CHARACTERIZATION AND MANAGEMENT OF ANIMAL BITE INJURIES REPORTED AT GATUNDU AND THIKA REFERRAL HOSPITALS, KIAMBU COUNTY, KENYA

BY

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A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE IN FIELD EPIDEMIOLOGY OF MOI UNIVERSITY

DECLARATION

Declaration by Candidate:

I, the undersigned declare that this thesis is my original work and to the best of my knowledge has not been presented for a ward of degree in any university. No part of this thesis should be reproduced without the permission of the author and/or Moi University.

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DEDICATION

I dedicate this work to my late parents Mr and Mrs Joseph Njau. I thank them for the strong foundation they gave me throughout my academic journey. To my daughters Annastacia, Shantel and Faustine may you be inspired by this work in your studies.

To my wife Anne, you are a strong pillar in my life. I thank you for the moral and emotional support you have given me, especially during my post graduate studies. I thank you too for taking care of our family during my study leave period. Lastly to all animal bite victims, May this work lessen the burden of animal bite cases in future.

ABSTRACT

Background: Animal bite injuries are a major cause of public health problems worldwide; however severe losses occur in the middle and lower income countries. Animal bite injuries can lead to trauma, morbidities and mortalities when infectious organisms such as *Rabies virus, Pasteurella* spp and *Tetanus* are introduced through the bites**.**

Objectives: To describe animal bites cases and factors influencing compliance with the recommended regime for the management of animal bites injuries, and determine the application of One Health approach in the management of the animal bites.

Methodology: A cross-sectional study was conducted to eligible patients with complaints of animal bite injur**ies** in Thika and Gatundu level five hospitals from January 2021 through to May 2021. Data were collected using semi-structured questionnaire, further Treatment information was obtained from patient records. Epi Info. 2.7.4 was used for statistical analysis. Frequencies and proportions were calculated for categorical variables, while measures of central tendency and dispersion were calculated for continuous variables. Chi-squared statistics was used to measure the statistical significance of the association between independent variables and the outcome of the animal bites at 95% Confidence Level at bivariate analysis. Unconditional logistic regression was done to identify independent factors associated with animal bites.

Results: A total of 127 patients were interviewed; 69 (54.3%) from Thika Hospital and 58 (45.7%) from Gatundu Hospital. Their median age was 23 years, (Range 3–90 years, IQR 30). Respondents aged 10–14 years were 29 (22.8%) while 31 (24.4%) of the bites occurred in Thika West Sub-County. Bites on the legs were 105(82.7%). Dogs inflicted 120 (94.5%) of the bites. Biting animals with unknown ownership status were 56 (44.1%) while biting animals with antirabies vaccination status known were 20 (15.6%). Respondents who immediately washed the bite wound with soap at home were 55 (43.3%), those who received the first antirabies vaccine injection within 24 hours were 95 (77.8%). Only 3 (2.4%) respondents were referred by attending clinicians to the veterinary professional or local administration offices regarding biting animals' interventions. Respondents who complied fully with WHO guidelines for animal bites management were 43 (35.2%). Factors associated with WHO compliance were those who were employed (aOR= 7.53, 95% CI: 2.45–23.09) and not knowing the biting animal ownership status (aOR= 3.3, 95% CI: 1.27-8.67)

Conclusion: Compliance with WHO guidelines for animal bites management among respondents was low. Respondent's employment status and biting animal of unknown ownership status were associated with compliance.

Recommendations: The health authorities should increase the supply of human anti-rabies vaccines, raise community awareness on animal bites injuries, preclinical wound management, enforce responsible dog ownership and strengthen one health Approach in animal bites management.

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ABBREVIATIONS AND ACRONYMS

CCEEVS - Cell Culture Egg Embryonated Vaccines

CDC – Centres for Disease Control and Prevention

CFR – Case Fatality Rate

DALY- Disability Adjusted Life Years

FAO- Food and Agriculture Organization

KFELTP- Kenya Field Epidemiology Laboratory Training Programme

HIV- Human Immunodeficiency Virus

IQR-Interquartile Range

KDVS- Kenya Directorate of Veterinary Services

KDHIS- Kenya District Health Information System

MRSA - Methicillin-Resistant Staphylococcus Aureus

OIE- World Animal Health Organisation

SP- Subspecies

WHO- World Health Organization

ACKNOWLEDGEMENT

Am grateful to almighty God for giving me good health which enabled me to pursue further studies. Am grateful to Moi University for my admission to pursue post graduate studies. Am very grateful to my supervisors Professor Simeon Mining and Dr. Maurice Owiny for the unreserved advice and guidance you have accorded me in the preparation and implementation of this research. Am also grateful to Field Epidemiology Laboratory Training Programme (FELTP) faculty for the support they gave me in the implementation of this research.

Special thanks to the Ministry of Health, Ministry of Agriculture, Livestock and Fisheries and Centre for Disease Control and prevention (CDC) for sponsoring and facilitating me to undertake this important course. The Narok County Government for unreservedly granting me the study leave. Special thanks to Kiambu County Director of Medical Services, Thika and Gatundu Hospitals Medical Superintendents for permitting me to undertake research in the hospitals under your leadership. Am also grateful to all health workers working in Thika and Gatundu Hospitals who supported me in data collection and all respondents who agreed to participate in the study. Lastly, I appreciate the support accorded to me by my fellow colleagues FELTP residents.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Animal bites are a public health problem with the injuries inflicted by the bites leading to scar formation, permanent disability and deaths especially when highly infectious organisms are introduced. Some of the infectious organisms introduced through animal bites are Rabies virus, *Pasteurella* spp, Clostridium tetani (Abrahamian & Goldstein, 2011). WHO recommended post animal bite wound management procedures include;- washing the wounds immediately after the bite occurrence with water, soap and antiseptics to reduce the infectious organisms load introduced thus decreasing the chances of development of infectious diseases or the wound becoming septic. At the health facilities, the animal bite wounds are managed by application of antiseptics, administration of antibiotics, rabies and tetanus vaccines injections (C. Rupprecht *et al*.., 2017). Rabies patients who have developed symptoms do not survive despite treatment case fatality rate (CFR) = 100%) (Malahias et al., 2014).

Globally, it is estimated that 60,000 people lose life annually due to rabies disease with most of the deaths occurring in Africa and Asia (Hampson *et al*.., 2015). In Kenya, the annual mortality due to Rabies disease is about 2000 persons (Bitek et al., 2018). There are huge economic losses associated with animal bites. These losses include treatment costs, loss of man-hours due to incapacitation (Nel, 2013). Some products used for bites management such as nervous tissue prepared rabies vaccine can cause adverse reaction further contributing to economic losses associated with animal bites (WHO, 2013). Animal bites can also lead to death especially when highly infectious organisms are introduced such as *rabies virus, Clostridium tetani* bacteria and *Pasteurella Spp* (Fèvre et al., 2005).

Globally, it's that estimated millions of people seek treatment due to animal bites (World Health Organisation, 2018). In the U.S.A, about 4.5M animal bite cases are attended to annually, which contribute to 1% of hospital emergency cases (Ellis & Ellis, 2014). In the United Kingdom, animal bites account for 1–2 % of emergency care patients attended (Cliquet, Picard-Meyer, & Robardet, 2014). In Africa, the estimated number of animal bites cases reported annually is 200,000 (Hampson et al., 2015). The Majority of these bites are caused by dogs (90%), followed by cats (5%) (Fèvre *et al.*., 2005). Ecological studies previously done shows that some counties in Kenya have high dog density estimated to be 15 dogs per 100 persons (Kitala *et al.*., 2001). Most of these dogs are kept for security purposes both in rural and urban areas. In urban areas, they are also kept as pets. Most of the dogs in rural areas are communally owned and fed by neighbours while others mainly roam as they scavenge for food in the urban centres. This kind of dog ownership promotes transmission of rabies disease as animals roam in search of food are at high risk of coming in contact with rabies infected dogs. Dog bites are usually proxy for rabies disease transmission. Rabid animals may have unique behaviours such as being friendly to the owners. They scratch or lick their owner's hands and facial body parts which are highly innervated thus introducing the rabies virus. Rabies infected animals secrete virus days up to weeks before becoming symptomatic (C. Rupprecht *et al.*.., 2017).

Kenya has adopted a strategic plan for elimination of dog transmitted rabies disease by the year 2030. It's a stepwise approach strategy which advocates application of one health approach in the management of animal bites with Ministry of Health and Department of Veterinary Services taking the leading role in its implementation. The key principle that support application of one health approach in rabies disease control is that rabies virus has diverse host range.

The virus attacks all warm blooded animals which include; domestic animals, wildlife, humans and bats which act as carriers . Poor responsible dog ownership practised in African communities where dogs are left to scavenge for food support rabies virus transmission. Weak urban areas waste management systems provide habitat for the stray dogs which are the leading cause of the bites (C. Rupprecht et al., 2017). Domestic dogs play a very big role in spread of rabies virus from the wildlife cycle to domestic cycle. Some developed countries among them USA and united Kingdom have successfully eliminated dog transmitted rabies disease ((Leelia, 2015). The internationally adopted rabies control strategy recommends mass dogs vaccination with a target of vaccinating 70% of the dog population and responsible dog ownership which entails restriction of dogs movement. The adopted control strategy recommends strict enforcement of the following legislations ; Animal Diseases Act Chapter 364 of Laws of Kenya, Rabies Control Act Chapter 365 of Laws of Kenya and Public Health Act Chapter 242 of laws of Kenya. These legislations have provisions for annual dogs vaccinations and guidelines for containment measures to be executed during rabies disease outbreaks. The control strategy recommends improved supply of human antirabies vaccines at Government health facilities to ensure the post bite antirabies vaccination is initiated within the recommended 24 hours. The adopted strategy recommends upscaling of community awareness on animal bites management through strengthening of community-based surveillance systems and public education. The strategy recommends building of partnerships and synergies with international organizations and development partners such as World Health Organisation (WHO), World Animal Health Organisation (OIE) and Food and Agriculture Organisation (FAO).

These organizations have already started initiatives at international community with aim of creating advocacy and resources mobilization targeting elimination of dog transmitted rabies disease globally by the year 2030. Key achievement of this partnership is the establishment of animal antirabies vaccines bank where countries can secure the vaccines at lower prices which will eventually increase dog population vaccinated.

1.2 Problem Statement

Animal bites are of huge public health concern as they transmit various diseases such as Rabies, Tetanus and Pasteurellosis (Abrahamian & Goldstein, 2011).The bite injuries can also cause permanent scars, disfiguration, disability and psychological disorders. There are huge economic losses associated with animal bites. In the U.S.A, animal bites contribute to 1 % of all cases attended in hospital emergency departments approximated to be 4.5 million cases annually (Ellis & Ellis, 2014). In India, the annual incidence of animal bites is estimated to be 17.4 per 1000 population (Menezes, 2008). In China, 5 million people receive post-exposure treatment annually while Asia and Africa account for 99% of all rabies disease fatalities globally (Knobel *et al...*, 2005).

In Africa, it is estimated that 200,000 cases of animal bites occur annually. In Kenya its estimated that between 1000 to 2000 persons die as a result of Rabies annually (Bitek *et al*, 2018). Morbidity and Mortality due to Rabies disease leads to loss of *3.7M* Disability-adjusted life years *(*DALY*)*(Hampson *et al..., 2015)*. Globally its approximated USD 860 Million is used to manage the post animal bites exposure treatments (Hampson *et al*, 2015). In Africa and Asia, the cost of Rabies management is estimated to be USD 600 Million. The direct costs for post-bite treatment per person in Africa is 40 USD while in Asia its 50 USD.

In Kenya, studies done on rabies prevention and control are limited mostly to small geographical and administrative regions despite rabies disease being reported in the country consistently since 1912. The burden of animal bites is unknown in Kenya, subsequently the allocation of resources for their management is insufficient as the burden of a disease informs the resources allocation by the policy makers. There is high dog density in Kenya approximated to be 16 dogs per 100 persons (Kitala et al., 2001). Kiambu County is among the top six counties in Kenya with high burden of rabies disease where cases are reported in humans, livestock and wildlife (Bitek *et al*, 2018).

1.3 Justification

The study will inform the status of occurrence of animal bites and patient compliance with animal bites management as per the recommended WHO guidelines (Bitek et al., 2018).

Animal bites studies have been used for modelling of the burden of rabies disease and monitoring of effectiveness of prevention and control measures (Cleaveland et al., 2002). This study will provide information on dog ownership characteristics in Kiambu County such as responsible dog ownership information (rabies vaccination status, restriction of movements). (Blakley, 2009), noted that stray dogs are a major source of animal bites especially in urban areas. This study will describe the contribution of stray dogs to animal bites' burden in Kiambu County. The study will provide information on the application of One Health approach in the management of animal bites by describing the involvement of both medical and veterinary departments in the management of animal bites in humans and also in animals. There are limited studies done in Kenya describing the burden of animal bites (Bitek *et al..*, 2018).

