AN INVESTIGATION OF ENVIRONMENTAL RISK FACTORS INFLUENCING CHORELA EPIDEMIC IN MAGALE SUB-COUNTY, MANAFWA DISTRICT OF EASTERN UGANDA

BY:

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DECLARATION

I **LOGEL GLORIA** hereby declare that this research report is due to my own knowledge, effort and it has never been submitted by any other person for any academic purposes or otherwise.

Signature ……………………… Date 03/11/2017

SUPERVISOR'S APPROVAL

This research proposal has been done under my supervision and submitted with my approval

Signature. Date

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LIST OF ABBREVIATIONS

CFR Case fatality rate

DC District Code

MOH Ministry of Health

DOH Department of Health

GIS Geographic Information System

JOCs Joint Operation Committees.

MDGs Millennium Development Goals

NHLS National Health Laboratory Services

RDP Reconstruction and Development Programme

V. Cholera Vibrio cholera

VIP L Ventilated Improved Pit Latrines

WHO World Health Organization

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ABSTRACT

Cholera is an acute enteric infection caused by the ingestion of bacterium Vibrio cholera present in faecally contaminated water or food. Primarily linked to insufficient access to safe water and proper sanitation, its impact can be even more dramatic in areas where basic environmental infrastructures are disrupted or have been destroyed.

The aim of the study was to investigate the factors contributing to the prevalence of cholera and the environmental risk factors associated with cholera in the Magale sub county, Manafwa district. The objectives of the study were to identify environmental risk factors for cholera and to determine the number of cholera cases in the Magale sub county, Manafwa district.

The study used a quantitative, retrospective and cross-sectional research method. The records of 317 patients who met the study criteria were reviewed using an audit tool. The Statistical Package for Social Sciences (SPSS) version 22 was used to analyze the data. The results revealed that lack of adequate hygiene practices, limited access to safe drinking water, lack of safe food preparation and handling, and inadequate sanitation system are risk factors associated with cholera. The study recommends prevention, control of cholera outbreak and case management.

Keywords: Cholera, outbreak, Vibrio cholerae 01 and 0139, Watery diarrhea (ricewater),Prevalence, Risk factors.

CHAPTER ONE

1. INTRODUCTION

Cholera is an acutely dehydrating, watery disease caused by the bacterium Vibrio cholera. It is often described as a classic water-borne disease because it is commonly associated with contaminated water (David, Bradley, Balakrish & Siddique, 2004). This description oversimplifies the transmission of Vibrio cholerae, because the bacterium can also be transmitted by contaminated food. Frequently contaminated water is mixed with food, allowing either to act as vehicle for transmission, and contaminated water is more common in less developed countries (Shapiro, Otieno & Adcock, 1999).

1.1 BACK GROUND

Cholera has claimed many lives through history and continues to be a global health threat. Cholera cases mainly occur in the developing world (Reidl & Close, 2002). In the early 1980s, death rates are believed to have been greater than 3 million a year, although it is difficult to calculate exact numbers of cases, as many go unreported due to concerns that outbreak may have impact on the tourism of country (Sack, Bradley & Chaignat, 2006). A total of 293, 121 cholera cases and 10, 586 cholera deaths were reported worldwide in 1998, which is almost twice the number of cases as reported in 1997 (WHO, 1999). In 2008, 56 countries notified 190, 130 cholera cases and 5, 143 deaths to the World Health Organization (WHO); however, the actual estimated burden is 3 to 5 million cases worldwide and this caused 100, 000 to 130, 000 deaths a year as of 2010 (WHO, 2010).

Cholera may occur as sudden progressive outbreak after a natural disaster such as a cyclone, flood, and an earthquake. The disruption of the water distribution system and an inadequate hygiene situation or inadequate sanitation system after a natural disaster may cause cholera outbreaks as the disease is transmitted mainly through contaminated water (Watson, Gayer, & Connolly, 2007). Diarrheal diseases constitute a major global public health problem, and affect indigenous populations and travelers. Apart from natural disasters, human migration has also been identified as a cholera risk

factor, as it plays a role in introducing disease into new populations (Wilson, 1995). Increases in population density as a result of massive migration, can strain existing sanitation systems, thus putting people at increased risk for many diseases including cholera (Root, 1997; Siddique, Zaman, Baqui, Akram & Mutsuddy, 1992).
Throughout history, populations all over the world have been affected by devastating outbreaks of cholera, and Africa where cholera outbreaks have been reported at an increasing annual rate since 1990, has been described as the new homeland for cholera (Gaffga, Tauxe & Mintz, 2007). In South Africa, the Limpopo outbreak between 2008 and 2009 was probably due to the human migration as cholera risk factor. The epidemic originated from Zimbabwe where 88, 834 cholera cases were reported in March 2009 (Mintz & Guerrant, 2009). This was the country's worst cholera epidemic in recent memory and as a result, Zimbabwe declared a national emergency in early December 2008.

Lack of access to safe water remains a serious problem in the developing countries (Bhunia & Sougata, 2009); as a result some of the rivers, the main source of water for communities, are commonly contaminated with bacteria that cause disease by producing one or more enterotoxins. Among these, Vibrio cholerae causes the most severe (Sanchez & Holmgren, 2005). According to Van den Bergh, Holloway, Piennar, Koen, Elphinstone, and Woodborne (2008), there have been concerns about the recurrence of epidemics of diseases such as cholera, previously thought to be under control. Many scientific studies have been undertaken to study cholera and factors contributing to its re-occurrence and spread to new areas (Goldstein, 2005).
Cholera occurs in epidemic form when there is rapid urbanization without adequate sanitation and access to clean drinking water. Several cholera outbreaks from various countries such as India, Bangladesh, Indonesia, Peru, Mozambique, Tanzania, have been reported to be associated with contaminated piped water, and poor sanitation (Bhunia & Sougata, 2009). Other risk factors include poor hygiene, overcrowded living conditions and lack of safe food preparation and handling. Unstable political and environmental conditions such as wars, famines, floods that lead to displaced

populations and the breakdown of infrastructures are very important risk factors as faras the cholera disease is concerned (Nevondo & Cloete, 2001). Hence, the focus of epidemics/ pandemic has shifted to developing countries, where the above risk factors are common, over the last century (Nevondo & Cloete, 2001).

Cholera has been prevalent also in sub-Saharan African countries including Uganda, According to WHO(2000) The largest cholera outbreak ever reported in Uganda occurred in 1997–1998 associated with the heavy rainfall and flooding that occurred as a result of the El Nino weather phenomena . During this time period, several countries of the Horn of Africa were already affected by cholera outbreaks. In Uganda, this epidemic resulted in a total of 38 697 cases and 1576 deaths officially reported in 43 of the then existing 45 districts

1.2 Problem statement

Great efforts have been made to contain the spread of cholera. For disease control, the government of Uganda has used a multisectoral approach spearheaded by the MOH with support from WHO, development partners, and affected districts to mobilize resources and institute appropriate interventions to prevent the spread of cholera and control the outbreaks. The measures employed include disease surveillance and case management, provision of safe water, proper fecal disposal, safe food handling, and promotion of personal hygiene and health education. The response efforts illustrate that it is possible to effectively control outbreaks when the necessary financial and human resources are available and the response is coordinated early. Refresher trainings have been delivered periodically to medical and public health personnel on the prevention and response to cholera outbreaks. There is also cross border collaboration between states in East Africa and regular sharing of information on outbreaks through entities such as East African Public Health Laboratory Network (EAPHLN). Although this cooperation is active at the central level, the collaboration is weak at the local level in most districts in which has exposed them to the risks of cholera outbreak including Magale sub county.

According to AlajoSO, NakavumaJ, ErumeJ(2006) Uganda experienced a particularly high number of cholera cases following heavy rainfall and floods, which affected the eastern part of the country, causing landslides and serious contamination of water sources and disruption to sanitation facilities in 5 districts of Eastern Uganda namely: Mbale, Pallisa, Tororo, Butaleja, and Manafwa.

However, whether this risk factor has contributed to the cholera situation in the study area is not documented. This research therefore, intended to establish the associated environmental risk factors and observed cholera incidences in Magale sub-county.

1.3 AIM OF THE STUDY

The aim of the study was to investigate the factors contributing to the prevalence of cholera and the contributing factors associated with cholera in Magale sub-county, Manafwa district of Eastern Uganda.

1.4 OBJECTIVES OF THE STUDY

The objectives of the study were:

(i)To determine the number of cholera cases at the Magale sub-county, Manafwa district

(ii)To identify the contributing factors for cholera in the Magale sub-county, Magale sub county

(iii)To identity the clinical aspects associated with cholera

1.5 RESEARCH QUESTIONS

The following research questions guided the study:

(i)What is the prevalence of cholera infection in the magale sub-county Manafwa district?

