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OUTBREAK REPORT

Cholera Outbreak in Chienge and Nchelenge Fishing Camps, Zambia, 2017

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On the 15th of February, 2017, the first case of suspected cholera was reported from Chienge district which has fishing camps with its neighbor district Nchelenge. We investigated the extent, the serotype of the *Vibrio cholera* and possible sources of exposure of the outbreak.
A suspected cholera case was defined as any resident from Chienge or Nchelenge who presented with acute watery diarrhea from February 14th through April 4th 2017. A Confirmed cholera case was defined as a suspected cholera case in which *Vibrio cholerae* O1 or O139 was isolated through culture. Rectal swabs from three case-patients were collected for culture. We interviewed suspected case-patients using a semi structured questionnaire. Twelve water samples were tested for fecal contamination.
A total of 73 suspected cases and 3 confirmed cases were identified. Majority (76%) of the cases were from Chienge district. The mean age was 24 years. *Vibrio cholera 01,* serotype Inaba was isolated. Of the 76 case-patients, 60 were interviewed. 27 percent of the suspected cases interviewed did not use soap for hand washing while 75% used stagnant water for hand washing. 7 of the 12 water points were contaminated with fecal coliforms. There is need to provide access to safe water and sanitation and effect social behavior change interventions on hygiene practices in Chienge and Nchelenge districts.

Background

Each year, there are 1.3 to 4.0 million cases of cholera, and 21, 000 to 143, 000 deaths worldwide [1]. The Sub-Saharan Africa accounts for 60% of the cases [2]. In southern Africa, 4 countries in 2010 reported 16, 330 cholera cases of which 41.6% were from Zambia [3]. Cholera has continued to be a public health problem in Zambia, in 2016 there were a total of 1,179 cumulative cases of cholera reported [4]. Most (73%) of the cholera outbreaks in Zambia have been reported in Lusaka province followed by Luapula province (7%) [3].

Nchelenge had recorded a total of 1, 155 cumulative cases of cholera from 2002 to 2007 [5]. Chienge district reported the last outbreak of cholera in 2013, with 217 case-patients and seven deaths. Since 2013, there have been no record of cholera outbreak in Nchelenge and Chienge districts, however, on the 15th of February, 2017 an acute diarrhea and vomiting illness, suspected to be cholera and the index case, was reported at Kabwe Rural Health Centre in Chienge district. The index case was a female 24-year-old who tested positive for Cholera using a Rapid Diagnostic Test (RDT). By 27th March, 2017, a total of 68 patients were admitted for suspected cholera in Chienge and Nchelenge districts. The Zambia Field Epidemiology Training Program was called by Ministry of Health to support the provincial office to control the cholera outbreak. We investigated the extent of the outbreak, the serotype and antibiotic susceptibility of the *Vibrio cholerae*, and possible sources of exposure.

Methods

Luapula province is located in the northern part of Zambia bordering the Democratic Republic of Congo. Chienge and Nchelenge are neighboring districts in Luapula province located in the valley along Luapula River and Lake Mweru. These districts are relatively rural and the main occupation for the population is subsistence farming and fishing. People usually move to fishing camps during the fishing period [5]. There is an influx of traders into these districts coming from all over the country and neighboring countries to buy fish and other farming produce. Kefulwa fishing camp boarders between Chienge and Nchelenge districts. Kafulwe Rural Health Centre is located in Kafulwe village on Lake Mweru about three kilometers west of Chienge-Nchelenge road.

We reviewed medical records from Kafulwe and Kabwe Rural Health Centres for suspected and confirmed cases. Information regarding date of onset of symptoms, signs, symptoms and outcome was collected and used to update the line list. We defined a suspected cholera case as any resident from Chienge or Nchelenge presenting with acute watery diarrhea from February 14th through April 4th, 2017. A Confirmed cholera case was defined as a suspected cholera case in which *Vibrio cholerae* O1 or O139 was isolated through culture. We interviewed all the case-patients that we could locate using a semi-structured questionnaire. The questionnaire included questions on demographics, cholera risk factors, sources of drinking water and knowledge about cholera.

Oral consent was obtained from the participants before administering the questionnaire. We explained the purpose of the interview to the participants and that participation was voluntary. Confidentiality was guaranteed by ensuring that data collected was anonymous and not identifying participant's information by use of codes. Permission was sought to review the records from the Provincial health officer and district health officer. Ethical approval was obtained post investigation prior to publishing, from the University of Zambia Biomedical Research Ethics Committee (UNZABREC)

We collected three rectal swabs from three suspected cholera patients (before the patients were given antibiotics) who were admitted to Kafulwe Rural Health Centre at the time of the outbreak (2nd April 2017) investigation. The three rectal swabs were transported to the University Teaching Hospital Laboratory in Lusaka, just over a thousand kilometers away. The samples were cultured and serological tests were done using using polyvalent O1 and mono-specific Ogawa and Inaba antisera. Susceptibility to antimicrobial agents namely ampicillin, *salbactam* and septrin was determined by the Kirby–Bauer disk diffusion method and interpreted as recommended by the National Committee for Clinical Laboratory Standards with commercial antimicrobial discs (Oxoid, Basingstoke, UK) [6].