This study will provide further information of animal bites especially now that Kenya has banned the use of strychnine for the depopulation of dogs as from 2016 (Guidelines on delivery of Veterinary Services-(KDVS 2015, (Ortega-Pacheco & Jiménez-Coello, 2011) which are the major cause of animal bites injuries . Information that will be obtained from this study can be used in the formulation of policies, guidelines and strategies for animal bites prevention and control by the Kiambu County Government and also by other Kenya Government agencies and private institutions at community levels.

1.4 Research Questions

1. What are the characteristics of human-animal bites cases that are attended at Thika and Gatundu level 5 hospitals?
2. Which factors determine compliance with WHO guidelines for post-exposure treatment of animal bites?
3. Is one health approach used in response to animal bites ?

1.5 Main objective

To characterize and describe management of animal bite injuries among patients attending Thika and Gatundu level five hospitals.

1.6 Specific Objectives of the study

1 To describe animal bite cases in terms of animal species involved, person, place and time.

2 To identify factors influencing compliance with the recommended WHO regime for the management of animal bites injuries.

3 To describ**e** the application of the One Health approach in the management of animal bites.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Definition of animal bites

An animal bite is an injury caused by the mouth and teeth of an animal (including humans). They may be bruising, deep anatomical structure disruption, the introduction of infectious agents, and envenomation (injection of toxin by a bite or sting) (Evgeniou et al., 2013). Animal bites pose a major public health problem both in children and adults worldwide (Lyu et al., 2016). They usually result in hospital visits with attendant morbidity and mortality.

2.2 Causes of animal bites

Animal bites occur when there is a disruption of the relationship between man and animals. This happens when animals are frightened by provocation. Animal bites also occur when one is separating animals that are fighting among themselves (Evgeniou *et al..*, 2013). Some animal diseases such as rabies make the animal friendly to humans or sometimes aggressive thus end up attacking humans.

2.3 Types of injuries inflicted by animal bites

The wound can be minor, moderate or severe depending on the animal responsible for the bite (Evgeniou *et al..*, 2013).The wound can also be a simple scratch or laceration and if the attack is by a huge animal it can cause tearing of muscles and tendons. Licking of body openings such as mouth or anus by a rabid animal is a potential source for the introduction of rabies virus especially in children (Nel, 2013).

2.3.1 Dog bites

Dogs cause the majority of human-animal bites (74%) (Knobel et al., 2005). Dog bites are majorly puncture wounds (60%), lacerations (10%) or combinations (30%) (Abrahamian & Goldstein, 2011).

Dog bites usually occur in the body's extremities such as the face, hands and legs. These body areas are usually highly innervated thus predisposing the bite victims to development of rabies disease if the bites were from a rabid animal. Common bacteria types isolated in dog bites wounds are majorly polymicrobial. They are either colonized by aerobic or anaerobic types or a mixture of both. Bite wounds can be purulent or non-purulent depending on the bacterial organisms introduced. Types of bacteria commonly isolated from dog bite wounds include; *Pasteurella multocida, Staphylococcus aureus, Clostridium tetani, Staphylococcus intermedius, Haemolytic streptococci*. Anaerobic bacteria are present in approximately one-third of dog bite wounds and are associated with the formation of abscesses and with relatively serious infections (C. E. Rupprecht *et al.*., 2019). Rabies virus which causes a highly fatal disease in human if no treatment is given in time is introduced to humans through licks, scratches and bites. Though dogs are much treasured companion animals by the African communities, they are rarely vaccinated against rabies disease. This has led to dogs becoming major source of rabies to humans despite availability of cheap and effective animal vaccines (Lavan et al., 2017).

2.3.2 Cat Bites

Cat bites usually occur on the face and hands. Women are more likely to get cat bites than men (World Health Organisation, 2018). Puncture wounds and lacerations are common in cat bites. The incidence of cat bites in Italy is 18 per 100,000. In the USA there are 400,000 cat bites and 66,000 hospital emergency visits every year (World Health Organisation, 2018).

Cats are at high risk of being bitten by bats which are carriers of the rabies virus, thus risk spread of rabies disease to man if post-exposure treatment is not given due to underestimating cats as a potential source of rabies disease (Abrahamian & Goldstein, 2011).

Common bacteria types isolated in cat bites wounds include *Pasteurella spp*. Wounds infected by this organism present with acute intense inflammatory response, if left untreated there is a risk of sepsis. Other common bacterial types isolated in cat bites wounds are;- *Streptococcus* spp, and *Staphylococci* spp (C. Rupprecht *et al.*., 2017). Cats are the main reservoir of *Bartonella henselae* which causes Cat Scratch Disease (Abrahamian & Goldstein, 2011). Cat Scratch Disease mainly present as lymphadenopathy or fulminant infection associated with osteomyelitis and encephalopathy.

2.3.3 Bites from large herbivorous animals (cattle, donkeys, and horses)

These bites are likely to occur to animal handlers and their owners. Due to the strong jaws and muscles of these animals, bites from these animals are usually severe. They can cause crush injuries to bones and also penetrate tissues causing severe soft tissue injuries. Microorganisms usually isolated from these bites are usually polymicrobial. These organisms include; - *Aeromonas, Pasteurella spp,* and *Actinobacillus spp.* These bites require aggressive treatment as they stand a risk of complications development such as osteomyelitis. The paralytic form of rabies disease in the ruminants majorly presents clinically as choke due to paralysis of oesophageal muscles. This can lead to transmission of rabies disease to livestock keepers and animal health service providers when attending such cases (Kiambu County Department of Veterinary Services reports).

Apart from the regular wound management these victims should also be given tetanus and anti-rabies vaccinations if the animal is suspected to be rabid (Calleo et al., 2018).

2.3.4 Snake Bites

The actual global incidence of snake bites is not known but it is estimated that 1.4 Million to 5.5 Million people are bitten by snakes annually (World Health Organisation, 2018). About 2.5 Million of these people are bitten by envenominous snakes (World Health Organisation, 2018). Approximately 20,000 to 90,000 people lose their lives globally as a result of envenomation from snake bites (Kasturiratne et al., 2008). In Eastern Nepal, snake bites cause mortality of 162 per 100,000 persons (WHO, 2007). In North-Eastern Nigeria snake bites are estimated to be 497 per 100,000 with mortality approximated to be 12.5% (WHO, 2007). The high mortality associated with snake bites is mainly due to inadequate supply of antivenoms, poor health services and inaccessibility of health facilities (Ochola *et al.*., 2018). Snake bites usually occur to agricultural workers making it an occupational disease (Gutiérrez *et al.*., 2006). Venom secreted by snakes cause deleterious effects in humans such as; - neurotoxic reactions which cause paralysis of body systems such as the respiratory system. The venom can also cause cytotoxic reactions which cause permanent tissue damage characterised by swelling, blistering, haemorrhage and necrosis of skeletal muscles (Gold *et al.*., 2002). Local tissue reaction develops rapidly if immediate care is not given leading to disability and extensive tissue damage.

2.3.5 Pigs and rodents bite injuries

Pig bites occur as an occupational disease for farmers keeping pigs. Pig bites occur during transportation, capture and immobilization. The bites occur in the body extremities.

Common bacteria species isolated include;- *Streptococcus agalactie, Streptococcus dysagalactie, Streptococcus suis, Pasteurella aerogenase, E. coli, Pasteurella multocida*.

In the Netherlands, nasal colonization by *Methicillin-Resistant Staphylococcus aureus (*MRSA) has been isolated in humans who have come in contact with pigs (Abrahamian & Goldstein, 2011)**.** Rodent bites majorly occur in children (Glaser *et al.*., 2000). Rat-bite fever disease is associated with rat bites. The causative agent for rat-bite disease is *Streptobacillus moniliforms* and *Spirilium minus*. The first reported case of rat bat fever in Kenya was done by (Bhatt & Mirza, 1992) where a 17-year-old patient was successfully treated using penicillin and gentamycin. Rat-bite fever disease is characterised by fever, rash, myalgia, nausea and vomiting. The disease is self-limiting within a fortnight however complications can occur and cause polyarthritis and polyarthralgia.

2.4 Diseases transmitted through animal bites

2.4.1 Rabies Disease

Rabies virus is introduced to humans through bites and scratches of infected animals. Rabies virus is a single-stranded unsegmented RNA virus belonging to the genus *Lyssavirus* and family *Rhabdoviridae.* The Rabies virus affects all warm-blooded vertebrates. Rabies virus has multiple hosts and reservoirs making it difficult to eradicate (C. Rupprecht et al., 2017). Rabies disease is a high ranking priority zoonosis transmitted to humans majorly by domestic dogs (WHO, 2007). The disease is mostly seen in the poor people in the community who can't afford the post-exposure treatment (C. Rupprecht *et al.*., 2017). Dogs account for almost 90% of all human-animal bites (Sambo *et al.*., 2014).

Between 74-90 % of all dog bites in Rabies endemic regions usually result in Rabies virus transmission especially if no immediate post-exposure prophylaxis is administered (C. Rupprecht *et al.*., 2017).

A high concentration of Rabies virus is found in the saliva of affected animals, thus patients who get facial bites are more likely to develop Rabies disease as opposed to those bitten on other body parts. Aerosol transmission of the Rabies virus occurs when the rabies virus is excreted in the urine of affected bats and foxes. This form of transmission is an occupational hazard for wildlife institutions personnel and laboratory staff. Rabies disease is an occupational disease for animal health personnel and farmers. They can easily get the disease when manipulating rabid animals presenting with symptoms similar to those of choking due to paralysis of oesophageal muscles.

In most African communities, the domestic dogs are kept as companion animals. Licks from domestic dogs in rabies endemic regions are not taken as a source of rabies thus no post-exposure prophylaxis is given when such licks occur thus predisposing the patients to rabies disease (Nel, 2013). Some African cultures also hold a belief that licks from domestic dogs on wounds have a therapeutic effect (Nel, 2013). After entry of the Rabies virus through the scratches and bites caused by the rabid animal, initially, the virus multiplies in non-nervous tissue before entry to the peripheral nerves then moves to the central nervous system. The typical route involves entry via the motor endplates into motor nerve axons where the virus can then travel to the spinal cord and brain. There a productive infection takes hold and the virus travel outward to other highly innervated organs like the salivary glands.

The incubation period for Rabies disease in humans is highly variable ranging between three to eight weeks, but in some cases could be as short as a few days or longer to several years depending on site of the bite, severity of the wound, and amount and type of Rabies virus involved.

The patients initially present with furious form signs of Rabies disease which include apprehension, biting of animate and inanimate objects, followed by a dumb form of the disease which has the following signs;- drooling saliva, photophobia and hydrophobia followed by death due to respiratory system collapse (C. Rupprecht *et al.*., 2017). Rabies disease is usually confused clinically with diseases associated with neurological disorders such as cerebral malaria which is endemic in Africa (C. Rupprecht *et al.*., 2017).

Some African Communities believe patients presenting with aggressive behaviours due to encephalitis such as those with rabies disease are usually taken to traditional healers. These communities believe the patients are victims of sorcery or demon possession. Treatment methods given by the traditional healers include exorcism and administration of toxic herbs (Nel, 2013)(G/hiwot *et al.*., 2016).

Failure for such patients to seek medical attention in hospitals leads to underestimation of rabies disease burden as such patients are not captured by the rabies disease surveillance system. The laboratory facilities which can assist in confirmatory diagnosis are not readily accessible as they are mostly centrally located in major urban centres. The Development of diagnostic tests which are easy to perform brings hope that laboratory facilities in rural areas will be able to provide rabies disease diagnostic tests. These tests are direct rapid immunohistochemical tests and also rapid immunochromatographic tests (Cleaveland & Hampson, 2017).

Globally more than 15 million people receive post-bite vaccination costing about USD 8.6 billion annually (Hampson *et al..*, 2015). In Africa, approximately 200,000 persons get Rabies disease post-exposure treatment annually to prevent them from developing Rabies disease. Rabies disease associated deaths in Africa are estimated to be 24,000 (Cleaveland *et al..*, 2014).

Globally it is estimated that 59,000 people die as a result of Rabies disease (Hampson *et al..*, 2015). Most industrialized countries have eliminated rabies disease transmitted by domestic dogs through mass vaccination of dogs and very strict animal movement control regulations (Cliquet *et al..*, 2014). However, in the majority of developing countries, Rabies disease remains endemic in domestic dog populations (Fèvre *et al..*, 2005).

