ORIGINAL ARTICLE

Factors Associated With the Recurring Cholera Outbreaks in Sinazongwe District of Southern Zambia

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ABSTRACT

Objective: Possible risk factors associated with the recurring Cholera outbreaks in Malima and Nkandabbwe communities as well as know the available knowledge in managing and preventing the disease.

Methods: The data was derived from mixed methods of descriptive and analytical cross sectional design with both quantitative and qualitative data collection strategies employed. Analyses of potential risk factors were stratified by safe drinking water, safe waste disposal, knowledge levels and climatic variations. Data was presented in frequency tables. Chi square tests were done to determine possible associations. All variables that were significant multiple logistic regression analysis was performed to control for confounders.

Results: There was a statistical significance in terms of households hand washing with safe water as well as saving hot food [$X^2 = 19.3783$, df=4, P value = 0.001]. A range of variables from number of people in a household, occupation, main source of water, water treatment, reasons not treating water to knowledge about cholera were all found significant when $\mathbf{X^2}$ tests were performed. However, after running the multivariate regression analysis test, only number of people in a household [coef =.0712297; Std.Err = .0263932; t=2.70; p=0.008; 95CI .0190736 - .1233858] and the main source of drinking water were statistically significant [coef = -.0566683; Std.Err = .011744; t=-4.83; p=0.000; 95CI -.0798758 - -.0334607]. The rainfall patterns produced a correlation of 0.40000 was significant at p value 0.05. Though small, the correlation is significant and suggests that cholera cases vary with rainfall patterns for each year. Increased rainfall patterns may be associated with high numbers of reported cases.

Conclusion: Water treatment was found to be occasional and most household's access water from surface sources such as rivers, lakes and streams. Chlorine is well known for water purification but social marketing is lacking due to free distributions.

INTRODUCTION

Cholera is an acute intestinal bacterial disease with an incubation period of one to two days. There are more than sixty serotypes of *Vibrio cholera*, a type of bacteria, but only serogroup 01 causes cholera. The pathogen multiplies in the gut of the carrier and is excreted through the stool. The bacteria are sensitive to high temperatures, acidity and dry conditions (3).

The disease of Cholera is mainly endemic in low income countries in Africa, Asia, Central and South America (2). A total of 177 963 cases and 4 031 deaths corresponding to a 2.3% case fatality rate have been reported to WHO 2007 with Africa having the largest share of worldwide reported Cholera cases 94% and 96% deaths. This share of official reported results from Africa has from 20% in the 1970's to 94% in the period between 2000 and 2005. Asia share has simultaneously dropped from 80% to 5.2% over the same three decades. With regards to reported deaths, Africa's share has increased from 22% to 97% while Asia has reduced

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from 77% to 2.4%. Places where Cholera has been endemic have certain common features such as low lying lands, less than 500feet above the sea level and often subject to flooding by the large rivers which flow through them; the climate change is hot and humid; and the population density is high (3). These features are similar malima and Nkandabbwe sub sites of Sinazongwe district were Cholera has been prevalent. In 2009, the district reported the following number of cases: Chiyabi 15 cases, Buleyamalima 16 cases, Sinamalima 74 cases, Siatwiinda 1 case and Sinazeze 1 case (4). Epidemics of infectious diseases such as cholera, meningococcal, meningitis, typhoid, typhus and plague are an important threat in many tropical countries (5). Long term solutions are needed to prepare communities in the fight of such diseases.

Therefore, this study the main objective of this study was to describe the potential risk factors to the recurring of Cholera outbreaks in Malima and Nkandabbwe. The rationale of the study was that the epidemic in these communities may be a familiar feature of everyday life and not necessarily water borne hence to determine daily behaviour patterns of water safety, hygiene food handling, proper utensil cleaning; hand washing safe disposal of waste could be lacking and hence perpetuating Cholera outbreaks. Outbreak control measures often require changes to hygienic behaviour.

METHODS

This was a mixed methods descriptive and analytical cross sectional design with both quantitative as well as qualitative collection strategies employed. The study areas were Malima and Nkandabbwe communities as they often report Cholera outbreaks in the district. Heads of households were the respondents in the study. In situations where the heads of households were not present at the time of data collection, senior member of the family who were above 18 years of age were interviewed. They were not restricted to gender. A sampling frame comprising the total number of households in both Malima and Nkandabbwe was used. The criteria for households' selection to participation in the study were through random sampling and later systematic probability sampling. This was chosen so as to give an equal chance to the entire households in the study communities to participate in the study. A total 152 households, i.e., 72 from Malima and 80 from Nkandabbwe were selected to take part in the study. The sampling interval was to interview every 13th household in both communities.