(ii)What are the contributing factors associated with cholera in the Magale sub-county Manafwa district?

(iii)What are the clinical aspects of cholera in the population?

1.6 Scope of the Study

The research scope composed of time scope, content scope and geographical scope.

Time Scope. The research covered a period from 2000 to- date (2017)

Content Scope. The study focused on environmental risk factors associated with cholera epidemic in Magale subcounty, Manafwa district.

Geographical Scope. The study took place in Magale Sub-County, Manafa district located in the Eastern Uganda.

1.7 SIGNIFICANCE OF THE STUDY

Outbreaks may cause a high burden of disease and a rapid damage to the curative health services where public health systems have broken down, leading to a considerable public health and economic impact. Specific and rapid identification of interventions would be useful in limiting the spread and case-fatality rate of these outbreaks. An understanding of the socio-environmental risk factors and the pattern of outbreak can inform prevention efforts for this disease and those of similar nature. This will influence policy-makers as cholera is a preventable disease. It may also be used to develop an early warning system for future cholera outbreaks. Such an approach will tackle the morbidity and mortality due to the cholera disease. Cholera, like other water related diseases, can cost governments billions of rand to eradicate. Absenteeism by the workforce caused by cholera adversely affects industrial output. Cholera outbreaks can adversely affect tourism and affect Tax revenues (productivity losses for business and individual due to illness decrease tax revenues).

Cholera outbreaks may also lead to loss of trade. Therefore, a better understanding of the socio-economic, environmental and public health consequences of water supply and sanitation related diseases obtainable through better monitoring surveillance systems may help the public and policy-makers understand the value of microbiologically safe water as well as improved sanitation facilities. Basic hygiene education and sanitation programs can be used to improve human health in developing countries, particularly in rural communities, where resources may be inadequate.

1.8 Operational definitions

Cholera

Cholera is a bacterial infection of humans caused by Vibrio cholera (of classical or El Tor biotypes) which characteristically causes severe diarrhea, and death (in those severely affected) from water and electrolytes depletion. Cholera has been called "blue death" due to a patient's skin turning a bluish-grey color from extreme loss of fluids (McElroy & Patricia, 2009).

Cholera case

Cholera case refers to any patient, irrespective of age, with acute watery diarrhea and severe dehydration (usually with vomiting). Bhunia and Sougata (2009) define a cholera case as the occurrence of acute watery diarrhea (i.e. three or more loose stools per day); with severe dehydration among patients of any age.

Epidemiology

Epidemiology is the study of the distribution and determinants of health-related states or events (including disease) in specified populations, and the application of this study to the control of diseases and other health problems (Last, 1995). It is also defined as the study of the distribution of clinical phenomena in populations.

Outbreak

An outbreak is an explosive event, characterized by a sudden and rapid increase in the number of cases of disease in a population (Gordis, 2004).

Epidemic

An epidemic is the presence or the occurrence in a community or region, of a group of illness of similar nature, clearly in excess of normal expectancy, and derived from a common or from propagated source (Gordis, 2004).

Endemic disease

Endemic disease refers to the constant presence of a disease or infectious agent within a given geographic area or population group; may also refer to the usual presence of a given disease within such area or group (Last, 1995).

Case-fatality rate

A case-fatality rate is the number of people who die of a disease divided by the number of people who have the disease. Given that a person has the disease, what is the likelihood that he or she will die of the disease? Thus, case-fatality is a measure of the severity of the disease (Gordis,2004).

Prevalence

Prevalence refers to the number of affected persons present in the population at a specific time, divided by the number of persons in the population at that time. It is calculated per 1000 (Gordis, 2004).

Incidence

According to Gordis Incidence refers to the number of new cases of a disease that occur during a specific period of time in a population at risk for developing the disease (Gordis, 2004).

1.9 Conceptual Frame work

Diarrhea prevalence is influenced by the interplay of many risk factors. Among them are:

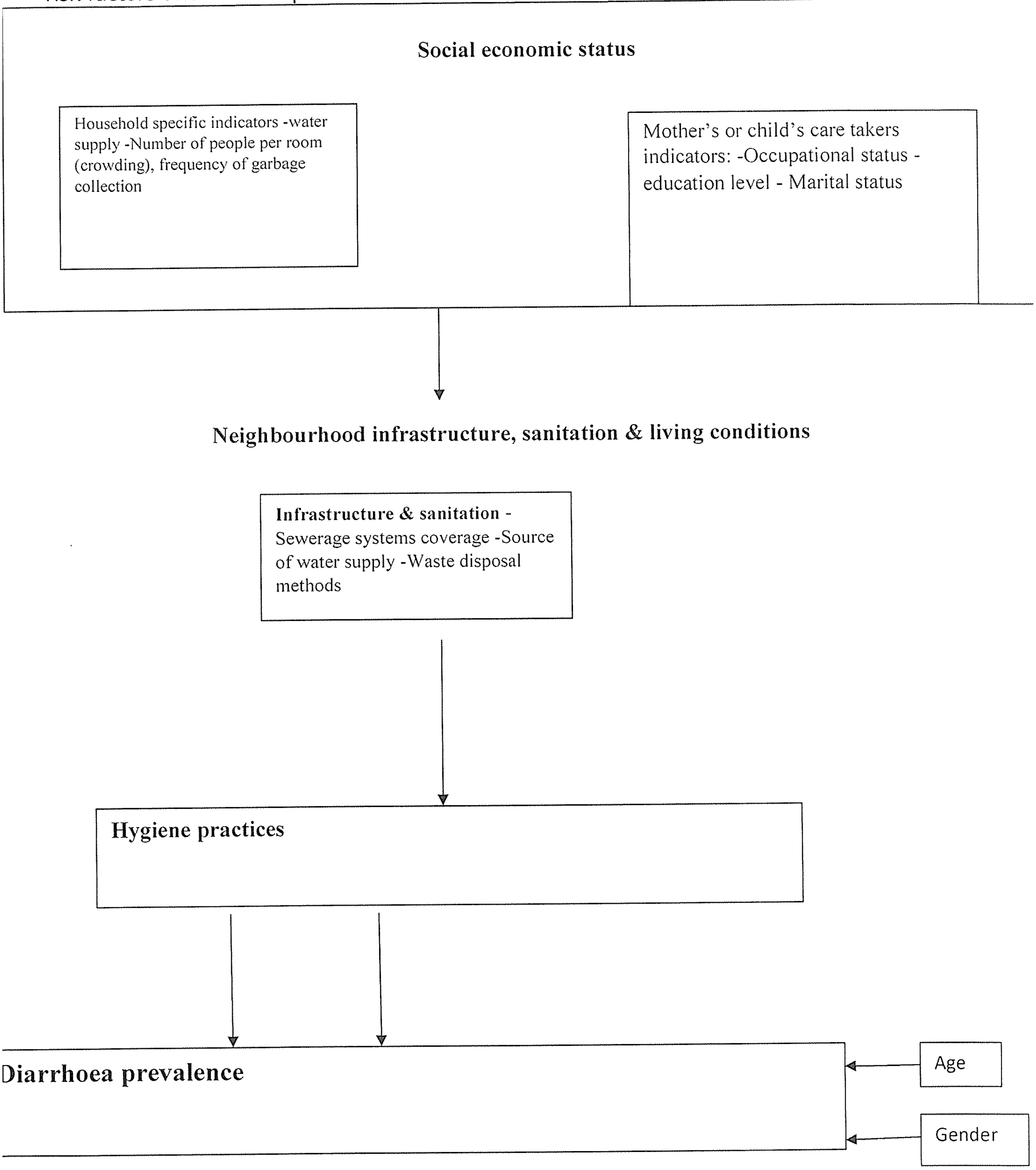
a) **Social economic status:** These include the mother's education levels, marital status and the household's income levels.

b) **Infrastructural factors**: These factors include sanitation and living conditions for example sewerage systems, source of water supply, nature and type of toilets.

c) **Hygiene factors: T**hese factors include both household and personal hygiene behavior

d) **Demographic factors:** These factor include age and gender of the child's care giver respectively.

