ESTIMATES OF THE INCIDENCE AND BURDEN OF HUMAN CASES OF DOG BITES IN JUBA CITY, SOUTH SUDAN

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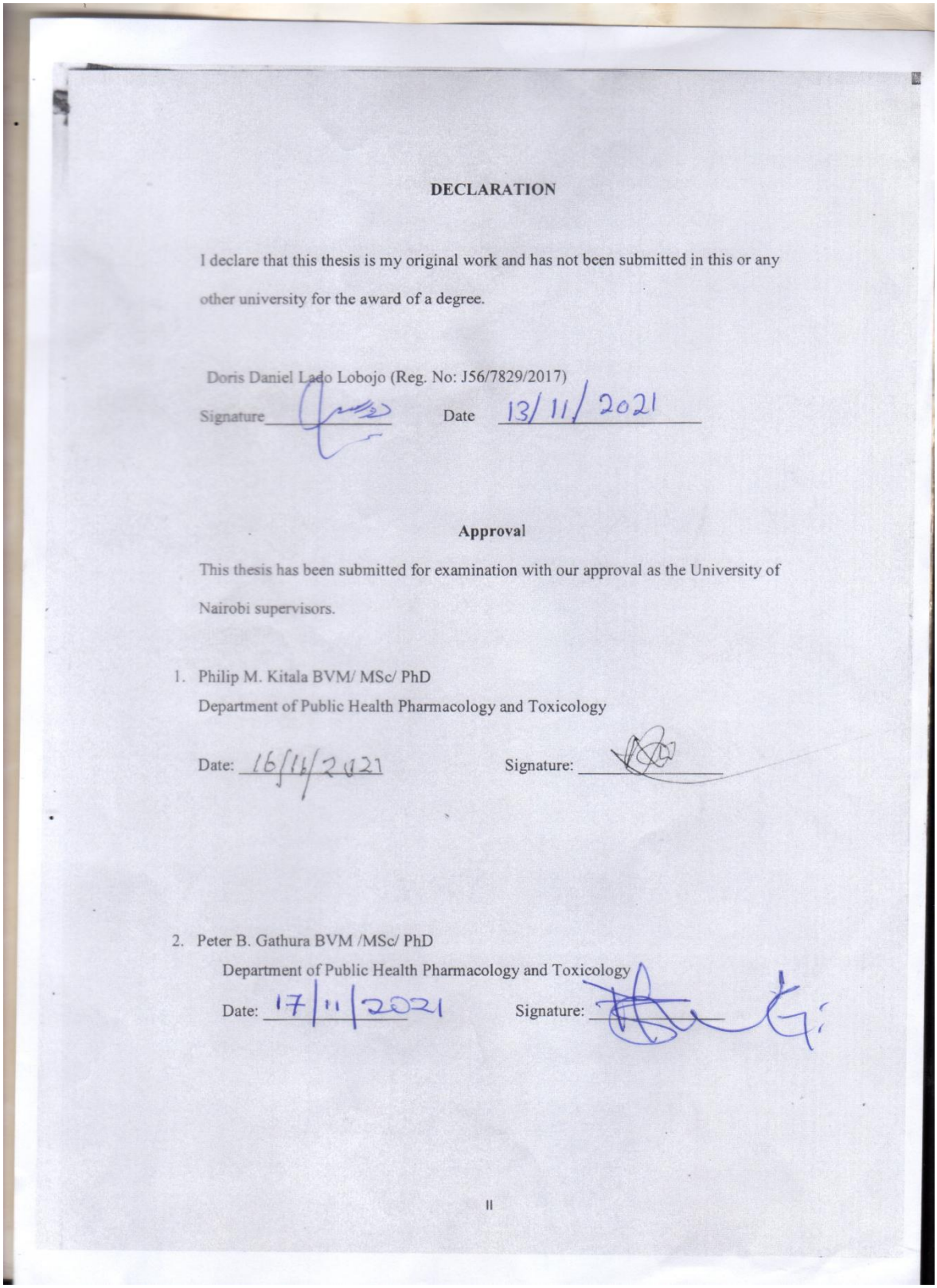
DECLARATION



DECLARATION

I declare that this thesis is my original work and has not been submitted in this or any other university for the award of a degree.

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Approval

This thesis has been submitted for examination with our approval as the University of Nairobi supervisors.

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II

DEDICATION

I dedicate this thesis to my parents, husband and my children for their love, care, support and patience during my study time

And to

A loving soul of late Engineer Vincent Wunyi Yama

ACKNOWLEDGEMENTS

I would like to thank Borlaug Higher Education Research and Development (BHEARD) Scholarship and University of Nairobi for hosting me in the MSc programme, appreciation goes to my supervisors Prof P.M. Kitala of University of Nairobi and Dr. P.B. Gathura of University of Nairobi for their guidance in data collection, analysis and writing of this thesis. My thanks go to Dr. Yuhanis E. Odhuk , Dr Jada Wani , Dr Samuel Abba, Mobile Humanitarian Agency I am also grateful to my colleagues from south Sudan for their support in data collection on dog bites cases . I would like to thank Dr John Kanisio, Dr. Jacob Korok , Dr. Munier Lado , Dr Robert Patrick, Dr Richard Laku , Dr John Ponsiano and Dr Ben Lowki for providing conducive work environment. Special thanks go to BHEARD coordinator Mr George Otieno and the MoH South Sudan Ministry of Livestock, Juba Teaching Hospital Administration and the Juba Veterinary Clinic they willingly provided retrospective data on dog-bites in their records. Finally, I would like to thank my family for their patience and support.

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LIST OF ABBREVIATIONS AND ACRONYMS

CDC	Centres for Disease Control and Prevention
CFSPH	Centre for Food Security and Public Health
DALY	Disability Adjusted Life Year
JCC	Juba City Council
JTH	Juba Teaching Hospital
JVC	Juba Veterinary Clinic
MMWR	Morbidity Mortality Weekly Report
OIE	World Organization for Animal Health
PEP	Post –Exposure Prophylaxis
PET	Post Exposure Treatment
SSP	South Sudanese Pounds
WHO	World Health Organization

ABSTRACT

Rabies is a disease of ancient time. It has a case fatality rate of 100% and it is transmitted to humans by rabid animal especially domestic dogs. Thus dog-bites are an indicator of the burden of rabies in human populations. The objectives of this study were 1) To estimate the incidence of human cases of dog-bites in Juba City South Sudan 2) to assess the burden of dog bites in Juba City, South Sudan.

The study was conducted in two parts a retrospective five years (2015-2019) data collection at the Juba Teaching Hospital (JTH) and Juba Veterinary Clinic (JVC). Then data were collected prospectively at the same health facilities for four months (August-November, 2019). Data were collected by administration of questionnaire via personal interviews with the dog-bite cases. Data collected included age, sex, location site of the body where bite was inflected, vaccination status of the biting dog and Post-Exposure Prophylaxis(PEP). (Epi-Info version 3.5) were used for data analysis.

A total of 138 cases of dog bites were reported in the five-year retrospective data at the JTH and JVC. There was steady increase in the number of human cases of dog-bites in the years (2015-2019) under review. Dog bites appeared throughout the year with a peak in July and September. Cases of dog-bites were reported throughout the administrative units of Juba City Council, Kator (58%), Munuki (27%) and Juba (15%). Kator had the highest human population age density. Boys especially bellow twenty years of age were the most affected by dog bites. More males than females of all age-groups were affected. The majority (69.9%) of the bites were inflected in the lower extremities. Other sites included upper extremities (23%), face (2%) and stomach (2%).

Thirty-Seven human cases of dog bites were reported at the JTH in for the four-month prospective study and the bite incidence was estimated at 36.9/100,0000 population per year.

The biting patterns were similar to the retrospective study. People were reportedly bitten by own dogs (24.3%) neighbour's dog (45%) and unknown dogs (29.7%). In addition, females were more likely to be bitten by neighbour's dog (65%) and boys by unknown dogs (44%). Most the biting attacks were by provoking the dogs especially by boys. In the four-month prospective period 37 cases of human dog-bites were reported to the JTH and JVC there was a strong relationship between dog ownership and wound location 47% of leg wounds reported to be bitten by unknown dogs (P.value >0.05) and there was no evidence of an association between wound location and sex (P.value 0.3). Only 32.4% of the cases received anti-rabies vaccine and a huge proportion (67%) received none 92 % of those who receive the vaccinate are males while 8% are females (OR 5.17: 95% CI). Of those who received the first dose of vaccine none completed the recommended vaccine regime of day 0,3,7,14 and 28. At the time of this study JTH did not have the anti-rabies vaccine in stock. Transport costs to the clinic and the cost of anti-rabies vaccine were reportedly the major costs in seeking Post-Exposure Prophylaxis.

In conclusion the study has shown that dog-bites and subsequently rabies is a major public health problem in Juba City Council. The incidence of dog bites is high and the dog population is in-adequately protected against rabies via vaccination. There is need to design and implement dog vaccination campaigns. For the campaign to succeed public participation and sympathy should be enlisted.

