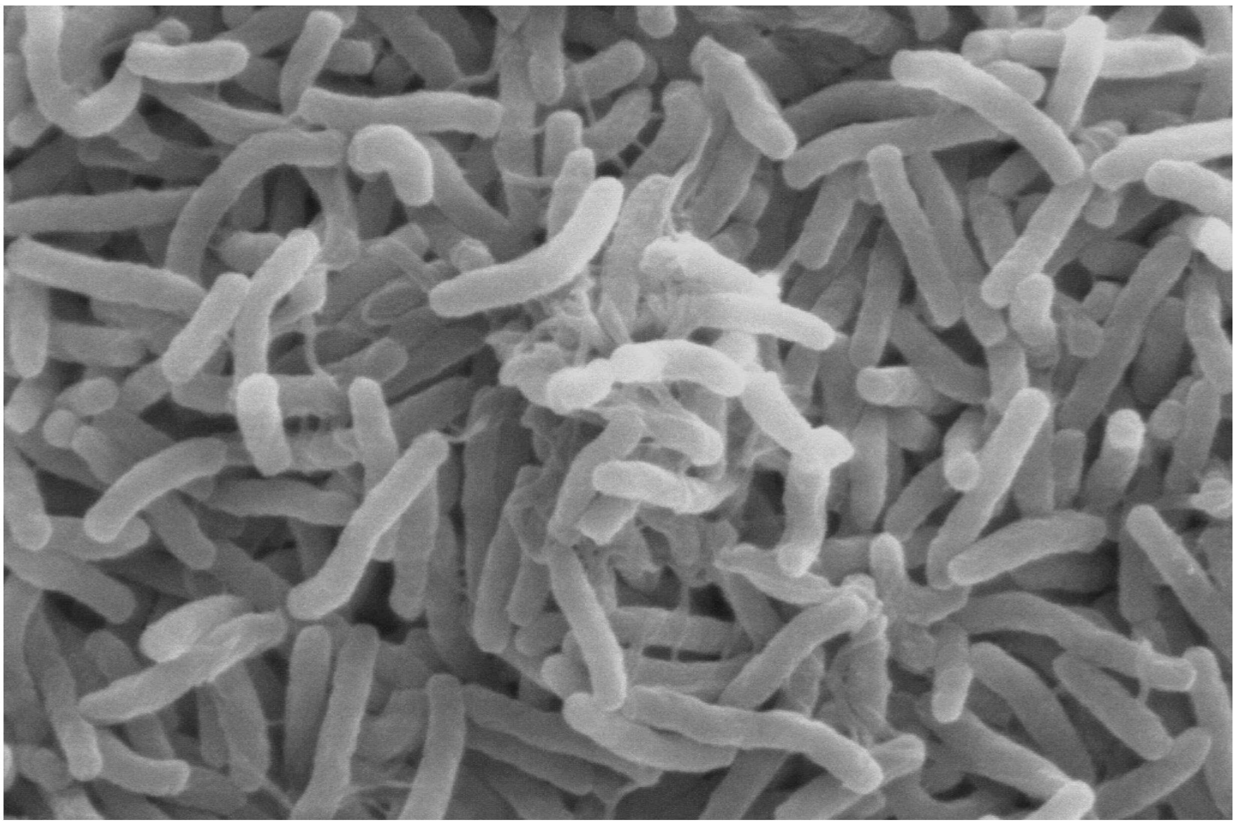
Medical Xpress

Responding to cholera before it strikes

August 29 2018, by Leon Tune



Scanning electron microscope image of Vibrio cholerae. Credit: Wikipedia

Research by University of Maryland microbiologist Rita Colwell is enabling a new British-led international aid effort to predict and stop potential epidemics of the disease cholera before they happen.