Figure 1.1: Conceptual framework visualizing the inter-relationships between potential risk factors and Cholera prevalence



CHAPTER TWO:

REVIEW OF THE RELATED LITERATURE

Concepts, ideas, and opinions of Experts/ Authors

Epidemiology

Enteric infections causing diarrheal disease remain a major concern worldwide.
According to Sanchez and Holmgren (2005), it has been estimated that 2 billion to 4billion episodes of infectious diarrhea occur annually in developing countries, resulting in 3 million to 5 million deaths, with the highest incidence and case-fatality rates in children below the age of five years. Diarrheal disease also constitutes the most common health problem in travelers to developing countries (Sanchez & Holmgren, 2005). Almost half of all cases of diarrhea are due to bacteria that cause disease by producing one or more enterotoxins. Among these, V. cholerae causes the most severe disease. Cholera is thought to be at least as prevalent now as it was 50 years ago, with approximately 100, 000 – 300,000 cases reported annually to WHO in 1995- 2004 (Zuckerman et al, 2007). Populations all over the world have sporadically been affected by devastating outbreaks of cholera.

Historical overview of cholera

Recorded evidence of cholera epidemics goes back to 1563 in a medical report from India (Nevondo & Cloete, 2001). Cholera is known to have started in Asia: "Asiatic cholera", as it was sometimes called, has been endemic in South Asia, especially the Ganges Delta region. It was much feared because it regularly occurred in epidemics with high mortality rates (Bhunia & Sougata, 2009). In the nineteenth century cholera spread from its apparent ancestral site in the orient to other parts of the world, producing pandemics in Europe (Nevondo & Cloete, 2001). The first pandemic was recorded in 1817 and it showed a spread of the disease outside the Indian subcontinent along trade routes to the west of southern Russia.

A second pandemic started in 1826 and reached the major European cities by the early 1830s.1831, the pandemic reached the UK and the response was important in that it led to the establishment of local Boards of health and a "Cholera Gazette", which served as aclearing house for tracking the epidemic (Rosenberg, 1962).At that time cholera was thought to be spread by the "miasma" (like a fog) coming from the river, but the classic epidemiological study of John Snow in 1854 in London showed that the disease was associated with contaminated drinking water even before any were known to exist (Snow, Frost & Richardson, 1936).
Three more pandemics continuing up to 1925 involved Africa, Australia, Europe, and all the Americas. The causative agent, Vibrio cholerae, was not identified until 1884 in Kolkata (where a cholera temple was built for protection against the disease), during the fifth pandemic (Koch, 1984). Leading causes of earlier pandemics and the way they ended is not known. However, cholera did not persist in any of the new geographical areas that it had invaded but continued as an endemic disease in the Ganges Delta. Due to a large numbers of cases and deaths during the pandemics, the disease was viewed as amajor public-health disease requiring governmental intervention.

The New York cholera epidemic led to the first Board of Health in the USA in1866 and cholera become the first reportable disease (Duffy, 1971). The seventh cholera pandemic involved almost the whole world. The pandemic began in Indonesia, rather than the Ganges Delta, and the causative agent was a biotype of V. cholerae serogroup 01 called El Tor (Cvjetanovic & Barua, 1972). It was first isolated in 1905 from Indonesian pilgrims and was found again in 1937 in Sulawesi, Indonesia (Tanamal, 1959). Then in 1960, for unknown reasons, this strain began to spread around the world. It invaded India in 1964, reaching West Africa in 1970 (Cvjetanovic &Barua, 1972), Southern Europe in 1970 (Baine, Mazzotti & Greco, 1974), and reached South America in 1991 (Swerdlow, Mintz & Rodriguez, 1992). The disease spread rapidly in Latin America, causing nearly 400, 000 reported cases and over 4, 000 deaths in 16 countries of the Americas that year (Nevondo & Cloete, 2001). By the end of 1996,cholera had spread to 21 countries in Latin America again, causing over 1 million cases and more than 12, 000 deaths (CDC/NCID, 1999). This epidemic has now subsided.

When an epidemic strikes an area where health care is not adequate the results can be disastrous, as demonstrated in a refugee camp in Goma, Zaire (DRCongo) in 1994. An Estimated 58, 000- 80, 000 cases and 23, 000 deaths occurred within 1 month (Goma Epidemiology Group, 1995).

The seventh pandemic has still not receded; on the contrary, the disease has now become endemic in many of these places, particularly South Asia (India, Bangladesh) and Africa. Only serogroup 01 was then known to cause epidemic cholera, but in 1992 a newly described non-01 serogroup of V. cholerae, designated 0139 Bengal (WHO, 2000a) was found to cause unusual cholera outbreaks in India and Bangladesh (Cholera working group, 1993). Both serogroups 0139 Bengal and 01 now coexist and continue to cause large outbreaks of cholera in India and Bangladesh. The isolation of the serogroup 0139 has now been reported from 11 countries in South Asia (WHO,2000b). Although 0139 continues to be detected in South Asia, accounting for 15% of all existing strains (WHO, 2001b), the outbreaks have not yet led to the eighth cholera pandemic as was initially feared.

In 2013, a total of 47 countries from all continents reported 129, 064 cases of cholera to the WHO, of which 43% were reported from Africa and 47% from the Americas where a large outbreak started in Haiti at the end of October 2010 (WHO, 2015a). The trend is that globally, the cases reported from Africa have decreased since 2012 with 43% of cases reported in 2013 against 93% to 98% of total cases worldwide reported from Africa between 2001 and 2009. In contrast to a global trend of decreasing case fatality ratios (CFRs), CFRs have remained stable in Africa at approximately 2%. However, many people still die of the disease, notably in sub-Saharan African, Asia and in Hispaniola, clearly showing that cholera remains a significant public health problem (Mengel, Delrien, Heyerdahl, & Gessner, 2014).

Environmental factors

As described in the historical overview of this chapter, cholera has been prevalent worldwide since the 19th century. This disease has been prevalent also in Sub-Saharian African countries, including Uganda. Several cholera outbreaks have been reported as related to contaminated piped water and poor sanitation, as noted in cases from different parts of India (Bhunia, Ramakrishnan, Hutin & Gupte, 2006).

Bhunia and Sougata study (2009) had three limitations: First, the case control study was conducted in a highly affected area during the outbreak period. This may have decreased the ability to describe in detail the association between the disease and various risk factors; however it is unlike to affect the conclusions. Second, the small sample size of 228 for 1, 076 cases limited the capacity to conduct a meaningful multivariate analysis. Third, it was not possible to obtain laboratory confirmation for more than two cases. Thus, it could not be excluded that the outbreak could have been caused by other microorganisms than V. cholera. Endemic cholera was believed to occur only in the estuarine deltas of tropical and semitropical areas such as the Ganges basin. These areas are generally densely populated with sewage facilities near water sources, which are being used for washing, bathing, drinking, and defecating (Glass and Black, 1992). In these settings, human feces containing vibrios contaminate water that if consumed perpetuates the transmission of the organisms.

A study was conducted by Mohammad, Emich, Donnay,Yunus, and Sack (2002) in Matlab, a rural area of Bangladesh, 53 km southeast of Dhaka, where cholera is endemic. The study area has poor water and sanitation conditions, and the objective was to identify environmental risk factors for cholera in an endemic area of Bangladesh, using a geographic information system (GIS) approach. The study data were collected from a longitudinal health and demographic surveillance system, and integrated within a geographic information system database of the research area. Two study periods were chosen because they had different dominant biotypes of the disease: from 1992 to 1996 El Tor was dominant and from 1983 to 1987 classical cholera was dominant.

The study found the same three risk factors for the two biotypes of cholera including proximity to surface water, high population density, and poor educational level. The GIS database was used to measure the risk factors and spatial filtering techniques were employed. These robust spatial methods are offered as an example for future epidemiological research efforts that define environmental risk factors for infectious diseases. This study indicates that by identifying a suitable environment for cholera and mapping spatial patterns of the disease, efforts can be taken at appropriate places to prevent cholera. Thus, a major effort to prevent fecal contamination of water is needed in order to reduce cholera incidence in endemic areas.

A comparison of spatial and social clustering of cholera was conducted once again in Matlab, Bangladesh, by Sophia, Mohammad, Yunus and Emich (2010). In order to compare spatial and social clustering of cholera, this study investigated cholera transmission in rural Bangladesh from 1983 to 2003, using a kinship-based social network where household clusters act as nodes and are connected by individual migrations. Social networks were constructed and used to model kinship relationships because they are likely to engage in some form of interaction, either within or outside of the household. The results illustrate that spatial clustering of cholera is much more prevalent in Matlab than clustering socially. This is likely due to socio-environmental risk factors at the neighborhood scale, such as water and sanitation environments and population density.

The main limitation of this study, from a social perspective, is that only kinship connections were measured. However, a comparison of social and spatial clustering suggests that the local environment is of greater importance than social connectivity in cholera transmission. Furthermore, the possibility exists that the observed clustering in space is a result of not only environment, but also social interaction with non-kin. The spatial network may thus, effectively, also capture a social network.

