Analysis of Factors Contributing to the Spread of Cholera in Developing Countries

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ABSTRACT

Objective: Cholera has been endemic in Nigeria since the 1970s and has resulted in several early deaths, which probably could have been avoided. This study examined the various factors that contribute to the infection and spread of cholera in Benue State, Nigeria, from 2008 to 2017. We also proposed a cloud based health management system (CBHMS) for the timely identification and management of cholera in an epidemic.

Materials and Methods: A cluster random sampling in the form of a close ended questionnaire was used to collect data from a sample of 420 participants comprising farmers, traders, housewives, and students who were randomly selected from different locations in Makurdi. Statistical analyses, such as demographics, reliability, and descriptive analysis, of the collected data were performed, and a socio-technical design approached was used in the system development.

Results: Terrorism, floods, improper sewage disposal, and lack of environmental hygiene were the main causes of the spread of cholera in Benue State.

Conclusion: The research highlights the factors aiding the spread of cholera in Nigeria by directing donor agencies and government to channel their focus and prepare ahead in view of an emergency. The proposed CBHMS will aid the early detection and management of cholera in an epidemic.

Keywords: Cholera, Cloud, health, management, system, Nigeria

Introduction

The prevalence of communicable diseases has been ravaging in the African countries since many years; moreover, it has been recorded as one of the major causes of death. Since 2010, there has been a reduction (1% per annum) in the number of deaths associated with communicable diseases [1]. However, the World Health Organization (WHO) believes that the statistics are likely to change, and the number will increase sporadically before 2050. Some of the communicable diseases include small pox, dengue fever, rabies, Hantavirus infection, hepatitis A and B, measles, human immunodeficiency virus infection/acquired immunodeficiency syndrome, cholera, Zika, and the most recent Ebola virus. While the first-world countries have eradicated some of these diseases, the second- and third-world countries are still battling them. In this study, we focused on cholera to provide further clarity.

Vibrio cholerae of the Vibrionaceae family is the causative agent for cholera. Cholera is characterized by an intense stomach infection caused by the consumption of foods and water contaminated by the bacteria. Various stereotypes of cholera are known; however, only cholera genetic V.01 and 0139 are known to be responsible for the disease. The manifestation is in the form of diarrhea and a subsequent very rapid dehydration process followed by death if untreated owing to the limited incubation time [2]. The bacterium can survive in any environment, and the disease can affect both genders and individuals of all age groups. An individual could be asymptomatically infected with *V. cholerae*; however, between 7 and 14 days of the infection, traces of the bacteria could be found in the feces of the infected individual [3]. Human attitude and behavior, such as living in a well-sanitized environment, appropriately cooking food before consumption, using sterilized water, and following general personal hygiene, contribute to a great extent to the survival and spread of cholera [4].

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Cholera cases have been quite noticeable across countries in West Africa. Ghana, for example, has witnessed about 4,190 cases of cholera resulting in 36 deaths with causes linked to unhygienic environment and inappropriate fecal disposal [5]. In Senegal, between 2002 and 2005, about 31,719 cases and 458 deaths related to cholera have been reported, which was largely attributed to the adverse effects of a devastating flood. This record has been the highest to date in the country. An article published by the Guardian [6] revealed the poor rate of fecal waste disposal in Liberia. It is estimated that six out of seven households in Liberia do not have access to a toilet, and the only source of water available to the people are rivers and streams, which perhaps might be contaminated.

In Nigeria, cholera has been on the rise since the 1970s majorly due to extreme poverty and lack of good potable drinking water. The probable reasons are the result of government negligence in embarking on initiatives that will improve the lives of an ordinary citizen. The majority of the people in Benue State, Nigeria, are rural dwellers who have little or no access to basic modern facilities; hence, the outbreak of diseases is inevitable.

The aim of this study therefore is to primarily investigate the mitigating factors to which cholera is endemic in Nigeria with the need of establishing a relationship between cholera and people's willingness to treatment by profiling way(s) for curtailing and purposing a way that aids early detection and management via remote access. The study will help determine the trend and pattern of the disease, enabling the government and donor agencies to prepare adequately for the future. Furthermore, the findings from this study could help the government, donor agencies, and health care institutions focus their searchlight on areas/persons that are most vulnerable.

Geographical description of the study area

Benue State is predominantly a rural community comprising 23 local government areas, and the state capital is located in Makurdi. Otukpo and Gboko are the second largest communities and situated in the middle belt region of Nigeria. The state (Figure 1) is surrounded by Nassarawa State in the north, Cross River State in the south, Taraba State in the east, and Enugu/Kogi state in the west. Geographically, the state lies between longitude 8.75° N and latitude 7.33° E with a population of 4,253,641 according to the last census of 2006 [7] and a land mass covering up to 34,059 km².

The state has two major rivers (River Benue and River Kastina-ala) along with streams and ponds, which serve as the primary and only sources of water supply, particularly to the rural/remote villages. It is possible that some of these streams/ponds dry up during the summer season due to climate change, which leads to a severe water scarcity. Hence, the habitants use water from the dirty and unhygienic environment, thereby exposing themselves to contaminated/water-borne diseases [8]. In addition, during the raining season, the rivers, streams, and ponds rise above the normal water level, which may lead to floods and spread of vector species as well as cholera.

