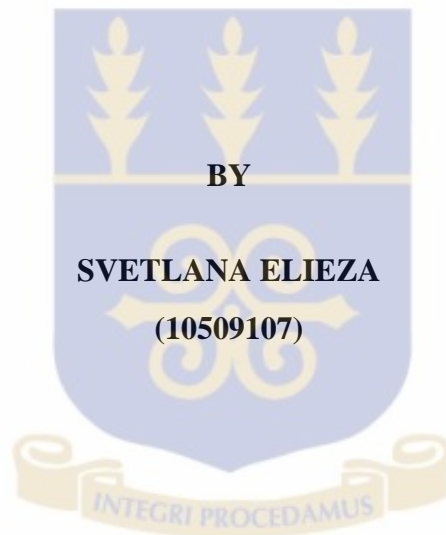


**SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA**

**TRENDS IN DOG BITES AND HUMAN RABIES IN GREATER ACCRA REGION,
GHANA**



**THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF GHANA,
LEGON IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE
AWARD OF MASTER OF PUBLIC HEALTH DEGREE**

MAY, 2016

DECLARATION

I hereby declare that this study report is as a result of my own effort alongside my supervisors support, the work from other authors has been duly acknowledged.

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**Svetlana Elieza
(Student)**

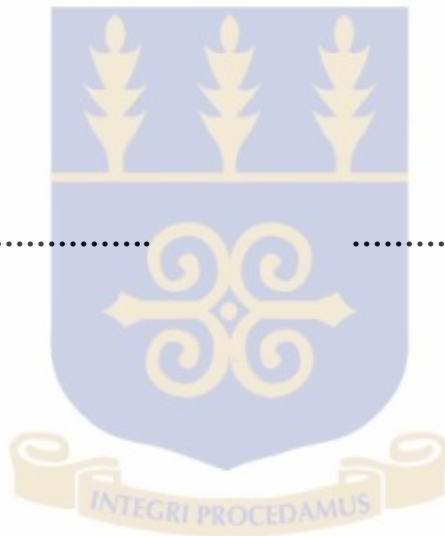
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**Dr. Patricia Akweongo
(Supervisor)**

Date



DEDICATION

This work is dedicated to my beloved ones.



ACKNOWLEDGEMENTS

In the name of Almighty God, the higher, gracious and the most merciful, all praises to him for the strength and His blessing in completing this work. My gratitude goes to my beloved parents and my relatives for their endless love, prayers and encouragement.

Special appreciation goes to my supervisor, Patricia Akweongo, for her supervision and constant support. Her invaluable help of constructive comments and suggestions throughout this work have contributed to the success of this research.

I would like to express my gratitude and sincere thanks to Madam Elizabeth Awini whose contribution in stimulating suggestions and encouragement, helped me to coordinate my work especially in writing this research report.

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ABSTRACT

Background

Rabies remain a public health threat although can be eliminated by vaccinating dogs which are major reservoirs of the disease and through pre and post-exposure prophylaxis in humans. Rabies is a fatal viral encephalitis disease which is untreatable when clinical symptoms develop. It is a neglected and old infectious zoonotic disease with fatality rate of 100%, worldwide distributed but more endemic area being in developing countries of Asia and Africa. In Ghana from 2000 to 2004 there were 123 clinically confirmed human cases reported by public health officers. Most rabies cases are not reported, due to lack of surveillance, laboratory infrastructure and also due to some cultural and social factors. The study aim was to describe the trends of dog bites and human rabies in Greater Accra region of Ghana from 2010 to 2014.

Methods

The record of human rabies cases and dog bites were reviewed from Korle-Bu Teaching Hospital and Ridge regional hospital from 2010 to 2014. The results were expressed in frequencies, percentages, and in graphic forms. The STATA version 12 software was used for data analysis.

Results

Human rabies and dog bites reported from 2010 to 2014 were 22 cases of human rabies from Korle-Bu teaching hospital and 233 dog bites from Ridge Hospital. The trends observed in this study did not show a clear pattern though the highest number of dog bites and human rabies were observed in 2014 while the lowest number of dog bites was observed in 2011 and for human rabies was year 2013. The male child (54.5%) less than fifteen years were more affected with the dog bites than adult, while more adult (50%) were affected by human rabies regardless of their age. Vaccine status was (94%) for those

who reported to have dog bites before developing clinical symptoms and received recommended five post-exposure prophylaxis while 5% did not finish the vaccine and 1% did not take any vaccine.

Conclusion

The burden of dog bites and human rabies is still a public health problem in Greater Accra though the trend of the disease does not show a steady pattern

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LIST OF ABBREVIATIONS

CDC	Center for Disease Control and prevention
DRT	Direct Rapid immune-histochemical Test
Intra-ACP	Africa, Caribbean and the Pacific Academic Mobility scheme
IU/kg	International Unit per Kilogram
MPH	Master of Public Health
OIE	World Organization for Animal Health
POEP	Post exposed prophylaxis
PREP	Pre-exposed prophylaxis
RNA	Ribonucleic Acid
US	United State of America
USD	United State Dollar
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

In this chapter I discuss causes of rabies, effect of the disease on humans worldwide, the factors contributing to human rabies in Africa and Ghana and the economic impact of the disease as well as the justification for this study.

1.1 Background information

Rabies is a viral disease caused by a negative-stranded RNA virus belonging to the Lyssavirus genus of a family- Rhabdoviridae which affects the central nervous system of mammals (Badoe & Wilmshurst, 2014). It is a neglected lethal zoonosis transmitted from animals to humans through bite, scratch, or licking of wounds or on mucosa (Stahl et al., 2014). Inter-human transmission has been reported incidentally, following transplant of infected tissue or organs (Stahl et al., 2014).

It is an important cause of animal and human mortalities worldwide, where about 60,000 human deaths in a year occur globally (Fooks et al., 2014). The disease is more endemic in Africa and Asia and it is approximated that 240,000 death each year occur in Africa (Badoe & Wilmshurst, 2014; Geerdes, 2014; Hayman et al., 2011). About 2 million disabilities adjusted life year(DALYs) are lost in a year where economically it is estimated to be 4billion US Dollar per year (Fooks et al., 2014).

Rabies also has an economic implication where it is estimated to cause expenses of about 695million US Dollars worldwide annually, where these cost can be direct or indirect (Shwiff, Hampson, & Anderson, 2013). Direct cost in monetary form is estimated to cause loss of 1.8 to 2.2 billion US Dollars of human death, excluding indirect cost which are post exposure treatment, livestock losses and cost associated with diagnostic testing (Fooks et al., 2014; Shwiff et al., 2013) . Also about 21000 cattle die in Asia and Africa which are

estimated to be 12 million US dollar per year as a result of decrease in producer income (Shwiff et al., 2013; The et al., 2011). Globally, the total annual cost of canine rabies alone is estimated to reach 10 billion US Dollars (Fooks et al., 2014).

People of all age groups are susceptible to the disease but more fatalities are found in young children less than fifteen years where 30%-54% of reported dog bite cases are of young children, (Bourhy, Dautry-Varsat, Hotez, & Salomon, 2010; Edward, Gbeddy, & Quist, 2014) . Also reports show that people living in rural areas and in low income societies are more exposed and affected by the disease compared to those living in town and cities (Masthi, Narayana, Kulkarni, & Belludi, 2014).

Rabies is a public health problem causing death in mammals and being a zoonotic fatal neglected disease it affects human and other mammals which is preventable (Pfukenyi, Pawandiwa, Makaya, & Ushewokunze-Obatolu, 2007). About 60-70% vaccination of dogs have been reported to reduce burden of disease to humans to about 90% (S Cleaveland, 2003). Most of human rabies cases have been reported in rural areas especially among people with low social economic status. Also young children have been affected more than adults and adult men have been more affected than women (Masthi et al., 2014). The young children are reported to be affected more because of their habit of enjoying to play with dogs without recognizing behavioral change of the animal and therefore, lead to being exposed to the disease by being bitten in heads, neck, arm and other locations close to central nervous system hence fasten disease development if not prevented earlier (Geerdes, 2014).

Human rabies most of the time occur due to bite from a rabid dog, where 99% transmission is bite from a rabid dog (Banyard, Horton, Freuling, Müller, & Fooks, 2013; Fooks et al., 2014) although other carnivores such as Cat and wild animals Fox, Raccoon,

Mongoose and Bats are also reservoir of the disease (Both et al., 2012; Stahl et al., 2014). The biting habit serve as the mechanism of the virus to bypass the dermal barrier and hence being deposited into tissue where they will replicate and travel via peripheral nerve to the spinal cord then to the brain (Fooks et al., 2014).

1.2 Statement of the problem

Rabies is a neglected zoonotic disease and its case fatality rate is about 100% (Jackson, 2013). It is estimated that about 90% of rabies cases are due to dog bites (Fooks et al., 2014). The disease can be spread through bite or scratches of rabid dog (Fooks et al., 2014; Franka et al., 2013; Geerdes, 2014; Jackson, 2013; Masthi et al., 2014). Dogs are domesticated animals serving as companion, protector, investigator and hunters and also as source of food to human being in some parts of the world (Hutabarat, Geong, Newsome, Ruben, & Cutter, 2003). But they serve as source of rabies to human being due to close contact and relationship between dog and human (Hutabarat et al., 2003). In Ghana, between 2000 to 2004 there were 123 clinical confirmed human cases reported by public health officers (Hayman et al., 2011). Also in 2009 to 2012 in Techiman Municipal, 546 people were reported to be bitten by dog, where about 54 people were bitten by the dogs which tested positive for rabies (Edward et al., 2014). Exposure to bites relates to sex and age of the person, the type of animal biting and also by the area of residence. There are other factors like socio-economic status, education. The published data above were not epidemiological but only detected the presence of two Sub-Saharan lineage rabies virus (Africa 1 and 2), this means the disease exist in Ghana (Hayman et al., 2011). It is important to report data about rabies in Ghana so as to provide the burden of the disease in the country. In regional and referral hospitals of Accra, cases of wound in people due to dog bite are still reported and it is known that 90% of human rabies cases result from the

dog bite. Thus, this study is designed to describe trends of human rabies cases reported from 2010 to 2014 in the Great Accra Region.

