Weather, stomach bugs and climate change: Refining the model

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Monitoring extreme weather, such as periods of high temperature, is one way to predict the timing and intensity of infectious diseases like cryptosporidiosis, an intestinal disease that causes upset stomach and diarrhea. Two public health researchers have created a model that takes into account weather and other factors that affect the number of people who will fall ill during an outbreak. With this model they show that the risk of weather-sensitive diseases may increase with climate variability or even gradual climate change. Better understanding of the ways in which climate can affect disease will help researchers forecast infectious disease outbreaks and design early warning systems.

In a paper published in Environmetrics, first author Elena Naumova, PhD, associate professor in the Department of Public Health and Family Medicine at Tufts University School of Medicine in Boston and co-author Ian MacNeill, PhD, professor emeritus, in the Department of Statistics & Actuarial Sciences at the University of Western Ontario, introduce a model that takes into consideration the lag time between exposure and infection. The authors then demonstrate this model by analyzing the association between high temperature and daily incidence of cryptosporidiosis in Massachusetts from 1996-2001.

In this new model, Naumova and MacNeill consider several factors: outdoor temperature, base level of a disease in a community before an outbreak, the number of people infected throughout the course of the outbreak, and incubation time of a given disease. "It is this last factor that affects what we call the lag time," says Naumova, "infected

individuals go on to infect others, and current models may be underestimating the number of cases in an outbreak by failing to account for lag time."

"To consider such time-distributed lags is a challenging task given that the length of a latent period varies from hours to months and depends on the type of pathogen, individual susceptibility to the pathogen, dose of exposure, route of transmission and many other factors," write the authors. "Using data from the Massachusetts Department of Public Health, we demonstrated that the number of cases of cryptosporidiosis increased and can be sustained over the 21 days following a temperature spike exceeding 90 degrees Fahrenheit. This model is able to provide an accurate estimate of cases of cryptosporidiosis that can be attributed to both lag time and the weather," says Naumova.

"We hope that this model can be expanded upon by public health researchers to gain insight into how disease is spread, and what populations are most susceptible. Our goal is to tailor this model for specific climate regions, infections and at-risk subpopulations, and look for patterns between outbreaks. Continually refining our models will enable us to assess the effects of climate change on human health and make better projections about future infectious disease outbreaks," says Naumova.

This work builds on Naumova's previous research developing mathematical models to predict, more accurately, the timing, severity and impact of diseases. Naumova, a biostatistician, is the director of the Tufts Initiative for the Forecasting and Modeling of Infectious Diseases (Tufts InForMID). This group aims to improve biomedical research by developing innovative computational tools in order to assist life science researchers, public health professionals, and policy makers. Her research focus is developing tools for time series and longitudinal data to study disease surveillance, exposure assessment, and studies of growth.

Source: Tufts University