In terms of focus group discussions, participants were chosen purposefully in terms of distance to the nearest health centre and only among those households that did not take part in answering the questionnaire. One focus group discussion (FGD) in each community was done, i.e., Malima and Nkandabbwe. Each FGD was comprised of 10 members and gender was equally being considered. The reason of choosing new people in the focus group discussions was to avoid contamination of the information as heads of households who would have answered the questionnaire will have prior information to the discussions.

Sample size was 151 households. The *inclusion criteria* were that heads of households or family members above 18 years were interviewed in the study. These household had existed in the study community for a period of over 6 months. The *exclusion criteria* were members of the family below 18 years. Visiting adults were also not to act as alternate in situation where the required adults were absent in the household.

Both primary and secondary data were collected through structured interviews through designing a questionnaire and the focus group discussions (FGD. Secondary data from the district health office such as cases recorded and the amount of rain recorded were collected to answer the questions in the study. Epi data was used for data entering and storing a data base while STATA for analysis. Analysis was restricted to access to safe water, safe waste disposal, and knowledge levels about the disease as well as trends in rainfall patterns against the reported cholera cases. The monthly rainfall records were taken from the month of October current year to the month of March in the following

year. Cumulative rainfall data for each cropping period was used for possible association with reported cholera cases from 2006 to 2011.

Descriptive variables were analyzed by calculating frequencies, i.e., response rates of the risk factors determinants questions. Findings were presented in frequency tables and chi square cross tabulations were used to show possible associations. Data on climatic variations were analyzed using Spearman Rank Correlation. Further analysis of the variables to control for confounders was done doing the multivariate logistic regression model. The p values less than 0.05 were considered significant. These results were later discussed to give findings of the study

The study protocol received clearance from the University of Zambia Biomedical Research Ethics Committee (UNZABREC). Other ethical clearances were from the Sinazongwe District Community Medical Office and the Sinazongwe District Commissioners' Office. Participants in the study were informed about the purpose of the study and consent was sought. Benefits to participate in the study were given to the participants. However, individuals who could not give consent were not forced but their decision was respected. A consent form was signed for individuals who consented. The literate participants signed on their own while the illiterate participants signed through the use of ink and thumb print. Study participants completing participation was at their discretion. They were free to withdraw from the study at any point during the course of the study.

RESULTS

Demographic data: The variables chosen to describe the respondent's characteristics were gender, age, marital status, income, education, number of people in the household and occupation. It was observed among the respondents that 24.5% were male while 75.5% were female. The majority of the respondents were in the ages between the ages of 36 to 65 years and the score was 47.68%. Many respondents were married totaling about 64.24%, 13.25% single, 7.28% divorced, and 10.6% widow. The majority (45.7%) of the surveyed respondents depended on agriculture for their economic livelihood while fishing was the second most popular occupation followed by trading

Access to safe water and food: The results showed that 37.09% access household's water from surface sources such as streams and the lake.

Table 1: Household's water safety, consistency in water treatment and safe disposal of waste.

Variable	Frequency	Percentage
Safe water		
Household estimated time needed		
Less than 15 minutes	86	57
Between 15 and 30 minutes	58	38
Between 30 and 45 minutes	7	5
Approximate distance covered to get water		
Less than 500m	145	96
Between 500m and 1km	5	3
Between 1km and 2km	1	1
Household water treatment		
Yes	111	73.51
No	40	29.49
Households methods of making drinking water safe		
Boil	52	46.85
Add chlorine	59	53.15
Reason for not treating water always		
It takes a lot of time	52	37.14
It is costly	47	33.57
Water is ok	23	16.43
Don't know	5	3.57
Other	13	9.29
Consistency in water treatment		
Always	11	10
Sometimes	100	90
Safe disposal of waste		
HH kind of toilet facility		
Pit latrine	131	86.75
No toilet/use the bush	20	13.25
households sharing toilet facility		
Yes	38	29.01
No	93	70.99
Households disposal of daily refuse		
Rubbish pit	72	47.68
House bin	2	1.32
Across/ in the road	36	23.84
Other	40	26.49
I do not know	1	0.66

This was followed by 35.10% where they accessed water from the boreholes. Piped water was 27 households representing 17.88% and among them, 22 from Malima and 5 from Nkandabbwe. Table 1 below shows other possible factors to household water safety, consistency of household's water purification and safe disposal of waste.

