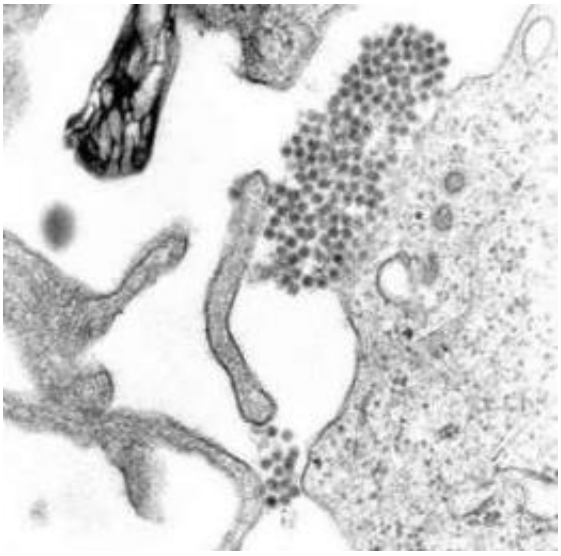
Researchers show phone calls can forecast dengue fever outbreaks

July 8 2016



A TEM micrograph showing Dengue virus virions (the cluster of dark dots near the center). Image: CDC

A team of scientists has developed a system that can forecast the outbreak of dengue fever by simply analyzing the calling behavior of citizens to a public-health hotline. This telephone-based disease surveillance system can forecast two to three weeks ahead of time, and with intra-city granularity, the outbreak of dengue fever, a mosquito-borne virus that infects up to 400,000 people each year.

"Thousands of lives are lost every year in developing countries for

failing to detect epidemics early because of the lack of real-time data on reported cases," observes Lakshminarayanan Subramanian, a professor at New York University's Courant Institute of Mathematical Sciences and part of the research team. "We think our technique can be of use to public-health officials in their fight against the spread of crippling diseases."

The work is described in the journal *Science Advances*.

The system measures the number of calls received at a health hotline facility to forecast the number of dengue cases at a block-by-block level.

"Instead of allocating a large work force to collect block-by-block level data on disease incidences, we crowdsource these data using citizen inquiries and feedbacks," says Umar Saif, the Vice Chancellor of Information Technology University, Punjab and Chairman of the Punjab Information Technology Board, which implemented the system in Pakistan. "This makes health hotlines ideal for resource-constrained environments in developing countries."

Collecting disease surveillance data traditionally requires a huge infrastructure to collect and analyze disease incidence data from all healthcare facilities in a country. Whereas, the primary appeal for this system is its capability to closely monitor disease activity by merely analyzing citizen calls on a public-health hotline.

"Early warning systems in the past only generate alerts of disease outbreaks on a city or state level," says Nabeel Abdur Rehman, a doctoral student in computer science and engineering at NYU and one of the project's researchers. "Alerts are often of little significance given that governments don't have enough resources to allocate to large geographical units. Our goal was to develop a system that could pinpoint the location inside a city where disease activity has increased so the

government could perform targeted containment of a disease."

The efforts to develop the system started in the aftermath of the 2011 dengue outbreaks in Pakistan, which infected over 21,000 people and took 350 lives. Because there is no known cure or vaccine for treating different stages of dengue fever, most public health efforts focus on prevention through disease surveillance and vector control methods—i.e., eliminating the carriers of a particular disease, such as mosquitoes.

The team used more than 300,000 calls to the health hotline, set up in the aftermath of the 2011 outbreaks, to forecast the number of dengue cases across the city and at a block-by-block level over a period of two years. The researchers then matched their predictions with the actual number of cases reported in public hospitals. The results showed a high level of accuracy for the model's predictions: the system not only flagged an outbreak, but also made an accurate forecast of both the number of patients and their locations two to three weeks ahead of time.

"To the best of our best knowledge, this system is the first to demonstrate, with significant empirical evidence, that an accurate, locality-specific disease forecasting system can be built using call volume data from a public health hotline," says Subramanian.

"This simple technology can save thousands of lives in the developing world," adds Saif.

More information: "Fine-grained dengue forecasting using telephone triage services," *Science Advances*, advances.sciencemag.org/content/2/7/e1501215

Provided by New York University