The estimated annual economic losses associated with Rabies disease is estimated to be USD 8.6 Billion (Goldstein, 1992).

Poor rabies vaccination coverage in African countries is majorly associated with logistical and economic challenges rather than technical challenges. There is poor availability and also unaffordability of rabies vaccines (Perry *et al..*, 2013). Inconveniences of the presentation of dogs to the vaccinations centers also contribute to the reduced vaccination coverage (Beyene *et al..*, 2018).

2.4.2 Pasteurellosis

Pasteurella multocida is normal flora in the mouths of animals. The organisms are introduced to humans through animal bites. The disease initially presents as a local lesion which includes; - cellulitis, lymphangitis, or purulent form. If not well managed *Pasteurella spp* may cause systemic infections which can involve various body systems and cause the following infections; - meningitis, empyema, peritonitis, severe pneumonia, osteomyelitis, endocarditis and septicaemia.

Management of Pasteurellosis involve wound drainage and administration of antibiotics especially penicillin which has high efficacy (Arons *et al*.., 1982).

2.4.3 Tetanus

Tetanus is a bacterial disease which is caused by *Clostridium tetani.* The organism is ubiquitous in the environment. This bacterium is commonly isolated in humans and domestic animals' faecal material. The organisms multiply in deep sited wounds such as puncture wounds where it produces neurotoxins. The neurotoxins secreted cause neurological symptoms in the affected patients.

Approximately 1Million deaths occur globally due to tetanus disease (Cook *et al*.., 2001). Tetanus disease is prevented by routine vaccination.

2.4.4 Cat scratch disease

The Aetiology of cat scratch disease is *Bartonella henselae* bacteria. Cat scratch disease was described in 1950, however the causative agent was isolated in 1992.

In the USA cat-scratch disease has an annual incidence of 9.3 persons per 100,000 populations. Majorly the disease is seen in children and young adults. The cat flea *(Ctenocephalides felis)* is involved in its transmission. The organisms are introduced to humans through cat bites which are usually small in size about 3mm. The cutaneous lesions start as vesicles which later become pustules. It is usually a mild disease characterised by lymphadenopathy. However, in immunocompromised patients, the disease may present as a systemic disease characterised by malaise, fever, anorexia and headache.

2.5 Common aerobic and anaerobic bacteria isolated from animal bites wounds

a) **Aerobic species; -** include Staphylococcus, Streptococcus, Neisseria, Enterococcus, Bacillus, Corynebacteria, Pseudomonas, Klebsiella, Actinomyces, and Lactobacillus among others. (Abrahamian & Goldstein, 2011). It's imperative

to note that cases of methicillin-resistant staphylococcus aureus (MRSA) isolation from animal bites wounds have also been reported (Udo et al., 2017)

b) **Anaerobic species;-** include the following;-Fusobacterium, Bacteriodes, Peptostreptoccus, Porphyromonas, Prevotella, Propionibacterium (Abrahamian & Goldstein, 2011).

2.6 Factors that determine the degree of animal bite wound infection

Individual factors such as the age of the patient, history of diabetes, HIV and other related diseases that impair the strength and development of the immunity, liver and spleen diseases influence the wound healing process.

In this group of patients wound healing is often impaired, therefore keeping the wound open to drain and allowing the wound to heal by secondary intention or delayed closure would most likely be a better alternative.

It is important to avoid primary closure of wounds that are at high risk of infection (Williamson & Thomas, 2017). The time taken before seeking health attention also determines the wound healing process because the rate of microbial multiplication increases with delayed medical attention. Some microbial infections introduced through animal bites can be severe in patients with poor immune status. These organisms include; *Capnocytophaga canimorsu*s which is a bacterial organism mostly introduced by dog bites. *Capnocytophaga canimorsu*s infection is severe in immunocompromised patients where it causes septicaemia while in people with strong immune system its causes a mild infection.

2.7 Management of animal bites

Rabies virus infected patients already presenting with clinical signs notwithstanding treatment do not recover (CFR=100%).

It is recommended that post-exposure treatment be initiated immediately after the exposure especially where the animal involved is suspected to be rabid. Post-exposure treatment involves washing the wound with soap and water. Puncture wounds are usually irrigated with water in a syringe. Wound debridement is also done; it is not recommended that animal bite wounds be sutured except the severe ones. They are left open to allow for the removal of pathogenic organisms that would make the wound become septic (World Health Organisation, 2018). The use of antiseptics in wound cleaning is recommended, common antiseptics used are; -povidone-iodine and chlorhexidine.

Antibiotics and tetanus injections are also given to prevent sepsis of wound and patient developing tetanus as *clostridium tetani* are ubiquitous organism can easily enter the patient body system through the wound. If antiseptics are not available the wound should be cleaned with a copious amount of water (WHO, 2013).

Bites of upper extremities especially in children are more likely to be severe which can lead to hospitalization for both surgical corrections and non-surgical management (Speirs *et al.*., 2015). Factors that determine the kind and type of post-exposure treatment to be given to bite patients include the following; - if the patient is epidemiologically linked to a patient who was bitten by a rabid animal, severity of the exposure, if bites happened in highly innervated areas of the body or the bites wounds are bleeding then the patient should receive Rabies vaccines and immunoglobulins.

The vaccination status of the animals responsible for the bite, the availability of the bite animal for observation or euthanasia after laboratory confirmation of rabies disease also determines the duration of post-exposure treatment. If the animal responsible for the bite is observed for ten days without signs of being rabid observed then the post exposure prophylaxis can be stopped after the three doses of Rabies

vaccine administration (day 0,3,7) (World Health Organization, 2013). It is recommended that multisectoral collaboration of both the Medical and the Veterinary departments is implemented as envisaged in the one health approach for the management of zoonotic diseases such as rabies and anthrax diseases. The Veterinary department is obligated to undertake necessary actions as prescribed by the existing legislations which include animal Diseases Act Chapter 364 of Laws of Kenya and Rabies Disease Control Act Chapter 365 of Laws of Kenya. These actions comprise observation of the in-contact animals for development of rabies disease due to the high risk of exposure from the affected animal and also initiate vaccination campaign activities in the affected areas.

The Medical department through support of community health extension workers should conduct active rabies disease surveillance activities and community trainings with aim of searching of patients who probably also were bitten by the affected animal with view of initiating treatment.

Key benefit that accrue from application of one health approach include timely response when the zoonotic diseases outbreaks have occurred. Immediate interventions measures undertaken for the outbreaks response supports in reduction of disease transmission thus reducing healthcare costs incurred for treatment of the humans. For the livestock subsector the disease control measures applied such as vaccination activities, their costs are affordable to the community and public entities (Cleaveland et al., 2017).

2.7.1 Rabies Vaccines and immunoglobulins for humans

The Rabies vaccines and immunoglobulins have been available in the market for the last four decades. They are very safe and efficacious with strong immunogenic properties.

They have been administered for both routine vaccination and also for post-exposure prophylaxis purposes to millions of people. There are two types of rabies vaccines, they are the following;

a) Cell Culture and Egg Embryonated Based Vaccines (CCEEVs).

These types of vaccines are propagated in cell substrates such as human diploid cells, Vero cells, primary chick embryos or duck eggs embryo. They are less expensive, highly efficacious and safe. Rabies vaccines are supplied as a single dose of 0.5ml or 1 ml. WHO approved rabies virus vaccine do not contain thiomersal as a preservative (WHO, 2013). Thiomersal contains mercury which has risk of exposure to heavy metal poisoning to humans which can damage vital organs such as kidney, spleen and liver.

b) Nerve tissue Rabies vaccines

They have a high risk of causing severe adverse reactions. They are less immunogenic than CCEEVs. WHO has recommended that their production be discontinued and be replaced by CCEEVs. Many developed countries have complied with the WHO advice. Nerve tissue culture vaccines are still being used by a few Asian countries and also some countries in Latin America (WHO, 2013). Adverse events after active rabies immunization cell culture egg embryonated Rabies vaccines are well tolerated by humans with few minimal side effects. The side effects may occur depending on the degree of purity of the inactivated Rabies virus which varies depending on batches. Minor side effects noted are transient erythema at the injection site, pain and swelling at the injection site particularly after intradermal administration of booster (Verma, 2013).

Mild systemic side effects observed after administration of Rabies vaccines include transient fever, headache, dizziness and gastrointestinal symptoms that have been observed on 5-15% of people vaccinated. Serious side effects include;- Guile –Barre syndrome and allergic reactions (Verma, 2013).

Table 1:World Health Organization categories of exposure and post exposure prophylaxis

Category	**Nature of exposure**	**Post-exposure treatment recommended**
Category I	Touching or feeding animals. licks on intact skin, contact on intact skin by a rabid animal or human	These are not regarded as exposures, hence no post exposure prophylaxis given
Category II	Nibbling of uncovered skin, minor scratches, or abrasions without bleeding	Rabies vaccine administration as soon as possible
Category III	Single or multiple transdermal bites or scratches, licks on broken skin, contamination of mucus membrane with saliva from licks and exposure to bats	Vaccine and Immunoglobulins administration at distant sites as soon as possible Immunoglobulins can be administered up to 7 days after injection of the first dose of vaccine

For Category II and III types of animal bite exposures, it's advised the local wound treatment (cleaning with soap and application of antiseptics) is important to prevent the multiplication of rabies virus which happens initially at the bite site before spreading to other body systems.

2.7.2 WHO recommended regimes for Rabies vaccines administration

a) Intramuscular Rabies vaccine regime

Its recommended 5 doses (Essen regime) be given as follows day 0,3,7,14,28. Four doses Zagreb Regime, two doses are given on day zero followed by one dose day seven and another one dose on day 21. (day 0,7,21).

b) Intradermal Rabies vaccine regime

This regime is only used in countries where it has been adopted. The quantity of vaccine administered is 0.1 ml usually given intra-dermally. It's useful for category II and III exposures. The regime is given as follows 2-2-2-0-2. It's usually given on day 0,3,7,28. For people who have already received exposure through vaccination, they are given intramuscularly for day 0 and day 3 or they are given intradermal vaccination at 4 sites (deltoid, thigh, suprascapular).

2.8 Management of snake bites

Treatment of snake bites injuries includes administration of anti-venoms. They are highly effective in neutralizing toxins responsible for systemic effects such as haemorrhage, coagulopathy and other haemodynamic disturbances (Ochola *et al.*., 2018). They are also good for reversing neurotoxicity. The main challenge with anti-venoms is that they are not effective in sites where local tissue damage has occurred (WHO, 2007). Anti-venoms' administration has the risk of development of adverse reactions; they can cause early and also late-stage adverse effects. Other forms of treatments considered for snake bites victims include; - ventilation where there is respiratory system failure, plasma expanders are given when there is hypovolemia, surgical debridement for wound management and dialysis if the patient has signs of acute renal failure (Kihiko, 2013).

