

# Weather patterns can be used to forecast rotavirus outbreaks

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Monitoring weather factors like temperature, rain, and snowfall is one way to predict the timing and intensity of rotavirus, a disease that causes extreme diarrhea, dehydration and thousands of death annually, particularly among children.

In a paper published May 31 in the journal [PLoS One](#), a research team led by Elena Naumova, Ph.D., professor of civil and environmental engineering at Tufts School of Engineering, correlated temperature and precipitation with [rotavirus](#) outbreaks in one of the hardest- hit regions of the world, South Asia.

In 2004, rotavirus resulted in 527,000 deaths worldwide in children younger than five years, the study noted. The majority of deaths are clustered in [poor areas](#) of developing countries in Africa and Asia. Being able to predict infection increases opportunities for health professionals to take effective [preventive measures](#) such as vaccination that could substantially reduce deaths.

Naumova's research focuses on developing methodology for analysis of large databases to enhance [disease surveillance](#). In this study the team examined seasonal differences in the environment by creating mathematical models based on factors such as temperature, humidity and precipitation in the region over 22 years.

"We found that rotavirus is sensitive to [seasonal patterns](#) that are defined as a combined effect of temperature and precipitation," said Naumova,

who is senior author of the study. This work builds on Naumova's previous research developing mathematical models to predict the timing, severity, and impact of diseases. "Our goal is to develop an integrated model which will allow monitoring the virus and also forecasting outbreaks."

Naumova and the research team analyzed monthly rates of rotavirus from 39 published epidemiological studies that were conducted on outbreaks between 1988 and 2010.

In this new model, the researchers considered meteorological characteristics based on data from the [National Climatic Data Center](#) and the Global Historical [Climatology](#) Network to classify four geographic regions in South Asia—moist tropical climates; arid and semiarid; humid, mid-latitude areas, and cold temperature areas.

The incidence of rotavirus throughout Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka was higher during the coldest, driest months of the year—from December to March--the study indicated. Increases in temperature and precipitation in other parts of the year resulted in lower levels of the virus. Patterns were consistent across the geographical regions, though the fluctuations varied in intensity.

Additionally, the researchers found an association between rotavirus and vegetation density. Using remote sensing data derived from satellite images produced by moderate resolution imaging spectroradiometer (MODIS), a sensor on NASA's Terra satellite, the researchers were able to monitor and measure the amount of fresh vegetation across the region. A second source of remote sensing data was provided by the Global Inventory Monitoring and Mapping Studies (GIMMS).

The images were processed using mathematical techniques for turning satellite data into vegetation growth measurements. Researchers were

able to measure changes in vegetation from 2000 to 2007. An analysis of data associated decreases of vegetation with an increase in the virus.

**More information:** [dx.plos.org/10.1371/journal.pone.0038168](https://doi.org/10.1371/journal.pone.0038168)

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