Knowledge on Cholera: The respondents were asked about the common diseases in the community. The result showed that Malaria was mentioned 137 times while Diarrhea 88 times. None of the other diseases were mentioned.

In the focus group discussions, it was also revealed malaria, diarrhea and cholera are common disease in the community. Among the mentioned diseases, cholera was said to be a seasonal disease and that it occurs during the rainy season. The question was further narrowed to respondents knowing about cholera as a disease. The results showed that 91.78% said they know about Cholera while 8.22% said they had no knowledge about cholera. The results show that watery diarrhea and vomiting were well known as symptoms for choleras they were both mentioned 134 times each. In focus group discussions, some of the signs and symptoms of cholera mentioned was vomiting, diarrhea, body hotness, passing light and watery feces. The results show that 138 times was drinking contaminated water mentioned as a medium to transmitting cholera. While 128 times was mentioned that cholera is transmitted through eating contaminated food.

Trends of rainfall in relation to reported Cholera cases: the spearman correlation of analysis between the recorded number of cholera cases and the rainfall patterns for the 4 chosen years produced a correlation of 0.40000 was significant at p value 0.05. Though small, the correlation is significant and suggests that cholera cases vary with rainfall patterns for each year. Increased rainfall patterns may be associated with high numbers of reported cases.

Other possible risk factors

Having observed the frequencies, table 4.3.0 below shows X^2 analysis to determine possible sources of association in the variable under the study.

Table 4.3.0: Potential risk factors and measures of associations

Potential Risk Factor	n(yes)	n(No)	df	. .	P value
Number of people in a HH					
Less than 5	86(56.95%)	1(0.66%)			
Between 5 and 10	43(28.48%)	6(3.97%)			
Above 10	13(8.61%)	2(1.32%)	1	8.5001	0.014
Occupation					
Fishing	429(27.81%)	0(0%)			
Agriculture	60(39.74%)	9(5.96%)			
Trading	40(26.49%)	0(0%)	2	11.3735	0.003
Main source of drinking water					
Piped water to the HH	19(12.58%)	8(5.38%)			
Communal tap	14(9.27%)	0(0%)			
Borehole water	53(35.10%)	0(0%)			
Surface water	55(36.42%)	1(0.66%)			
Protected dug well	1(0.66%)	0(0%)	4	33.0383	0.000
Time taken to the water source and back to the HH					
Less than 15 minutes	77(50.99%)	9(5.96%)			
Between 15 and 30 minutes	53(38.41%)	0(0%)			
Between 30 and 45 minutes	7(4.64%)	0(0%)	2	7.2335	0.027
Water treatment					
Yes	108(71.52%)	3(1.99%)			
No	34(22.52%)	6(3.97%)	1	7.9332	0.005
Reasons water not treated					
It takes a lot of time	51(35.92%)	1(0.70)			
It is costly	45(31.69%)	2(1.41)			
Water is ok	22(15.49%)	1(0.70)			
Don't know	5(3.52%)	0(0%)			
Other	10(7.04%)	5(3.52%)	4	20.9567	0.000
Knowledge about Cholera					
Yes	131(89.73%)	3(2.05%)			
No	6(4.11%)	6(4.11%)	1	43.4336	0.000
Last time got information on health issues(cholera)					
Recently	64(42.38%)	0(0%)			
Long time ago	46(30.46%)	7(4.64%)			
I cannot remember	32(21.19%)	2(1.32%)	2	9.0232	0.011

A *multivariate analysis* was further conducted to control for confounders. The entire above variables were included in the model as they had proved significant. However, table 4.3.1 below shows variables in that remained significant after adjusting for other variables.

Table 4.3.1: Potential factors Multivariate Regression Analysis

Equation	obs	PARMS	RMSE	R-sq	F	P
Cholerapat	151	3	.216788	0.1782	16.04376	0.000
Cholerapat	Coef.	Std. Err.	T	P>|t|	[95% conf.	Interval
number of people in HH	.0712297	.0263932	2.70	0.008	.0190736	.1233858
main source of water	- .0566683	.011744	-4.83	0.000	- .0798758	- .0334607
	1.158641	.062979	18.40	0.000	1.034186	1.283095