CHAPTER ONE

1.0 Introduction

1.1 Background

Animal bites are vital causes of morbidity and mortality worldwide due to possibility of exposure to rabies, which may be prevented by timely and acceptable post-exposure prophylaxis (PEP) (Esmaeilzadeh *et al*., 2017). Ninety -nine percent of human rabies cases is due to dog bites and 50% of the cases occur in children ≤ 15 years old (Salamao *et al*., 2017). In developing countries, many studies reveal that dog bites accounts for between seventy-six and ninety-four percent of the total bite injuries ensuing leading to high rabies incidence and higher fatality rates because of lack of access to anti-rabies treatment (Ngugi *et al*., 2018). Moreover, the health consequence of animal bite counts on the type of animal species causing the bite, susceptibility of the host species to rabies, availability of nearby health facilities and skilled personnel for management of bites cases (Gosavi and Deshmukh, 2015).

Annually more than 10 million individuals in different region of the world are treated because of animal bites (Charkazi *et al.*,2013). Moreover 96.5% of the economic losses caused by rabies treatment have occurred in low and middle income countries of approximately 560 million dollars (Hatami *et al*., 2007) This is due to the shortage of advanced care system for rabies. Approximately above 2.5 million individuals worldwide are in threat of the disease and indeed the disease has been reported in more than a hundred countries.

Studies in Australia indicate that about 6553 Australians were injured between the year 2000-2002 as a result of dog bites which is equivalent to an annual adjusted rate of 11.3 dog bites cases (Kreisfeld and Harrison, 2005). In Australia dogs accounted for between 85 and 90%, of total animal bites cases followed by cats (5-10%), humans (2-3%), and rodents

(2-3%) in 1994. Recent publications confirmed that in the United States of America about 4.7 million cases of dog bites occurred annually (Steele *et al*., 2007).

In Kenya, the incidence of animal-bite wounds is 336 bites/100,000 people and 858 confirmed human rabies cases from uncontrolled free-roaming domestic dog have been documented between 2002 and 2012 (ZDU, 2014). Although there is no data on rabies in South Sudan only few records on suspected cases were available to be studied. Rabies is hierarghically among the highest 5 priority animal disease in Kenya. It is estimated that annually a 1000 to 2000 cases of human bites occur (Ngugi *et al*., 2018). In Kenya, the burden of human rabies is assumed to be under reported due to issues that hinder the use of PEP as well as lack of diagnostic capabilities, unavailability of anti-rabies vaccines and inadequate information and management of cases of animal-bite injuries (Obonyo *et al*., 2016). The incidence and kind of animal and human bite injuries depend upon geographic location, manufacturing plants and cultural factors (Sreenivas *et al.,* 2017). The incidence of animal bites within the US is calculated at two hundred per 100 000 persons annually. Roughly a hundred million dogs and cats in American households cause approximately 1–2 million dog bites and 0.4 million cat bites annually (Norton, 2008)

German epidemiological data declared that data on animal bites are not considered to be legally reportable thus no statistical data are kept. In Italy, the rate of cases of animal bites in two areas (Bologna and South Tyrol) was 50–60 per 100,000 persons per year (Morositti *et al.*, 2010)

In India, the annual estimates of dog bites is 17.4 million, resulting in 18,000-20,000 cases of human rabies per year (Gongal and Wright, 2011). Because rabies is not a reportable disease in India and the majority of deaths occur in rural regions with poor surveillance, it is usually assumed that this statistic is an underestimate.

In the past, many rabies patients did not receive any immunization at all, and many did not complete the recommended course (Sudarshan *et a*l., 2006).

1.2 Economic Burden of Rabies

In animal reservoirs, rabies is maintained, like all zoonotic diseases by animals. The virus may continue to circulate in wildlife in developed countries where canine rabies has been eliminated, whereas the main reservoir in most developing countries is the domestic dog (Weyer, 2011). The incidence of human rabies depends totally on dog-related transmission factors, Zinsstage *et al.* 2009 simulated the effects of the culling of a percentage of the dog population on human rabies incidence and a mass vaccination of dogs. A single campaign of rabies-vaccination achieving a coverage of 70 percent is sufficient to interrupt transmission of rabies to humans for at least 6 years (Zinsstag *et al.*, 2012).

The economic burden of Rabies is unknown (WHO, 2013) and the limitation facing estimation of the true magnitude of rabies is the absence of surveillance data for the countries where the disease is endemic. Basic information about mortality due to rabies in exposed individuals are required to advocate for proper management programme (Hampston *et al.*, 2015).

Rabies burden has been estimated in different components.

a- Societal cost: This includes morbidity and mortality and productivity loss due to premature death, the death that occur due to vaccine side-effects and psychological problems of exposure to a fatal disease that can be expressed as Disability Adjusted Life Year (DALYS).

b- Direct cost: This includes direct cost of rabies vaccine and vaccination, multiple visits to the hospital and loss of income from the government side, cost of establishment or strengthening of surveillance system and provision of preventive measures (Hampson *et al*., 2015).

c- In-direct costs of seeking PEP due to travel and accommodation for multiple clinic visits and lost income, fall upon the medical sector and affected communities.

1.3 Problem Statement

Nowadays the One Health idea has been cited a good method to complicated public health issues that involve various disciplines. Typically, animal health human health, and environmental health are observed as closely coupled. Samples of such complicated issues embody rising, food safety, infectious diseases and choice of antimicrobial resistant pathogens. particularly, emerging zoonosis issues are currently exceptional common (Xie *et al*., 2017).

Exposure to animal bite may lead to secondary bacterial infection. There are a few organisms that commonly result from the high-impact and anaerobic microbial greenery from saliva of the biting animal relatively from the patient's own body micro flora, can be recuperated from bite wounds. Most of the infection cases are poly-microbial. The importance of anaerobic microorganism in bite wound infections has been increased recently (Brook, 2003). Anaerobic microorganisms have been isolated from most of animal and human cases of bite wound contaminations, Vertebrate animal bites cases considered to be a major threat to the public. In 2001, within the United States of America, it has been confirmed that above three thousand persons have confirmed to be treated within the Emergency Departments for non-fatal bite connected injuries and confirmed that children at the age of 5-9 were the most reported injury rates (Nelima *et al.*, 2010)

The true magnitude of dog bites is unknown in Juba City Council due to limited literature review on animal bites in Juba City Council.

Several cases of dog bites have been reported by the local community in 2018/ 2019 and exposure to animal bites can result in infections that can kill the victim. Some of the important

diseases that can be transmitted to humans via bites by animals include rabies, pasteurellosis, cat scratch fever, tularemia and tetanus.

No studies have been conducted to determine the epidemiology of dog bites in human population in South Sudan

This research will seek to produce useful information and appropriate recommendations to be used by The animal and human health departments about animal bites thus promoting awareness; and will assist in appropriate interventions to prevent and control Rabies.

1.4 Objectives

1.4.1 General Objective

To estimate the incidence rate and the burden of human cases of dog bites in Juba City South Sudan

1.4.2 Specific objectives

- To Estimate the incidence of human cases of dog bites in Juba City, South Sudan
- To assess the burden of human cases of dog-bites in Juba City, South Sudan

CHAPTER TWO

2.0 Literature Review

2.1 Epidemiology of Rabies

2.1.1 Aetiology

Rabies is one of the viral zoonoses caused by the rabies virus of the genus Lyssavirus. The disease is cosmopolitan and might infect a large array of species especially those in the developing countries (Olusegun *et al*., 2016). In spite the actual fact that rabies is preventable with safe and effective vaccines, the disease is considered to be a leading health problem in numerous countries (Ichhpujani *et al*., 2008). One of the underlying problems of rabies is under-reporting. The death is predictable in humans after the onset of the clinical signs. The causative agent is a neurotrophic virus of the genus Lyssavirus that belongs to the family of Rhabdoviridae. Other Lyssavirus have been identified worldwide they cause disease indistinguishable from rabies (CFSPH, 2012).

2.1.2 Species Susceptibility

Dogs are the major pool and vector of rabies (Rupprecht, 2002). Many other freelance pools for lyssavirus are found in many types of insectivorous bats, foxes and Jackals covering the patterns of lyssavirus alternates maintained among terrestrial mammals (Blanton *et al*., 2006).

2.1. 3 Occurrence and distribution

Rabies is widespread and is considered to be the leading neglected zoonotic disease, affecting mainly poor and vulnerable individuals living in areas with poor human and animal health services (WHO, 2014). For centuries, rabies has threatened man from the Mediterranean Basin to India (Blancou, 2004). Wide outbreaks of rabies have been reported in Europe and the Mediterranean Basin, with wolves and dogs being the most

commonly reported source (Louise, 2015). Rabies virus is a highly expedient pathogen and canine rabies tends to spread to new regions, as seen by the outbreak in China (Guo *et al.*, 2013).

Disregarding the historical and modern progress in rabies control activities in the developed countries, rabies continues to be neglected in the third world like in Asia and Africa, where disease victims come from the poor individuals of the society (Lankester *et al.*, 2014).

In Africa rabies has been reported in several wild animals yet domestic dogs still remain the main source of rabies due of its close relationship with humans (Taylor *et al*., 2001).