Season and pattern of infection in Nigeria

Cholera is a climate-based disease and findings has shown that the changes in the environment or climate thus indeed influence the spread of cholera [9]. Based on the epidemiological observation of various cholera epidemics in Nigeria, it has been seen that the seasonal distribution of the outbreak based on age and gender is not constant [10]. For example, in a recent epidemic at an internally displaced persons camp in Borno State, Nigeria, in September of 2015, a total of 385 cases and 13 deaths were recorded in a population of 11,384, with an attack rate of 3.4% [11]. In contrast, according to the recent WHO report, as of June 30 2017, there was an epidemic in Kwara State and 1,558 cases and 11 deaths were reported with a 0.7% fatality rate. Out of these reported cases, 49% were females and 50% were males. All the age groups were found to have been affected in these reported cases [12].

Nigeria has two seasons: the raining season and the dry seasons. The raining season is known to be associated with floods that lead to an increase in the water level, a phenomenon that favors the growth and spread of bacteria and some other vector species, and cholera, making cholera a seasonal infection [13]. However, the climate change can provoke the level of air pollution [14], thereby increasing the rate of infection [15]. Also, the authors have investigated a cholera epidemic that occurred in the dry season in Calabar, southern Nigeria. Moreover, a change in the climate directly affects the lives of the poor making them vulnerable and susceptible to diseases and infections since they live in an unhygienic environment and drink contaminated water [16]. Hence, the seasonal distribution of cholera infection is not really applicable to Nigeria since the epidemic has been known to occur both in the dry and rainy seasons.

Chronology of the Epidemics of Cholera in Nigeria

According to WHO, Lagos in Nigeria recorded the first ever cases of cholera with a figure of 22,931 and 2,945 deaths. Subsequently, four northern states in the late 1970s witnessed about 260 deaths from the pandemic, mainly affecting Maiduguri, Jere, Gwoza, Biu, and Dikwa local government councils [17]. According to the WHO, between 1991 and June 2017, Nigeria has recorded a significant number of deaths due to a cholera outbreak with the pandemics in 1991 and 2010, which recorded total cases of 59,478 and 7,654 deaths and 26,240 cases and 1,182 deaths, respectively, being the highest to date [18]. The data from 2008 to 2017 are presented in Table 1 [19-26].

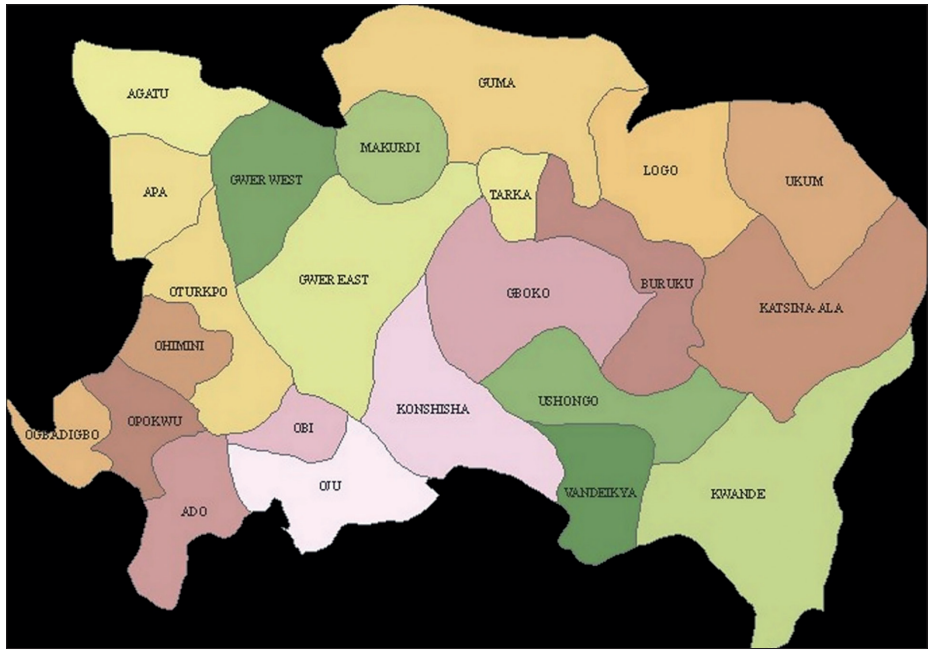

Figure 1. Map of Benue State

Table 1. Cholera epidemic in Nigeria for 10 years

Year	State	Total reported cases	Total reported deaths	CFR (%)	Causes	Reference
2008	Zamfara, Bauchi, Kano, Katsina, Benue	1,7854	429	2.4	Improper sewage disposal	[18]
2009	Borno	260	96	3.27	Excreta of infected persons washed by rain into wells and ponds	[19]
2010	Bauchi, Kastina, Yobe Taraba, Jigawa, FCT, Osun, Gombe, Borno, Kaduna, Rivers, Cross River, Plateau, Benue	26,240	1,182	4.5	Improper sewage disposal washed by rain into wells and ponds	[20, 21]
2011	Osun, plateau Bauchi, Kaduna, Benue	22,454	715	3.2	-	[18]
2013	Benue	80	12	-	Inadequate access to medical care	[22]
2014	Bauchi, Ebonyi, FCT, Kano	35,996	20	3.3	-	[23]
2015	Rivers, Kano, Ebonyi, Anambra	2,108	97	4.7	-	[24]
2016	Lagos	45	6	-	Consumption of a staple food	[25]
2017	Borno, Kwara	5,492	65	0.7	Boko Haram, access to clean water and poor hygiene	[26,12]