2.9 Conceptual Framework

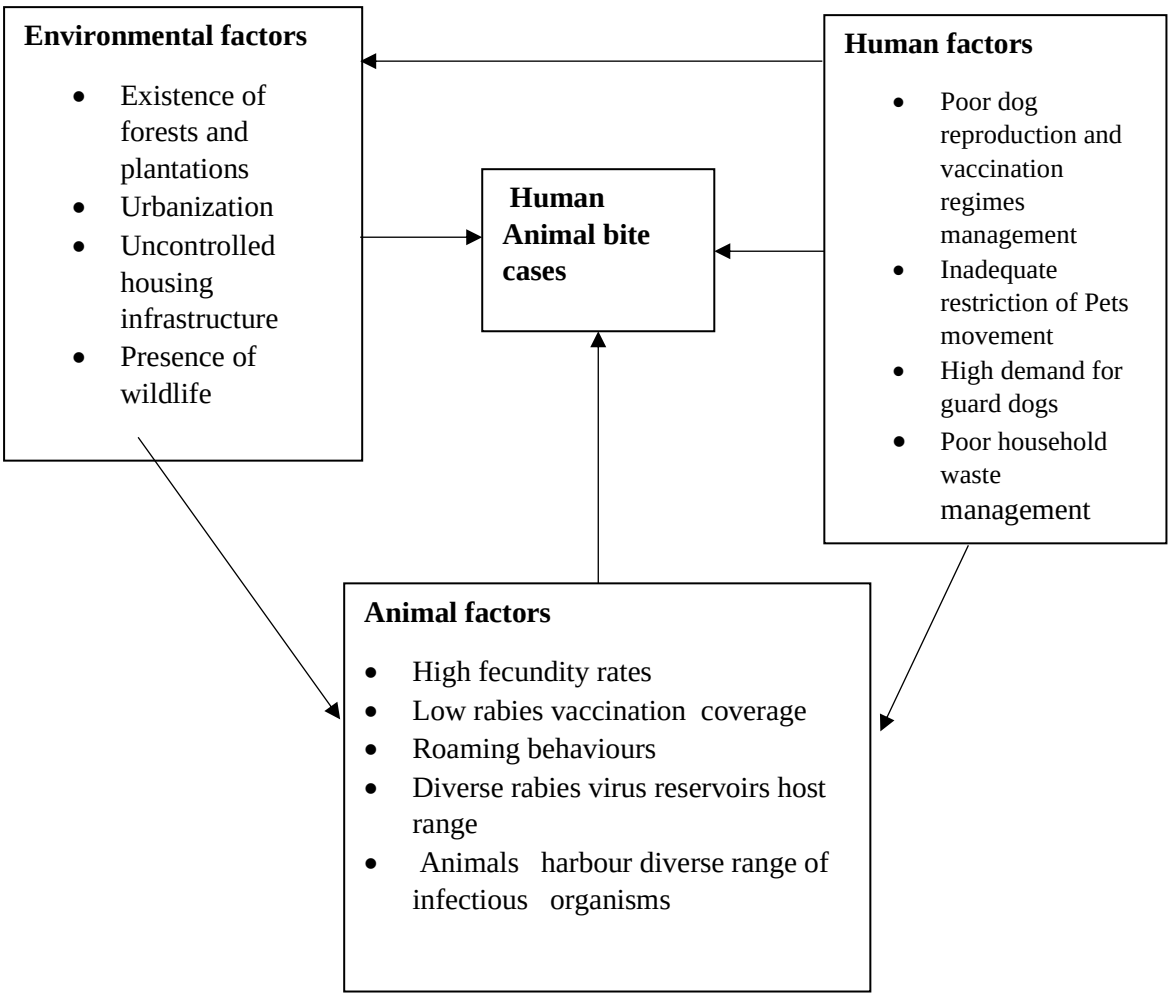

Figure 2- 1 Conceptual Framework (designed by the author from Literature Review)

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Study site

The study was conducted at Thika and Gatundu level five hospitals, which are the busiest health facilities on the Eastern side of Kiambu County. They serve residents of greater Thika and Gatundu sub-counties with a population of 454, 887. Due to the good infrastructure network, Thika level five Hospital also receives patients from neighbouring counties of Machakos and Muranga. Kiambu County is located in the central part of Kenya with an approximate size of 2,543 Kilometres Squared with a forest cover of 476 Kilometre squared. According to the 2019 Kenya population and housing census, Kiambu County has a population of 2,417,735 persons (Kenya population and housing census, 2019). Kiambu County borders Nairobi and Kajiado counties to the South, Machakos County to the East, Muranga County to the North, North East, Nyandarua County to North West, and Nakuru County to the West. The county lies between latitudes $0^{o}25'$ and $10^{o}20'$ South of equator and longitude $36^{o}031'$and $37^{o}015'$ East. Due to proximity to Nairobi City County, the county offers residential areas to people working in the city. This has led to the rapid urbanisation of its major towns. Kiambu County is divided into 4 topographical zones which are the following; - upper highland, lower highland, upper midland and lower midland. The agricultural economic activities undertaken by farmers are highly influenced by the type of topographic zones. The main economic activities include; - horticultural farming, animal husbandry, coffee and tea farming. The county faces challenges of recurrent outbreaks of zoonotic diseases among them Rabies disease which attacks both humans and livestock. Animal bites cases data reported through the Kenya Health Information System (KDHIS) for one year (October 2018- September 2019).

During this period a total of 1,833 bite cases were reported from greater Gatundu and Thika sub-counties health facilities. Provision of health services in the two sub-counties is by both private and public health facilities. Some of the private health service providers such as chemists and clinics may not be captured by the Ministry of Health diseases surveillance system. The county has a huge dog population which are mainly kept as guard dogs and also as pets. The large forest cover, coffee and tea plantations in the county provide habitat for wild carnids some of which could be reservoirs of rabies virus.

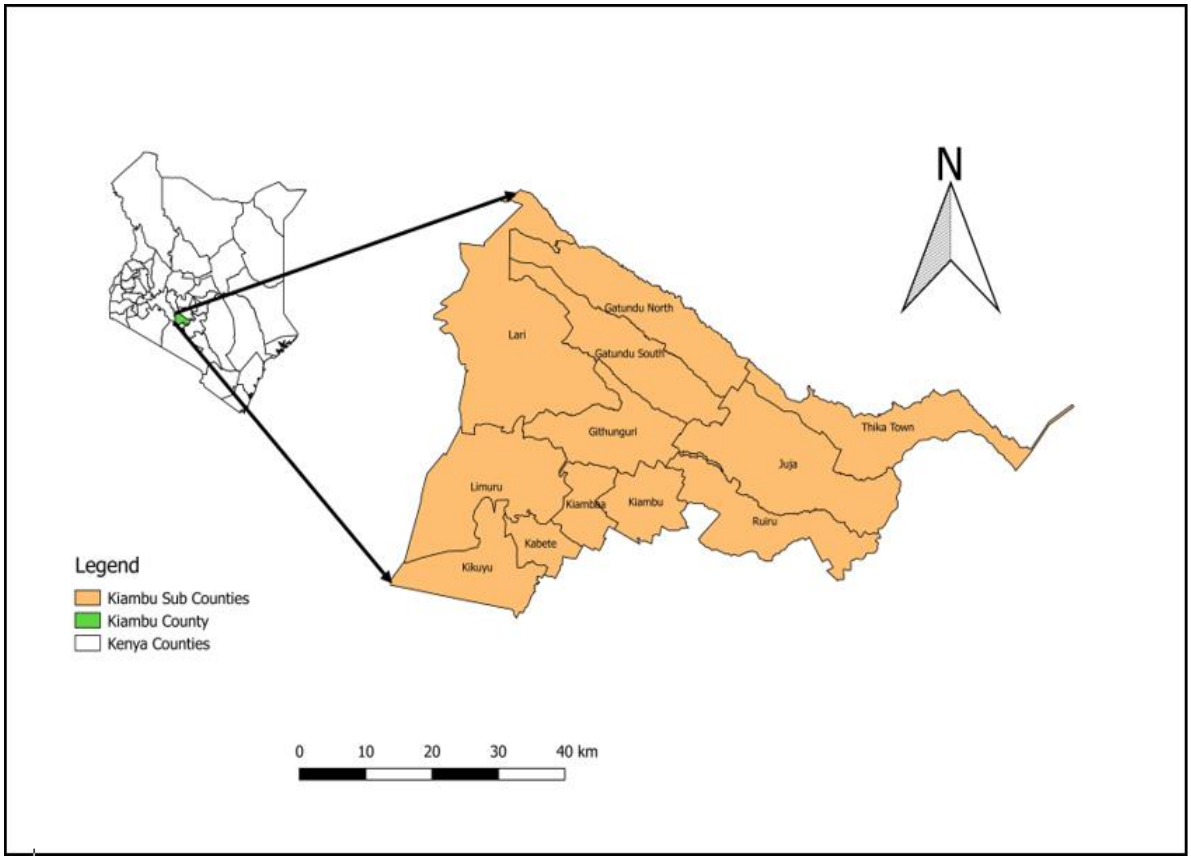

Figure 3 - 1 Kiambu County Map

3.2 Study design

A cross-sectional study was conducted on patients reporting for treatment of animal bite injuries in both Gatundu and Thika Level five Hospitals.

Data such as their social demographic information and bite animal characteristics were collected from the patients when they reported for treatment.

All animal bite cases were eligible for inclusion in the study; notwithstanding the number of antirabies vaccine doses they have been given. Other respondent's data such as treatment details were obtained from their hospital records**.**

3.3 Study Population

All patients presenting at both Thika and Gatundu level five hospitals with complaints of animal bite injuries for the period January to May 2021 were included in the study. Animal bite injuries could be licks, scratches, or bites by animals.

3.3.1 Inclusion criteria

All patients who attended Thika and Gatundu level five hospitals presenting with complaints of licks, scratches, or bite injuries caused by vertebrate animals during the study period.

3.3.2 Exclusion criteria

All patients who presented with bites from non-mammalian species such as insect stings.

3.4 Sample size determination

Cochran formula (1963) as described by (Charan & Biswas, 2013) was used for sample size calculation. The Cochran formula allows for the calculation of an ideal sample size given a desired level of precision, desired confidence level, and the estimated proportion of the attribute present in the population.

The Cochran formula $n=z^2 p(1-p) / d^2$

Where;

n; is the desired sample size,

z; 1.96 (standard normal deviate for the two-tailed test based on alpha level)

p; is the prevalence of animal bites which is estimated to be 50 per 1000 as reported by (Sharma *et al.*., 2016)

d; is the precision of the study (4%). Investigators are permitted to use up to a maximum of 5% precision in the determination of sample size (Hazra & Gogtay, 2016).

$$n = 1.9622^2 * 0.05*(1-0.05)/0.04^2$$

$$n = 114$$

The sample size was adjusted to 127 by adding 10 per cent to cater for anticipated non-response.

The sample of cases was distributed proportionately between the two health facilities. Using animal bite cases data reported through the Kenya District Health Information System (KDHIS) for one year (October 2018- September 2019). During this period, a total of 1833 bite cases were reported for greater Gatundu and Thika sub-counties**.** The formula for calculating the number of cases selected per facility was as follows; The number of cases sampled per sub-county was calculated on a pro-rata basis.

Gatundu Level 5 Hospital: cases to be selected= 843/1833* 127= 58 patients

Thika Level 5 Hospital: cases to be selected = 990/1833* 127= 69 patients

Table 3-2 gives a summary of cases of animal bites that were reported to the KDHIS for one year (October 2018- September 2019) per the sub-county.

Table 2: Distribution of animal bite patients sample sizes between Thika and Gatundu Level 5 hospitals

Sub-county	Number of human-animal bites-cases reported through KDHIS 2018	Distribution of sample size selection n=127	Percentage of patients contribution per sub-county
Gatundu	843	58	46
Thika	990	69	54
Total	**1833**	**127**	**100**

3.5 Sampling procedure

3.5.1 Definition of an animal bite

Animal bite patient was defined as those patients who present with licks or injuries caused by the mouth and teeth of an animal. They may be licks by animals on mucus membranes such as oral or anal cavities or broken skin, bruising, deep anatomical structure disruption, the introduction of infectious agents, and envenomation (injection of toxin by a bite or sting (Evgeniou et al.., 2013).

3.5.2 Enrolment of study participants

Kiambu County was selected as the study site as it is among the counties in Kenya with a huge dog population which has been documented as a major cause of human-animal bites (Kitala *et al..*, 2001). Both Thika and Gatundu level five hospitals were purposefully selected as they are the busiest health facilities on the Eastern side of Kiambu. They are referral hospitals serving the lower category of health facilities located in the greater Gatundu and Thika sub counties.

These two hospitals have huge patient catchment from both rural and urban populations residing in the county and also from neighbouring sub-counties.

The patients were accessed at the hospitals outpatient departments with assistance from the health personnel attending to them. To achieve the desired sample size all patients presenting with animal bite injuries, scratches, or licks at both Thika and Gatundu level five hospitals were eligible to be included in the study. Recruitment of study participants was done when animal bite cases presented at the health facilities until the desired sample size was achieved during the study period.

Details of the study procedure were explained to the animal bite patients, those who agreed to participate and were eligible. Subsequently, they were requested to sign the consent form (Appendix-I). For the children aged 18 years and below presenting with the animal bite injuries consent to participate in the study was sought from their parents or guardians who brought them for treatment. Before obtaining consent from parents or guardians assent was obtained from children aged 12 – 18 years. The patients or their guardians were requested to provide their mobile telephone numbers which were coded against the form number to ensure it is only accessible to the investigator only. Data collection was done by administration of semi structured questionnaire when the animal bite injuries patients reported to the hospital. Further treatment information was obtained from their hospital treatment records.

Data collected included; social demographic information, information about the animal that caused the bite, information about their compliance on receiving the recommended five anti-rabies injections as recommended by WHO rabies post-exposure treatment guidelines.

Additional patient treatment details which include; treatment information such as drugs administered, wound care treatment information such as wound stitching or left to heal by secondary intention was accessed from their hospital files and also from hospital outpatient registers where they were attended.

