TOPIC: SPATIAL AND SEASONAL ECOLOGY OF CHOLERA IN ACCRA METROPOLITAN AREA (AMA) FROM 2008 TO 2016

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Declaration

This is to certify that this thesis is the result of research undertaken by Mawulikplim Kafui towards the award of the Master of Philosophy (M.PHIL) degree in Geography at the Department of Geography and Resource Development, University of Ghana.

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Dedication

This work is dedicated to my entire family. Mr Kenneth Kafui, Vida Toseafa, Mrs Mawuyram Tsaku, Nutifafa Kafui and David Kekeli Kafui.

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Abstract

The Accra Metropolitan Area (AMA) is a cosmopolitan area with people coming from various economic, social and health backgrounds. Cholera has however been endemic in the area for over three decades. The research aimed at finding the conditions causing the endemic presence of the disease within the Accra Metropolitan Area.

The study involved the mapping of cholera risk factors across selected communities of different income levels within the AMA in order to show the level of risk faced by the communities. According to the findings, the main mode of spread of cholera in the low income areas was through personal contact or contagious spread. Both middle and high income areas suffered the relocation mode of spread where surrounding communities with poor sanitation were highly influential in the spread of the disease. There were also more cholera risk factors in the form of dumpsites, open defecation sites, open drains and public toilets found within low income communities. These factors coupled with poor sanitation make the areas hotspots for the spread of the disease. Knowledge in terms of cholera was also found to be high across the various study communities in the AMA. There was however a high number of respondents that ate from outside their homes hence increasing the risk of contracting cholera.

There was however a complex relationship between weather and cholera in the short term which was explained by other behavioural and sanitation factors. It was observed from literature that the onset of the raining season increases the risk of contracting cholera in the AMA. Based on these findings, the study recommends a community based approach in tackling the sanitation problems in the AMA. There is also the need to intensify and sustain Cholera education in AMA.

Keywords: Spatial, Seasonal ecology, Accra Metropolitan Area

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AMA	Accra Metropolitan Area
GSS	Ghana Statistical Service
GHS	Ghana Health Service
WHO	World Health Organization

CHAPTER 1

GENERAL INTRODUCTION

1.1 Introduction

Cholera is a disease associated with poor sanitation and hygiene conditions. The ingestion of faecally contaminated food and water is the main mode of transmission of the disease. The disease affects about 4 million people worldwide on an annual basis with over 100,000 deaths recorded (Dzotsi, 2014).

Cholera is a diarrhoeal disease which is endemic in over 50 countries worldwide (Kaper et al, 1995). Out of 132,121 cholera cases recorded from 38 countries across the world in 2016, there were 17 affected countries from Africa, 12 affected Asian countries, 4 affected European countries, 4 in the Americas and 1 from Oceania (WHO, 2017). According to the report, five countries namely Somalia, Democratic Republic of Congo (DRC), Tanzania, Haiti and Yemen represented 80% of all the reported cases. The disease burden according to the data is high in Africa as well as Asia.

For over five decades, cholera has been eradicated from the developed world through the improvement of water and sewage treatment infrastructure which increased overall sanitation conditions of the environment. The situation is quite different when it comes to Africa. Poor sanitation, poor water sources and a high rate of poverty makes populations more vulnerable to the spread of the disease (Smith et al, 2005).

The disease can also be seen to be influenced by some form of seasonality. According to Emch et al (2008), cholera outbreaks show a more organized seasonal pattern in the higher latitudes making it much easier to predict epidemics. Countries closer to the equator on the other hand have much more unpredictable seasonal characteristics of cholera making the chain of causality quite complex and

difficult to identify. The study show evidence of more outbreaks occurring around the equator than at the higher latitudes.

The growth of African cities has brought about a lot of challenges especially to the health sector. Generally, urban areas are seen as having improved health services as compared to rural areas. Weeks et al (2013), emphasizes the spatial inequality of diseases in cities in terms of accessibility to health and vulnerability to diseases. Poor communities are therefore more vulnerable to disease outbreak as a result of their environment whilst higher income communities have much less environmental vulnerability to diseases. Cholera as a disease is therefore more likely to occur and have a greater impact in these poor communities as compared to wealthier environments.

The year 2013 saw 22 African countries report a total of 56,329 cholera cases and 1,367 deaths. Compared to the year 2012 there was a 52% reduction in the number of cholera cases recorded. Four countries namely Angola, Democratic Republic of Congo (DRC), Nigeria and Somalia accounted for 83% of recorded cholera cases on the continent (WHO, 2014).

In addition, Nigeria is also documented as one of the countries with the greatest burden of the cholera epidemic in West Africa. High poverty levels, poor sanitation conditions, high illiteracy levels and inadequate drinking water sources were pointed out as reasons behind the high incidence of cholera in Nigeria. These conditions are not alien to the rest of the West African sub-region and hence the disease thrives within the geographical area (Leckebusch and Abdussalam, 2015).

Cholera was introduced to Ghana in the 1970's and has hit epidemic levels since then. The frequency of the disease keeps fluctuating with high and low periods recorded over the years. In 1983, the country recorded a total of 15,032 cases. There were 13,743 cases also recorded in 1991 which represents one of the highest recorded epidemics in the country. However, 28,975 cases were recorded in 2014 giving

evidence to a yearly fluctuating level of cholera spread within the country (Dziedzom, 2015). Greater Accra, Central and Western regions are the areas mostly affected by an outbreak of the disease and hence the disease is documented to be more endemic in the coastal regions of the country.

1.2 Problem Statement

Diseases are not found uniformly over the surface of the earth, they are spatially distributed at different areas as a result of different factors such as demographic, environmental, behavioural, socio economic, genetic and infectious risk factors (Asaana, 2012). Cholera is said to have been reported in Ghana since 1970 when the first case was officially detected and has since remained a great disease burden in the sphere of public health within the country. The main factors identified as affecting the distribution of cholera in the AMA are environmental, socio- economic and infectious risk factors.

Environmental factors in the form of open defecation sites, inappropriate dumping sites, chocked and unclean drains are conditions necessary for the endemic nature of the disease. According to Dziedzom, (2015), cholera outbreaks have also been observed to occur perennially in the raining seasons. The combination of environmental and seasonal factors help greatly in determining the scale and intensity of the disease outbreak.

Normally, social classes also determine housing patterns and the environment in which one lives. People of higher social classes are more likely to live in clean and more planned environments whilst people of lower classes are more likely to live in filthy and unclean environments making them more vulnerable to contracting the disease. Infectious risk factors such as flies and other vectors make it easy for the disease to be spread from different sources. The higher the presence of these factors, the more the vulnerability of people to the spread of cholera.

Other important factors affecting vulnerability of cholera include Gender, age and income. According to UNICEF, (2010) these factors play an important role in the exposure of various individuals to the disease either through dictating social roles or behaviors.

The Accra Metropolitan Area (AMA) is predominantly an urban area which keeps growing by the day. Because of its nature as a business centre, the area has a high population during the day and this is as a result of the influx of labour from the surrounding peripheries. It is estimated that over one million people move in and out of AMA daily for various socio-economic purposes. The area also has about 2.3% of its households having no toilet facilities while about 31.9% have private water closets (GSS, 2014). Dogbe & Dumenu (2007), described the situation where waste collection is mostly carried out on a door to door system in high and middle income communities whilst the low income areas have large dump sites where all members of the community are expected to dispose their rubbish. However, poor waste management systems coupled with a high population pressure in the Accra Metropolitan area has led to poor sanitation conditions which has made the area seasonally vulnerable to the outbreak of cholera.

The spatial differentials in waste management and sanitation conditions in Accra metro give rise to cholera risk and vulnerability in the area. According to Dziedzom (2015), issues of sanitation impacts various communities and households economically hence causing diseases related to sanitation as well as reducing productivity of affected adults in the working class. This in turn increases the number of children who drop out of school as a result of low household incomes.

The recent cholera outbreaks in Greater Accra have seen infection being skewed mostly towards the men as compared to women with age groups between 20 and 29 having the greatest burden of the disease. This shows a more youthful vulnerability to the cholera disease burden. All the various risk

factors coupled with seasonal variations of weather contribute to the prevalent nature of cholera in Accra.

A number of interventions including the national sanitation day and the national cholera prevention campaign have been rolled out to help Eliminate cholera from Accra and the country as a whole. Despite these interventions, cholera remains endemic in Accra and the country as a whole.

The research however seeks to identify the complex relationships that exist between environmental, socio-economic, biological (age and gender) and seasonal risk factors that contribute to the endemic nature of cholera in the Accra Metropolitan Area since little research has been focused on these aspects of cholera studies in the area.

1.3 Objectives

1.3.1 Main Objective

The primary objective of this study is to examine the spatial and seasonal relationship of cholera within the Accra Metropolitan Area from 1990 to 2016**.**

1.3.2 Specific Objectives

The specific objectives include the following;

- Examine the spatial extent of cholera in the Accra Metropolitan Area.
- Analyze the intra-urban patterns of cholera within the AMA disaggregated by gender, income and age.
- Analyze the seasonal trends of cholera in the Accra Metropolitan Area.
- Discuss the social, economic and health impacts of cholera in the Accra Metropolitan Area.
- To discuss the institutional responses to the cyclical cholera epidemic in the country.
- Make suggestions and recommendations

1.4 Study Hypothesis:

H0- High educational levels do not result in high levels of knowledge of cholera in the Accra Metropolitan Area.

H1- High educational levels results in high levels of knowledge on cholera in the Accra Metropolitan Area.

1.5 Research Questions

1. What accounts for the endemic nature of cholera in AMA?
2. What accounts for the spatial differences of the disease within AMA?
3. What can explain the variation of the frequency of the disease in AMA over the past 8 years?
4. Which areas are more vulnerable to the outbreak of cholera within AMA?

1.6 Literature Review:

1.6.1 Geography of Cholera

According to Njoh (2010), cholera is a communicable disease that has gained international attention. It is also noted that the disease is still greatly vibrant in the developing continents of Asia, Africa and South America. The document goes on to suggest that low income communities and areas with high poverty are more vulnerable to the outbreak of the disease since they are more exposed to conditions of poor sanitation and inadequate drinking water. According to WHO (2012), cholera is a diarrhoeal disease which can result in death if left without treatment. The disease is caused by the bacteria *vibro cholerae* which is transmitted through contaminated food or drinking water. However, inadequate

records and recording systems have resulted in a situation where the disease is underreported worldwide.

It was estimated that there were 2.8 million cholera cases recorded within the period of 2000 to 2008 within which 91,000 deaths were recorded on an annual basis (Ali et al, 2012). The document also goes on to stress that the unavailability of data has also led to inadequate cholera data worldwide. This meant that any country which did not report cases of cholera but actually experienced an outbreak of the disease was excluded from world records. However, cholera was identified to be endemic in over 51 countries which are mostly developing countries. India, Ethiopia, Nigeria, Haiti, the Democratic Republic of Congo (DRC), Tanzania, Kenya and Bangladesh were identified as having high cholera cases and deaths annually.

Sosa (2010) report also lends support to the spatial presence of cholera within poor countries and refugee camps. This is attributed to the poor environmental and sanitation conditions found within these areas. Evidence of this was seen in the city of Goma of the Demographic Republic of Congo (DRC) where a refugee camp experienced an outbreak of cholera in 1994. Between 58,000 to 80,000 cases were recorded with 23,800 deaths recorded in just one month within that year.

Diseases are unevenly spread over the earth's surface. Some diseases are more likely to occur at more specific areas compared to others and this gives rise to disease differentials worldwide. On a global scale, Weeks et al (2013) identified urban areas as being more vulnerable to the outbreak of diseases as compared to rural areas. It was further identified that within urban areas there were spatial differences in the outbreak of diseases. According to Weeks, high income communities face lower risk and danger when it comes to issues of diseases. They are therefore classified as low risk areas in terms of disease outbreaks. Low income and overcrowded areas within urban centres are more vulnerable to the outbreak of diseases.

There is a spatial distribution of the disease in Ghana. Cholera is commonly found in the southern part of the country where there are higher levels of urbanization. Accra suffers tremendously from the outbreak of cholera and this is attributed to poor waste management practices. The 2014 cholera outbreak in the country was the second largest epidemic recorded in the history of the disease. The disease was reported to be more acute in the capital city of Accra with over 30,000 cases and 200 deaths recorded (Bagah et al, 2015). This poses a challenge to city planners and also health facilities within urban centers since there will be pressure on the limited resources in the area. The Figure 1.1 shows the distribution of cholera cases on a global scale for six years.

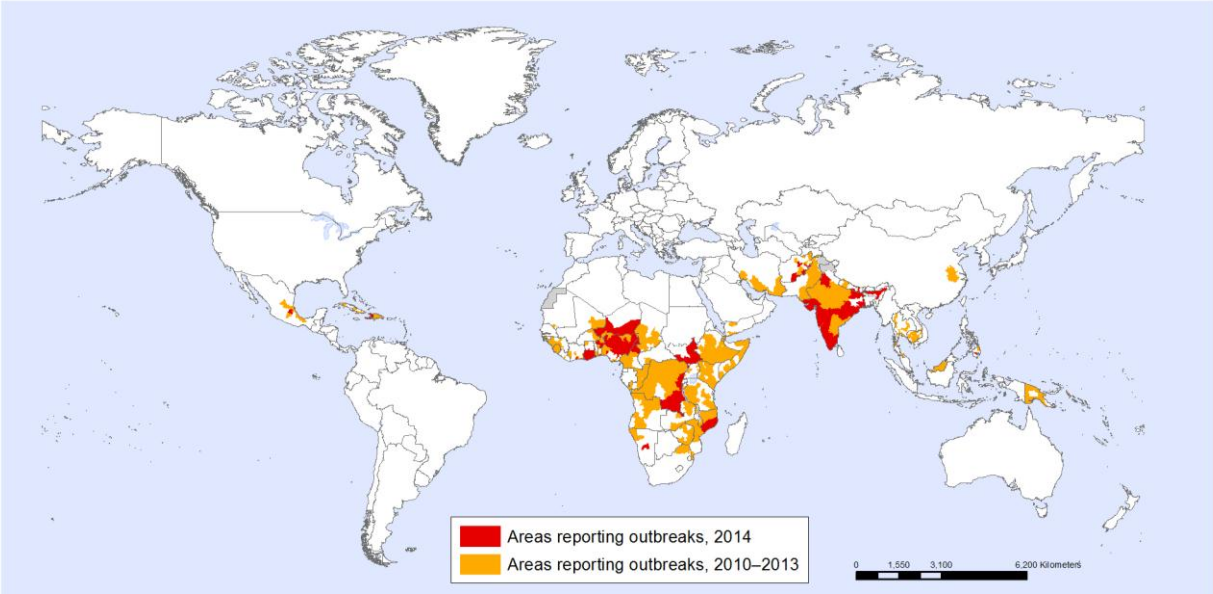


Fig 1.1 Spatial Distribution of Cholera from 2010 to 2016

Source: ***http://gamapserver.who.int/mapLibrary/Files/Maps/Global_Cholera_outbreaks.png***

1.6.2 Epidemiology of cholera

According to Oppong and Harold (2009), the disease ecology model attributes any disease to genetics, environment and behaviour. The document goes on to explain that the cause of any disease can be traced to any or a combination of the factors mentioned earlier. The occurrence of diseases

are also attributed to physical, biological and social factors. Most importantly climate, the natural environment and the anthropogegraphical environment play an important role in the epidemiology of diseases (Sorre, 1933).

Cholera has previously recorded six pandemics that killed millions of people worldwide. The disease spread from its source in the Ganges Delta in India to various parts of the world within the 19th Century and finally receded to south Asia. The previous six pandemics recorded killed millions of vulnerable populations in Europe, Africa and the Americas. The seventh pandemic is ongoing and started in 1961 from South Asia. In 1971 the seventh pandemic had reached Africa and spread to the Americas in 1991 (Njoh, 2010).

The causative pathogen known as vibrio cholerae cannot be easily eliminated from some countries therefore giving them the status of cholera endemic countries (WHO, 2008). According to the document, two serogroups of vibrio cholerae namely O1 and O139 are responsible for the outbreaks of the disease. Vibrio cholerae O1 has been identified as the cause of all recent epidemics of the cholera disease whilst the O139 strain is associated with cholera outbreaks in the past. The O139 strain was identified in Bangladesh in 1992 and has since been limited to Asia. The disease also thrives in people and aquatic environments that are quite salty and warm like estuaries and coastal areas. Regions where cholera continuous to affect currently include Africa, Asia and parts of the Middle East. Recent cholera studies have also shown the phenomenon of climate change giving rise to cholera in some areas (Poppick, 2014).

The disease is known to have a short incubation time as a result of the causative bacterium. The means of infection is by the ingestion of faecally contaminated food or water. According to Volk et al (1991), the bacterium does not spread beyond the gastrointestinal tract. They rather stay stuck to the intestinal mucosa and produce secretions of an enterotoxin called choleragen which results in diarrhoea.

The disease has been identified to be linked to the domestic use of contaminated shallow water sources such as shallow wells, rivers or streams (Njoh, 2010). The consumption of sea food like contaminated shellfish has also been identified as a means of spread of the disease.

The socio economic status of an area has also been identified as a factor that aids in the distribution of cholera .According to Steffen et al (2003), the cholera bacteria rapidly spread in areas where living conditions are crowded. These areas are likely to have poor water sources and unhygienic disposal of faeces. These conditions can increase the spread of the disease to a large extent.

1.6.3 Seasonality of cholera

Various studies have been conducted in relation to the causes of cholera globally. Apart from the primarily known environmental causes, a lot of researchers have tried to establish a link between the disease and the period in which it occurs. The distribution of cholera worldwide in terms of frequency, severity, duration and endemicity varies greatly.

Emch et al, (2012) conducted a seasonal study of cholera worldwide from 1974 to 2005. According to Emch, many studies attributed seasonality of the disease to environmental and climatic factors at various geographic locations. An example of seasonality can be found in Bangladesh where there is a defined seasonal cycle of the disease. The seasonal patterns were differentiated using the different strain types of cholera namely the *El Tor* and the *O139*. It was found out that the El Tor normally occurs on a small scale immediately after the spring period and on a large scale after the Monsoon period. The O139 type also followed a similar pattern with the frequency of the disease increased tremendously after the Monsoon. Other studies conducted by Emch revealed seasonally distributed outbreaks of the disease in other countries. In Pakistan, cholera was said to occur during the cool, dry winter and hot, dry spring periods in an increasing pattern. Evidence of seasonality of the disease is also found in

Kolkata, India where the outbreak of the disease peaks preceding and during the major Monsoon season.

Cholera displays consistently regular patterns worldwide but also varies spatially from place to place. Bouma and Pascaul, (2001) studies the seasonal variation and inter annual variation of cholera in Bengal. This study was as a result of the strikingly obvious pattern displayed by the disease in Bengal. Both climatic and environmental factors were attributed as the causes of the seasonality of the disease. The study revealed that the coastal regions of Bengal have a double seasonal outbreak of cholera but with a higher frequency recorded during the spring period. The dryer parts of the country including Bihar, Orissa, Punjab and Assam experience their peak of epidemics during the Monsoon period.

In Ghana, cholera is normally at its peak during the rainy season and is normally found along the coast of the country (MOH, 2011). As recorded by MOH, (2011), there was a gradual spread of the disease from Bawjiase in the Central Region to the Eastern Region followed by the Greater Accra Region in the year 2010. The disease was also diffused to the Upper West and Northern regions of the country. The outbreak was attributed to poor waste management, inadequate access to potable water and heavy rains amongst others.

1.6.4 Cholera in Ghana

Guinea was reported to be the first West African country to have recorded cases of cholera. The disease continued to spread to other West African countries through various means of transportation and communication routes and finally found itself in Ghana in 1970.

According to Dziedzom (2015) the first case of cholera in Ghana was identified on 1st September 1970. A Togolese national on a transit flight from Guinea was diagnosed of the disease at the Kotoka International Airport of Accra after collapsing. The introduction of the disease into the country subsequently had devastating effects on many communities. The fishing communities of Akplabanya

(in the then Ada District) and Nyanyano (Winneba District) were greatly affected by the disease. The disease was apparently "smuggled" into those areas by the relatives of dead fishermen for burial from Guinea and Togo respectively. The disease then spread rapidly throughout the country and was reported in the Ashanti Region in June 1971. As a result there have been seasonal outbreaks of the disease since then. The disease is reported to reach epidemic levels at least once every 4 to 6 years (Ashitey, 1994). More specifically cholera in Ghana is seen as an urban problem affecting already large cities and fast growing areas. There is little control over population expansion in such areas which leads to pressure on existing resources. Rapid population growth in these areas lead to degradation of the environment, lack of access to potable water and great challenges in disposal of waste.

The country recorded a total of 11,068 cases in 1982, this figure increased to 15,032 cholera cases in 1983. A total of 1,015 cases were documented in 1984 which represents a great decrease in the number of cholera cases recorded annually. The year 2014 reported a total of 2,8975 cases which represents one of the highest frequencies of the disease recorded in the country's cholera history. The frequency of the disease keeps fluctuating with the country recording low, medium and a high number of cases over the years. In 1991, the number of cases recorded over the country was 13,743 whilst 1992 and 1993 recorded 273 and 1,470 cases respectively (Dzotsi, 2014; Dziedzom, 2015). Over the years the disease has become endemic around coastal areas of the country affecting regions such as the Greater Accra Region, Central Region and Western Region.

Cholera in the country has been observed to have a cyclic pattern. This situation is as a result of the inability of the city authorities to provide adequate long term sanitation infrastructure such as good quality water and proper refuse disposal systems within urban communities. The case fatality rate of cholera within the country is high and this has been attributed to the inability of health systems to respond to the outbreak of the disease (Ofori-Adjei & Koram, 2014). In 2015, the case fatality rate

within the country was recorded as 0.9% as of June 2015 (WHO, 2015). According to Dziedzom, (2015) the burden of cholera in Ghana has brought about loss of life, reduced rate of socio-economic activities and slowed development of affected communities.

1.6.5 Urbanization, sanitation and water provision

In Ghana, the statistical definition of an urban center is any settlement with a population of 5,000 or more people (Songsore, 2009). It has however been projected per the current population trends that over half of the country's population will live in urban areas by the year 2020 (Nabila, 1988). Despite the advantages associated with urbanization such as the access to essential public services as good education and health facilities, challenges in relation to the environment are continuously posing risks to the quality of human life within urban areas.

In terms of urbanization, various case studies have been associated with different cholera scenarios. According to Osei and Duker (2008), rapid urbanization occurring in developing countries such as Ghana tend to be associated with high incidence of cholera. This has been attributed to overcrowding and unsanitary living conditions associated with the demographic nature of urbanization in the developing world. In Ghana, unreliable water sources coupled with poor sanitation practices provide conditions necessary for the spread of cholera in urban areas. The document also identifies areas such as Mexico where cholera is associated with low urbanization.

WHO (2006) connects rural-urban migration to the upsurge of poor sanitation and lack of clean and adequate water resources in urban areas. An influx of people from rural areas in search of better jobs, schools and push factors such as rural poverty leaves urban areas highly vulnerable to poor environmental conditions leading to cholera.

The increase in the number of cities have brought about new risks in the spread of diseases. This include poor housing which can lead to the increase of household insects and rodents that spread vector related

diseases. Urban planning emerged to help prevent cholera and other infectious diseases that occur in the urban areas. The urban poor were identified as the most vulnerable settlers in cities and towns as a result of lack of access to essential resources for better sanitation and healthy wellbeing (Corburn, 2004).

The various factors making urban areas highly vulnerable to the spread of cholera are summarized as poor sanitation, poverty, malnutrition, overcrowding, ignorance and lack of basic health services (Lee and Dodgson, 2000; Ohene-Adjei et al, 2017). These conditions are postulated to be present in most urban areas within the underdeveloped world hence posing high risk to the spread of cholera in urban areas.

A report by Global Communities, (2017) indicated that more than half of Ghana's urban population are living in non-formal settlements which are characterized by unreliable water systems and poor sanitation. This situation however makes these urban areas highly vulnerable to the disease outbreak.

1.6.6 Socio-economic and cultural determinants

According to Dziedzom (2015) poor households with fixed incomes have to reduce their expenditure on basic needs as food and shelter just to cater medical related bills. In relation to cost of medical expenditure to households, Germany has a per capita GDP of US$ 32,860 but household's only pay up to 11.3% of all medical expenses while the rest is taken care of by the government or by social health insurance. The Democratic Republic of Congo on the other hand has a GDP of US$120 but households bear about 90% of medical related costs directly. This however shows the difference in the health burden of diseases on households between developing and developed countries.

The social impact of cholera has been mainly seen to relate to the financial influence it has on the lives of people (Schaetti et al, 2013). A study done by Schaetti et al, (2013) in Western Kenya also saw a

strong association between cholera and the belief and prayer systems of the people. Income and education were also seen to have a positive influences on cholera.

Ngwa et al, (2017) also identified a high rate of cholera in the mountainous areas of Cameroon as compared to the plains. This was attributed to the culture of burying the dead on mountains which in turn increases the risk of contracting the disease in those areas. According to the document the culture as well as the risk perceptions at the community or individual level gives a clue to understanding the dynamics of cholera for effective control by public health agencies.

1.6.7 Global and local cholera mobilization efforts

The cholera burden has been eliminated from the global north for decades. However the developing countries of sub Saharan Africa and South East Asia continue to suffer a great deal of the disease burden. The disease impacts communities and counties that have had some experience of conflict, lack some level of infrastructure and that face issues of malnutrition (Legros, 2018). The Global Task force on Cholera Control (GTFCC) is seeking to eliminate cholera by 2030. According to Legros, (2018), the strategy to be adopted is by linking the fight against cholera with the Sustainable Development Goals (SDGs) in order to eliminate the disease. The strategy to combat global cholera also involves early warning and response systems, an integrated support system from all sectors and coordination as well as collaboration to build capacity of cholera vulnerable areas.

The introduction of the cholera vaccine has been one of the innovations introduced to reduce and end the cholera burden in endemic areas. There have however been cultural and social barriers that hamper the efficient and effective use of the vaccine. However with places where the vaccine is accepted, the issue of shortage comes up hence making the use of the cholera vaccine unpopular (C Ivers, 2018; Sundaram et al., 2012).

In terms of local mobilization, there have been efforts by NGOs and health related organizations such as the Ghana Red Cross Society (GRCS) in Ghana to curb cholera at the community and household levels. These interventions include community clean ups, provision of reliable and safe water sources and the provision of public toilets all in attempt to improve sanitation in smaller communities (IFRC, 2013).

1.6.8 Long Term Trends

Cholera is traced back as far as the period of Hippocrates (460-377BC) and Galen (129-216AD) when cholera-like characteristics were spotted in the plains of the Ganges River. The 19th Century however saw advances in understanding of the disease as researchers such as Filippo Pacini and John Snow began understanding the causes and treatment of the disease (Dziedzom, 2015).

According to Laws (2006), there have been seven world pandemics of cholera in history. The year 1817 marked the start of the worldwide pandemic of the disease. It was also identified that all the pandemics originated from Asia and spread to other parts of the world. Ganges in Bangladesh was discovered to be the origin of the first six pandemics with the classic 01 strain being the main bacterial strain of the disease.

Vibro cholera was discovered in 1854 by the Italian scientist, Filippo Pacini. It was 86 years after Pacini's death that the international committee on nomenclature adopted Vibrio cholerae as the name to be given the bacteria in 1965. Cholera has since then taken different trends worldwide. According to WHO (2013), cholera is gaining great attention in the sphere of public health as the number of endemic countries continue to increase worldwide. The disease keeps gaining grounds in countries previously known to have had little or no trace of cholera and hence keeps increasing its burden worldwide. This pattern of cholera outbreak is attributed to the climate change phenomena which is modifying various local climates around the world and introducing new weather conditions which was previously absent

in some geographical locations. According to the document, Africa recorded 211,748 cases of cholera which represented 72 % of the disease burden worldwide in the year 1998. Latin America also experienced an increase in the number of cholera cases within that period with the disease increasing from 17,760 in 1997 to 57,106 in 1998. This increase has been attributed to the operations of the El Nino and Hurricane Mitch in that area.

Asia also experienced similar conditions with countries like Afghanistan, India, Cambodia, Malaysia, Nepal and Sri Lanka suffering greatly. Cholera is said to be strongly endemic in some parts of Asia notably in Bangladesh and India. These countries have been identified to have an annual outbreak of the disease but in varying degrees. It is therefore easier to identify the periods in which cholera will occur in these areas. It has however been observed that some African and South American countries are also cholera endemic but have sporadic outbreaks of the disease. This condition however makes tracking seasonality of cholera in these areas quite difficult (Emch et al, 2012).

1.6.9 Effect of Cholera

The impacts of cholera have been extensively studied in different parts of the world. Studies on cholera reveal a variety of areas the disease impacts greatly. According to WHO, (2006) the disease is responsible for millions of deaths worldwide which in turn affects the socio-economic aspects of individuals, communities and countries hence impeding development. Panic and disruption of the social and economic systems are often encountered in cholera endemic countries. For example the cholera outbreak in Peru in 1991 cost the country US$ 770 million as a result of trade embargoes. Other countries restrict movement or travel of people, goods and services from cholera endemic countries.

Cholera outbreaks also have a great effect on the expenditure of families and individuals. Additional income has to be allocated to pay hospital and other health related costs. This reduces the amount of money left for spending hence affecting families adversely (Dziedzom, 2015). The document also

refers to the pressure on health facilities in terms of cholera epidemics. Hospitals and other health posts are under pressure since they do not have enough facilities to meet the number of cases recorded. Health professionals are also stretched since they spend more hours at work trying to deal with the overwhelming number of cases.

According to Ofori-Adjei and Koram, (2014) cholera in Ghana normally occurs in the urban areas and mostly affects the urban poor. However, the urban poor are therefore more vulnerable to the impact of the disease as compared to the middle class. The high rate of population increase in urban areas coupled with inadequate economic, health and social infrastructure has led to the increased cyclical burden of the disease in the country. The weak responses to efforts in mitigating the cholera disease has led to an effect on the psychological, social, cultural, economic and health system responses of the country.

Rebaudet et al, (2016) documents the cholera situation in Haiti since the country has experienced some of the greatest and most identifiable cholera epidemics in recent times. The study focused on the intra-urban disparity of the disease showing the differentials in the burden of the disease within a local region. According to the document the town of Gonaives which is situated in Haiti was one of the most vulnerable towns in terms of the 2010/2011 cholera outbreak in the country. The town recorded an estimated crude death rate of about 19.1 deaths per 1000 persons per year which represents a double fold of the cases recorded in previous years. This situation can affect different aspects of life within the town since more people are lost to the disease. It could lead to a breakdown of the family system and other important social structures that ensure the continuity of the society.

1.7 Conceptual Framework (Disease Ecology)

1.7.1 Introduction:

The model below gives a brief overview of the broad causes of cholera and their association with various vulnerable areas. The main causes of cholera are socio economic, environmental and climatic in nature. The presence or absence of these factors can either inhibit or promote the spread of the disease.

Cholera Ecology Model

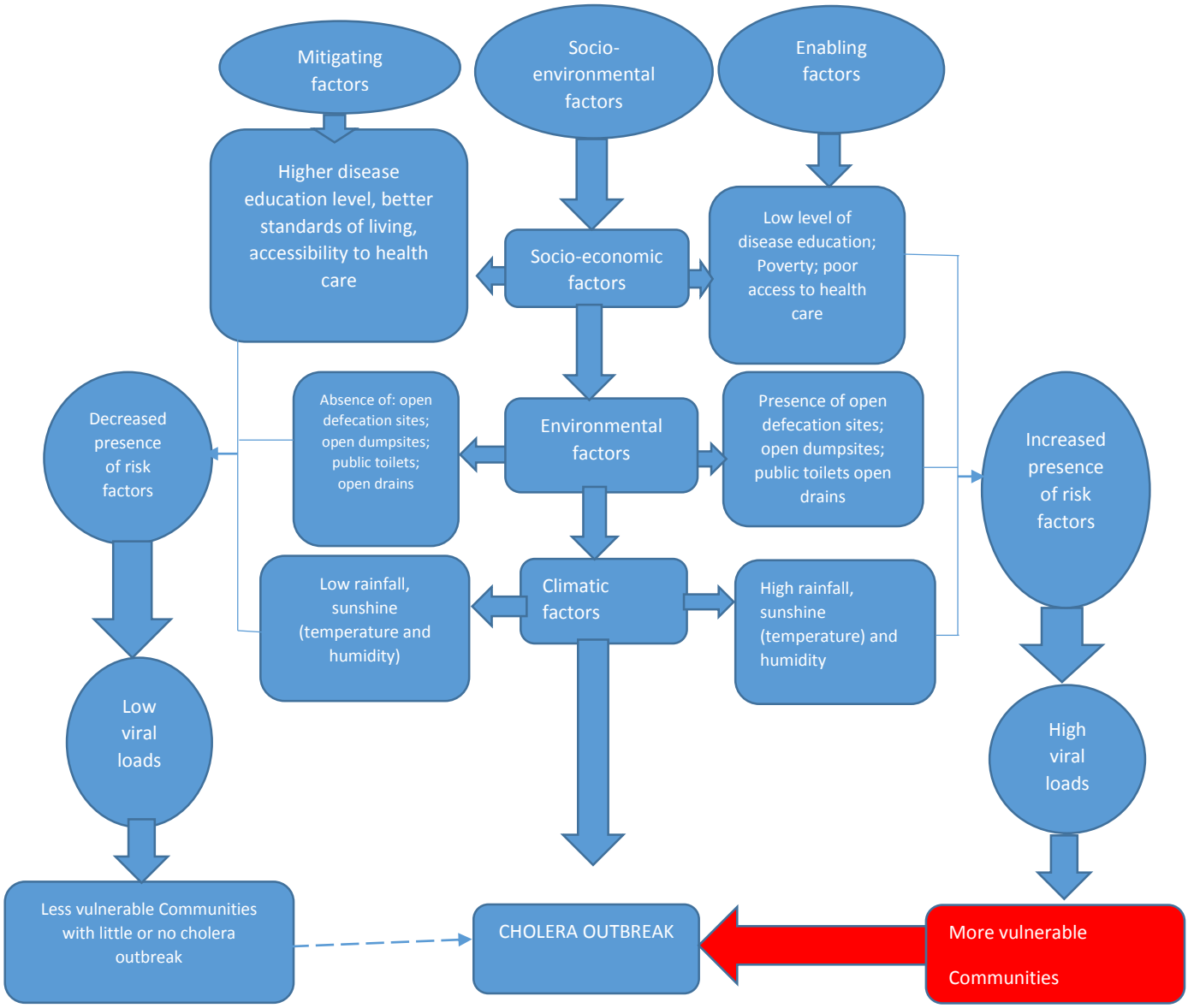


Fig1.2: Disease Ecology Model for Cholera
Source: Authors construction

The conceptual framework adopted parts of the human ecology framework in Meade and Emch, (2010). The human ecology model based the transfer of diseases amongst human communities on the interaction between population, behavior and habitat. In relation to the model, population sees the human being as a potential host for diseases and hence looks at factors like nutritional, immunological and the physiological status of a person as influencing the rate of vulnerability to various diseases. Behavior deals basically with various human cultures that predispose people to diseases. This factor is however influenced by mobility, roles, cultural practices and technological innovations. The last factor which is habitat relates to the places people live. This includes homes, workplaces, settlement patterns and their proximity to essential services such as healthcare, transportation and government services.

