Smartphone app can effectively lower cholera risk

August 13 2024, by Jeremy Norman
Cholera risk prediction maps for Matlab, Bangladesh from March to November 2021. Researchers used imagery, based on satellite data from NASA, to create the risk forecasts for the application. Cholera risk is measured on a scale of 0 (low cholera risk) to 1 (high cholera risk). Colors depict categorized risk levels: green areas have predicted risk levels between 0 and 0.33; yellow between 0.33 and 0.66; and red between 0.66 and 1. Credit: Kevin Boyle

The seventh cholera pandemic, which began in 1961, has annually afflicted millions and claimed tens of thousands of lives. Recognized by the World Health Organization as the longest-lasting pandemic in history, cholera spreads through contamination of household water sources by the Vibrio cholerae bacterium, often from poor sanitation infrastructure.

In nations such as Bangladesh, where cholera is endemic due to high population density and inadequate access to clean water and sanitation facilities, the disease poses a significant public health risk.

Could providing high-risk populations with an early warning system for local cholera risks encourage households to adopt safer water, sanitation, and hygiene practices, thereby reducing susceptibility to cholera infection?

Supported, in part, by NASA and administrated by Resources for the Future, Kevin Boyle and colleagues from Moravian University, Penn State, and the University of Rhode Island assessed the feasibility of implementing a smartphone app designed to convey cholera risk forecasts to households to mitigate the threat of cholera in Bangladesh.
Their research, "Early warning systems, mobile technology, and cholera aversion: Evidence from rural Bangladesh," was published in the May edition of the *Journal of Environmental Economics and Management*.

For the purposes of this research, the team developed CholeraMap, an Android-based smartphone application that conveys cholera risk forecasts to households. The app enables users to access risk predictions—from low to medium to high—for both their community and individual home locations. The app also offered guidance on understanding the cholera threat associated with their household locations and provided essential public health information to reduce cholera exposure.

"While cholera risk is seasonal, changing weather patterns make historical cholera risk predictions less dependable, indicating a need for predictive models," said Boyle, the Willis Blackwood Professor of Real Estate at the Pamplin College of Business and professor of agricultural and applied economics in the College of Agriculture and Life Sciences.

"Environmental scientists on our team had been working on a predictive model for monthly cholera risk in Bangladesh, and we investigated how to best communicate these predictions directly to vulnerable populations."

To develop a cholera threat model, the team utilized remote sensing data such as rainfall observations, anomalies, forecasts, temperature, and elevation, as well as data on population density and past cholera incidence. This model was then calibrated for Matlab, a rural sub-district of Bangladesh.

"NASA was interested in understanding the value of satellite data in decision-making," said Emily Pakhtigian of Penn State. "In our project, we examined how cholera risk predictions, based on NASA satellite
data, could help households understand their cholera risks and make real-time decisions to minimize exposure."

The CholeraMap application was installed on the smartphones of approximately 750 households across Matlab. Another 750 households received a companion app—CholeraApp—which provided publicly available information about preventing cholera. Finally, as a control, 500 households that did not receive access to either app were tracked.

To assess the impacts of CholeraMap on household behaviors and health, the researchers conducted surveys among the participating households before and after the application's installation. The respondents were asked about their households' water use, sanitation and hygiene practices, recent health experiences, water security, and their experiences using CholeraMap.

The team discovered that households using smartphone apps decreased their dependency on surface water, a significant source of cholera transmission. Surface water serves as a crucial water source in Matlab, especially for activities such as laundry, dishwashing, and bathing. By minimizing their reliance on surface water, households using CholeraMap were lowering their risk of contracting the disease through proactive measures.

Lead investigator Sonia Aziz, who trained with Boyle as a graduate student at Virginia Tech, and co-investigator Ali Shafqat Akanda, who developed the predictive model for the app, are from Bangladesh and provided an understanding of key social and behavioral aspects relevant to the investigation.

"Smartphone applications place geographically personalized, dynamic information about environmental risks directly in the hands of the vulnerable populations," Akanda said.
This interdisciplinary research highlights the potential of employing various data sources, such as satellite imagery, to develop user-friendly early warning systems. Such systems are crucial for addressing public health priorities and could significantly reduce the impact of endemic diseases in regions like Bangladesh. Though the application is not available for use by the general public, the study underscores the valuable role that mobile phone applications like CholeraMap can play in this effort.

"Our analysis shows that people respond and act when presented with better information," Aziz said. "Bangladeshi villagers have absorbed health damages as an inevitable consequence of day-to-day life for almost a century. Applications such as this have the potential to change that."


Provided by Virginia Tech