DISCUSSION

The findings revealed that households main source of water were surface sources such as lakes and rivers. This is in line with the Sinazongwe District Situational Analysis which highlighted that the district is rural with a large number of rural population of about 90 000, i.e., excluding urban population (6). The sources of water for the rural population are mostly from streams, rivers, dams, and springs which are not well protected and hence unsafe water for household use. However, some areas in the rural communities have been serviced with protected water sources such as boreholes and protected wells. The District Situational Analysis document further stated that 38% of the rural district population are without access to safe drinking water (6). In a study conducted in Kenya found that among the risk factors identified for cholera, drinking water from Lake Victoria was of particular interest. The epidemic had most affected the districts of Nyanza Province near Lake Victoria (7). Water supply in Malima and Nkandabbwe is erratic as a result of drought valley climatic conditions. Therefore, discouraging household's use of river and lake water may not be helpful as it may result in water shortages. The proposed solution is to discourage contamination at the water points and also promote households water treatment at the point of use.

The study also revealed that 32.45% had no specific place for water storage. The study conducted in Kenya found that keeping water stored in the home in sealed or covered containers was protective against cholera (8). In addition, the consistency in households water treatment was worrying as the practice observed in the present study was very low. District Community Medical Office distributes chlorine. The community must always be waiting for the next distribution and not used to buy chlorine. The common vehicle for cholera transmission is contaminated water. This is because cholera is water and food borne disease spread through fecal–oral transmission (9). Insufficient infrastructures for safe water, hygiene, and sanitation are recognized as major factors that contribute to cholera outbreak. Another evidence based study in agreement to this study is from Tanzania that showed that recurrences of cholera outbreaks in Tanzania were due to the use of inadequate and contaminated water (10). Therefore, the recurrences of cholera outbreaks in Malima and Nkandabbwe may be associated with the community members getting water for drinking from surface sources such as streams, rivers, lakes and inconsistent water treatment.

Safe disposal of waste: the majority of the households had pit latrine and were also a reduced number of households sharing latrines. Many households seem now to have pit latrines facility at their household, however, the sewer system, flush/pour water facility, ventilated pit latrine with a slab are lacking. the standards of these present toilet facilities in the community are worrying as they are very basic without a slab. Improved latrines are hygienically approved as they are washable and can be cleaned after use for the next person. These results are consistent with the Sinazongwe District Situational Analysis also revealed that only 14% of

the total population has access to sanitary facilities, i.e., pit latrines with a slab, which is too low (6). The sanitary facilities are still lacking and the community members need to upgrade the current sanitary services to improved sanitary services.

Knowledge on cholera: The common diseases identified in the community are malaria and diarrhea. These results are similar to Sinazongwe district situational analysis were the top 5 causes of morbidity in the District are stated as Malaria, Upper Respiratory tract Infections, Diarrhea, Eye infections, and injuries, in that order (6). The most disease that the district is fighting with throughout the months in each year is malaria. On the other hand, it was observed that the presence of cholera in both communities is well known. With references to the top disease mentioned as malaria and the high population acknowledging to have heard of a cholera patient in the community, it could be said that cholera is a seasonal disease in the district. Cholera may be a forgotten disease and only remembered when there is an outbreak. There is need to maintain high levels of caution about cholera in order to make a free zone from diseases.

On the other hand, the knowledge about cholera as the disease and drinking untreated water as a risk factor, the behaviour lagged behind the knowledge levels. In the absence of chlorine other methods like boiling are not done as they are considered to take a lot of time. Similar results were observed in Peru where 88% of Pueblo Libre and 92% of Napo River respondents believed that drinking treated water was important to prevent cholera, but only 25% and 23%, respectively, always drank treated water (11). In another case-control study conducted in Iquitos during the epidemic implicated drinking untreated water as a risk factor for cholera (12). Therefore, having the knowledge does not automatically result into practice. This agrees with the cognitive dissonance theory. The theory states that when people become aware that their freely chosen actions violate important or relevant attitudes, the inconsistency produces an uncomfortable state of arousal called *dissonance*, which motivates people to change their initial attitudes to make them consistent with their behavior. For cognitive dissonance to occur, it is important that the attitude is important and self-relevant. The four steps necessary to produce dissonance, and for that dissonance to produce attitude change are that t*he individual must perceive the action as inconsistent,* t*he individual must take personal responsibility for the action, the individual must experience uncomfortable physiological arousal* and *the individual must attribute the arousal to the inconsistency between attitude and action (*13). There is need for change of attitude among individual behaviours to influence positive change. People may have the information about risk behaviours but still act the same risk behaviour. Therefore, effective community sensitizations messages that will draw individual behaviours with the focus on attitude change must be encouraged.