The disease ecology model represented in Figure 1.2 combines the factors of the human ecology model namely population, behaviors and habitat under the socio-environmental factors affecting the spread of the cholera disease in AMA. The socio-economic factors represented combine both population and behavioral factors as represented in the human ecology model. Educational and poverty levels affect the nutritional and physiological status of people hence representing the population in the human ecology model. Access to health care is a factor of behavior which is influenced by both proximity and affordability of the health facility.

Socio-economic factors such as low educational levels, poverty and poor access to health could increase the presence of the disease within a community. On the other hand, a higher level of education in relation to environmental cleanliness and cholera awareness as a result of a better means of public communication and awareness as well as better standards of living and better access to health facilities

can serve as factors that help to reduce and mitigate the disease spread in the area. Environmental factors can also influence the increase or decrease of cholera in an area. The presence of open defecation sites, open dumpsites and public toilets makes an area vulnerable to the spread of cholera. The absence of these factors ensures a less vulnerable environment for the spread of the disease.

Climate invariably plays a role in the spread of the disease. Developing countries face a lot of sanitation problems in terms of poor waste disposal methods and this leads to the accumulation of filth within their urban centres. Extreme climatic conditions coupled with poor sanitation could lead to floods which can ensure the disease bacterium is spread faster and further. The disease also thrives in moist environments which are influenced to a large extent by the climate of an area. The presence of these conditions or factors may either increase or decrease the viral loads of cholera hence leading to either an increase or decrease of the disease burden within an area.

Spatially, the presence of the enabling factors in the diagram above increases the vulnerability level of the communities in which they are located. The mitigating factors on the other hand reduce the spread of cholera within communities. In terms of the seasonality of cholera, the presence or absence of these socio-environmental factors leads to a variation in the dynamics of the disease. As a result of this, temporal studies of the disease show a variation over years of continuous cholera outbreaks.

CHAPTER 2

METHODOLOGY

2.1 Research Design

The study employed a cross-sectional research approach in the Accra Metropolitan Area which has been identified to be one of the cholera endemic districts in the capital region of Greater Accra. Data was also collected from 6 communities within different socio-environmental zones using both qualitative and quantitative data collection methods.

2.1.1 Sampling Design for Questionnaire Survey

Purposive sampling method was employed in the research. The Accra Metropolitan area was demarcated into various ecological zones on the basis of socio-environmental characteristics. This was to enable easy access to relevant communities and areas where data was collected. The area was divided to indicate areas of predominantly high income, middle income and low income. Two of each of the categorized communities were selected and compared to find similarities and differences relating to the spread of the disease.

After the selection of the relevant communities, each community was sub-divided into smaller blocks to help identify areas of importance to the study of the disease. These smaller blocks were selected on the basis of their social and environmental conditions. The focus in the low income communities were on areas which have a higher vulnerability to the outbreak of the disease. The higher income communities were studied for the areas which have a low vulnerability to the disease. This enabled the researcher to identify and elaborate on the factors that drive the spread of the disease and others which inhibit the bacterial transfer. This division is important since no community is absolutely homogenous. In high income communities, settlement was on the basis of individual households. In this case one individual or one family occupied one residence. Data was however taken on the basis of individual

households which were likely be found in each residence. The systematic sampling method was applied to get a good sample for data analysis. This also helped eliminate human bias by the researcher in selecting familiar households. After the first randomly selected house, every 3rd housing unit was selected for the collection of data. Low income communities on the other hand had their housing patterns arranged differently. More than one household was found in one residence or house compound. The researcher therefore targeted one household in every housing unit visited as systematic sampling was applied to determine the houses visited.

The Accra metropolitan area has an estimated population of about 1,665,086 with males constituting 48.1% and females constituting 51.9%. The demographic data mentioned above guided the researcher to have adequate representation of both sexes in the data collected.

2.2 Quantitative Research Methods

Quantitatively, questionnaires were used to take data from within the communities. Questions on the patterns, causes, effects and distribution of the disease were represented in the questionnaires.

The questionnaires were designed to target local residents within the various communities since they have experienced the changing trends of the disease. Questionnaires were therefore distributed to each community based on the estimated level of the disease burden in the various areas. Lower income communities had a total of 50 questionnaires each since they are assumed to carry denser populations and more of the disease burden. Middle and high income communities had a total of 30 and 20 questionnaires each respectively. *Table 2.1* displays the areas and number of questionnaires that were distributed within the selected communities of the study. The sample size was limited to 200 questionnaires as a result of cost constraints.

Table 2.1 Quantitative Sampling Summary Table

Residential Category	Communities	Questionnaires Distributed
High	East Legon	20
High	Cantonments	20
Middle	North Kaneshie	30
Middle	Dansoman	30
Low	Chorkor	50
Low	Maamobi/Nima	50

2.3 Qualitative Research Methods

Qualitatively, data was collected through verbal communication methods. Interviews were held with opinion leaders and residents of the communities to find out the major causes of cholera within their respective areas. Another qualitative method that was employed was in- depth interviews. These interviews were organized with older members of the community and focused on people who had spent a period not less than 30 years within the study areas. This enabled the researcher have a brief history of the disease dynamics in the various areas. Secondary stakeholder interviews were also held with health workers within the communities concerning the reasons for the endemic nature of cholera in their various areas and the best way to control the disease. Victims of the cholera disease were interviewed to help in tracing the source of the disease within the various communities. Focus group discussions were organized in all the selected areas of study. This enabled community participation and

helped to bring out issues of sanitation and other socio-economic and climate related issues that increased the vulnerability to cholera within communities in the Accra Metropolitan Area. The focus group discussions were organized by male and female community leaders within the low income areas Observation was also employed in gathering relevant information. The number of focus group discussions and interviews as presented in *Table 2.2* was determined by the availability of various groups and individuals ready to be interviewed in the various communities.

Table 2.2 Qualitative Sampling summary

Residential Category	**Communities**	**Number of focus group discussions**	**Number of participants**	**Number of Male Participants**	**Number of Female Participants**	**Number of interviews**	**Number of stakeholder interviews**
High	East Legon	1	10	5	5	5	3
High	Cantonments	1	10	5	5	5	3
Middle	North Kaneshie	1	15	8	7	5	3
Middle	Dansoman	1	15	8	7	5	3
Low	Chorkor	2	20	10	10	10	5
Low	Maamobi/Nima	2	22	10	12	10	5

2.4 Secondary Sources of Data

Other sources of data included journals, internet documents, health reports, newspapers and other useful databases. This helped in gathering historical information of the disease in AMA.

2.5 Mapping and Data Analysis

2.5.1 Introduction

A Global Positioning System (GPS) was also used to capture relevant spatial information such as the dumpsites, drains, open defecation sites, public toilets as well as the health centres within the various communities. This approach gave a spatial picture and helped to draw a relationship of vulnerability between the various communities. ESRI ArcGis 10.3 was used to perform various spatial analysis as well as the production of the study area map.

The spatial and attribute data were captured and presented in an excel format (.xls) by the GPS device. This data was inputted into ArcMap 10.3 and converted into shapefile format. This was done by launching the ArcMap software and selecting "File", "Add Data" and "Add XY data" options sequentially

2.5.2 Cholera data

The cholera data was obtained from the Greater Accra Regional health directorate at Adabraka in Accra. The data collected involved the cholera cases for all communities (spatial unit for reporting) in AMA for the years 2008, 2009, 2011 and 2012. Raw rates of the disease were calculated by using population data from the 2010 Ghana census provided by the Ghana statistical service (GSS). This was calculated by dividing the number of cholera cases within each community by the population of the various areas and multiplying by a factor of 10,000 to represent the raw rates as per 10,000.

2.5.3 Dot Maps

Dot mapping is a spatial mapping technique that uses dots to constitute values of various phenomenon within different enumeration units. Dot maps show the variation of a phenomenon by displaying hypothetical patterns. It involves the selection of both the dot size as well as the dot value which represents the raw data by dots.

Dot maps were however used in showing the distribution and patterns of cholera cases within the the Accra Metropolitan Area. This tool was also accessed through Esri ArcMap 10.3. The various communities in Greater Accra Metropolis were populated with the number of cholera cases per thousand and used to produce the dot maps.

The "Start Editing" option was selected on the editor toolbar drop down. The various areas were populated by right clicking on the Accra Metropolitan Area boundary shapefile and "Open Attribute Table" option. The various cases were populated into the various communities by manually typing them into a new field. The dot maps analysis was however done by clicking on the Accra Metropolitan Area layer properties and selecting "Symbology". The "Quantities" and "Dot density" options were selected. The appropriate field of cases were inputted into the Field option. The "OK" option was selected to run the analysis. Each dot value was rescaled to represent 2 cholera cases using cholera cholera counts within the various areas.

2.5.4 Population Density and Cholera Density Maps

Density maps were also used to represent the population as well as the cholera counts within the Accra Metropolitan Area. The area of the various communities was calculated in hectares and this was divided by the raw population values. It was however rescaled intuitively by multiplying by a factor of 10,000 to represent the data as per 10,000 people. The Arcmap 10.3 software was used to create Density maps per area (Hectares).

The properties of the various layers were selected and density maps were created using the Quantities function under the "Symbology" option. The same process was repeated for the creation of cholera density maps and represented in a 5 color classification.

2.5.5 Buffer Maps

The buffer tool is a proximity tool that can be used to show the relation in terms of distance between different phenomena. This tool is was used to draw radius of 1, 2 and 5 kilometers around hospital facilities in AMA to see the level of accessibility to health facilities within area. The buffer maps were produced using Esri ArcMap 10.3. The buffer tool is found in the ArcToolbox under "Analysis Tools", "Proximity" and "Multiple Ring Buffer" sequentially. A dialog box appears which has options for "Input Features", "Output Feature class" and "Distance". The "Input Features" is filled with the shapefile of the environmental factor of interest. The "Output Feature class" is filled with the storage destination of the completed buffer analysis on the computer. The various distances are inputted into the distance option. The analysis is run by clicking on the "OK" button.

2.6 Graphs

Graphs were also generated in Microsoft Excel. There were different graphs used in the research some of which include Combo charts and line graphs. These graphs were used to display vital information like the temperature and rainfall.

CHAPTER 3

STUDY AREA PROFILE

3.1 Background

The Accra Metropolitan Area represents a large area of the capital city of Ghana. The 2010 census estimated the population of the area to be 1,665,086 (GSS, 2014). This figure represents about 42% of the total population of Greater Accra which is the country's capital. The AMA is also fully urbanized and this comes along with its own challenges. The most used source of water is the pipe borne water within the house holds representing 31.8% of the total source of domestic water in the Accra Metropolis. The use of outside pipe borne water is represented as 28.4%. Other important sources of water within the area include community stand pipes, bore holes, rain water and tanker supply which represent 9.1%, 0.3%, 0.2% and 0.5% respectively (GSS, 2014). Since water is considered as one of the main routes of cholera transmission, the reliance on open water sources can leave the area more vulnerable to the spread of the disease (GSS, 2014). The document goes on to throw more light on the density of population in the area. There are about 149,689 houses in Accra with an estimated 450,794 households. Most of the housing and accommodation units are occupied on commercial basis where more than one household share the same housing structure. The data also makes it easy to see the density of the number of people living and working in the Accra Metropolitan area. This situation makes it quite simple for the spread of the disease because of shared facilities as toilets, cooking space and perhaps water sources.

Bagah et al (2015) describes the Accra Metropolitan Area as one of the most urbanized part of the city having conditions that encourage the spread of cholera. In terms of solid waste management, the area produces over 2,000 tonnes of solid waste daily. Out of this, only 1,800 tonnes are managed properly.

The remaining 200 tonnes are disposed improperly on open streets and they eventually find themselves in open drainage channels. These waste materials disrupts the flow of liquid waste through the drains leading to the accumulation of stagnant water. This provides good conditions for various diseases including cholera to thrive. The Accra Metropolitan Area has been described as having a large number of its population coming from the surrounding peripheries during the day for economic activities (GSS, 2014). As a result of this, the AMA stands out as a hub for the distribution of communicable diseases including cholera. It is however important to focus a lot of attention on reducing the disease burden in the area in order to boost the health status and productivity of one of the economically important populations within the country and also to avoid the potential spread of the disease to new geographical locations.

3.2 Physical Features

3.2.1 Geology and soils

In terms of geology, the AMA consists of Precambrian Dahomeyan Schists, Granodiorites, Granites, Gneiss and Amphibolites. It also includes late Precambrian Togo Series comprising mainly Quartzite, Phillites, Phylitones and Quartz Breccias. Other formations found are the Palaeozoic Accraian Sediments - Sandstone, Shales and Interbedded Sandstone-Shale with Gypsum Lenses (GSS, 2014).

3.2.2 Climate

In terms of climate, the Accra Metropolitan Area can be found in the Accra Plains climatic zone (Kick off, 2013). The area is characterized by two rainy seasons. The major and minor rainy seasons. One occurs from May and ends half-way in July and the second occurs between mid- August to October. Annually, the area records an average rainfall of about 730mm which is one of the lowest in the country (GSS, 2014).

According to Dickson and Benneh, (2001), temperature variation throughout the year is very little. The mean monthly temperatures range from 24.7°C in August which is the coolest month to 33°C in March which is the hottest month with an annual average of 26.8°C (Dickson and Benneh, 2001). As the area is close to the Equator, the daylight hours are practically uniform throughout the year. Relative humidity is generally high varying from 65% in the mid-afternoon to 95% at night. These climatic conditions coupled with high demographic growth rate as well as the general sanitation of Accra create conditions that encourage the spread of cholera (Bagah et al, 2015).

3.3 Political and Administrative Structure

The Accra Metropolitan Area is part of the 16 Metropolitan, Municipal and District Assemblies (MMDA's) found in Greater Accra Region as well as the 216 MMDA's in Ghana. The AMA came into being by the Local Government (Act 462) in 1993. After going through a number of variations in relation to the size and number of Sub Metro's, the present state of the AMA was established in 2012 with L.I. 2034 following the creation of the La Dadekotopon Municipal Area (GSS, 2014).

3.4 Economy

"The Accra Metropolitan Area is the economic hub of the Greater Accra Region and the rest of the country. It hosts a number of manufacturing industries, oil companies, financial institutions, telecommunication, tourism, education, health institutions and other important establishments. These institutions provide employment opportunities to residents of the City.

Their presence continues to attract people from all parts of the country and beyond to transact various businesses. Majority of residents in the city are engaged basically in the primary, secondary and tertiary sectors of the economy. They are engaged in occupations or employments such as trading, construction,

fishing, farming, services, manufacturing among others. The indigenous people until recently were mostly engaged in fishing and farming" (GSS, 2014.p4).

The study area map has been displayed in *Fig:3.1*. This map displays the Accra Metropolitan Area and highlights the study communities.

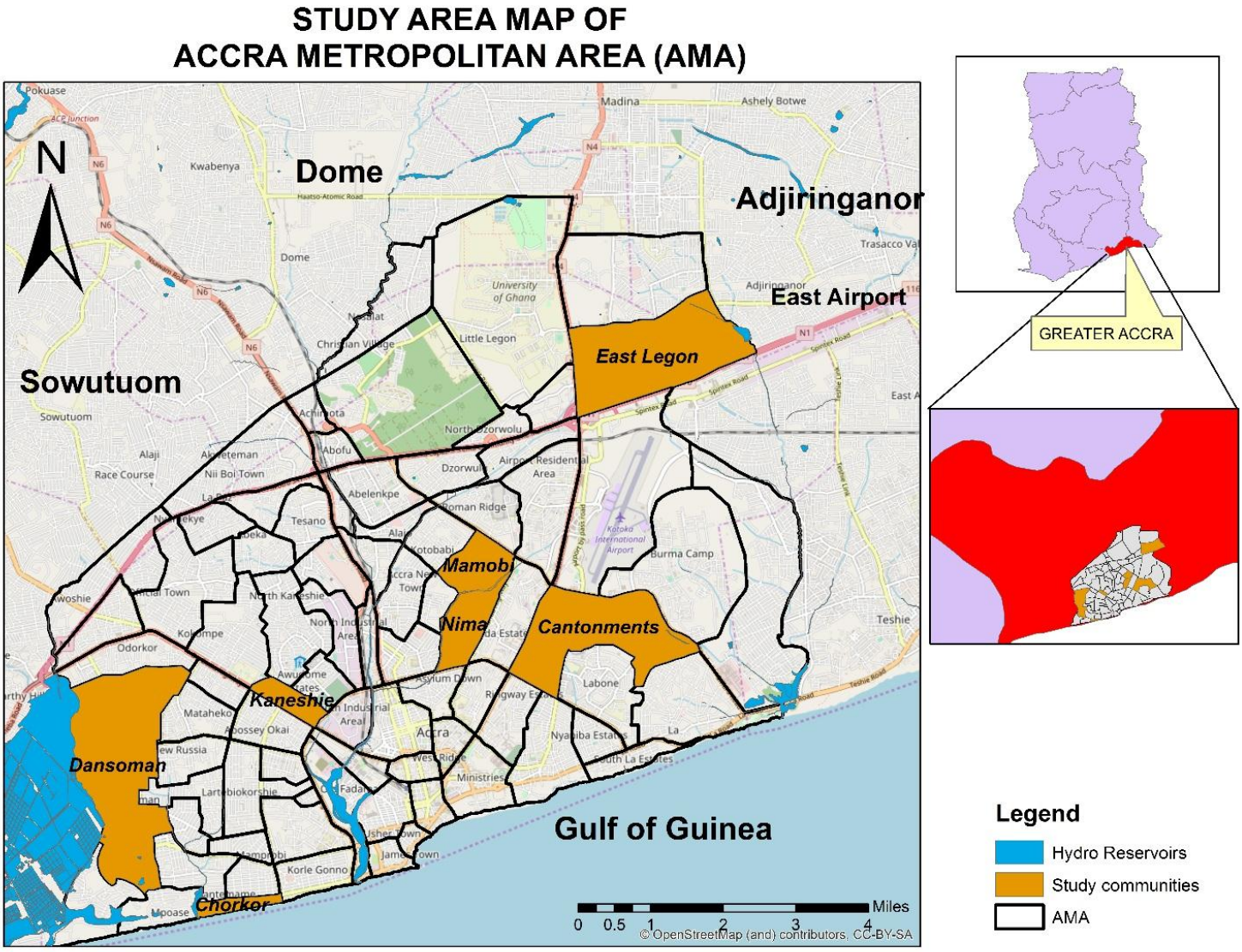


Fig: 3.1 Study Area Map

Source: Researchers construction from secondary data

3.5 Age-Sex Structure

According to GSS, (2014) the age structure of the AMA in terms of population is dominated by the youth. A youthful dominated population is a characteristic of most developing countries. The population pyramid below *(Fig 3.2)* does not coincide with the expected pattern of reductions with advancing age. The highest population is represented in the 20-24 age category. This is followed by those in the age group 25-29 years. According to the document "these are more than expected and could be attributed to the influx of migrants into the Metropolis, perhaps for employment purposes. In general, there are more females than males in almost all the age groups which conforms to other districts in the region. This is consistent with the fact that females constitute more than half of the total population of Ghana" (GSS, 2014,p16).

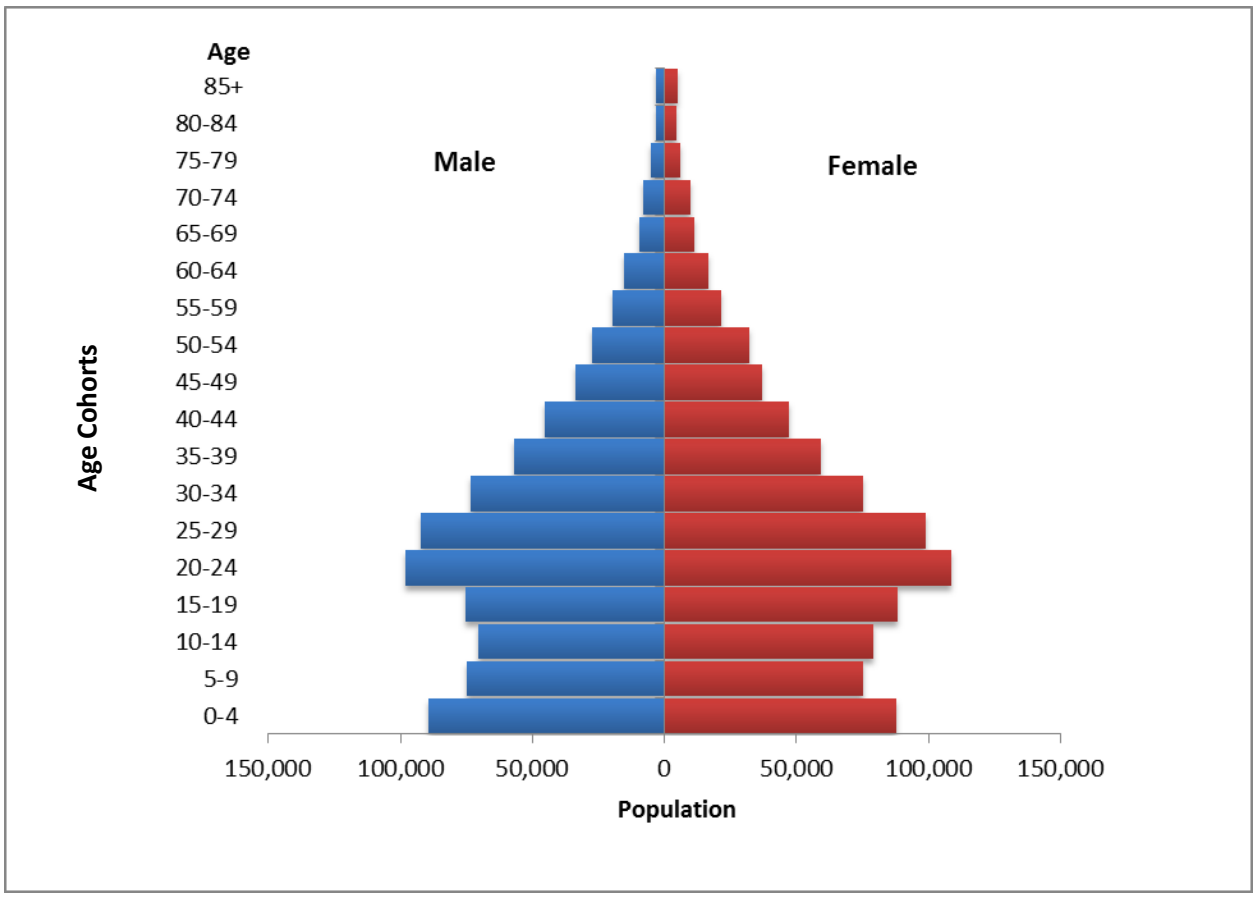


Fig 3.2 Population pyramid of Accra Metropolitan Area

Source: Ghana Statistical Service, 2010 Population and Housing Census

3.6 Fertility

Information on fertility was recorded in the 2010 census of the country. Data collected include that of females 12-14 years which is below the recommended age-specific fertility range of 15-19 years which is usually used in computing adolescent fertility. Table 3.1 below indicates the Total Fertility Rate (TFR), General Fertility Rate (GFR) and Crude Birth Rate (CBR) by district. As stated by GSS, (2014) the table indicates "that the Accra Metropolis has a TFR of 2.2, which is lower than the regional average of 2.6". According to the document, both the GFR and CBR of the Metropolis (GFR=63.7 and CBR=19.7) indicated lower values as compared to the regional averages (GFR=75.7 and CBR=22.7).

It was therefore suggested that the relatively low levels of TFR, GFR and CBR identified within the Accra Metropolis might be as a result of the use of birth prevention methods such as the use of contraceptives by women, outmigration of males or increase in male mortality.

Table 3.1: Reported total fertility rate, general fertility rate and crude birth rate by district for Greater Accra Region.

District	Population	Number of women 15-49 years	Number of births in last 12 months	Total Fertility Rate	*General Fertility Rate	**Crude Birth Rate
All Districts	4,010,054	1,203,838	91,077	2.6	75.7	22.7
Ga South Municipal	411,377	117,377	13,078	3.9	111.4	31.8
Ga West Municipal	219,788	64,817	5,783	2.9	89.2	26.3
Ga East Municipal	147,742	44,036	3,703	2.8	84.1	25.1
Accra Metropolis	**1,665,086**	**514,523**	**32,770**	**2.2**	**63.7**	**19.7**
Adenta Municipal	78,215	23,158	2,033	2.7	87.8	26.0
Ledzokuku/Krowor Municipal	227,932	69,038	4,990	2.4	72.3	21.9
Ashaiman Municipal	190,972	57,936	4,489	2.6	77.5	23.5
Tema Metropolis	292,773	89,924	6,138	2.3	68.3	21.0
Shai Osudoku	51,913	13,269	1,222	3.0	92.1	23.5
Ada East	71,671	17,576	1,817	3.5	103.4	25.4
Ga Central Municipal	117,220	34,365	3,193	3.1	92.9	27.2
La Dade Kotopon Municipal	183,528	56,845	3,466	2.0	61.0	18.9
La Nkwantanang Madina Municipal	111,926	35,055	2,514	2.5	71.7	22.5
Kpone Katamanso	109,864	32,751	2,681	2.6	81.9	24.4
Ningo Prampram	70,923	18,932	1,558	2.8	82.3	22.0
Ada West	59,124	14,236	1,642	4.0	115.3	27.8

Source: Computed from the 2010 Population and Housing Census

3.7 Mortality

In terms of mortality the 2010 Population and Housing Census recorded 7,276 deaths in the last 12 months which is the highest in the Greater Accra Region. According to Table 3.2, Accra Metro has a crude death rate of 4.4 per 1000 population which is relatively higher than the regional total which is

4.3 per 1000 population. This was attributed to the following causes which include accidents, violence, suicide, homicide and maternal deaths (GSS, 2014). According to the document, overcrowding in households have also led to faster spread of infectious diseases which also leads to death.

Table 3.2: Total population, deaths in households and crude death rate by District

District	Total Population	Deaths in Households	*Crude death rate
All Districts	4,010,054	17,363	4.3
Ga South Municipal	411,377	1,739	4.2
Ga West Municipal	219,788	727	3.3
Ga East Municipal	147,742	504	3.4
Accra Metropolis	**1,665,086**	**7,276**	**4.4**
Adenta Municipal	78,215	265	3.4
Ledzokuku/Krowor Municipal	227,932	818	3.6
Ashaiman Municipal	190,972	738	3.9
Tema Metropolis	292,773	1,300	4.4
Shai Osudoku	51,913	318	6.1
Ada East	71,671	742	10.4
Ga Central Municipal	117,220	360	3.1
La Dade Kotopon Municipal	183,528	807	4.4
La Nkwantanang Madina Municipal	111,926	395	3.5
Kpone Katamanso	109,864	441	4
Ningo Prampram	70,923	550	7.8
Ada West	59125	383	6.5

Source: Computed from the 2010 Population and Housing Census

Note: * Number of deaths per 1,000 population

3.8 Migration

About 47.0 percent represented by 778,267 out of a total population of the Accra metropolis were migrants born from other regions and relocated to the area (GSS, 2014). The document states that "it is observed that persons born outside the Greater Accra Region but resident in the Metropolis were mostly from the Eastern Region (27.8%) (183,426) while those from the Upper West region were the least (1.2%) (8,068)".

Table 3.3 below also indicates that 14.5 percent of migrants had resided in the Metropolis for less than a year, about 26.1 percent had stayed between 1-4 years while 21.4 percent had stayed over 20 years.

Table 3.3: Birthplace by duration of residence migrants

		Duration of existence (%)				
Birthplace	Number	Less than 1 year	1-4 years	5-9 years	10-19 years	20+ years
Total	778,267	14.5	26.1	17.3	20.8	21.4
Born elsewhere in the region	117,297	14.1	27.7	17.7	19.7	20.8
Western	30,655	15.4	25.7	16.7	20.1	22.0
Central	93,697	13.3	24.4	16.7	22.0	23.7
Greater Accra	-	-	-	-	-	-
Volta	110,881	13.5	23.9	17.1	21.4	24.2
Eastern	183,426	12.3	22.4	17.2	23.2	24.9
Ashanti	99,983	15.0	26.0	18.2	21.6	19.3
Brong Ahafo	22,823	15.9	28.4	20.0	20.6	15.2
Northern	50,334	18.8	34.2	17.5	15.5	14.0
Upper East	20,463	16.8	27.0	16.8	19.8	19.6
Upper west	8,068	17.4	25.9	17.6	19.1	20.0
Outside Ghana	40,640	20.6	36.2	15.7	15.2	12.3

Source: Ghana Statistical Service, 2010 Population and Housing Census.

As stated in GSS, (2014) Figure 3.3 below "shows reported age-specific death rates by sex. Age-specific death rates were generally higher among males in most of the age groups in the Metropolis. It was higher among males than females below age 5 years. This confirms the fact that male children are more likely than their female counterparts to experience childhood mortality. Age-specific death rates were the same for both sexes between ages 5-24 years. More females than males died between ages 25-49 years. This might be due to maternal mortality since those ages fall within the reproductive period among females. However, higher proportions of deaths were recorded among males than females after

age 49 years. This is expected because the nature of the work that men do usually expose them to the risk of dying earlier than females as age increases. The estimated mortality pattern exhibited in Figure 3.3 is similar to patterns observed in other districts in the region.

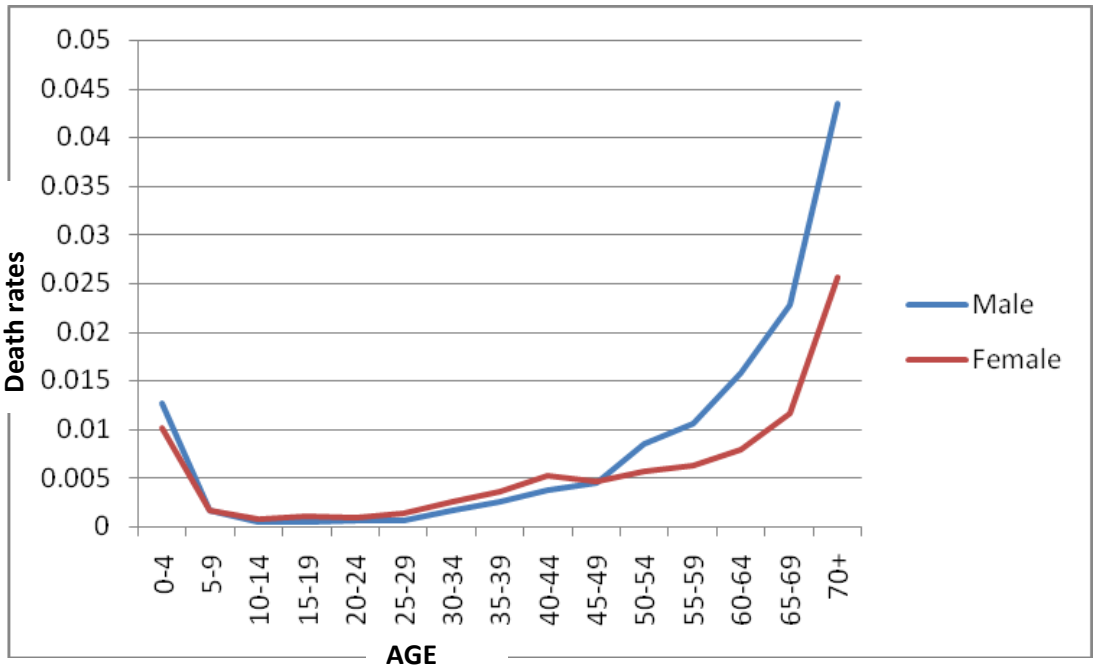


Figure 3.3: Reported age specific death rates by sex

Source: Ghana Statistical Service, 2010 Population and Housing Census

CHAPTER 4

SPATIAL DISTRIBUTION OF CHOLERA IN ACCRA METROPOLITAN ASSEMBLY (AMA)

4.1 Introduction:

This chapter gives a broad overview of the distribution of cholera cases and risk factors within AMA for the period 2008, 2009, 2011 and 2012. According to Osei, (2010) urban populations are seen to record higher frequencies of cholera during an outbreak. This is mainly attributed to the geographic and demographic characteristics of an area. Environmental and socio-economic factors are also linked to the high rate of urban cholera cases. In view of this, the spatial distribution of environmental risk factors and cholera cases will play a vital role in understanding the differentials of the disease within the Accra Metropolitan Area.

The spatial methods applied in this chapter include the use of dot maps, thiessen polygons as well as density maps. The dot maps are used to show the density or concentration of the disease within the study area. This will help visualize the communities that have been most affected by the disease and hence provide insight into the various risk factors propelling the disease in the various communities. Each dot value represents one cholera case. The thiessen polygons and the density maps help to show the mode of the disease spread. The chapter begins with a broad scope of the trends of cholera in Greater Accra region hence laying down issues that promote the increase of the disease in AMA.

The study took into consideration different communities of different income levels. These include low income, middle income and high income areas. The low income areas include Chorkor and Maamobi-Nima communities whilst the middle income areas include Dansoman and North Kaneshie. East legon and Cantonments represent the high income areas of the study.

4.2 Trends of cholera in Greater Accra

Figure 4.1 below shows the trends of cholera in the Greater Accra Region. The cases of cholera vary greatly across the years. As seen in the diagram, 2011 recorded 9,174 which represents the highest within the 15 year period. On the other hand the year 2007 and 2010 recorded 7 cases each within the region and this represents the lowest number of cases within the period displayed. The number of deaths resulting from cholera also vary over the period with 2011 recording 72 deaths. In 2012, 48 deaths were recorded whilst 2010 recorded no death.

The 2014 outbreak of the disease in the country saw about 16,500 vulnerable people being affected within the city. The bulk of the cases were recorded in the Greater Accra region with a representation of 72% of the total disease burden (Songsore, 2017).