1.3 Justification

Much effort is made to reduce the burden of disease in endemic areas through mass vaccination of domesticated Dogs and Cats, but still most of people who keep them do not care about the welfare of their animals (such as vaccination, housing feeding and treatment), hence these practices cause exposure of people to rabies (Bourhy et al., 2010; S Cleaveland, 2003; The et al., 2011). Also most of rabies cases are not reported, this is due to lack of surveillance, laboratory infrastructure and also due to some cultural and social confounded factors (Fooks et al., 2014). This study will be conducted in Accra at Korle-Bu Teaching Hospital and the finding may help to advocate increasing measures for fighting against rabies and may provide baseline information about the disease in Ghana for future policy decision making.

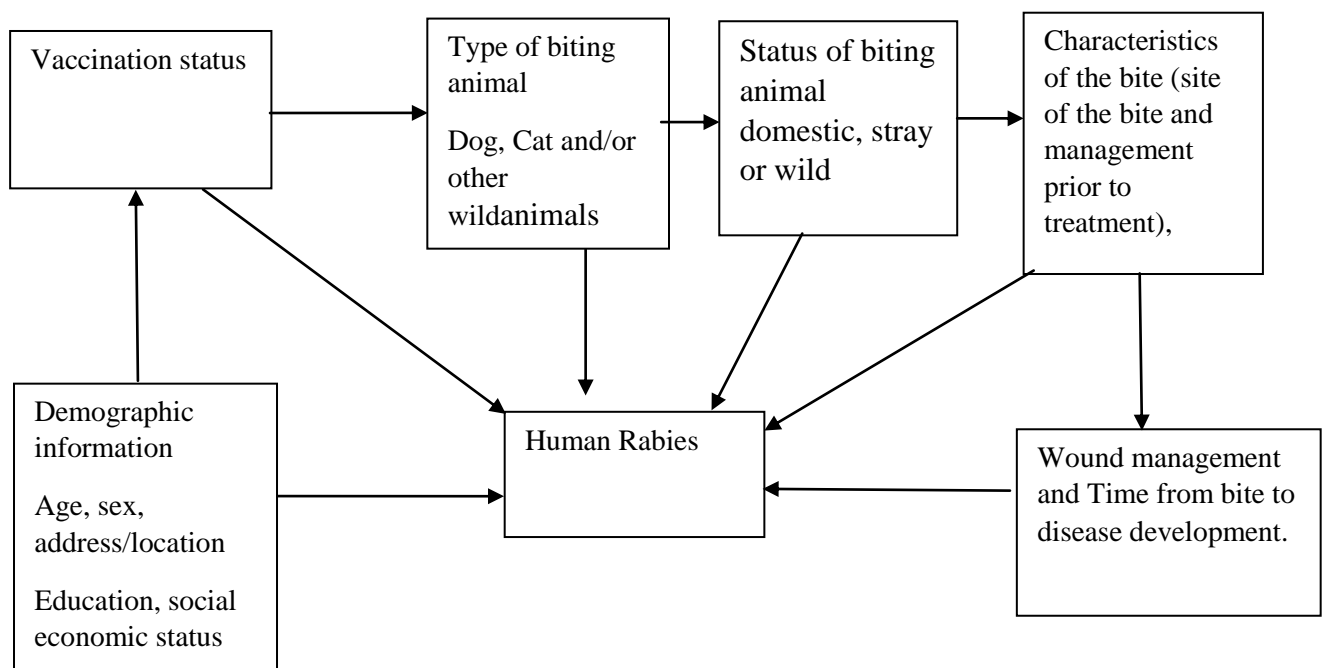


Figure 1: Conceptual framework on Human Rabies

Figure 1 explains how different factors may lead to presence of human rabies and prevalence of the disease.

Demographic information (age, sex, address/location, education, and social economic status) as reported in different articles that most young children less than 15 years have been affected by the disease; also more men have been affected than females because of handling the animal (Masthi et al., 2014). Address or location has been shown to lead to increase of disease prevalence in rural areas and in the areas near national parks or game reserves where there is more interaction of domestic dogs and wild animals and where some wild carnivore animals serve as the reservoirs of the disease (S Cleaveland, 2003; Masthi et al., 2014). Education and social economic status also lead to increase prevalence of rabies because of absence of education and information about rabies and insufficient funds to buy vaccine for dogs and human (Masthi et al., 2014). Vaccination status affects prevalence of human rabies as: more number of unvaccinated dogs lead to increase of prevalence of Human rabies than when high number of dogs are vaccinated. About 90% human rabies can be reduced by vaccination of dogs and cats (S Cleaveland, 2003; Masthi et al., 2014).

Type of biting animal which can be rabid dog, cat or wild animals also lead to increase of disease prevalence; for instance dog and cats cause about 90% of disease in humans while wild animals (such as hyena, jackals) cause about 50% of disease into humans (Pfukenyi et al., 2007). The animal status either stray or domesticated has a direct effect on the prevalence of the disease and also it has the effect on the vaccination status and site of the bite (S Cleaveland, 2003; Masthi et al., 2014).

1.4 Objectives

1.4.1 General objective

To describe trends of dog bites and human rabies in Greater Accra Region

1.4.2 Specific objectives

1. To describe trends in human rabies reporting trends in selected health facilities in the Greater Accra region
2. To describe trends of dog bites reported at Ridge hospital in the Greater Accra region To describe the types of biting animal
3. To determine characteristic of the bite prior to disease development

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter describes the following under literature review; history and etiology of human rabies as mostly caused by dog bite, burden of rabies, factors contributing to human rabies outbreak, biting animals and transmission, pathogenesis, and symptoms of human rabies, diagnosis, management, trends in animal and human vaccination against rabies, control and prevention of the condition.

2.2 History and Etiology of a disease

Rabies is the oldest infectious disease with fatality rate of 95%-100% (Franka et al., 2013). The disease was confirmed in dogs for more than 4000 years (Both et al., 2012) . The virus was discovered in Egypt 2300 Before Christ and was described by ancient Greek. In 1885 Luis Pastor was able to develop a vaccine which treated a nine years old boy who was having deep bitten wound; the nature of virus at that time was still unknown (Bourhy et al., 2010). Although the disease is distributed worldwide, the effort of eliminating it in dogs and wild carnivores has revealed success result in Central and South America (The et al., 2011).

Rabies virus is a single stranded RNA from a family Rhabdoviridae and genus *Lyssavirus* which come from the Greek word lyssa which means lysis (Bourhy et al., 2008; Jackson, 2013). The genus consist of seven genotype in which a genotype 1 consist of classical rabies virus, genotype 2; lagos bat virus also known as rabies related virus, genotype 3; mokola virus genotype 4; duvenhage virus, genotype 5 and 6 consist of European lysavirus 1 and 2 and the last one is genotype 7 which contain Australian bat virus (Weyer

et al., 2011). In Africa there are three viruses genotype which have been isolated, these are lagos bat, mokola virus which was isolated in a girl's brain who died from paralytic disease in Nigeria in 1971. The duvenhage virus is named after the first person who died with the disease (Both et al., 2012; Talbi et al., 2009; Weyer et al., 2011).

2.3 Burden of Rabies

Rabies still remains a zoonotic infection of public health concern in human and animals. WHO ranks rabies as a 12th list of infectious and parasitic disease which cause death in humans (Ehimiyein & Ehimiyein, 2014). It is distributed worldwide except in the areas where strictly quarantine measures, elimination and eradication program were rigorously conducted. It is also not occurring in the areas which are separated by natural barriers like rivers and mountains, because of strict measures recently placed in places like north America-US and some parts of Europe(western Europe) have been declared canine rabies free (Both et al., 2012; Fooks et al., 2014; Franka et al., 2013; Freuling, Klöss, Schröder, Kliemt, & Müller, 2012; Stahl et al., 2014; Talbi et al., 2009). Though these countries they are still struggling with rabies caused by wild animals like fox, bats and raccoon which is still cause human rabies (Ehimiyein & Ehimiyein, 2014; Stahl et al., 2014).

By 1995, the world estimated deaths were about 70,000 humans per year, which are about 200 humans each day worldwide. However, there are only about 35,000 notifications per year (Ehimiyein & Ehimiyein, 2014). The disease is more endemic in Africa, Asia and some part of Latin America where about 90% to 98% of all death have been reported to occur and the causative agent being a dog (Ehimiyein & Ehimiyein, 2014; Freuling et al., 2012; Masthi et al., 2014; Senior, 2012; Shwiff et al., 2013; Stahl et al., 2014; Warrell, 2014).

About 50% of deaths due to canine rabies are being reported in rural and in low socioeconomic parts of India alone, deaths due to canine rabies is estimated at 32000 deaths per year, followed by China (Ehimiyein & Ehimiyein, 2014; Ogun et al., 2010; Okonko et al., 2010). Other Asian countries affected by canine rabies are; Pakistan, Sri Lanka, Afghanistan, Nepal, Bangladesh, Myanmar, Thailand, Laos, Cambodia, Vietnam, parts of Indonesia, Philippines and the former Soviet Republics (Ehimiyein & Ehimiyein, 2014).