This international effort, which has already begun in Yemen, draws on decades of Colwell's work to understand the water-borne bacterium Vibrio cholerae that causes the disease, and uses a computer model designed to forecast cholera outbreaks developed by a team of U.S. scientists led by Colwell, a Distinguished University Professor in the University of Maryland Institute for Advanced Computer Studies, Antar Jutla, a hydrologist and civil engineer at West Virginia University, and UMD's Anwar Huq, a former graduate student of Colwell's who is a research professor in the university's Maryland Pathogen Research Institute.

Colwell—who began studying the bacterium in the late 1960s and first conceived the idea of forecasting and proactively fighting cholera outbreaks in 1995—said seeing her vision realized in this new endeavor "is the greatest satisfaction any scientist, mathematician, or engineer could possibly have… essentially a dream fulfilled."

Using data from NASA satellites and other sources, the team's computer model provides risk maps for cholera in Yemen and other regions in the world based on factors that include air and water temperatures; precipitation amounts; severity of natural disasters; availability of clean water; sanitation and hygiene infrastructure; population density; and severity of natural disasters.

"By being able to predict when and where cholera is of highest risk, it makes it possible to deliver supplies and arrange for safe drinking water effectively and accurately," said Colwell, a former director of the U.S. National Science Foundation whose highly acclaimed career bridges the disciplines of microbiology, genetics, ecology, infectious disease, public health, data analysis and satellite technology.

This spring, based on the model's predicted locations and timing for cholera outbreaks in war-torn Yemen, the British government together with UNICEF began providing aid to lessen both the spread and severity of the illness, which causes severe diarrhea that can lead to dehydration, and even death, if untreated. Aid workers have distributed supplies for water sterilization and personal hygiene to reduce people's exposure to the bacteria, and provided rehydration salts, intravenous fluid packs and other supplies to reduce the severity illness in those that became infected.

"The conflict in Yemen is the worst humanitarian crisis in the world, with millions of people at risk of deadly but preventable diseases such as cholera," said Department for International Development Chief Scientist, Professor Charlotte Watts. "By joining up international expertise with those working on the ground, we have, for the very first time, used these sophisticated predictions to help save lives and prevent needless suffering for thousands of Yemenis."

"This [collaborative effort] means public health intervention accurately, precisely delivered when and where needed," said Colwell. "It is truly satisfying to be able to see one's research, including that done here at the University over the past forty plus years, incorporated into an effective public health success on a global scale."

"I certainly hope other governments, NGOs, and the United Nations will incorporate our model into their ongoing work," she said. "Cholera offers a superb model for other waterborne and vector transmitted diseases."

A Vision Realized

The ability to predict and better respond to potential cholera epidemics is the direct result of Colwell's five decades of award-winning work to understand Vibrio cholerae and how it multiplies and spreads to cause disease.

Her first key discovery was that the natural habitat for this bacterium was water, particularly among and within the microscopic animals and plants that constitute plankton. This meant that cholera outbreaks must first arise from consumption of contaminated drinking water drawn from sources such as rivers and ponds. Later she identified environmental conditions that determine whether these disease-causing bacteria lie dormant in their aquatic environments or flourish and proliferate. She also developed a simple, inexpensive and effective method of using readily available used sari cloth to filter pond and river to greatly reduce the incidence of cholera in villages in Bangladesh.

In 1995, while looking at colorful NASA satellite imagery showing a coastal bloom of plankton that are home to Vibrio cholerae, Colwell realized that satellite data could be used to forecast potential cholera outbreaks. More recently, Colwell has worked with colleagues Jutla, Huq and others to advance the science and computer science needed to develop this predictive capability. She also has led research that has increased our understanding of how changing environmental factors, such as the world's warming climate, are affecting the health risks posed by Vibrio cholerae and other vibrio bacteria.

"We still have a lot of work yet to do to increase accuracy and geographic applicability [of our predictive model]," said. "We also need to continue to accumulate ground truth data to strengthen the model. This means continuing our valuable molecular biology and genomic research on cholera done here at the University of Maryland. And we will be expanding our work in Africa where cholera continues to be devastating."

Provided by University of Maryland

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