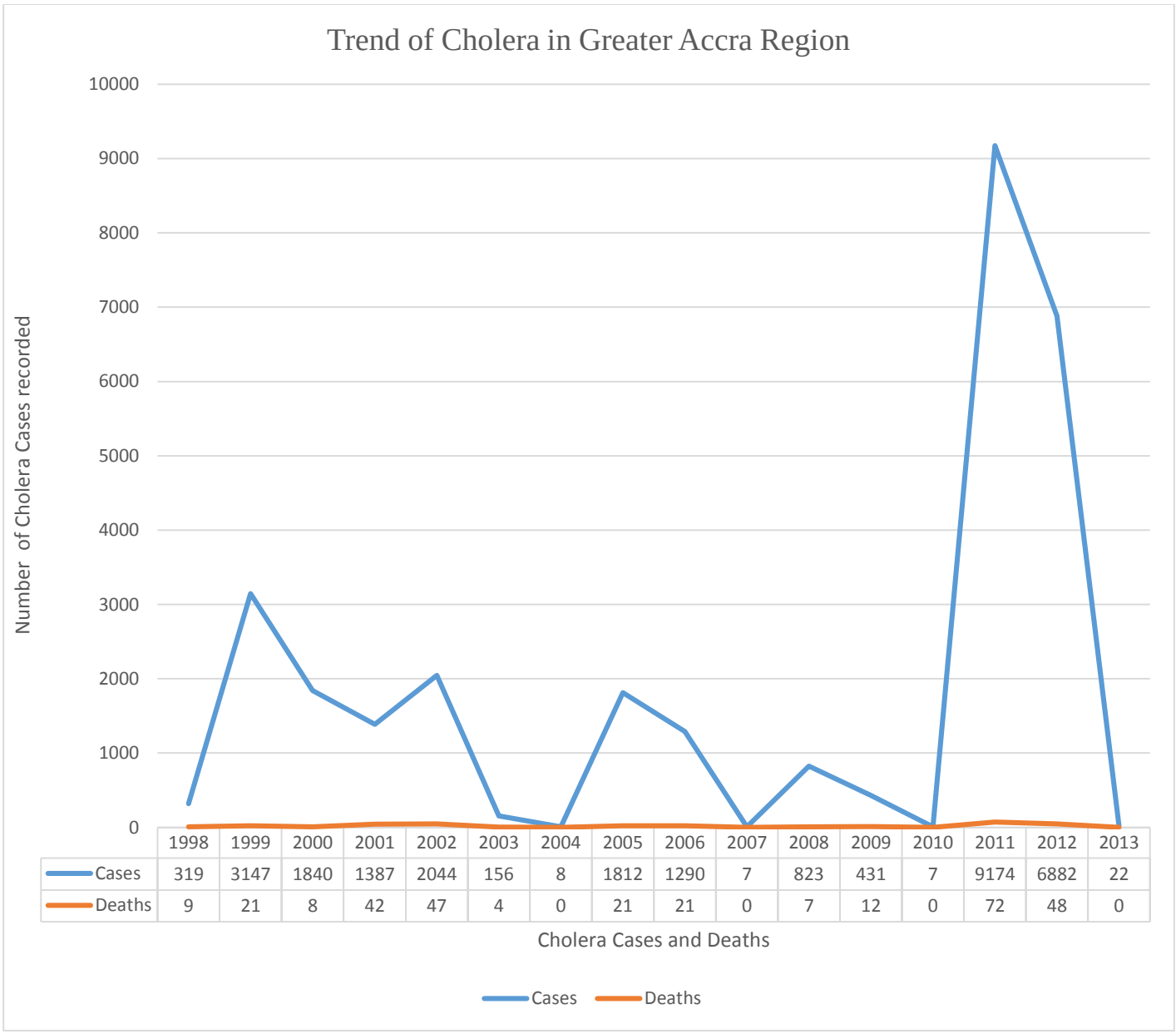


Figure 4.1 Cholera trends in Greater Accra Region

Source: Survey Data; Author's computation from Excel.

The varying nature of the cases have been attributed to the level of education and awareness created concerning the disease in the various communities within the region. An interview with a doctor of Maamobi hospital indicated that;

> *"We forget about the disease, but when it comes massively and the community has lost people they start thinking so much about it and become more careful"*

According to health professionals, people tend to forget about the main causes of cholera and hence engage in practices that make them vulnerable to contracting the disease. Such activities may include no hand washing after the use of the toilets as well as dumping of refuse in close-by drains hence making them full and liable to floods. Such activities normally attract high number of cholera cases within that year. In the years where cholera cases have been minimal, high cholera education and sensitization have been attributed to the low number of cases recorded.

4.3 Intra-regional Variation of Cholera in Greater Accra Region.

Studies have shown that children in slum and poor sanitation areas are three times more likely to have diarrhoea, cholera and other sanitation related diseases as compared to children in high income areas with proper sanitation systems (Songsore and McGranahan 1998; Timaeus and

Lush 1995).

The Figure 4.2 displays and compares districts in the Greater Accra Region in relation to the cholera cases recorded in the years 2011, 2012 and 2014. The diagram shows a graphical picture of the intra-urban differences of the cholera disease. Accra Metro recorded as high as 6,960; 4,623 and 10,129

cases in 2011, 2012 and 2014 respectively whilst La Dadekotopon recorded no cholera case in 2011 and 2012. In 2014, 1899 cases were recorded in the La Dadekotopon area.

According to Songsore (2009), the Greater Accra Region has been the most urbanized region in the country over the years. There are however differences in the frequency of the cholera disease within the region.

Table 4.1. Incidence of Cholera by District in Greater Accra Region

DISTRICTS	2011	2012	2014
ASHIEDU KETEKE			848
AYAWASO			781
OKAIKOI			3668
OSU CLOTTEY			1503
ACCRA METRO	6,960	4,623	10,129
ADA EAST	1	0	103
ADA WEST			1
ADENTAN	42	84	19
ASHAIMAN	17	7	67
GA CENTRAL			152
GA EAST	758	0	190
GA SOUTH	420	765	1,942
GA WEST	621	356	1,237
KPONE KATAMANSO			263
LA DADEKOTOPON			1,899
LA NKWANTANANG			770
LEDZOKUKU KROWOR	276	269	1,196
NINGO PRAMPRAM			32
SHAI OSUDOKU	8	11	315
TEMA	71	13	1,092
TOTAL	**9,174**	**6,882**	**19,407**

Source: Survey Data; Author's computation from Excel.

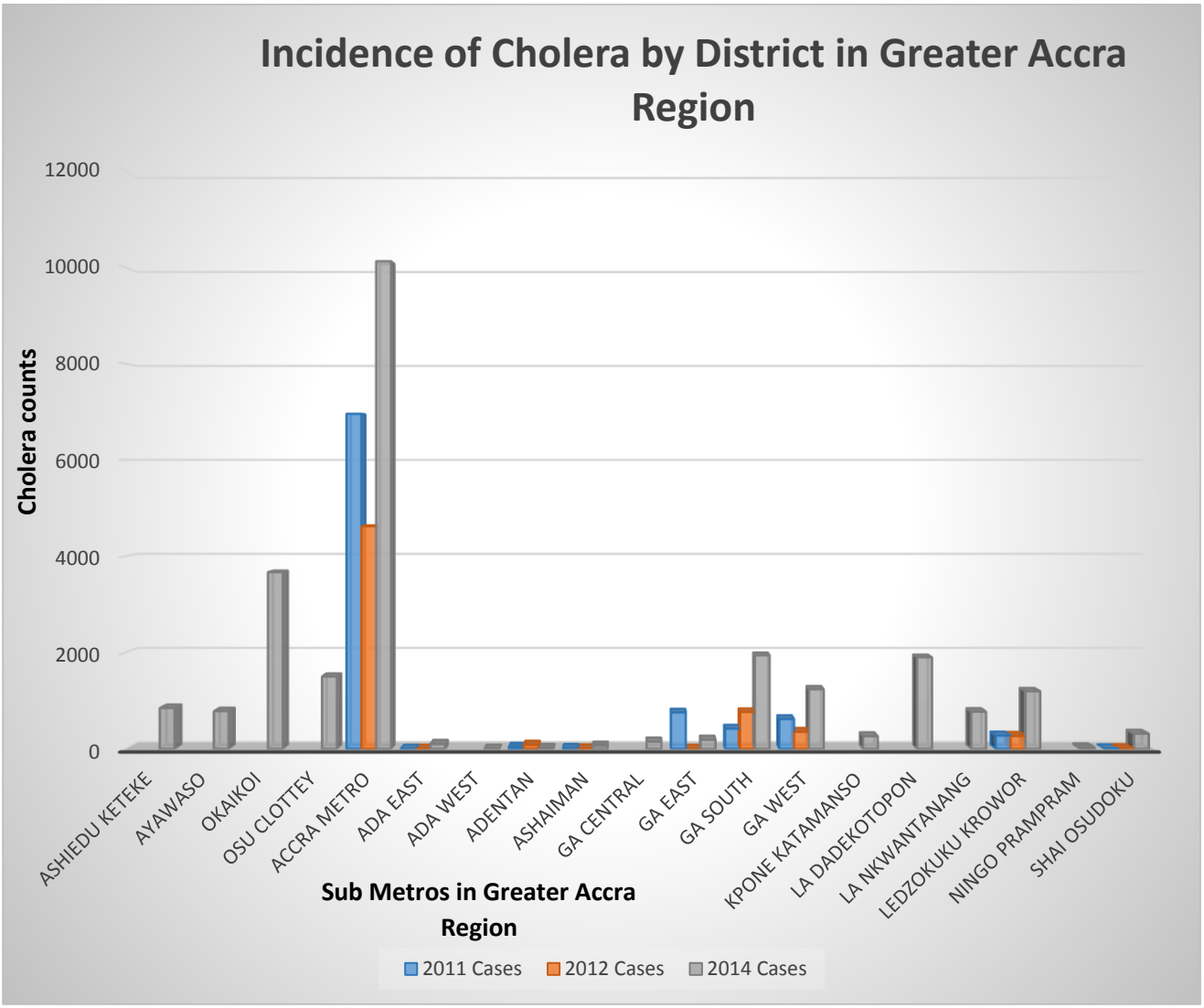


Figure 4.2 Cholera Cases in Greater Accra

Source: Survey Data; Author's computation from Excel.

These variations in the disease within the urbanized Greater Accra Region are attributed to the socio-economic differences and sanitation practices of the various districts and areas. The growing population of the AMA and the poor waste management practices have increased the cholera risk levels which reflect in various cholera related statistics of the area (Bagah et al, 2015).

The map of the Accra Metropolitan Area is displayed in Figure 4.3. The distribution of cholera cases in AMA is skewed towards the central and southern communities. The northern part of the map has fewer cases of cholera as compared to the central and southern part which is closer to the sea.

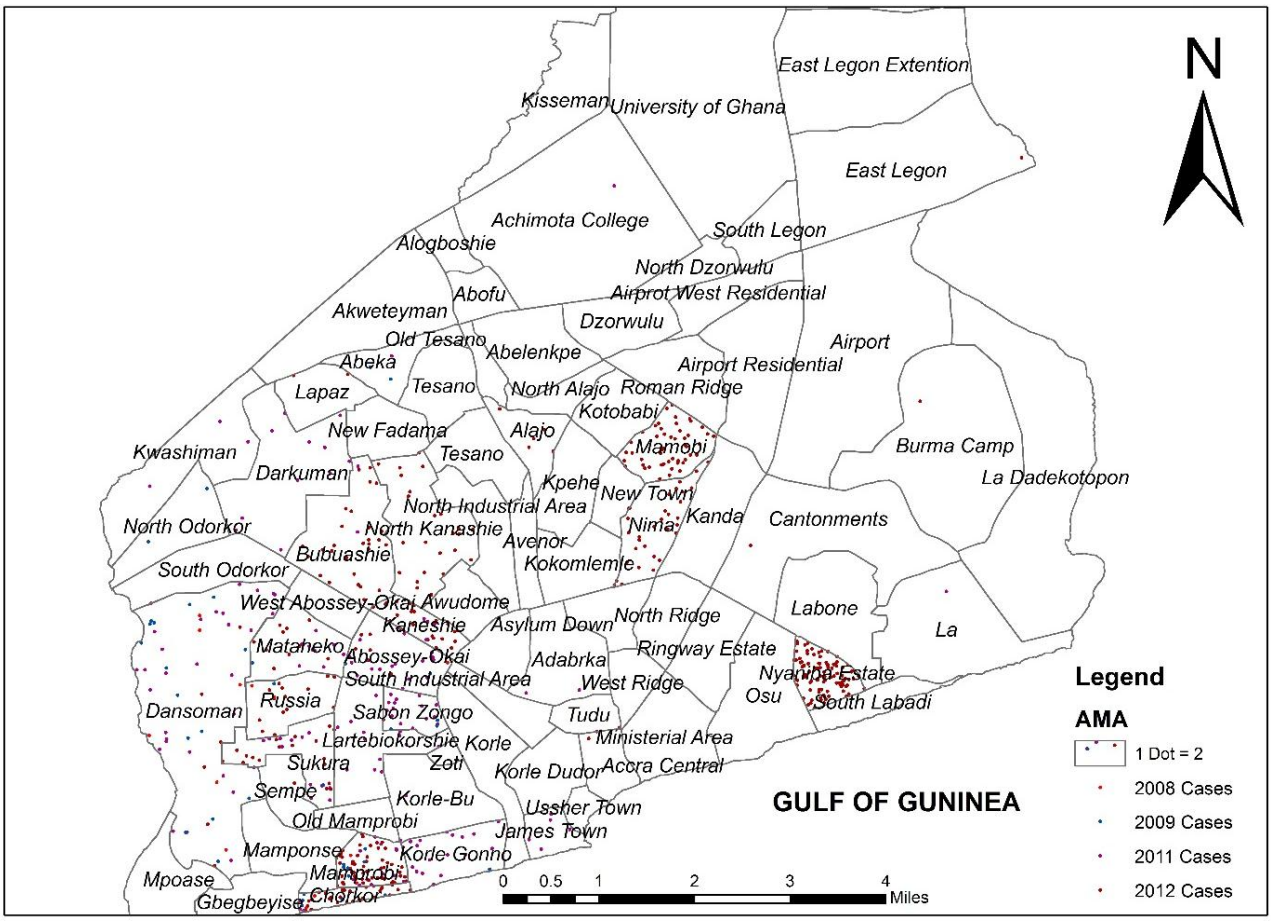


Fig 4.3 Distribution of Cholera cases in Accra Metro (2008, 2009, 2011 and 2012 Combined)

Source: Researchers construction from secondary data

However, some high income communities like Kanda, Labone and Cantonments at the central part of AMA have very few or no cases of the disease. According to Songsore, (2011), environmental conditions are greatly improved in low density high income and middle income areas. Low income areas on the other hand are normally characterized by slums, poor water and sanitation issues which makes it more likely for people living in these areas to get cholera. According to health professionals in Chorkor and Maamobi, the poor sanitation conditions coupled with the inability of residents to afford health care has greatly influenced the rapid spread of the disease amongst the low income populace in AMA. The continuous delay in seeking medical attention in relation to diarrheal diseases can lead to the disease spread within the immediate family, household and community at large. This occurs largely as a result of their close social and housing patterns.

The observed pattern in the cholera incidence has also been attributed to the poor sanitation practices in and around the low and middle income communities of AMA. The intra-urban patterns as a result of occupational, educational, health and social functions within the AMA has greatly resulted in the spread of the disease to new areas with few or no cholera risk factors. On the other hand, the wealthier communities have good sanitation practices that keep their environments clean hence leaving little or no room for cholera to affect the residents. A focus group discussion by the residents living in *Dansoman* pointed to the situation where movement of people from surrounding communities such as *Mataheko*, *Russia* and *Sukura* which are dominated by low and middle income residents have increased the spread of the disease within the community.

4.4 Population and Cholera Distribution

The general distribution of cholera has been overlaid on the population map of the Accra Metropolitan area. As observed in Fig 4.4, high population areas such as Dansoman, Darkuman and

Maamobi-Nima have very high rates of cholera incidences over the years. The high rate of the disease in the densely populated areas of the city has been attributed not only to the high population levels which make it difficult for individuals in those communities to have access to basic sanitation facilities such as proper and hygienic toilet facilities and good drinking water but also to the low level of cholera literacy in these areas. Information gathered by the researcher while working in the low and middle income communities in AMA points to a lack of cholera awareness within these areas.

Cotter and Patrick (1981) have also suggested other factors other than population that cause cholera in urban areas. According to GSS (2014), 89% of the population in the Accra Metropolitan Area are literate. The other 11 % are non-literate. However only about 52% could speak and write English leaving the rest of the 48% who are not literate in speaking and understanding the English language. This large percentage of non-speaking people in the AMA can be seen to be the vulnerable population which lacks understanding of the issues concerning the cholera disease as a result of the English medium in which cholera education is communicated through.

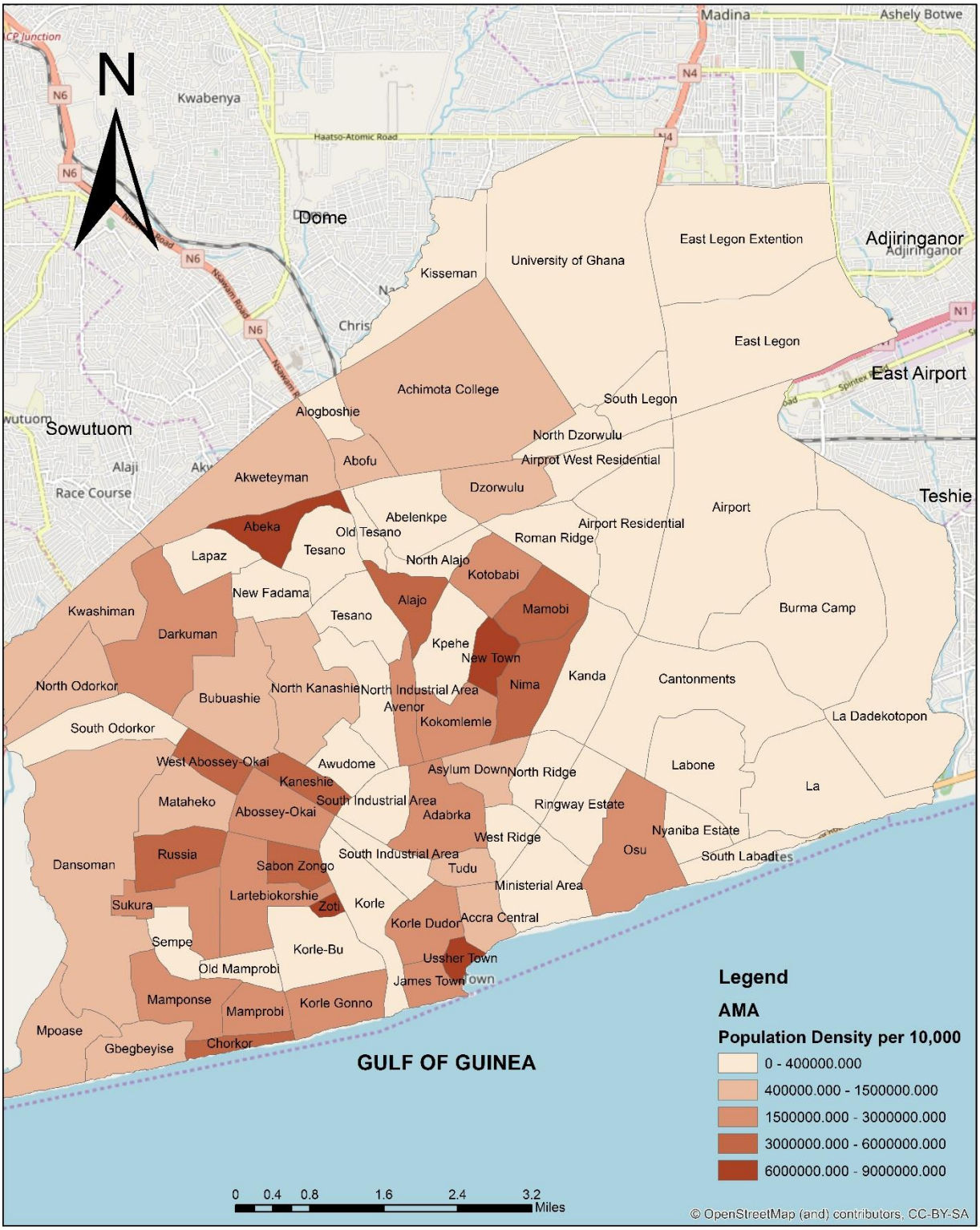


Figure 4.4 Population Density per 10,000 of AMA from 2008 to 2012

Source: Researchers construction from secondary data

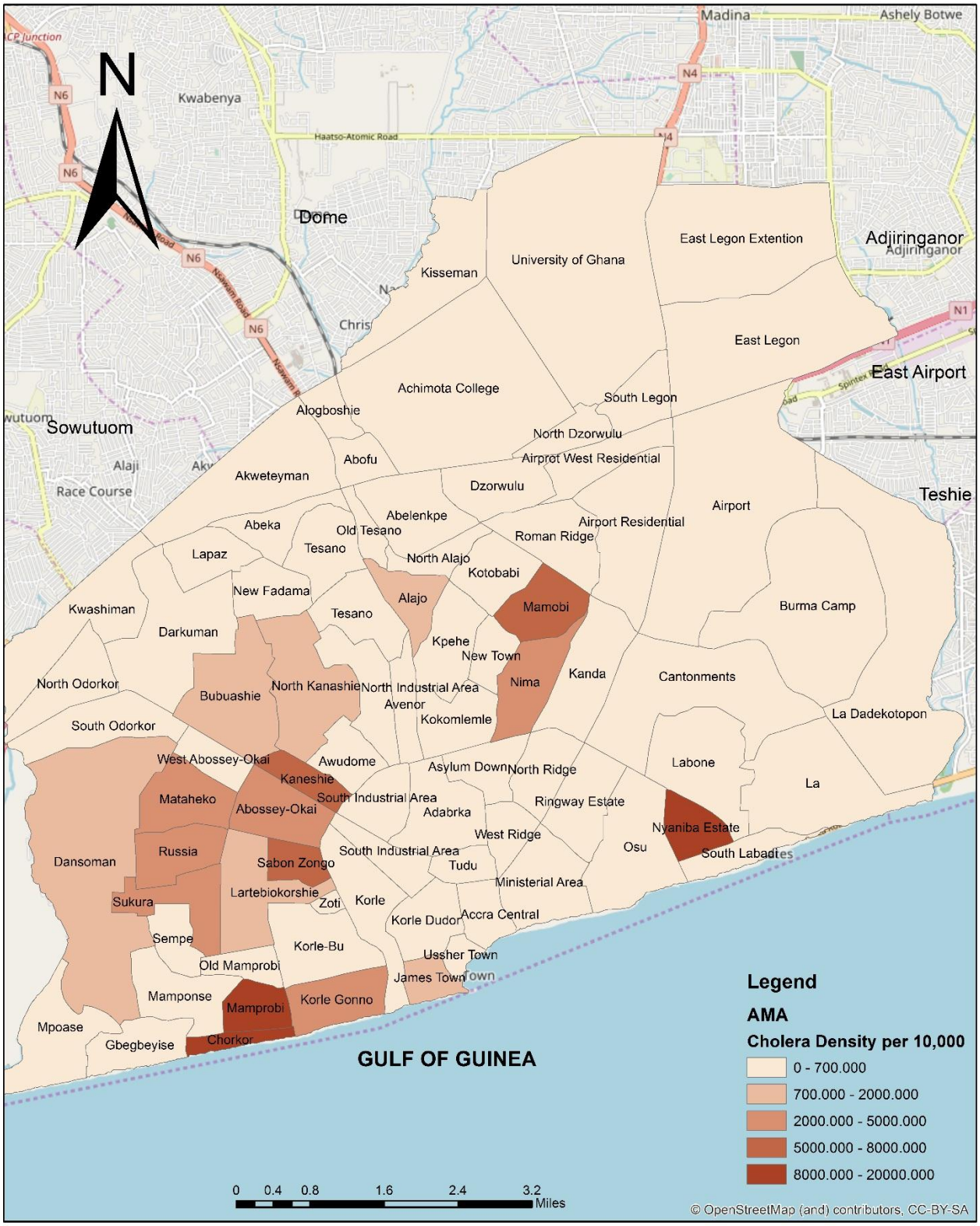


Figure 4.5 Cholera Density per 10,000 of AMA from 2008 to 2012

Source: Researchers construction from secondary data

High income areas such as Cantonments, Labone, Airport residential area and East Legon have lower populations and few or no cases of cholera. The general trend of high income areas having lower cases of cholera has also been attributed to the availability of good water and sanitation conditions within these areas. The exception can however be seen at Nyaniba Estates which is located at the south eastern part of AMA. The area has a low population but high incidence of cholera. This situation can be attributed to the movement associated with its surrounding communities. Movements from Osu and South Labadi as a result of economic and social activities is the most likely cause of the spread of the disease to the Nyaniba Estate area.

The linkages between population density and cholera distribution in the Accra Metropolitan Area can be based on the lines of sanitation, movement and education.

4.5 Drainage and Cholera Spread in Accra Metro

Water bodies also serve as a reservoir for the distribution of cholera (Colwell et al., 1985; Colwell and Huq, 1994; Faruque et al., 2005). According to Osei et al (2010) the vibrio cholera bacteria depends on additional organic nutrients for growth and sustainability. However, increased surface runoff from rainfall may cause contamination of major water sources as well as increase organic nutrients necessary for the survival of the cholera bacteria.

According to Nee-Whang (1999), the Densu River is a major source of water for drinking and domestic use in Accra West and its surrounding communities. The Weija reservoir as a result of rapid urbanization is being polluted on a regular basis hence making it a potential reservoir for the spread of cholera. The Korle Lagoon on the other hand has been polluted to a large extent by human activities such as the dumping of liquid and solid waste from Sodom and Gomorrah and other parts

of the city. The Korle Lagoon prior to its pollution was a beautiful river that was used for the breeding of fish such as tilapia. This has however been turned into a filthy drain full of waste. All locations within the city are vulnerable to the spread of the disease since flies or other flying insects may serve as mediums for taking the cholera bacterium to new locations (Bako, 2012).

The distribution of the cases as suggested by the map points to the idea of the increase of cholera cases as one moves closer to an infected water source. According to Amanda, (2011) cholera cases are more pronounced closer to water sources. As observed water bodies serve as a reservoir for the distribution of cholera (Colwell et al., 1985; Colwell and Huq, 1994; Frauque et al., 2005). This idea can however be used to explain partly the distribution of cholera cases in the AMA.

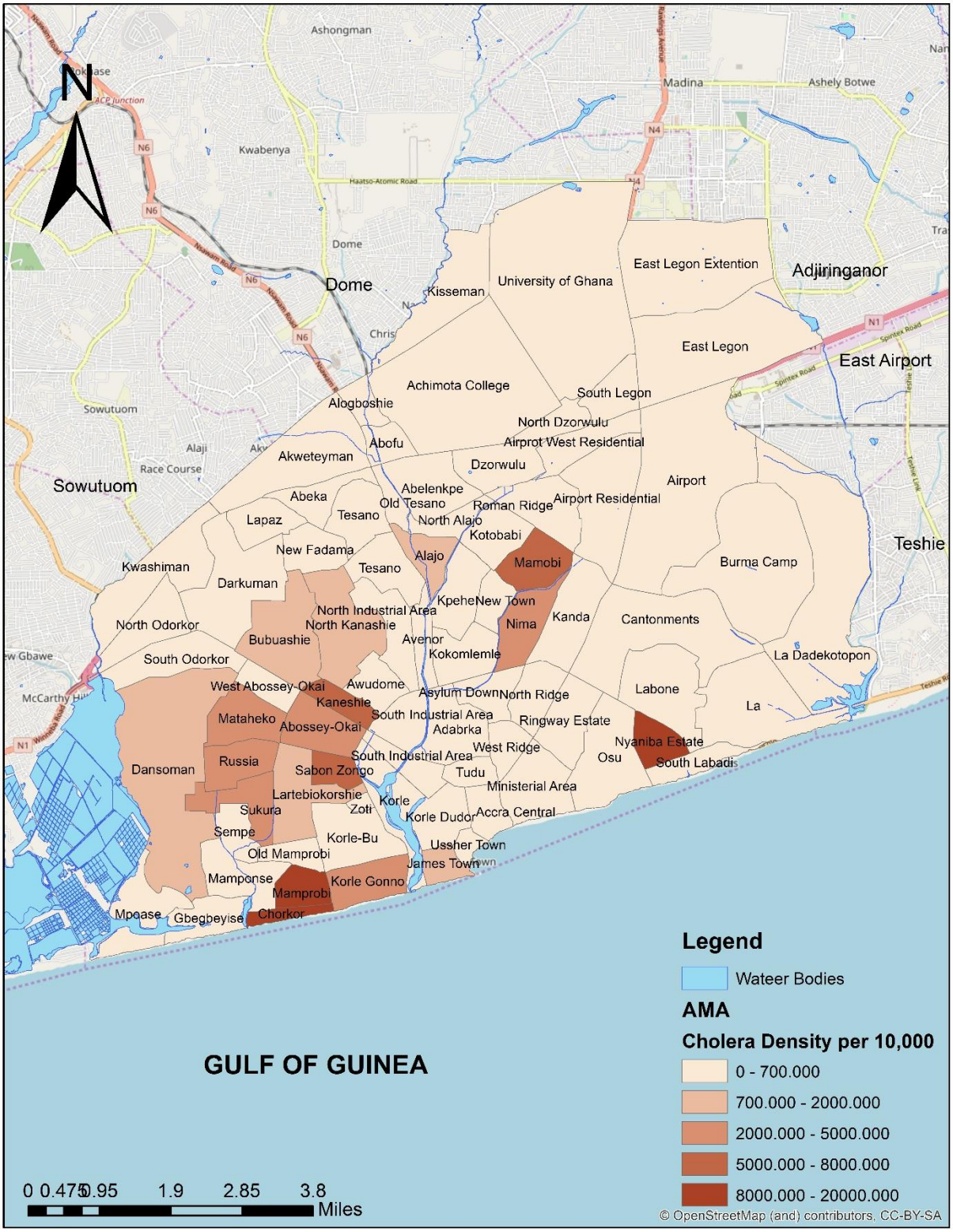


Figure 4.6 Cholera density and major drainage systems in the Accra metropolis

Source: Researchers construction from secondary data

Communities like Dansoman, Sabon Zongo, James Town and Korle Gonno can be seen to have a high number of cholera cases as a result of the influence of the water resources located around them.

4.6 Chapter Summary

The Accra Metropolitan area is a cosmopolitan area with various communities of different income, sanitation and educational levels. The AMA is a Cholera endemic area. However there is great variation in the level of cholera within the various communities. The low income areas tend to receive more cases of the disease as compared to the middle and low income areas and this has been attributed to the level and distribution of sanitation resources in Accra. Lack of good portable water and toilet facilities have made some low income high population areas highly vulnerable to cholera whilst other middle and high income areas have better water and sanitation facilities and hence are less vulnerable to cholera. Low levels of cholera sensitization have also increased the risk of people contracting the disease in various areas especially within highly populated middle and low income communities within AMA.

CHAPTER 5

DISTRIBUTION OF CHOLERA AND RISK FACTORS IN AMA

5.1 Introduction

According to Olanrewaju and Adepoju, (2017) spatial mapping of diseases can provide ways of investigating various diseases and drawing relationships with genetic, epigenetic and environmental factors. The various communities under study have unique conditions which either pre-dispose them to an outbreak of cholera or make them less vulnerable to the disease. The distribution of risk factors within the sampled communities gives an insight to the sanitation situation and attitudes that expose people to the disease.

Proximity analysis is used in the form of thiessen polygons to show the sphere of influence of the various cholera risk factors within the various selected communities. Thiessen polygons are used to define areas of influence around the cholera risk factors within the various communities. It is also used to give an insight of the means of spread in terms of distance decay.

5.2 Low Income Communities (Chorkor Community)

Chorkor is an overpopulated fishing community located at the outskirts of Accra. *Chorkor* is also one of the poorest indigenous low income communities within the Accra Metropolitan Area. The indigenes speak Ga and are mostly fisher folks as a result of their proximity to the sea. In terms of sanitation, the area faces great challenges with refuse disposal and proper defecation infrastructure. This has made the *Chorkor* community a highly vulnerable area to the outbreak of cholera.

5.2.1 Risk Factors

According to Songsore et al, (2005) low income communities within the Accra Metropolitan Area are at risk of experiencing hygiene related issues. The Chorkor area as indicated has a number of risk

factors identified for spreading the cholera disease. The pronounced number and presence of these factors shows that the area is highly vulnerable to an outbreak and spread of the disease.

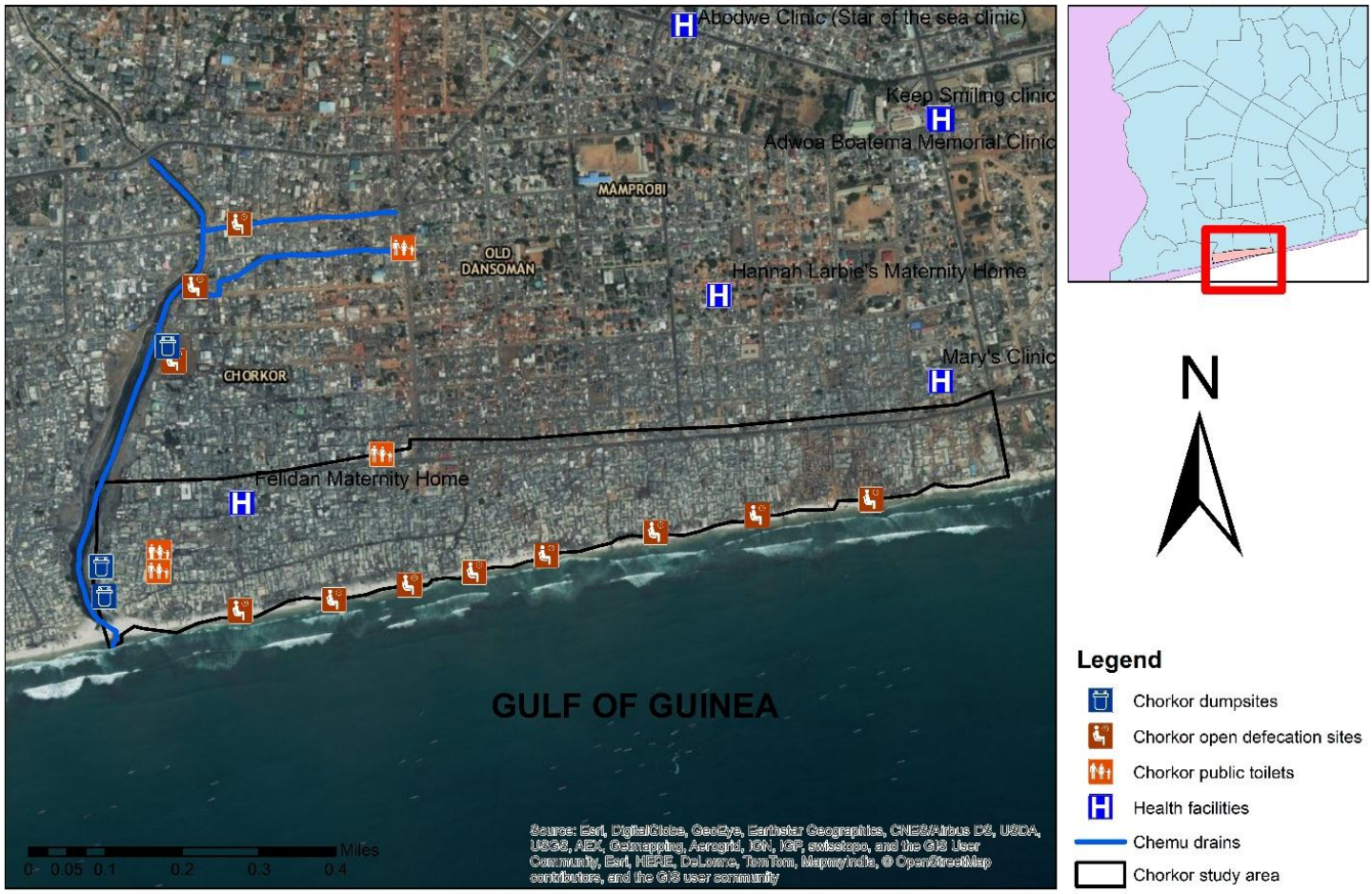


Figure 5.1 Cholera risk factors in Chorkor

Source: Researchers construction from Arcmap

Figure 5.1 shows a map of Chorkor and some important cholera risk factors that exist within the community. Amongst these include open drains, open defecation sites, public toilets and dumpsites.

The *Chemu River* flows through Dansoman to Chorkor and into the sea. This open drain has been converted into a dumpsite as well as an open defecation zone at some portions of its course of flow.

Plate 5.1 Drains in Chorkor

Source: Researcher's field data (2017)

According to Acheampong, Mumin and Abrokwah (2016), the high population found in Chorkor makes it difficult for the provision of affordable and adequate housing as a result of limited space available for accommodation. This has resulted in a situation where dump sites are located at the outskirts of the community. The major dumping areas are however along the beach and the Chemu drain. Most households dump their rubbish in the sea and the sea in turn brings the rubbish back ashore. The shoreline can be seen to be filled with filth and plastic waste materials. As stated in an interview with a resident named Sylvester Antwi who has lived in the community for 19 years;

> *"There is no place in the community to put big dustbins because of the number of people living here. Some new community members try to bring dustbins but don't find them after a while."*

According to other residents, community dwellers who are located further away from the major refuse dumps at the outskirts of the community end up dumping their household refuse within the community in black polythene bags. This has contributed to the deteriorating sanitation conditions of the community.