Africa contributes about 44% of human death due to rabies in the world which is estimated to be 24,000 deaths per year, these cases being mostly caused by dog bite (Sarah Cleaveland, Fe, Kaare, & Coleman, 2002; Geerdes, 2014; Hayman et al., 2011; Knobel et al., 2005; Ogun et al., 2010; Talbi et al., 2009). Most people affected are those who are living in rural areas where there is no access of post exposure prophylaxis, also this is due to ignorance and sociocultural factors hence most of the information are not documented and this leads to underestimation of the burden of disease in Africa (Adedeji et al., 2010; S Cleaveland, 2003; Ehimiyein & Ehimiyein, 2014).

2.4 Factors contributing to human rabies outbreak

Factors contributing human rabies outbreak worldwide are presence of virus in different reservoir animals such as domestic and wild carnivores. Hence in spite of presence of rabies vaccine, it becomes difficult to eliminate the virus in wild animals therefore this leads to continual outbreak of rabies in humans (Adedeji et al., 2010; Okonko et al., 2010). Unavailability of resources especially in endemic areas such as Africa and Asia also cause continual outbreak of rabies in humans because there are no resources to buy vaccine for prevention, to do surveillance of disease, to build laboratory and to buy equipment for diagnosis of disease (S Cleaveland, 2003; Okonko et al., 2010).

Other factors contributing to rabies outbreak in human are abandoning of dogs by families on transfer to new areas, human activities such as agriculture practice, deforestation, mining and development of human habitat who encroach wild animals habitat hence cause increase interaction of domestic and wild animals. these factors increase outbreak of rabies in domestic animals which cause increase in rabies outbreak in human too (Adedeji et al., 2010; Bourhy et al., 2010; Masthi et al., 2014; Okonko et al., 2010).

Other factors which cause increase human rabies outbreak include increase in population of dogs where this lead to increase of stray dogs which does not get annual vaccine hence become carrier of the rabies virus (Adedeji et al., 2010; Geerdes, 2014; Ogun et al., 2010; Okonko et al., 2010).

Therefore these factors can be divide into three categories which are; human factors, Animal factors and vaccine and vaccination factors.

Human factors are; increase in human activities and change in attitude, socioeconomic factors, lack of public education about the disease, lack of data about the disease, poverty, age, sex ,place of stay, and education. Increase in human activities and change in attitude such as change in agricultural practices, deforestation, hunting with dogs, and increase demand of meat and food these are factors which contribute to human rabies outbreak (Adedeji et al., 2010; Bourhy et al., 2010).

Change in agricultural practice from small scale agriculture to large scale agriculture so as to increase food production due increase of human population, means that big area for farming and feeding domestic animal is required (Ogun et al., 2010). Therefore deforestation and clearing of bushes will be done where these area are habitat of wild animals (Ogun et al., 2010; Pfukenyi et al., 2007; The et al., 2011). The wild animals' especial carnivores such as wild dogs, hyena, fox, mongoose and jackals are reservoirs of

rabies virus therefore because of disruption of their habitat, these wild animals come in contact with domestic animals and human being hence transmit virus to domestic animals especial dogs and cats and therefore lead to human rabies outbreak (Adedeji et al., 2010; Geerdes, 2014; Okonko et al., 2010; Pfukenyi et al., 2007).

The other human activities and change of attitude factor which contribute to rabies outbreak is habit of human being hunting meat from wild animals with dogs as it has been documented that wild animals' especial carnivores are reservoir of rabies virus. Therefore during hunting dogs may get rabies virus from the bite of the wild animal hence transmit the virus to human (Ogun et al., 2010; Pfukenyi et al., 2007; The et al., 2011).

Social economic factor is also a human factor which contribute to human rabies outbreak, this occurs through ecological changes, poverty and increase demand of meat and change in agricultural practices (Bourhy et al., 2010; S Cleaveland, 2003; Sarah Cleaveland et al., 2002; Ogun et al., 2010).

Ecological changes occur because of environmental change and climate change, these changes are due to global warming caused by contamination of water, air and deforestation (Adedeji et al., 2010; Bourhy et al., 2010; S Cleaveland, 2003; Haupt, 1999; Okonko et al., 2010; Pfukenyi et al., 2007). Through these factors, contact between wild animals which are reservoir of the rabies virus with domestic animals and human will increase because of searching of water, food and habitat (Knobel et al., 2005; Okonko et al., 2010; Pfukenyi et al., 2007). Therefore it is important to understand the ecology pattern, frequency and extent movement of infected animal in predicting the spread of the disease where this will help in the control of the disease (Bourhy et al., 2010; Hutabarat et al., 2003; Pfukenyi et al., 2007).

Poverty also is the socioeconomic factor which contribute to human rabies outbreak where most of people fail to pay for the post exposure prophylaxis after being bitten by a rabid animal because of ignorance and lack of resources to pay for the prophylaxis, hence become affected by the disease (Franka et al., 2013; Geerdes, 2014; Haupt, 1999).

Education also is the human factor that contribute to human rabies outbreak where there is lack of adequate public awareness about the disease and lack of data about the disease.

Lack of public awareness has been observed in many developing countries where lack of awareness in a population including medical practitioners, health authorities and other policy makers about the risk associated with widespread of disease and transmission from dog to human (Ogun et al., 2010; Okonko et al., 2010; The et al., 2011; Weyer et al., 2011). Therefore people who are exposed to rabies virus do not go for post-exposure prophylaxis because they are not aware of the contracting the disease (Bourhy et al., 2010). And also lack of awareness about the disease to the policy makers hence they do not prioritize resources to control the disease as they are not aware of burden and impact of the disease (Adedeji et al., 2010; Bourhy et al., 2010; Ogun et al., 2010; Okonko et al., 2010; Shwiff et al., 2013; The et al., 2011).

Lack of rabies data also is another human factor which contribute to disease outbreak as it has been reported that in many developing countries there is weak or non-existent surveillance system (Banyard et al., 2013; Jackson, 2013; Ogun et al., 2010; Pfukenyi et al., 2007), under reporting of cases by local and central authorities (Knobel et al., 2005; Masthi et al., 2014; Okonko et al., 2010; The et al., 2011), inadequate or absence of diagnostic tools and laboratories hence most of cases are diagnosed based on clinical criteria (Adedeji et al., 2010; Banyard et al., 2013; Fooks et al., 2014; Geerdes, 2014; Horton et al., 2013). And poor infrastructure in places where there is a burden of disease

hence lot of cases are reported late where post exposure prophylaxis and vaccination cannot be done (Bourhy et al., 2010; S Cleaveland, 2003; Franka et al., 2013).

Age also contributes to human rabies outbreak where it has been reported that in poor developing countries; most people who are affected are young children below 15 years of age where it is estimated to be 30% to 50% of the 55000 victims each year (Badoe & Wilmshurst, 2014; Bogel & Motschwiller, 2000; Fooks et al., 2014; Franka et al., 2013). Also the study done in Techiman municipality in Ghana in 2014 by (Edward et al., 2014) shows that about 54% of dog bite victim reported from 546 dog bite victims were young children below 15years of age.

Sex also contributes to human rabies outbreak where it is also been reported that in highly endemic areas men are more affected than women due to taking control of domestic animals such as dogs when they misbehave and also men are the ones who participate much in hunting activities where they use dogs to help them to catch the animal they are hunting for meat (Adedeji et al., 2010; Badoe & Wilmshurst, 2014; Bogel & Motschwiller, 2000; Edward et al., 2014; Geerdes, 2014; Masthi et al., 2014; Ogun et al., 2010).

Place of stay/habitat also contributes to human rabies outbreak where most of rabies cases have been reported in people who are living in villages and rural areas where there is no health facilities or the facility is far from the area. Also poor infrastructure from the village to the health facilities cause difficult access to health care and hence cause increase in the disease (Bourhy et al., 2010; S Cleaveland, 2003; Jackson, 2013; Ogun et al., 2010; Pfukenyi et al., 2007).

Animal factors such as illegal animal importation, migration of dogs, stray animals, migration of wild animals to human habitat, status of animals either stray or domesticated

animal and type of biting animals which are dogs, cats, other domestic animals and wild animals cause outbreaks of human rabies.

Illegal animal importation cause spread of virus of rabies disease from one place to another through importation of domestic or wild animals such as dogs and wild carnivores which are reservoir of rabies virus (Ogun et al., 2010; Pfukenyi et al., 2007). Wild animal illegal importation occur due to high demand of bush meat, zoo establishment and tourist attraction, where both of these activities bring lot of money to the people who are doing those business (Adedeji et al., 2010; Ogun et al., 2010; Okonko et al., 2010). Therefore these animals are transported without being vaccinated or their health checked hence they become source of rabies virus to the new area where they will be transferred (Ogun et al., 2010; Pfukenyi et al., 2007). Illegal importation of domestic animals especially cats and dogs occur when people who own these animals are illegally migrating from one place to another or when they are avoiding to pay for their pets when they are migrating hence these lead to introduction of rabies virus to new areas (Masthi et al., 2014; Ogun et al., 2010; Shwiff et al., 2013; Stahl et al., 2014).

Migration of dogs, is also animal factor which contributes to human rabies outbreak where it has been observed that when people migrate from one place to another they migrate with their dogs (Fooks et al., 2014; Masthi et al., 2014; Ogun et al., 2010). Therefore if dogs are coming from the rabies endemic area they will transfer virus to the new place (Masthi et al., 2014; Ogun et al., 2010).

Status of animal, contribute to human rabies outbreak where stray dogs and cats are shown to cause spread of rabies to human being more than owned domestic dogs and cats (S Cleaveland, 2003; Geerdes, 2014; Knobel et al., 2005; The et al., 2011; Warrell, 2014; Weyer et al., 2011). This is because most stray dogs and cats are not confined therefore it

is easier for them to move from one place to another hence they get virus from other affected animals or from wild animals which are reservoirs of the disease (Geerdes, 2014; The et al., 2011).