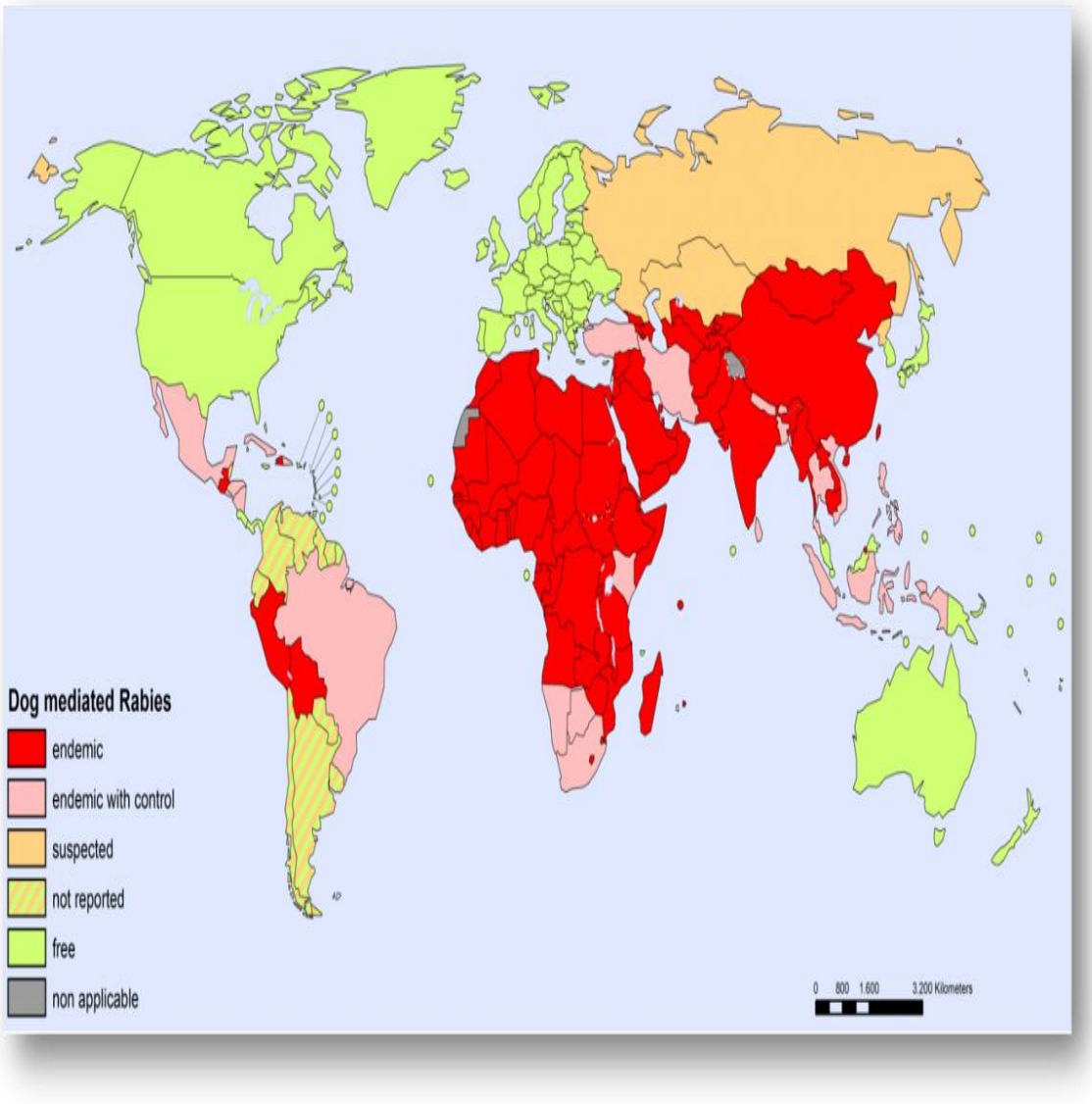

Figure: 2.1 Global distribution of Risk of Human Rabies (WHO, 2013)

2.1.4 Mode of Transmission and Pathogenesis

Rabies is mostly transmitted via a bite of an infected animal and it is also possible that some people might become infected through non-bite exposure which can include abrasions, scratch or open wound that is exposed to saliva when an individual has been exposed (Hemachudha *et al.*, 2002). The severity of lyssa infection differs with the character and degree of that exposure. Bites by infected animal mostly inoculate

contaminated saliva through the skin into muscular tissue and subcutaneous tissues (Warrell and Warrell, 2004). During the incubation period the virus binds to nicotinic acetylcholine receptors at the neuromuscular junction and travels towards the spinal cord within axon of peripheral nerves (Jackson, 2014).

2.2 Animal bites

2.2.1 Dog Bites

Dogs are kept for companionship, love and have well-tried health benefits. Nevertheless, in the United Kingdom, due to increase in dog attacks cases on children and adults, the 1991 Dangerous Dogs Act was developed (Graham, 2016). Almost 78 percent of dog-bites in young children occurred on the neck and head whereas only 10% occur on this location in adults. This important distinction is as a result of the short height of children that makes their face more vulnerable. Some parts of the body like the cheek, nose and lips are considered to be the 'target areas (Nataraja *et al*., 2012). Bites on the head typically has shorter incubation period due to its proximity to the central nervous system (Efren *et al.*,2011).

Dog bites results in a combination of puncture-type of wound with adjacent tearing of tissue, the 'hole and tear' effect. Several degree of crush injury also occurs due to the dynamics of the bite. The clinical necessitates are that puncture wounds pose a great risk of infection, as they harbour micro-organisms deep within the wound which has a narrow entry point, and hence poor drainage and has an environment ideal for the growth of anaerobic bacteria (Panagiotis *et al*., 2009).

2.2.2 Cat bites

Cat bites account for up to fifteen percent of all animal bites and typically have an effect on the hands, arms and face. Most cases of cat bites occur in children. However not all bite

cases obtain medical attention though up to 58% of cat bites will get infected (Okisi *et al*., 2014).

2.2.3 Bat exposure

Bats are also responsible for rabies transmission to humans in America (Blanton *et al.*, 2008). The risk if bat exposures in human populations is difficult to determine due to limited number of bat exposures compared to the other species or it might be difficult to recall of a bat experience that might have happened a few weeks or months prior. Indeed, few bat-related rabies viruses may well be more likely to result in contamination after inoculation into shallow epidermal layers (MMWR, 2008). Apart from Rabies virus bats are considered to be reservoirs for most lethal viruses such as Marburg, Ebola, SARS and Nipah (WHO, 2015).The global distribution of rabies is shown in figure 2:1.

2.3 Clinical Sings

Rabies incubation period varies from days to year. However, the majority of human cases become active within three months (OIE, 2009). The early indications may incorporate non-specific clinical signs such as fever, malaise, headache and discomfort and pain at the place of virus entry. Throughout the incubation period bite case experience confusion, anxiety and agitation, this may progress to abnormal behaviour, insomnia, hypersensitivity to light and sound, hallucinations, lean or partial paralysis, hyper-salivation, difficulty in swallowing, pharyngeal spasms upon exposure to liquids, and convulsions (CDC, 2019). Encephalitic (furious) type with hyper-excitability, hydrophobia and a paralytic (dumb) form characterized by generalized paralysis predominate are the two types of rabies . Death generally occurs between 2 to 10 days; survival is extremely rare (CFSPH, 2009).

2.4 Treatment and Prevention

Treatment of rabies in humans when clinical signs and symptoms are manifested is futile. The WOH (2005) recommends the thorough washing of the wound with copious amounts of water. The aim is to remove as much as possible the virus in saliva. After washing antiseptics are applied to the bite wound and then administration of rabies antiserum is done at 40 IU/kg body weight of antiserum from equine origin and 20 I-U /Kg of human origin. Half of the dose is filtrated around the wound and the rest is given intra-muscles.

Then anti-rabies vaccine is (tissue culture) administered in the diploid region on days 0,3, 7, 14 and 28. This process includes multiple visits to the clinic. This post-exposure vaccination is out of the reach of the rural poor and some may choose forego it.

2.5 Pre exposure prophylaxis

People at high risk occupation are recommended to be given Pre-exposure prophylaxis. This include laboratory personnel handling tissues infected with the virus, veterinary doctors, and wildlife officers. Three-dose regimen can be administered, one injection each on days 0, 7, and 21 or 28 (Haradanhalli *et al.*, 2013)

2.6 Diagnosis

2.6.1 Direct Microscopy

Infected cells contain groups of infectious agents known as Negri bodies. These inclusion bodies are found intra-cytoplasmic and are for rabies infection. The size of these bodies range from 3μm as large as 30μm and their shapes are oval or round and extremely eosinophilic with specific stainability granules, usually organized on a form of a rosette, among the eosinophilic matrix. (WHO, 2013).

2.6.2 Fluorescent Antibody Test (FAT)

Fluorescent Antibody Test (FAT) is an accurate test recommended by WHO and it gives reliable results in few hours.The technique is done by mixing a drop of purified immunoglobulin previously conjugated with fluorescein isothiocyanate. It is added to an acetone-fixed brain tissue smear, preferably made from several parts of the brain stem. FAT provides a reliable diagnosis in 98–100% of cases for all sero-types if a potent conjugate is used (OIE, 2008). A positive result is characterized by areas of orange fluorescent when the slide is viewed under a fluorescein microscope.

2.6.3 Rapid Rabies Enzyme Immuno-diagnosis (RREID)

This diagnostic method is built on detection of rabies N protein in a brain sample using polyclonal antibodies. Subsequently, the antigen is identified by adding peroxidase conjugated polyclonal antibodies. This test has been improved by the addition of biotinylated N antibody followed by streptavidin peroxidase and color change identified with o-phenylene diamine di-hydrochloride (OPD) and hydrogen peroxide. In various studies, this test has shown to be as sensitive and specific as FAT. (Mani and Madhusudana, 2013).