3.6 Data Collection Methods

Data were collected through a semi-structured questionnaire (Appendix -III) that was administered to the participants and also from the respondent's treatment records in the hospitals. The questionnaire was presented in two languages both English and Kiswahili to take care of uneducated patients. Data collected included demographics, socioeconomic, clinical information, and bite management information. These included;- age, sex, level of education, employment details, date event occurred, species of the animal that caused the bite, place where the bite occurred, ownership of biting animal, site of the bite, vaccination history of the biting animal, vaccination certificate, if the animal bite case was reported to Veterinary Department, police or to the provincial administration, availability of the biting animal for observation for development of rabies disease signs, date patient sought medical attention, treatment given (Rabies injection, tetanus injection,) source of the vaccines (government or private hospital), number of anti-rabies vaccine injections given, and treatment outcome.

For assessment of application of one health approach in animal bite injuries management, the following policies and legislations which promote multi sectoral and collaboration of various government departments and agencies as envisaged in the one health approach in responding to zoonotic diseases outbreaks were applied ; WHO and OIE guidelines on zoonotic diseases control, strategic plan for the elimination of dog transmitted rabies disease in Kenya, Rabies Disease Control Act

Chapter 365 of Laws of Kenya, the Animal Diseases Act Chapter 364 of Laws of Kenya and Public Health Act Chapter 242 of Laws of Kenya , variables such as reporting of animal bites injuries to other government departments such as veterinary services , police and administration offices , bite animal characteristics variables such as their ownership status, vaccination history, animal behaviours such as aggression ,quarantining of biting animal was used for assessment of application one health approach in management of the animal bites . The policies and legislations already mentioned recommend roles of various government departments, state agencies and animal owners and also promote outbreaks information sharing especially between human health and animal health departments when responding to zoonosis outbreaks.

3.7 Dissemination

The study findings will be disseminated to Moi University, KFELTP, the Director of Veterinary Services, Kiambu County Departments of Health and Veterinary Services. A manuscript will be prepared and presented for publication in a peer-reviewed journal.

3.8 Data management and analyses

Data collected were uploaded into the Microsoft excel software and cleaned. Data cleaning involved the removal of double entries and also of study participants with incomplete data entries. Descriptive statistics (mean, mode, and median, standard deviation, range) were calculated for continuous variables. Frequencies and proportions were calculated for categorical variables. Bivariate analysis were conducted to identify risk factors associated with the animal bite treatment outcome where a respondent was considered compliant if he or she observed the recommended WHO animal bite wound management guidelines by immediately washing the bite wound with soap and water and also received medical attention within 24 hours while

a noncompliant respondent were those patients who did not wholly adhere to the WHO animal bite management guidelines.

The prevalence odds ratio was calculated for the independent factors associated with the compliance of the animal bite treatment protocol using a contingency table.

Chi squared statistics was used to measure the statistical significance of the association between categorical variables and the outcome of the animal bite treatment where the respondents were classified as compliant or not. Confidence Intervals at 95% level of confidence and P-values were calculated, associations with P-value of less than 0.05 were considered statistically significant. Factors that were significant during bivariate analysis ($P \leq 0.02$) were taken for unconditional logistic regression where a backward stepwise elimination method was used to identify independent factors associated with the WHO compliance of the animal bite treatment guidelines. During the backward stepwise method, all factors whose association had a p-value ($P \leq 0.05$) were considered to be independently associated with treatment outcome of the animal bites.

3.9 Limitation of the study

Data collection was done by self-reporting by the patients, which may have led to inaccuracies of information obtained due to poor recall of information concerning the circumstances of bites occurrence. To improve on accuracy of information obtained from the respondents their health records were used to verify information they shared and also as source of respondents further information. The study captured only animal bite patients who reported to the hospitals for treatment, this can affect generalization of the study findings to the wider community.

Some bite patients also seek medical services from small private health facilities not captured by the surveillance system can lead to underestimation of magnitude of animal bites cases reported. It was presumed that the bite patients in this locality have similar characteristics.

3.10 Ethical Considerations

The study protocol was approved by Moi University – Moi Teaching and Referral Hospital Institutional Research and Ethics Committee (MU-MTRH IREC) Reference number, IREC/2020/97, Appendix-VI and National Commission of Science, Technology and Innovation (NACOSTI)-Appendix VII. Permission to conduct the study was also obtained from Kiambu County Department of Medical Services management and medical superintendents in charge of Thika and Gatundu level five hospitals (Appendix –VIII). The details of the study were explained to potential participants before recruitment into the study. It was further explained to them that participation in the study was voluntary and they have the freedom to withdrawal from the study at any point. Written consent was sought from the patients before they were recruited in the study. The consent was presented in two languages both English and Kiswahili. To maintain the confidentiality of information acquired no information was shared with third parties. To shield patients' identities from access by unauthorized persons, unique person identifiers were used during data collection such as coding of their telephone contacts, processing and analysis. Data captured was stored in password-restricted computers to ensure data is only accessible to permitted persons only.

CHAPTER FOUR

4.0 RESULTS

4.1 Results of Objective 1; To characterize animal bites cases in terms of animal species involved, person, place and time.

4.1.1 Proportion of the study respondents that were attended at Thika and Gatundu level five hospitals

A total of 127 study participants from both Gatundu and Thika level five hospitals were enrolled for the study from January 2021 through to May 2021. Of the 127 study participants, 69 (54.3%) were from Thika level five Hospital while 58 (45.7%) were from Gatundu level five Hospital.

4.1.2 Proportion of animal species that were responsible for the bites

Of the 127 animal bites, 120 (94.5%) were inflicted by dogs, snake bites 5 (3.9%), cat 1 (0.8%) and cow 1 (0.8%).

4.1.3 Locations where the study participants were bitten

Of the 127 study participants, 52 (41%) reported that they were bitten while at homesteads, 51 (40.1%) respondents were bitten along the road, 14 (11%) respondents were bitten at the trading centers and 10 (7.8%) were bitten in the forests or at the farms.

4.1.4 Ownership of the biting animals

Of the 127 study participants, Ownership of 56 (44.1%) of the biting animals was unknown, while 48 (37.8%) were owned by persons known to the respondents and 23 (18.1%) of the biting animals were owned by the respondent’s family.

4.1.5 Vaccination status of the biting animals (domestic animals)

The vaccination status of 62 (50.8%) of the biting animals was unknown, 40 (32.8%) of the biting animals were not vaccinated and 20 (16.3%) of the biting animals were vaccinated.

4.1.6 Clinical signs exhibited by the biting animals

The biting animals the following clinical signs; aggression 90 (70.9%), calm 33 (26%) and hyper salivation 4 (3 %).

4.1.7 Circumstances that led to the bite

Study participants who had no interaction with the biting animals were 64 (50.4%), 26 (20.5%) respondents reported that they were playing with the biting animals and 1(0.8%) was playing with the young ones of the biting animal, as shown by table 4-1

Table 3: Different circumstances that led to the bites

Circumstances that led to the bite	Frequency n=127	Percent %
Non interaction with the biting animal	**64**	**50.4**
Playing /petting the biting animal	26	20.5
Attacked by biting animal which had young ones	24	18.9
Provoked the biting animal	7	5.5
Socializing with biting animal	5	3.9
Playing /petting with young ones of the biting animals	1	0.8

4.1.8 Socio-demographic characteristics of the study participants

The study participants age ranged from 3–90 years with a median age of 23 years and inter quartile range (IQR) of 30 years, males were 76 (59.8%) of the total respondents, Twenty nine (22.8%) were aged 10–14 years, 31 (24.4%) were from Thika West Sub-County, 68 (53.5%) had at least attained primary level of education, 43 (33.8%) were casual labourers.

Males aged ≤ 15 years were 32 (25.2%), while females aged ≤ 15 years were 11 (8.7%) as shown in table 4-2

Table 4 Socio-demographic Characteristics of the study participants

Characteristics	Frequency n=127	Percent (%)
Sex		
Male	**76**	**59.8**
Female	51	40.2
Age group		
<5 Years	3	2.4
5-9 Years	11	8.7
10-14 Years	**29**	**22.8**
15-19 Years	14	11
20-24 Years	10	7.9
25-29 Years	9	7.1
30-34 Years	8	6.3
35-39 Years	5	3.9
40-44 Years	10	7.9
45-49 Years	13	10.2
50-54 Years	4	3.1
55-59 Years	4	3.2
>60 Years	7	5.5
Sub-County of Residence		
Thika West	**31**	**24.4**
Gatundu South	30	23.6
Thika East	24	18.9
Gatundu North	23	18.1
Others	19	15
Level of Education		
Primary education	**68**	**53.5**
Secondary education	47	37.1
College and university	6	4.7
No formal Education	6	4.7
Employment Status		
Causal employment	**43**	**33.8**
Unemployed	38	29.9
Student /Pupil	36	28.4
Formal employment	10	7.9

4.1.9 Distribution of the study participants per administrative ward

Of the 127 study participants, 16 (12.6%) were from Kamenu and Ngoliba Wards each, 13 (10.2%) were from Ndarugo Ward, while 19 (15%) were from other wards neighbouring Gatundu and Thika Sub-Counties as shown in table 4-3

Table 5:Distribution of study participants per the ward administrative units

Administrative Ward	Population (census 2019)	Frequency n=127	Percent %
Gatuanyaga Ward	14,003	8	6.3
Githobokoni Ward	21,009	4	3.2
Gituamba Ward	23,327	5	3.9
Kamenu Ward	**53,496**	**16**	**12.6**
Kiamwangi Ward	21,164	7	5.5
Kiganjo Ward	29,379	11	8.7
Mang'u Ward	47,170	6	4.7
Ndarugo Ward	**23,280**	**13**	**10.2**
Ngenda Ward	50,668	5	3.9
Ngoliba Ward	**15,313**	**16**	**12.6**
Township Ward	192,493	10	**7.9**
Others*		19	15

*Respondents from other neighbouring Kiambu sub counties and counties who were treated at Thika and Gatundu level five hospitals (Juja Sub county 6 (4.7%), Ruiru Sub county 4 (3.1%), Muranga County 4 (3.1%), Machakos County 5 (3.9%)

4.1.10 Average monthly income of the study participants

Study participants who earned a monthly income of below Ksh. 1,000 were 65 (51.2%), while 9 (7.1%) respondents earned monthly income above Ksh. 20,000. Incomes earned by the other respondents figure 4-1

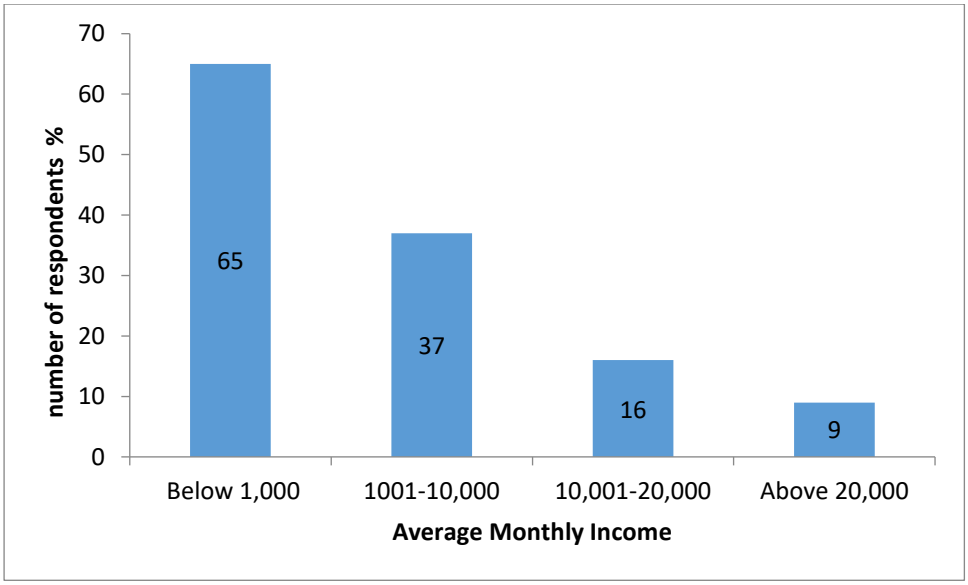

Figure 4 - 1Average monthly income earned by the study participants

4.1.11 Proportion of Animal bites reported per month

The highest number of animal bites were recorded on March 39 (30.7%) and the least number of animal bites was recorded on May 11(8.7%), further details of monthly bites cases reported as shown in figure 4-2.