Type of biting animal either dog, cat, wild animals and other domestic animal, dogs are main reservoir of human rabies in developing countries of Africa and Asia where they contribute about 90-99% of human death (Hayman et al., 2011; Jackson, 2013; Masthi et al., 2014). Wild animals also continue to be source of infection in people who are living near national parks and game reserves as they are also reservoir of the disease where most of the time they get infected by dogs through biting them (Ogun et al., 2010; Pfukenyi et al., 2007; The et al., 2011). Also in North America most of human rabies cases are reported to be caused by wild animals such as bats, therefore they are still a source of the disease (Fooks et al., 2014; Geerdes, 2014; Jackson, 2013). Cats are also source of rabies to human beings as when they are rabid they become more aggressive and run away where they spread disease to other domestic and wild animals (Ogun et al., 2010).

Low vaccine coverage where this happens can cause increase in non-immune population of dogs and cats, this occur due to low resources provided by the government to vaccinate dogs compared to dog population in the area (Ogun et al., 2010). This can also be due to lack of rabies control strategies in the area (Adedeji et al., 2010; Bourhy et al., 2010; S Cleaveland, 2003; Fooks et al., 2014; Masthi et al., 2014; Okonko et al., 2010). Also due to political and economic instability of the government it may become difficult to make strategies for controlling the disease in the area (Adedeji et al., 2010; Ogun et al., 2010; Okonko et al., 2010). Insufficient resources and ignorance of people who are keeping dogs and cats may lead to they not taking advantage of vaccinating their animals (Bourhy et al., 2010; S Cleaveland, 2003; Geerdes, 2014)

Vaccine failure may arise due to counterfeit vaccines being given to the animals can lead to reoccurrence of the disease and virus in the area. (Adedeji et al., 2010). Also vaccine failure occurs due to disruption of cold chain when in storing or transporting vaccine due to the poor and insufficient equipment it fails to keep vaccine in its viable form (Bourhy et al., 2010; Fooks et al., 2014).

Incomplete post-exposure prophylaxis in patients who are bitten by suspected rabid animals due to not knowing the advantage of the post-exposure prophylaxis in preventing them from developing rabies disease. Therefore this can lead to low Seroconversion testing of post-exposure prophylaxis in the patient which means that he/she will have low immune to fight against rabies virus (Adedeji et al., 2010; Ogun et al., 2010; Okonko et al., 2010).

2.5 Biting animals and transmissions of the disease

Biting animals which transmit disease to human are mammalian carnivores where 99% of human rabies is caused by rabid dog, followed by other animals such as cat and ferrets and wild carnivores such as hyena, mongooses, jackals, foxes and wolves (Bourhy et al., 2010; Fooks et al., 2014; Franka et al., 2013). Transmission of rabies to human by bite from monkey and mice is rarely reported (CDC,2011; Stahl et al., 2014). Also in livestock such as horses and donkey when infected with rabies, they become aggressive, vicious and start to bite other animals and humans. Other livestock such as cattle and buffalo do not bite when they are rabid but precaution is to be taken when examining and handling sick animals that are salivating (CDC,2011; Stahl et al., 2014).

Inter-human transmission has been reported incidentally, following transplant of infected tissue or organs (Stahl et al., 2014). Apart from transmission through transplanted tissue,

human-to-human transmission lies largely in the realm of folklore as reported by (Stanley 2000).

2.6 Pathogenesis

Development of disease starts when the virus enters into the tissue of the animal or human. It is estimated that 99% transmission of virus to human is through dog bite (Bourhy et al., 2010), where this serves as inoculation of virus to the tissue by escaping the outer layer of the skin which serve as a protective barrier (Banyard et al., 2013; Geerdes, 2014). After inoculation virus replicate in the skin and muscle tissue (Badoe & Wilmshurst, 2014). Then they bind to the nicotine acetylcholine receptor at the neuromuscular junction and transported via retrograde axonal by peripheral nerve to the spinal cord (Badoe & Wilmshurst, 2014; Fooks et al., 2014). The virus will continue to replicate in the motor neuron of the spinal cord and the dorsal ganglia root, and ascending to the brain, up to this time there is no clinical sign/symptoms shown by the patient (Badoe & Wilmshurst, 2014; Jackson, 2013). Then in the brain the virus will continue to replicate in the brain stem which will cause neuronal dysfunction hence lead to clinical symptoms (Jackson, 2013).

In carnivores mammals both wild and domesticated especially dog and cat, the virus will be found in the oral cavity in the saliva, because rabies virus will be transferred to the salivary gland since it is innervated from parasympathetic nervous system via submandibular ganglion and glossopharyngeal nerve by sympathetic innervations via superior cervical ganglion by afferent innervations (Fooks et al., 2014; Geerdes, 2014; Jackson, 2013). Human beings are described as dead host because they do not give account into progress transmission. Human to human transmission occur in rare cases especially through organ transplantation (Fooks et al., 2014).

2.7 Clinical symptoms of the disease

Clinical symptoms are not clearly defined and are associated with headache, fever, nausea and abdominal pain seen after the incubation period of 7-90days or several years in some cases (Badoe & Wilmshurst, 2014). The symptoms are divided into two forms; which are dumb (paralytic) form and furious/prodromal (encephalitic form). Dumb form is characterized by flaccidity muscle weakness where there is ascend paralysis and duration of illness is longer within 14 days compared to the furious form (Both et al., 2012; Jackson, 2013).

Furious form is characterized by pain and pruritus at the site of inoculation which lead to inflammation and infection in the local sensory ganglia, paresthesia, aerophobia, hydrophobia, and encephalitis characterized by episode of excitement, hallucination and lucidity then followed by coma and death which can occur within 7 days after onset of the clinical symptoms (Both et al., 2012; Hemachudha et al., 2013). It is suspected that death occurs due to respiratory arrest caused by spasms of laryngeal muscle, diaphragm and accessory respiratory muscle which are caused by hydrophobia (Badoe & Wilmshurst, 2014).

2.8 Diagnosis

Ante-mortem diagnosis of rabies is very difficult because there is no test available to detect it in human and therefore clinical symptoms such as hydrophobia are served as diagnosis tool in most endemic part of Africa and Asia (Banyard et al., 2013). Postmortem examination is more effective for detection of the disease virus but lack of diagnostic laboratory in endemic area cause it to be expensive and difficult (Banyard et al., 2013; Geerdes, 2014). Postmortem can be done through different ways which are fluorescent immunoassay technique where fluorescent labeled antibody and fluorescent microscope

are used to detect virus from brain sample by doing brain smear of touch impression smear (Hemachudha et al., 2013). The second method is direct rapid immune-histochemical test (dRT) where the virus can be detected within an hour in a fresh brain impression (Fooks et al., 2014; Hemachudha et al., 2013). Other diagnosis techniques are virus isolation technique and PCR technique which is used to confirm the origin of virus isolate (Hemachudha et al., 2013).

2.9 Management

Management of rabies in human beings can be done by vaccination of biting animals which are carrier of disease and other domesticated animals, and also vaccination of people through pre-exposure or post-exposure vaccine.

In animals, it is recommended to do annual vaccination in dogs and cats as follows; a puppy will get first vaccine at age of four weeks after birth, the second dose will be at age of three month, then after that vaccine will be given annually throughout their life. The recommended route of administration according to OIE is through injection of one mls of vaccine subcutaneously or intramuscular route (CDC, 2011; Stanly, 2000). Also annually vaccination can be done in other livestock domesticated animals such as cattle, goat, sheep and horses to prevent them from developing rabies when bitten by a rabid mammalian carnivore and also to prevent them to transmit rabies to human being after developing rabies disease (CDC, 2011; Stanly, 2000).

Rabies management in human is done through pre exposure and post exposure vaccination before development of clinical symptoms to the exposed individual. After a person being bitten by a suspected rabid dog WHO recommends that, the wound should be washed with clean water and soap also antiseptics such as chlorhexidine and povidone iodine can be used (Fooks et al., 2014; Stanly, 2000; WHO, 2014). Then the post exposure treatment

should start immediately while the suspected rabid animal will also be confined and observed for ten to fourteen days if it will develop clinical signs of the disease. If the suspected animal will not develop clinical signs the person can stop the post-exposure treatment if otherwise he/she needs to continue with treatment regime (Fooks et al., 2014; WHO, 2014).

The treatment is divided into two categories. First category is treatment to the people who have never been vaccinated against rabies and second category is for the ones who have been vaccinated against rabies before. People in first category will receive four or five injections of vaccine and this is given on day 0 which is the first day of vaccination, then day 3,7,14 and day 21 or 28. Or at day 0 an individual can be given two doses then followed by day 3,7,14, 21 or 28 through intramuscular or intradermal route or both routes (Fooks et al., 2014; Franka et al., 2013; Jackson, 2013).

Post exposure treatment is done in two ways; people who do not have a history of being vaccinated with rabies before and people who have history of receiving post-exposure vaccine after being bitten by a rabid animal. Post exposure treatment is for people who have never been vaccinated before and it starts first by washing the wound with soap and clean water and then antiseptics such as povidone iodine, then antibiotic is given to the patient, followed by rabies immunoglobulin which will be given intramuscular while other dose can be infiltrated around the wound, then followed by post-exposure vaccine (Both et al., 2012; Stanley 2000). Post-exposure vaccine will be given as follows; four or five injections of vaccine and this is given on day 0 which is the first day of vaccination, then day 3,7,14 and day 21 or 28 simultaneous with ant-tetanus and tetanus anti-serum. Or at day 0 an individual can be given two doses then followed by day 3,7,14, 21 or 28 through intramuscular or intradermal route or both routes (Fooks et al., 2014; Franka et al., 2013; Jackson, 2013). Post-exposure vaccine to people who have history of being bitten and

vaccinated before is done first by washing the wound with soap and water, then rabies immunoglobulin will not be given instead the person will start to take rabies prophylaxis vaccine immediately (Stanley 2000).