2.6.4 Molecular Techniques

Molecular detection by polymerase chain Reaction and macromolecule sequence-based amplification techniques has highest level of sensitivity. However, it needs standardization and extremely demanding internal control (Rodney *et al.*,2013). Rabies Virus is RNA virus and it is detected from biological fluids (saliva, cerebro-spinal fluid CSF tears skin biopsy and urine). Such techniques can produce false results and they should be confirmed by other test (WHO, 2005).

2.7 Control of Rabies

Dogs and cats have the ability to transmit rabies to humans. About 99 percent of rabies cases in humans are caused by canine or dog-mediated rabies. There are a number of safe animal rabies vaccines in the market that offer long-lasting immunity. In countries where rabies is spread by dogs, mass parenteral vaccination programs are the mainstay of rabies prevention (WHO, 2018). Another strategy for controlling rabies is to reduce dog population density by culling, based on the theory that rabies transmission is density-dependent, with disease density increasing in direct proportion to host density (WHO, 2019).

Furthermore, developing strategic and long-term collaborations between government agencies responsible for human and animal health and non-governmental organizations engaged in service delivery. These activities increase awareness and encourage effective dog bite management strategies in vulnerable human populations or communities, as well as assisting with stray dog vaccination **(**Crowcroft and Thampi, 2015). To determine the epidemiology of different lyssavirus species in Africa and Asia, a proper diagnostic and surveillance strategies are recommended. Such planning must include the gathering of zoonoses data and providing it to public health agencies so that they can formulate successful plan of action (Lembo *et al.*, 2011; Zinsstag *et al.*, 2009).

CHAPTER THREE

3.0 Materials and Methods

3.1 Study Area

The study was conducted in South Sudan a country that recently (2011) gained independence from the greater Sudan. It has a land mass covering 619,745 Km2 and has a human population of 12 million people the majority of whom are Nilotes. The country borders Sudan to the North, Uganda to the South, Ethiopia to the East, Democratic Republic of Congo to the Southern West, Kenya to the Southern East and the Central Africa Republic to the West (Figure 3.1). The White Nile passes through the country.

Being a recently independent state its veterinary and public health infrastructure is rudimentary. The country is made of 28 states.

The mainstay of the economy in South Sudan is Agro-pastoralism but with a significant number of pastoralism e.g. the Dinka they keep livestock including cattle, sheep, goats, camels and donkeys. Dogs are also kept particularly by the pastoralists to aid in herding. The estimates of dog population is unknown in Juba but according to South Sudan Veterinary Association report during rabies vaccination campaign in 2018 it has been estimated that the total number of vaccinated dogs was 2554. Juba City where this study was carried out has a human population of 300,690 and consists of three subdivisions (Payams) including Juba, Malakia and Kator. The study area occupies a land mass of 52 Km^2.

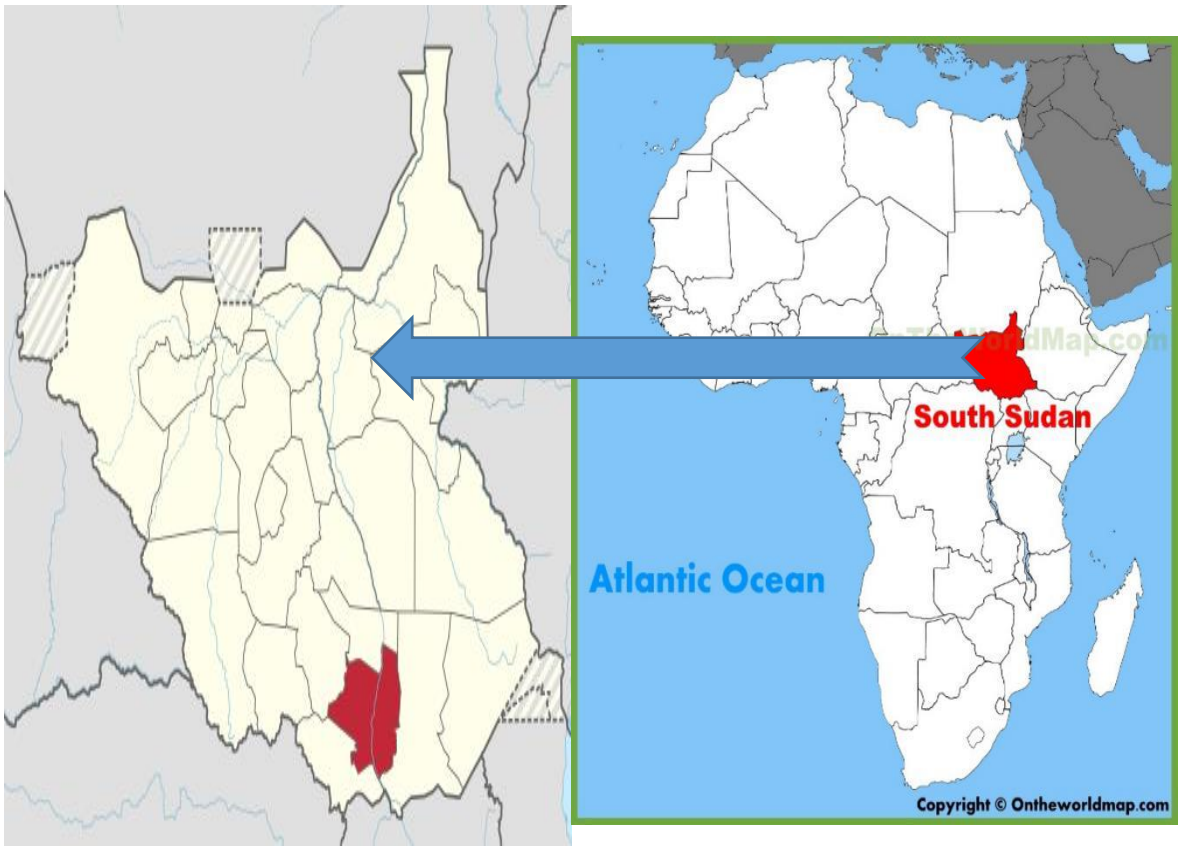

Figure 3.1: Map of South Sudan showing the location of Juba (savethechildren.org)

3. 2 Study design

The study was conducted in two parts a five-year (2015-2019) retrospective data collection on human cases of dog-bites by reviewing records at the Juba teaching hospital (JTH) and at the Juba veterinary clinic (JVC). Then a four-month (August - November, 2019) prospective data on human cases of dog-bites were also collected at the two facilities.

3.3 Sampling Method

Convenience Sampling method

3.4 Study population

The study population was all human cases of dog-bites at both The Juba Teaching Hospital (JTH) and Juba veterinary clinic (JVC). The JTH and JVC are the only major facilities providing health and veterinary services respectively to the residents of Juba City and the surrounding areas.

3.5 Data collection

Data were collected from individuals who reported to the both hospitals using questionnaires which were administered via individual interview (Appendix1) which were handled via individual interviews to the human cases of dog-bites or a guardian for a child. Information collected included age and sex of the bite cases, residential area, time and date of exposure to animal bite, wound location and severity of bite, dog ownership, site of bite, depth of the wound, immunization status of the biting animal, case management after the bite and post-exposure vaccination of the bit cases. Data were prospectively collected for four months.

3.6 Retrospective data

3.6.1 Hospital Data

Data were collected from previous reports on dog bites for the last five-years (2015-2019) and included demographic information of the victims, date of bite, place of bite and Post Exposure Prophylaxis (PEP).

3.6.2 Veterinary office data

Records on human cases of dog bites that were kept at the veterinary clinic in Juba were reviewed and included information on the demographic information of the victims, time and date of exposure to animal bite, wound location and severity of bite and the cost of treatment.

3.7 Data Analysis

Epi-Info. (Version 3.5) statistical software was used to analyse data. Frequencies, proportions, tables and figures were generated. The chi square test was used for categorical variable to assess the association at $P < 0.05$. The mean, median and range were calculated for numerical variables.

3.8 Ethical considerations

The main purpose of the study were explained to the study participants and an informed written consent was sought from each participating individual. Confidentiality of the information was observed and maintained. Ethical approval on data collection and analysis was obtained from ethical review board of the Ministry of Health and the ministry of livestock.

CHAPTER FOUR
4.0 Results

4.1 Retrospective Data

4.1.1 Human dog-bite cases (2015-2019)

A total of 138 human cases of dog bites were documented from both the Juba Teaching Hospital(JTH) and Juba Veterinary Clinic(JVC) in the five-year period. The number of bites reported appeared to increase over the years from a low of 17 cases in 2015 to a high of 40 in 2019 (Figure 4.1). More cases were recorded in JTH (63.7%; 88/138) than the JVC (38%;50/138).