CFR: case fatality rate; FCT: Federal Capital Territory; WHO: World Health Organization

Cloud-Based Health Management System

One of our main goals was to design a cost-effective cloud-based health management system (CBHMS) that could detect and manage cholera using a socio-technical design methodology, which can mainly be used in the health care information design [27] and is easily affordable and accessible, considering most importantly the developing countries. CBHMS is an envisaged technology, which has not been implemented. Upon adoption and implementation, the proposed model is expected to enhance the early detection, identification, and treatment of cholera in the future.

A recent disclosure estimated that 98.3 million Nigerians are active internet users. Likewise, the International Telecommunication Union, 2017, reported that in per one-hundred population of Nigeria, 75.9% of them are active mobile–cellular subscribers. There has been a rise in the usage of mobile–cellular subscription as against 33% observed in 2013 [28].

Figure 2 shows the process flow of data/information in the CBHMS. The CBHMS is a web-based system that employs the MySQL™ database for data storage and PHP to implement the frontend/server scripting language. The system is accessed through a single login for each user, and the platform interface is user specific. The proposed system is generic and is expected to perform real-time ondemand infectious diseases recognition, such as cholera identification, drug prescription, management, and monitoring. It consists of three role players, namely, the community health worker (CHW), patient, and doctor.

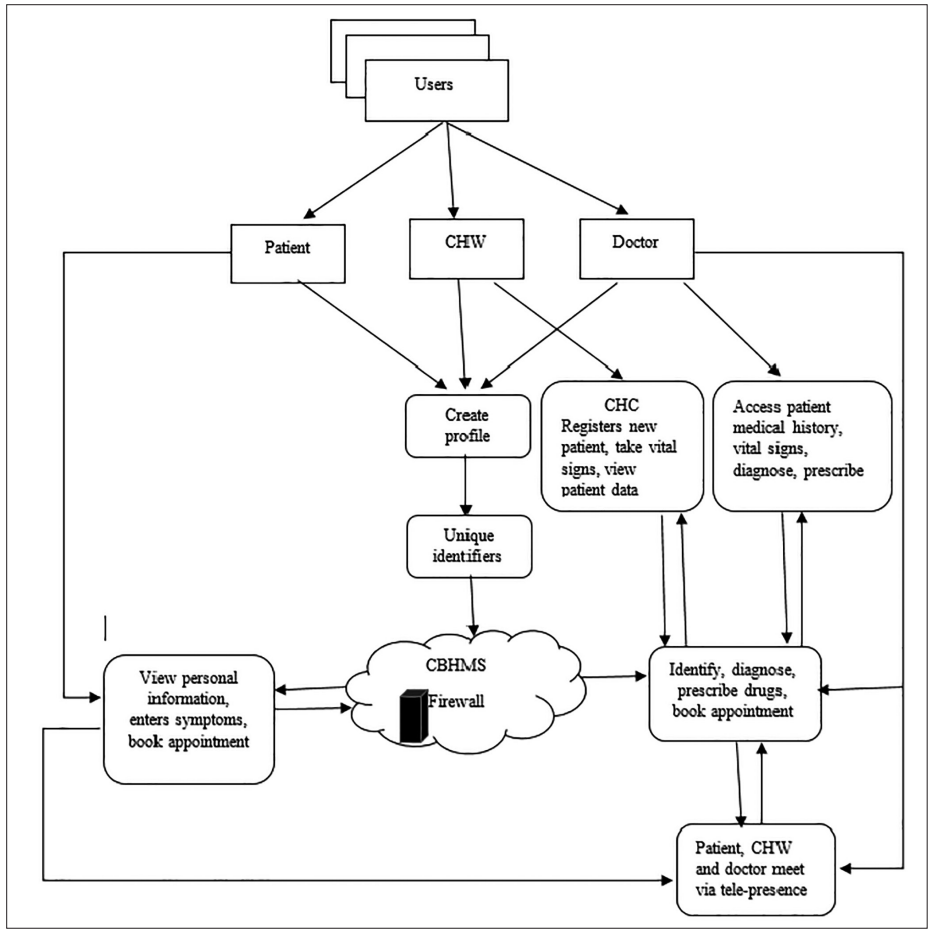

Figure 2. CBHMS process flow diagram

The CHW serves as the intermediary between the patient and doctor. The CHW who is positioned at a community health center through internet-enabled devices, such as desktop, laptops, iPad®, or mobile phone, scans or inspects the community to register patients who do not have access to a computer device or those who can neither read nor write. They also measure the vital signs of patients shortly before a face-toface meeting with a doctor. In addition, the CHW can view the medical information of patients as well as the doctor's appointment schedule.

