Scientists pinpoint river flow associated with cholera outbreaks, not just global warming

August 4 2011

An examination of the world's largest river basins found nutrient-rich and powerful river discharges led to spikes in the blooms of plankton associated with cholera outbreaks. These increased discharges often occur at times of increased temperature in coastal water, suggesting that predicting global warming's potential temperature effect on cholera will be more complicated than first thought, according to a new study published today in the *American Journal of Tropical Medicine and Hygiene*.

The findings by the authors will help give public health authorities another critical clue toward predicting future outbreaks of cholera based on climatic and environmental models in the hopes of preventing the spread of the deadly and highly infectious disease that currently plagues Haiti and several other countries.

The study began in the Bay of Bengal where researchers aimed to solve a mystery: When sea temperatures rise, phytoplankton—microscopic plants that live in the ocean and provide a food source for zooplankton, with which cholera bacteria are associated—decrease. So why had past studies found sea temperatures rising and numbers of phytoplankton also increasing? The authors analyzed twelve years of data, including images from NASA satellites, and pinpointed the large flows from the Ganges, Brahmaputra, and Meghna rivers, carrying nutrients from soil, as the cause of a bloom of phytoplankton. This is followed by zooplankton blooms and thus contributes to outbreaks of cholera.

"We weren't satisfied with just this result, so we then went to test this finding in other places—the Orinoco (in South America), the Congo, and the Amazon river basins, and we found the same thing: The positive relationship between phytoplankton blooms and ocean temperature is related to large river discharges," said Shafiqul Islam, PhD, the lead investigator of the study and a professor in the Department of Civil and Environmental Engineering and at the Fletcher School of Law and Diplomacy at Tufts University in Medford, Mass. "The main significance is that finding an association between sea surface temperatures and cholera outbreaks should not lead us to conclude that with global warming, cholera will definitely go up."

But Islam said that global warming may play a role in other ways in outbreaks of cholera, including contributing to droughts and high salinity intrusion in the dry season and floods in the wet season. Both of those conditions have been found also to contribute to cholera epidemics, as published recently in the journal *Water Resources Research.* "If river flows are more turbulent, if droughts are more severe, if flood is more severe, cholera is more severe," he said. "But cholera may not have direct linkage with rising sea surface temperatures."

Cholera is caused by the bacterium *Vibrio cholerae,* which produces a toxin that causes severe diarrhea. Cholera occurs most frequently in areas with poor sanitation, crowding, and social instability. It creates intense fear because of the sudden onset of diarrhea with the potential for high numbers of deaths.

In the Democratic Republic of Congo, a raging cholera outbreak that started nine months ago has killed hundreds and sickened more than 100,000 people, the World Health Organization reported in July. Haiti is currently seeing a fresh upsurge in cholera cases since the rainy season started this spring. That epidemic, which began in October 2011, has caused illness in more than 300,000 people, killing nearly 5,000.

"We don't know for sure if Haiti's cholera outbreak is related to its river system, but its rivers were severely impacted by the earthquake," said Rita R. Colwell, PhD, co-author of the study and a professor at both the University of Maryland and the John Hopkins Bloomberg School of Public Health. "It's a system we should study in Haiti. I'm intrigued to see this relationship between cholera and river flow. It gives us much more detail about what can trigger cholera outbreak."

Peter J. Hotez, MD, PhD, President, American Society of Tropical Medicine and Hygiene, said the study underscored the "complex ecology associated with cholera," adding that researchers' work in understanding cholera outbreaks is critically important now.

"Cholera seems to be gaining a foothold in more places than it used to be," Hotez said. "We used to see shorter outbreaks, but in Africa, and now in Haiti, we're seeing nationwide epidemics lasting months or more than a year. We obviously need to be taking a different approach."

Provided by Burness Communications