This study conducted by Sophia et al (2010) in Matlab, shows that cholera always clusters in space and seldom within social networks. Cholera is transmitted mostly

through the local environment rather than through person-to-person. Comparing spatial and social network analysis can however help improve understanding of disease transmission Vibrio cholera spreads rapidly where living conditions are crowded, water sources unprotected and where there is no hygienic disposal of faeces, such as in refugee camps as well as farms and countries that are environmentally underdeveloped (WHO,2000b). The potential changes in spatial and temporal spread of diseases and ecological and sociological changes associated with predicted climate changes mean that the potential for Vibrio cholera 01 and 0139 outbreaks cannot be ignored.
Importantly, accurate identification of cholera epidemic strains is paramount for the implementation of vaccination programmes in outbreak areas. These methods of protection reduce the risk of cholera to the traveler and minimize the possibility of transmission of cholera to disease-free regions (Paz, 2009).

Cholera transmission

According to (Mengel et al, 2014).Cholera transmission is closely linked to inadequate environmental management. Typical at-risk areas include peri-urban slums, where basic infrastructure is not available, as well as camps for internally displaced people or refugees, where minimum requirements of clean water and sanitation are not met. Early propagation of cholera outbreaks depends largely on the extent of individual bacterial shedding, host and organism characteristics, the likelihood of people coming into contact with an infectious dose of V. cholera and the virulence of the implicated strain. Cholera transmission can then be amplified by several factors including contamination of human water- or food sources; climate and extreme weather events; political and economic crises; high population density combined with poor quality informal housing and poor hygiene practices; and spread beyond a local community through human travel and animals, e.g. water birds . The consequences of a disaster – such as disruption of water and sanitation systems, or the displacement of populations to inadequate and overcrowded camps – can increase the risk of cholera transmission should the bacteria be present or introduced. Epidemics have never been arisen from dead bodies. Cholera, therefore, remains a global threat to public health and a key indicator of lack of social development (WHO,2015b).

Risk factors for cholera epidemics

According to BwireG, et al. (2013), demographic analysis of cases for 2011 showed that more males (61%) were affected by cholera than females (39%). For these outbreaks, this difference is thought to be associated with possible occupational risk factors. For example, males are usually more involved in fishing and farming in the affected districts. These occupations are often linked to certain risk factors for transmission of cholera, including poor hygiene and access to sanitation facilities. The results of our age distribution analysis showed a majority of cases occurred in those 15–45 years old (61.2%).

Imported cholera cases and risk of travelling

According to Zuckerman et al (2007), most cases of cholera worldwide are unreported and most cases of imported cholera go undetected. Failure to acknowledge a cholera epidemic may hinder governmental response and control efforts in epidemic settings. Epidemic cholera is a disease of great local importance, as evidenced by large, past outbreaks in Haiti and Zimbabwe. However, the burden of cholera in endemic areas, which appears to dwarf the burden in non-endemic areas, is often overlooked. There is a need to be vigilant for imported cases, since there is always a possibility that infected persons could introduce *V. cholera* into informal water supplies. Between the years of 1995 and 2001, the WHO reported 1, 829 cases of cholera in developed countries, the majority of which were imported, However it is believed that this figure reflects less than 10% of the incidence of cholera due to milder cases being unrecognized, as well as significant under reporting (Steffen et al, 2003).

Seasonality of cholera outbreaks

Cholera has pronounced seasonality. There have been concerns about the recurrence of epidemics of diseases such as cholera, previously thought to be under control (Goldstein, 2005). Many scientific studies have been undertaken to study cholera and factors that may contribute to its re-occurrence and spread to new areas. In Bangladesh, where the disease is endemic, two peaks occur each year that corresponds with the warm seasons before and after the monsoon rains (Siddique et al, 1992). Specifically, linkages between environmental conditions and outbreaks of cholera in Bangladesh have been demonstrated by Huq and Sack (2005), where the

Poisson regression model has been used to model cholera case data. In Peru, epidemics are strictly confirmed to the warm season (Tauxe, Mintz & Quick, 1995). The seasonality seems to be related to the ability of vibrio to grow rapidly in warm environmental temperatures. In this study two seasons are also taken into consideration as risk factors to cholera epidemics. The rainy season (humid) and the dry season are picked by the instrument used by the researcher to collect data in the selected areas. The research intends to demonstrate whether there is a relationship between cholera cases and the period of occurrence.

A study by Gil, Louis, and River (2004) indicated the relationship between cholera incidence and elevated sea surface temperatures and effects of the 1997-1998 El Nino in Peru. Furthermore, Pascual, Rodo, Ellner, Coxwell, and Bouma (2000) investigated the relationship between El Nino Southern Oscillation (ENSO) and the occurrence of cholera.

In 2010, Haiti experienced cholera epidemics as a result of a huge earth quake disaster. 60, 240 cumulative cholera cases including 1, 415 deaths at national level were reported (WHO, 2010b). Laboratory tests on the cholera strain responsible for the outbreak in Haiti, conducted by the US Centre for Diseases Control and Prevention (CDC) in Atlanta, showed that it is most similar to cholera strains found in South Asia. In endemic areas, annual rates of disease vary widely, probably as a result of environmental and climate changes. Better understanding of the relation to climate would thus allow better planning for epidemics by public-health officials.

Cholera: a new homeland in Africa

Cholera was largely eliminated from industrialized countries through water and sewage treatment over a century ago. Today it remains a significant cause of morbidity and mortality in developing countries, where it is a marker of inadequate drinking water and sanitation infrastructure (Gaffga et al, 2007). In the 1960s, at the beginning of the seventh and current cholera pandemic, cholera had an exclusively Asia focus. In 1970, the pandemic reached sub-Saharan Africa, where it has remained entrenched. According to Gaffga et al, 2007, Africa where cholera outbreaks have been reported at increasing annual rates since 1990, has been described as the *"new homeland"* forcholera. People in Africa are increasingly affected by cholera outbreaks caused by the V. cholerae 01 and 0139 bacteria. The African region account for over 90% of the cases of cholera reported to the World Health Organization (WHO, 2007).

The persistence or control of cholera in Africa will be a key indicator of global efforts to reach the Millennium Development Goals (MDGs) and of the commitments by leaders of the G-8countries to increase development aid to the region.

CHAPTER THREE:

3.1METHODOLOGY

3.2.1 Research design

The purpose of a research design is to provide a logical framework upon which the research project is conducted and enables the researcher to gather evidence that will allow the research question to be addressed. A retrospective cross-sectional study was used to determine the factors that contribute to the prevalence of cholera in Magale sub-county,Magale sub county.

The researcher carried out a cross-sectional study for the following three main reasons:

i. To describe a population or a subgroup (cholera patients) within the population with respect to an outcome and a set of risk factors.

ii. To find the prevalence of cholera, for the population or subgroups within the population of Magale sub- county,Magale sub county at a given time point.

iii. To investigate the distribution of cholera by factors such as place, type of water sources, sanitation systems, hygienic practices, food sources etc...

3.2.2 Data collection method.

A quantitative method was used because it is systematic and objective in its ways of using numerical data from a selected subgroup of a universe (or population) to generalize the findings to the universe that is being studied (Kobus, 2011). This method was used because the researcher was dealing with quantities or numerical data. It involved the gathering of measurable data and statistical analysis of that data. The researcher sought to prove the research questions. It is a quantitative-descriptive method used by the researcher, which required questionnaires in the form of a tool as a data collection method.

3.2.3 Area of Study

The study will took place in, Magale sub county Manafwa district. Subcounty is composed of five parishes and only four were selected in the study that is; Bumbo ,Mahala, Bupoto ,Matuwa.

3.2.4 Study Population

The target population consisted of all persons living in Vhembe district, that are 2 years or older who presented with the symptoms of sudden watery diarrhea, with or without vomiting. In this study, the size of the population was 1, 160, written as N = 1, 160. This number represents the group of individuals or the total number of patients diagnosed with cholera available in the database. The total population of Vhembe district is 1, 302, 113 with a population size of 550 as given by Morgan & Krejcie (1970). The baseline study population for this research project consisted of all patients of 2 years or older who presented with the symptoms of watery diarrhea (rice-water), dehydration, with or without vomiting, and diagnosed with cholera during the period of cholera outbreak (2008 and 2009) in all health facilities of the Magale sub county.

3.2.5 Sample Size

The researcher obtained the final sample size for each stratum by using the sampling fraction technique of ½. The researcher randomly sampled 105, 111, 47, 22, 27, 3 and 2 subjects from each stratum

3.2.6 Sampling procedures

The study used two sampling methods namely, the stratified sampling and cluster sampling technique. This technique was useful in this study because it ensured the presence of the key subgroups within the sample which made it possible for the researcher to sample the rare extremes of the given population.