Plate 5.2 Dumpsites in Chorkor

Source: Researcher's field data (2017)

Open defecation is quite common along the shoreline and along the Chemu Lagoon as well as along the beach. People of all ages and sexes can be seen daily defecating along the beach as indicated in *plate 5.3*. According to residents, most homes do not have private toilet facilities and this forces them to use the shoreline as public place of convenience. There are several public toilets in the area as indicated in *figure 5.4*. Despite the presence of the public toilets most residents still resort to defecating along the beach and this is attributed to the relatively high fees charged before using these public toilets. Most public toilets charge 50 pesewas for use of their facility. The toilet facilities are also not in good sanitary conditions with bad smell emanating from them. According to residents, they enjoy the cool breeze as they defecate at the sea side compared to the stuffy smell coming from the public toilets.

Plate 5.3 Open defecation sites in Chorkor

Source: Researcher's field data (2017)

Plate 5.4 Public Toilets in Chorkor

Source: Researcher's field data (2017)

5.2.2 Mode of Disease spread

The location of 30 households where cholera victims lived was mapped in order to aid in identifying the mode of spread of the disease within the community. Thiessen polygons were used to show the relationship between the cholera risk factors and the cholera cases that were captured. Each polygon drawn uses triangulation to represent boundaries around each cholera risk factor such that any cholera case found within the triangulated sphere of the cholera risk factor is attributed to be associated with that cholera risk factor.

According to Osei (2010), inhabitant's close in proximity to cholera causing factors are more vulnerable to contracting the cholera disease. As seen in Figure 5.2, the location of the mapped cholera cases were mostly within the community and within the sphere of the polygons drawn around the various cholera risk factors. The close proximity of the location of recorded cholera cases to the cholera risk factors shows a relationship of distance decay. That means a housefly or any or disease spreading vector can fly very short distances to spread the disease to closer households. The risk of contracting the disease becomes minimal further away from the risk factors. The contagious spread

of the disease within the Chorkor area also means that movement of infected cholera carrier to other surrounding communities or new places could introduce the disease in those new areas.

This points to a contagion mode of spread of the disease within the community. The disease is however spread by direct contact with risk factors such as public toilets, open defecation sites, open drains or an infected person.

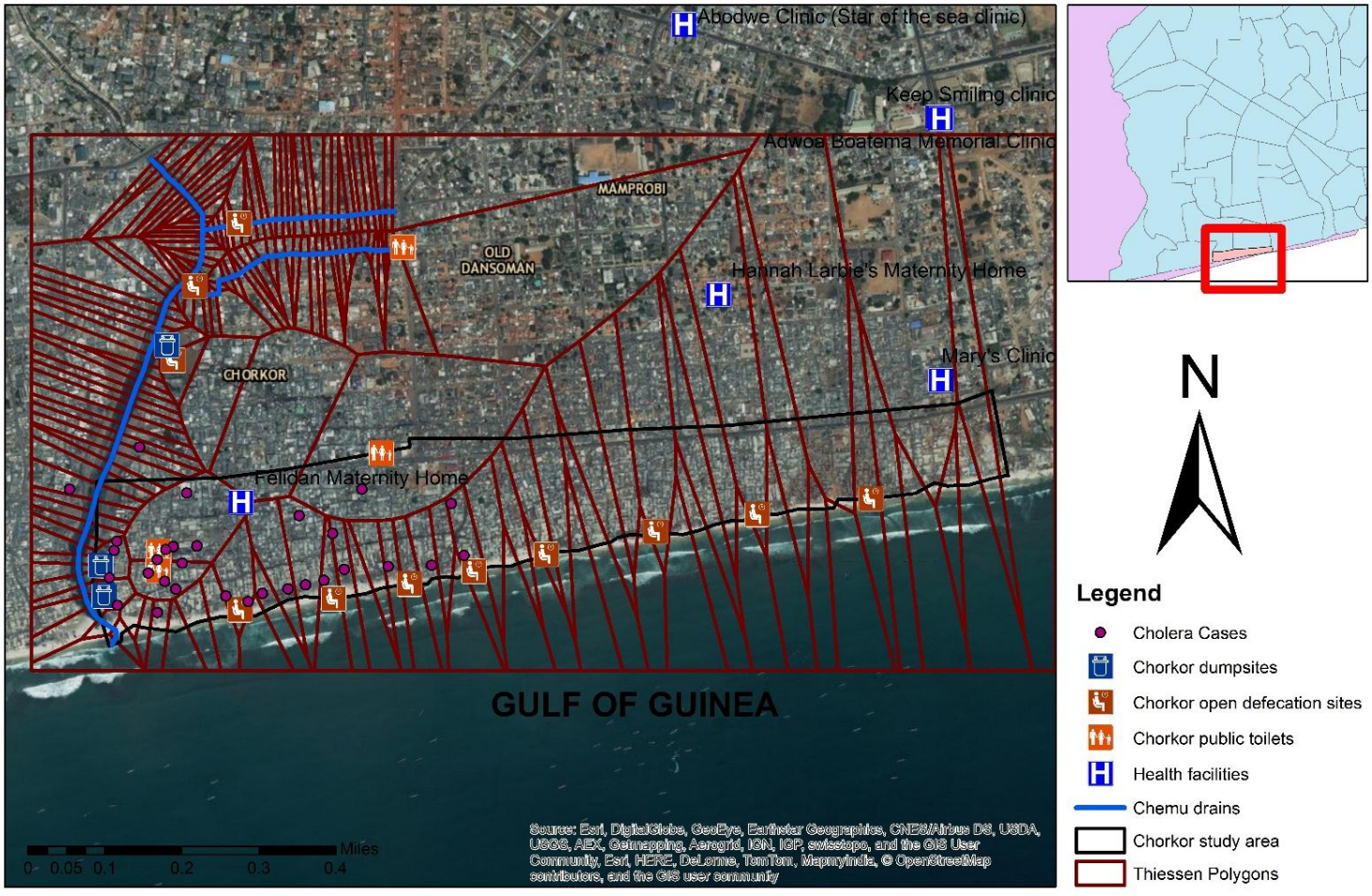


Figure 5.2 Map showing recorded cholera cases and thiessen polygons in Chorkor

Source: Researchers construction from Arcmap

The distribution of cholera risk factors in the chorkor area are displayed in *Figure 5.3*. A density map was used to analyse the peak or epidemic center of cholera risk factors within the area. A kernel density was therefore used to show the concentration of the mapped cholera causing factors namely dumpsites, open defecation sites, drains and public toilets in and around Chorkor.

The kernel density tool was used to calculate the density of point features around each raster cell output. The analysis involves the fitting of smooth curved surfaces over each point or in this case the risk factor. The kernel density assigns high values at the location of clustered points hence giving it the deepest color. The further the distance from the point the lower the value and hence a different colour code is assigned.

The area with the highest mapped number of cholera risk factors is indicated using the red color code showing the high vulnerability areas around Chorkor as represented in *Figure 5.3.* The area of high vulnerability has quite a number of open defecation sites as well as dumpsites hence making the transmission of the disease much easier to residents. The waste from these activities are also washed down into the sea by the Chemu drain. This situation creates a buffer of vulnerability around the drain which in turn affects the Chorkor community as a whole. The coastline also serves as a major source of the disease spread. This is because a lot of residents prefer defecating on the beach. The role of the beach in terms of increasing cholera vulnerability arises as a result of the high likelihood of direct contact with various cholera infected faeces on the coastline. The inability to eliminate the waste generated within the community from having direct contact with inhabitants within the community has been suggested as the cause of the endemic nature of cholera within the Chorkor area.

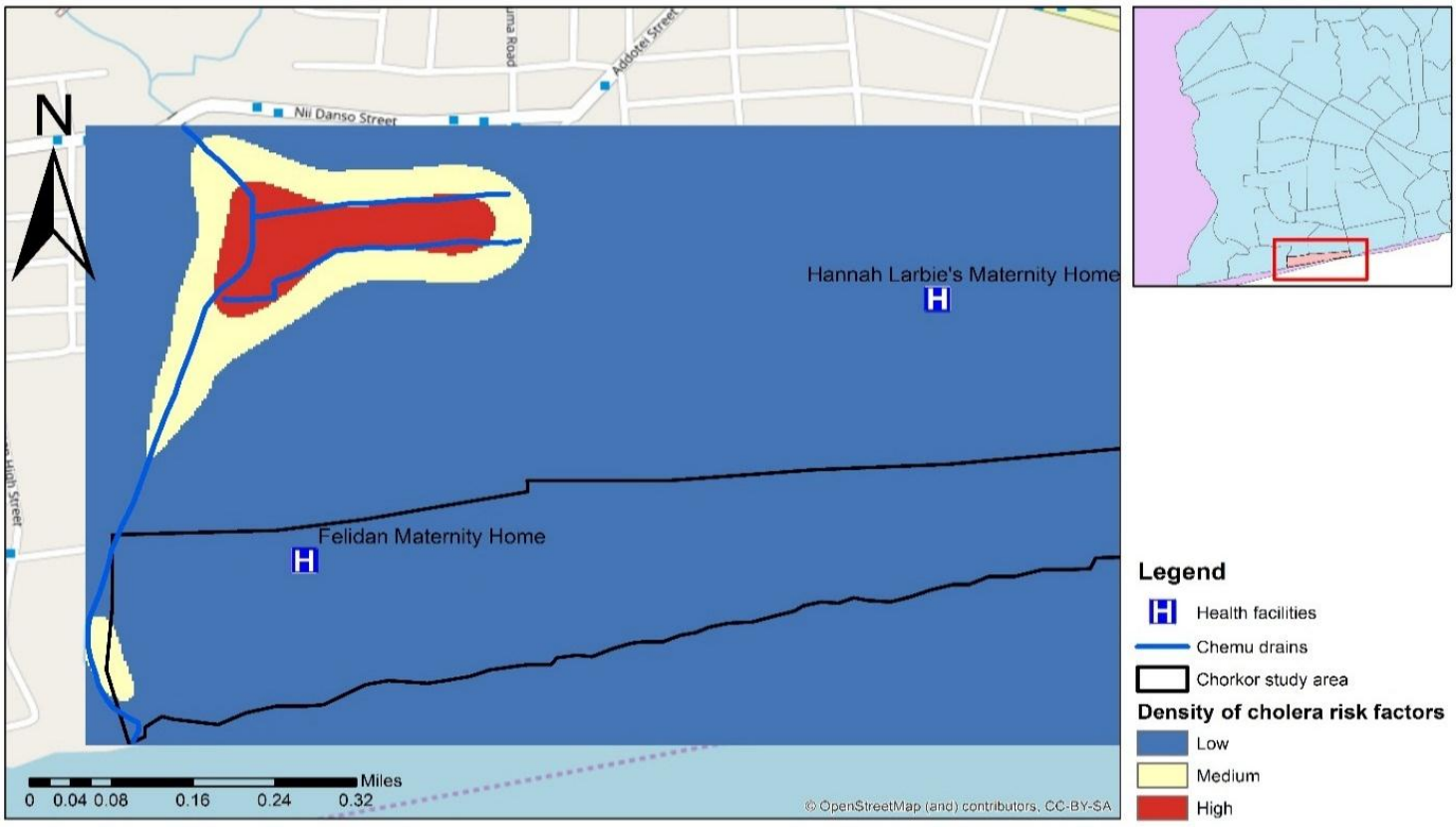


Figure 5.3 Density map of cholera risk factors in Chorkor
Source: Researchers construction from Arcmap

5.3 Low Income Communities (Maamobi-Nima community)

Maamobi- Nima is a migrant community located within the Accra Metropolitan Area. The area is composed of settlers from across the country but is dominated by Muslims. In terms of population, the area is greatly increasing demographically. The population of the Maamobi-Nima community is estimated to be 142,567 (PHC, 2010). There is also a great increase in the physical development of the area with no corresponding spatial planning (Millenium Cities Initiative, 2012). The Maamobi –Nima area according to the data collected has the presence of all the risk factors outlined in the research namely public toilets, open defecation sites, open drains and public dumpsites. It is also referred to as

a zongo. According to MCl, (2012.p7) "A zongo translates as a *stranger's quarters*, a term typically applied to migrant communities from Northern Ghana and other West African migrants of Hausa and other origins; such communities have usually grown in an unplanned manner in which squatting on land occurs to at least some extent".

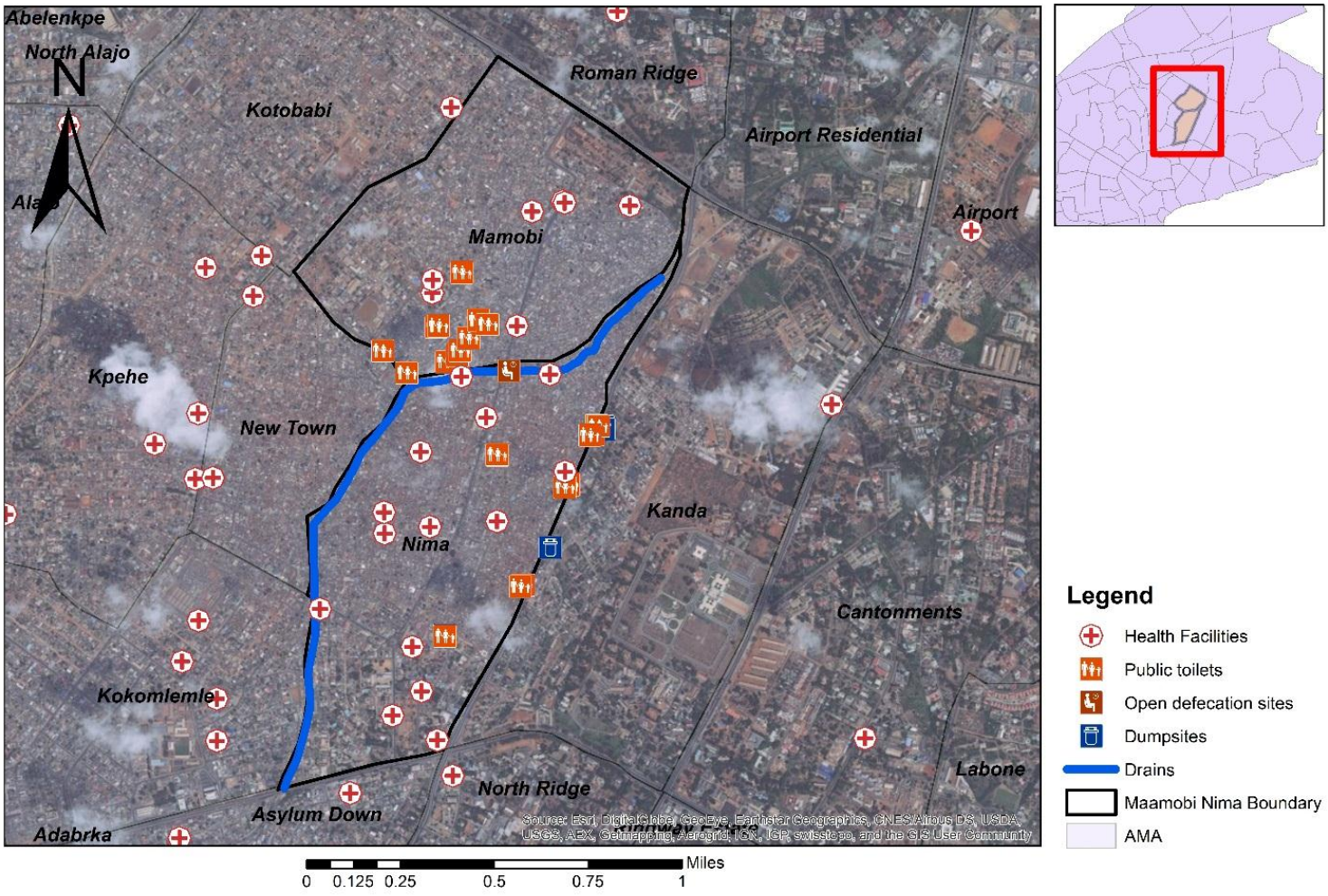


Figure 5.4 Associated Cholera risk factors in Maamobi-Nima

Source: Researchers construction from Arcmap

5.3.1 Risk Factors

From the mapping done on the field there is a pronounced presence of public toilets in the Maamobi-Nima area. Each public toilet having its unique name based on the owner or the area. Some of them include Kofi, Nuria and Frankies public toilets. These public toilet facilities lack good sanitary conditions with some making it easy to have contact with other people's faeces. In terms of vulnerability, the whole area is at risk including anywhere the public toilet user decides to go if he or she doesn't wash up well. In case a person infected with cholera uses the facility and does not wash his or her hands properly, people will be more likely to contract the disease through handshake or eating together. Other important transmission agents such as house flies can carry the infected faeces to uncovered food close by for consumption.

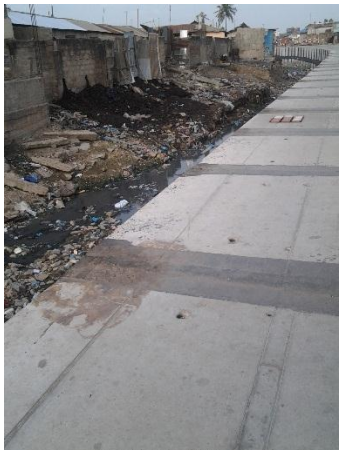
Within the Maamobi-Nima area, there are a lot of public toilets which are distributed throughout the whole area. This is because most structures in the area are built without toilet facilities and this forces them to use other public toilet facilities within the community.

Plate 5.5 Public toilets in Maamobi-Nima

Source: Researcher's field data (2017)

In situations where households or individuals cannot afford these public toilets, they resort to open defecation. Open defecation is done along the Nima Gutter drain which stretches from the "Kawkudi" end of the Kanda highway through both communities towards Asylum down in Accra. The Nima Gutter as it is popularly known carries liquid waste through the community. However community members use it as a dumping place for both solid and liquid waste. This situation has led to the drain being a health threat to the community especially during the rainy season when it sometimes gets flooded. The implication is that since the drain serves as a dump site for both solid and liquid waste as well as an open defecation site, all the waste found within it is transferred back to the various households either through vectors such as houseflies or flooding of the drains. If there is any cholera infected excreta found in the drain as a result of open defecation or dumping of human excreta in polythene bags, the drain will therefore serve as a much easy route for transferring the disease.

Plate 5.6 Drains in Maamobi-Nima



Source: Researcher's field data (2017)

Similar to Chorkor, there are a few dumpsites within the community whilst most of them are located at the outskirts of the community. This is because most of the space is either occupied by temporal or permanent structures for various economic, health or housing functions leaving very little space for other facilities such as community play grounds and refuse dumping.

According to residents of Maamobi-Nima, refuse collection is left in the hands of members of the community and hence most residents dispose their refuse in the drains since the main dumpsites are further away from them. All these can increase the risk of the community contracting cholera and other sanitation related diseases.

Plate 5.7 Dumpsites in Maamobi-Nima

Source: Researcher's field data (2017)

A density map of cholera risk factors in the Maamobi-Nima area is represented in *Figure 5.5*. A kernel density was used to show the concentration of cholera risk factors within the area based on the researchers mapping. The Nima gutter which extends from Nima through Maamobi plays a vital role in the spread of cholera within the area. The gutter is also used by the residents as a dumping and defecation site which also carries liquid and solid waste through the community. The community becomes more vulnerable during the rainy season when heavy rains ensure the movement of the waste throughout the area using the drains as a medium. The practice of throwing human excreta wrapped in plastic bags into these drains raises concern for the kind of waste that is transported through the community.

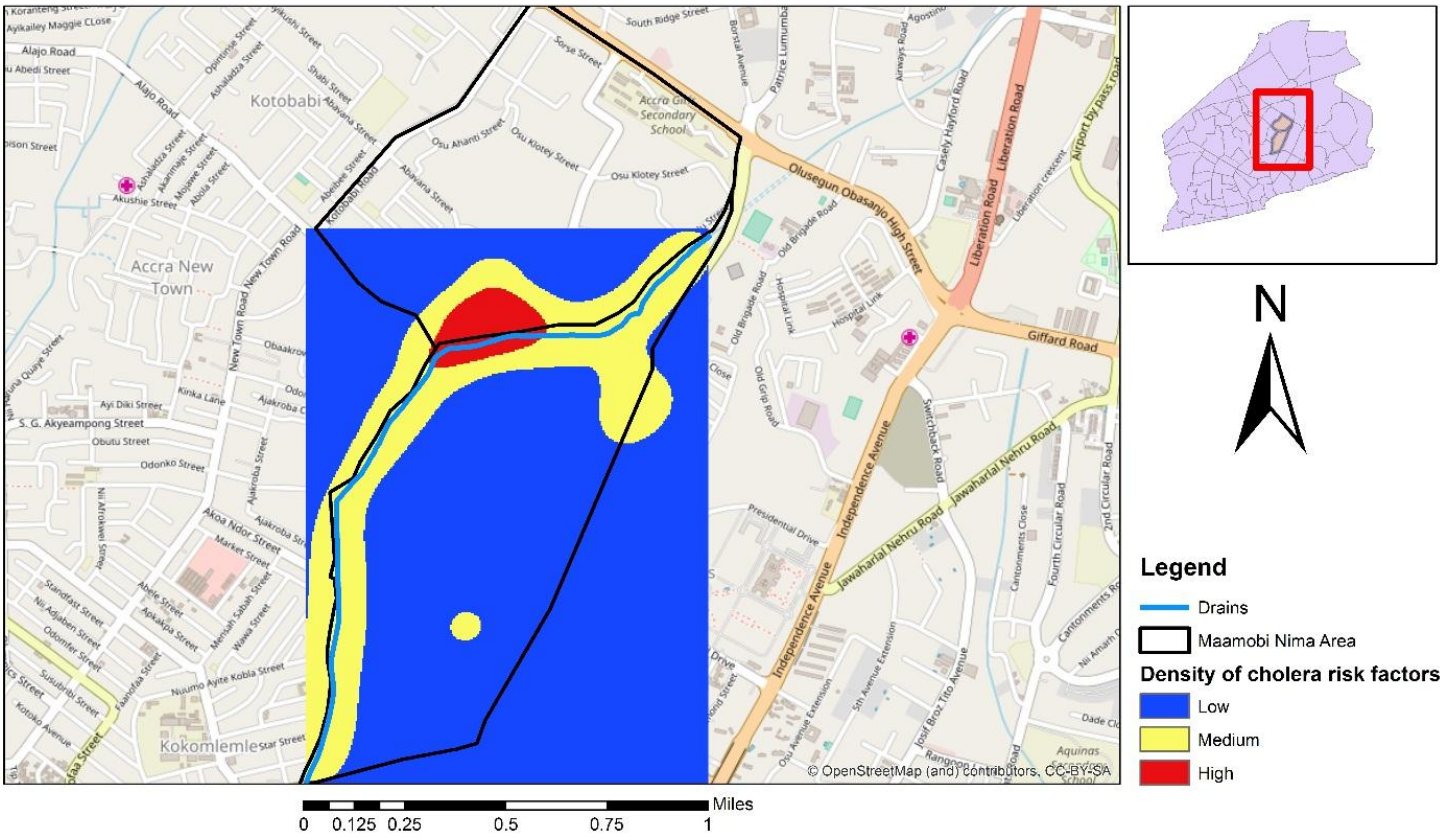


Figure 5.5 Density of Cholera Risk factors in Maamobi-Nima

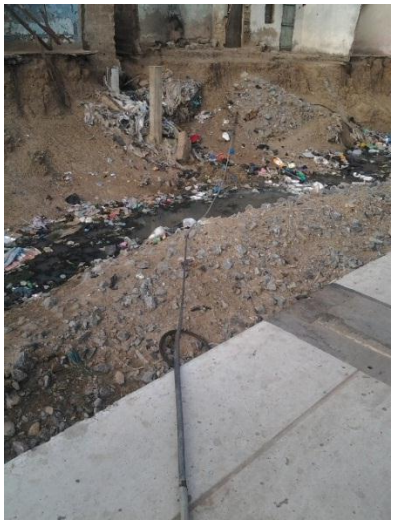
Source: Researchers construction from Arcmap

In terms of vulnerability, the Maamobi-Nima community can be seen to have high, medium and low areas of vulnerability as seen in *Figure 5.5.* The high vulnerability areas represent an area in the community with the highest cluster of cholera risk factors. There are also medium and low vulnerability areas as represented by the density function used. The situation where community members can be exposed to the excreta of an infected person through these drains is highly likely during the flooding of the Nima gutter drain. In terms of proximity or likelihood of contracting the disease, the households located along the drain or closer to the various risk factors are more likely to contract the disease. This

can also be spread throughout the area because of the slum layout and the interaction that exists in the community. The existence of these factors helps to explain the endemic nature of the disease in the area.

Information gathered from the community shows that awareness has been created concerning throwing solid and other waste materials into the Nima gutter but the unavailability of proper waste collection systems as well as the cost involved in using public toilets have left community occupants with no choice than to continue these practices which comes back to affect them in the long run.

Plate 5.8 Open Defecation Sites in Maamobi-Nima



Source: Researcher's field data (2017)

5.3.2 Mode of Spread

As seen in *Figure 5.6* a thiessen polygon analysis was performed on all cholera risk factors in Maambi-Nima to find the proximity of the various cholera victims to them. Most of the cases are located within the thiessen polygons of the various cholera risk factors hence showing that there is a relationship of proximity between them.

The analysis shows that the disease is spread in a contagious manner. Direct contact with a risk factor or a carrier of the disease has been identified as the main mode of spread of the disease in the Maamobi-Nima community. As part of the focus group discussions held in the Nima area one mother stated that;

> *My child went to the public toilet one morning. After that he started running and vomiting. I was scared to take him to the hospital because of the bills but eventually took him and I was told he was suffering from cholera.*

Other contributions from members of the community point to the situation where the contraction of the disease is as a result of direct contact with the risk factors present in the community. The distance decay theory therefore comes to play. The further one is from the risk factors the less vulnerable he or she is from contracting the disease.

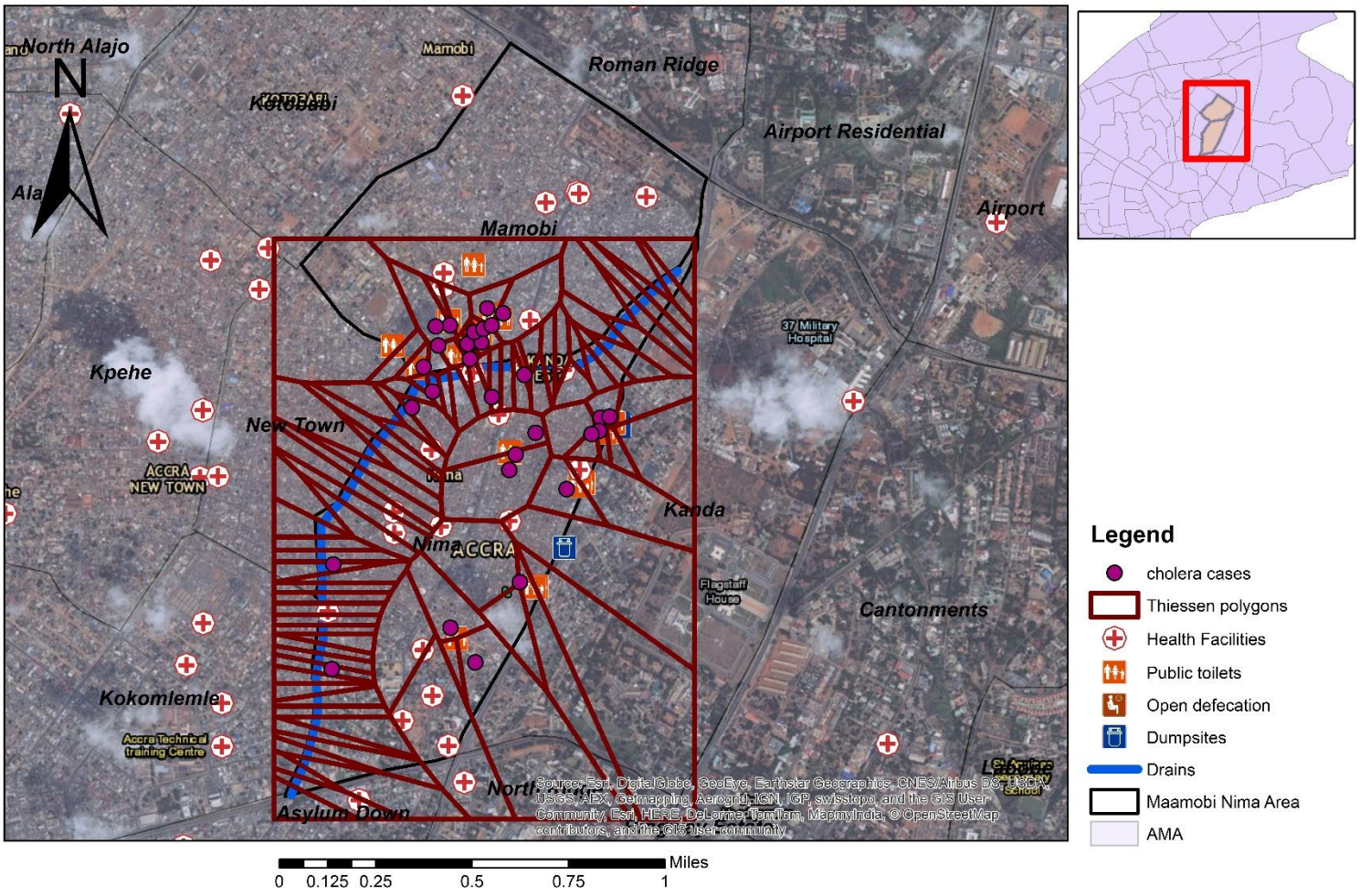


Figure 5.6 Recorded cholera cases and thiessen polygons in Maamobi-Nima
Source: Researchers construction from Arcmap

The thiessen polygon analysis shows that the locations of the various cholera cases recorded fall within the sphere of influence of the various cholera risk factors. This however indicates a close association between them. A good number of cholera cases were recorded close to public tolilets and the Nima Gutter drain.

5.4 Factors affecting endemic nature of cholera in the low income communities of AMA

The endemic nature of cholera in the low income areas of AMA have been attributed to the high presence of identified cholera risk factors including open defecation sites, open dumpsites, public toilets and open drains. All these factors play an important role in the development and transfer of the disease. This idea as supported by Osei and Duker (2008) suggests that the closer one is to a refuse dump the more vulnerable the person is to contracting cholera. Sanitation, overcrowding and proximity to surface water were also identified by Ali et al, (2002) as factors contributing to the endemic nature of the disease in Bangaladesh. As identified by Ali et al, (2002), similar factors affect play a great role in the endemic nature of cholera in the low income study areas of AMA. In terms of proximity to surface water, overcrowded areas which have low educational levels were identified to be highly vulnerable to cholera when located closer to such water bodies. High faecal concentrations in surrounding surface water is the likely to occur as a result of such poor sanitation resulting from of adequate resources such as toilets and dumpsites and overcrowded conditions. The Chemu drain that moves through the Chorkor community can be seen to have similar conditions surrounding it. As can be seen in plate 5.1, the Chemu river serves as a reservoir for filth and open defecation hence making it a habitat for breeding the disease. In relation to the Maamobi-Nima area as well, the Nima gutter also has similar conditions hence contributing to the endemic nature of the disease in the area.

High population density and overcrowding in the low income areas as a result of rapid urbanization also lead to shorter disease transmission paths hence making cholera easily transferable between individuals especially with contagious means of transfer. The low educational levels of respondents within the low income communities of chorkor and Maamobi-Nima as seen in *Table 6.1* suggests some level of vulnerability in relation to cholera. A study conducted in Ghana ten years after a major

cholera outbreak concluded that cholera educational messages discussed on radio during the epidemic were however not correctly recalled. There were also a number of fallacies associated with the various discussions pushed out to the public. A similar study conducted in Peru in 1991 found out that information about preventive cholera measures had been effectively passed on to 2 study communities but failed to result in attitudinal change by members of the communities (Einarsdbttir, Passa and Gunnlaugsson, 2001). The *Table 6.2* however shows the respondents have some level of knowledge when it comes to cholera but this hardly translates into attitudinal change especially in the low income areas. This situation can be attributed to the lack of adequate facilities as good and accessible water resources, toilet facilities and effective waste management systems which are hardly present in these areas.

5.5 Middle Income Communities (North Kaneshie)

North Kaneshie is a suburb of the Accra Metropolitan Area. It shares a boundaries with Kaneshie, Awudome, North Industrial Area, Tesano, New Fadama and Bubuashie. The area has a more organized settlement and housing patterns in some areas while temporary and mini squatter settlements can be found in other areas. *Figure 5.7* displays a map of cholera risk factors within the North Kaneshie community.

5.5.1 Risk Factors

The area has fewer cholera risk factors as compared to Maamobi-Nima or Chorkor. However the surrounding communities such as Kaneshie and Bubuashie pose some level of risk to the North Kaneshie community. Dumpsites and public toilets in these surrounding communities have the tendency of spreading cholera within the area.

