of Natural Science and a coauthor of the study. "We found that it wasn't one factor by itself, but temperature and humidity together."

Researchers at UC San Francisco and Stanford University contacted Sugihara to apply the EDM framework - an approach initially designed for ecological forecasting and identifying causal drivers - to understand flu outbreak patterns. EDM uses observational data from the field along with an intricate backbone of nonlinear mathematical theory to study complex systems whose parts are interdependent and always changing - a holistic data-driven approach for studying nature.

"This paper provides an important missing link by showing that humidity is an important driver of outbreaks in the real world and not just in artificial laboratory conditions," said Deyle. "It's our hope that it will spur further investigation and the implementation of public health interventions that address the role dry air plays in flu outbreaks in countries with temperate climates."

"These findings offer a unifying synthesis that explains flu outbreaks with a single model that applies equally to the tropics and temperate regions, said Sugihara. "It provides an opportunity for experiments that address the transition across climate regions to test the results."

More information: Ethan R. Deyle et al, Global environmental drivers of influenza, *Proceedings of the National Academy of Sciences* (2016). DOI: 10.1073/pnas.1607747113

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