Immediately after the interviews, water samples were collected from water points where the case-patients usually fetched drinking water. The water samples were tested using Hydrogen Sulphide test kit (Visio Technologies, Karnataka, India) to check for possible fecal contamination. Details of the water points, date, and time of sample collection and the name of the collector were indicated on each Hydrogen Sulphide test bottle for identification.

We worked together with the Luapula provincial health team to respond to the outbreak by giving health education and conducting contact tracing for the cholera case-patients that came during the time of the investigation. The health education involved discussions on cholera prevention with the case-patient's family and neighbors. Prophylaxis and health education on personal hygiene was given to contacts of case patients.

Table 1 Demographic Characteristics of Cholera Case-patients From Chienge and Nchelenge Districts, February to April 2017

CHARACTERISTIC	Number (%)	Population by Age	Attack Rate Per 100,000 People
Age (Years) (n=76)			
≥9	12 (16)	119,589	10
10- 19	18 (24)	73,368	25
20 – 29	23 (30)	53,582	43
30-39	12 (16)	44,019	27
≥40	11(14)	50,295	22
SEX (N=76)			
Males	51 (67)	167,975	30
Females	25 (33)	165,106	15
SYMPTOMS (n =50*)			
Watery Diarrhoea	50 (100)		
Vomiting	32 (64)		
Abdominal Pains	20 (40)		
Fever	8 (16)		
Headache	1 (2)		
EMPLOYMENT STATUS (n =60)**			
Fishermen	36 (60)		
Farmer	14 (23)		
Traders	6 (10)		
Unemployed	4 (7)		
Formal Employment	0 (0)		
EDUCATION (n=60)**			
No Education	19 (32)		
Primary	34 (57)		
Secondary	7 (12)		
Tertiary	0 (0)		
RESIDENCE (n =60)**			
Temporal	5 (87)		
Permanent	53 (91)		
Missing	2 (3)		

)

Table 2 Attack and Fatality Rate of cholera in Chienge and Nchelenge Districts of Luapula province February – April 2017 (n=76

District	n (%)		Number of Fatalities	Population	Attack Rate Per 100,000 People	Case Fatality Rate (%)
Chienge	58 (76)		1	141988	41	2
Nchelenge	17 (24)	0	191092	9	0	

