



Cholera outbreak associated with drinking contaminated lake shore water, Namayingo District, Uganda, July–August 2023

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Summary

Background: On July 24, 2023 Uganda's Ministry of Health confirmed a cholera outbreak on Sigulu Island, Namayingo District. We investigated to determine its magnitude, identify possible exposures and recommend evidence-based control interventions.

Methods: We defined a suspected case as acute onset of watery diarrhea in a resident of Sigulu and Bukana Sub-counties in Namayingo District from July 1–August 15, 2023, and a confirmed case as a suspected case with positive *Vibrio cholerae* serotype 01 and 0139 stool culture. Cases were identified by active case search and records review at the health centers. We conducted descriptive epidemiology, environmental assessment at the lakeshore water collection points, and generated hypotheses. We additionally collected water samples from lakeshore water collection points and Jericans used for household water storage for cholera testing. We conducted an unmatched individual case-control study to compare exposures among case-patients and asymptomatic controls residing in Sigulu and Bukana sub-counties.

Results: We identified 24 cases of which 4 were confirmed to have *V. cholerae* serotype 01 and 0139 ogawa. Fifteen (62%) cases were female and the median age of cases was 27 years (range:2-68 years). Nine (37%) received the oral cholera vaccine (OCV) in 2020/2021. The epi curve showed a propagated outbreak after the contamination of a communal water collection point on July 8, 2023 by the primary case who had recently traveled back from a neighboring country with a cholera outbreak. Eighteen (75%) were resident of Secho village in Sigulu sub county. All case-patients drunk lakewater but no water samples tested positive for *Vibrio cholerae*. Compared to other water collection points, drinking water from water point A in Secho, Sigulu sub-county increased odds of getting cholera (aOR=4.3, 95% CI: 1.3–15). Treatment of drinking water by any means (aOR=0.085, 95% CI: 0.097–0.74) and receiving OCV (aOR=0.16, 95% CI: 0.051–0.56) were both protective. We observed residents directly drawing lakeshore water for laundry, bathing, and drinking.

Conclusion: This cholera outbreak in an island community was associated with the introduction of *Vibrio cholerae* by a traveller, followed by community consumption of untreated lakeshore water. We recommended mass distribution of water treatment tablets, repeated OCV, and community mass sensitization about risks associated with drinking untreated lake water.



Introduction

Cholera is characterized by profuse rice water diarrhea and is caused by the bacterium *Vibrio cholerae*. It is transmitted through the consumption of *Vibrio cholerae* fecally contaminated food and water (1). It has an incubation period of hours to 5 days, with most infected persons being asymptomatic carriers capable of transmitting infection (2). Most of the global burden of cholera is seen in developing countries and areas with poor sanitation (ref). Globally, there are about 1.3 to 4 million cases and 22,000 to 143,000 deaths annually (3). Clusters of cholera are common due to either person to person spread or through spread from contamination of the environment by a case (4). Strategies for prevention of cholera include; vaccination in hotspots, and improving water, sanitation and hygiene. The global targets are a reduction of deaths by 90% and elimination of transmission in 20 countries by 2030 (5).

Uganda is one of the cholera endemic countries targeted for cholera elimination by the global task force for cholera. Between 2015 and 2021, Uganda had reported 63 outbreaks from 61 districts with a total of 8,498 cases(6). There are several hotspots in the country including border and refugee hosting districts and, lakeshore communities. Urban slums are also at high risk of cholera(7,8). While progress has been made in the fight against Cholera, over 15 districts remain endemic for Cholera in Uganda including Namayingo (6,9). Between 2018 and 2021, the country rolled out the Oral Cholera Vaccination (OCV) campaign in several districts, including Namayingo in a bid to eliminate Cholera from these districts. The vaccine is given in 2 doses, 14 days apart to people aged ≥ 2 years and provides protection upto 80% for 3 years (10). Despite this, the country still grapples with cholera outbreaks from time to time (6).

On July 24, 2023, the Ministry of Health was notified of a confirmed outbreak of Cholera in Sigulu Island. This followed an alert on July 15, 2023 of four residents from Secho village, Sigulu Island in Namayingo District presenting with acute profuse watery diarrhea and vomiting. Stool samples from 4 of the suspected cases were sent to the Central Public Health Laboratory (CPHL) for testing and three of the four were confirmed culture positive for *Vibrio cholerae* 01 *ogawa*. We investigated the outbreak to determine its magnitude, identify possible associated exposures and recommend evidence-based control and prevention interventions.

