Cholera outbreaks at Lake Tanganyika induced by Climate Change?
Lakes as Source of Cholera Outbreaks, Democratic Republic of Congo

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We studied the epidemiology of cholera in Katanga and Eastern Kasa in the Democratic Republic of Congo, by compiling a database including all cases recorded from 2000 through 2005. Results show that lakes were the sources of outbreaks and demonstrate the inadequacy of the strategy used to control cholera.

The association between *Vibrio cholerae* and aquatic environments has long been studied, but emphasis has been almost exclusively placed on coastal areas such as the Bay of Bengal, the point of origin of cholera. These outbreaks are closely linked to adverse events, such as environmental *V. cholerae* strains emerge and then spread in human communities during the monsoon season (1) by attaching themselves to surfaces provided by plants, algae, and zooplankton (2,3). Some recent studies have investigated environmental and climatic factors that may encourage the spread of cholera in African countries (4,5); these studies also focused on coastal areas. Except for 2 case-control studies performed in Benin and Kenya (6,7), little is known about the epidemiology of cholera in inland areas of Africa. A recent article, based on the analysis of 632 reports of cholera outbreaks worldwide, has shown that 87.7% of cholera cases occurred in sub-Saharan Africa and that the highest concentration of outbreaks was in the eastern provinces of the Democratic Republic of Congo (DRC) (8). In this country, dozens of emergency programs have been implemented by humanitarian organizations, national health services, and international agencies; they have, however, failed to achieve long-term control of cholera epidemics. To search for environmental factors that could explain the recurrence of cholera outbreaks, we conducted an epidemiologic study in 2 inland provinces of the DRC severely hit by cholera.

Négro

This Study

From 2002 through 2005, reports of cholera cases and deaths from cholera were collected weekly from each health district of Katanga (497,076 km², 5,598,380 inhabitants) and Eastern Kasa (170,103 km², 6,713,059 inhabitants) with the help of local and national staff of the DRC Ministry of Health. The definition of a case-patient was "any person 5 years of age or older in whom severe dehydation develops or who dies from acute watery diarrhea"; the age limit was lowered to 2 years for cases associated with confirmed cholera outbreaks, as recommended by the World Health Organization (WHO) (9). Each new outbreak was confirmed by culture and identification of *V. cholerae* O1 from 5 to 10 stool samples.

For 2000 and 2001, only cumulative data collected weekly in each province were available; no detailed database was kept. However, data were completed with information from reports of epidemic investigations and interventions (10), and the testimonies of medical teams interviewed during field visits. A geographic information system was established, based on the data collected from the 100 health districts of the 2 provinces. Six health districts were removed from statistical analysis because ~10% of weekly reports were missing (Figure 1). Using regression techniques (see online Technical Appendix, available from www.cdc.gov/EID/content/14/7/036-Technical.pdf), we statistically examined the relationship between the number of cholera cases in each health district and the following list of geographic and environmental variables: mean temperature, population, and presence/absence of cities of ~100,000 inhabitants, of railway stations, of harbors, of major roads or roads, and of lakes.

A total of 67,738 cases and 2,666 deaths (case-fatality rate 3.4%) were reported from 2000 through 2005 in Katanga and Eastern Kasa, which corresponded to 8.4% of the population. This rate was much higher than the national average of 3% reported by the Ministry of Health; the difference was especially high in the eastern provinces, which had higher cholera case rates than the national average. This study showed that the DRC Ministry of Health must consider the spatial distribution of cholera cases in order to implement interventions. We thus recommend that interventions be targeted at specific periods or at specific geographic areas, because the epidemic findings showed that cholera epidemics were not uniformly distributed over the country. These findings support the need for an epidemiologic study to determine the risk factors in the eastern part of the country, which is the most affected by cholera outbreaks.

Figure 1. Kataera and Eastern Kasai, showing distribution of cholera attack rates from 2002 through 2005 and average attack rate of cholera per 10,000 inhabitants per health district.


CHOLTIC project 2011-2015
Apparent correlation **plankton** vs **cholera** in Tanganyika

Cholera cases from DLM (D. Bompanque)  
RS data from CLIMFISH (BELSPO/Stereo)

CHOLTIC project 2011-2015
Objectives:
to investigate the role of great lakes as environmental reservoir of CHOLERA in Central Africa and early warning.

Africa: 82% of world cases

Focus: Lake Tanganyika

Preliminary results indicate links between cholera and plankton blooms

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- CRH (RD Congo)
- DOF (Zambia)
- NBGB, ULG, UCL (Belgium)
- DLM & INRB (RD Congo)
- IMT (Belgium)
- APHM (France)

(Griffith et al., 2006)
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