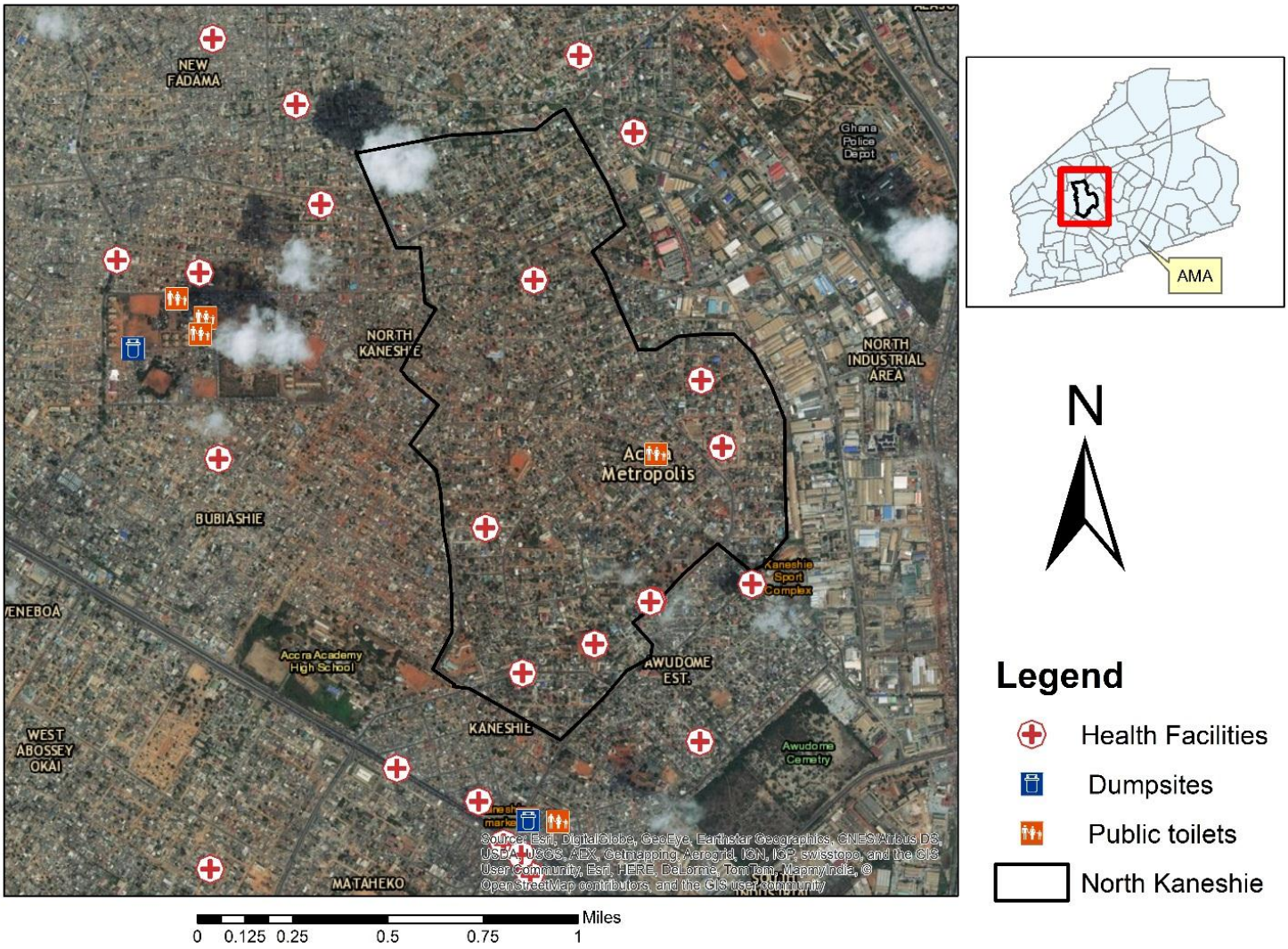


Figure 5.7 Cholera risk factors in North Kaneshie

Source: Researchers construction from Arcmap

An area known as Cable and Wireless located in Bubashie poses great danger to the spread of the disease within Bubuashie which is easily transferred to North Kaneshie through movement. The Cable and Wireless area is a large area where cattle are reared. The area has a number of public toilets with poor sanitary conditions. Large portions of the land within the area have been converted into dumpsites and hence the area has very poor sanitation. According to residents, the situation worsens during the

rainy season and makes movement quite difficult since the area gets flooded and carries with it all the cattle droppings as well as other solid waste materials.

The North Kaneshie area has fewer risk factors in terms of public toilets and open defecation sites and hence is less vulnerable to outbreak of the disease compared to the low income areas. As shown in *Figure 5.7* shows some dumpsites that pose a risk of cholera transfer to the North Kaneshie area.

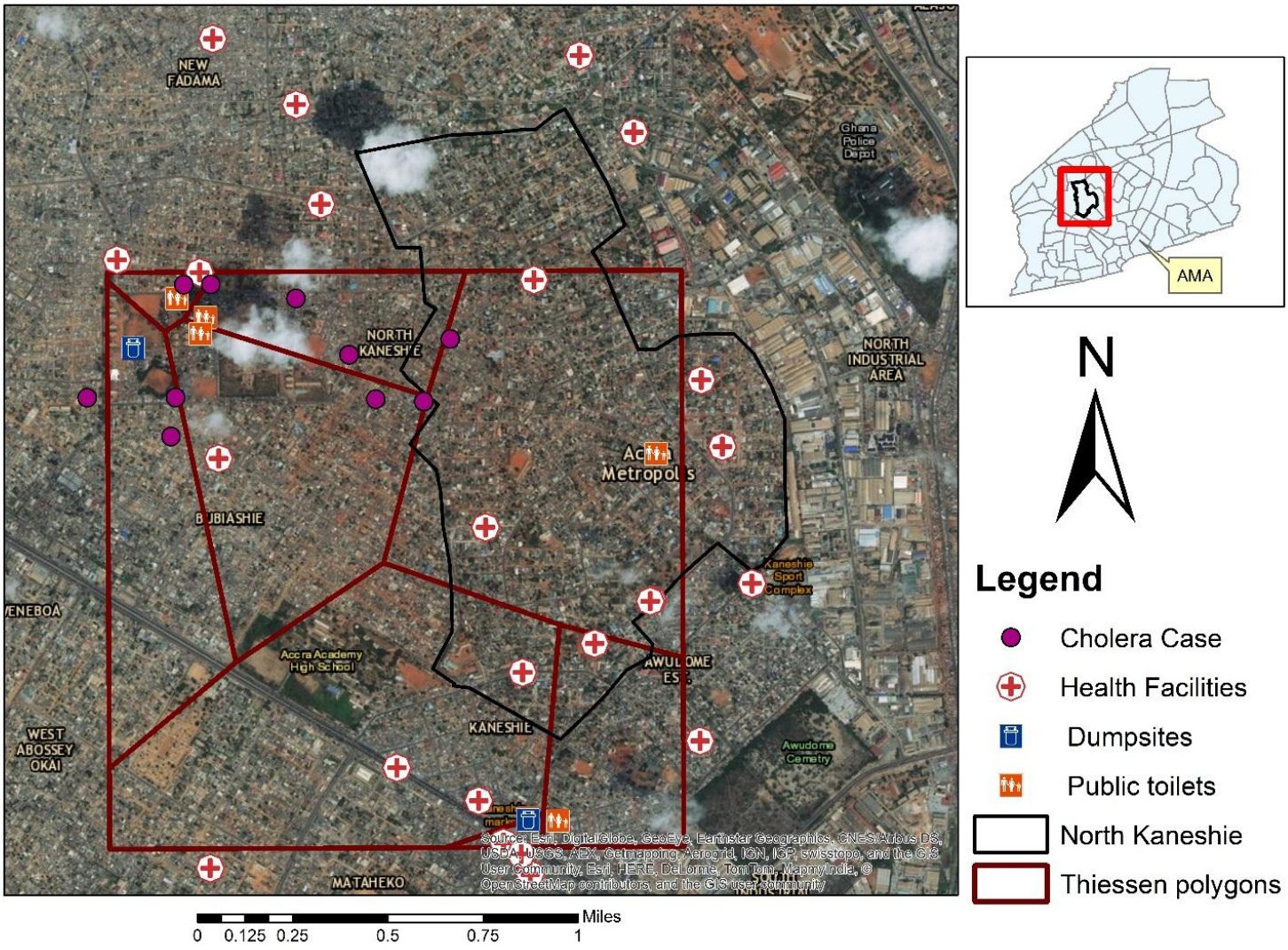


Figure 5.8 Thiessen analysis of Cholera risk factors in North Kaneshie

Source: Researchers construction from Arcmap

A thiessen analysis performed and displayed in *figure 5.8* shows that most of the households affected by the disease are close to the cable and wireless area outside the North Kaneshie area. There were however minimal cases of cholera recorded in the study community.

Plate 5.9 Pictures of cholera risk factors in Kaneshie

Dumpsite in Kaneshie Market

Dumpsite at Cable and wireless

Public Toilet at Cable and Wireless

Dumpsite at Cable and wireless

Public Toilet at Kaneshie

Source: Researcher's field data (2017)

5.5.2 Mode of Transmission

The North Kaneshie community has a variety of cholera risk factors both within and its surrounding communities. The main mode of the disease spread in this community has been attributed to relocation transmission. This occurs when people from surrounding communities and areas such as the Cable and Wireless area with high cholera vulnerability transfer the disease to the Kaneshie community which has less cholera risk factors. Most cholera cases were reported to be coming from surrounding areas of Kaneshie as can be seen in the location of cholera cases in *Figure 5.8*

It is however evident that as a result of the important function the North Kaneshie area plays in relation to its educational, health and business activities, there is a lot of movement from and to its surrounding areas.

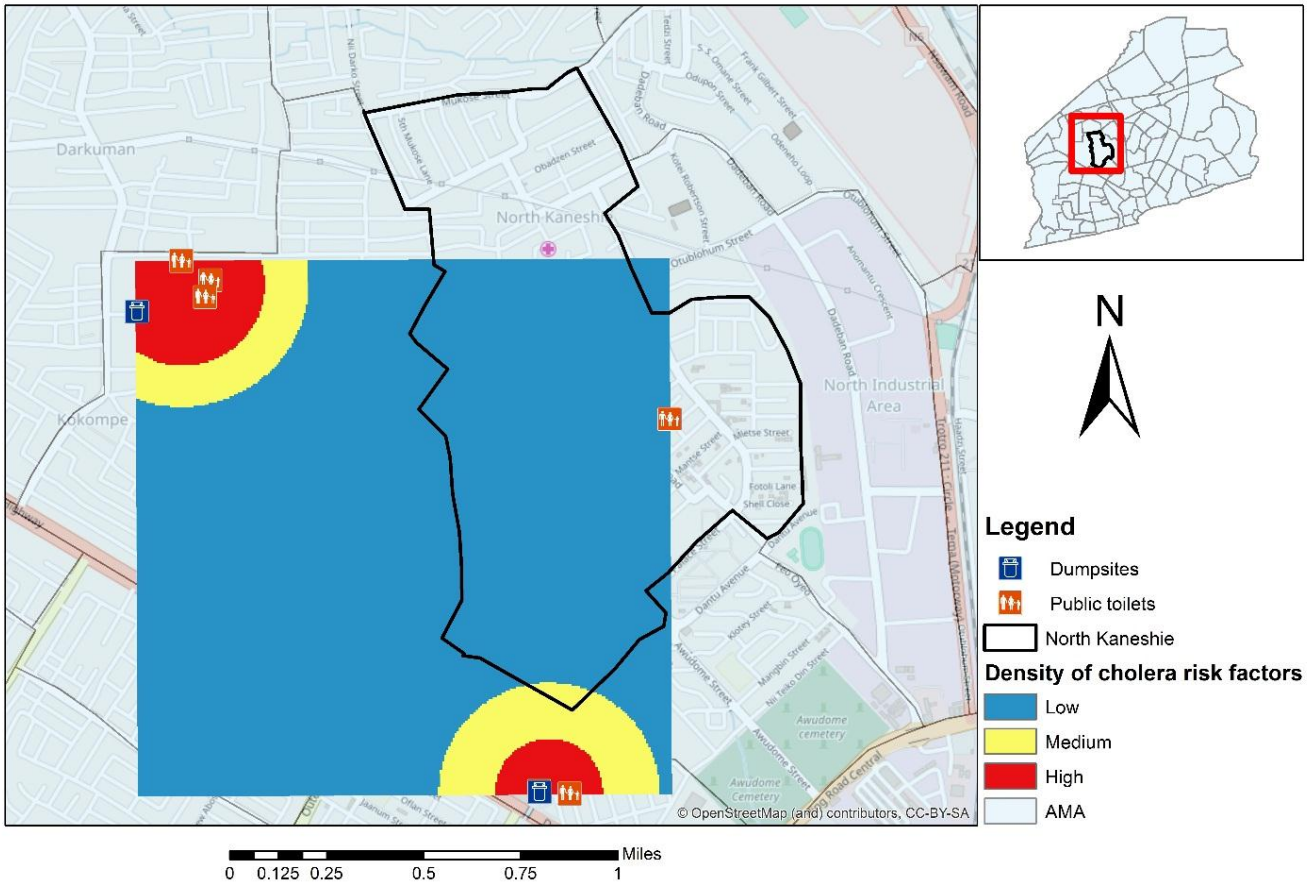


Figure 5.9 Density map of Cholera risk factors in North Kaneshie
Source: Researchers construction from Arcmap

The *Figure 5.9* helps to show the distribution of cholera risk factors in and around the Kaneshie area. The distribution of these factors also helps to identify the likely source of the disease. The North Kaneshie area has very few cholera risk factors. The disease epicenter is located in the Cable and Wireless area outside the North Kaneshie community. The disease can therefore be transported to the North Kaneshie community through movement of people in and out of the community for occupational, educational, health and other purposes. The movement of infected persons from outside the community to the North Kaneshie community can also increase the vulnerability and spread of the disease in area. The role of cholera vectors such as flies and cockroaches are key in explaining the spread of the disease across communities. These vectors may get in contact with contaminated excreta and later visit unprotected food items thereby implanting the germ into the food chain of consumers (Kinsai, 2011).

5.6 Middle Income Communities (Dansoman)

Dansoman is a suburban area in the Greater Accra region of Ghana. According to residents of the place, the area was a well-planned town and hence has an improved sanitation compared to most parts of the capital city, Accra. In terms of waste collection, the area depends on door to door waste collection systems by waste management companies. It is rare to find open dumpsites within the area. There is also the absence of open defecation sites and public toilets and this is because all houses have built-in toilets.

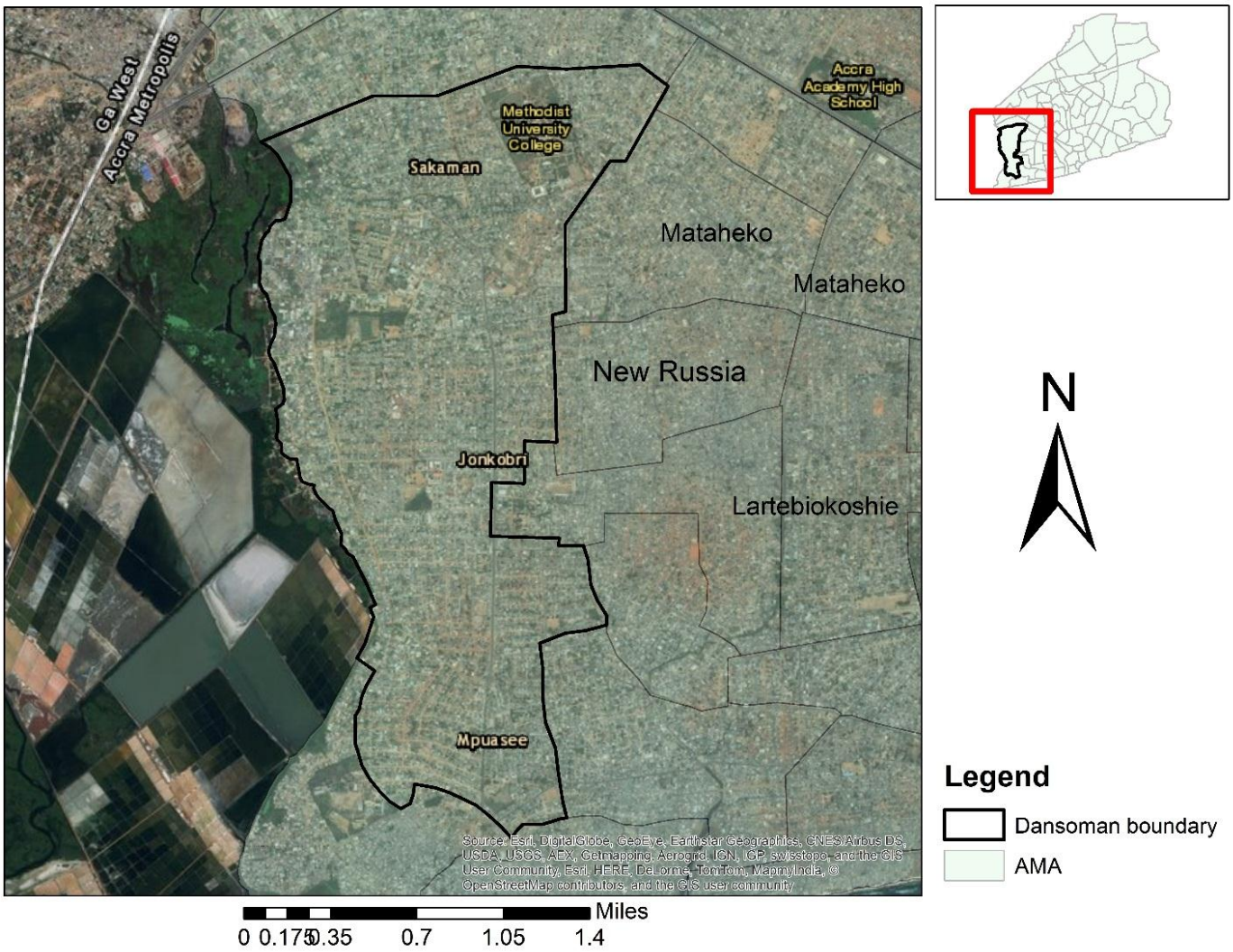


Figure 5.10 Map of Dansoman
Source: Researchers construction from Arcmap

5.6.1 Risk factors

However interviews with health professionals reveal that the surrounding communities pose a threat to the distribution of cholera within the Dansoman populace. Surrounding areas such as Sabon zongo, New Russia, Abossey Okai and Mataheko have poor sanitation conditions that can support the generation and transfer of cholera to the Dansoman community. *Figure 5.10* shows a map of Dansoman and its surrounding communities. The area therefore has less cholera risk factors and hence making Dansoman a less risk prone area to live in terms of cholera.

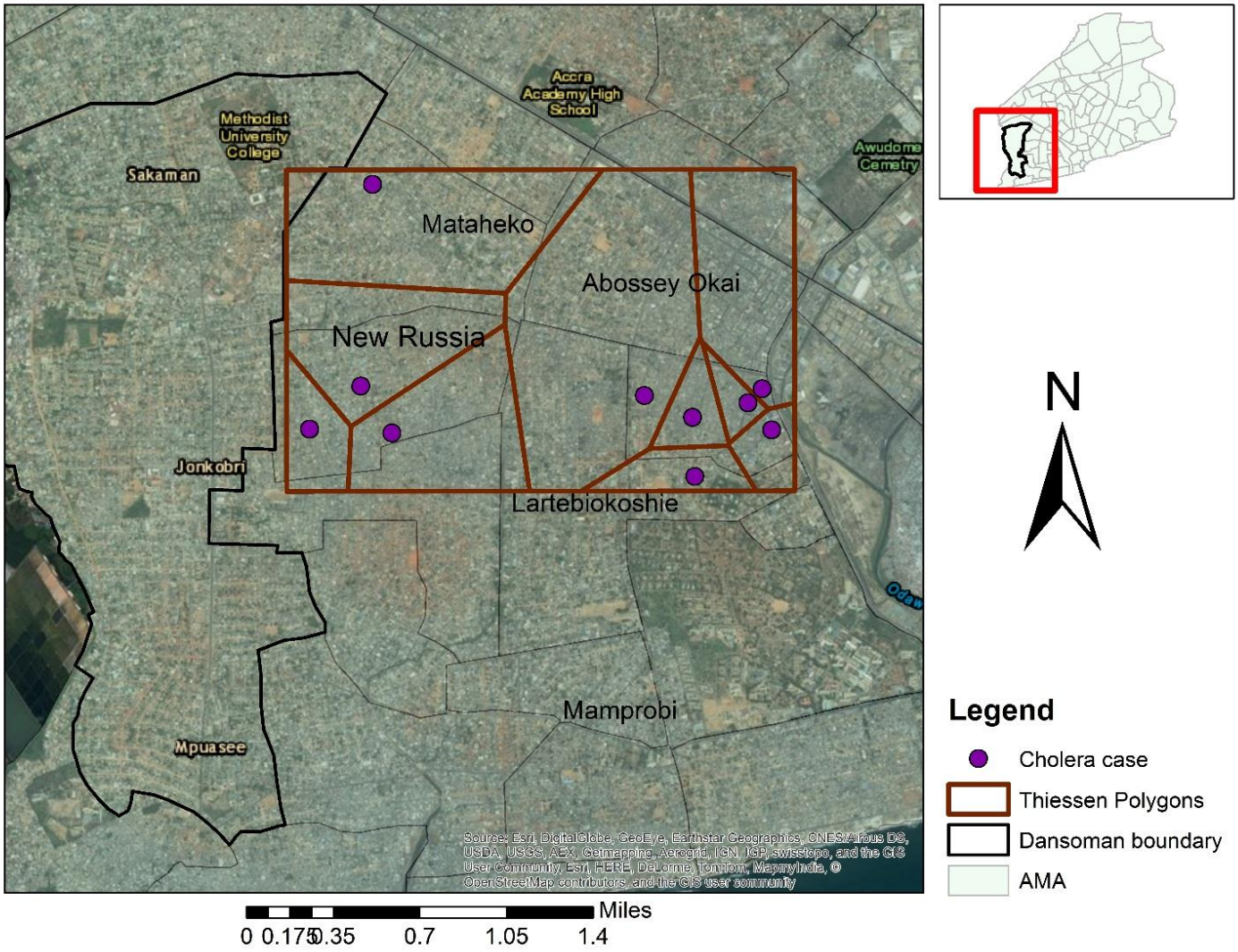


Figure 5.11 Cholera identified households around Dansoman
Source: Researchers construction from Arcmap

As can be seen in *Figure 5.11* above the risk factors mapped are coming from outside the Dansoman community with areas such as Sabon Zongo and Russia posing risk to Dansonman. Sabon Zongo is a community located close to Dansoman. This community has a population of 27,668 (PHC, 2010). The community also has poor sanitation conditions and hence serves as a hotspot for the spread of cholera.

The Korle Lagoon which is also close to Sabon Zongo serves to spread the disease further along its banks and to communities the lagoon flows through such as Korle-bu and Korle Gonno areas.

5.6.2 Mode of transmission

The cases of cholera recorded at the Dansoman Polyclinic were traced to be coming from outside the community. As a result of this the main means of transmission of the disease in the Dansoman area is the relocation transmission means. Cases of cholera contracted in the surrounding communities like Sabon Zongo and Russia can be transferred easily to residents of the Dansoman community

5.7 High Income Communities (East Legon)

East legon is one of the high income communities within Accra Metropolitan Area. The area is characterized by well-planned neighbourhoods and social facilities such as hospitals and schools. East Legon as displayed in *Figure 5.12* has a few cholera risk factors present in the area.

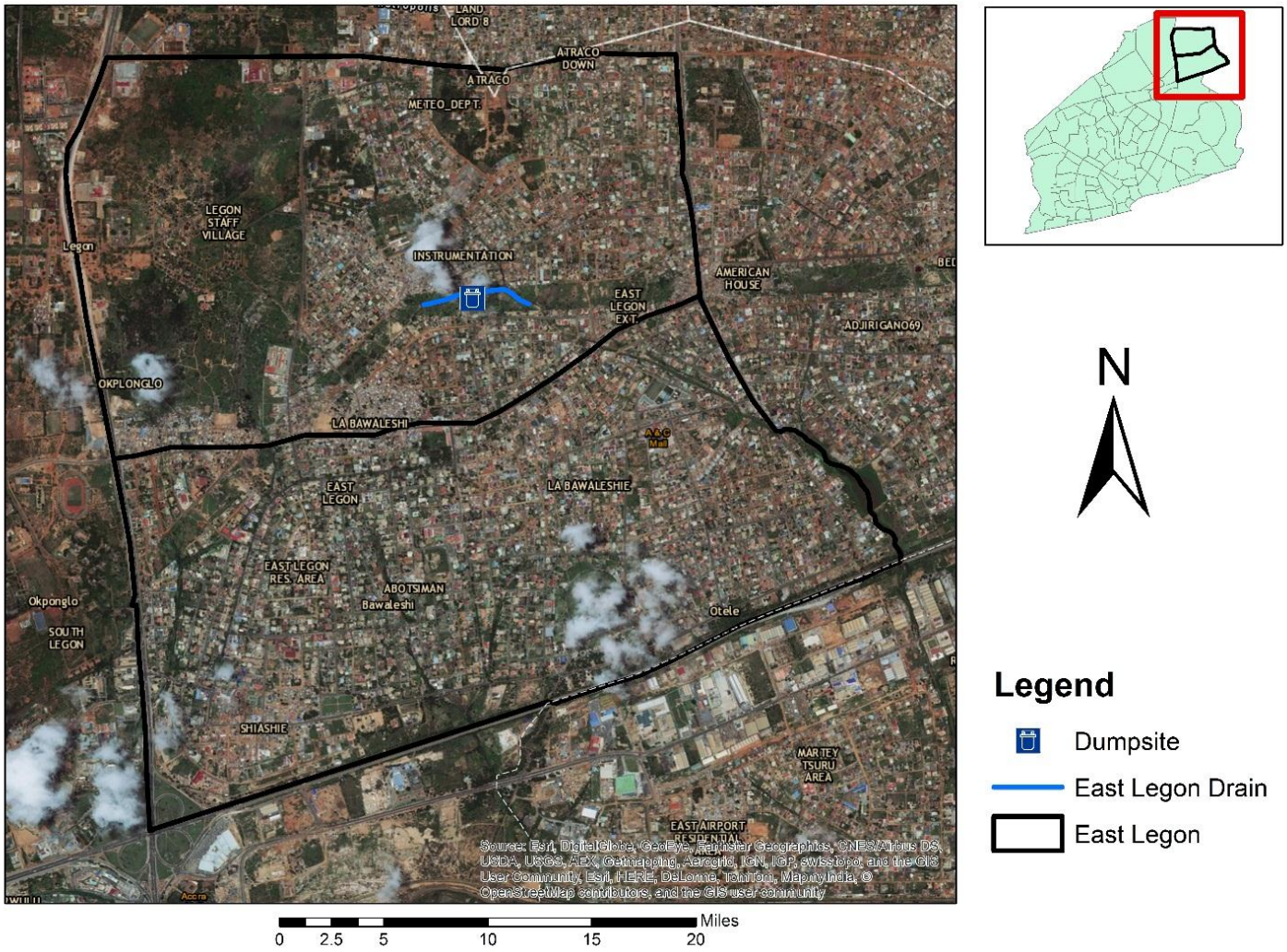


Figure 5.12 Cholera risk factors in East Legon
Source: Researchers construction from Arcmap

An open dumpsite and an open drain located within the community makes the area prone to the spread of cholera. However, the open drain covers a small area within the community. The drain does not also serve as a dumpsite or an open defecation site therefore enabling water to flow freely through it. The drain does not get flooded easily as communicated by the residents and this leads to a situation where surrounding residents do not face floods which could get them in contact with the vibro cholera bacteria.

As portrayed in *figure 5.12* the East Legon area has very few public dumpsites where the cholera disease can be spread easily.

Plate 5.10 Pictures of Cholera risk areas in East Legon

Open Drain

Dumpsite

Dumpsite

Source: Researcher's field data (2017)

5.8 High Income Communities (Cantonments)

Cantonments is an affluent area within the capital city of Accra. The area was intended to be a military settlement under the colonial rule but has been upgraded to a modern planned residential settlement occupied by government officials, academicians and the wealthy in society. Cantonments Hospital, Police Hospital and the Health Care Centre and Clinic of Cantonments are the main health centres in the community.

As displayed in *Figure 5.13*, the Cantonments area has very few cholera risk factors. The area has a well ordered waste collection system with each house having a dustbin which is collected by waste management companies regularly. The area also has a good drainage system with very little solid waste blocking the flow of the open gutters. The community is quite neat with very few street food vendors. According to health professionals from the Police Hospital, most cases of cholera that are treated are

coming from the surrounding low and middle income communities such as Osu and La. According to them, the disease is quite difficult to transmit or transfer within the community because most homes are gated and have good water sources. There are also few food street vendors who also practice good hygiene. The other means of getting food is through restaurants or domestic cooking and these are done under relatively high hygienic conditions.

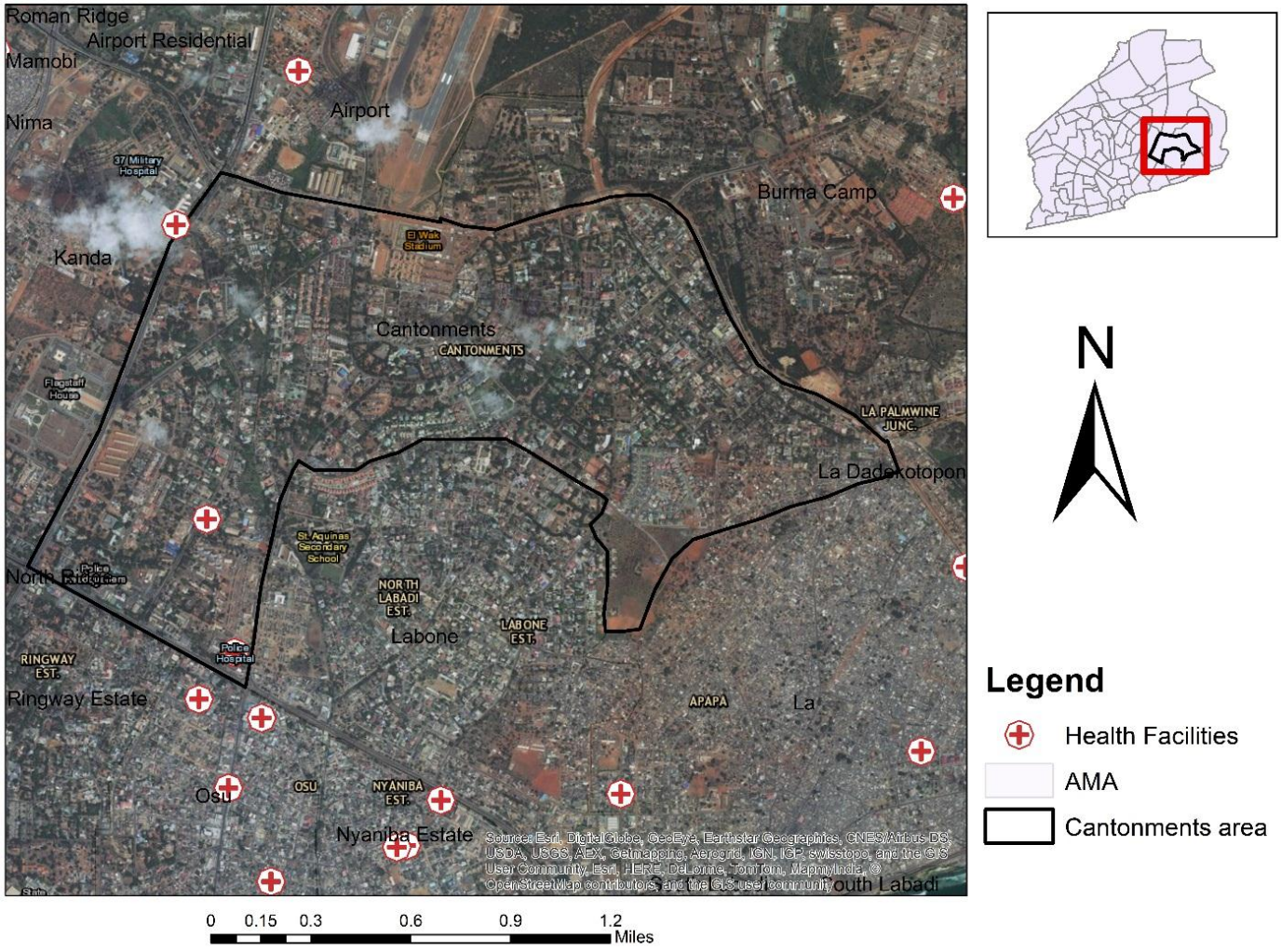


Figure 5.13 Map of Cantonments showing no cholera risk factors
Source: Researchers construction from Arcmap

5.9 Accessibility to Health Facilities in the Accra Metropolitan Area

According to Islam and Aktar (2011), the issue of health service delivery is an important challenge facing various governments of developing countries. According to the WHO requirements, every individual should have access to a health facility within a 5 kilometer (km) radius which is equivalent to a one hour walking distance (Boom et al, 2004). However there are still people living further than 8 kilometers radius to health facilities in Ghana (GHS, 2003). According to WHO (2005), an estimated time of 26 minutes and 5 seconds was required to reach a health facility within the urban areas of Ghana.

A multiple buffer analysis was performed on the health facilities in AMA to find out the areas further away from them. The buffers utilized a 1 km, 2 km and 5 km buffers around the health facilities as displayed in *Figure 5.14*.

From the distribution, it can be seen that accessibility to health facilities within the Accra Metropolis is not so much of an issue. The map shows that almost every location in AMA has high access to a health facility leaving very few places to have moderate accessibility. Communities such as Airport, Cantonments and South Odorkor have few areas that fall within the 2 km buffer radius.

However, the accessibility of these health facilities to people is dependent on a number of factors. One key factor that directly affects the utilization of health facilities is the efficiency and affordability of the transport system. The transport industry according to Wilson (2008), is dominated by the informal sector which provides about 95% of transport services within the country. These services are however marked by unreliability, safety issues and issues of comfort according to the document. All these issues coupled with the increasing traffic within the Accra Metropolis increase the difficulty in accessing health facilities within the Metropolis.

Hospital charges and services also play a role in the accessibility of health facilities in Accra Metropolitan Area. Most people prefer going to private hospitals but do not have the monetary means of accessing their services. Such people are forced to move to the nearest public hospitals which are less costly and which could also be further away from their residence.

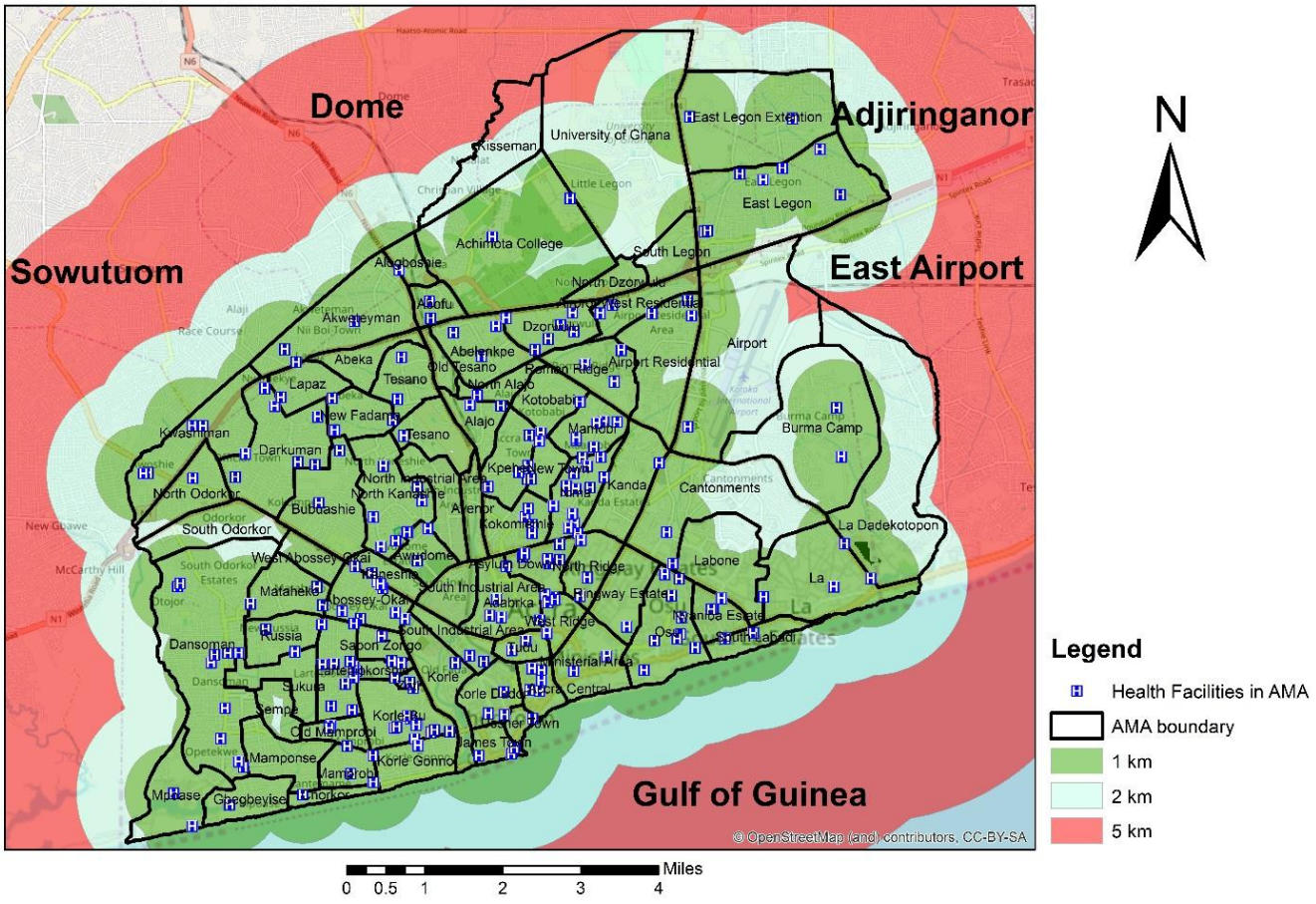


Figure 5.14 Accessibility to health facilities in AMA

Source: Researchers construction from Arcmap

5.10 Chapter Summary

The AMA has a complex chain of factors that lead to the spread of cholera and other communicable diseases. However the level of risks and the mode of cholera spread vary in terms of the income status of the various communities. The researcher identified that the main mode of spread of the cholera disease in the low income areas is through close contact or contagious spread. This is because the slum settings of these communities predispose the members to contact with various cholera risk factors. Overcrowding in these communities also ensure a high vulnerability of members in terms closer interactions between them. The middle income areas on the other hand face the problem of relocation distribution of the disease. These communities even though not completely organized in terms of housing and sanitation have much lower vulnerability to cholera. However surrounding poorer communities pose a high risk to these middle income areas hence introducing cholera.