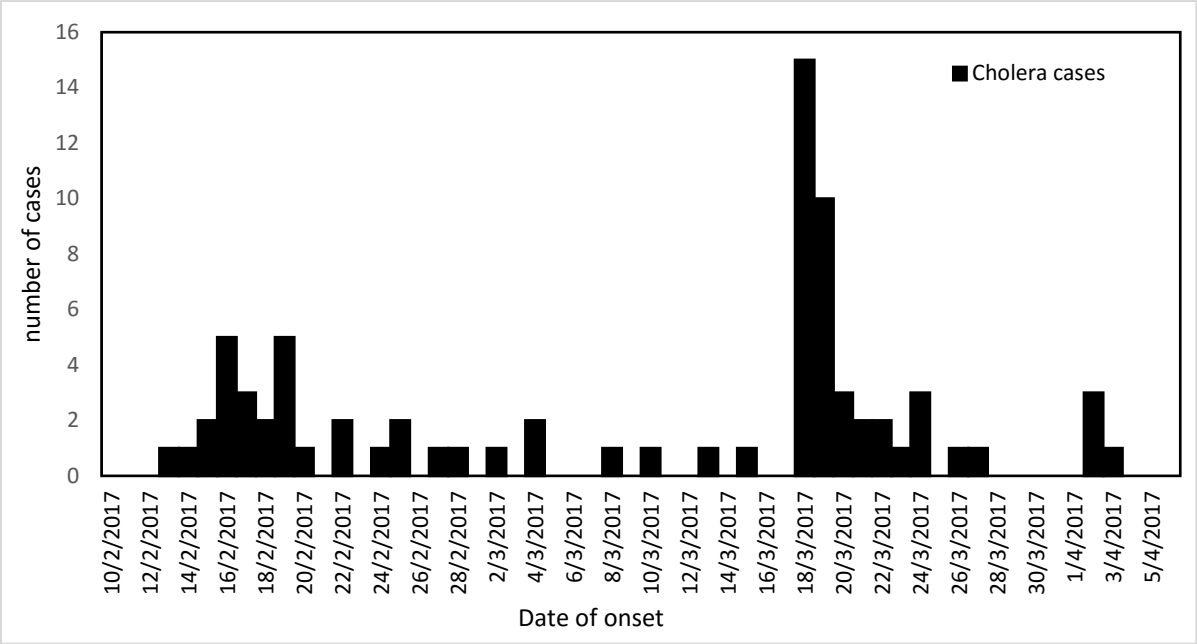

Figure 1 Cholera cases by date of symptom onset in Chienge and Nchelenge district, February – April, 2017 (n=76).

The data were entered and analyzed using Epi Info, Version 7 (CDC, Atlanta, USA). Descriptive statistics were carried out to measure relative frequencies, and percentages of the variables. The Central Statistics Office population projections [7] were used to calculate the attack rate per 100, 000 population. We described the outbreak by time, place and person

Results

Table 3 Knowledge, Attitudes and Practices of the Suspected Cholera cases towards Cholera from Chienge and Nchelenge District of Luapula Province of Zambia, February-April, 2017 (n=60)

Characteristic	Number (%)
Ever heard about cholera	
Yes	38 (63)
No	5 (8)
Don't know	12 (20)
Data Missing	5 (8)
How is cholera transmitted*	
By mosquito bites	3 (5)
Drinking contaminated water	26 (43)
Eating contaminated food	34 (57)
Close contact with a cholera patient	7 (12)
Airborne	10 (17)
Don't know	17 (28)
Knowledge on prevention*	
Cleaning surroundings	35 (58)
Treatment of water for drinking	28 (47)
Washing hands before eating	40 (67)
Washing hands after using toilets	30 (50)
Washing fruits before eating	11 (18)
Don't know	6 (10)

Table 1 shows attack rate of males (30/100, 000) was twice that of females (15/100, 000). The majority of the case-patients were from Chienge district (76%) which had an attack rate of 4 per 10, 000 population (Table 2). 3 case-patients were confirmed by culture. There was one death recorded in Chienge (case fatality of 2 %). The epi curve showed a propagated cholera outbreak (Figure 2). Table 4 shows Risk factors for the Suspected Cholera cases, of note is that 80% of the respondents reported consuming unsafe water. Health education on prevention of cholera was given to 845 contacts, 55 bottles of chlorine were also distributed.

Laboratory results confirmed *Vibrio cholera 01* isolates, serotype Inaba (from all the 3 samples cultured) sensitive to ciprofloxacin, ampicillin and salbactam and resistant to septrin. Of the 12 samples collected from the water points (shallow wells, boreholes, and a stream) within the affected communities and tested, five boreholes and two wells were contaminated with fecal coliforms

Discussion

The cholera outbreak in Chienge and Nchelenge districts was caused by *Vibrio cholera 01,* serotype Inaba. Chienge was the most affected than Nchelenge which might have been due to its densely populated fishing camps and trading area on the shores of Lake Mweru. *Vibrio cholera 01,* Ogawa was reported in the cholera outbreaks in Lusaka in the year 2003, 2004, 2015 and 2016 [8] which was different from what was isolated in Chienge and Nchelenge districts of Luapula province of Zambia. However, *Vibrio cholera 01,* serotype Inaba is the most common cause of cholera epidemics in other parts of Africa such as Democratic Republic of Congo (DRC), Kenya and Namibia [9, 10, 11]. These findings suggest that the index is likely to have acquired it from the neighboring areas along Lake Mweru in DRC. Among the tested antibiotics, *Vibrio cholerae* was only resistant to septrin. Complete resistance to septrin has continued in Zambia from the year 2004 to date which

might be due to its continued use for therapy and prophylaxis in other conditions [12].

Table 4 Risk factors for the Suspected Cholera cases from Chienge and Nchelenge District of Luapula Province of Zambia, February-April, 2017

Characteristic	Number (%)
Where do you buy your food	
Markets	13 (22)
Streets	15 (25)
Do not buy food	32 (53)
Treatment of water*	
Chlorination	11 (18)
Boiling	7 (12)
Do not treat	42 (70)
Residence	
Temporal	5 (8)
Permanent	53 (88)
Missing	2 (3)
Availability of toilets (pit latrines) in their homes	
Yes	56 (93)
No	4 (7)
Sources of drinking water for the households *	
Stream	21 (35)
Borehole	14 (23)
Shallow well	15 (25)
Lake	10 (18)
Spring	8 (13)
Rain water	2 (3)
Do you wash your hands with soap/ash?*	
With soap	34 (57)
With ash	14 (23)
With nothing	16 (27)
Do you use running water or stagnant water?*	
With running water	13 (22)
With stagnant water	45 (75)
Missing data	2 (3)