3.2.7Research instruments

The researcher used a data collection tool in order to gather relevant information on cholera outbreak. Patients' medical records and database were reviewed in Magale sub

county health facilities. Data were collected over a period of 4 weeks which include the months of July and August 2017 in the light of the following methods:
A self-developed audit tool was used to collect data from patients' medical records, registries of reportable diseases and from database. Data included the following Variables: age, gender, location, water sources, sanitation, hygienic practices, employment, ethnicity, size of household, and period of cholera occurrence.

3.2.8 Sources of Data

The data was collected by researcher from the field as primary data, also the researcher collected data from other sources such as books, pamphlets, and web sites as a secondary data.

3.2.9 Ethical considerations.

Ethics were crucial for the successful accomplishment of this research work. Therefore, the following five ethical issues were taken into consideration in order to get approval to conduct the study:

1. Ethical clearance was obtained from University of Kampala International University.

2. Permission to use patients' records and medical database was given by the hospitals managers.

3. The study, even though a retrospective study that used the document reviews Methodology, did not mention any of the patients' names. Anonymity was assured by omitting the subjects' identifying particulars such as names and addresses. A coding system was used instead. Age group and gender were added for statistical purposes.

4. When reporting data, codes and pseudonyms were utilized in order to ensure confidentiality

3.2.10 Data Analysis

This study used Statistical Package for Social Sciences (SPSS) as the statistical software for data analysis. Descriptive statistics were calculated to determine the frequencies and distribution of cholera cases in Vhembe district. Inferential statistics with Chi-square test was calculated to establish the relationship between variables such as settlements and the number of cholera cases, water sources and cholera cases.

3.2.11 Data Presentation

For data description, the main statistical tools were tables, graphs, percentage, frequencies, mean (median) and standard deviation. For relationships and/or association between variables, Chi square test was performed while for comparisons of quantitative variables ANOVA was performed.

3.2.12 Limitations of the study

1. Extraneous variables was beyond the researcher's control such as respondents' honesty, personal biases and uncontrolled setting of the study
2. Testing : the use of research assistants can bring about inconsistency in the administration of the questionnaires in terms of time of administration, understanding of the items in the questionnaires and explanations given to the respondents

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 INTRODUCTION

The previous chapter discussed how the research was undertaken. The purpose of this chapter is to present and discuss the empirical findings of this research. The discussion of the results is divided into demographic and clinical aspects of the study. Presentation of results is done through the use of tables and figures. This chapter also provides answers to the objectives of the study and the research questions.

4.2 BIOGRAPHIC DATA

4.2.1 Age

Cholera cases in the rural communities of the Magale sub county were distributed according to the age groups. The results indicated that the cases were predominant among people of more than 15 years of age with 88.3% of the cases. For children less than 5 years and between 5–15 years, cholera cases are equally distributed representing 6% for each group. The distribution of cases per age group is shown in the following table:

Table 4.1

Age	Frequency	%
2 - 4 years	19	6.0
5 – 15 Years	18	5.7
>15 years	280	88.3
Total	317	100.0

Chi-square test was calculated with regard to the relationship between the age of Patients diagnosed with cholera disease and the disease itself. Table 4.12 shows the association of the age groups with cholera cases and the results of Chi-square test:

Table 4.12: Comparison of cholera cases by age groups.

Age groups	Cholera cases	Chi-square
2 - 4 years	19	0.687
5 – 15 years	18	
> 15 years	280	
Total	317	**0.687 (>0.05%)**

The results of Chi-square test shows that p=0.687, greater than required p of 5% (0.05).

Therefore, this implies that age groups did not have an impact on/association with the cholera cases. People were infected through contaminated food and water, and also through direct contact with an infected person, regardless of their age. According to Steffen, et al (2003), the incidence of cholera in endemic areas is highest in children, and decreases with age due to acquired immunity. In non-endemic areas, cholera prevalence is not age–dependent, as the majority of the populations have no immunity to the bacterium. Therefore, the association of age groups with cholera cases could not be established in this study because the Magale sub county is a non-endemic area.

4.2.2 Gender

In this study cholera cases seem to be equally distributed among male and female patients, thus gender does not have an impact on/association with the cholera outbreak.

The distribution of cholera cases per gender is represented in figure 4.1:

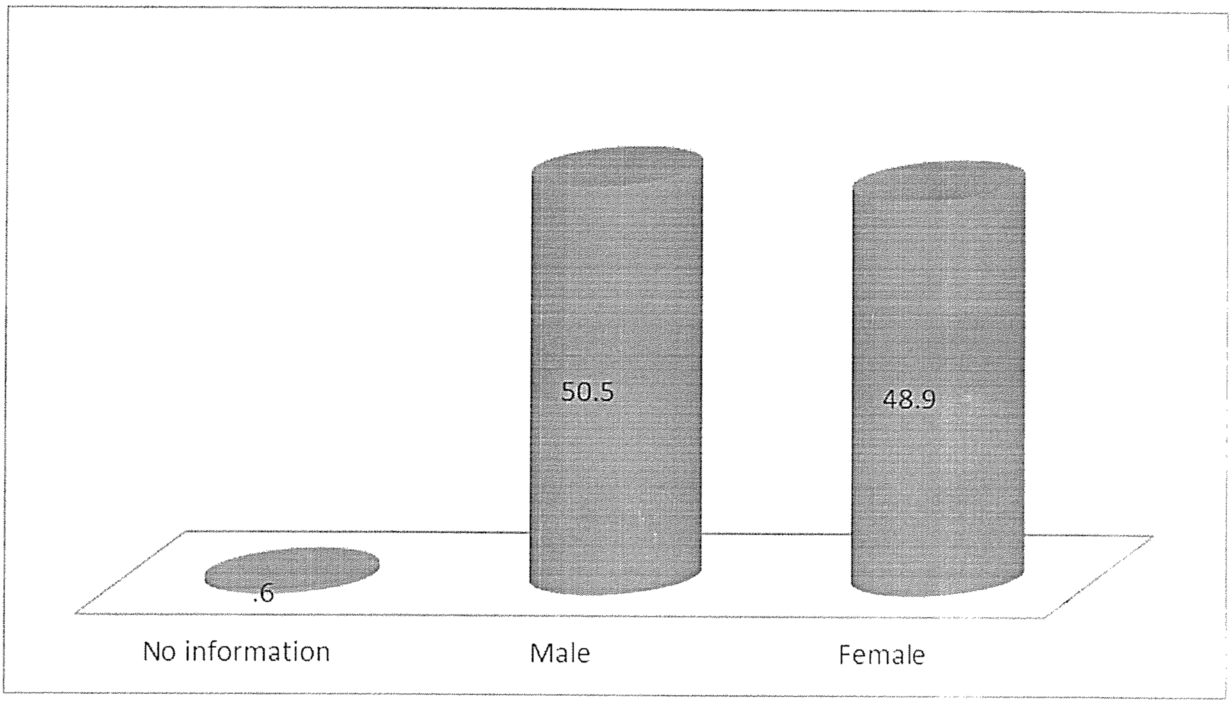


Figure 4.1: Distribution of cholera cases per gender

Figure 4.1 shows that the male and female patients were infected at equal proportion, with slight increase of 1.6% for male. Cholera cases were respectively 50.5% for male and 48.9% for female, with a minimal difference between the two genders. The researcher could not get information for 0.6% with regard to gender with cholera cases. Chi-square test was calculated in order to establish the relationship between the gender and number of cholera cases. The following table 4.13 represents the association of gender with cholera cases and the results of the chi-squared tests.

Table 4.13: Comparison cholera cases by gender.

Gender	**Cholera cases**	**Chi-square**
No information	02	0.237
Male	160	
Female	155	
Total	317	**0.237 (>0.05%)**

The results show a Chi-square test p-value=0.237, greater than 5% (0.05). Therefore, gender does not have association with cholera cases in this study. People are infected regardless of gender, this explains the apparent equal distribution of cholera cases in this study (50.5% for male and 48.9% for female).

In addition, the age distribution of patients differed substantially in these epidemics of V.cholera 01 in these locations where most of the patients were adults. There was also not much difference between male and female patients as shown in table 4.13. The following table 4.14 includes age groups and gender with cholera cases.