The patient is the person who experiences some symptoms of a disease. These symptoms are entered into the system by the patient after duly registering into the system with a unique username and password. Based on the symptoms of the disease and a pre-entered list of diseases in its database, the software conducts a diagnostic check and identifies the specific disease as well as proffers a solution to the identified disease acquired by patient. If not contented with the diagnosis, the patient can schedule an appointment and visit the doctor.

Based on the availability and the specialties of doctors, patients are assigned automatically by the CBHMS. The doctor interacts with the patient through video calling made possible either via Skype™, WhatsApp®, Facebook®, or any dedicated secured social media video calling platform through the supervision of the CHW. The CHW can view and update a patient medical history as well as the prescribed drugs and refer the patient to a particular hospital.

An APACHE web server in addition to firewalls is used as a security measure to monitor the activities in the system by providing a secured, efficient, and extensible server with HTTP services in accordance with recent HTTP standards to prevent unauthorized access to patient data.

Limitations, such as the inability of rural dwellers to independently use the system, could arise from the use of CBHMS. However, this limitation could be overcome considering that the CHW can guide the users on how the system is utilized. Moreover, passwords could be easily stolen as most of the users might use mobile phones. Additionally, internet access might not be available; however, users can subscribe to personal internet service from the available service providers.

Materials and Methods

Study Design, Setting, and Participants

A cross-sectional analysis was used to investigate and identify the factors aiding the transmission and spread of cholera in Benue State. A cluster random sampling [29] was used for participant selection. The sample size calculation by Yamane [30] was adopted to determine the sample size of this study. The formula used was $n=\frac{N}{1+N(e)^2}$, where n=sample size; N=population size and e=marginal error. We assumed e=0.05, with a 95% confidence level. Substituting the variables will result in $n=\frac{N}{1+N(e)^2}$

$$n=\frac{2500}{1+2500\ (0.05)^2}$$

$$n=\frac{2500}{1+6,25}$$

$$n=344.82$$

Hence, a sample size of least 344 participants is required for this survey. However, to arrive at a robust result, 420 participants were recruited for this study. The participants who were informed that their participation is voluntary and that their responses would be confidential were drawn randomly from among farmers, students, housewives, and traders and among others who had at least a minimum education. All participants provided written informed consented before the questionnaire was administered to them. The study was conducted in Benue State, Nigeria, during the Tropical Continental air-mass popularly known as the dry season (October 2017 to April 2018) and the Tropical Maritime air-mass popularly known as the raining season (May 2018 to September 2018).

Data Collection Tools

A quantitative survey approach was used to collect data from the participants in different locations (High level, Wurukum, Northbank, and Wadatta) of Makurdi the Benue State capital. The questionnaire items adopted from other studies [31, 32] comprised of demographic data and questions, which required the participants to relate their opinions, as it concerns their willingness, awareness, and attitude toward cholera infection. A seven-point Likert scale was used to rate the questionnaire, wherein 1=strongly disagree, 2=disagree, 3=slightly disagree, 4=neutral, 5=slightly agree, 6=agree, and 7=strongly agree. In total, 420 questionnaires with each consisting of 19 items were administered, and 340 questionnaires were returned, with an 80.9% response rate. However, 40 questionnaires were not used in the final analysis due to blank or incomplete responses from the respondents. Therefore, only 300 questionnaires were used in the final analysis. Data collection was carried out from the July 1, 2018 to August 1, 2018. The Statistical Package for Social Science (SPSS®) software version 21 was used in the analysis.

Survey Procedure

The concept of communicable diseases and cholera was explained to the participants. Thereafter, the authors distributed hard copies of the questionnaires to the participants with a cover letter stating the objectives and the necessities of the study. To ensure the validity of the measuring instruments, the questionnaire was vigorously cross-checked and validated by professionals in the field of health care management. The modifications to the questionnaire, which resulted in a valid content, was guided by their suggestions. The completed questionnaires were collected on the same day from the participants.

Statistical Analysis

Participant's responses were analyzed with the aid of a Statistical Package for Social Science version 21 (IBM Corp.; Armonk, NY, USA). This software is commonly used by researchers in the statistical analysis of data. Analysis performed on the collected data includes demographic analysis to the see the categories of participants who participated in the survey, a reliability analysis, to determine the reliability of the measuring instrument and lastly, a descriptive analysis, describing participant's responses and each variables used in the study.

Ethics

An ethical approval with a reference number MOH/STA/204/Vol.1/28 was obtained from the Health Research Ethics Committee of the Federal Republic of Nigeria.