The high income areas face very little or no spread of cholera. With well demarcated and planned communities, the threat of cholera has been eradicated. However the rate of urbanization of AMA may mean that more people will move to these high income areas and therefore bring along problems of population increase such as poor sanitation and high demand for water and physical infrastructure which could make these communities high cholera risk areas.

CHAPTER 6

MAJOR FACTORS AFFECTING THE SPREAD AND DISTRIBUTION OF CHOLERA

6.1 Introduction

This chapter elaborates on the factors other than environmental cholera risk factors that predispose people within AMA to various risk levels of cholera. The methodologies used in this chapter vary from crosstabs to bar graphs and charts.

6.2 Educational Level of communities

The *Table 6.1* shows the relationship between the sample communities of the various income areas and their educational levels. The implication here is that, the higher the number of educated people, the better their understanding of the causes and effects of the cholera disease and hence helping to build more resilient communities (Dziedzom, 2015). Educational data was however categorized into No Formal Education, Basic Education, Secondary Education, Post-Secondary Education and University Education. According to the data, Maamobi-Nima however recorded 40% of the total sample having only basic education. Basic education was classified as people who had attended "Kindergarten" to "Junior Secondary School". This relatively high percentage of residents having only basic education partly explains the reasons for higher number of cholera cases in the area. This is because of their inability to absorb and make better sanitary choices (Dziedzom, 2015). The second low income community which is Chorkor also has 38% of its respondents having only basic education and only 4 % of the respondents having university education which is same for Mamobi-Nima.

The high income areas of Cantonments and East Legon had 95% and 90% of their respondents having University education respectively. This could be reflected in the minimal cases of cholera recorded in

these communities. In relation to the middle income communities, North Kaneshie recorded a 63% of respondents having university education while 13% had secondary education. Dansoman also recorded 33% of respondents having university education and 37% attending a technical institution. This is relatively higher in terms of educational levels compared with the low income communities. However, a lot of cholera cases recorded in the middle income areas are attributed to movement from surrounding communities of lower economic and environmental conditions.

Table 6.1 Level of education for the selected study communities

Study Area	Not answered	Basic education (Primary school)	No formal education	Post-Secondary (Technical/training institutions)	Secondary school	University	Total
Chorkor	1	19	8	13	7	2	50
	2.0%	38.0%	16.0%	26.0%	14.0%	4.0%	100.0%
Maamobi-Nima	0	20	8	13	7	2	50
	0.0%	40.0%	16.0%	26.0%	14.0%	4.0%	100.0%
Dansoman	2	2	2	11	3	10	30
	6.7%	6.7%	6.7%	36.7%	10.0%	33.3%	100.0%
North Kaneshie	0	2	2	3	4	19	30
	0.0%	6.7%	6.7%	10.0%	13.3%	63.3%	100.0%
East Legon	0	0	0	2	0	18	20
	0.0%	0.0%	0.0%	10.0%	0.0%	90.0%	100.0%
Cantonments	0	0	0	1	0	19	20
	0.0%	0.0%	0.0%	5.0%	0.0%	95.0%	100.0%
Total	**3**	**43**	**20**	**43**	**21**	**70**	**200**
	1.5%	**21.5%**	**10.0%**	**21.5%**	**10.5%**	**35.0%**	**100.0%**

Source: Survey Data; Author's computation from Excel.

The level of education within the selected study communities have been displayed graphically in *Figure 6.1*.

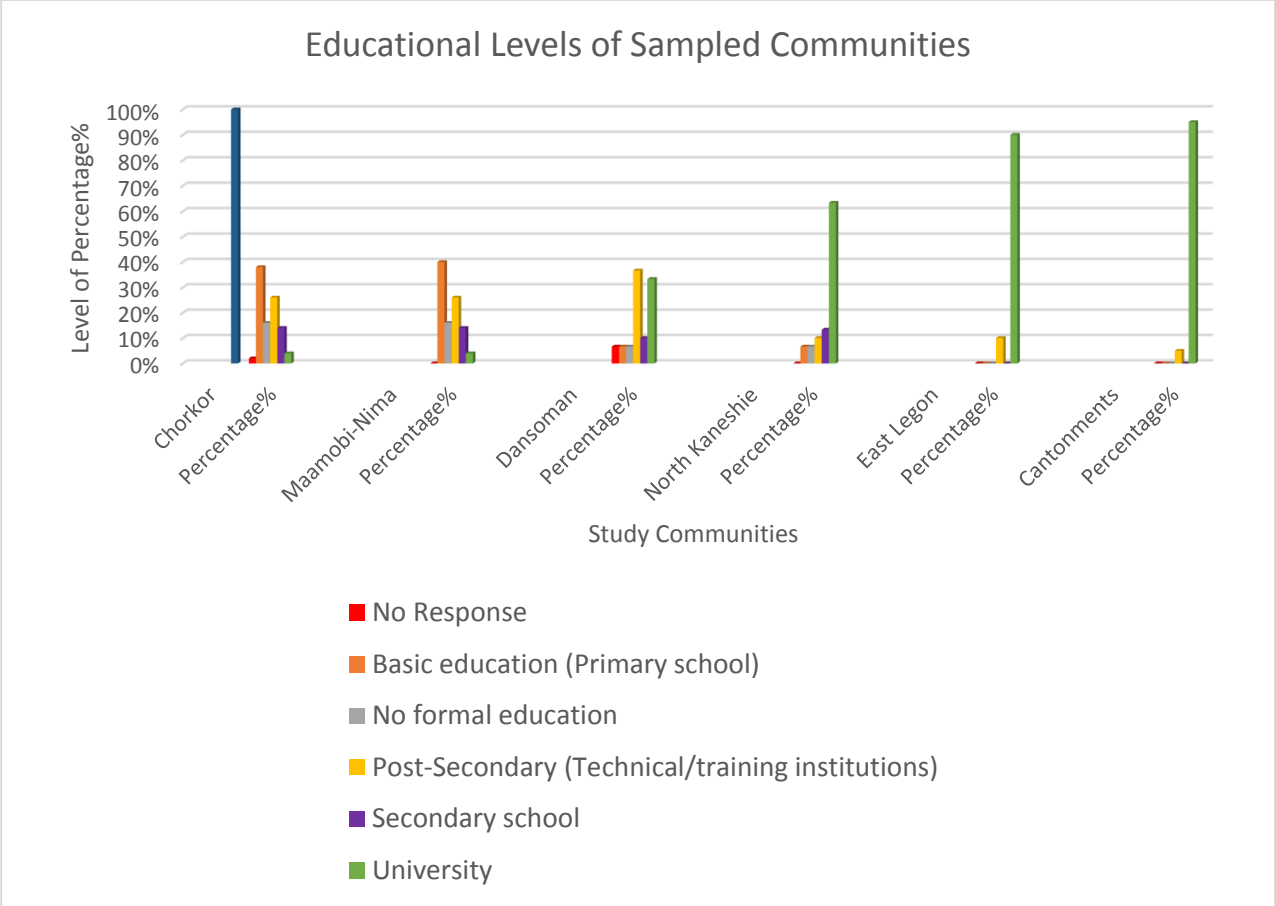


Figure 6.1 Educational levels in the various study communities

Source: Survey Data; Author's computation from Excel.

6.3 Level of Education and Knowledge of Cholera

Table 6.2 shows the educational background of respondents in the various study communities in relation to their knowledge of cholera. In terms of respondents who have only basic education, 97.7% of the sample have heard of cholera through one medium or the other whilst 2.3% have not heard of the disease before. In relation to university education, 98.6% of respondents have come across some form of cholera education. In almost all educational levels, cholera knowledge is high amongst respondents. However respondents with No Formal Education, Basic Education and in some cases "Secondary Education" were seen not to actually understand cholera preventive measures and hence

were more vulnerable to the disease outbreak. Interviews with some respondents revealed that even though they had heard of cholera and its effects, they were not as sure as to how to stop the disease in their various communities. This concern was more in the middle income areas where cholera education was very minimal as compared to the low income communities. This situation has increased the vulnerability of such communities to the disease.

Table 6.2 Educational level and Knowledge of Cholera

Educational Background	**Have you heard of cholera before?**		**Total**
	a. Yes	b. No	
No Response	3	0	3
Basic education (Primary school)	42(97.7%)	1(2.3%)	43
No formal education	18(90.0%)	2(10.0%)	20
Post-Secondary (Technical/training institutions)	43(100.0%)	0(0.0%)	43
Secondary school	21(100.0%)	0(0.0%)	21
University	69(98.6%)	1(1.4%)	70
Total	**196(98.0%)**	**4(2.0%)**	**200**

Source: Survey Data; Author's computation from Excel.

Table 6.3 Chi square table of educational level and knowledge of cholera

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.038[a]	5	.154
Likelihood Ratio	6.231	5	.284
N of Valid Cases	200		

Source: Survey Data; Author's computation from Spss

A chi square test between the level of education within the studied communities and their knowledge of cholera was run. The result as indicated by the Asymp. Sig. (2-sided) of .154 which is greater than the chi square p value of 0.05 showed that there is no significant relationship between educational level and the knowledge of cholera within the Accra Metropolis. However, it is shown that cholera education has been spread to all educational levels leaving very little difference in the variation of the knowledge of the disease at different levels. Both the educated and uneducated have some level of knowledge about the disease.

However an interview with a survivor of the disease with a basic school certificate as the highest level of his education showed that the disease was contracted a few hours after visiting the public toilet. As stated;

> *I visited the public toilet in the afternoon before going for lunch. My stomach started paining me after hours and I started vomiting and defecating. I got the disease from the public toilet because I did not have soap and water to wash my hands after going there.*

This opinion goes to strengthen the point that almost all the residents have a good level of knowledge in relation to the fundamental causes and symptoms of the cholera disease.

6.4 Cholera by Age and Sex Distribution in AMA

Figure 6.2 gives a representation of the number of cases recorded by both sexes at different age cohorts based on the data collected in the AMA. The male sex recorded more cases than the female sex and this has been attributed to the fact that men especially between the ages of 20-49 years eat more from external food vendors than domestic sources.

Table 6.4 Cholera distribution by age and sex (2008, 2009, 2011 and 2014 Combined)

Age	Male	Female
0 to 4	49	40
5 to 9	56	35
10 to 14	61	62
15 to 19	107	90
20 to 29	317	225
30 to 34	79	98
35 to 39	74	56
40 to 44	51	37
45 to 49	29	37
50 to 54	26	37
55 to 59	13	13
60 to 64	13	7
65 to 69	13	7
70 to 74	10	13
75 to 79	9	8
80 to 84	4	5
85+	0	1

Source: Survey Data; Author's computation from Excel.

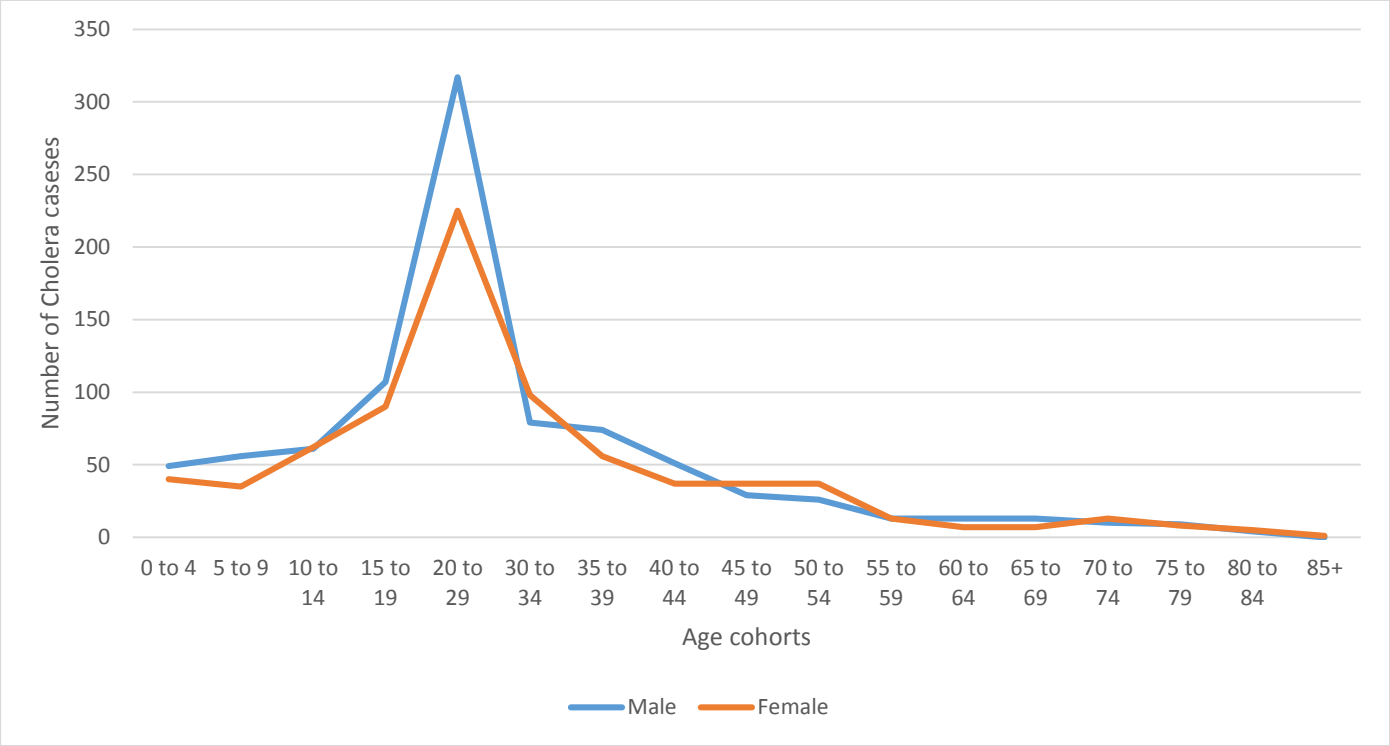


Figure 6.2 Cholera Distribution by Age and Sex (2008, 2009, 2011 and 2014 combined)

Source: Survey Data; Author's computation from Excel.

This practice makes them more vulnerable to getting affected by food borne diseases like typhoid fever, dysentery, hepatitis and cholera (WHO, 2014). The disease reduces drastically in number after age 60 and above. The dependency groups had fewer cases with the aged group having much fewer cases than the infant group. According to interviews held within the communities, the aged are less vulnerable to cholera because of the attention given them in terms of nutrition and health care. Frequent visits to hospitals ensures that such diseases are minimized. Another school of thought attributed the low number of cholera cases among the aged to the disease knowledge base acquired by people of such ages. It is greatly assumed that by ages 60 and above one has sufficient knowledge about a variety of health issues including cholera.

6.5 Income Distribution within Accra Metropolitan Area

Figure 6.3 represents the income levels of the various study communities within the Accra Metropolitan Area. The communities were selected based on income levels with areas selected from high, middle and low income categories. Chorkor and Maamobi-Nima represent the low income areas. The middle income areas are represented by Dansoman and North Kaneshie whilst the high income areas are represented by Cantonments and East Legon. The low income areas can be seen to have high percentages of people with no reliable income sources.

Table 6.5 Estimated income levels of study communities

Study Area	No reliable source of income	Below 100 cedis	Between 100 and 500 cedis	Between 500 and 1,000 cedis	Between 1,000 and 2,000 cedis	Above 2,000 cedis	Total
Chorkor	9	10	15	8	8	0	50
(%)	18.0%	20.0%	30.0%	16.0%	16.0%	0.0%	
Maamobi-Nima	9	10	15	8	8	0	50
(%)	18.0%	20.0%	30.0%	16.0%	16.0%	0.0%	
Dansoman	10	0	3	9	8	0	30
(%)	33.3%	0.0%	10.0%	30.0%	26.7%	0.0%	
North Kaneshie	12	3	4	9	2	0	30
(%)	40.0%	10.0%	13.3%	30.0%	6.7%	0.0%	
East Legon	1	0	0	1	12	6	20
(%)	5.0%	0.0%	0.0%	5.0%	60.0%	30.0%	
Cantonments	0	0	0	0	9	11	20
(%)	0.0%	0.0%	0.0%	0.0%	45.0%	55.0%	
Total	**41**	**23**	**37**	**35**	**47**	**17**	**200**
Total (%)	**20.5%**	**11.5%**	**18.5%**	**17.5%**	**23.5%**	**8.5%**	

Source: Survey Data; Author's computation from Excel.

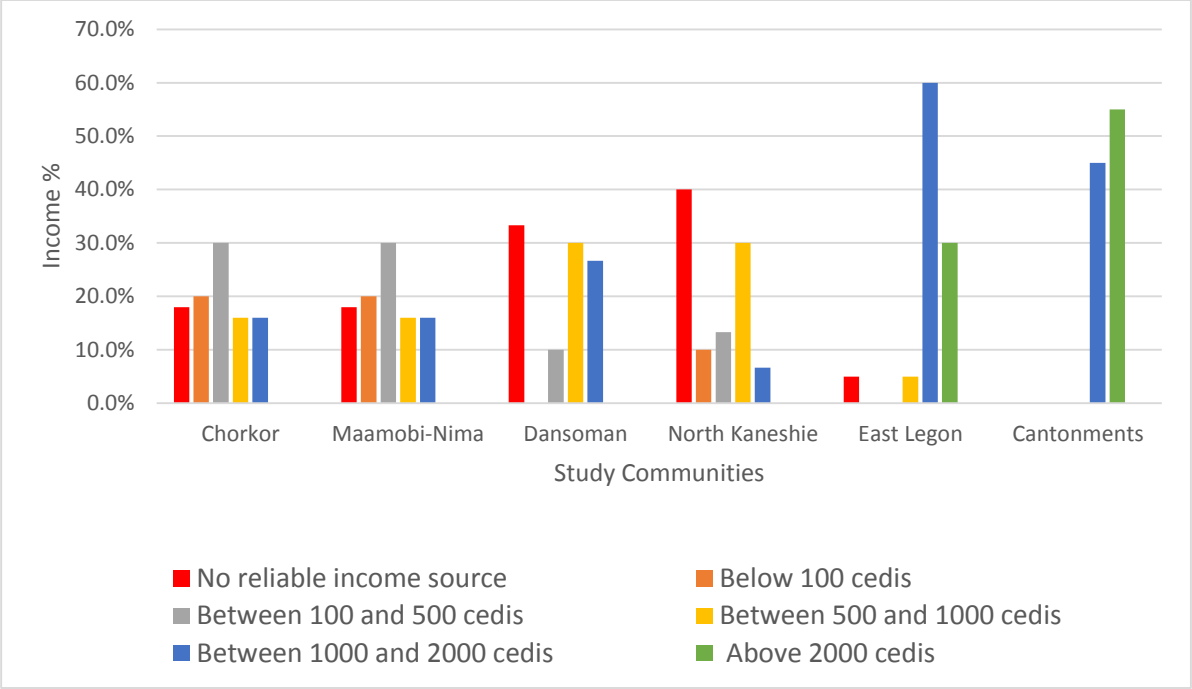


Figure 6.3 Estimated income levels of study communities

Source: Survey Data; Author's computation from Excel.

Both Chorkor and Maamobi-Nima recorded 18% each of people with no reliable source of income. The middle income areas also recorded a high number of people having no reliable source of income. Cantonments and East Legon recorded 0 and 5% respectively in terms of the number of people with no reliable income source. The low income areas also recorded a higher number of people with low income represented from 100 Ghana Cedis to 500 Ghana Cedis. High income areas had majority of their respondents having 1,000 Cedis and above as a regular source of income. A substantial number of respondents also earned above 2,000 Ghana Cedis in the high income areas.

The middle income areas had more respondents between 500 to 1000 Ghana Cedis. Income levels of various communities have an important role to play in the spread of cholera. Interviews granted by health professionals and representatives of city planning and maintenance institutions show that low income areas in the Accra Metropolis are impacted more in terms of cholera outbreaks because they do

not have enough resources to solicit for important amenities like good water and effective waste disposal services. A similar research conducted by Fenin and Edoh, (2009) in the Akim Oda area of Ghana revealed similar results. High income areas on the other hand are less vulnerable to an outbreak of cholera since they have much more resources to afford good water supply, effective waste collection systems and better access to quality healthcare. Kaneshie being a middle income area has a stratified community setting with a mix of both high and low income settlers. This has resulted in a situation where the high income earners are less vulnerable to the outbreak of the disease as compared to the other income groups within the same community.

6.6 Behavioural factors

6.6.1 Handwashing Practices in AMA

Hand washing is an important part of cholera prevention. According to Zohura et al (2016) washing hands with soap and running water after using the toilet and before eating or handling food is a highly effective means of reducing the risk of cholera.

Table 6.6 compares the level of basic knowledge in AMA with their hand washing behaviors. According to the data collected, 49.7% of the respondents who have basic knowledge of cholera always wash their hands after visiting the toilet. A total of 68 respondents representing 35.6% of those who have basic cholera knowledge wash their hands most of the time after visiting the toilet. Out of the respondents 8% said they never wash their hands after using the toilets and this was attributed to their experience in relation to cholera. Based on their perception, their biological systems were immune to cholera and hence they believed strongly that they could not contract the disease.

On the other hand 12% of respondents who had no basic knowledge of cholera answered to always washing their hands after using the toilet while 87.5% wash their hands most of the time after using the toilet.

Table 6.6. Basic cholera knowledge and hand washing practices

		Do you normally wash your hands with soap and running water after visiting the toilet?				
		Always	Most of the time	Never	Sometimes	**Total**
Do you have basic knowledge of Cholera?		1	0	0	0	1
		100.0%	0.0%	0.0%	0.0%	100.0%
	Yes	95	68	8	20	191
		49.7%	35.6%	4.2%	10.5%	100.0%
	No	1	7	0	0	8
		12.5%	87.5%	0.0%	0.0%	100.0%
Total		**97**	**75**	**8**	**20**	**200**
		48.5%	**37.5%**	**4.0%**	**10.0%**	**100.0%**

Source: Survey Data; Author's computation from Excel.

Table 6.7. Basic cholera knowledge and hand washing practices

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.956[a]	6	.127
Likelihood Ratio	10.903	6	.091
N of Valid Cases	200		

Source: Survey Data; Author's computation from Spss.

A chi square test between knowledge of cholera and frequency of hand washing shows that there is no significant relationship between them since the Asymp. Sig. (2-sided) value of .127 is greater than the chi square p value of 0.05. Based on this result, people with basic knowledge of cholera do not necessarily engage in hand washing activities after using the toilet. It is however important to intensify the already existing hand washing campaigns in order to promote the practice and reduce the risk of contracting cholera.

6.6.2 Eating patterns in AMA

The eating patterns of the sample population interviewed are displayed in *Figure 6.4*. Majority of the respondents represented by 52.5 % answered to always eating from food vendors whilst 34.5% eat from food vendors most of the time. A small proportion of the sample population represented by 6% answered to never eating outside the home whilst 7% of the population sometimes eat from food vendors.

Table 6.8. Eating habits in the Accra Metropolitan Area

How often do you eat outside the home?	**Frequency**	**Percent (%)**
Always	105	52.5
Most of the time	69	34.5
Never	12	6.0
Sometimes	14	7.0
Total	**200**	**100.0**

Source: Survey Data; Author's computation from Excel.

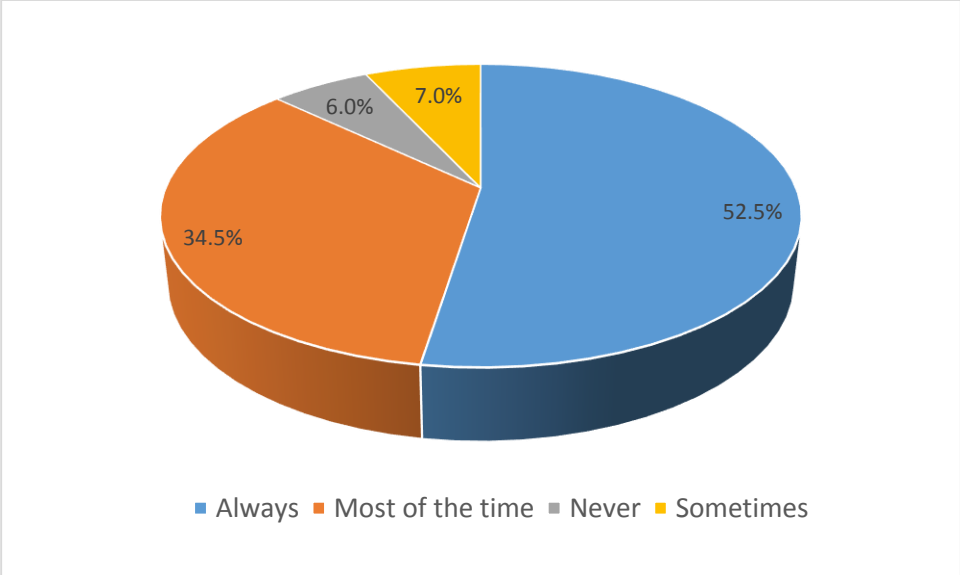


Figure 6.4 Eating behaviors in AMA
Source: Survey Data; Author's computation from Excel.

The high frequency of respondents eating from external sources means that a lot more people are at risk of contracting the disease if the external food sources are contaminated. According to Nsagha et al. (2015) eating outside the home is an independent risk factor that can have varying effects on the level of cholera depending on the quality of food, surrounding sanitation conditions and behavioural practices such as hand washing. As a result of this there must be proper hand washing education as well as education on how food should be kept and served when buying from external food vendors.

Table 6.9. Basic cholera knowledge and eating behaviors

		How often do you eat outside?				
		Always	**Most of the time**	**Never**	**Sometimes**	**Total**
Do you have basic knowledge of Cholera?	No Response	0	1	0	0	1
		0.0%	100.0%	0.0%	0.0%	100.0%
	Yes	105	61	12	13	191
		55.0%	31.9%	6.3%	6.8%	100.0%
	No	0	7	0	1	8
		0.0%	87.5%	0.0%	12.5%	100.0%
Total		**105**	**69**	**12**	**14**	**200**
		52.5%	**34.5%**	**6.0%**	**7.0%**	**100.0%**

Source: Survey Data; Author's computation from Excel.

Table 6.10. Basic cholera knowledge and eating patterns in AMA

	Value	**df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	14.060[a]	6	.029
Likelihood Ratio	16.945	6	.009
N of Valid Cases	200		

Source: Survey Data; Author's computation from Spss.

Based on the chi square test performed in table 6.10. There is however no relationship between basic cholera knowledge and eating patterns. This has been attributed to the fact that people in the working class are time pressed with occupational stresses and do not have enough time to cook at home before or after work. As a result of this, they have no choice but to eat from external sources which can expose them to the disease if not careful.

6.7 Chapter Summary

In terms of the educational level of the study communities, the low income areas had populations who had mostly basic education. This however affected their understanding and attitude towards cholera related issues leaving them vulnerable. The middle income areas were also affected by this with a high percentage of the sample having basic education. Amongst the middle and high income groups, post-secondary education in the form of technical schools and tertiary education were more prominent. This contributed greatly to the reduced incidence of cholera within those areas as compared to the highly populated low income areas. However 98% of respondents interviewed across the study communities had knowledge about cholera and hence the intra-urban differences of the disease were attributed to the frequency and mediums of cholera sensitization within the various communities.

In terms of gender, data collected within the AMA showed that more men are predisposed to the cholera disease as a result of their eating patterns. Men tend to eat outside the home much more often compared to women and this increases their risk level to cholera. Better and more stable income levels in the high income areas also ensure that people can afford better health care as well as water, toilet and other essential sanitation services as compared to the low and middle areas of AMA.

The risk of contracting the disease in AMA is also high as a result of handwashing and eating behavioural practices. With 4% of the respondents answering to never washing their hands after using the toilet, the surrounding population is at risk of contracting the disease from handshakes and personal contact whilst eating outside the home predisposes majority of the working class to cholera.

CHAPTER 7

SEASONAL VARIATION OF CHOLERA INCIDENCE

7.1 Introduction

According to Drassar, Tomkins and Feachem (1981), the main climatic factors that influence and drive the spread of diseases are rainfall and temperature. This chapter examines the influences of these main climatic factors on the spread and short-term pattern of cholera epidemiology in AMA. Secondary data in the form of annual rainfall and temperature records are also analysed in addition to other seasonal studies of the Accra Metropolitan Area.

The unavailability of disease data to carry out a longitudinal study in terms of climate and cholera patterns has limited the researcher to using only a few available years of both rainfall and cholera data to explain different occurrence of the disease and likely factors that triggered the cholera outbreak.

7.2 Climate and Cholera in AMA

Climate plays a crucial role in determining the distribution of various diseases worldwide. The survival of various disease causing agents such as bacteria, fungi and viruses depends on climatic variables such as rainfall, humidity and temperature since they can create good survival biomes.

According to literature, there is no direct link between climatic factors such as rainfall and temperature in relation to the outbreak of cholera (Songsore et al, 2009). However, there are indirect influences of weather and climate on the outbreak of the disease in the Accra Metropolitan Area. According to Songsore et al (2009), the rainy season within the Greater Accra Metropolitan Area (GAMA) is seen to be often associated with the spread of cholera and other sanitation and diarrheal diseases.

The indirect influences of climate involve the support of insects and vectors that spread the disease. With houseflies being the most popular means of the spread of the disease, the weather conditions of a place can provide support to either increase or decrease insect populations and hence either increase or decrease the spread of cholera. Cockroaches, houseflies and mice play an important role in the spread of the disease. According to Benneh, Songsore, Nabilla et al., (1993) houseflies have the ability to transfer diseases between communities far apart.

The endemic nature of the disease in AMA has been attributed to the nature of sanitation as well as behavioural attitudes of the various communities which is aggravated by climatic factors.

The low income areas of Maamobi-Nima and Chorkor have poor sanitation conditions which leave their communities filled with solid and liquid waste materials. The survival of insects and cholera transfer vectors depends greatly on the state of waste within the various communities. In communities with poor sanitation, high temperature and high rainfall can create good conditions for the survival of the bacterial diarrhoea as well as cholera vectors.

In the high income areas of AMA, rubbish is alienated from the residents by way of door to door rubbish pick-up tracks and other door to door rubbish collection systems hence creating very unfavorable conditions for cholera transfer vectors and bacteria. These well planned communities are also built to avoid floods which could increase the risk of contracting cholera. In terms of floods, places within the Korle- lagoon catchment area such as Accra Central, Maamobi, Nima and Alajo get affected (Songsore, Alhassan, Avle et al., 2014).

7.3 Rainfall and Cholera

The relationship between cholera and rainfall will give an insight to the seasonal dynamics of the disease within the Accra Metropolitan Area.

Table 7.1 Average rainfall totals and cholera cases.

Year	**Rainfall Total**	**Cholera Cases**
2008	1264.7	189
2009	656.2	150
2012	594.7	773
2013	527	22
2014	987.9	2,0199
2015	984.3	372

Source: Survey Data; Author's computation from Excel.

Table 7.2 Correlation between rainfall and cholera.

Correlations

		Rainfall Total	Cholera Cases
Rainfall Total	Pearson Correlation	1	.255
	Sig. (2-tailed)		.625
	N	8	6
Cholera Cases	Pearson Correlation	.255	1
	Sig. (2-tailed)	.625	
	N	6	6

Source: Survey Data; Author's computation from SPSS

The table shows the relationship between rainfall records and cholera cases within the Accra Metropolitan Area from 2009 to 2015 and excluding 2010 to 2015 for lack of adequate data. According to *Table 7.2* the Pearson correlation value is 0.255. This value shows a weak correlation between the outbreak of cholera cases and rainfall distribution in the Accra Metropolitan Area. The significance value of .625 is also greater than the significance level of 0.05 which indicates a negligible or no relationship between the two variables. This leaves the outbreak of cholera to be explained by indirect factors such as sanitation, cholera transfer vectors like houseflies and community attitudes to cholera spread. This test however proves that there is no significant relationship between rainfall and cholera cases in the Accra Metropolitan Area.

7.4 Rainfall and Cholera patterns in Accra Metro

The rainfall patterns in Ghana exposes the southern portion of the country to two seasons of rainfall the first which begins in April and ends in July. The second rainy season is the minor rainy season. This minor season starts in September and ends in November. The hottest months in Ghana are February and March whilst the coldest months are either January or August. The relation of cholera to rainfall has been highly emphasized in a variety of cholera literature (Bouma and Pascual, 2001: Ruiz-Moreno et al, 2007).

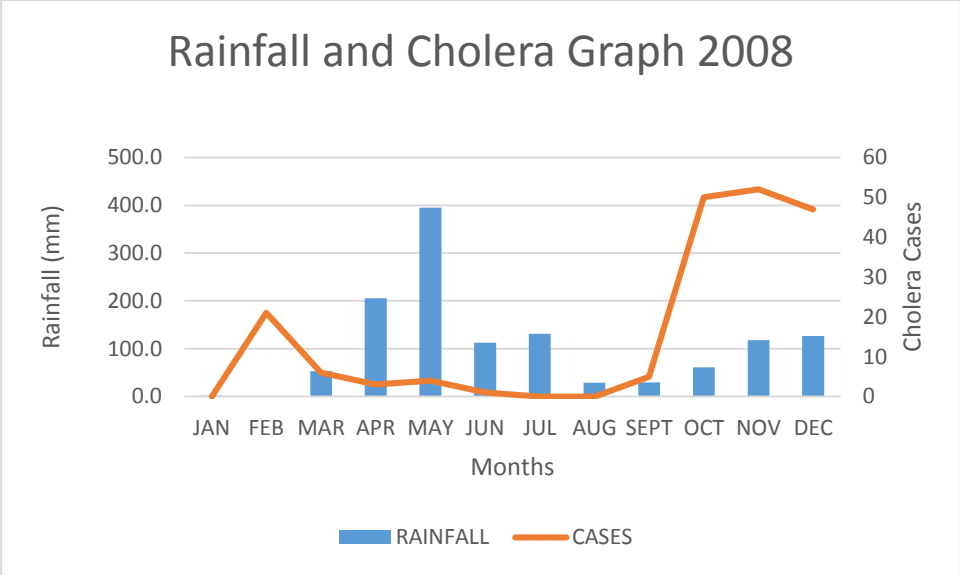


Figure 7.1 Rainfall and Cholera (2008)

Source: Survey Data; Author's computation from Excel

Figure 7.1 shows the relationship between rainfall and cholera outbreak in the year 2008. As displayed in the rainfall and cholera graph for 2008, there are two cholera peaks represented in the graph. The first is a small rise in cholera cases from January to February and a reduction from February to March. This small peak occurs in the driest months of the year. However, the month of May recorded the highest rainfall but very few cases of cholera. The second peak occurred from September to December. This period saw a rapid increase in the number of cholera cases which peaked in November and remained high in December. This second peak also occurred in the minor rainy season. The increase in the number of cholera cases can therefore be attributed to other factors such as environmental and sanitation conditions of the various affected areas in the Accra Metropolis as well as cholera sensitization within communities of AMA.