Table 4.14: Age and gender distribution of patients with cholera

Age(years)	**No of patients (% in each age/gender category)**	
	Magale sub county (n = 317)	
	Male	Female
2- 4 years	09 (2.83%)	11 (3.47%)
5-15 years	12 (3.78%)	06 (1.89%)
>15 years	139 (43.8%)	138 (43.5%)
Total	**160 (50.5%)**	**155 (48.9%)**

Employment status

The employment status which determines the socio-economic status of the patient was also investigated as a risk factor associated with the occurrence of cholera infection. Patients were classified in 4 groups as indicated in the following table 4.17 which represents the frequency distribution of cholera in relation to the employment status.

Table 4.15**:** Distribution of cholera cases per employment status

Employment status	**Frequency**	**%**
Unemployed	201	63.4
Employed	74	23.3
Self employed	9	2.8
Student	33	10.4
Total	317	100.0

Table 4.17 shows that 63.4% of the population did not have jobs; 26% were employed and students represented only 10.4% of the overall cholera cases.

Chi-square test was used to demonstrate that there could be a relationship between employment status and cholera. The results of Chi-square test obtained from this aspect of the study are shown in table 4.18 which also include the association of employment status and cholera cases.

Table 4.16: Comparison of cholera cases by employment status

Employment status	**Frequency**	**%**
Unemployed	201	0.811
Employed	74	
Self employed	9	
Student	33	
Total	317	**0.811 (>0.05%)**

The results of the Chi-square test shows p=0.811, greater than required p-value of 5% (0.05). Therefore, this implies that employment does not have an impact on/association with the cholera cases. People were infected with cholera irrespective of whether they were employed or not. V. cholera does not choose the socio-economic status of a person and transmission could occurred at any time, in any place through contaminated food and water, or from person–to–person. The majority of the population are the poor black people (99.1%) and without a job. Those employed were working either as domestic workers or as farmers, or just self-employed. This might have contributed in the transmission of the disease because of the low level of education and poor hygienic practices. The study demonstrated that "employment" as a variable does not have an association with cholera cases. Males and females were infected at equal proportion; thus gender did not have impact in cholera cases.

4.2 DEMOGRAPHIC RESULTS

4.2.1 Parishes

Table 4.1.7:Cholera cases per parish

Parish	Frequency	%
Bupoto	154	48.6
Bumbo	111	35.0
Matuuwa	47	14.8
Mahala	5	1.6
Total	317	100.0

Table 4.1.7 shows that Bupoto municipality was the most affected area with 48.6% of cholera cases, followed by Bumbo the entry gate with 35%. A majority of the cases amounting to 83.6%, were found in the Bupoto–Bumbo parishes' corridor. Mutuwa and Mahala parishes had respectively 14.8% and 1.6%. Chi-square tests were performed for a possible relationship or association between the local parishes and the number of cholera cases.

The following table 4.1.8 includes the four parishes of the Magale sub county, the number of cholera cases and the chi-square results. The researcher sought to discover if there is an association between parishes and the occurrence of the outbreak. The fact that these parishes are rural with poor living conditions could have contributed to outbreak.

Location (Parishes)	**Cholera cases**	**Pearson chi-square**
Bupoto Bumbo Muutuwa Mahala	154 111 47 5	
Total	317	**0.005 ($p<0.05$)**

The results from using the chi-squared test for the 4 parishes in comparison with the number of cholera cases show $p=0.005$, which is less than required p-value of 5% ($p=0.05$). Therefore, this implies that local parishes in the Magale sub county had an association with the number of cholera cases. More cases were found in the Buputo – Bumbo parishes' corridor, probably due to their geographical position on the N1 road. These areas have a high population density, and according to the WHO, overcrowded communities with poor sanitation and unsafe drinking water supplies are most frequently affected by epidemics (WHO, 2015a).

4.2.3 Sanitation systems

Lack of adequate sanitation systems in most of the areas visited is still a major challenge. According to the WHO, cholera outbreaks can occur sporadically in any part of the world where water supplies, sanitation, food safety and hygiene practices are inadequate (WHO, 2015b). The type of sanitation was indicated in patient's collection forms which were designed at the time of cholera outbreak. The table 4.7 presents the frequency distribution of cholera with the type of sanitation.

Table 4.1.9: Distribution of cholera cases per sanitation types

Sanitation types	Frequency	%
Presence of sanitation services	2	.6
Absence of toilets	93	29.3
Pit latrines	221	69.7
Others	1	.3
Total	317	100.0

The majority of patients' records revealed inadequate sanitation systems; 69.7% use Pit latrines and 29.3% do not have toilets at all. A Pearson Chi-squared test was used to establish whether there is a relationship between cholera cases and sanitation. The following table 4.1.10 includes the types of sanitation, cholera cases and the results for Pearson Chi-square test.

Table 4.1.10: Comparison of cholera cases by sanitation types.

Sanitation types	**Cholera cases**	**Chi-square**
Presence of sanitation services	02	0.982 (p>0.05)
Absence of toilets	93	
Pit latrines	221	
VIP latrines	01	
Total	31	

The results of Chi-square test show that p=0.982, greater than required p value of 5% (0.05%). Therefore, this implies that sanitation in this study did not have an association with the cholera cases. This raises the need to analyze the types of sanitation separately in order to identify which one could have been associated with cholera outbreak. Table 4.5 gives the different chi-square results for the different types of sanitation.

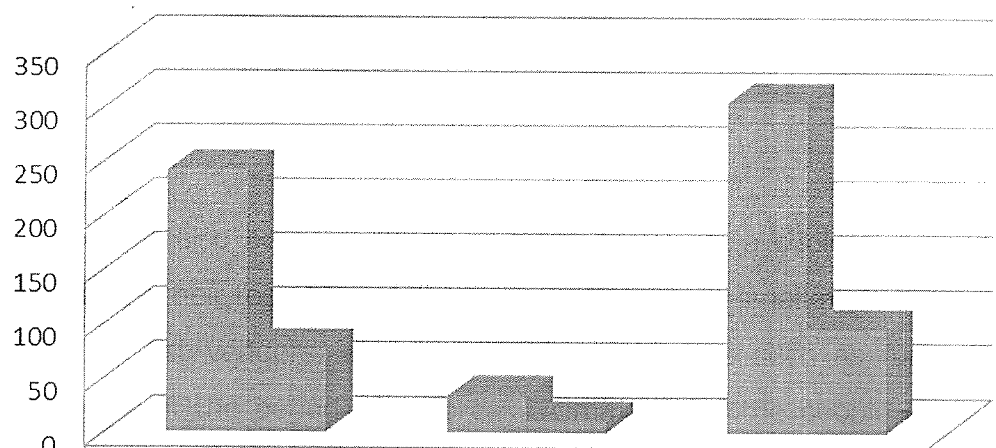
Table 4.1.11: Comparison of cholera cases by sanitation types.

Sanitation types	**Cholera Cases**	**Chi-square**
Presence of sanitation Services	02	0.485 (>0.05)
Absence of toilets	93	0.016 (<0.05
Pit latrines	221	0.094 (>0.05)
VIP latrines	01	0.387 (>0.05)
Total	317	

Pit latrines are used in most of the villages; this might have contributed positively in limiting the chain of transmission. The use of chi-square test shows p=0.094, which is greater than required p-value of 5% (0.05%). This implies that Pit latrines did not have an association with cholera cases in this study. At the other hand the absence of toilets was found to have an association with cholera. The p-value of 0.016 is less than required value of 0.05%. Therefore, this implies that the absence of toilets has an impact on/association with cholera cases.

4.2.4 Food sources

Contaminated food has also been identified as a risk factor for a cholera outbreak. In these areas people get their food from different sources such as small restaurants along the street, shops, street vendors, and from public gatherings such as funerals and weddings as reported at the period of outbreak. A majority of the people cooks their own food, but that does not exclude them for eating food from other sources. The results of the investigation are presented in figure 4.2.



	From shops	From Funeral	Self-cooked
Frequency	241	34	305
Percent	76	10.7	96.2

Figure 4.2: Distribution of food sources with cholera cases

The people who cook their food represent 96.2% and 76% rely on food from shops and street vendors. A further 10.7% of the people received food from funerals. These food sources were indicated in patient's form on admission at the hospital. The Pearson chi squared test was used to establish the relationship between cholera cases and food sources. The results of Chi-square tests, as well as the association of food sources with cholera cases are shown in table 4.6 as follows:

Table 4.1.12: Comparison of cholera cases by food sources.