Methods

Outbreak area

The outbreak occurred in Namayingo District, Busoga Region, in South Eastern Uganda. The district has nine subcounties and 193 villages with an estimated population of 247,400 people (11). Three of the district sub counties (Bukana, Sigulu and Lolwe) are Island sub counties, with an estimated population of 42,900 people. Safe water coverage in the district is 62% (12), and latrine coverage is 20% (13).



Case definition and finding

We defined a suspected case as any resident of Sigulu and Bukana Subcounties in Namayingo District aged ≥ 2 years with acute onset of watery diarrhea between July 1 – August 15 2023. A confirmed case was a suspected case with *Vibrio cholerae* O1 or O139 confirmed by stool culture. Cases were identified through records review at the health centres and active case search in the community.

Descriptive epidemiology

We conducted descriptive analysis of the cases identified during July 1 to August 15, 2023 by age, sex, clinical presentation, place of residence, possible exposures, and vaccination status. We calculated attack rates by age, sex, and place of residence using population estimates from Namayingo district biostatistician and Uganda Bureau of statistics, of persons aged ≥ 2 years. An epicurve was used to describe the distribution of cases by dates of symptom (diarrheal) onset.

Laboratory investigations

We collected both stool (ten samples) and water (six samples) and shipped to the Central Public Health Laboratories in triple packaging bags for testing.

Environmental assessment

We inspected six water collection sources identified by the case-patients in the villages of Secho, Bukana, Buhere, Buhone, and Bulagaye to observe for open defecation, water collection practices, and activities at the water collection sites like washing clothes and bathing.

Hypothesis generation

We used a case investigation form to collect information on potential exposures including sources of household water, water treatment practices, consumption of commercial foods and drinks, food preparation, contact with an individual with profuse watery diarrhea, and travel from an area with known cholera. We also assessed vaccination status of case-patients by looking at vaccination cards and for those with no cards, a vivid recall of the vaccination exercise, dose schedule, and vaccine administration. One was considered fully vaccinated if they had received 2 doses of the OCV.

Case control study

We conducted a 1:4 individual unmatched case control study in Sigulu and Bukana subcounties where the case-patients resided. Control persons were residents of the same village as the case patients but never had an episode of acute watery diarrhea from July 1, 2023 to the time of the investigation. They were selected randomly using the case patient household as the starting point and spinning a bottle to obtain direction of the next household. This was continued until all the 4 controls were selected.



Ethical considerations

The Ministry of Health (MoH) gave permission to investigate this outbreak. We additionally sought permission and support to conduct the investigation from district health authorities of Namayingo District. In addition, the office of the Center for Global Health, US Center for Disease Control and Prevention determined that this activity was not human subject research and with its primary intent being for public health practice or disease control. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy. § § See e.g., 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. §241(d); 5 U.S.C. §552a; 44 U.S.C. §3501 et seq.

We sought verbal informed consent from the respondents who were either sick at the time or survivors of cholera. All respondents were informed that their participation was voluntary and their refusal would not attract any negative consequences. To ensure confidentiality, personal identifying information collected was only accessed by the investigators.

Results

Descriptive epidemiology

We identified 24 cases of which four were confirmed cases of *Vibro cholerae*, serotype 01 and 0139 ogawa. There was no death reported. The median age of the case-patients was 27 years (range: 1-68) and those above 15 years (79% (19) Attack rate (AR) 7/1000) were most affected. Both sexes were affected. However, females (63% (15), AR: 12/100,000) were more affected than males. Cases were clustered around water collection points, and the most affected were residents of Secho village in Sigulu sub county (79% (19), attack rate: 13/1000 (Figure). The epi curve showed a propagated outbreak following the washing of fecally soiled clothes by the primary case on July 8, 2023 (Figure 2). The majority of case patients 92% (22) drank untreated lake water and 38% (9) received the OCV.