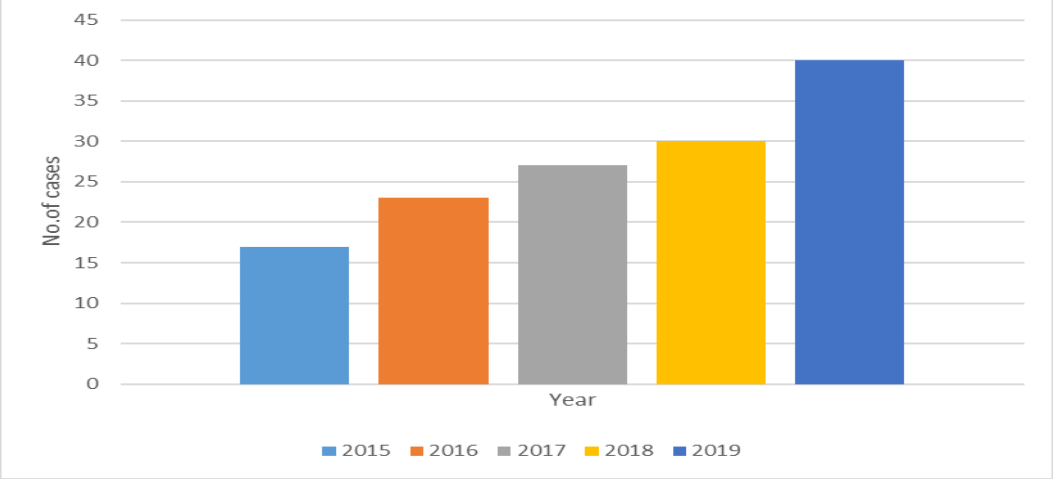

Figure 4.1: Number of human cases of dog bites reported to Juba Teaching Hospital and Juba Veterinary Clinic (2015-2019)

4.1.2 Monthly Variation of dog-bites cases

The monthly cases of dog-bites reported for the five-year retrospective data is shown in the Figure 4.2. The cases increased steadily from January to peak in June. There was another smaller pick in September.

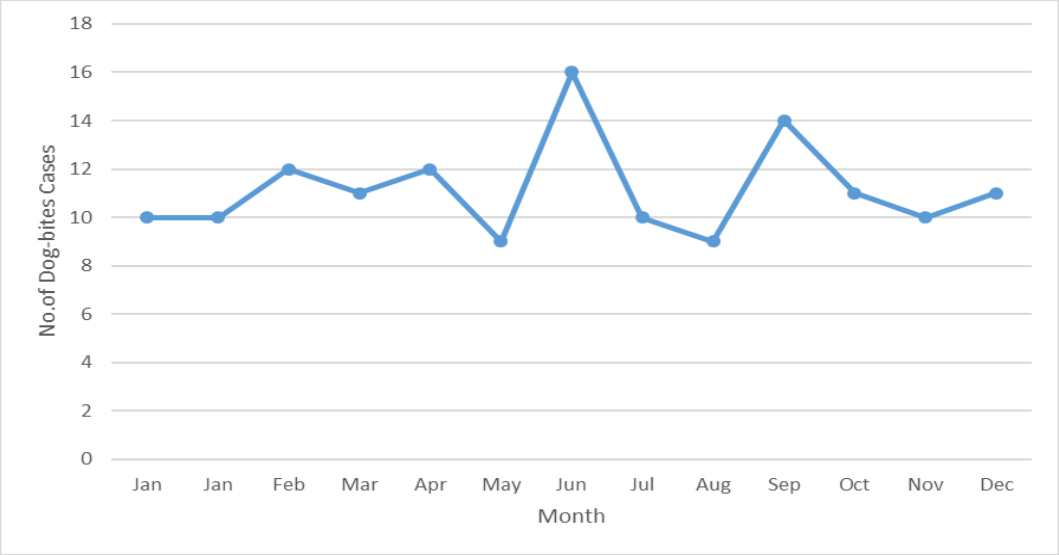

Figure 4.2: Monthly variation of the number of dog- bites in Juba City 2015-2019

4.1.3 Age-sex distribution of bite cases

Of the 138 cases reported at the two hospitals 68.1% were males and 31.9% were females. The distribution of the cases by age and sex is show in Figure 4.3. Males especially age group 11-20 years were the most affected. Indeed, there were more male cases of dog-bites in all the age-groups.

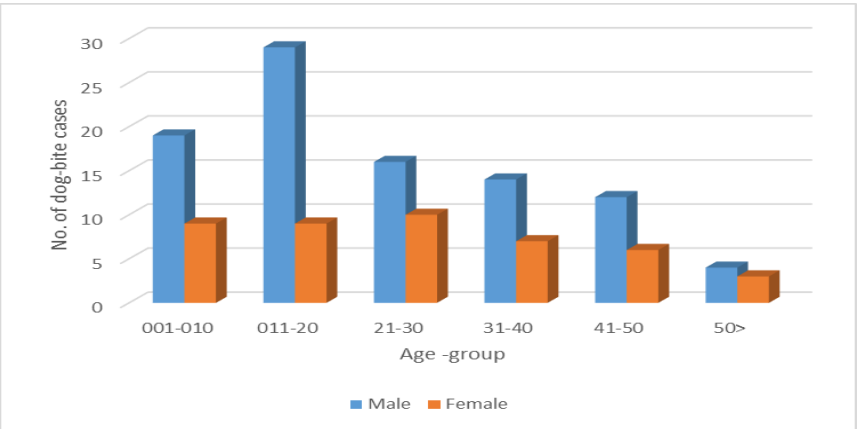

Figure 4.3: Age-group and sex distribution of dog-bites cases in Juba City, South Sudan (2015-2019)

4.1.4 Spatial distribution of dog-bite cases

Human cases of dog bite were reported from all the three Payams (Administrative areas) of Juba City Council. However, the majority of the cases were from Kator Payam. The rest of the cases were reported as shown in Figure 4.4.

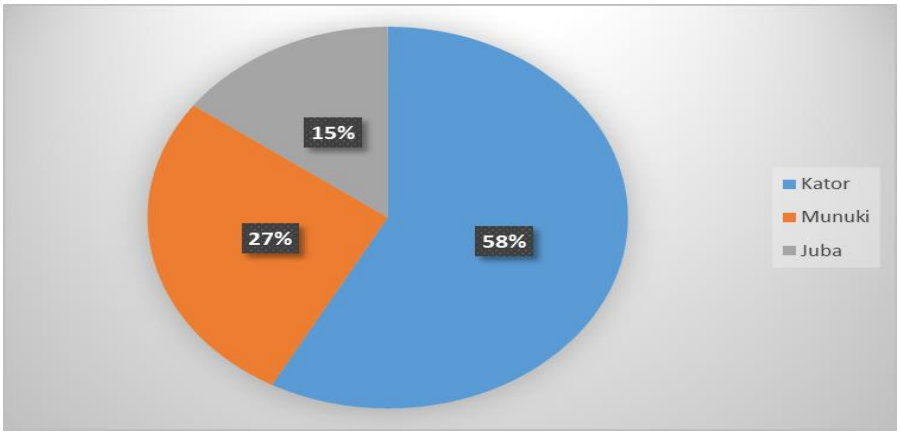

Figure 4.4: Distribution of human cases of dog-bites by Administrative units of Juba City(2015-2019)

4.1.5 Occupation of the dog-bite cases

The majority (45%) of the bite cases were students followed by the self-employed (26%). Other occupations are affected as shown in Figure 4.5

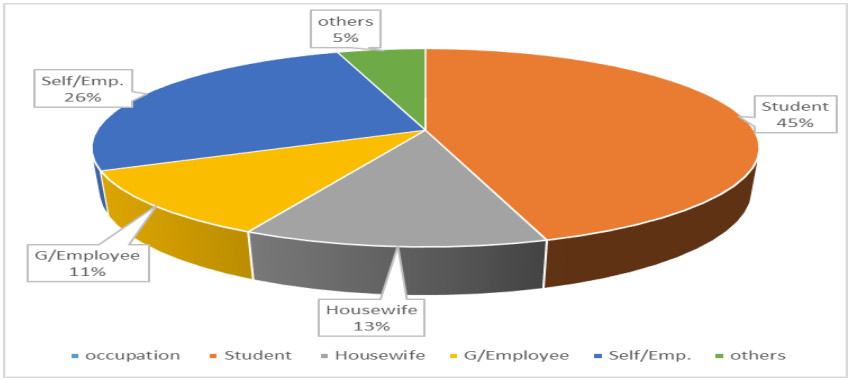

Figure 4.5: Occupation of human cases of dog-bites reported to Juba City (2015-2019)

4.1.6 Site of the bites

Almost two-third (69 %) of the 138 dog-bite cases had wound in the lower extremity. Bites on the upper extremity were also common (23%). Bites on multiple sites were rear recorded in 1% of the human cases of dog bites (Figure 4.6)