The people in the second category who have already received pre exposure vaccine before, they receive two post exposure vaccine on day 0 and day 3 by intramuscular injection. Or will receive four doses on day 0 through intradermal route (Fooks et al., 2014; Hemachudha et al., 2013).

Treatment regime guidelines for post exposure in Ghana are removing saliva from site of bite by flushing the wound with saline solution or cetrimide together with chlorhexidine solution. Then the wound is infiltrated with 10 IU/kg body weight of rabies immunoglobulin. This is followed by tetanus immunization, then followed by ant rabies vaccine and immunoglobulin while the condition of suspected rabid animal is under observation for ten days (Badoe & Wilmshurst, 2014).

Treatment for an individual who has already developed clinical symptoms is not effective but there are clinical management strategies which are done to calm the condition of an individual through administration of immunotherapy and ketamine (Fooks et al., 2014; Hemachudha et al., 2013).

2.10 Trends in animals and human vaccination against rabies

WHO recommend atleast 70% of dogs should be vaccinated, because study shows that 90% source of human rabies are caused by dog bite. Therefore to prevent human rabies atleast 70% of dogs population in every country should be vaccinated against rabies (S Cleaveland, 2003; Jibat, Hogeveen, & Mourits, 2015). Where most of experts accept that dog vaccination is more cost-effective than postexposure treatment. And according to WHO

the dog vaccination programme costs 25-50% of postexposure treatment, so it is cost effective than postexposure treatment (Jackman & Rowan, 1992; Shwiff et al., 2013). Therefore practically there will be declining of rabies cases in the countries which will eventually cause decrease demand of postexposure treatment (Shwiff et al., 2013).

The trends of vaccination differ from one continent to another and from one country to another. For instance North America and Eastern Europe they were able to attain 70% of dog and cat rabies vaccination (S Cleaveland, 2003; Franka et al., 2013; Freuling et al., 2012; Jackman & Rowan, 1992; Jibat et al., 2015). This is because in 1983 the Pan American Health organization (PAHO) and WHO set year 2005 as the target for eliminating canine rabies (Jackman & Rowan, 1992). Because of this target, every year 44 million of dogs are vaccinated in the area and hence achieved 80% coverage of vaccination. Therefore lead to dropping of human rabies up to 91% and canine rabies declined to 93% from 1983 to 2005 (Jackman & Rowan, 1992).

In Africa and Asia the situation is different where most of the country they have not reached 70% dog vaccination because of socioeconomic factors, political instability and lack of commitment (Jibat et al., 2015; Ogun et al., 2010). The average dog vaccination coverage is currently estimated to be 9.7% in Asia and 10.3% in Africa which is very low to get rid of human rabies according to WHO (Jackman & Rowan, 1992; Jibat et al., 2015). And in order to achieve the coverage of 70% mass dog vaccination, the countries need at least two years of campaign and vaccination process but most of endemic areas in Africa and Asia they are not able to manage this longterm activity (S Cleaveland, 2003; Jibat et al., 2015). But the study have shown that the place where there is free mass dog vaccination the coverage increases from 9% to 70% (S Cleaveland, 2003). For example the targeted free mass vaccination in rural north western Tanzania in Africa have shown to

achieve reduction of dog rabies by coverage 70% hence lead to reduction of human rabies (S Cleaveland, 2003; Sarah Cleaveland et al., 2002).

2.11 Control and prevention

Prevention of disease to human by mass vaccination of reservoir animals' especial dogs has shown success result in Central and South America (Banyard et al., 2013). Also prevention by pre exposure vaccine is recommended by WHO to people who are working with animals or working in laboratories which are dealing with rabies samples such as Veterinarian, animal health scientist and laboratory technician (Banyard et al., 2013; Jackson, 2013; WHO, 2014). Controlling dog population by sterilizing them while controlling stray dogs by confining or slaughtering has been reported (Franka et al., 2013; Gerdes, 2014).

CHAPTER THREE

METHODS

3.1 Study Design

This was a descriptive cross-sectional study, which involved reviewing of hospital clinical and treatment records of human rabies for the past five years (2010 to 2014) from Korle Bu Teaching Hospital and dog bites from Ridge regional hospital.

3.2 Study Area

The study was done at Korle-Bu Teaching Hospital located at Ablekuma Sub-Metro and the Ridge hospital which is located in Osu Klottey Sub-Metro also in Accra metropolis in the Greater Accra region of Ghana. These two hospitals are both referral hospitals and thus were selected as they would most likely have most of the reported cases on animal bites and human rabies. The Korle-Bu Teaching Hospital is the third biggest hospital in Africa. Korle-Bu Teaching Hospital currently has a bed capacity of 2000, with 17 departments and more than 1000 health workers. The hospital has daily outpatients' attendance of about 1500 and about 2500 inpatients. It has the emergency unit where bites from animals and trauma are first reported. The confirmed rabies cases are then transferred to the fever unit. The hospital is suitable for this study because it is a referral hospital and all confirmed cases from the districts and regions are referred to the hospital. The study was also done at the Ridge hospital which has the capacity of 191 beds and is undergoing an expansion to a 620 bed capacity. The hospital was suitable for the study because it serves as regional hospital in the region therefore referred cases from the district is reported to the hospital.

3.3 Variables

The variables used for this study included demographic information such as; age, sex, and address/location. For the rabies cases, the variables used were, rabies cases, animal status (domesticated, stray, and wild), type of animal exposure (bite, saliva, and scratch), characteristic of a bite (site/location of the bite), reporting date and time from bite to disease development. For data on bites, the variables used were, vaccination status, date of reporting, and dates of the various vaccinations.

Table 2: study variable description and analysis

Variables	Variable description	Scale of measurement
Age	Children 0-15 years Adult 16 years and above	Mean and SD
Sex	Male Female	Percentage
Address and location	Rural Urban	Percentage
Characteristic of a bite	Location (head, leg, arm)	Percentage
Animal status	domesticated strayed	Percentage
Vaccination status	Vaccinated Non vaccinated Receive 5 doses	Percentage Percentage
Animal exposure	Bite Scratch Saliva	Percentage
Date of exposure	Date	Time/duration
Reporting Date	Date	Time/duration
Time from exposure(bite) to rabies clinical disease development	Numeric	percentage

3.4 Data Collection Techniques/Methods and Tools

Clinical diagnosed human rabies data confirmed by clinical symptoms criteria were collected at Korle-Bu teaching hospital, while dog bite data were collected at Ridge hospital. Data were collected through reviewing the monthly and annual human rabies records at the Korle-Bu teaching hospital from 2010 to 2014. For Korle-Bu Teaching Hospital sources for collecting data were admission and discharge books, and report books which contained all information on the daily status of the patient health. At Ridge hospital, the source of data was vaccination register book of people bitten by the dog from 2010 to 2014. The information obtained from the report book, admission and discharge books were age, sex, address of the patient, time from bite to disease development, animal involved in biting, patient bitten site and status of the animal involved in bite. Information obtained from vaccination register book of people bitten by the dog were date, age, sex and number of vaccine the patient received.

3.5 Quality Control

The quality control of data was done by double-checking the entries of the data from the hospital. The data was double entered and verified before the analysis.

3.6 Data Processing and Analysis

The data were entered into excel spreadsheet and then exported into STATA 12 for analysis. Descriptive and summary statistics were used to express the categorical variables as proportions and the numeric variable as means and standard deviation. Some of the numeric variables were recoded as categorical variable. For instance, age was recoded into age groups, 0-15 years and 16 years and above while number of vaccination doses received recoded as 5 doses and less than 5 doses. Time from bite to disease development

was also recoded into three categories (0-30, 31-90, > 90days). The locations of residence of the patients were also grouped into Rural and Urban for the analysis. The results were presented in tables and figures.

3.7 Ethical Considerations

Before the study was carried out, the ethical approval was obtained from Ethical Review Committee of Ghana Health Service in order to conduct this study at Korle-Bu Teaching hospital and Ridge Hospital. The data was anonymize for confidentiality. No record could be traced to the individual.

3.8 Limitation of Data obtained

Data obtained from Korle-Bu teaching hospital and Ridge Hospital could not allow testing/analysis by combining data obtained in these two facilities because information on referred cases from Ridge Hospital to Korle-Bu teaching hospital were missing in both hospitals. Therefore there was no link between clinical diagnosed human rabies data obtained from Korle-Bu teaching hospital and dog bite data obtained from Ridge Hospital. Also the dog bite data obtained did not allow analysis of time or date from exposure (bite) to treatment (first vaccination). Due to the inability to link the two data sets from Korle-Bu and Ridge Hospitals this study was not able to test hypothesis with respect to trends on time exposure to bite and clinical diagnosis of rabies.

CHAPTER FOUR

RESULTS

4.1 Cases of dog bites reported at Ridge hospital from 2010 to 2014.

From 2010 to 2014 total number who reported at the Ridge hospital that they have been bitten by the dog was 233. The proportion of males was 54.5 % (127) which was, higher than female 45.5 % (106). Children 0 to15 years of age were 50.6% (118) with 47.6% (111) being adult people aged 16 years and above while for 1.7 (4) had no values recorded for age. The highest number of dog bites reported was at year 2014 where 34.3% (80) people reported that were bitten by the dog while the lowest number of dog bites were reported in 2011 where 10.3% (24) people reported to be bitten by the dog (Table 2).