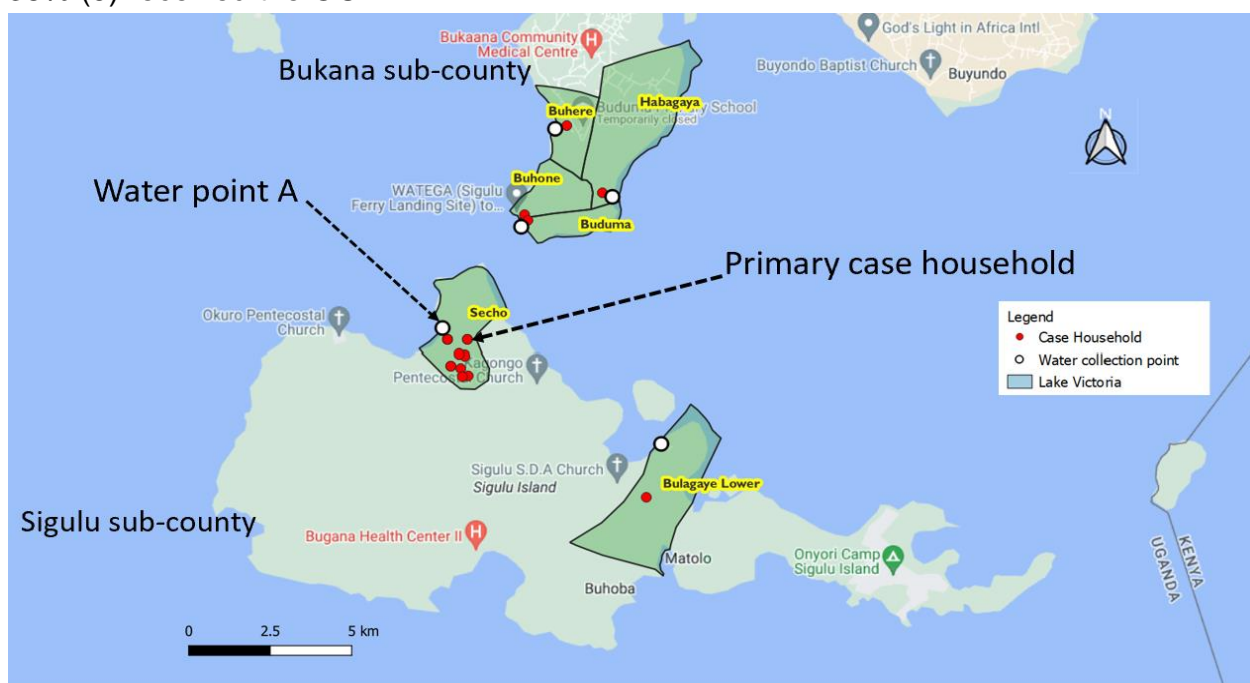


Figure 1: Location of affected villages and households affected by cholera and, the lake shore water collection points in the affected villages in Sigulu and Bukana sub county, Namayingo District, July 1 – August 15, 2023



Cases started to rise after the primary case washed her fecally soiled clothes at the water collection point A, on July 8. After confirmation and institution of control measures from July 25, cases declined and eventually stopped.