Results

The results and analysis of the survey data used in the study are described. Each question was examined using a coding scheme that summarized the rejoinders into subjects. First, a statistical test was carried out to analyze the data. A frequency test for the demographic questions, reliability analysis to determine the Cronbach's alpha value of the questionnaire, and a descriptive examination of the survey questions were performed. The outcomes of the demographic data and survey questions were further interpreted and evaluated to achieve the study objectives and proffer solutions and necessary direction for future research purposes.

Demographic Results

The demographic information presented in Table 2 shows the frequency and percentage of the respondents, including gender, occupation, and years of experience.

In total, 157 females (52%) and 143 males participated in the survey. This ensures a balanced opinion in terms of gender participation. The study also ensured that different categories of

individuals were selected as a part of the sample from a larger population. This is also to ensure whether cholera has an effect on different occupations. The participants' age ranged from 18 years to 70+ years.

Reliability Analysis

To calculate the value of the Cronbach's alpha of the Likert scale, the questionnaire items for investigating the factors that cause the cholera disease were tested using the reliability analysis.

Table 2. Socio-demographic results of the data (n=300)

Demographics	Category	Frequency (n)	Percentage (%)
Gender	Male	143	47.7
	Female	157	52.3
Occupation of respondents	Farmers	48	16.0
	Students	74	24.7
	Traders	82	27.3
	Housewives	50	16.7
	Others	46	15.3
Age of respondents, years	18-30	53	17.7
	31-43	56	18.7
	44-56	82	27.3
	57-69	56	18.7
	70+	53	17.7

N: frequency of occurrence

Table 3. Reliability analysis for Cronbach's alpha value

Cronbach's alpha	Cronbach's alpha based on standardized items	Number of items
0.911	0.912	19

The Cronbach's alpha value was used to measure the internal reliability (that is consistency) of the Likert scale, which is shown in Table 3.

The Cronbach's alpha value was 0.911, which is greater than the recommended threshold value of 0.7 mentioned in another study [33]. However, researchers have different opinions about the recommended threshold value of the Cronbach's alpha. For example, the Cronbach's alpha value should be at least 0.6 before it can be considered satisfactory [34]. Other studies have proposed a value of 0.7 and ≥0.8 for Cronbach's alpha [35, 36]. Therefore, the value obtained in this study (α=0.911) indicates that it has satisfied all the threshold values mentioned in other studies. This value indicates that the questionnaire items are closely related and measure the same subject. In addition, the value shows that the questionnaire is a reliable and a good measuring instrument for the survey.

Descriptive Analysis

Table 4 presents the summary of the frequency and percentage of the survey data.

The questionnaire items are in a coded format, where ATPH means Attitude toward Personal Hygiene; AOCS means Awareness of Cholera Symptoms, WTGT means Willingness to Get Treatment, and finally ATHWF means Access to

Table 4. Frequency–percentage of the survey analysis

Questions	Strongly disagree	Disagree	Slightly disagree	Neutral	Slightly agree	Agree	Strongly agree
ATPH1	7 (2.3%)	15 (5.0%)	16 (5.3%)	4 (1.3%)	58 (19.3%)	105 (35.0%)	95 (31.7%)
ATPH2	3 (1.0%)	12 (4.0%)	15 (5.0%)	11 (3.7%)	78 (26.0%)	73 (24.3%)	108 (36.0%)
ATPH3	5 (1.7%)	7 (2.3%)	31 (10.3%)	30 (10.0%)	73 (24.3%)	82 (27.3%)	72 (24.0%)
ATPH4	11 (3.7%)	12 (4.0%)	15 (5.0%)	9 (3.0%)	70 (23.3%)	100 (33.3%)	83 (27.7%)
ATPH5	3 (1.0%)	12 (4.0%)	41 (13.7%)	16 (5.3%)	85 (28.3%)	108 (36.0%)	35 (11.7%)
ATPH6	9 (3.0%)	11 (3.7%)	32 (10.7%)	26 (8.7%)	116 (38.7%)	98 (32.7%)	8 (2.7%)
AOCS1	12 (4.0%)	7 (2.3%)	40 (13.3%)	10 (3.3%)	99 (33.0%)	87 (29.0%)	45 (15.0%)
AOCS2	8 (2.7%)	23 (7.7%)	25 (8.3%)	18 (6.0%)	104 (34.7%)	89 (29.7%)	33 (11.0%)
AOCS3	11 (3.7%)	12 (4.0%)	21 (7.0%)	16 (5.3%)	110 (36.7%)	106 (35.3%)	24 (8.0%)
AOCS4	2 (0.7%)	15 (5.0%)	37 (12.3%)	8 (2.7%)	86 (28.7%)	103 (34.3%)	49 (16.3%)
WTGT1	5 (1.7%)	15 (5.0%)	21 (7.0%)	23 (7.7%)	102 (34.0%)	77 (25.7%)	57 (19.0%)
WTGT2	0 (0%)	15 (5.0%)	12 (4.0%)	69 (23.0%)	69 (23.0%)	76 (25.3%)	59 (19.7%)
WTGT3	0 (0%)	8 (2.7%)	19 (6.3%)	33 (11.0%)	68 (22.7%)	122 (40.7%)	50 (16.7%)
WTGT4	0 (0%)	4 (1.3%)	23 (7.7%)	47 (15.7%)	114 (38.0%)	68 (22.7%)	44 (14.7%)
WTGT5	1 (0.3%)	4 (1.3%)	20 (6.7%)	64 (21.3%)	87 (29.0%)	89 (29.7%)	35 (11.7%)
ATHWF1	1 (0.3%)	13 (4.3%)	33 (11.0%)	44 (14.7%)	85 (28.3%)	96 (32.0%)	28 (9.3%)
ATHWF2	0 (0%)	11 (3.7%)	32 (10.7%)	48 (16.0%)	75 (25.0%)	103 (34.3%)	31 (10.3%)
ATHWF3	1 (0.3%)	15 (5.0%)	49 (16.3%)	41 (13.7%)	81 (27.0%)	66 (22.0%)	47 (15.7%)
ATHWF4	0 (0%)	13 (4.3%)	19 (6.3%)	69 (23.0%)	84 (28.0%)	79 (26.3%)	36 (12.0%)