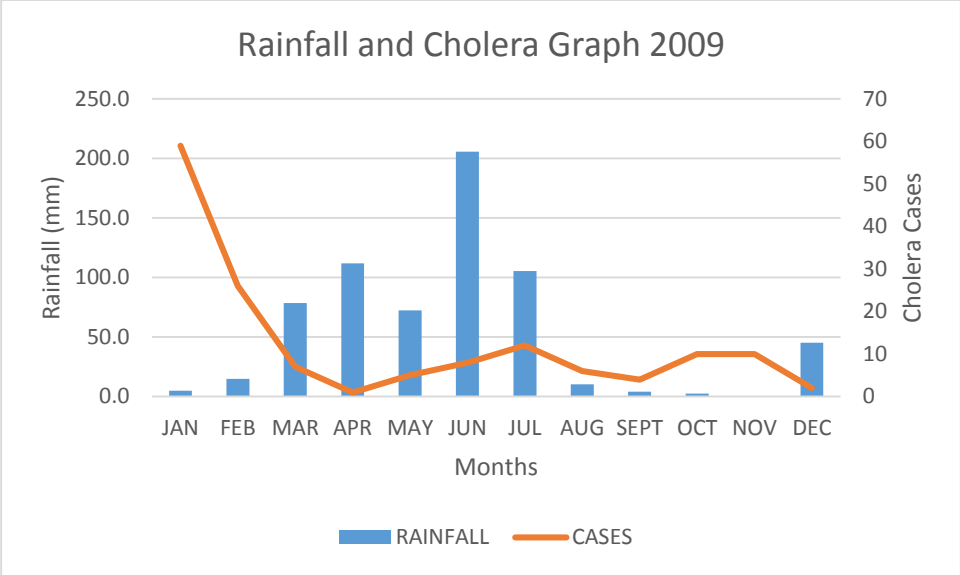


Figure 7.2 Rainfall and Cholera (2009)

Source: Survey Data; Author's computation from Excel

Figure 7.2 represents the rainfall and cholera distribution in the year 2009. The number of cholera cases is high in January and reduces to its lowest point in April. The disease starts increasing at a lower rate throughout the main raining season from April to July. The number of cases also increases in the minor rainy season as well. This distribution shows a slight relationship between rainfall and cholera since the disease increases in the rainy season but at a slow rate. However, as rainfall increases in March and April the number of cholera cases reduce sturdily. According to health professionals, this can be attributed to cholera sensitization during the cholera outbreak at the beginning of the year. A lot more people are trying to avoid the disease and hence observe better sanitation, hand washing and eating practices.

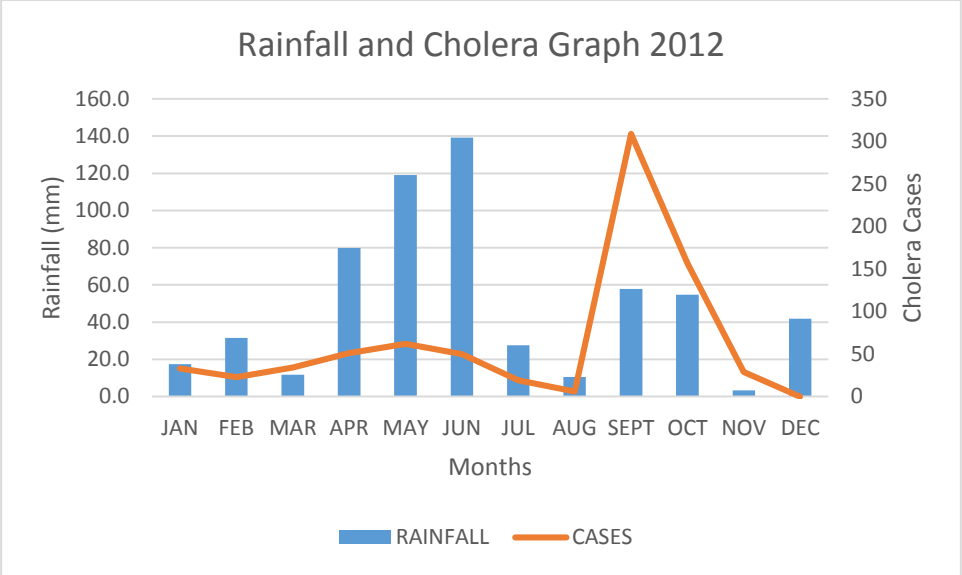


Figure 7.3 Rainfall and Cholera (2012)

Source: Survey Data; Author's computation from Excel

The 2012 rainfall and cholera distribution can be seen to have recorded a high number of cases from September to November which is the minor rainy season. The major rainy season on the other hand recorded an increasing number of cholera cases but at a very slow rate. The influence of rainfall can be observed in this distribution as well. However the relationship is not clear since the period of high rainfall had fewer cholera cases as compared to the period with lower rainfall. This can be explained by the situation where people were not sensitized enough about the cholera disease. According to local knowledge, most people were not cautioned by the rising number of cases that were recorded between the months of March to July and hence the minor rainy season months of September and October triggered a high outbreak of the disease. According to Davies-Teye et al. (2012), the 2012 cholera outbreak was as a result of poor sanitation and infrastructural issues within the affected areas.

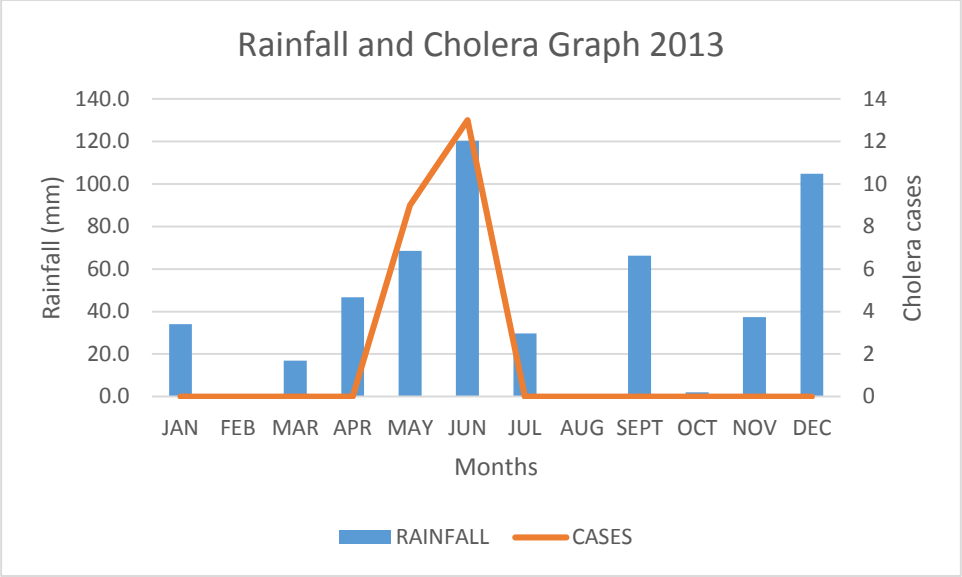


Figure 7.4 Rainfall and Cholera (2013)

Source: Survey Data; Author's computation from Excel

In *Figure 7.4*, the cholera outbreak directly coincides with the major raining season. The period of April to July recorded the peak of cholera outbreak whilst the other months recorded very few or no cases at all. According to health professionals and local knowledge, the reason for the disappearance of the disease after the major raining season is because of the increased sensitization about the disease after the first outbreak in the major raining season. People were more cautious of their surroundings and sanitation issues and this resulted in the prevention of the disease in the subsequent months. This situation as compared to that of 2012 made adequate preparations to prevent the disease in the subsequent months.

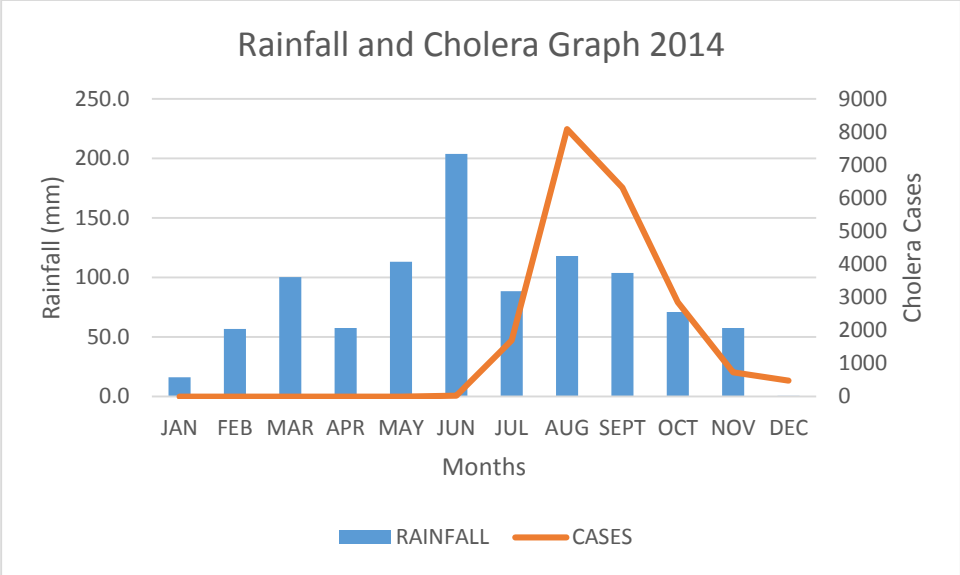


Figure 7.5 Rainfall and Cholera Graph (2014)

Source: Survey Data; Author's computation from Excel

In 2014, the cases of cholera started increasing in July and got to the peak in August. The frequency of cases reduced all the way till December. The high number of cholera cases in 2014 occurred at the end of the major raining season and continued to show varying number of cases each month till the end of the year. According to city authorities, the high rainfall experienced between the months of April and July provided a base for the spread of vibro cholera bacteria in the subsequent months. Rainfall figures in July exceeded 200 mm and this indicates a high amount of rainfall. Floods occurring as a result of the rain within the capital city carried the water thriving bacteria into various homes as well as new areas and this increased the risk of more people contracting the cholera disease.

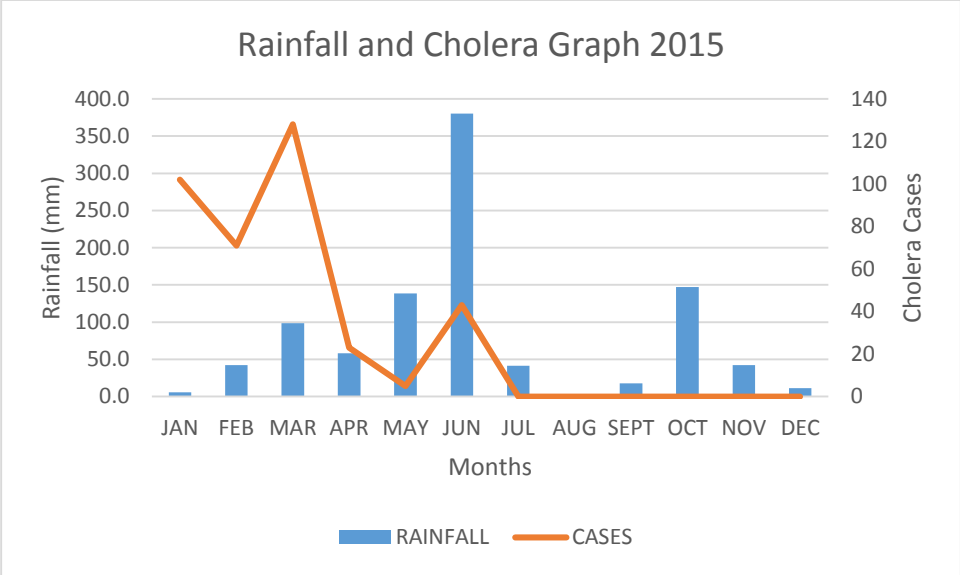


Figure 7.6 Rainfall and Cholera Graph (2015)

Source: Survey Data; Author's computation from Excel

Figure 7.6 however shows a high distribution of cholera cases at the beginning of the year. The frequency reduces towards the month of May but increases in June which had the highest amount of rainfall. The subsequent month had little or no cases of cholera recorded. The ever-present nature of the disease in the Accra Metropolis shows is endemic characteristics within the area.

From the graphs displayed above it can be realized that there are two main patterns of cholera outbreaks in the Accra area. The first pattern shows a single outbreak of the disease annually. The second pattern on the other hand shows a double outbreak of the disease during the year.

As explained earlier, the single outbreak pattern is attributed to public sensitization which results in the improvements in proper sanitation practices and hence the avoidance of a second outbreak of the disease. However the influence of rainfall on cholera is minimal since high cholera cases are recorded in some dry months. The dynamics of cholera in the Accra Metropolitan Area can therefore be explained by the presence of other environmental factors and the role they play in the sanitation of various communities in Accra.

7.5 Temperature Trends and Cholera in Accra Metro

Table 7.3 displays the maximum and minimum monthly temperatures as well as the associated cholera cases. The annual temperature variation for the year 2008 was 9.9 degrees Celsius. The highest number of cholera cases were recorded in November where temperature ranges are averagely high. The month of February with the highest recorded temperature in the year had 21 cases of cholera cases.

Table 7.3 Maximum and Minimum temperature values and cholera cases for 2008

YEAR	Max	Min	Cases 2008
JAN AV	33.0	23.1	0
FEB AV	33.0	25.9	21
MAR AV	32.9	25.6	6
APR AV	32.1	24.6	3
MAY AV	31.6	23.9	4
JUN AV	29.8	23.6	1
JUL AV	29.3	23.6	0
AUG AV	28.9	23.3	0
SEPT AV	29.8	23.5	5
OCT AV	31.6	24.0	50
NOV AV	32.1	24.6	52
DEC AV	32.3	25.1	47

Source: Survey Data; Author's computation from Excel

High temperatures as well as high rainfall have the tendency to increase the spread of cholera among various populations (Poppick, 2014). The document further asserts that high temperatures result in the reduction of water and estuarine bodies which serve as a reservoir for the Vibro Cholerae bacteria. This situation results in dangerously higher concentrations of the bacteria in these already reduced water bodies making such areas highly dangerous. Excessive rainfall on the other hand can lead to the spread of the disease to new areas hence enhancing contact with new populations.

Table 7.4 Maximum and Minimum temperature and cholera cases for 2009

YEAR	Max	Min	Cases 2009
JAN AV	32.6	24.6	59
FEB AV	32.6	25.7	26
MAR AV	32.8	25.7	7
APR AV	32.3	25.0	1
MAY AV	32.1	24.9	5
JUN AV	30.0	24.0	8
JUL AV	28.2	23.5	12
AUG AV	28.2	23.2	6
SEPT AV	30.1	23.7	4
OCT AV	31.0	24.3	10
NOV AV	32.4	25.1	10
DEC AV	32.7	25.6	2

Source: Survey Data; Author's computation from Excel

Table 7.4 displays the temperature diagram in relation to cholera in the year 2009. The year 2009 recorded its highest number of cholera cases in the first two months of the year. The maximum temperatures in the first two months are amongst the highest temperatures recorded in the year. The second peak of cholera observed was recorded in the month of July which also recorded one of the lowest temperatures in that year.

Table 7.5 Maximum and Minimum temperature and cholera cases for 2012

YEAR	Max	Min	Cases 2012
JAN AV	32.5		33
FEB AV	32.1	24.5	23
MAR AV	33.1	25.8	34
APR AV	32.5	25.3	51
MAY AV	31.6	24.2	62
JUN AV	29.5	22.0	50
JUL AV	28.5	22.0	19
AUG AV	28.0	21.2	6
SEPT AV	29.7	23.3	309
OCT AV	31.0	24.0	157
NOV AV	32.5	25.0	29
DEC AV	32.6	24.9	0

Source: Survey Data; Author's computation from Excel

In *Table 7.5*, the peak of cholera cases are found in the month of September. The month of September did not record the highest maximum temperatures or the lowest minimum temperatures for the year hence leaving the explanation of the high outbreak of the cholera disease to other environmental and social factors such as sanitation conditions of various communities and cholera education of the various populations.

Table 7.6 Maximum and Minimum temperature and cholera cases for 2013

YEAR	Max	Min	Cases 2013
JAN AV			0
FEB AV	32.9	26.2	0
MAR AV	33.6	26.3	0
APR AV	33.2	25.6	0
MAY AV	31.9	24.5	9
JUN AV	29.9	24.2	13
JUL AV	28.4	23.5	0
AUG AV	28.5	22.9	0
SEPT AV	28.9	23.5	0
OCT AV	31.3	24.3	0
NOV AV	31.9	24.9	0
DEC AV	32.2	23.9	0

Source: Survey Data; Author's computation from Excel

In the year 2013, March recorded the highest maximum temperature and July and September recorded the lowest minimum temperatures. The month of June had the highest number of cholera cases. This distribution as well cannot be easily explained by the temperature pattern in the year.

Table 7.7 Maximum and Minimum temperature and cholera cases for 2014

YEAR	Max	Min	Cases 2014
JAN AV	32.4	25.3	2
FEB AV	32.6	25.0	0
MAR AV	32.8	25.2	0
APR AV	32.7	25.3	0
MAY AV	32.1	24.9	0
JUN AV	30.1	24.0	26
JUL AV	28.1	23.2	1705
AUG AV	27.7	23.0	8087
SEPT AV	29.2	23.5	6313
OCT AV	30.7	24.0	2850
NOV AV	32.1	24.6	734
DEC AV	33.0	25.2	482

Source: Survey Data; Author's computation from Excel

As displayed in *Table 7.7* the highest cholera cases are recorded in the months of July, August, September and October. The lowest minimum temperatures of the year were also recorded in July, August and September. The pattern of cholera outbreak however coincides with the months where the lowest minimum temperatures were recorded hence suggesting some association between them.

Table 7.8 Maximum and Minimum temperature and cholera cases for 2015

YEAR	Max	Min	Cases 2015
JAN AV			102
FEB AV	32.8	25.4	71
MAR AV	33.1	25.3	128
APR AV	33.0	25.7	23
MAY AV	32.5	25.4	5
JUN AV	29.2	24.0	43
JUL AV	29.0	23.9	0
AUG AV	29.1	23.8	0
SEPT AV	29.8	24.1	0
OCT AV	31.3	24.5	0
NOV AV	32.0	25.0	0
DEC AV	33.4	24.7	0

Source: Survey Data; Author's computation from Excel

Table 7.8 shows the temperature and cholera patterns of 2015 in the Accra Metropolis. The highest number of cholera cases occurs in March. This same month has the highest maximum temperature hence indicating some influence of temperature on the outbreak of the cholera disease that year. The annual temperature range of 2015 is 9.6 degrees Celsius which is averagely lower than that of the years 2012, 2013 and 2014.

The relationship between temperature and cholera is however not clearly defined but with the above diagrams, there is an indication of an irregular and inconsistent association between both variables. However**,** Asante and Amuakwa-Mensah (2014) projected an increase in temperature and a decrease in rainfall over the country in the year 2020, 2050 and 2080. This prediction is to bring along with it an increase in the rate cholera and other water borne diseases. With the current sanitation and behavioural conditions in AMA, these predictions are likely to occur with the aid of rainfall and temperature variables.

7.6 Chapter Summary

According to studies, there is a pattern of cholera outbreak after or during the wet seasons in Accra. This pattern is however not as a result of a direct influence of rainfall. Other factors such as sanitation and attitudes of people in the various communities contribute greatly to the spread of the vibro cholera with rainfall and sunshine acting as catalysts. Temperature variables however do not show any strong influence on the spread of the disease in AMA.

CHAPTER 8
IMPACTS OF CHOLERA

8.1 Introduction

The impacts of cholera can be very devastating and widespread. This chapter discusses the social, economic and the health impacts of the disease on various households. It also throws more light on the institutional responses that are currently ongoing to reduce the impacts of cholera in the various endemic communities and the country at large.

8.2 Social Impacts of Cholera in the Accra Metropolis

The location of the Accra Metropolitan Area within the capital region of the country makes it the most urbanized city in the country and this brings about its own implications. Like most African or developing countries, rapid urbanization is associated with problems of sanitation in the form of poor waste management solutions which make them vulnerable to the cholera disease (Bagah et al, 2015). However, studies by Opare et al (2012) indicates that cholera has affected the socio economic aspects of various communities.

Qualitative and quantitative data in the form of interviews and collected during the study identified that the impacts of cholera vary across the Accra Metropolitan Area based on the income levels of the various communities. Some of the social impacts of the disease identified include the crippling of the family system and the negative stigma associated with the disease in various communities.

The impact of cholera on a family depends greatly on the role of the infected member within the family. The impact is strong when the affected member plays a strong role in the social and economic existence of the family. Normally when parents or guardians are infected, the social role performed by these

members are relegated to other extended family elders or younger family members. Roles such as socialization of children, provision of food and vital educational, religious and health support are under performed by new guardians. Individuals contracting the cholera disease within families can also result in the breaking of close relationships or family ties between members. Some nuclear family members avoid contact or dealing with cholera infected family members who were previously close to them because of the fear of contracting the disease.

All these factors have played a role in disrupting the family system which is a subsystem of the society. There are however a lot of exceptions to this impact on the family system. Most members from the survey in the low income communities had been affected by cholera and hence had an understanding of the disease. This knowledge enabled them to support each other and build stronger relationships whilst supporting cholera infected family members.

The study also showed from the interviews conducted within the high income communities that any indication of the cholera disease displayed by members of the family attracted a negative attitude in the form of confinement and seclusion from other family members.

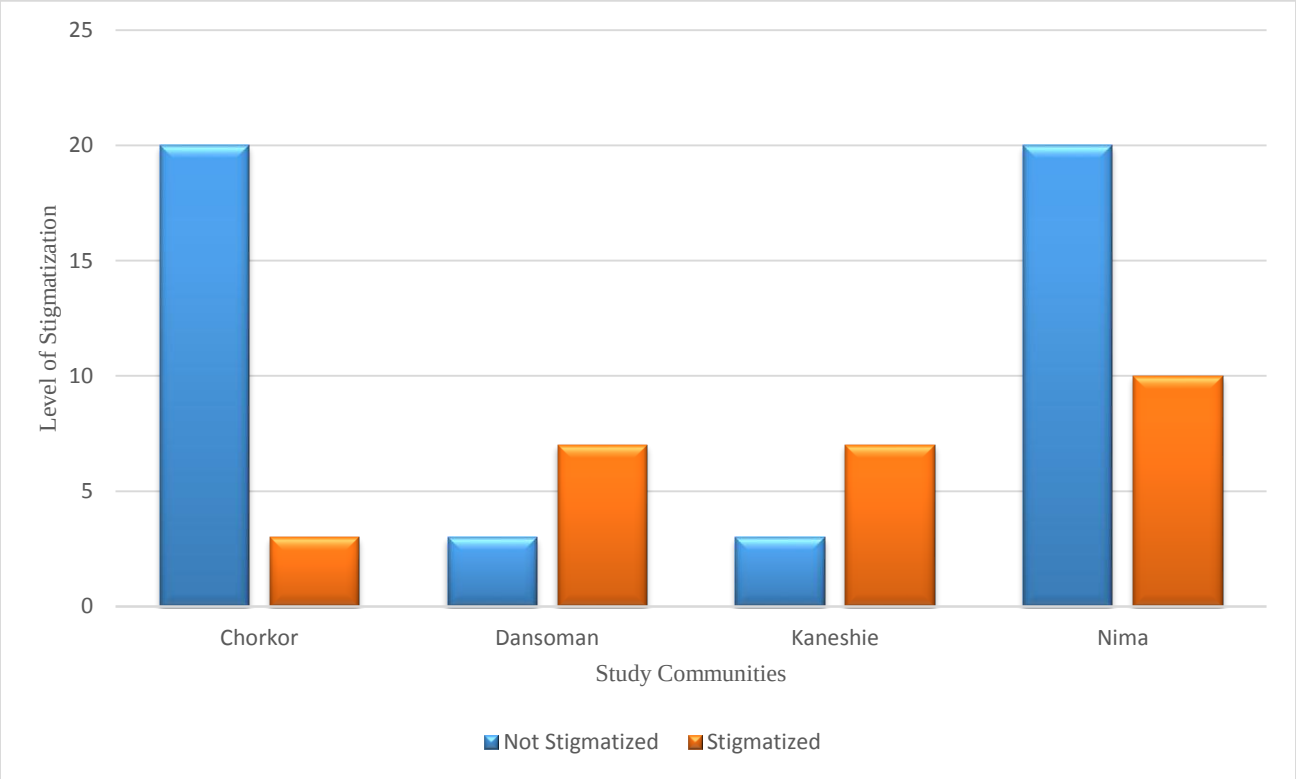


Figure 8.1 Levels of cholera stigmatization in selected communities of AMA
Source: Survey Data; Author's computation from Excel

The impacts of cholera stigmatization was also high in the middle income areas whilst the low income areas had fewer instances of stigmatization as seen in *Figure 8.1*. People or families who were affected by cholera were avoided by people within their society because of fear of contracting the disease. Though minimal cholera cases were recorded in the high income communities, health professionals believe that the incidence of cholera within these areas are more but people are not comfortable to report their cholera cases to the hospitals as a result of the stigma it carries and this affects the overall data collected within the area and country as a whole. Interviews organized in the low income areas however indicated cholera stigmatization is not an issue within such communities because almost all the households have experienced or had cases of cholera.

8.3 Economic Impacts of Cholera in the Accra Metropolis

The economic impacts of cholera within the Accra Metropolis is quite pronounced especially in the high incidence areas (Dziedzom, 2015). These impacts have been separated into direct and indirect effects based on information gathered from the research. The expenditure or cost to the family as a result of hospital bills, bills of drugs and other related treatment was much more of a burden in the low income areas as compared to the middle income and high income areas.

According to interviews conducted in households of cholera victims, the impact of the disease was more adverse when family members who played important economic roles such as paying rent and providing food for the family were affected with the disease. This meant that most of these families had to cut down on some essential amenities and services as electricity and water consumption and education in severe cases. The impact of the disease is more pronounced in low income communities where family income levels are low. An interview with Fathima, a mother of 2 in the Maamobi-Nima area showed that hospital bills affect the ability of people to visit the hospital especially in the low income areas. As stated by Fathima;

> *"I was asked to pay GH¢ 100 after my child was treated at the Polyclinic. After that time I decided to treat myself and my children at home anytime we fall sick. The money was too much for me to pay so I had to borrow from some friends around"*

This also translates to employers who loose valuable labour and hence record low productivity as a result of absenteeism.

A study conducted by Dziedzom (2015), to evaluate the economic loss of the 2014 cholera outbreak in various parts of Accra highlighted similar issues faced in the Accra Metropolis. The research showed that cholera affected households in both Shai Osudoku and La Dade Kotopong districts of Greater

Accra had a direct economic loss of about GH¢ 123,435.6 in terms of expenditure spent on medical bills . According to the document about 49.49% of this cost was used in treating the disease. This information is relevant because the treatment of cholera is supposed to be free during cholera outbreaks. In terms of indirect economic impact, the study found out that days missed by both cholera patients and caretakers at work affected the income of various households. Some affected households actually said their infected relatives lost their jobs as a result of being absent for weeks. All this affect productivity in the long run. The research also recorded cases where fully recovered cholera victims were stigmatized in the work places by their colleagues. This situation could also affect productivity at work and lead to negative impacts on work outputs.

8.4 Health Impacts of Cholera in the Accra Metropolis

The impacts of cholera on health can be seen from the effects the disease has on the overall wellbeing of the infected individual as well as the effects on the health systems and services of the area. The major symptoms of the disease include dehydration through severe diarrhoea and vomiting in a few cases. Although some cholera patients show minimal or no symptoms, they can still contribute to the spread of the disease. Other symptoms indicting dehydration include rapid heart rate, loss of skin elasticity, dry mucous membranes, including the inside of the mouth, throat, nose, and eyelids, low blood pressure, thirst and muscle cramps. Dehydration if not treated can lead to shock and death in a matter of hours.

Some affected households within the study communities complained of the situation where caretakers of cholera victims also fell sick as a result of the stress encountered. Also, the household of the affected persons were vulnerable to contracting the disease as encountered in some scenarios. The health

impacts of the disease can however spread to close friends and family who may contract the disease if not careful.

According to health professionals, there is the need to set up additional emergency services to accommodate the cholera victims during epidemics. The 2014 outbreak of the disease saw a lot of health facilities in the Accra metropolis seriously lacking the capacity to cope with the incoming cases. Logistics such as beds, medicines and medical attendants were fully stretched to capacity and this led to increased loss of lives and pressure on medical services. The Korle Bu polyclinic during the 2014 outbreak was serving surrounding communities such as Agbogbloshie, James Town, Chorkor and other surrounding areas (Osam, 2014). The hospital had to deal with the situation with very few personnel and no cholera unit. This created a lot of logistical problems as mentioned.

8.5 Institutional Responses to Cholera

The endemic nature of cholera in the Accra Metropolitan Area has raised important questions in relation to the measures taken by various institutions and organizations in controlling the disease. There have been several interventions put in place to reduce the cholera disease in the Accra Metropolitan Area as well as throughout the nation.

As part of efforts to end the endemic nature of cholera in Ghana, the National Cholera Prevention Campaign was rolled out in April, 2016 by WHO, USAID/Global Communities, UNICEF and the Ministry of Health. This campaign was targeted to reach all citizens and communities in the country. The main of the intervention was to reach out and sensitive people on good hygiene practices including washing hands with soap under running water, hygienic storage and preparation of food as well as safe breast feeding (WHO, 2016).

Another intervention to improve sanitation and reduce the impact of cholera in the country was the National Sanitation Day (NSD) exercise that was declared on November 1st 2014. This initiative was to address the cholera epidemic that affected the country earlier that year when 28975 cases and 273 deaths were recorded which represented the highest cholera epidemic in 30 years. The first Saturday of every month was set aside to clean up the filth in the cities and townships of the country. The exercise went a long way to rid the city of filth and reduced the annual cholera burden nationwide. It was also observed that the country was yet to record cholera cases nearly two years after the initiation of the NSD. However the exercise was short-lived as the enthusiasm and participation of citizens greatly reduced. This was attributed to the poor attitudes of Ghanaians towards clean environments (Daisie, 2015).

The fight against cholera has also been greatly aided by foreign and local partnerships in the form of NGO's, foreign government organizations and other donor partners. A collaboration between Global Communities and United States Agency for International Development (USAID) saw efforts towards reducing the cholera epidemic in the country by improving access to improved water sources and good sanitation conditions within various communities and cities nationwide.

Using a community-driven approach involving local residents and other stakeholders, a program was implemented by Global Communities, an environmental NGO to encourage sustainable improvement in the access to water and improved sanitation while improving the hygienic behaviours of residents of the various communities. Water Access Sanitation and Hygiene for the Urban Poor (WASH-UP), funded by USAID, helped to improve availability and access to water and sanitation services in three slum communities within Accra and two slum communities in the urban area of Sekondi-Takoradi (Global Communities, 2017). All these initiatives have helped to control the disease since the 2014 cholera outbreak.

CHAPTER 9

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

9.1 Introduction:

This chapter summarizes the major findings of the research as well as presents sustainable community based recommendations for the reduction of the cholera disease within urban communities in the Accra Metropolitan Area.

9.2 Main findings of the study

The study was divided into various themes which produced different findings. The spatial mapping of the various communities showed that the low and middle income communities have more cholera risk associated factors which makes those communities vulnerable to cholera as compared to the high income communities. The high income communities on the other hand have very few cases of the cholera disease and this is as a result of the limited presence of cholera risk factors.

Spatially, the distribution of cholera is limited to the middle and low income areas whilst the high income areas rarely report cases of cholera. The main mode of spread of the disease is through direct contact with risk factors within the low income areas of AMA. The middle and high income areas face the relocation means of spread as a result of the poor sanitation of communities surrounding them.

The study showed that men are more predisposed to cholera as compared to women. This is attributed to their feeding and occupational lifestyles.

In terms of seasonality, cholera within the AMA is influenced greatly by attitudes and lifestyles of various communities. Rainfall however serves as a catalyst to propel the disease to new areas and hence increase the incidence of the disease through flooding. The dynamics of cholera are however

determined by environmental and sanitation conditions and influenced by weather conditions of various communities in the Accra area.

9.3 Conclusion

The research sought to find out the spatial and seasonal factors that interact in order to maintain an annual outbreak of cholera in AMA. The study therefore made useful contributions to knowledge as listed below;

- Stigmatization of cholera infected residents are relatively high in the middle and high income areas of AMA whilst the low income areas saw little or no stigmatization levels.
- The disease is spread through direct contact in the low income areas whilst it is most likely spread by relocation distribution in the middle and high income areas of AMA.
- Temperature and rainfall patterns have very little influence in relation to the seasonality of cholera in the Accra Metropolitan Area.

Despite these outcomes, the research was limited by finances and lack of adequate data. Other areas of interest for further studies in relation to the research topic include;

- A historical research of cholera in the Accra Metropolitan Area.
- The rate of cholera spread in peri-urban areas of Accra.

9.4 Recommendations

The Accra metropolitan area is an economically vibrant area that deals with a high population of people on a daily basis. Poor housing and sanitation are results of the population burden in the Accra Metropolitan Area. These conditions lead to the spread of the disease greatly within the area.

One important recommendation is the constant education of community dwellers. Creating constant sensitization of the disease within communities will go a long way to remind people of the dangers associated with poor sanitation and hygiene practices. According to Hubley (1986), the shortfalls of health educational messages can be traced to the following;

1. The ability to reach the intended audience
2. Inability of the message to gain the necessary attention
3. The inability of the audience to correctly understand the message
4. The level of acceptance of the message by the audience
5. The ability of the message to result in changed behavior
6. The ability of the message to bring about improved health in the target community

Based on this, a community based approach will be needed since there are different communities with different characteristics in relation to information transfer. In low income communities like Maamobi, interventions from the hospitals have gone a long way to sensitize the people through community forums as well as through the community health nurses.

There is also the need for effective and cheap waste management systems especially in the low income areas of the Accra Metropolitan Area. A community like *Chorkor* has a poor waste management system and this forces residents to throw rubbish onto the beach. The community does not have dustbins so that people can drop rubbish in them. An efficient and cost effective waste management system is

needed in the Accra Metropolitan Area. This will ensure that residents can pay for the rubbish they are disposing.

In relation to the association of the occurrence of cholera during the rainy seasons, regular clean up exercises will help clear drains passing through the various communities of filth which can easily transmit cholera in case of a flood. There is however the need to re-introduce the national sanitation day which was started in November 2014 as result of the high cholera cases recorded that year. This exercise will ensure communities become less filthy. There has also been the concern for rubbish collection after every major cleaning exercise. There is the need for rubbish collection especially from the posts of gutters which are more likely to find their way back in the gutters within a few days if not properly disposed.