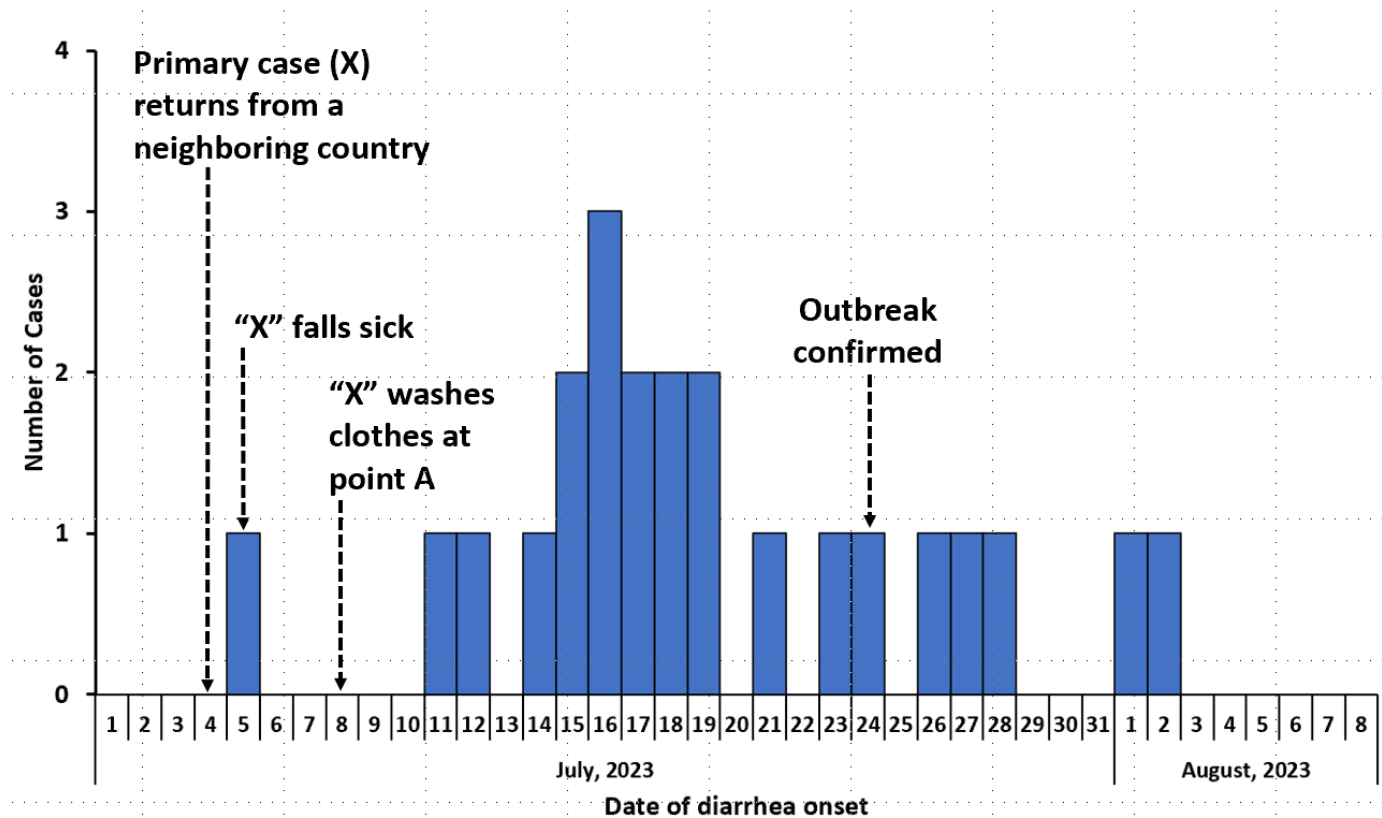


Figure 2: Distribution of symptom onset of cholera cases, Sigulu and Bukana sub-counties, Namayingo District, Uganda, July 1 – August 15, 2023

Environmental assessment findings

We found that residents drew lake water for all domestic use, but also bath and washed clothes at the lake shore water collection points. Residents were also seen drinking water directly drawn from the lake. The available boreholes had salty unpalatable hard water.

Exposures associated with cholera in Sigulu and Bukana subcounties, Namayingo District, Uganda, July 1 – August 15, 2023

From the case-control study, compared to other water collection points, drinking water from water point A in Secho, Sigulu sub-county increased odds of getting cholera (aOR=4.3, 95% CI: 1.3–15). The odds of getting cholera were reduced by treatment of drinking water by any means (aOR=0.085, 95% CI: 0.097–0.74) and receiving OCV (aOR=0.16, 95% CI: 0.051–0.56).



Discussion

This was a cholera outbreak following possible importation of *Vibrio cholerae* into Secho Village, Sigulu Island in Namayingo District. Six villages in 2 sub-counties were affected. We also show evidence that drinking untreated lake water was a risk factor, while the cholera vaccine remained protective after 2 years of administration.

Namayingo District borders Kenya to the east and is a cholera epidemic prone district. In the past, the district has had several cholera outbreaks, mainly affecting the island subcounties. There have also been cases of the outbreak spreading to the mainland for example in 2018, where 90% of mainland cases were reported to have originated from the Islands(14). Being a border district, cross border movements between Uganda and Kenya provide an efficient channel for spread of epidemic diseases like cholera(15). During this outbreak, it is reported that Busia Kenya had a protracted cholera outbreak. The primary case travelled back to Sigulu after possible exposure at a hospital in Busia Kenya where she shared a ward with suspected cholera patients between June 27 and July 4 2023.