ATPH: Attitude Towards Personal Hygiene; AOCS: Awareness of Cholera Symptoms; WTGT: Willingness to Get Treatment; ATHWF: Access to Healthcare Workers and Facilities

Healthcare Workers and Facilities. The 7-point Likert scale with responses from the participants was used in the analysis.

Analysis of Attitude toward Personal Hygiene

The analysis showed that 86% of the participants reported washing their hands with soap and water before/after eating or using the toilet. When asked about cooking food, 86% reported that they ensure that the food is cooked thoroughly; 75% of the participants answered positively regarding washing vegetables and fruits before eating. Similarly, 75% reported that they keep their cooking utensils clean. Finally, the results indicated that 74% of the participants agreed that they make sure the food is covered to avoid flies from touching the food.

Awareness of Cholera Symptoms

The participants were asked about their level of awareness regarding the symptoms of cholera and what cholera causes to the human body; 75% of the participants reported being aware that the main symptom of cholera is watery diarrhea. When asked about what the other symptoms of cholera, 77% of the participants are reported that cholera causes fever, 80% reported that they are aware that cholera usually causes stomach or abdominal pain, and 79% reported that they are aware that cholera causes dehydration (loss of body fluid).

Willingness to Get Treatment

About 79% of the participants reported that they would be willing to visit a cholera center to receive treatment. The participants were asked questions about the nature of the treatment they prefer to receive, and the results of the analysis showed that 68% preferred oral rehydration solution or sugar salt solution. In contrast, 68% reported that they preferred to visit a traditional healer for treatment, and 75% reported that they would prefer to undergo self-treatment. Finally, 70% reported that they do not choose to receive any treatment.

Access to Healthcare Workers and Facilities

The participants were asked questions about the availability of access to health care workers and facilities; 69% reported that there is an availability to access a health care center for those who are infected. Also, 70% of the participants reported that there are adequate health care workers who specialize in the treatment of cholera infection. The participants were asked to confirm whether the health care center is close to the residential area or at a far distance, and 65% reported that the health care center is at a close proximity to residential areas. Finally, 66% reported that the infected patients are well managed.

Discussion

The findings of this study identified some factors that play a significant role in causing the cholera epidemic in the country. These factors include, but are not limited to, terrorism-related activities and civil unrest, which prevents people from access to clean water, and lack of proper environmental sanitation. This finding corresponds to those another study that qualitatively assessed the resistance toward cholera intervention in Mozambique [37], wherein insecurity, social disequilibrium, and perceived institutional negligence were reported among the factors that aid the spread of cholera epidemics. Another factor that causes cholera epidemic is flooding to due heavy rainfall, which is prevalent in the areas covered by the case study because of inadequate drainage system. This problem usually contaminates the rivers and streams (which is the source of water for most people in the area) with dirty items, particles, and human and animal waste. This finding is related to the findings of another study that assessed the knowledge, attitudes, and practices regarding cholera preparedness and prevention in South Africa. Contaminated water was reported as a major source of contracting cholera disease [38]. Similarly, lack of proper sewage disposal has been identified as another causative factor because people sell and buy food closer to the bins, which in turn contaminates the food and water around the area. A cholera epidemic can occur when people consume the infected foods and water. This finding corresponds to those of a study on Geospatial assessment of cholera in a rapidly urbanizing environment, wherein it was stated that waste dump sites affects the environment, which in turn causes the spread of cholera [39]. Another causative factor identified by the study includes the unhygienic environment. Findings from the study also revealed that people who were infected did not bother to get appropriate treatment as a result of the fear of intimidation or victimization. Others did not get treatment due to financial incapability and poor support from the government.

The study findings identified some key lessons that are essential for enhancing the prevention and control of cholera. Firstly, although the seasonal distribution of cholera infection does not apply in Nigeria, the time of outbreaks and geographical distribution is however predictable. Secondly, there exists substantial evidence on the menace and protective dynamics of the transmission of cholera; taking into cognizance inhibiting factors, such as consumption of contaminated water, unhygienic environment, and inappropriate disposal of waste products, which are all possible routes for the transmission of cholera. Thirdly, the proper and adequate availability of information and awareness of the people regarding the mode and pattern of cholera transmission can help reduce the occurrence of cholera infection and death.

