

How El Niño forecasts can prevent cholera deaths in Africa

May 15 2017, by Justin Lessler, Andrew Azman, Benjamin Zaitchik, And Sean Moore



Pit latrine in Dar es Salaam, Tanzania. Access to clean water and sanitation are key to preventing cholera epidemics. Credit: D. Schafer, SuSanA/Flickr, CC BY

Since it first emerged from the Ganges River delta 200 years ago, [cholera](#) has killed tens of millions of people around the world. It causes acute diarrhea that can kill quickly without proper treatment. Before the 1970s it was not unusual for healthy adults to die of dehydration within days of infection, despite drinking large amounts of water.

By some estimates, [over a billion people worldwide](#) live in areas where there is [risk](#) of [cholera](#), and hundreds of thousands die every year. But when people have access to [clean water](#), appropriate treatment or vaccine, the risk of cholera is greatly reduced. With well-trained medical staff and supplies, appropriate and timely treatment of cholera patients can ensure that almost no one dies.

In a [recent study](#), our group sought to understand how weather changes caused by El Niño impact cholera risk in Africa, where most cholera deaths occur. El Niño events can now be forecast as much as a year in advance, so knowing this relationship may help forecast where cholera outbreaks are most likely to occur.

We found that major shifts occurred in El Niño years, with more cholera cases occurring in areas where rainfall increased. This kind of advance warning can help health officials plan and have appropriate resources at the ready, thereby preventing substantial numbers of cholera deaths.

Focus on drinking water

People become infected with cholera when they ingest the *Vibrio cholerae* bacteria, usually from contaminated food or water. By increasing the chances that people will consume contaminated food or water, weather patterns can change cholera risk in several ways.

One of the main ways that cholera can get into water supplies is through the feces of infected individuals. Heavy rains sometimes trigger

flooding, causing sewers or latrines to overflow and introducing cholera into otherwise clean water supplies. Conversely, in drier areas where people depend on shallow wells or rain-catching cisterns for their clean water, drought can dry up these supplies and force people to drink from unsafe sources.

Finally, some researchers have found a [relationship](#) between sea surface temperature and water salinity and cholera risk. Warmer sea surface temperatures can favor the growth and survival of *V. cholerae* in coastal waters, increasing the likelihood of a [cholera outbreak](#) if the pathogen is introduced into the population via coastal water supplies or contaminated seafood.

Changes in the weather may affect cholera risk via any of these three pathways. This means it is essential to understand local conditions in order to project where cholera outbreaks may occur.

Impacts of El Niño

The El Niño Southern Oscillation (ENSO), usually referred to as [El Niño](#), is a cyclical phenomenon that profoundly affects global weather patterns. During El Niño events, some areas experience more rainfall, while precipitation is reduced in others. Local temperatures may also be affected.

To see whether El Niño events were associated with changes in cholera risk in Africa, we created maps of cholera incidence in Africa during El Niño and non-El Niño years occurring from 2000-2014. We collected nearly 1,000 separate reports of cholera incidence from throughout Africa, and then used advanced statistical techniques to create detailed maps of where these cases occurred.

We found that overall, the number of cases of cholera reported

throughout the continent was similar in El Niño and non-El Niño years – about 210,000 per year. However, there were big shifts in where these cases occurred. Notably, regions of East Africa experienced 50,000 more cholera cases in El Niño years, with large increases in several countries, including Tanzania and Ethiopia. These regions are also places where rainfall increased substantially during El Niño years.

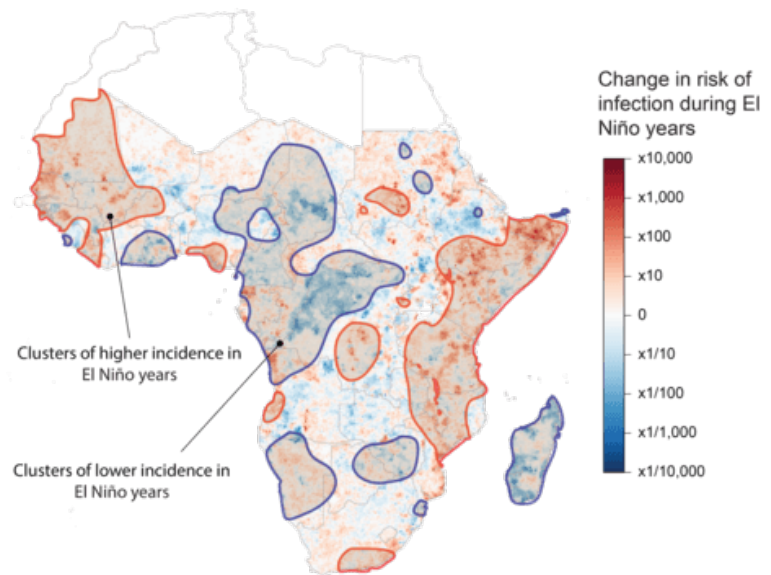
Understanding El Niño's impact on cholera can inform epidemic prediction for three reasons. First, El Niño is a relatively persistent phenomenon lasting several months at a time. Hence, current El Niño conditions are an indicator of likely El Niño status in a coming season.

Second, El Niño affects climate around the world through coupled ocean and atmosphere processes that play out over weeks or months. For this reason, knowing current El Niño conditions can inform seasonal weather forecasts relevant to cholera, even if the sea surface temperature patterns that define the El Niño event fade.

Third, El Niño prediction systems have improved in recent years, and there is now meaningful forecast information up to a year in advance for some seasons. This information can inform epidemic warnings and preparedness with long lead times.

Cholera prevention and response

In the 1960s, researchers from Johns Hopkins and other institutions [discovered](#) that drinking water mixed with appropriate quantities of sugar and salt could keep cholera patients hydrated. Administration of these "oral rehydration salts," combined with intravenous rehydration for the most severe cases, can virtually eliminate deaths from the disease. Early in outbreaks, however, health care workers often do not have the necessary training or resources to treat cholera, and death rates can be very high.



During warmer, wetter El Niño years 50,000 additional cholera cases occur in East Africa as compared to non-El Niño years. Credit: Justin Lessler, Author provided

The surest way to virtually eliminate the risk of cholera is to provide access to clean water and proper sanitation. But history shows that it is hard to provide and sustain access to clean [water](#) and sanitation in the poorest places on the planet. And it is harder still to do so quickly during a crisis.

Oral cholera vaccines are being used more to combat potential or emerging epidemics, but protection from the vaccines does not last forever, and supplies are limited. The World Health Organization [recommends](#) that in areas where cholera is endemic or there is risk of an outbreak, vaccines should be used along with other prevention and control strategies.

Knowing where cholera risk is most likely to occur could help public health agencies to use the vaccine to protect those most at risk before an outbreak happens.

Climate change and infectious diseases

The relationship between El Niño and cholera also tells us something about the relationship between climate change and infectious disease. Changes in disease risk due to shifting weather patterns will create both winners and losers around the world. While many areas will be at increased risk from cholera and other diseases, the risk might decrease in others as conditions change.

To understand who the winners and losers are likely to be, we need to know more about where and how local conditions are likely to change, and about how climatic factors impact disease risk. Our research has identified one major driver affecting one disease. Finding more such connections is critical for biosecurity here and in other nations.

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