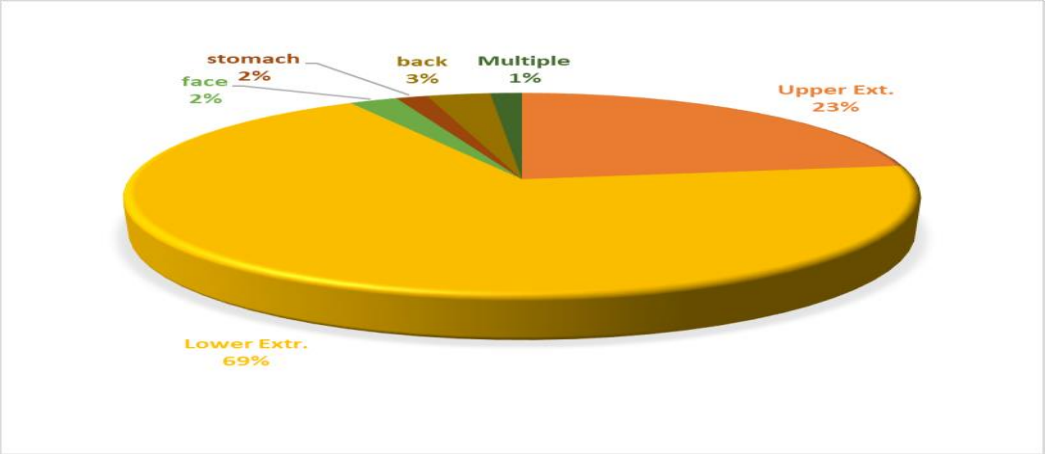

Figure 4.6: Site on the human body where dog-bite were inflicted in Juba City South Sudan (2015-2019)

4.1.7 Type of Exposure

The majority (92%) of the 138 bite cases were puncture wounds and only 8% of the exposure were scratch as shown in Figure 4.7

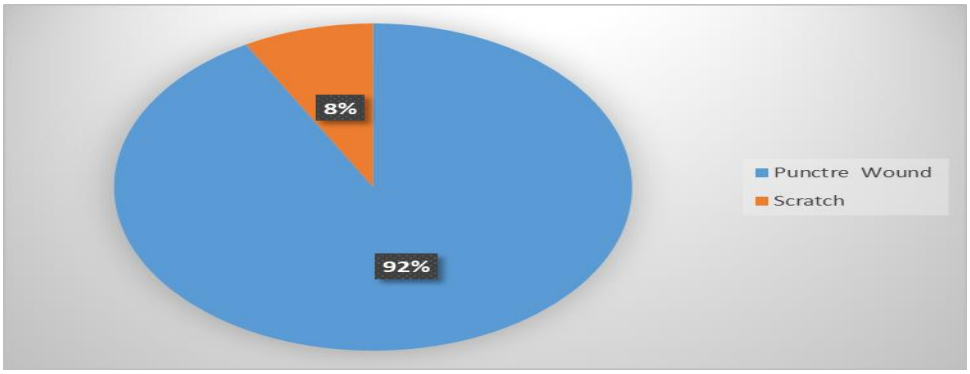

Figure 4.7: Type of exposure among dog bites cases in Juba City (2015-2019)

4.2 Prospective Data

4.2.1 Incidence of dog bites

In the four- month prospective data collection period both at the Juba teaching Hospital and Juba Veterinary Clinic 37 bite cases were reported. Almost equal number of the bite cases were reported at both the Juba teaching Hospital (18 cases) and Juba Veterinary Clinic (19 cases). Most of the cases were reported in the month of September 2019 then declined through October to a low in November 2019. (figure 4.8)

Figure 4.8: Monthly reports of human cases of dog- bites in Juba City, South Sudan (2019)

4.2.2 Spatial distribution of Human cases of dog bites by Administrative units

Of the 37 cases reported nearly half (48%) were from Munuki Payam and the other half from Juba and Kator Payam. (Figure 4.9).

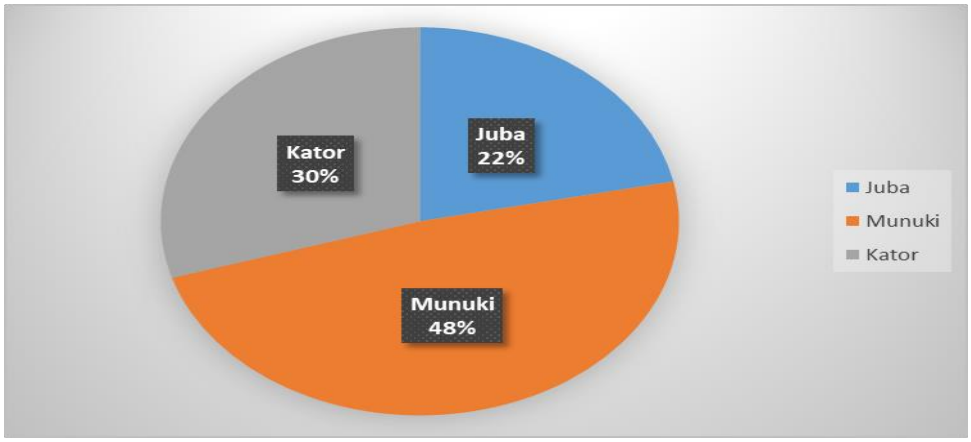

Figure 4. 9 Spatial distribution of Human cases of dog bites by administrative units of Juba City ,South Sudan (August - November 2019)

4.2.3 Sex of the respondent

More males (75.7%) than females (24.3%) were reported have been exposed to dog bites at the Juba Teaching Hospital and the Juba Veterinary clinic in the four-month data collection. The difference of the two proportions were statistically significant ($P < 0.05$)

4.2.4 Educational Level of dog-bites cases

Of the 37 human cases of dog-bites interviewed, the majority (40.5%) had achieved primary level of education. Almost (30%) had no formal education (Table 4). Few had secondary and tertiary education.

Table 4 .1 level of education of the dog-bite cases in Juba city council South Sudan

Educational Level	Frequency	Proportion
Primary	15	40.5%
Secondary	5	13.5%
Tertiary	6	16..2%
No formal education	11	29.7.%

4.2.5 Dog-bites incidence

The population of Juba City Council was 300,690 out of which 37 were bitten by dogs. This translates to 12.3 bites per 100,000 population. Assuming the biting rate remained constant throughout the year then the incidence was equivalent to 36.9 bites per 100,000 populations (Martin *et al.*,1987).

4.2.6 Ownership of biting dogs

People were bitten either by their own dogs (24.3%), neighbor's dogs (46%) or unknown dogs (29.7%). Figure 4.10

More females (58%) than males (42%) were reported to be bitten by neighbor's dog than were by owned dogs or unknown dogs. The rest of the majority of the bite cases were through unprovoked attack (62.2%). Provoked attacks especially by boys comprised (37.8%) the bites cases.

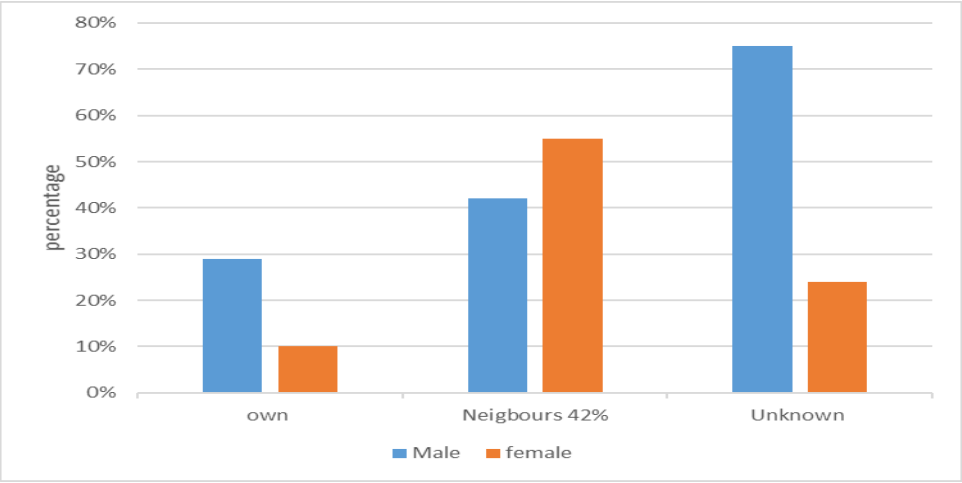

Figure 4.10 The patterns of dog bite according to ownership and sex of the biting case in Juba City, South Sudan (August -November 2019)

4.2.7 Post Exposure Treatment

4.2.7.1 Wound washing

Two-thirds (67.6%) of the bite cases reported to have washed the bite wound after the bite incident. The remaining 32.4% did not wash the bite wound.

4.2.7.2 Anti-Rabies Prophylaxis

Of the 37 bite cases only 32.4% received a starting dose of anti -rabies vaccine following the bite incident. The majority (66.7%) did not receive the life-saving rabies vaccines. At the time of the prospective study 92 % of those who received the vaccine are males while 8% are females (OR 5.17 : 95% CI). None of the rabies vaccine was present at the hospital and had to be purchased from private pharmacies within Juba City. None of those who received the vaccine had the recommended dose on days (0,3,7,14 and 28) WOH (2005). They commonly cited failure to receive the PEP was the high cost of the vaccine and transport cost to the clinic.

Table 4 .2 Anti rabies administration of the dog-bite cases in Juba city, South Sudan

Anti rabies Administration	Male	female	TOTAL
Yes	11	1	12
Row %	91.7	8.3	100.0
Col %	39.3	11.1	32.4
No	17	8	25
Row %	68.0	32.0	100.0
Col %	60.7	88.9	67.6
TOTAL	28	9	37
Row %	75.7	24.3	100.0
Col %	100.0	100.0	100.0

4.2.8 Vaccination status of the biting dogs

Of the 37 cases of dog-bites that reported, only quarter (25%) were reportedly bitten by vaccinated dogs A further 44.4% were bitten by reportedly unvaccinated and 30% were bitten by dogs of unknown vaccination status. Usually this last category of dogs had no known owners and disappeared after the biting incidence.