Trend of rainfall patterns in relation to reported Cholera cases: In this study, the correlation of rainfall patterns in relation to reported cases was quiet small and moderate. It may not be a very firm correlation but is significant and suggests that cholera cases vary with rainfall patterns for each year. Increased rainfall patterns may be associated with high numbers of reported cases. Similar studies found that after analyzing several years of disease and environmental data from cholera-endemic areas of Zanzibar, Tanzania, scientists from the International Vaccine Institute in Seoul, Korea a mere one degree Celsius increase in the average monthly minimum temperature was a warning sign that cholera cases were likely to double within four months (14). Similarly, a 200-millimeter increase in monthly rainfall totals indicated a slightly lower but still substantial increase could be expected within two months. The consistency of the results in the present study and others that have found rainfall patterns to trigger some disease burdens as this is the case for cholera could be used for Public Health planning. The studies suggest for a combined team of experts from geographical, health practitioner and social behaviour change health promoters to

plan ahead the outbreaks with signals of increase in temperature and rainfall. Developing a reliable forecasting system that would monitor temperatures and rainfall patterns is vital in preventing future outbreaks. Cholera is particularly feared for its ability to cause such a sudden and intense onset diarrhea that a victim can go from seemingly healthy to death in 24 hours. Also, when outbreaks occur, the number of people infected increases dramatically and the case fatality rate can rise rapidly, too.

Other possible risk factors: a number of variables showed significance but only number of people in a household and the main source of drinking remained significance after conducting regression analysis. This may mean that the recurrence cases of cholera may be as result of unsafe water.

In addition, households were not in the habit of serving hot food as it was done occasionally. Saving hot food has been identified as a protective factor in cholera transmission. A study review showed that among foods and beverages served on the flight, only a cold seafood salad, served between Lima and Los Angeles County, was strongly associated with culture-confirmed infection, i.e., odds ratio of 11 6; 95 % confidence interval, 3-3-44 5 (15). Eating cold foods has remained a risk factor to diarrheal diseases and cholera has also reported cases resulting from such risk factor. Hot food is hygienically good and bacteria are unlike to be present.

The geographical land of both Malima and Nkandabbwe communities is rocky and this came out during the focus group discussions. This has resulted in constructing pit latrines that are less deep and quiet temporal and it may be costly to make a latrine with washable slab as the toilet may not be able to stand for a long time. On the other hand, a paper review on water and sanitation found that most of the soil type in Arban Munich, Ethiopia was fragile to support structures so collapsing and flooding of pit latrines was identified as a challenge to implementing improved sanitation toilets. Most of the pit latrines were found to be shallow because of the loose soil structure. The households had a challenge to build built washable toilets that are shallow as it proved to be expensive (16). Such expenses to build washable pit latrines may be a similar in Malima and Nkandabbwe and this could be the reason why the community has pit latrines without washable floors. Building deeper toilets so as to have long lasting pit latrines has proved to be a challenge as the land is rocky. Concerted efforts from other partners may be needed to build long lasting pit latrines which are washable.

CONCLUSION

Cholera has recurred in Malima and Nkandabbwe communities of Sinazongwe district and in this study revealed that water treatment is occasional in most households. Some households had no specific container for drinking water and this increased the chances of drinking untreated water in many households. This is an identified risk to cholera and could be contributing to reported diarrhea cases in the communities. Chlorine is well known to water safe unlike other methods. However, social marketing of chlorine may be lacking as the community see it as an expense to buy product chlorine against their own health. The majority of the households have pit latrines but without washable floors. The rainfall patterns and the cholera cases vary from year to year. This is important for the district Disaster Management Team to intensify hygiene sensitizations prior to the beginning of the rain season.

Cholera is known for instant killing and this is why it should never be treated as a forgotten disease to areas like Malima and Nkandabbwe were it has reoccurred. The community sanitation teams should be strengthened and encouraged to consistently remind the local people about the dangers of cholera as well as diarrhea. The occurrence of cholera and diarrhea come with other costs related to productivity loss and premature death, diverting expenditures from other essential items. Furthermore, comprehensive district planning with a variety of expertise may use weather patterns to plan for successful management of cholera should the outbreak prevail.

Study limitations

The study was not done concurrently with cases as would have been reported. This reveal potential limitation to disease control measures during outbreaks. However, the study collected behavioural information that saves purpose for those health promotion strategies to implement in the community so as to control the disease and reduce future outbreaks

Competing interests

There are no competing interests to establishing this study. It was just a requirement in partial fulfillment to the award of the Master Science in Public Health.

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