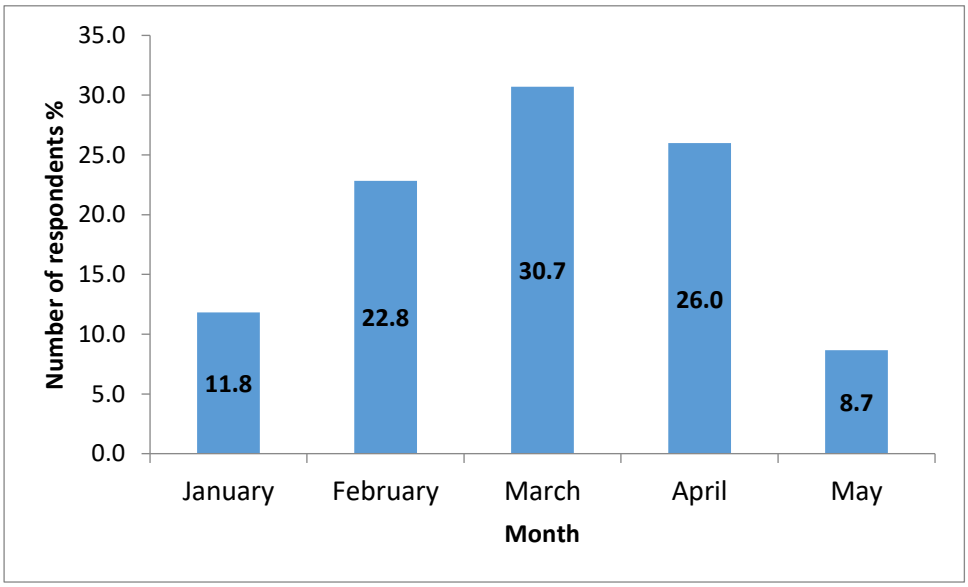

Figure 4- 1 Distribution of monthly animal bites occurrence reporting

4.1.12 Proportions of the time period when the bites occurred

Most of the bites occurred during the daytime, where 36 (28.4%) of the animal bites occurred between 10.01 am to 12.00 pm and also a similar number occurred late afternoon between 4.01 pm to 6.00pm , while the least number of the bites 6 (4.7%) were reported at night between 6.01pm to 10.00pm. further details of bites time occurrence is as figure below 4-3

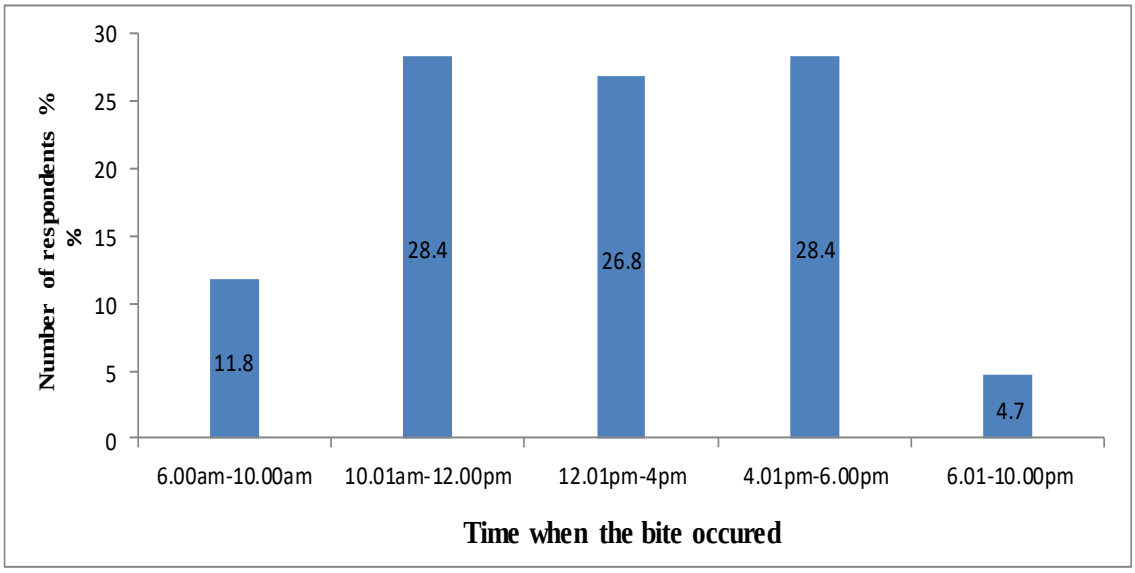

Figure 4- 2 Distribution of period when the animal bites occurred

4.1.13 Basic wound management at home before visiting the hospital

Respondents who did not receive any form of first aid at home before seeking medical assistance were 64 (50.4%) ,55 (43.3%) respondents washed the bite wounds with soap and water, while 8 (6.3%) respondents took pain killers

4.1.14 Duration of time that elapsed from when the respondents were bitten up to when they reported to the hospital to seek treatment.

Respondents who reported to the hospital within 24 hours of bite occurrence were 97 (76.4%), while 26 (20.5%) reported to the hospital after lapse of 24 hours after bite occurrence and 4 (3.1%) reported to the hospital after lapse of 48 hours after bite occurrence.

4.1.15 Type of treatment given at the hospital

Respondents who had their bite wounds cleaned at the hospital were 78 (60.1%), those vaccinated (anti-rabies and tetanus) were 106 (83.5%), those given antibiotics were 58 (45.7%), those given pain killers were 60 (47.2%) while 5 (4%) had their wounds stitched. Details of treatment are shown in table 4-4

Table 6: Description of treatment given to the respondents at the hospital

Type of treatment given at the hospital	Frequency n=127	Percent (%)
Wound Cleaning		
Yes	**78**	**60.1**
No	49	38.6
Vaccination*		
Yes	**106**	**83.5**
No	21	16.5
Antibiotics		
Yes	58	45.7
No	69	54.3
Pain Killers		
Yes	60	47.2
No	67	52.8
Wound Stitching		
Yes	5	4
No	122	96

*Vaccination refers to both anti-rabies and tetanus injections

4.1.16 Proportions of bite wound types and of the body part that was bitten

Regarding the classification of the type of bite wound injuries, 57 (44.8%) were puncture wounds, 39 (30.7%) were lacerations and 31 (24.5%) were scratch wounds. The leg bites 105 (82.7) were the most reported, while the least body part bitten was the head 1 (0.8%). More details of wound classification and body part bitten is as per table 4-5

Table 7 Proportions of bite wound types and the body part that was bitten

Bite wound Characteristics	Frequency (n=127)	Percent %
Type of bite wound		
Puncture wound	**57**	**44.8**
Laceration	39	30.7
Scratch	31	24.5
Body part bitten		
Legs	**105**	**82.7**
Hand	14	11
Torso	6	4.7
Head	1	0.8
Multiple sites	1	0.8

4.1.17 Administration of Anti Rabies Vaccine within the recommended 24 Hours

Respondents who received Anti Rabies vaccine within 24 hours were 95 (77.9%), 15 (12.3%) respondents received the Anti-rabies vaccine after 48 hours while 12 (9.8%) respondents did not receive Anti-rabies vaccine

4.1.18 Source of Anti Rabies Vaccine

Respondents who purchased the anti-rabies vaccines from private chemists were 79 (64.7%), while 20 (16.4%) respondents received the anti-rabies vaccines from public hospitals, further details of anti-rabies vaccine sources are as the table below 4-6

Table 8: Description of various sources of anti-rabies vaccines

Source of Anti-Rabies Vaccine	Frequency n =122	Percent (%)
Private chemists	79	64.7
Public hospitals	20	16.4
Private hospitals	6	5
None	17	13.9

4.1.19 Number of Anti Rabies vaccine doses received

Of the 122 respondents required to receive antirabies vaccine, 47 (38.5%) had received one dose only, 17 (13.9 %) did not receive the anti-rabies vaccine while 4 (3.2%) had received 4 doses. More details of the vaccines doses received is in the figure 4-4.

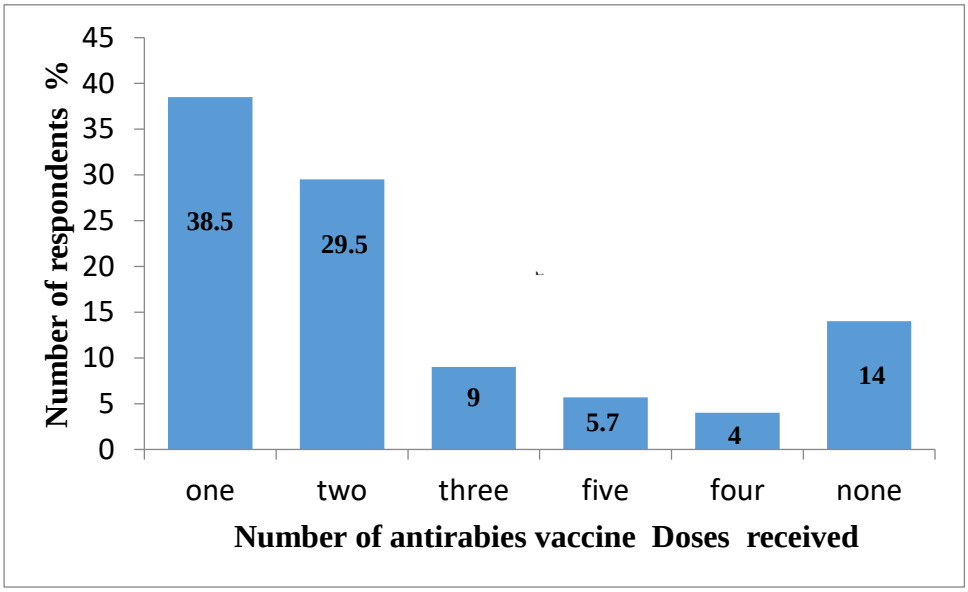

Figure 4- 3 Number of Anti-rabies vaccine doses received by the respondents

4.1.20 Outcome of the bite treatment

One hundred and twenty four (97.6%) respondents were treated as outpatients while 3(2.4%) were admitted and later discharged with follow up.

4.2 Objective 2; To describe factors influencing compliance with the recommended WHO regime for the management of animal bites injuries.

4.2.21 Bivariate analyses

At the bivariate analysis, it was done by comparison of the respondents who complied with WHO guidelines on animal bite injuries management (washing the bite wound with soap and water for 15 Minutes and receiving the first anti-rabies vaccine injection within 24 hours' post bite) and those who did not comply with the WHO guidelines (the respondents who did not wash the bite wound at home with soap for 15 minutes and also they did not receive the anti-rabies vaccine within 24 hours).

Respondents with education level above the secondary school had 3 times the odds of complying with WHO guidelines compared to those with education below secondary level prevalence odds ratio (pOR) = 3.4, 95% CI: (1.55-7.31). Those above 15 years had 3 times the odds of complying with WHO guidelines compared to those below, (pOR=2.7, 95% CI: (1.28-5.89) while those who were employed had also 3 times the odds of complying compared to their non-employed (pOR= 2.7, 95% CI (1.25-5.81). Among those who did not know the ownership status of the biting animal , they had 3 times the odds of complying compared to those who knew, pOR=2.9, 95% CI: (1.33-6.31). Those who were bitten by aggressive animals had 2 times the odds of complying compared to those who were bitten by calm animals pOR=2.4, 95%CI: (1.13-5.08).

Table 9: Bivariate Analysis of Factors Associated with Compliance of the WHO guidelines for animal bites management

	Compliance with WHO animal bites management Guidelines		**pOR (95% CI)**	**P Value**
	Not Compliant (n=79)	**Compliant (=43)**		
Variable	**Frequency (%)**	**Frequency (%)**		
Education level				*
Below Secondary	49	14	**Ref**	
Above Secondary	30	29	3.4(1.55-7.41)	0.002
Age				*
<15 Years	47	15	**Ref**	
>15 Years	32	28	2.7 (1.27-5.93)	0.01
Sex				
Female	33	15	**Ref**	
Male	46	28	1.4 0.65-2.10)	0.5
Employment Status				
Not Employed	59	22	**Ref**	*
Employed	20	21	2.8 (1.29-6.17)	0.02
Average monthly income				
<10,000	64	34	**Ref**	
>10,000	15	9	1.1 (0.45-2.85)	0.81
Place of Bite				
Home	32	20	**Ref**	
Away from home	47	23	0.8 (0.37-1.66)	0.57
Type of wound				
Scratch	47	22	**Ref**	
Lacerated/Puncture	32	21	1.4 (0.66-2.96)	0.45
Animal ownership				
Family /known person	58	21	**Ref**	*
unknown person	21	22	2.9 (1.33-6.31)	0.009
Animal vaccination status				
Known	7	13	**Ref**	*
Unknown	72	30	0.22 (0.08-0.62)	0.004
Biting animal clinical signs				
Not Aggressive	52	19	**Ref**	*
Aggressive	27	24	2.4 (1.14-5.20)	0.02
pOR= Prevalence Odd Ratio, CI=Confidence Interval, *= Significant variables in bivariate analysis with P<0.2,				

4.2.22 Multivariate analysis of independent factors associated with WHO compliance on the management of animal bite wounds.