4.2.9 Cost of Post-Exposure prophylaxis

Post-Exposure prophylaxis against rabies has numerous costs associated with it. In this study only cost of vaccine, transport to the clinic and lunch were cited as the most important components. The PEP cost range between 200 - 800 South Sudanese Pounds which is equivalent to (1-4) dollars per a visit.

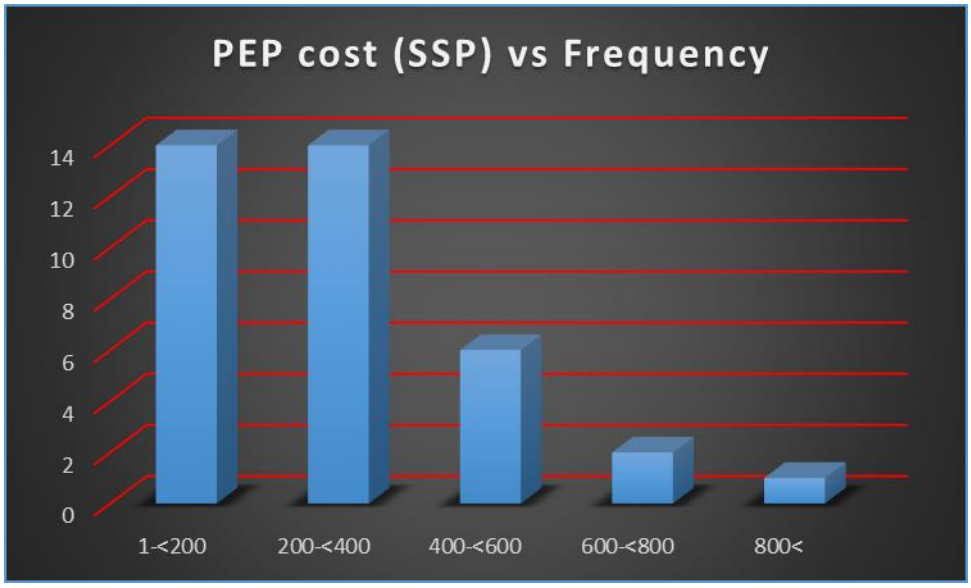

Figure 4.11 Cost of Post Exposure Prophylaxis in Juba City, South Sudan (August -November 2019)

CHAPTER FIVE
5.0 DISCUSSION

Dog -bites were reported in all the study areas of Juba City Council but more cases were reported in the more populous and dense in the human population in Kator Payam. The Kator Payam is an informal settlement newly settled by internally displaced refuges as a results of a civil war in South Sudan after independence from Sudan. Naturally they are with their livestock including dogs. This pattern of dog-bites has been observed and reported in Machakos County where dog-bites decreased from urban areas, peri-urban areas and the least in rural areas (Rosamond, 2015). An earlier study in the County documented a similar pattern (Kitala *et al*, 2001). Rabies and dog-bites cases is a density-dependent disease and thus the observed pattern of dog-bites.

Dog-bite cases were reported throughout the year. However, there was a large peak in June and a smaller one in September. A similar pattern of human cases of dog-bites was reported in the peri-urban and rural areas of Machakos County (Kitala *et al.*, 2000). The two peak occurred with a time lag and coincided with the breeding season of dogs. This period is characterized by serious fights of male dogs and such dogs are likely to bite humans.

More dog-bite cases were reported at the Juba Teaching Hospital than at Juba Veterinary Clinic. This observation is in accordance with a study conducted in Machakos where most people of bite cases were reported to public hospitals relative to the veterinary clinic. This practice is totally unacceptable. In Kenya the Rabies Control Act (Cap.365) guides on what is to be done in cases of a dog bite. The person bitten is supposed to report without delay to the veterinary authorities who asses the circumstances surrounding the bite then recommends to the medical personnel on whether to treat or not. Indeed, in the Machakos

study indicated that individuals who reported to the veterinary officers did so because they knew owners of the biting dog so that they could meet the cost of treatment.

In most cases the anti-rabies vaccine is not available in public hospitals and bite cases are referred to private chemists to purchase the vaccine. The cost of the vaccine is probably high for most rural and urban poor and some may forego the whole Post-Exposure Prophylaxis (Kitala *et al.,* 2001) (Knobel *et al.*,2005).

The incidence of dog-bites in this study was estimated at 36/100,000 population similar to an estimate of 36/100,000 in a study in Texas USA (Bonnie *et al.*, 2020). It was much lower than an estimate of 234/100,000population conducted in Machakos. The reason could be because the Machakos study was an active surveillance for dog bites and thus may revealed more cases.

Most of the bites were inflected in the lower extremities. A similar study in India yielded results that were in agreement with the current study (Sirshundu, 2015). These bite wounds may have been inflected as the person fled from the attacking dogs. There was a strong relationship between dog ownership and wound location 47% of leg wounds reported to be bitten by unknown dogs (P.value >0.05) and there was no evidence of an association between wound location and sex (P.value 0.3).

More males especially boys bellow twenty years of age were bitten more than females and the other age-groups. Indeed, they were bitten more by unknown dogs then by owned dogs or neighbour's dogs. Boys have a habit of provoking dogs they do not know thus provoking dog attacks and bites. On the other hand, females were bitten by neighbour's dogs than by other categories of dogs. Women have the habit of visiting households in the neighbourhoods for one reason or another thus exposing themselves at risk of dog bites.

Only a small proportion of dogs causing bites were reported to be vaccinated against rabies. Other bites were by dogs of unknown vaccination status. This was a serious situation especially in the mating season of dogs where serious dog fights are rampant mostly fights by unvaccinated dogs Thus, people are bitten by unvaccinated dogs. The low vaccination cover of dogs against rabies was reported in many parts of Africa (Perry, 1995; Kitala *et al*., 2001; Knobel, 2005). There is a need to scale up dog vaccination to reach the recommended 70% vaccination coverage (WHO, 2005). A good example of a such program is the recently inaugurated rabies elimination strategy in Kenya by the Zoonotic Disease Unit in Kenya by 2030.

Anti-rabies vaccines were not available at the time of the study. Indeed, only 32.4% of the bite cases received the starting dose of anti-rabies vaccine the rest had to forego the remaining doses reportedly due to the cost of the vaccination another reason is due to transport cost to the clinic. The results are in compliance with what has been reported earlier in Africa (Perry, 1995; Kitala *et al*., 2001) (Knobel 2005).

In conclusion this study has shown that dog-bites are serious public health problem in South Sudan and the dog proportion is inadequately vaccinated against rabies.

There is a need to initiate rabies control program through dog vaccination for this to succeed public participation and sympathy should be enlisted.

Study limitations

- Study design and sampling methods
- Time limits
- Missing information on dog bites registry
- Lack of previous research on dog bites in South Sudan

CHAPTER SIX
6.0 Conclusion and Recommendation

6.1 Conclusions

The following conclusions can be drawn from this study

- The study has shown that dog bites are major public health problem in Juba City Council, South Sudan. The human dog-bites incidence was estimated at 36/100,000 population. Dog-bites occurred throughout the year with a peak in June and September. Males especially boys below twenty years of age were the most affected. Boys were the most likely to be bitten by unknown dogs while women were more bitten by neighbour's dog. Most of the bites were caused by dogs whose vaccination status against rabies was unknown The burden of dog-bites was likely to have been great. None of the cases completed the recommended vaccination regime due to the high cost of anti-rabies vaccines and transport cost to the clinic. Thus, most of the bites cases forced to forego

6.2 Recommendations

- The rabies control program should include the provision of anti rabies vaccines as a public good in government hospitals
- Dog vaccination should be stepped-up. The vaccination should be aimed at the WHO recommended coverage of 70% of the dog population.
- This study has provided the basic information abut epidemiology of dog bite that can be used by the ministry of livestock and the ministry of health as a guidelines on rabies control programs hence there is no documented study on dog bits in South Sudan therefore further study is recommended.