The results revealed that the attack rate for men was twice that of women which might have been because most of the case-patients were fishermen. Scarcity of toilets and proper sanitation in the fishing camps might have contributed to the fishermen acquiring cholera. This finding was consistent with a study done in Uganda, where Cholera outbreaks were reported as the main cause of morbidity and death in the fishing villages [13]. Studies in Burundi, the DRC and Tanzania have also shown that Cholera outbreaks have been reported in areas and villages on the lakeshores [14]. Cholera outbreaks are common in communities around the lake shores because aquatic environment like lakes are reservoirs for cholera [15]. In addition, studies have also shown that the predisposing factors of cholera outbreaks along the lakeshores include poor sanitation and hygiene, illiteracy and using contaminated lake water [16].

The findings showed that there were knowledge gaps about cholera transmission among the residents of Chienge and Nchelenge districts. Studies have also shown that people who have knowledge and understanding of a risk are likely to adopt preventive measures [18, 19]. Most case-patients did not observe water treatment procedures and proper personal hygiene prior the outbreak which might have contributed to the transmission of cholera from one person to another thus resulting in a propagated outbreak. A study conducted in in 2010 in Nchelenge district also revealed that most (52%) of the respondents did not observe

personal hygiene such as washing hands after using the toilet [5]. A study assessing knowledge, attitudes and practices regarding cholera in South Africa Limpopo area, reported that most people (86%) had knowledge on cholera transmission however, most hygiene practices such as washing hands was not followed [17]

Some water points were found to be contaminated; this may be attributed to the fact that the water sources in this

area were groundwater sources such as shallow wells, springs, streams and wells which are easily contaminated by fecal material [20]. Most outbreaks resulting from contamination of ground water sources such as wells and boreholes with *V. cholera* have been reported in other countries [11, 21]. In most of these outbreaks, an epidemiological link to a contaminated ground water sources has been established [13, 21, 22]. An outbreak of cholera reported among participants at a wedding ceremony in a village in Qazvin, Iran was associated to well water [21]. Approximately 95,531 suspected cases of cholera reported in Zimbabwe in 2008 were linked to drinking contaminated water from boreholes and wells [23].

There were two limitations identified in the investigations. Firstly, only a few specimens were confirmed by culture because the microbiology laboratory in Luapula province was closed for renovations. Therefore, confirmation of the etiology of the outbreak was delayed because specimens had to be transported to the University Teaching Hospital Laboratory in Lusaka for culture which is over a thousand kilometers away from Chienge and Nchelenge. Secondly, an analytical study to determine risk factors for the outbreak was not done. In spite of only confirming 3 out of 76 cases, this report is a record of the serotype and the antimicrobial susceptibility pattern of *Vibrio cholera* isolated in Luapula province. Additionally, the antimicrobial susceptibility pattern of *Vibrio cholera* recorded is essential to guide the selection of antibiotics and monitor changing trends in the local isolates of *Vibrio cholera*. Despite these limitations, this report provides important epidemiological information about the outbreak that happened in this area in 2017, and this information can be used to institute control measures and serve as a reference point for future outbreaks if any.

Providing safe water and proper management of excreta to avoid contamination of other water sources are significant measures to decrease cholera transmission in Chienge and Nchelenge districts. We recommend a health education intervention program to educate people on transmission, prevention and control of cholera with a lot of emphasis on the use of water-treatment procedures. As a short-term measure, introduction of cholera vaccination among the population at risk would be an important step to prevent and control cholera in Chienge and Nchelenge districts as some of the social determinants may take long to be addressed. Finally, joint cross boarder surveillance and response programs between Zambia and the DRC would be essential to decrease cholera transmission in communities along Lake Mweru.

The outbreak of cholera in Chienge and Nchelenge from February 14th through 4th April 2017 was caused by *Vibrio cholera 01,* serotype Inaba. Poor sanitation and personal hygiene, drinking unsafe water from the shallow wells and boreholes might have been the possible sources of exposure for developing cholera in both Chienge and Nchelenge. We recommend further research on factors associated with cholera outbreaks in Chienge and Nchelenge. The findings suggest the need of continuous sensitization of cholera for the population at risk such as the fishing camps even in the absence of outbreaks. It is strongly recommended that providing safe water and social behavior change communication for the population at risk to improve appropriate hygienic practices and sanitation are important measures that should be taken to reduce cholera transmission in Chienge and Nchelenge district of Zambia.

Competing Interests

The authors declare that they have no competing interests.

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