Table 3: People who reported dog bites at Ridge hospital from 2010 to 2014

Variable	Frequency	Percentage
Sex		
Female	106	45.5
Male	127	54.5
Total	233	100
Age group(year)		
0-15	118	51.5
≥ 16	111	48.5
Unknown		
Total	229	100
Dog bite/year		
2010	35	15.0
2011	24	10.3
2012	50	21.5
2013	44	18.9
2014	80	34.3
Total	233	100

4.2: Seasonality of dog bites

Figure 2 below presents the temporal distribution of dog bites reported at the Ridge hospital over the five years period. The month that reported high number of dog bites in all five years from 2010 to 2014 at the Ridge hospital was November with 15.5% (36) of people reporting that they were bitten by dogs while the month which had the lowest number of dog bites was March which had 2.2% (5) of people reported being bitten by the dog.

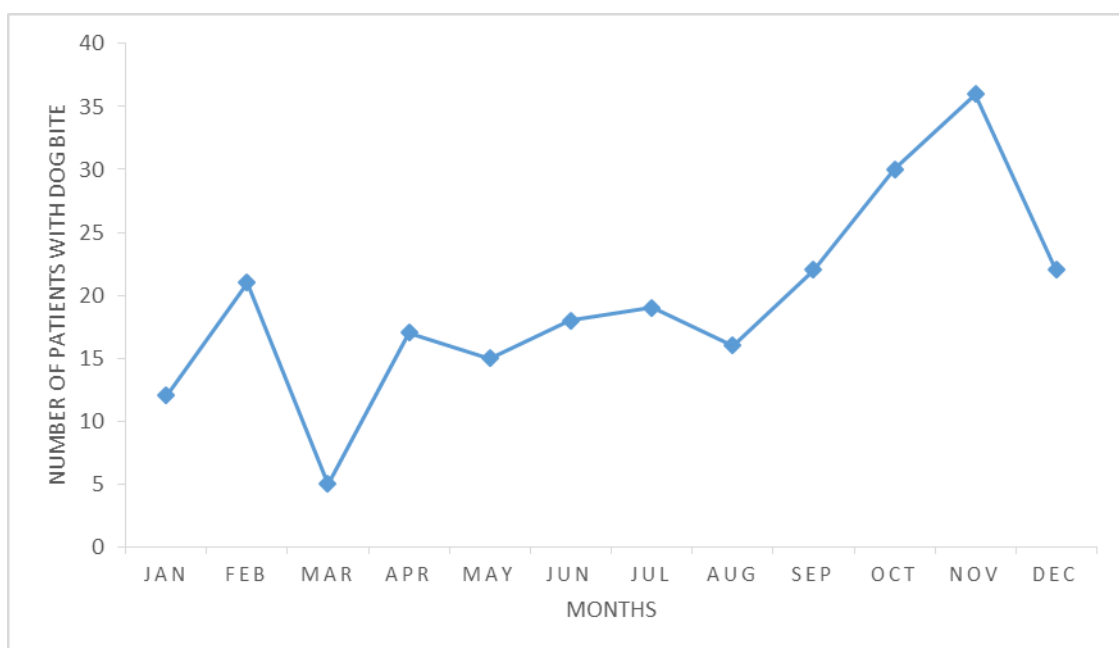


Figure 2: Seasonality of dog bites over five years period (2010-2014)

Figure 3 shows temporal distribution of dog bites reported at Ridge Hospital for each year from 2010 to 2014. Though generally November was the month that had the highest reported cases of dog bites and March the lowest over the five year, this was not so for all the years. In 2011 for instance, though November recorded the highest proportion of 25% (6) of bites, the lowest was in October (0%). In 2012, August recorded the lowest proportion of zero cases with November 2% (1) being the second lowest. The highest proportion of reported dog bites cases was, however, in October with 24% (12) followed

by February, 18% (9). For 2013, the highest proportion of dog bites was in September, 15.9% (7) while March recorded no case at all. June and October recorded the second highest with 13.6% (6) each. The years 2010 and 2013 also had the distribution of reported bites cases spread over the months which is quite different than the other years where a single month records about a quarter of the cases.

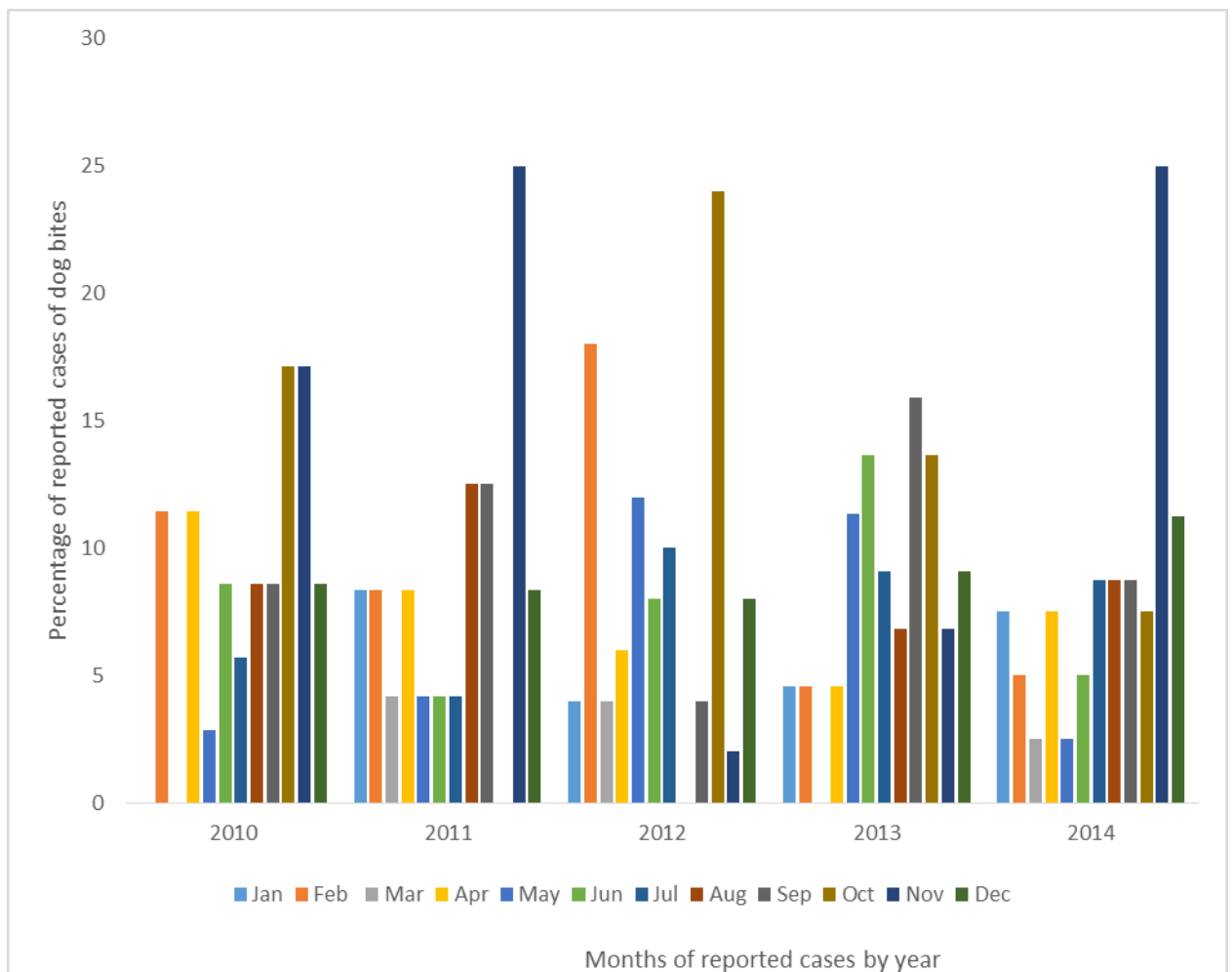


Figure 3: Monthly distribution of dog bites by year from 2010-2014

4.3 Coverage of prophylaxis rabies vaccine for patients reporting at Ridge hospital from 2010 to 2014 with dog bites

Out of the total of 233 people who reported at Ridge hospital that they had a dog bite and they needed prophylaxis rabies vaccine 93.6% (218) received the recommended five doses of vaccine while 0.9% (2) did not receive a single dose (Table 3). The rest, however, received less than the recommended five doses of the vaccine.

About 94% (217) received the first dose of the vaccine the same day they reported at the hospital with dog bite. The records indicates that three people received the first dose of vaccine after 30 days from the day they reported at the hospital that they had a dog bite (Table 3).

Table 4: Vaccination status of patients reporting for prophylaxis rabies vaccine at Ridge hospital from 2010 to 2014.

Variable	Frequency	Percentage
people who reported and didn't take vaccine	2	0.9
people who reported and take < 5 vaccine	13	5.6
people who reported and take 5 vaccine	218	93.6
Total	233	100
number of days between reported and first vaccine		
people who received vaccine the same day they reported	217	93.9
people who received vaccine one day after reported	6	2.6
people who received vaccine 4days after reported	1	0.4
people who received vaccine 5days after reported	1	0.4
people who received vaccine 6days after reported	2	0.9
people who received vaccine 23days after reported	1	0.4
people who received vaccine 31days after reported	1	0.4
people who received vaccine 39days after reported	1	0.4
people who received vaccine 50days after reported	1	0.4
Total	231	100

4.4 Vaccination status from 2010 to 2014 (Number of doses received by the people bitten by the dog)

Figure 4 shows the number of prophylaxis vaccine received when the person reported to have a dog bite. About 94% (217) people received five prophylaxis vaccine after being bitten by the dog while 1% (2) of people who reported to have been bitten by dog but did not receive the prophylaxis vaccine while the rest received less than five prophylaxis vaccine.