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APPENDICES

Appendix 1 Questionnaire

ESTIMATES OF THE INCIDENCE OF HUMAN CASES OF DOG BITES AND THE BURDEN OF RABIES JUBA COUNTY, SOUTH SUDAN

University of Nairobi Faculty of Veterinary Medicine Department of Public Health, Pharmacology & Toxicology, P.O. Box 29053 00625, Nairobi Email:

dept-publichealth@uonbi.ac.ke

The information obtained will be treated confidentially and will be used synonymously

Questionnaire No.----------

Date ----------

Hospital ---------- Interviewer ----------

Identification information

1- Name (optional) ----------

2- Age---------- 3- Sex a) Male ☐

b) Female ☐

4- Payam ---------- 5- Village ----------

6- Occupation a) Student ☐ b) House wife ☐

c) Government employee ☐ d) Private sector ☐

e) Others specify --------

7- Educational Level a) Primary education ☐ b) Secondary ☐

c) Tertiary ☐ b) Uneducated ☐

8- Date of Exposure ----------

9- Reporting date ----------

10- Pet ownership a) Own pet ☐ b) Neighbor s pet ☐ c) Unknown ☐
d) Others ☐

11 – type of Exposure a) Bite ☐ ☐ b) Scratch ☐
c) contact with saliva

12- Wound location a) Leg ☐ b) Hand ☐

13- c) Face ☐ d) Mucosa ☐ e) Unknown ☐

14- f) others specify ----------

13 type of Attack a) provoked ☐ b) unprovoked ☐

c) Unknown ☐

14- Animal Vaccination status a) vaccinated ☐

b) unvaccinated ☐ c) unknown ☐

Case management

Did you visit a veterinary clinic first? a) Yes ☐ b) No ☐

15 washing of the wound after the exposure a) yes ☐ ☐ b) No
other ----------

16 Anti tetanus administration a) Yes ☐ b) No ☐
c) don't know ☐

17 Anti rabies Vaccine administration a) Yes ☐ b) No ☐

c) I don't know ☐

18- Source of vaccine ☐ a) Available at the hospital ☐

b) Purchased from a chemist c) Others (Please specify) ----------

19- Time taken to receive PEP after the bite a) Immediate ☐

b) 2-5 Hours ☐ c) Others _____

20- Transport fare to reach the hospital ----------

21- Other costs (lunch, accommodation) ----------

22- Biting animal quarantine a) Yes ☐ b) No ☐

c) I don't Know ☐

Appendix 2 Consent Form

Title of Study: Estimates of The Incidence of Human Cases of dog Bites and The Burden of Rabies Juba County, South Sudan

Invitation:You are invited to participate in a study whose goal is to estimate the incidence of humans cases of dog bites and to determine the burden of rabies in Juba City Council

Introduction: Dog bites are vital causes of morbidity and mortality worldwide due to possibility of exposure to rabies, which may be prevented by timely and acceptable post-exposure prevention, the rate of dog bites, on the other hand, is uncertain, which has consequences for understanding the true burden on public health and economic damage to the healthcare system

Procedures

If you agree to participate in this study, only questionnaire will be administered through interview no sample will be collected

Risks

There is no risk

Benefits

The results of this study will be communicated and disseminated to the people concerned for them to take action on the recommendations that will come out from the study results.

Payment

There is no payment for participating in the research conducted in Juba City Council

Alternatives

If you decide not to participate on this study, you will still receive routine care.

Confidentiality

All the information recorded will be kept confidential and used for this research only. The result of this research may be published in scientific journals or presented at medical meeting, but your identity will not be disclosed.

Compensation for illness/injury

It is expected and known that there no injury

Voluntary Participation

Your participation is voluntary and you may choose not to join the study.

Approval of the Study

This study had been approved by:

University of Nairobi Department of Public Health Pharmacology and Toxicology Nairobi, Kenya. And the Ethical Review Board Ministry of Health South Sudan

CONSENT

I have been fully informed about the study and the benefits of it. I had the opportunity to ask questions and any questions I had been asked and satisfactorily answered. I therefore consent voluntarily to participate in the study.

Name of Participant…….

Signature or thumb print of parent/legal guardian or care taker (participant's age is less than 18 years): ……

Date……

Name of Research Assistant…….

Signature……..

Date……..

Appendix 3 Ethical Approval

The Republic of South Sudan

Ministry of Health

MOH/ERB 32/2019

To: Doris Daniel Lobojo
University of Nairobi

Date: 28th Aug. 2019

RESEARCH APPROVAL LETTER

Dear **Doris**

Subject: Estimating the Incidence of Human Cases of Dog Bites and the Burden of Rabies in Juba City Council

I am writing in response to the request for authorization for the study on **'Estimating the Incidence of Human Cases of Dog Bites and the Burden of Rabies in Juba City Council'** in Juba- South Sudan.

After a close review of the proposal, I am glad to inform you that the ethical committee at the ministry of Health – Republic of South Sudan has approved the study. The Ministry acknowledges the importance of the study to provide primary data to policy makers that will be used for decision making in the Country.

Please, keep the Ministry of Health- Republic of South Sudan and the State Ministry of health informed in case of any changes regarding the study and on its progress. I look forward to the result, especially the recommendations that will be generated from the study. Note that any information generated from the study should not be published without the consent of the Ministry of Health RSS.

Good luck don't hesitate to get in touch should there be any queries.

MINISTRY OF HEALTH 28 AUG 2019 REPUBLIC OF SOUTH SUDAN

Dr. Richard Lako Lino Loro
Director General for Policy, Planning, Budgeting and Research
Ministry of Health, Republic of South Sudan

CC: Undersecretary- MOH, RSS
CC: Director General, Primary Health Care - RSS
CC: Director Generals, State Ministry of Health

30 AUG 2019

Approved

Headquarters, Ministerial Complex. Juba, South Sudan - P.O.Box 88, Juba.
Tel: +211 (0) 177 800 281 / +211 (0) 177 800 278

Appendix 4 Raw Data

Epi Info

Results Library

Current View: C:\Users\HP\Desktop\Bites Juba\Bites Juba.MDB:viewjuba

Record Count: 37 (Deleted records excluded) Date: 12/11/2020 03:08:19

Next Procedure

Forward

7- Occupation	Frequency	Percent	Cum Percent	
a) Student	61	44.5%	44.5%	
b) House Wife	16	11.7%	56.2%	
c) G. Employee	15	10.9%	67.2%	
d) private	36	26.3%	93.4%	
e)others	9	6.6%	100.0%	
Total	137	100.0%	100.0%	

95% Conf Limits

a) Student 36.0% 53.3%
b) House Wife 6.8% 18.3%
c) G. Employee 6.3% 17.4%
d) private 19.1% 34.5%
e)others 3.0% 12.1%

Next Procedure

Forward

4- Sex	Frequency	Percent	Cum Percent	
a) Male	94	68.1%	68.1%	
b) Female	44	31.9%	100.0%	
Total	138	100.0%	100.0%	

95% Conf Limits

a) Male 59.6% 75.8%
b) Female 24.2% 40.4%

6 Occupation	Frequency	Percent	Cum Percent	
a) Student	15	40.5%	40.5%	
b)House wife	2	5.4%	45.9%	
c) Goverment Emplo	9	24.3%	70.3%	
d) Private sec	6	16.2%	86.5%	
e) Others	5	13.5%	100.0%	
Total	37	100.0%	100.0%	

95% Conf Limits

a) Student 24.8% 57.9%

b)House wife 0.7% 18.2%

c) Goverment Emplo 11.8% 41.2%

d) Private sec 6.2% 32.0%

e) Others 4.5% 28.8%

Previous Dataset Results Library

FREQ NSex

Next Procedure

Forward

3 Sex	Frequency	Percent	Cum Percent	
a) Male	28	75.7%	75.7%	
b) female	9	24.3%	100.0%	

Total	37	100.0%	100.0%	

95% Conf Limits

a) Male 58.8% 88.2%

b) female 11.8% 41.2%

Next Procedure

Forward

4 Administration	Frequency	Percent	Cum Percent	
a) Juba	8	21.6%	21.6%	
b)Munuki	18	48.6%	70.3%	
c)Kator	11	29.7%	100.0%	
Total	37	100.0%	100.0%	

95% Conf Limits

a) Juba 9.8% 38.2%

b)Munuki 31.9% 65.6%

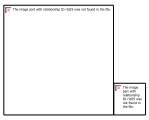
c)Kator 15.9% 47.0%

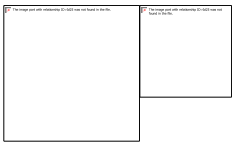
Previous Dataset Results Library

Forward

Q12 WOUND LOCATION

3 Sex	a Leg	b)Hand	c) Face	TOTAL
a) Male	17	10	1	28
Row %	60.7	35.7	3.6	100.0
Col %	73.9	76.9	100.0	75.7
b) female	6	3	0	9
Row %	66.7	33.3	0.0	100.0
Col %	26.1	23.1	0.0	24.3
TOTAL	23	13	1	37
Row %	62.2	35.1	2.7	100.0
Col %	100.0	100.0	100.0	100.0





SEX			
Yes	11	1	12
Row %	91.7	8.3	100.0
Col %	39.3	11.1	32.4
No	17	8	25
Row %	68.0	32.0	100.0
Col %	60.7	88.9	67.6
TOTAL	28	9	37
Row %	75.7	24.3	100.0
Col %	100.0	100.0	100.0

Single Table Analysis

	Point Estimate	95% Confidence Interval Lower	Upper	
PARAMETERS: Odds-based				
Odds Ratio (cross product)	5.1765	0.5662	47.3252	(T)
Odds Ratio (MLE)	4.9892	0.6621	125.5762	(M)
		0.5351	250.1973	(F)
PARAMETERS: Risk-based				
Risk Ratio (RR)	1.3480	0.9804	1.8536	(T)

Risk Difference (RD%)	23.6667	-0.3941	47.7274 (T)

(T=Taylor series; C=Cornfield; M=Mid-P; F=Fisher Exact)

STATISTICAL TESTS	Chi-square	1-tailed p	2-tailed p
Chi-square - uncorrected	2.4672		0.1162491222
Chi-square - Mantel-Haenszel	2.4005		0.1212993497
Chi-square - corrected (Yates)	1.3490		0.2454611872
Mid-p exact		0.0685866296	
Fisher exact		0.1207511084	

Doris Thesis

ORIGINALITY REPORT

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PRIMARY SOURCES

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(2) PROF J.D MAMBO
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(1)

This is to certify that Dr Doris Lokoto has carried out all the [illegible]