Sequel to these findings, we believe that the following recommendations can enhance the prevention, management, and control of the spread of cholera infections. Considering the connotation that exists amid cholera transmission and the intake of contaminated food, addressing the ways in which food/drinks are handled is a crucial objective. Hence, there is a need for the implementation of environmental and food regulation standards to uphold high hygienic practices of food. In addition, reinforcing the need for food and water safety as well as ensuring that food handlers and traders undergo basic hygiene trainings is necessary to reduce the menace of cholera infections [40].

Through various communication channels, such as television, radio, and social media, we could create awareness and enlighten the public regarding the menace of cholera infection as well as enhance the significance of food, personal, and environmental hygiene. Furthermore, the development and implementation of a computerized mechanism for the identification of cholera and its readiness and response are required to ensure that the cholera outbreak is detected in a timely manner, and the responses are also provided promptly. The proposed CBHMS could offer this valuable support when it is implemented in the future.

Moreover, WHO has recommended that along with the preventive measures presently in use, immunization programs for the people living in a geographical area susceptible and endemic to cholera infections should be implemented. This action plan will be useful in the long term for preventing new cholera infections. Additionally, the use of oral vaccines has shown to offer a temporary defense of about 85–90% across all age collections within 4-6 months after immunization. However, stakeholders in the health care sector must agree on the choice of cholera vaccines to be used, and such choices should be steered by the availability of necessary logistics and facilitating conditions not forgetting to address the political effects and scopes of the vaccines [41].

The study is limited by geographic scaling in that it was conducted in one country and only one state was included. Hence, there is a need for future studies with an increased scope to include more countries and bridge any gap that

might not have been covered by the present study. However, the limitation notwithstanding factors that contribute to the spread of cholera were adequately investigated and identified.

Ethics Committee Approval: Ethics committee approval was received for this study from the Health Research Ethics Committee of the Federal Republic of Nigeria (MOH/STA/204/Vol.1/28).

Informed Consent: Written informed consent was obtained from all the participants who participated in the study.

Peer-review: Externally peer-reviewed.