All age groups were affected. However, adults ≥ 15 years and females were more affected in this outbreak. Cholera is a water borne disease, and all age groups and gender can be affected by the infection, though some age groups and genders may be more affected than the others. Outbreaks in other settings have indeed shown different age groups being affected by cholera, for example in the cholera outbreak in the democratic republic of Congo, December 2022(16), Bagdad, Iraq in 2015(17) and Kampala, Uganda in 2018(18). Females especially those above 15 years play a more central role in water collection, food preparation and washing of clothes, either as wives or older siblings in the household (19,20). They therefore have more exposure to the water sources than male counterparts. In this investigation, we found that indeed females above 15 years were more affected.

The index case was suspected on July 16, ten days after the primary case developed symptoms of cholera. The 7-1-7 protocol requires that an infectious disease outbreak is detected within 7 days, notified within a day and response measures mounted within 7 days after notification. This outbreak was detected 10 days after the primary case developed symptoms. An outbreak of cholera is detected when two or more suspected cholera cases are reported from the same unit within a week of each other or if there is a death in a person 2 years and older due to acute watery diarrhea with no other known cause(21). This presented a missed opportunity to curb the outbreak. If the primary case had been detected, she would not have washed clothes at the lakeshore water collection point as usual, thus stopping spread of the outbreak.

Drinking of untreated water from unsafe water collection points is a major risk for cholera. The lakeshore communities affected by this outbreak drink untreated water from the lakeshores. Like in many other outbreaks in lake shore communities, this has



been found to be a risk factor for outbreaks (22–25). Fresh water access at Sigulu and Bukana Sub counties are 59% and 30% respectively (12). However, the borehole water was heavily salty and unpalatable, and the piped lake water was only available in Bukana subcounty at a fee of 0.08 USD per 20 liter Jerican. This cost is prohibitive to the community members who find it expensive. Provision of safe drinking water is a major preventive strategy for the control of cholera, in addition to improved hygiene and sanitation(26,27).

The oral cholera vaccine was deployed in Namayingo in October 2020 as a strategy to control outbreaks especially in the outbreak prone lakeshore communities of the district (6). This investigation confirms that several residents received the vaccine and either had a vaccination card or could recall the vaccination process. The vaccine is given in 2 doses, 14 days apart and targeting individuals over 2 years and It provides protection upto 80% for 3 years (10) . We found that the vaccine given in the 2020/2021 campaign was 84% protective of cholera in the individuals who received it 2 years post vaccination. This is consistent with other studies in Zambia and Malawi that report vaccine protection upto 80% when 2 doses are administered(28,29).

Study limitations

This investigation had some limitations including. First, some patients with cholera experience mild or nonspecific symptoms or asymptomatic and may not have been picked up during case-finding. This likely led to an under estimation of the magnitude of the outbreak. Secondly, although drinking untreated and contaminated lake water was found to be significantly associated with cholera, *Vibro cholerae* was not isolated from any of the water samples tested. This is likely because of late collection of samples, which was over three weeks since contamination with soiled clothes by the primary case. Additionally, being an open lake shore collection point, any residual reservoirs could have been washed away by lake shore waves or the concentration of biofilms harboring *vibro cholerae* was low(30).

Conclusion

This outbreak was associated with drinking contaminated and untreated lake shore water. However, receiving the OCV was protective against cholera. We recommended emergency distribution of water treatment tablets, sensitisation of the community about cholera and treatment of all drinking water and deployment of periodic OCV to the high-risk island residents. The public health actions implemented included, distribution of water treatment tablets, mass sensitisation of the communities in the affected sub counties about cholera and refresher training of health workers about cholera and its management.

Conflict of Interest

The authors declare that they had no conflict of interest.



Authors contribution

JR, SW, DO, BK, and LB designed the study and contributed to data collection and analysis. JR led the writing of the bulletin. SW, DO, RM, BK, LB, and ARA participated in bulletin writing and review to ensure scientific integrity and intellectual content. All authors contributed to the final draft of the bulletin.

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