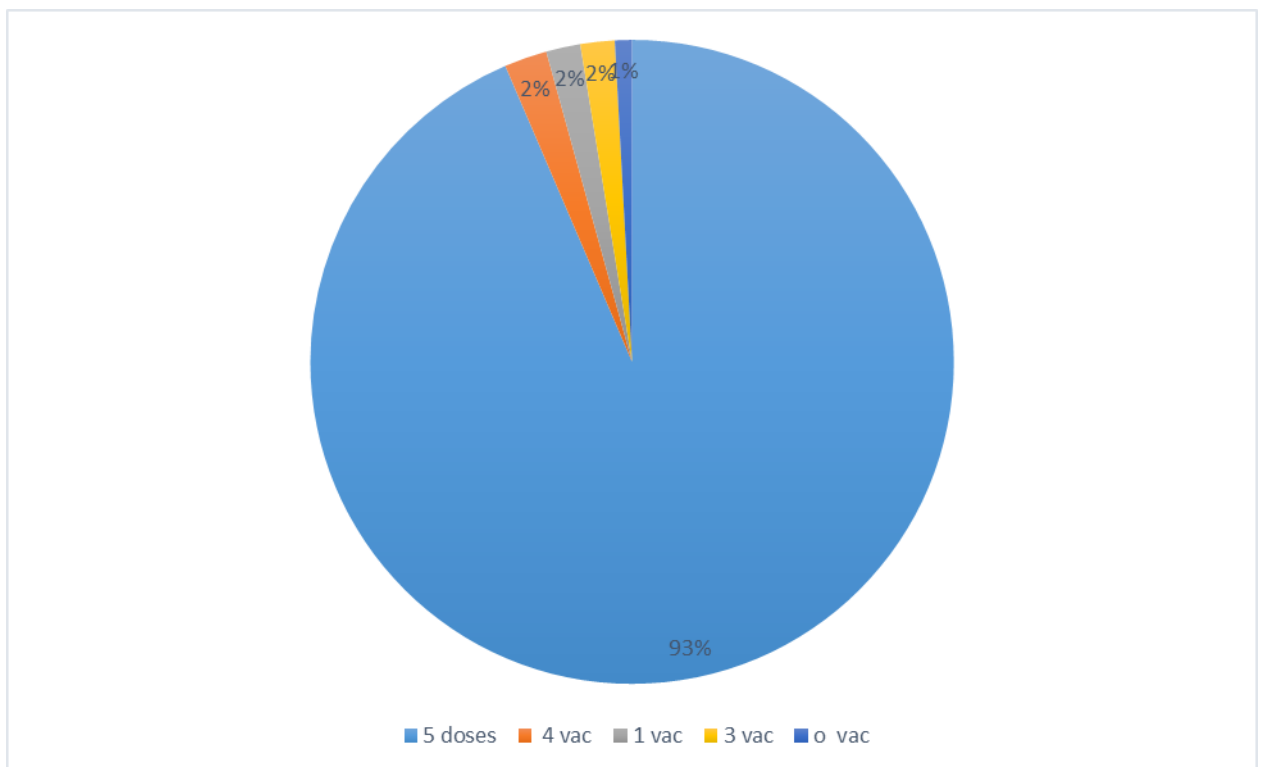


Figure 4: Vaccination status of people who reported being bitten by dog from 2010 to 2014.

4.5 Human rabies cases that were clinically diagnosed from Korle-Bu Teaching Hospital from 2010 to 2014

Total number of people who reported at the Korle- Bu Teaching Hospital with human rabies between 2010 and 2014 were 22. Out of this, 59.1% (13) were adult of age sixteen years and above while 40.9% (9) were children of age fifteen years and below. The proportion of males were the same as female, 50% each (Table 4). People who came from urban area were 59.1% (13) with 27.3% (6) were from the rural area while for 13.6% (3) of the cases the address or location was unknown.

Only 4.6% (1) of the cases had received two doses of prophylaxis vaccine before getting the rabies disease clinical symptoms while 95.5% (21) did not receive any rabies prophylaxis vaccine before development of rabies clinical symptoms. Also out of the 22 rabies cases reported, 59.1% (13) had the history (information) on biting site missing. For 27.3% (6) of the cases, the biting site was the leg while the remaining indicated the face and hands. For 40.9% (9) of the cases, the type of the biting animal was unknown. The rest of the 59.1% (13) of the reported cases indicated dog bites.

For 45.5% (10) of the cases, the status of the dogs that bit them was not recorded. About 31.8% (7) of the reported patients were bitten by stray dogs while the rest of 22.7 (5) of the patients were bitten by domesticated dogs. Also, out of the 22 cases reported 59.1% (13) of them were exposed to the rabies virus through bite while for 40.9% (9) of the patients the exposure was unknown. The incubation period (from the time of bite to disease development) was missing for 45.5% (10) of the cases reported. For those with incubation period recorded, it ranged from 14 days to 60 days. About 27.3% (6) of them had incubation period of 14 days while 13.6% (3) had incubation period of 60 days.

Table 5: Human rabies cases that were clinically diagnosed from Korle-Bu Teaching Hospital from 2010 to 2014

Variable	Frequency	Percentage
Age		
0-15	9	40.9
≥ 16	13	59.1
Total	22	100
Sex		
male	11	50
female	11	50
total	100	
address		
rural	6	27.3
urban	13	59.1
Missing	3	13.6
total	22	100
vaccination status		
Vaccinated (2doses)	1	4.6
not vaccinated	21	95.5
total	22	100
characteristic of a bite(biting site)		
Leg	6	27.3
Arm	2	9.1
Face	1	4.6
Missing	13	59.1
Total	22	100
biting animal		
Dog	13	59.1
Missing	9	40.9
Total	22	100
animal status		
domestic	5	22.7
Stray	7	31.8
Missing	10	45.5
Total	22	100
animal exposure		
Bite	13	59.1
Missing	9	40.9
Total	22	100
time from exposure to disease development(incubation period)		
14days	6	27.3
16 days	1	4.6
21days	1	4.6
30days	1	4.6
60days	3	13.6
Missing	10	45.5
Total	22	100

4.6: Number of rabies cases that were clinically diagnosed per year and per month reported at Korle-Bu Teaching Hospital

Number of rabies cases that have been reported at Korle-Bu Teaching Hospital from 2010 to 2014 were 22. Out of 22 cases, the highest number was 45.5% (10) which were reported in 2014. And the lowest number was 9.1% (2) which were reported in 2013. Also the month that the highest number of rabies cases 22.7% (5) were reported was April, while February, May, and June recorded no rabies cases.

Table 6: Number of rabies cases per year reported at Korle-Bu Teaching Hospital

Variable	Frequency	Percentage
Number of rabies per year		
2010	3	13.6
2011	3	13.6
2012	4	18.2
2013	2	9.1
2014	10	45.5
Total	22	100

4.7 Seasonality of clinically diagnosed human rabies from 2010 to 2014

Figure 5 shows that there was cumulative increase of rabies from March to April where the highest number of cases were in April in all five year and the lowest number were reported in October and November while February, May and June there were no rabies cases reported .

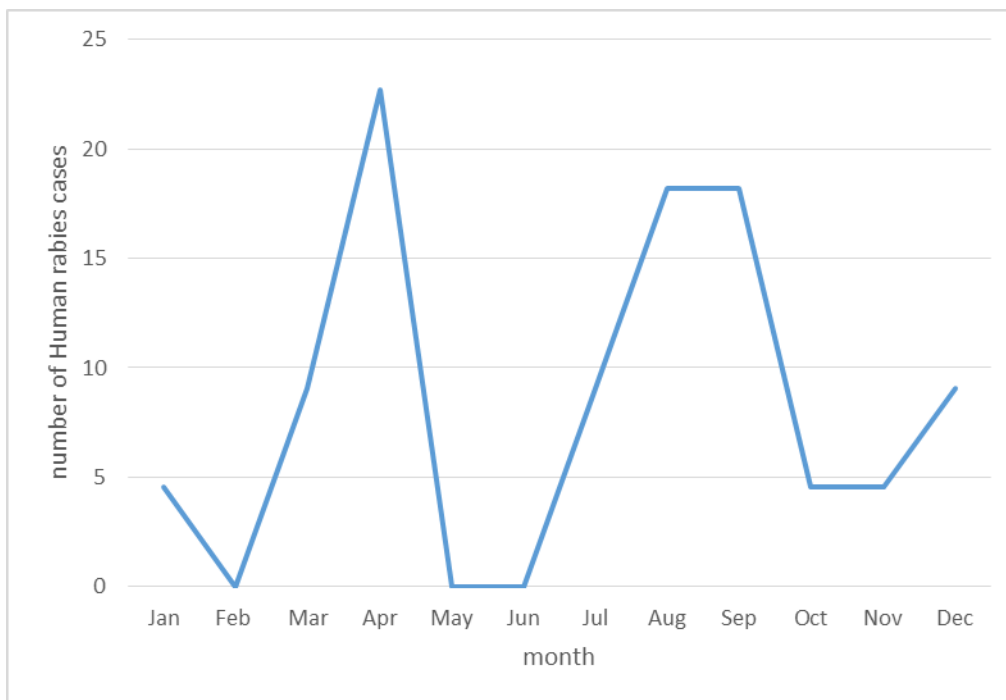


Figure 5: seasonality of human rabies cases from January to December in a period of five years

CHAPTER FIVE

DISCUSSION

This study described the trends and monthly distribution of dog bites reported at Ridge Hospital and human rabies cases reported at the Korle-Bu Teaching Hospital in the Greater Accra Region from 2010 to 2014.