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References

1. Dye, C. Infectious diseases in a new era of health and development. Philos Trans R Soc Lond B Biol Sci 2014; 369: 20130426. [CrossRef]
2. Barua D. History of Cholera. Cholera: Springer US; 1992. p.1-6. [CrossRef]
3. Adagbada AO, Adesida SA, Nwaokorie FO, Niemogha MT, Coker AO. Cholera epidemiology in Nigeria: an overview. Pan Afri Med J 2012; 12: 59.
4. Davies HG, Bowman C, Luby SP. Cholera-management and prevention. J Infect 2017; 74: S66-S73. [CrossRef]
5. Yankson NY. Cholera 'swallows' Accra. Ghanaian Chronicle. [Online], 2011. Available from http://www.modernghana.com/news/322631/1/cholera-swallows-accra.html [Accessed: Jan 2018].
6. Guardian development network. West Africa desperate for cleaner toilets to save slums from cholera [Online], August 2012. Available from https://www.theguardian.com/global-development/2012/aug/20/west-africa-toilets-slums-cholera. [Accessed: 11/11/17].
7. Isikwue MO, Iorver D, Onoja SB. Effect of depth on microbial pollution of shallow wells in Makurdi Metropoilis, Benue State, Nigeria. Br J Environ Clim Change 2011; 1: 66-73. [CrossRef]
8. Maxwell O, Oklo A, Bernard A. Profile of water related diseases in Benue State, Nigeria. Am J Hum Ecol 2012; 1: 87-94.
9. Islam MS, Sharker MA, Rheman S, et al. Effects of local climate variability on transmission dynamics of cholera in Matlab, Bangladesh. Trans R Soc Trop Med Hyg 2009; 103: 1165-70. [CrossRef]
10. Oloukoi G, Bob U, Jaggernath J. Perception and trends of associated health risks with seasonal climate variation in Oke-Ogun region, Nigeria. Health Place 2014; 25: 47-55. [CrossRef]
11. Abubakar AT, Dalhat M, Nguku P. Cholera outbreak-IDP camps in Maiduguri, northern Nigeria, September 2015. Int J Infect Dis 2016; 45: 132. [CrossRef]
12. World Health Organization. Cholera - Nigeria; disease outbreak news [Online] 12 July 2017. Available from -file:///C:/Users/hp/Desktop/PHD%20Assign%20folder/Research%20Method/8%20referencin. [Accesses: 13/11/2017].
13. Adelekan IO. Vulnerability of poor urban coastal communities to climate change in Lagos. In Fifth Urban Research Symposium 2009. pp.2011.
14. Jaggernath J. A Socio-economic and Spatial Investigation into the Health Implications of Air Pollution in Richards Bay, KwaZulu-Natal, South Africa. University of KwaZulu-Natal, Durban, Doctoral Dissertation.
15. Ndon JA, Udo SM, Wehrenberg WB. Vibrio-associated gastroenteritis in the lower Cross-River Basin of Nigeria. J Clin Microbiol 1992; 30: 2730-2.
16. Cazelles B, Chavez M, McMichael AJ, Hales S. Nonstationary influence of El Nino on the synchronous dengue epidemics in Thailand. PLoS Med 2005; 2: e106. [CrossRef]
17. Lawoyin TO, Ogunbodede NA, Olumide EA, Onadeko MO. Outbreak of cholera in Ibadan, Nigeria. Eur J Epidemiol 1999; 15: 367-70. [CrossRef]
18. World Health Organization. Third meeting of the Global Task Force on Cholera Control: 14-15 June 2016, Amman, Jordan.
19. Aminu M, Medugu JB. Increased cholera outbreaks in Nigeria: a review. Ghanaian Population 2014; 47: 47-64.
20. Gyoh SK. Cholera epidemics in Nigeria an indictment of the shameful neglect of government. Afri Health 2011; 33: 5.
21. UNICEF Situation Report (NIGERIA). Cholera and floods Sitrep #5 covering 23 September-4 October, Geneva: 2010.
22. The Nation. Cholera kills 12 in Benue [Online] November 2013. Available from http://thenationonlineng.net/cholera-kills-12-benue/ [Accessed: 18/11/17].
23. UNICEF. Nigeria Cholera Situation Report [Online] February 2014. Available from https://reliefweb.int/report/nigeria/unicef-nigeria-cholera-situation-report-10-february-2014 [Accessed: 18/11/17].
24. Relief web. Nigeria: cholera outbreak [Online] November 2013. Available from https://reliefweb.int/disaster/ep-2013-000162-nga [Accessed: 15/11/17].
25. Vanguard. Lagos Cholera outbreak [Online] September 2016. Available from https://www.vanguardngr.com/2016/09/6-dead-45-cases-recorded-lagos-cholera-outbreak/ [Accessed: 18/11/17].
26. United Nation News Center. Amid cholera outbreak in north-east Nigeria, UN steps up aid, warns pregnant women most vulnerable 57748# [Online] October 2017. Available from http://www.un.org/apps/news/story.asp?NewsID=57748#.WgaV5_IdW2o [Accessed: 14/11/17].
27. Carlsson SA, Henningsson S, Hrastinski S, Keller C. Socio-technical IS design science research: developing design theory for IS integration management. Inf Syst E-Bus Manag 2011; 9: 109-31. [CrossRef]
28. ITU ICT facts and figures [Online]. Available from https://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2017.pdf [Accessed 08/08/2018].
29. Teddlie C, Yu F. Mixed methods sampling: A typology with examples. J Mix Methods Res 2007; 1: 77-100. [CrossRef]
30. Yamane T. Statistics, an introductory Analysis 2nd Edition: Horper and Row. New York. 1967.
31. Pillay, M. Knowledge, Attitude and Practices (KAP) survey. Stellenbosch: Stellenbosch University, Doctoral Dissertation, 2005.
32. Date K, Person B, Nygren B, et al. Evaluation of a rapid cholera response activity-Nyanza Province, Kenya. The J Infect Dis 2013; 208: S62-8. [CrossRef]
33. Gliem JA, Gliem RR. Calculating, interpreting, and reporting Cronbach's alpha reliability coefficient for Likert-type scales. Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education. Columbus, Ohio, Ohio State University. 2003. pp.82-8.
34. Robinson JP, Shaver PR, Wrightsman LS, editors. Measures of personality and social psychological attitudes: Measures of social psychological attitudes. Academic Press; 2013 Oct 22; Vol (1).
35. DeVellis, R. F. Scale development: Theory and applications. 2nd Edition. Sage Publications, Inc. 2005; Newbury Park, CA. ISBN-13: 978-0761926054.
36. Nunnally, J. C. Introduction to psychological measurement. New York, NY: McGraw-Hill; 1970.
37. Démolis R, Botão C, Heyerdahl LW, et al. A rapid qualitative assessment of oral cholera vaccine anticipated acceptability in a context of resistance towards cholera intervention in Nampula, Mozambique. Vaccine 2018; 36: 6497-505. [CrossRef]
38. Ncube A, Jordaan AJ, Mabela BM. Assessing the knowledge, attitudes and practices regarding cholera preparedness and prevention in Ga-Mampuru village, Limpopo, South Africa. Jàmbá 2016; 8: 1-9. [CrossRef]
39. Olanrewaju OE, Adepoju KA. Geospatial Assessment of Cholera in a Rapidly Urbanizing Environment. J Environ Public Health 2017; 2017: 6847376. [CrossRef]
40. Olu O, Babaniyi O, Songolo P, et al. Cholera epidemiology in Zambia from 2000 to 2010: implications for improving cholera prevention and control strategies in the country. East Afr Med J 2013; 90: 324-31.
41. Adagbada AO, Adesida SA, Nwaokorie FO, Niemogha MT, Coker AO. Cholera epidemiology in Nigeria: an overview. Pan Afri Med J 2012; 12: 59.