The need for toilets in homes as well as affordable and clean public toilets should be emphasized. The proper management of public toilets can go a long way to encourage people to patronize such facilities and stop defecating indiscriminately at unauthorized places which has the risk of spreading cholera through direct contact especially in flood situations.

There is the need for adequate cholera data keeping within all health facilities. This will help in tracing the source of the disease as well as keeping useful records to guide research.

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Appendices

Appendix A: Cholera Data collated for Accra Metropolitan Area

		Years/ Cases			
Community	**Sub Metro**	**2008**	**2009**	**2011**	**2012**
Abeka	Okai Koi North	1	4	3	0
Abofu	Okai Koi North	0	0	1	0
Abossey-Okai	Ablekuma Central	3	4	37	13
Accra Central	Ashiedu Keteke	0	0	0	3
Achimota College	Okai Koi North	0	0	3	0
Adabrka	Osu Klottey	0	1	5	0
Akweteyman	Okai Koi North	1	0	0	0
Alajo	Ayawaso Central	0	1	0	10
Avenor	Okai Koi South	0	0	1	0
Bubuashie	Okai Koi South	0	0	5	56
Burma Camp	La	0	0	0	3
Cantonments	La	0	0	0	3
Chorkor	Ablekuma South	5	10	7	63
Dansoman	Ablekuma South	14	31	61	13
Darkuman	Ablekuma North	0	0	22	0
East Legon	Ayawaso West	0	0	0	2
Gbegbeyise	Ablekuma South	0	1	1	0
James Town	Ashiedu Keteke	1	0	10	0

Kaneshie	Okai Koi South	0	1	8	52
Kokomlemle	Ayawaso Central	1	0	0	0
Korle Gonno	Ablekuma South	0	3	38	0
Kwashiman	Ablekuma North	1	1	6	0
La	La	1	0	2	0
Lapaz	Okai Koi North	0	0	0	5
Lartebiokorshie	Ablekuma Central	1	1	26	0
Mamobi	Ayawaso East	0	0	0	101
Mamponse	Ablekuma South	0	0	1	0
Mamprobi	Ablekuma South	8	15	25	100
Mataheko	Ablekuma Central	0	4	16	23
Mpoase	Ablekuma South	0	0	1	1
New Town	Ayawaso East	0	0	0	1
Nima	Ayawaso East	1	0	1	64
North Kanashie	Okai Koi South	0	0	0	49
North Odorkor	Ablekuma North	0	5	0	0
Nyaniba Estate	La	0	0	0	194
Russia	Ablekuma Central	5	2	0	29
Sabon Zongo	Ablekuma Central	0	7	32	0
Sempe	Ablekuma Central	0	0	0	3
Sukura	Ablekuma Central	1	3	25	36
Tudu	Osu Klottey	0	0	4	0

Appendix B: QUESTIONNAIRE

PART 1: PERSONAL INFORMATION

1. Sex
   a. Male b. Female
2. Age
   a. Below 18 b. 18-24 c. 25-29 d. 30-39 e. 40-49 f. 50-59 g. 60 and above
3. Religious background
   a. Christian b. Muslim c. Traditional Religion d. Others (Specify) ……
4. Educational Background
   a. No formal education b. Basic education(primary school) c. Secondary school d. Post-Secondary (technical/ training institutions) e. University
5. Marital Status
   a. Single b. Married c. Divorced d. Widowed e. Others (specify)…… ……
6. Number of children
   a. Male…… b. Female…….

7. Apart from your children how many dependents do you have?
   Specify……
8. How long have you lived in Accra?
   a. Less than a year b. Between 1-4 years c. Between 5-10 years d. Between 10-20 years e. Above 20 years
9. Ethnicity
   Specify…….
10. Employment status
    a. Unemployed b. Employed c. Retired
11. If employed, what is your profession/ occupation?
    a. Civil Servant b. Public Servant c. Farmer d. Fisherman e. Other (Specify)……..
12. Rank at work
    a. Managerial position b. Middle level management c. Lower staff d. Others (Specify)……..

13. Estimated income per month
    a. Below 100 cedis b. Between 100 and 500 cedis c. Between 500 and 1000 d. Between 1000 and 2000 cedis e. If others (Specify)……..

14. Do you have any other source of income apart from your monthly salary?
    a. Yes b. No

15. If yes, what is the approximated amount and source?
    a. Source……
    b. Amount…….

PART 2: GENERAL INFORMATION

16. Have you heard of cholera before?
    a. Yes b. No
17. If yes, how did you hear of the disease? (through which media)
    a. Television b. Social media c. Print media(Newspapers) e. Community Sensitization Programs f. Others (Specify)……..

18. Do you have basic knowledge of Cholera?
    a. Yes b. No

    If yes explain…….

    ……
19. Have you heard of cholera outbreaks within your community?
    a. Yes b. No
20. If yes when was the first time?……..
21. How long have you had knowledge of the existence of cholera within your community? Specify…….
22. How often does the community experience cholera outbreaks?
    a. Annually
    b. Averagely after 2years
    c. Between 2 and 5 years
    d. Above 5 years
    e. No report of the disease
    f. Others (Specify)……..

PART 3: Drivers of the Cholera Epidemic

23. In your opinion, what are some of the causes of cholera within your community? Please list them…….
24. Which of these factors have been present within your community for long? (over 10 years)
    a. Please Specify how long…….
25. Which ones in your opinion are responsible for the recurring nature of the disease in your community?
    Please specify……..

26. In your opinion are there other factors that presently aid the outbreak of cholera in your community? …….
    a. ……..
27. Do you think rainfall and climate have an influence on the spread of the disease? (Disease dynamics).
    a. Yes b. No
28. If yes, how do you think rainfall and climate affect the spread of cholera?
    a. Rainfall increases the disease burden
    b. Rainfall reduces the disease burden
    c. If others (Specify)…….
29. Based on the current cholera causing factors outlined, do you think cholera will continue to affect your community in the coming years?
    a. Yes b. No
30. If yes, How?(Explain)……
31. What are the major sources of water in the community?
    a. Pipe borne b. Bore hole c. River d. Tankers e. Wells f. Others (Specify)……..
32. How clean are the sources of water within the community?
    a. Poor b. Average c. good d. Excellent
    …….
33. Are they (i.e water sources) close to any source of contamination? (open defecation sites, public toilets, Open drains or dumpsites)
    a. Yes b. No
34. If yes please specify….(eg. Well close to dumpsite)
    ……..
35. Are there any markets in your community?
    a. Yes b. No
36. How clean are your markets?
a. Very neat surroundings
b. Fairly neat surroundings
c. Dirty surroundings
d. Very dirty surroundings
e. Others (Specify)……
37. Are there food joints located close to these cholera causing factors (dumpsites, drains etc)?
    a. Yes b. No
38. How hygienic are the practices of these food vendors?
    a. Highly unhygienic
    b. Fairly unhygienic
    c. Hygienic
    d. Highly hygienic
39. Do you normally wash your hands with soap and running water after visiting the toilet?
a. Always
b. Most of the time

c. Sometimes
d. Never

40. How often do you eat outside your home?
    a. Always
    b. Most of the time
    c. Sometimes
    d. Never

PART 4: Spatial Distribution of Cholera in AMA

41. Which of the cholera causing factors (environmental factors) are located in your community?
    a. Public toilets
    b. Open defecation sites
    c. Open drains
    d. Dumpsites
    e. Others (Specify)……
42. Where in the community are these factors located?
    a. Public toilets……
    b. Open defecation sites…….
    c. Open drains……
    d. Dumpsites……..
    e. Others (specify)……
43. Please indicate how many of the above factors are within your community.
    a. Public Toilets……
    b. Open defecation sites……
    c. Open drains……
    d. Dumpsites……
    e. Others (Specify)…….
44. How are they distributed? (Approximate distance from home.)
    ……

PART 5: Accessibility to Health Facilities in AMA

45. How many health centers do you have in the community?
    ……
46. Name them……
    ……..
    …….
    i. ……

ii. ……..
iii. …….
iv. …….
v. ……
vi. …….

47. Where are they located within the community?

48. Which of the following factors do influence your choice of a health facility?
(Please rank in order of importance)
a) Economic reasons (e.g. cost of treatment and drugs)
b) Distance
c) Quality of services (e.g. availability of specialist, drugs, X-ray etc.)
d) Acquaintance (e.g. family/tribal ties, occupational facility, etc)
e) Type of the sickness
f) Others (Specify).....

49. How far is the facility from your house?
a) less than a kilometre
b) between 1 - 3 km
c) Between 4 - 5 km
d) Between 5 - 8 km
e) Between 8 -10 km
f) Above 10 km

50. Mode of transport to the health centre.
a) Private Car b) Walking c) Taxi/Hiring d) Trotro e) Others (Specify)…….

51. Approximate transport cost to and from your health centre (in cedis) (per trip)
a) below 1 cedi
b) 1cedi-5 cedis
c) 5 cedis-10 cedis
d) 10cedis – 20 cedis
e) 20 cedis – 50 cedis
f) above 50 cedis

52. Do transportation difficulty/problems influence your choice of a facility?
a) Yes b) No

53. If yes, explain……

54. Does the distribution of government hospitals/clinics within the city make it easy for you to get medical services?
a) Yes b) No c) indifferent

55. Why?.....
a) Lack of a health facility within the locality
b) Prevalence of diseases
c) Density of population

d) Transportation problems
e) Others (Specify)
.....

56. Explain
.....
57. Which part of the city would you suggest that a government hospital/health centre be built? (Specify)
a) Sub Metro..... .....
b) Residential Area.....
c) others…….

58. Explain……
59. Do you normally report at a hospital/health centre as soon as you fall sick?
a. Yes b. No

60. If No, why?
a) Lack of health facility within the locality
b) Financial constraints
c) Religious believes
d) Distance
e) Self medication
f) Others (Specify)
....
61. 20. What type of sicknesses (in order of importance) do you normally report at the hospital/health centre?
a) Diarhoea/ Cholera
b) Malaria
c) Fever
d) Accidents
e) Skin diseases
f) Pregnancy related
g) Hypertension
h) diabetes
i) Others (Specify)
.....
62. How will you rate the services of the hospitals within the community? *(Private Hospitals)*
a. Very poor
b. Poor
c. Average
d. Good

e. Very good
f. Excellent
g. Others (specify)…….

63. How will you rate the services of the hospitals within the community in terms of quality? *(Government hospitals)*
    a. Very poor
    b. Poor
    c. Average
    d. Good
    e. Very good
    f. Excellent
    g. Others (specify)…….

64. How will you rate the services of the hospitals in terms of quality? *(Private)*
    a. Very poor
    b. Poor
    c. Average
    d. Good
    e. Very good
    f. Excellent
    g. Others (specify)…….

PART 6: Community Interventions

65. Are the food vendors within the area located in clean environments?
    a. Most of them are
    b. A good number of them are
    c. Only a few
    d. Most of them are not located in clean environments
    e. Others (Specify)…….

66. Do the food vendors practice good hygiene? (washing hands/ cover food appropriately)
    a. Yes b. No

67. Are there house flies in the area of the food vendors?
    a. Yes b. No

68. If yes, what do you think is the source of the house flies?
    a. A surrounding dumpsite
    b. A surrounding gutter
    c. A surrounding public place of convenience(toilet, urinal)
    d. Others (specify)……..

69. Is there any means of cholera education within the community?
    a. Yes b. No

70. If yes, please list some of them (eg. Television, public health educators etc.)

…….

71. What can be done at the community level to reduce and eliminate the effect of Cholera in the community?

…….

72. What intervention can the AMA provide for the elimination of cholera in the community?

……

73. Any other contribution…….

Cholera victim Questionnaire

PART 1: PERSONAL INFORMATION

74. Sex
    b. Male b. Female
75. Age
    b. Below 18 b. 18-24 c. 25-29 d. 30-39 e. 40-49 f. 50-59 g. 60 and above
76. Religious background
    b. Christian b. Muslim c. Traditional Religion d. Others (Specify)
    ……
77. Educational Background
    b. No formal education b. Basic education(primary school) c. Secondary school d. Post-Secondary (technical/ training institutions) e. University
78. Marital Status
    b. Single b. Married c. Divorced d. Widowed e. Others (specify)……
    ……
79. Number of children
    b. Male…… b. Female…….

80. Apart from your children how many dependents do you have?
    Specify……
81. How long have you lived in Accra?
    b. Less than a year b. Between 1-4 years c. Between 5-10 years d. Between 10-20 years e. Above 20 years
82. Ethnicity
    Specify…….
83. Employment status
    b. Unemployed b. Employed c. Retired
84. If employed, what is your profession/ occupation?

b. Civil Servant b. Public Servant c. Farmer d. Fisherman e. Other (Specify)……..

85. Rank at work
    b. Managerial position b. Middle level management c. Lower staff d. Others (Specify)……..

86. Estimated income per month
    b. Below 100 cedis b. Between 100 and 500 cedis c. Between 500 and 1000 d. Between 1000 and 2000 cedis e. If others (Specify)……..

87. Do you have any other source of income apart from your monthly salary?
    b. Yes b. No

88. If yes, what is the approximated amount and source?
    c. Source……
    d. Amount…….

Causes of Cholera

What is/ was the main cause of the disease?

……

How long did you take to identify the disease?

……..

Did you face any form of stigmatization?

a. Yes
b. No

If yes what forms of stigmatization did you face?

……..

Did you go the hospital for treatment?

a. Yes
b. No

If yes, was the treatment affordable?

A. Yes
B. No

Were there any casualties as a result of the disease?

a. Yes
b. No

Coordinates:……..

Appendix C: Age and Gender Pyramid data

2009 CASES		
Age	**Male**	**Female**
0 to 4	0	0
5 to 9	1	4
10 to 14	4	3
15 to 19	5	12
20 to 29	21	24
30 to 34	8	15
35 to 39	6	3
40 to 44	13	3
45 to 49	3	2
50 to 54	2	5
55 to 59	4	0
60 to 64	2	1
65 to 69	1	0
70 to 74	3	1
75 to 79	0	0
80 to 84	0	2

85+	0	1

2011 CASES		
Age	**Male**	**Female**
0 to 4	11	18
5 to 9	19	9
10 to 14	29	25
15 to 19	38	31
20 to 29	121	84
30 to 34	43	20
35 to 39	31	21
40 to 44	9	12
45 to 49	8	15
50 to 54	10	20
55 to 59	1	0
60 to 64	6	1
65 to 69	8	2
70 to 74	3	7
75 to 79	4	3
80 to 84	3	2

85+		

Cases 2014		
Age	**Male**	**Female**
0 to 4	37	21
5 to 9	32	14
10 to 14	21	26
15 to 19	48	38
20 to 29	155	94
30 to 34	21	52
35 to 39	32	24
40 to 44	27	19
45 to 49	14	15
50 to 54	13	8
55 to 59	6	10
60 to 64	4	1
65 to 69	2	3
70 to 74	3	4
75 to 79	1	3
80 to 84	1	1

85+		

Appendix D: Rainfall and Cholera Cases

MONTH	RAINFALL	CASES (2008)
JAN	2.4	0
FEB	0.0	21
MAR	53.1	6
APR	205.6	3
MAY	395.3	4
JUN	112.6	1
JUL	131.2	0
AUG	29.2	0
SEPT	29.4	5
OCT	61.2	50
NOV	118.3	52
DEC	126.4	47

MONTH	RAINFALL	CASES (2009)
JAN	4.9	59
FEB	15.0	26
MAR	78.6	7
APR	111.8	1
MAY	72.5	5
JUN	205.7	8
JUL	105.5	12
AUG	10.3	6
SEPT	4.0	4
OCT	2.6	10
NOV	0.0	10
DEC	45.3	2

MONTH	RAINFALL	CASES (2012)
JAN	17.5	33
FEB	31.5	23
MAR	11.7	34
APR	79.8	51

MAY	119.1	62
JUN	139.2	50
JUL	27.6	19
AUG	10.5	6
SEPT	57.8	309
OCT	54.7	157
NOV	3.4	29
DEC	41.9	0

MONTH	RAINFALL	CASES (2013)
JAN	34.0	0
FEB	0.0	0
MAR	16.9	0
APR	46.7	0
MAY	68.6	9
JUN	120.3	13
JUL	29.7	0
AUG	0.4	0
SEPT	66.3	0
OCT	2.0	0

NOV	37.3	0
DEC	104.8	0

MONTH	RAINFALL	CASES (2014)
JAN	**16.3**	**2**
FEB	**56.9**	**0**
MAR	**100.4**	**0**
APR	**57.5**	**0**
MAY	**113.3**	**0**
JUN	**203.7**	**26**
JUL	**88.5**	**1705**
AUG	**118.1**	**8087**
SEPT	**103.9**	**6313**
OCT	**71.1**	**2850**
NOV	**57.6**	**734**
DEC	**0.6**	**482**

MONTH	RAINFALL	CASES (2015)
JAN	**5.8**	**102**
FEB	**42.4**	**71**
MAR	**98.8**	**128**
APR	**58.0**	**23**
MAY	**138.7**	**5**
JUN	**380.3**	**43**
JUL	**41.5**	**0**
AUG	**0.3**	**0**
SEPT	**17.6**	**0**
OCT	**147.1**	**0**
NOV	**42.4**	**0**
DEC	**11.4**	**0**

Appendix E: Cholera Stigmatization in AMA

Communities	Stigma		Total
	No	**Yes**	
Chorkor	20	3	**23**
	87.0%	13.0%	**100.0%**
Dansoman	3	7	**10**
	30.0%	70.0%	**100.0%**
Kaneshie	3	7	**10**
	30.0%	70.0%	**100.0%**
Nima	20	10	**30**
	66.7%	33.3%	**100.0%**
Total	**46**	**27**	**73**
	63.0%	**37.0%**	**100.0%**

Appendix F: Population density data of AMA

NAME	Sub Metro	Population	Area	AMA Area(Hectares)	Population per 10,000
East Legon	Ayawaso West	8861	6	618	140000
Cantonments	La	0	5	509	0
Kanda	Ayawaso East	8015	2	216	370000
Kpehe	Ayawaso Central	3758	2	155	240000
Tesano	Okai Koi South	5515	1	146	380000
Korle-Bu	Ablekuma South	7623	2	199	380000
Darkuman	Ablekuma North	61562	4	359	1710000
Achimota Colleg	Okai Koi North	57635	8	834	690000
Osu	Osu Klottey	59460	3	272	2190000
Korle Dudor	Ashiedu Keteke	27555	1	131	2100000

Mpoase	**Ablekuma South**	**13450**	**2**	**217**	**620000**
Gbegbeyise	**Ablekuma South**	**18314**	**1**	**132**	**1390000**
Dansoman	**Ablekuma South**	**56609**	**8**	**770**	**740000**
Mamponse	**Ablekuma South**	**31910**	**2**	**165**	**1930000**
Chorkor	**Ablekuma South**	**26855**	**0**	**46**	**5840000**
Mamprobi	**Ablekuma South**	**25852**	**1**	**89**	**2900000**
Old Mamprobi	**Ablekuma South**	**0**	**1**	**66**	**0**
Korle Gonno	**Ablekuma South**	**30555**	**1**	**142**	**2150000**
Zoti	**Ablekuma South**	**13231**	**0**	**16**	**8270000**
Sempe	**Ablekuma Central**	**0**	**1**	**83**	**0**
Sukura	**Ablekuma Central**	**34473**	**1**	**137**	**2520000**
Sabon Zongo	**Ablekuma Central**	**27668**	**1**	**67**	**4130000**
Lartebiokorshie	**Ablekuma Central**	**35183**	**2**	**206**	**1710000**
Russia	**Ablekuma Central**	**46912**	**1**	**131**	**3580000**
Abossey-Okai	**Ablekuma Central**	**26335**	**2**	**157**	**1680000**
Mataheko	**Ablekuma Central**	**14839**	**2**	**158**	**940000**

West Abossey-Okai	**Ablekuma Central**	**43642**	**1**	**76**	**5740000**
South Odorkor	**Ablekuma North**	**0**	**2**	**193**	**0**
North Odorkor	**Ablekuma North**	**18754**	**2**	**163**	**1150000**
Kwashiman	**Ablekuma North**	**30408**	**3**	**304**	**1000000**
Bubuashie	**Okai Koi South**	**43374**	**3**	**279**	**1550000**
Kaneshie	**Okai Koi South**	**31141**	**1**	**74**	**4210000**
South Industrial Area	**Okai Koi South**	**0**	**1**	**109**	**0**
Awudome	**Okai Koi South**	**0**	**1**	**97**	**0**
North Kanashie	**Okai Koi South**	**29497**	**3**	**267**	**1100000**
North Industrial Area	**Okai Koi South**	**0**	**2**	**153**	**0**
Avenor	**Okai Koi South**	**23367**	**1**	**80**	**2920000**
New Fadama	**Okai Koi North**	**0**	**1**	**116**	**0**
Lapaz	**Okai Koi North**	**0**	**1**	**115**	**0**
Tesano	**Okai Koi North**	**0**	**1**	**147**	**0**
Abeka	**Okai Koi North**	**85692**	**1**	**107**	**8010000**
Akweteyman	**Okai Koi North**	**20777**	**4**	**381**	**550000**
Abofu	**Okai Koi North**	**7267**	**1**	**75**	**970000**
Alogboshie	**Okai Koi North**	**1900**	**1**	**64**	**300000**
Kisseman	**Okai Koi North**	**12003**	**3**	**276**	**430000**
Old Tesano	**Ayawaso West**	**0**	**0**	**47**	**0**

Abelenkpe	**Ayawaso West**	**7383**	**2**	**198**	**370000**
Dzorwulu	**Ayawaso West**	**11537**	**2**	**161**	**720000**
North Dzorwulu	**Ayawaso West**	**0**	**1**	**77**	**0**
Roman Ridge	**Ayawaso West**	**2327**	**2**	**182**	**130000**
Airport Residential	**Ayawaso West**	**0**	**3**	**321**	**0**
Airprot West Residential	**Ayawaso West**	**0**	**1**	**129**	**0**
South Legon	**Ayawaso West**	**0**	**1**	**111**	**0**
University of Ghana	**Ayawaso West**	**0**	**11**	**1107**	**0**
East Legon Extention	**Ayawaso West**	**0**	**6**	**583**	**0**
Airport	**La**	**5079**	**8**	**829**	**60000**
Burma Camp	**La**	**0**	**6**	**646**	**0**
La Dadekotopon	**La**	**0**	**8**	**783**	**0**
South Labadi	**La**	**0**	**1**	**88**	**0**
Nyaniba Estate	**La**	**0**	**1**	**91**	**0**
Labone	**La**	**0**	**3**	**273**	**0**
La	**La**	**0**	**4**	**382**	**0**
Alajo	**Ayawaso Central**	**44044**	**1**	**101**	**4360000**
North Alajo	**Ayawaso Central**	**0**	**1**	**69**	**0**
Kotobabi	**Ayawaso Central**	**33628**	**1**	**132**	**2550000**

Kokomlemle	**Ayawaso Central**	**35320**	**1**	**143**	**2470000**
New Town	**Ayawaso East**	**58488**	**1**	**71**	**8240000**
Mamobi	**Ayawaso East**	**61724**	**1**	**136**	**4540000**
Nima	**Ayawaso East**	**80843**	**2**	**155**	**5220000**
Tudu	**Osu Klottey**	**6456**	**1**	**62**	**1040000**
Adabrka	**Osu Klottey**	**36510**	**2**	**191**	**1910000**
West Ridge	**Osu Klottey**	**0**	**1**	**76**	**0**
Asylum Down	**Osu Klottey**	**12802**	**1**	**106**	**1210000**
North Ridge	**Osu Klottey**	**0**	**1**	**121**	**0**
Ministerial Area	**Osu Klottey**	**0**	**2**	**194**	**0**
Ringway Estate	**Osu Klottey**	**2825**	**2**	**160**	**180000**
South Industrial Area	**Ashiedu Keteke**	**0**	**1**	**90**	**0**
Korle	**Ashiedu Keteke**	**0**	**2**	**192**	**0**
James Town	**Ashiedu Keteke**	**16221**	**1**	**63**	**2570000**
Ussher Town	**Ashiedu Keteke**	**28140**	**0**	**33**	**8530000**
Accra Central	**Ashiedu Keteke**	**6610**	**1**	**83**	**800000**

Appendix G: Cholera Density Data in AMA

Community	**Sub Metro**	**2008 Cases**	**2009 Cases**	**2011 Cases**	**2012 Cases**	**Population**	**Total cases**	**Area (Hectares)**	**Cholera Density**	**Density per 10,000**

East Legon	**Ayawaso West**	**0**	**0**	**0**	**2**	**8861**	**2**	**618**	**0.00323**	**32.36246**
Cantonments	**La**	**0**	**0**	**0**	**3**	**0**	**3**	**509**	**0.00589**	**58.939096**
Kanda	**Ayawaso East**	**0**	**0**	**0**	**0**	**8015**	**0**	**216**	**0**	**0**
Kpehe	**Ayawaso Central**	**0**	**0**	**0**	**0**	**3758**	**0**	**155**	**0**	**0**
Tesano	**Okai Koi South**	**0**	**0**	**0**	**0**	**5515**	**0**	**146**	**0**	**0**
Korle-Bu	**Ablekuma South**	**0**	**0**	**5**	**0**	**7623**	**5**	**199**	**0.02512**	**251.256281**
Darkuman	**Ablekuma North**	**0**	**0**	**22**	**0**	**61562**	**22**	**359**	**0.06128**	**612.81337**
Achimota College	**Okai Koi North**	**0**	**0**	**3**	**0**	**57635**	**3**	**834**	**0.00359**	**35.971223**
Osu	**Osu Klottey**	**0**	**0**	**0**	**0**	**59460**	**0**	**272**	**0**	**0**
Korle Dudor	**Ashiedu Keteke**	**0**	**0**	**0**	**0**	**27555**	**0**	**131**	**0**	**0**
Mpoase	**Ablekuma South**	**0**	**0**	**1**	**1**	**13450**	**2**	**217**	**0.00921**	**92.165899**
Gbegbeyise	**Ablekuma South**	**0**	**1**	**1**	**0**	**18314**	**2**	**132**	**0.01515**	**151.515152**

Dansoman	**Ablekuma South**	**14**	**31**	**61**	**13**	**56609**	**119**	**770**	**0.15454**	**1545.454545**
Mamponse	**Ablekuma South**	**0**	**0**	**1**	**0**	**31910**	**1**	**165**	**0.00606**	**60.606061**
Chorkor	**Ablekuma South**	**5**	**10**	**7**	**63**	**26855**	**85**	**46**	**1.84782**	**18478.26087**
Mamprobi	**Ablekuma South**	**8**	**15**	**25**	**100**	**25852**	**148**	**89**	**1.66292**	**16629.21348**
Old Mamprobi	**Ablekuma South**	**0**	**0**	**0**	**0**	**0**	**0**	**66**	**0**	**0**
Korle Gonno	**Ablekuma South**	**0**	**3**	**38**	**0**	**30555**	**41**	**142**	**0.28873**	**2887.323944**
Zoti	**Ablekuma South**	**0**	**0**	**0**	**0**	**13231**	**0**	**16**	**0**	**0**
Sempe	**Ablekuma Central**	**0**	**0**	**0**	**3**	**0**	**3**	**83**	**0.03614**	**361.445783**
Sukura	**Ablekuma Central**	**1**	**3**	**25**	**36**	**34473**	**65**	**137**	**0.47445**	**4744.525547**
Sabon Zongo	**Ablekuma Central**	**0**	**7**	**32**	**0**	**27668**	**39**	**67**	**0.58209**	**5820.895522**
Lartebiokorshie	**Ablekuma Central**	**1**	**1**	**26**	**0**	**35183**	**28**	**206**	**0.13592**	**1359.223301**

Russia	**Ablekuma Central**	**5**	**2**	**0**	**29**	**46912**	**36**	**131**	**0.27480**	**2748.091603**
Abossey-Okai	**Ablekuma Central**	**3**	**4**	**37**	**13**	**26335**	**57**	**157**	**0.36305**	**3630.573248**
Mataheko	**Ablekuma Central**	**0**	**4**	**16**	**23**	**14839**	**43**	**158**	**0.27215**	**2721.518987**
West Abossey-Okai	**Ablekuma Central**	**0**	**0**	**0**	**0**	**43642**	**0**	**76**	**0**	**0**
South Odorkor	**Ablekuma North**	**0**	**0**	**0**	**0**	**0**	**0**	**193**	**0**	**0**
North Odorkor	**Ablekuma North**	**0**	**5**	**0**	**0**	**18754**	**5**	**163**	**0.03067**	**306.748466**
Kwashiman	**Ablekuma North**	**1**	**1**	**6**	**0**	**30408**	**8**	**304**	**0.02631**	**263.157895**
Bubuashie	**Okai Koi South**	**0**	**0**	**5**	**56**	**43374**	**61**	**279**	**0.21863**	**2186.379928**
Kaneshie	**Okai Koi South**	**0**	**1**	**8**	**52**	**31141**	**61**	**74**	**0.82432**	**8243.243243**
South Industrial Area	**Okai Koi South**	**0**	**0**	**0**	**0**	**0**	**0**	**109**	**0**	**0**
Awudome	**Okai Koi South**	**0**	**0**	**0**	**0**	**0**	**0**	**97**	**0**	**0**

North Kanashie	**Okai Koi South**	**0**	**0**	**0**	**49**	**29497**	**49**	**267**	**0.18352**	**1835.20599 3**
North Industrial Area	**Okai Koi South**	**0**	**0**	**0**	**0**	**0**	**0**	**153**	**0**	**0**
Avenor	**Okai Koi South**	**0**	**0**	**1**	**0**	**23367**	**1**	**80**	**0.0125**	**125**
New Fadama	**Okai Koi North**	**0**	**0**	**0**	**0**	**0**	**0**	**116**	**0**	**0**
Lapaz	**Okai Koi North**	**0**	**0**	**0**	**5**	**0**	**5**	**115**	**0.04347**	**434.782609**
Tesano	**Okai Koi North**	**0**	**0**	**0**	**0**	**0**	**0**	**147**	**0**	**0**
Abeka	**Okai Koi North**	**1**	**4**	**3**	**0**	**85692**	**8**	**107**	**0.07476**	**747.663551**
Akweteyman	**Okai Koi North**	**1**	**0**	**0**	**0**	**20777**	**1**	**381**	**0.00262**	**26.246719**
Abofu	**Okai Koi North**	**0**	**0**	**1**	**0**	**7267**	**1**	**75**	**0.01333**	**133.333333**
Alogboshie	**Okai Koi North**	**0**	**0**	**0**	**0**	**1900**	**0**	**64**	**0**	**0**
Kisseman	**Okai Koi North**	**0**	**0**	**0**	**0**	**12003**	**0**	**276**	**0**	**0**

Old Tesano	**Ayawaso West**	**0**	**0**	**0**	**0**	**0**	**0**	**47**	**0**	**0**
Abelenkpe	**Ayawaso West**	**0**	**0**	**0**	**0**	**7383**	**0**	**198**	**0**	**0**
Dzorwulu	**Ayawaso West**	**0**	**0**	**0**	**0**	**11537**	**0**	**161**	**0**	**0**
North Dzorwulu	**Ayawaso West**	**0**	**0**	**0**	**0**	**0**	**0**	**77**	**0**	**0**
Roman Ridge	**Ayawaso West**	**0**	**0**	**0**	**0**	**2327**	**0**	**182**	**0**	**0**
Airport Residential	**Ayawaso West**	**0**	**0**	**0**	**0**	**0**	**0**	**321**	**0**	**0**
Airprot West Residential	**Ayawaso West**	**0**	**0**	**0**	**0**	**0**	**0**	**129**	**0**	**0**
South Legon	**Ayawaso West**	**0**	**0**	**0**	**0**	**0**	**0**	**111**	**0**	**0**
University of Ghana	**Ayawaso West**	**0**	**0**	**0**	**0**	**0**	**0**	**1107**	**0**	**0**
East Legon Extention	**Ayawaso West**	**0**	**0**	**0**	**0**	**0**	**0**	**583**	**0**	**0**
Airport	**La**	**0**	**0**	**0**	**0**	**5079**	**0**	**829**	**0**	**0**
Burma Camp	**La**	**0**	**0**	**0**	**3**	**0**	**3**	**646**	**0.00464**	**46.439628**

La Dadekotopon	**La**	**0**	**0**	**0**	**0**	**0**	**0**	**783**	**0**	**0**
South Labadi	**La**	**0**	**0**	**0**	**0**	**0**	**0**	**88**	**0**	**0**
Nyaniba Estate	**La**	**0**	**0**	**0**	**194**	**0**	**194**	**91**	**2.13186**	**21318.6813 2**
Labone	**La**	**0**	**0**	**0**	**0**	**0**	**0**	**273**	**0**	**0**
La	**La**	**1**	**0**	**2**	**0**	**0**	**3**	**382**	**0.00785**	**78.534031**
Alajo	**Ayawaso Central**	**0**	**1**	**0**	**10**	**44044**	**11**	**101**	**0.10891**	**1089.10891 1**
North Alajo	**Ayawaso Central**	**0**	**0**	**0**	**0**	**0**	**0**	**69**	**0**	**0**
Kotobabi	**Ayawaso Central**	**0**	**0**	**0**	**0**	**33628**	**0**	**132**	**0**	**0**
Kokomlemle	**Ayawaso Central**	**1**	**0**	**0**	**0**	**35320**	**1**	**143**	**0.00699**	**69.93007**
New Town	**Ayawaso East**	**0**	**0**	**0**	**1**	**58488**	**1**	**71**	**0.01408**	**140.84507**
Mamobi	**Ayawaso East**	**0**	**0**	**0**	**101**	**61724**	**101**	**136**	**0.74264**	**7426.47058 8**
Nima	**Ayawaso East**	**1**	**0**	**1**	**64**	**80843**	**66**	**155**	**0.42580**	**4258.06451 6**
Tudu	**Osu Klottey**	**0**	**0**	**4**	**0**	**6456**	**4**	**62**	**0.06451**	**645.16129**

Adabrka	**Osu Klottey**	**0**	**1**	**5**	**0**	**36510**	**6**	**191**	**0.03141**	**314.136126**
West Ridge	**Osu Klottey**	**0**	**0**	**0**	**0**	**0**	**0**	**76**	**0**	**0**
Asylum Down	**Osu Klottey**	**0**	**0**	**0**	**0**	**12802**	**0**	**106**	**0**	**0**
North Ridge	**Osu Klottey**	**0**	**0**	**0**	**0**	**0**	**0**	**121**	**0**	**0**
Ministerial Area	**Osu Klottey**	**0**	**0**	**0**	**0**	**0**	**0**	**194**	**0**	**0**
Ringway Estate	**Osu Klottey**	**0**	**0**	**0**	**0**	**2825**	**0**	**160**	**0**	**0**
South Industrial Area	**Ashiedu Keteke**	**0**	**0**	**0**	**0**	**0**	**0**	**90**	**0**	**0**
Korle	**Ashiedu Keteke**	**0**	**0**	**0**	**0**	**0**	**0**	**192**	**0**	**0**
James Town	**Ashiedu Keteke**	**1**	**0**	**10**	**0**	**16221**	**11**	**63**	**0.17460**	**1746.031746**
Ussher Town	**Ashiedu Keteke**	**0**	**0**	**0**	**0**	**28140**	**0**	**33**	**0**	**0**
Accra Central	**Ashiedu Keteke**	**0**	**0**	**0**	**3**	**6610**	**3**	**83**	**0.03614**	**361.445783**