Food sources	Cholera cases	Pearson chi-square
From shops	241	0.017 (<0.05)
From Funeral	34	0.142 (>0.05)
Self-cooked	305	0.401 (>0.05)
Total	580	

Table 4.10 shows a total of 580 instead of 317 or less, as 263 patients' records for more than one food sources. The results of Chi-square test show that food from shops had p=0.017, less than required p of 5% (0.05%). Therefore, this implies that food from shops in this study had an impact on/association with the cholera cases. With regard to food from funerals, the results of Chi-square test show that p=0.142, greater than required p of 5% (0.05%). Therefore this implies that food from funeral in this study did not have an impact on/association with the cholera cases; whereas the use of Chi-square test in order to establish the relationship between self-cooked food and cholera cases shows that p=0.401, greater than required p of 5% (0.05%). Therefore, this implies that self-cooked food did not have an impact on/association with the cholera cases in this study.

It appears to be a paradox because the results have shown that 96.2% of the people cook their own food, yet they were still infected with cholera disease. In this case the source of infection had to be found elsewhere such as contaminated food from other sources such as street sellers and small restaurants, also contaminated drinking water and direct transmission from other infected persons owing to inadequate hygiene practices (Mugero & Hope, 2001).

In addition, poor food handling might have played an important role in the transmission of the bacteria. Contaminated food from funerals and other public catering (10% of cholera cases), shops and street sellers (76% of cholera cases) was significantly associated with the disease. Chi-square test pointed to the food from street sellers, shops and small restaurants as the source of contamination.

4.2.5 Period of occurrence

The annual rates of disease in cholera endemic areas vary widely, probably as a result of environmental and climate changes (Van den Bergh et al, 2008). The seasonality of cholera outbreaks in relation to climate changes would allow better planning for epidemics by public-health officials. Cholera cases in this study were distributed according to the "rainy season" (hot and humid) and the "dry season" (winter). The results are indicated in table 4.22 as follows:

Table 4.1.13 Distribution of cholera cases per season

Seasons	**Frequency**	**%**
Rainy season	**314**	99.1
Dry season	**3**	.9
Total	**317**	**100.0**

Most of the cholera cases (99%) were observed in the rainy season (hot and humid), and only 1% of the cases was found in the dry season (winter).

The Chi-square test was calculated to establish the association between the rainy and dry season with cholera cases. The results obtained are illustrated in the following table 4.1.14 presenting also the association of period of occurrence with cholera cases.

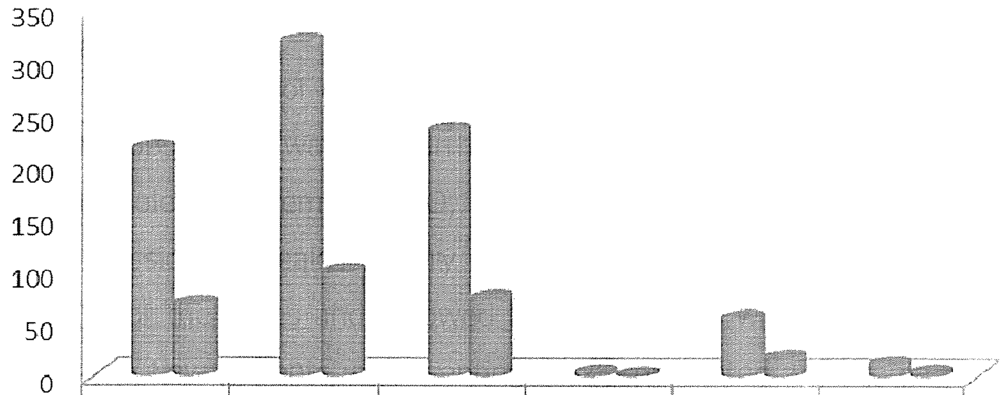
Table 4.1.14: Comparison of cholera cases by season types

Seasons	Cholera cases	**Chi-square**
Rainy season	314	0.679
Dry season	03	0.679(**>0.05%)**
Total	317	

The results of the Chi-square test shows that p=0.679, greater than required p-value of 5% (0.05). Therefore, this implies that the Period of occurrence (rainy and dry) does not have an impact on the cholera cases in this study. This study indicated a possible relationship between cholera incidence and the rainy season. The seasonality therefore seems to be related to the ability of vibrios to grow rapidly in warm environmental temperatures. Rainfall and temperatures are the environmental variables that may support the survival and population growth of the cholera bacteria, V. cholerae, in the natural environment and therefore cause cholera outbreaks. The period of outbreak covered the two seasons, rainy and dry seasons with 99.1% of cases in rainy seasons. Consequently the outbreak occurred more likely in rainy season than dry, but if the two variables are considered together there is no association with cholera cases as proven with chi-squared test.

4.2.6 Clinical features

According to the WHO, a case of cholera should be suspected when a patient aged 5 years or more develops acute watery diarrhea, with or without vomiting, in an area where there is a cholera epidemic (WHO, 2015c). The Magale sub county cholera epidemic was a classic outbreak; Watery diarrhea was the commonest symptom representing 98.7% of the cases and followed by Dehydration with 73.8%, as well as vomiting with 68%. A Few patients, representing 3.5%, presented with Coma and only 0.9% had Abdominal Cramps. Patients who had Fever represented 17.4% of the overall cholera cases. The results of this investigation are indicated in figure 4.3:



	Vomiting	Watery Diarrhoea	Dehydration	Abdominal Cramps	Fever	Coma
Frequency	216	318	234	3	55	11
Percent	68.1	98.7	73.8	0.9	17.4	3.5

Figure 4.3: Distribution of clinical features

The clinical features of the disease were indistinguishable from those due to V. cholera 01. Almost all the patients had severe secretory-type watery diarrhea and vomiting, with rapid onset of dehydration. The following table 4.25 summarizes the signs and symptoms of patients with acute watery diarrhea associated with V. cholera 01.

Table 4.1.15: Association of clinical symptoms with V. cholera 01

Clinical features	**Magale sub county** **n = 317**
Ages of patients	All ages
Watery diarrhea	313 (98.7%)
Severe dehydration	234 (73.8%)
Vomiting	216 (68.1%)

Table 4.1.15shows the three main clinical symptoms of cholera in all age groups: watery
diarrhea, severe dehydration and vomiting.

CHAPTER FIVE

SUMMARY, LIMITATIONS, RECOMMENDATIONS AND CONCLUSION

5.1 INTRODUCTION

This chapter discusses the summary of the study results regarding the factors contributing to the prevalence of cholera in Magale sub-county, Magale sub county of Easten Uganda. The chapter also presents the achievement of the aim and objectives of the study as well as its limitations. The conclusions and the recommendations are also presented.

5.2 SUMMARY

5.2.1 The research questions

The research questions of the study were:

(i)What is the prevalence of cholera infection in Magale sub county?

Prevalence refers to the number of affected persons present in the population at a specific time, divided by the number of persons in the population at that time. It is calculated per 1000. Therefore, the prevalence of cholera was:

Cholera Prevalence = 1160 x 1000 = 0.89%

1,302,113 (total population)

The prevalence of cholera in Magale sub county was estimated at 0.89% per 1000 population. This represents the degree to which cholera was prevalent, or the percentage (proportion) of all individuals in a population that was affected with cholera at a given time (period of outbreak). Cholera disease had a very low prevalence (less than 1%) due to its short duration.

(ii) What are the contributing factors associated with cholera in the Magale sub county? Lack of hygienic practices, lack of safe food preparation and handling, local settlements with poor living conditions and the absence of toilets in the rural community of the Magale sub county were identified as risk factors associated with cholera outbreak. Therefore, the research questions in this study were answered. The objectives were to link the number of confirmed cholera cases in relation to the environmental parameters identified in this study. The aim was to establish statistical relationships between the number of cholera cases and certain environmental factors that may support the survival and population growth of the cholera bacteria, Vibrio cholera, in the natural environment and therefore cause cholera outbreaks. According to the WHO (2000a), Vibrio cholera spreads rapidly in situations where living conditions are crowded, water sources unprotected and there is no hygienic disposal of feaces, such as in refugee camps, farms, villages townships.

(iii) What are the clinical aspects associated with cholera?

Three main clinical aspects were found to be associated with cholera:

- Acute watery diarrhea
- Dehydration
- Vomiting

Therefore the research question in this study was answered.

5.3 LIMITATIONS OF THE STUDY

The study was limited to Magala sub-county ,Magale sub county and cannot be generalized to the entire Eastern Uganda.

5.4 RECOMMENDATIONS

The study recommends the following:

5.4.1 Prevention of cholera

Measures for the prevention of cholera mostly consist of providing clean water and proper sanitation to populations who do not yet have access to basic services. Health education and good food hygiene are equally important; Communities should be reminded of basic hygienic behaviors, including the necessity of systematic hand washing with soap after defecation and before handling food or eating, as well as safe preparation and conservation of food. Appropriate media, such as radio, television or newspapers should be involved in disseminating health education messages. Community and religious leaders should also be included in the social mobilization campaigns (WHO, 2015d). In addition, awareness campaigns and health education to communities at risk of cholera infection should be done.