Independent factors associated with compliance to WHO guidelines on animal bite management among the respondents were; not knowing the biting animal ownership status and where respondents were bitten by aggressive animal. Respondents who knew about the ownership of the biting animal status had 3 times the odds of complying with the WHO guidelines as compared to those who did not know the ownership of the biting animal (aOR = 3.32,95% CI:1.27-8.67) P<0.01. Respondents who were bitten by an aggressive animal had 6 times the odds of complying with the WHO guidelines as compared to those bitten by non-aggressive animals (aOR= 5.6,95% CI:1.76-17.55) P<0.004

Table 10: Multivariate analysis of independent factors associated with WHO compliance on management of animal bite wounds

	Compliance with WHO Guideline		pOR (95% CI)	P Value	aOR (95% CI)	P Value
	Not Compliant (n=79)	**Compliant (n=43)**				
Variable	**Frequency (%)**	**Frequency (%)**				
Education level						
Below Secondary	49	14	**Ref**			
Above Secondary	30	29	3.4 (1.55-7.41)	0.002	1.88 (0.74-4.80)	**0.19**
Age						
<15 Years	47	15	**Ref**			
>15 Years	32	28	2.7 (1.27-5.93)	0.01	1.09 (0.37-3.20)	0.87
Employment Status						
Not Employed	59	22	**Ref**			**
Employed	20	21	2.8 (1.29-6.17)	0.02	7.53 (2.45-23.09)	**0.0004**
Animal ownership						
Family/Known person	58	22	**Ref**			**
Unknown person	21	21	2.9 (1.29-6.17)	0.02	3.32 (1.27-8.67)	**0.01**
Animal vaccination status						
Known	7	13	**Ref**			**
Unknown	72	30	0.2 (0.08-0.58)	0.004	0.05 (0.01-0.22)	**0.0001**
Biting animal clinical signs						
Not Aggressive	52	19	**Ref**			**
Aggressive	27	24	2.4 (1.13-5.08)	0.02	5.56 (1.76-17.55)	**0.004**

pOR= Prevalence Odd Ratio, aOR= Adjusted Odd Ratio, Ref= reference category, **= Significant variables in multivariate analysis with P<0.05

4.3 Objective 3 To evaluate the application of the One Health approach in the management of the animal bites

4.3.1 Referral of the study participants to the veterinary and administration offices

Of the 127 study participants, it is only 2 (1.6%) that were referred to the Veterinary offices by the medical professionals who attended to them and only 1 (0.8%) respondent reported the bite incident to the administration offices (chief office or police)

4.3.2 Advice given by the Veterinary Department and Administration Offices where bite occurrences were reported

Of the 127 respondents, 124 (97.6%) reported that they were not given any advice concerning any veterinary interventions to be done on the biting animals, while 2 (1.6%) were advised to destroy the biting animal and 1 (0.8%) reported that a veterinary professional was sent to attend to the biting animal.

CHAPTER FIVE

5.0 DISCUSSION

Objective 1; To Describe animal bite cases in terms of animal species involved, person ,place and time

The results of this study show that animal bite occurrences are a major cause of public health problem in both Thika and Gatundu. Dogs were the main cause of the bites, this finding is similar to studies done in Machakos County (Leelia, 2015) which reported that dog bites accounted for 95% of all reported animal bites . In this study, there were few cases of snake bites 5 (3.9%) which occurred majorly in the lower zones of Thika Subcounty which have hot climatic conditions favourable for snakes habitation (Kihiko, 2013). The snake bite respondents were mostly agricultural workers who were bitten when working in the farms, which is consistent with a study done in Kitui (Kihiko, 2013) where 40% of the all snake bites cases reported occurred in farms . There was a single report of a cow bite which was highly suspected to be rabid from the information given by the respondent. The domestic animals (ruminants) serve as dead end hosts in the transmission of rabies, however they pose risks to farmers, veterinary personnel as rabid domestic animals present clinically as choke and it's well documented that the rabies virus is majorly excreted through the saliva (C. Rupprecht *et al*., 2017). Livestock losses due to mortalities associated with rabies disease contributes to livestock keepers incurring huge economic losses which can lead to loss of livelihoods (Cleaveland et al., 2017). Thika West sub-county reported most bites 24.4%, followed by Gatundu South 23.6%. The high number of bites reported in these sub-counties can be attributed to high rate of urbanization which tends to lead to an increase in the number of owned dogs in the

households and also the existence of a large number of stray dogs in garbage dumping sites.

These sites provide the dogs with sources of food, a finding in agreement with a study done in Uganda (Kisaka et al., 2020) which reported that dog bites occurrence was almost at a similar proportion in both Kampala (49.5%) and Wakiso (50.5%) districts despite both districts being at different levels of urbanization

Most of the bites occurred in the homesteads (41%) and also along the roads (40.1%), this is similar to a study done in Kakamega (Nelima, 2016) that reported that bites that happened at homesteads were 42.1 % and along the roads and paths were 47.3%. Most of the biting animals exhibited aggressive signs when attacking. Dogs are territorial animals, they protect against invasion of their territories by intruders or from passers-bye walking along the roads. Most of the bites were caused by animals whose ownership status was unknown 56 (44.1%) , which is in agreement with studies done in Uganda (Kisaka et al., 2020) where they reported 53% of biting dogs owners were not known but the finding is contrary to a study done in India by (Samanta et al., 2016) which reported 85% of the bites were caused by stray dogs. In Kenya, dogs are communally owned, their owners release them to roam in the urban centres and their neighborhood homesteads in search of food. The roaming behavior promotes spread of rabies disease among the animals due to the congregation of the dogs at the garbage sites at the rural and urban centres.

In this study, only 20 (15.6%) of the biting animals vaccination status was known, this is inconsistent with a study done in Machakos (Leelia, 2015) where 50.5 % of the biting animals were vaccinated. Even though, it’s a legal requirement for all dogs owned in Kenya to be vaccinated against rabies annually, there is poor enforcement of

this requirement. This may be associated with the inadequate resource allocation for the provision of Veterinary Services (Molia et al., 2021).

Dog owners rarely accept to seek vaccination services from the private sector animal health service providers despite the animal antirabies vaccines being affordable and readily available in the private sector (Molia et al., 2021). The Kenyan Government in partnership with international organizations which include; WHO, OIE, and FAO is implementing a strategic plan for the elimination of dog transmitted rabies disease which recommends compulsory dogs vaccination with aim of attaining at least 70 % of the dog population are annually vaccinated. This strategy has been implemented in Europe, in Latin America, Malaysia and Philippines with a lot of success (Taylor & Nel, 2015) . The adopted rabies disease control strategy targets control of rabies disease in the dogs as they are the main intermediary between the sylvatic and domestic cycles of the rabies virus transmission. Rabies disease transmission has reproductive ratio (RO) of less than 2, with mass vaccination of dogs with aim of achieving 70% herd immunity, the chances of a rabies disease infected dog spreading the disease particularly at the furious phase of the disease development is greatly reduced (Bitek et al., 2019). The animal anti-rabies vaccines are cheap with approximated cost 1 USD and are readily available from local veterinary pharmaceutical distributors as compared to human antirabies vaccines which are expensive with approximated cost of 10 USD (C. Rupprecht et al., 2017).

In this study, males had a high proportion of animal bites cases than females 76 (59.8%), this is consistent with a study done in Uganda (Kisaka et al., 2020) which reported that males bite cases were 53.5% .This can be explained as a behavioral characteristic that males are more likely to stay outdoors longer than females thus increasing their likelihood of interacting with animals.

Males also tend to have more interaction with companion animals than females such as feeding and playing with them. Animal bites cases were reported across all ages, however for children aged fifteen years and below there were more cases in boys 32 (25.2%) than in girls 11 (8.7%), this findings is similar to a study done in India on children seeking treatment for animal bites where it was reported that proportion of the boys bitten was 67.5% (Samanta et al., 2016).

Boys are more inclined to have more interaction with dogs in the following scenarios; feeding them, petting the dogs and also increased likelihood of them fighting the dogs. Children also lack adequate techniques of protecting themselves against attacks by animals.

Most of the bites 56.9% occurred during day time (10.00 – 6.00pm) , this is similar to studies done in Uganda (Kisaka et al., 2020), which reported most of the bites (44.2%) occurred between 12.00 -6pm. Occurrence of the many of the bites at day time can be associated with people are more active during the day than at night. Most of the bites occurred in March (30.7%), this finding is similar to a study done in Kakamega (Nelima, 2016), the high number of bites occurrence at this time of the year can be associated with the occurrence of dogs breeding season. Dogs are seasonal breeders, during the breeding season there is excessive movement of male dogs in search of females. These movements can predispose them becoming more aggressive. The adopted rabies control strategy recommends implementation of dog population control methods such as castration and neutering of females.

The bite victims interviewed majority earned incomes of below ksh.1,000, this findings is similar to other studies where most of the animal bites happen to be poor and cannot afford rabies disease post exposure treatment due to the high cost of

antirabies vaccines and other related treatment costs such as transport(Wentworth et al., 2019).

The adopted rabies disease control strategy recommends adequate supply of human antirabies vaccines at public health facilities to ensure the affected patients receive the vaccines within the recommended 24 hours ,availability of the vaccines at public health institutions will cushion the poor households from incurring the high costs of the bite treatment (Wentworth et al., 2019) . The body part majorly bitten were the legs 105(82.5%)**,** followed by hands 14(11%), The bite victims usually fight off the attacking animals by either running away from them or using hand held objects (sticks, metal bars or stones) for chasing away the attacking animals (Kisaka et al., 2020) the body extremities are the accessible body parts as the biting animals take very short time to attack the victims.

According to WHO animal bites wounds classification guidelines, most of the bites were of type II classification which include; Puncture, scratches and licks 88(69.2%) and type III wounds were mainly lacerations 39(30.7%). If treatment of the bite wounds is ignored due to non-severity of the physical injuries they can serve as perfect entry points of pathogenic microorganisms to the body such as rabies virus which invariably results to mortality if the bite wound management is not done as per the WHO animal bite wound management guidelines. Thorough washing of the bite wound with running soap ,water and application of antiseptics reduces the risk of patients developing rabies disease by a third (Sambo et al., 2014).

Objective 2; To describe factors influencing compliance with the recommended WHO regime for the management of animal bite injuries.

In this study, only 50% of the bite victims washed the bite wound with soap as per the WHO guidelines, this is similar to studies done in India (Samanta et al., 2016) where

of 64 (66.67%) bite victims immediately washed the bite wound with soap but its inconsistent with a study done in Uganda (Kisaka et al., 2020) where 18.6% bite patients washed the wound with soap. This finding shows that there is inadequate public health education concerning preclinical management of animal bite injuries which helps in reduction of rabies virus multiplication at the bite site (Kisaka et al., 2020). In this study, 79/127 (62%) respondents had the bite wounds cleaned at the health facilities. It's expected that antiseptics such as povidone iodine was used in the wound cleaning as per the WHO guidelines. The antiseptics have strong virucidal potency thus reducing the rabies virus multiplication at the bite site before they spread to the rest of body systems through the central nervous system.

In this study, 96 (75%) respondents visited health facilities for treatment of the bites within 24 hours as the per the WHO guidelines. This finding is inconsistent with a study done in Uganda (Kisaka et al., 2020) which reported only 18 % of the bite victims reported to the hospital within 24 hours . It's expected that the health facilities will initiate administration of the first anti-rabies vaccine injection within the recommended 24 hours (C. Rupprecht et al., 2017). Respondents who reported to the hospital beyond the recommended 24 hours period were 31 (24%), this study finding shows that these patients either overlooked the severity of the bite injuries or had insufficient information on urgency of the bite wounds medical attention to deter entry of highly pathogenic microorganism such as rabies, tetanus and Pasteurellosis in the body. In this study, 95 (79%) of the respondents received the first anti-rabies vaccine injection within 24 hours. Studies done in Tanzania (Cleaveland et al., 2017) found that receiving the first anti-rabies vaccine injection beyond 24 hours without combination of rabies immunoglobulins did not prevent the patient developing rabies disease.

Majority of the patients 79 (64.8%) purchased the anti-rabies vaccines from the private chemists. This finding shows that the anti-rabies vaccines are not routinely stocked in public health facilities, poor accessibility of the rabies vaccines can lead to patients from poor households developing the rabies disease despite visiting the hospitals within the recommended 24 hours as the anti-rabies vaccines purchased from the private health facilities are expensive (approximately ksh. 1000) per dose without including other related costs such as transport (Wentworth et al., 2019).