Though an increase in reported cases of dog bites was observed from 2010, 15% (35) to 2014, 34.3% (80), there was no clear trend. The highest cases, of reported dog bites were observed in 2014, 34.3% (80) while the lowest reported cases were observed in 2011 10.3 (24). Similarly, human rabies cases increased from 13.6% (3) in 2010 to 45.5% (10) in 2014, however, the lowest proportion of 9.1% (2) cases were recorded in 2013. Similar findings were observed in other studies where the reported cases of dog bites and human rabies did not show a clear trend over the years (Cleveland et al, 2002 Pfukenyi et al, 2007).

The study shows that, there is no seasonal trend in dog bites reported at the hospital. Over the five year period, dog bites were highest in November, 15.5% (36) and lowest in March 2.2% (5). However, different patterns were observed when this was stratified by year. November recorded the highest dog bite cases for only three of the years. For instance, in 2012 the highest proportion was recorded in October, 24% (12) while the lowest was in August (0%) followed by November 2% (1).

For reported rabies cases over the five years, it was also observed that there was no seasonal trend. April recorded the highest proportion (22.7%) while February, May and June recorded zero cases each. Similar results were observed by Cleveland and colleagues where quarterly reported rabies cases did not show seasonal trends over a four year period (Cleveland et al, 2003). Also Pfukenyi et al, in 2007 analyzed 12 years data and observed no seasonal trend. The highest cases were however, in September.

Almost all 99% (231) of those who reported at the hospital with dog bite received post-exposure Prophylaxis vaccine. However, not all of them received the vaccine on the day they reported. About 94% (217) received the vaccine on the day of reporting and had the recommended five doses of vaccine. The rest did not receive the vaccine the same day and couldn't complete the five doses. This might be because they could not afford to pay for the vaccination the same day they reported and could not also pay for all the recommended five doses. Masthi and the colleagues reported similar findings where some patients could not receive the vaccine due to financial constraint (Masthi et al, 2014). Though most people received the recommended doses of vaccine, the few could not receive calls for concern since post-exposure prophylaxis reduces the risk of developing rabies. This is explained by (Both et al., 2012; Franka et al., 2013) where people who received post exposure prophylaxis vaccine after bitten by the dog and before developing clinical signs of disease, did not develop rabies disease.

The number of people with dog bites and demanding rabies prophylaxis vaccine is increasing year by year. This might have reflected in the increase of rabies cases from 2010 to 2014. This was also explained in other studies (S Cleaveland, 2003; Geerdes, 2014; Masthi et al., 2014) that as the dog bites increased human rabies cases increased.

The number of dog bites reported at the Ridge hospital was higher in children than in adults. This is similar to findings in other studies who reported high number of dog bites in children than adults (Badoe & Wilmshurst, 2014; Edward et al., 2014). However, rabies cases reporting at the hospitals in this study were high in adults than in children contrary to what is in the literature. This may be attributed to the fact that the adults might delay care seeking when bitten compared to the children who will always be rushed to the hospital.

The number of dog bites in male is higher than in females in this study and this might be because of the tendency of males to have a close relationship with animals such as dogs (Masthi et al., 2014), and also might be due to the fact that when there is a vicious animal around the area, males are the ones who try to control it so that it will not harm other members of the society. These reasons for males having higher bites from dogs also was reported in the study done by (Masthi et al., 2014; Pfukenyi et al., 2007).

Also for the rabies cases from Korle-Bu Teaching Hospital, the legs being the bite site was higher than in other part of the body of the victim. This might be because legs are lowest extremities part of the body that can be reached easily by the dogs compared to other area of the body. Also, when comparing the height of dog and human it is easier for the dog to attack the lower extremities like legs of human being compared to other part. Other studies have also reported that higher number of bites were on the legs than other part of the body (Pfukenyi et al., 2007; Stahl et al., 2014). The findings are however, contrary to what The et al, (2011) observed in their study where the dog bite injuries were reported more frequently on the head and hands and less frequently on the legs.

The data on dog bites did not have information on location or residence of the patients. For data on the rabies cases, the information shows more cases were coming from urban areas, 59.1 % (13) than the rural, 27.3 (6). This results is different from findings from other studies which indicated that many rabies cases were coming from rural area compared to urban area (Cleaveland, 2003; Masthi et al., 2014). This is however, expected since the study area (Greater Accra) is largely urban in this study. Also it has been reported that the rate of disease transmission depends on the dog population of the area. The higher the population of dogs, the higher the chance of getting human rabies (Geerdes, 2014).

For status (stray or domesticated) of the biting dogs, about a half, 45.5% (10) of patients did not have information. For those with information, the stray ones were more than the domesticated. This is because most of domesticated animals are confined while stray dogs are not and this also was observed by (S Cleaveland, 2003; Geerdes, 2014; Shwiff et al., 2013) that large number of animals that did biting was stray animals.

Dogs were mainly responsible for all those who reported to seek rabies prophylaxis at the Ridge hospital. Also 59.1% (13) of rabies cases admitted at Korle- Bu Teaching Hospital had information on the type of biting animal and the records indicated they were all due to dog bite. The rest of the cases, 40.9% (9) had no information on the type of the animal. This was also reported in the study done by (Stahl et al., 2014) where 99% of human rabies cases were due to dog bites.

The time from bite from a rabid animal to disease development was highly reported from day 14 to day 60 regardless of the part of the body which was being exposed by the virus through the bite. The incubation period in this study is similar to what was observed by Badoe et al, (2014) who stated that the incubation period was from 20 to 60 days and shorter than what was reported by Jackson, 2013 (Jackson, 2013) that the incubation period was from 30-90 days.

Many animal bites and rabies cases in human, especially in remote/rural areas which are far from hospitals and health centers may go unreported as only 27.3% (6) of reported bites are from the rural areas in this study. Therefore, the reported cases in this study only provide an index of the magnitude of the disease, and could be an underestimate of the extent of the problem.

5.1 Limitation

- Because the study was a descriptive cross-sectional study which involved reviewing past hospital records, it was difficult to get some important information such as referrer facility, time or date of exposure to bite injury for data analysis.
- It was difficult to link information on dog bites from Ridge hospital and clinically diagnosed human rabies cases that were referred from there to Korle-Bu Teaching Hospital. This made it impossible to estimate the burden or proportion of clinically suspected human rabies from dog bites
- Data for this study were mainly from the urban area so the findings were limited to urban area except a few who were referred from the rural area of the region.
- The dog bites data had no information on date of the dog bites so information on care seeking behavior (how long it takes to report to the health facility with a bite injury) could not be estimated.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The aim of the study was to determine trends of dog bites and human rabies in Greater Accra region from 2010 to 2014. The study shows that male and children less than fifteen years of age were more affected by dog bite while adult were more affected by rabies disease regardless of their sex. About 94% of all patients who reported at Ridge hospital that they had a dog bite, received recommended five doses of post-exposure prophylaxis vaccine. The result also shows that there is no clear steady pattern on the trends of dog bite and human rabies over the period of five years, although there is an increase of cases from 2010 to 2014. Similar pattern was observed for seasonality. There was no seasonal trend as November recorded the highest number of dog bites while March was the lowest. Rabies cases also show no seasonal trend. The highest cases were recorded in April.

6.2 Recommendations

The following recommendations are proposed based on the results of my study

- Dog bites and rabies cases in this study do not show seasonal trends, therefore public education on dog bites and about rabies is required throughout the year.
- Hospital authorities should expand in keeping records of human rabies outbreak and animal bites in hospitals by adding information such as address of patient, location of the body where the patient was bitten, and the status of the animal which did the biting.
- Hospital authority also should prepare the data base for dog bites and rabies cases which will have demographic information of the patient and information on the type and status of the animal that did biting.

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APPENDICES

Appendix 1: Data extraction sheet

HUMAN RABIES CASES

Variables	description		2010 (cases)	2011 (cases)	2012 (cases)	2013 (cases)	2014 (cases)	Total numbe r of cases
age	0-15 years							
	16years and above							
sex	male							
	female							
Address and location	Rural							
	Urban							
Characteristi c of a bite	Location(head, leg, arm)							
Biting animal	Dog							
	cat							
	wild							
Animal status	domesticated							
	stray							
Vaccination status	Vaccinate d	PRE P						
		POE P						
	Non vaccinated							
Animal exposure	bite							
	Scratch							
	saliva							
Time from exposure to disease development	Numeric							

Appendix 2: Ethical approval letter

*In case of reply the
number and date of this
Letter should be quoted.*



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9th February, 2015

Svetlana Elieza
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GHS-ERC
Review Summary

Protocol ID NO: GHS-ERC 109/02/15

Country: Ghana

Protocol Title: “Trends of Human Rabies Cases in Accra from 2010 to 2014”

Dear Svetlana Elieza

Please find the review summary of the Protocol titled: “**Trends of Human Rabies Cases in Accra From 2010 to 2014**” that was submitted to the ERC Secretariat for review.

We wish to inform you that the above-mentioned Protocol underwent full expedited review and that approval has been granted for its implementation

Your approval letter is been processed but please write your name and title on the GHS/ERC checklist and refill. Resubmit 1 copy of the full revised protocol to the ERC.

Please note that the revised protocol should have all the requirements for submission. (PI's response letter, other supporting letters, GHS-ERC completed administrative information form, checklist, participant information sheet and informed consent form, questionnaire, CVs, etc)

We wish you a successful project implementation.

Accept our congratulations.

Administrative Secretary, Ghana Health Service Ethics Review Committee

For: Chairman

Name: Ms Hannah Frimpong