5.4.2 Control of cholera

Among the people developing symptoms, 80% of the episodes are mild or moderate severity; the remaining 10%-20% of the cases develop severe watery diarrhea with signs of dehydration (WHO, 2015d). Once an outbreak is detected, the usual intervention strategy aims to reduce mortality by ensuring access to treatment and controlling the spread of disease. To achieve this, all partners involved should be properly coordinated and those in charge of water and sanitation must be included in the response strategy.

The fact that cholera is a fecal-oral highly transmissible water-borne disease means that water sanitation, clean water supply, sewage treatment, and an awareness and adoption of hygienic practices to should be improved or implemented to eliminate an outbreak. Even if improved water and sanitation are the mainstay of the prevention and a sustained control of cholera, those goals need time and a long term investment for results to be achieved, especially in impoverished countries where enteric diseases are endemic.

Recommended control methods, including standardized case management, have proven effective in reducing the case-fatality.

According to WHO (2015d), the main tools for cholera control are:

- Proper and timely case management in cholera treatment centers;
- Specific training of health care professionals for proper case management, including avoidance of nosocomial infections;
- Sufficient pre-positioned medical suppliers for case management (e.g. diarrheal disease kits);
- Improved access to safe water, effective sanitation, proper waste management and vector control;
- Enhanced hygiene and food safety practices;
- Improved communication and public information.
- Epidemiologic surveillance for early case detection.

5.4.3 Unaffected neighboring regions

According to the WHO (2015d), countries or any other regions neighboring an area affected by cholera should implement the following measures:

-Improve preparedness to rapidly respond to an outbreak, should cholera spread across borders, and limit its consequences;

-Improve surveillance to obtain better data for risk assessment and early detection of outbreaks, including establishing an active surveillance system.

However, the following measures should be avoided, as they have been proven ineffective, costly and counter-productive:

-Routine treatment of a community with antibiotics, or mass chemoprophylaxis, has no effect on the spread of cholera, can have adverse effects by increasing antimicrobial resistance and provides a false sense of security;

-Restrictions in travel and trade between countries or between different regions of a country;

-Set up a "*cordon sanitaire*" at borders, a measure that diverts resources hampers good cooperation spirit between institutions and countries instead of uniting efforts.

In summary, Transmission of the outbreak presented a unique characteristic: the first part due to the contaminated non-chlorinated drinking water, and the second part mainly by unsafe water and food handling practices; the third poor sanitary situation and inadequate hygienic practices. On the basis of these conclusions, a number of recommendations were planned:

-Repair of water pipelines, daily chlorination, periodic monitoring of water pipelines, and water quality assurance by testing.

-The district and sub county authority must ensure the implementation of these recommendations through several meetings with local authorities, leaders and engineers.

The cholera outbreak led to substantial death, disease and economic loss. A number of recommendations are made to prevent recurrences in the long term:

-Early diagnosis of cholera in the remote areas (village, farms, townships); thus the use of culture should be substituted with the use of rapid kit tests. Rapid detection, epidemiological investigation of diarrhea outbreaks and oral vaccination may be the only way to prevent death and disease (WHO, 2010a).

-Safe water must be made easily accessible at different points with less distance in these remote areas of the Manafwa.

-Rainwater harvesting followed by chlorination at household level, or solar disinfection may be achieved to prevent the type of environmental contaminations that triggered a waterborne outbreak followed by person-to person transmission during this disaster (WHO, 2005).

-Owing to the complex situation of the Magale sub county, a large–scale intervention may possibly be needed to increase access to safe water at household level by improving hygienic practices such as the use of narrow-mouthed containers for storage of drinking water, boiling of water and treating water with chlorine at the household level.

5.4.4 Areas for local environment development

Based on the findings of this research, some recommendations are suggested to the parish' managers, government agencies,
and lastly the National government.

5.4.5 Parishes' managers

It has to be noted the managers at the sub county level are responsible for the development of their local areas, most of which are still underdeveloped. In line with the MDGs, they should achieve the following goals for the community:

Goal 1: Eradicate extreme poverty and hunger

Goal 2: Achieve universal primary education

Goal 3: Reduce child mortality rates (e.g. from waterborne diseases)

Goal 6: Combat HIV/AIDS, Malaria, and other diseases (e.g. cholera...)

Goal 7: Ensure environmental sustainability, for example: sustainable access to an improved water source, and access to improved sanitation. Ensure housing at RDP standards.

5.4.6 Governments Agencies

Government agencies should effectively provide services to the people that they ought to serve. They have to implement sustainable strategies that can improve the health of the population. It is also suggested that Government agencies work hand in hand with the local government to improve access to safe water, sanitation and education on hygiene practices. Government agencies need to do more; instead of just focusing on the provision of resources. They should also equip health professionals with the necessary skills by providing training.

5.4.7 Provincial and National governments

National and provincial governments should assist in the provision of access to safe water, adequate sanitation and proper housing. Adequate water supply and sanitation are basic requirements for life. Access to clean water and improved sanitation facilities is a fundamental human right. Yet, in many developed and developing countries, water source quality shows continued deterioration and in many cases depletion. These effects are a function of increasing population pressure, agricultural misuse and the inability to keep pace with the increasing demands on the resource. The authorities at national and provincial level should understand that in developing countries where resources may be inadequate, particularly in rural communities, basic hygiene education and sanitation programs can be used to improve human health. They should work as a team with the governments' agencies to ensure and provide necessary training of health professionals, supply necessary equipment and medicines, upgrade the existing health facilities or build new ones with improved technology. Vaccines should be made available at any time.

5.4.8 Areas for further research

Critical needs for future microbiological safety of water include a more realistic valuation of water. This requires better education on the value and limitations of the resources for, both public and policy makers. The burden of water supply and sanitation related disease is constantly underreported and the surveillance systems are inadequate; thus intervention studies and aggressive surveillance systems are necessary to provide a clear understanding of disease burden from contaminated water. There is a need for a better understanding of increasingly susceptible populations in transmission of such diseases. Microbiologically safe water cannot be assumed, even in developed countries. The situation will worsen unless measures are immediately taken.

The need for safe drinking water as well as adequate sanitation is a need that binds all of humanity into a single, global community. It is suggested that the same study be carried out at national level in order to investigate the microorganisms in the local environment, commonly associated with diarrheal diseases in general.

5.5 CONCLUSION

The study concluded that factors associated with cholera in the Magale sub county include lack of hygiene practices, unsafe drinking water sources, lack of safe food preparation and handling, local settlements (villages, farms and refugee camp) due to poor living conditions and the absence of toilets. Sanitation inadequacies remain a major challenge in the Magale sub county where a majority of people commonly uses Pit latrines. Inappropriate sanitation, such as the use of open-air defecation, plays a key role in cholera transmission in rainy seasons. The limitations and recommendations of the study were also discussed.

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APPENDIX 1: AUDIT TOOL FOR PATIENTS RECORDS
CHOLERA DATA COLLECTION TOOL

SECTION 1: BIOGRAPHIC DATA

Tick one response or fill in where applicable.

1. Age

< 5 Years	1	
5- 15 Years	2	
>15 Years	3	

2. Gender

Male	1	
Female	2	

3. Employment status

Un employed	1	
Employed	2	
Self employed	3	
Student	4	

4. Hygiene

Hands washing before eating	1	
Hands washing before cooking	2	
Hands washing after using the toilets	3	

5. PLACE

5. Location (parish)

Bupoto	1	
Bumbo	2	
Matuuwa	3	
Mahala	4	

6. Health facilities

Arari Health centre 11	1	
Mercy hospital	2	
Kiyunga health centre	3	
Bisoni health centre	4	

7. Sanitation

Presence of sanitation services	1	
Absence of toilets	2	
Pit Latrines	3	
VIP Latrines	4	
Waste water and refuse	5	
Water-borne sewerage	6	

8. Food sources

Shops	1	
Funeral/ Public catering	2	
Self cooked	3	

9. Period of occurrence

Rainy season	1	
Dry season	2	

SECTION 2: CLINICAL ASPECTS

This section includes all cholera cases and deaths. Tick one response or fill in where applicable.

10. Year of admission

2008	1	
2009	2	
2010	3	

2011	4	
2012	5	

11.Clinical features

Vomiting	1	
Watery Diarrhea	2	
Dehydration	3	
Abdominal Cramps	4	
Fever	**5**	
Coma	**6**	