Using bivariate analysis, factors that were associated with compliance of the WHO guidelines on animal bite wound management were; education level above secondary school, employment, where the biting animal ownership status was unknown, age greater than 15 years and where one was bitten by an aggressive animal. These findings show that the community awareness level about animal bite management depended on their literacy levels, economic status and uncertainty about the health status of the biting animals.

Objective 3; To determine application of One Health approach in the management of the animal bites.

In this study, only 3 (2%) respondents were referred to other departments involved in One health approach in management of zoonosis, the main one being Veterinary Department, this findings is similar to a study done in Kakamega (Nelima, 2016) where only 3% of all reported animal bites cases were referred to veterinary department. This study finding is contrary to a study done in Machakos (Leelia, 2015) where 27% of all animal bites cases reported to the Veterinary Department. The difference in reporting between the counties mentioned can be associated with the burden of rabies disease which might have led to more disease control intervention activities which include active surveillance and reporting of animal bites cases and also improved community public health knowledge on animal bites management.

In this study, there was poor adherence of animal bites management guidelines as per the Kenya strategy for elimination of dog transmitted rabies disease which recommends various veterinary interventions to be carried out to the biting animals too (Lavan et al., 2017).

The minimal referral of the animal bites patients to the animal health professionals can inform that the health workers have inadequate information concerning involvement of their veterinary colleagues in management of the animal bites as envisaged in the rabies elimination strategy. The poor collaboration between the medical and veterinary departments in this study areas can lead to animal bite patients incurring unnecessary costs such as receiving the whole course of five anti-rabies vaccine doses as opposed to receiving only 3 doses upto the tenth day post bite where if the biting animals do not manifest rabies disease symptoms (Molia et al., 2021). The current global trend for rabies disease control advocates for mass canine vaccination, its cost effective rather than focus on human post exposure treatment which is expensive with likelihood of becoming inaccessible to the rural poor (Lavan et al., 2017). Involvement of police, regional and county administrative officers is vital as they hold responsibility of enforcement of the rabies control legislations such as rabies control act 365 and animal diseases act 364. The national and county administration offices can also be used for conflict resolution, where biting animal's ownership status is known, they can be compelled by invoking the rabies control act cap 365 to meet treatment expenses incurred by the bite victims.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Dogs were the major animal species that inflicted the bite injuries. Snake bites occurred in the lower zones of Thika Sub- County which are usually hot. There is low vaccination coverage of dogs against rabies disease, below the recommended 70% of the total dog population. Males are at high risk of animal bites than females. Children aged 15 years and below are at higher risk of animal bites than persons who are above 15 years.

There is poor adherence to WHO guidelines for the animal bite management, especially bite wound care at home and also on post exposure treatment at the health facilities. There is minimal application of one health approach in the management of animal bites this is not as per the recommendations contained in the adopted strategy for elimination of dog transmitted rabies disease.

6.2 Recommendations

1. Upscale community public health education on responsible dog ownership, these include; annual antirabies vaccination of dogs and restriction of the dogs movement by enforcement of existing legislations**.**
2. Health Department should sensitize the community about the recommended adherence to WHO animal bite injuries management guidelines. These includes; the preclinical (first aid at home) and clinical management at the health facilities.
3. Department of Health should increase supply of human antirabies vaccines to ensure the animal bites patients receive the first dose of the vaccine within the recommended 24 hours .

4. Institutionalize application of one health approach in the animal bites management protocols particularly the joint collaboration of the Medical and Veterinary departments.

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Appendices

Appendix I: Consent form

Hello, my name is ---------- from Ministry of Health, Nairobi. I am involved in a study on the characterization of animal bites cases and their management in the greater Gatundu and Thika sub-counties. I am going to ask you questions related to animal bites and personal related questions.

Confidentiality

Your name will not appear on the questionnaire. The information you give will be confidential.

Risks and benefits `

There are no direct benefits. If you choose to participate in this study the information will assist in the development of prevention and control strategies for animal bites.

Consent

You are free to withdraw from the study anytime without penalty. If you agree to be recruited into this study, please fill the attached forms as evidence of your voluntary participation.

I ---------- do willingly wish to participate in this study having fully understood the process and intended purpose of the study. I expect that the information collected will be confidential and utilized for the intended purpose.

Signature of participant ----------Date----------

Signature of investigator ---------- Date----------

Appendix II- Fomu ya kibali; Maombi

Mimi ---------- natoka Wizara ya Afya.

Najihushisha na Utafiti wa wagonjwa waliopata majeraha ya kuumwa na wanyama pamoja na matibabu waliopata. Eneo ambalo utafiti huu unafanyika ni lile la wilaya kuu ya Gatundu na Thika .

Jina lako halitaandikwa kwenye hojaji na habari utakoyopatiana itabaki siri.

Hasara na faida.

Hakuna manufaa yoyote ikiwa utaamua kushiriki katika uchunguzi huu lakini maoni yako yatakuwa msingi bora wa kutengeneza mikakati mwafaka ya kuzuia kuumwa na wanyama .

Uko huru kujiondoa katika uchunguzi huu wakati wowote bila kuadhibiwa.

Ikiwa umekubali kuchaguliwa kama mshiriki katika uchunguzi huu tafadhali jaza fomu ya Thibitisho ya kushiriki

Fomu ya kibali.

Maswali kuhusu uchunguzi wa wagonjwa waliopata majeraha ya kuumwa na wanyama pamoja na matibabu waliyopata. Eneo ambalo utafiti huu unafanyika ni lile la wilaya kuu ya Thika.

Mimi ----------najitolea kushiriki katika utafiti huu na kuulewa utaratibu, mbinu na sababu. Nataraji utafiti wangu utabaki kuwa wa siri na kutumiwa katika uchunguuzi huu.

Sahihi---------- Tarehe----------

Mtafiti ---------- Tarehe----------

Appendix III ; Questionnaire

Estimation, Characterization and Management of Animal Bite Injuries Reported at Selected Health Facilities in Kiambu County, Kenya, 2020

1. General information

Date of interview dd/mm/yr----------Hospital----------

Name of the interviewer ---------- ------ Questionnaire number ----------

2.Residence information

County ---------- Sub-county ----------Ward ----------

Location ---------- Sub location---------- Village ---

3.Socio-demographic information

3.1 Age ---------- Sex----------

3.2 What is your highest level of education attained?

❑ No formal education ❑ Primary school education ❑ Secondary school education❑ College and university education

3.3 What is your current Employment status?

❑ Unemployed ❑ Casual labourer❑ Formal employment

3.4 What is your average monthly income

❑ Below 1000 ❑ between 1001- 10,0000 ❑ between 10,001 – 20,0000 ❑ over 20,001

4. Bite information details

4.1 When you were bitten?

dd/mm/yr.----------

4.2 When did you seek medical care?

dd/mm/yr.----------

4.3 What Time were you bitten?

❑ morning (6.00AM- 10.00 AM), ❑Day time (10.01- 12.00 PM), ❑ Early afternoon (12.01- 4.00PM), ❑Late afternoon (4.01 PM- 6.00PM), ❑Night (6.01- 10.00PM)

4.4 Where were you bitten?

❑ Home❑ Along the road, ❑ Trading Centre, ❑ Forest or Farm

5. Nature of the bite wound

5.1The animal bite resulted in which type of wound?

❑ Laceration ❑ Scratch ❑ Puncture wound, ❑ Contact with saliva ❑ Others specify---

5.2 Which body part did the bite occur?

❑ head ❑ legs❑ body ❑hands❑multiple sites ❑

6. Animal details

6.1Which animal species bit you?

❑ Dog❑ Cat ❑ Cow ❑ Sheep/Goat ❑ wild animals❑ Human ❑ Others species specify ----------

6.2 Who owns the animal responsible for the bite?

❑ my family❑a person known to me ❑ unknown

6.3 What's is the Vaccination status of the animal responsible for the bite?

❑ Vaccinated❑ Unvaccinated ❑ Unknown

6.4 What are the clinical signs observed in the animal responsible for the bite?

❑ Aggressive (attacking people and other animals)❑ salivation ❑ red eyes

❑ paralysis ❑ others ----------

7 Circumstances of the bite

7.1 What led the animal to bite you?

❑ Playing or petting the animal

❑ Attacked by an animal which had young ones

❑ You provoked the animal

❑ Socializing with animal e.g. when feeding

❑ Animal was commanded to attack you

❑ No interaction

❑ Others

7.2 Where did you report the incident?

❑ hospital ❑ Veterinary office❑ Administration office❑ Police

7.3 what action did the veterinary and administration office or police advice you to undertake

❑ Advised to seek urgent medical attention ❑ an animal health personnel was dispatched to attend the biting animal ❑ advised we immediately destroy the biting animal ❑ was advised isolation of the biting animal ❑ urgent Vaccination of in contact animals ❑ public awareness sessions will be organized urgently

8 Information on post exposure treatment

8.1 Did you have basic wound management before seeking medical care?

❑ You washed the wound with soap and water ❑ Took pain killers❑ Antibiotics

8.2 What treatment were you given at the hospital?

❑ Wound cleansing ❑Vaccination❑ Antibiotics ❑ Pain killers❑ Wound stitching and bandaging

8.3 Has anti-rabies vaccine been administered to you?

❑ Yes ❑ No ❑ I don't know

8.4 If yes of the above when did you receive first dose of antirabies vaccine

❑ within 24 hours ❑ 48 hours ❑ beyond 72 hours

8.5 How many doses of antirabies vaccines have you received so far?

❑ none ❑ 1 ❑ 2❑ 3 ❑ 4 ❑ 5

8.6 Where did you get rabies vaccine from?

❑ Private chemists ❑ Public hospital ❑ Private hospital

8.7 What is the outcome of the bite treatment?

❑ Admission

❑ Am being treated as an outpatient

❑ I was admitted then discharged with follow-up

❑ Death

❑ Others specify ----------

Appendix IV Swahili Questionnaire

Makandilio, habari za magonjwa wa kuumwa na wanyama na kutibiwa kwa hayo wagonjwa katika hospitali katika kaunti ya Kiambu , 2021

1. Habari ya kijumla

Tarehe ya Mahojiano ---------- Hospitali----------

Jina ya mtafiti ---------- Namba ya hojari----------

2. Sehemu unayoishi

Kaunti ---------- wilaya---------- Wadi

Eneo ---------- Kata---------- --- Kijiji-----

3. Habari za kibinafsi

3.1 Umri---------- Jinsia ----------

3.2 Kiwango cha masomo ambacho umesoma cha juu kabisa

❑ Sinjaenda shule ❑ Darasa la nane ❑ Shule la upili

❑ Chuo kikuu ama college

3.3 **Unafanya kazi gani ?**

❑ Sina ajila ❑ Kibarua ❑ Nimeajiriwa

3.4 **Je mapato yako ya mwezi ni ngapi**

❑ Kati ya elfu moja – elfu kumi ❑ elfu kumi na shilingi moja hadi elfu ishirini ❑ Zaidi ya elfu ishirini

4. Habari za majeraha

4.1 **Uliumwa na mnyama tarehe gani ?**

Tarehe/ mwezi/ Mwaka .----------

4.2 **Tarehe uliyotafuta matibabu**

Tarehe/ mwezi/ Mwaka. ----------

4.3 **Uliumwa na mnyama masaa gani**

❑ asubuhi (thenesara- saa nne, ❑ mchana (saa nne na dakika moja – saa sita

❑ adhuhuri(saa sita na dakika moja- saa kumi ❑ jioni (saa kumi na dakika moja – thenesera) ❑ usiku (thenesara na dakika moja

4.4 **Uliumwa na mnyama ukiwa wapi ?**

❑ ukiwa nyumbani ❑ kwa barabara❑ kwa madukani ❑ msitu ama kwa shamba

5. Ulipata majereha ya aina gani

5.1 Ulipata kindonda cha aina gani

❑ kindonda cha juu❑ kugwaluzwa❑ kindonda cha ndani ❑ kulwabwa na mate ❑ aiana nyingine ----------

5.2 Ulipata njeraha sehemu gani ya mwili ?

❑ kichwa ❑ miguu ❑ mwili ❑ mikono ❑majereha sehemu mingi ya mwili

6.Habari za mnyama aliyekuuma

6.1 **Uliumwa na mnyama gani?**

❑ Mbwa❑ Paka❑ Ngombe ❑ Kondoo/Mbuzi❑ Mnyama wa msituni ❑ Binadamu ❑ Ama mnyama mwingine sinjatanja----------

6.2 **Nani mwenye mnyama mwenye kukuuma**

❑ Familia yenu ❑ Mwenyewe na mjua ❑ Mwenyewe simjui

6.3 **Je, unajua kama huyo mnyama alikuwa amechanjwa?**

❑ Ndiyo alikuwa amechanjwa ❑ Hajachanjwa ❑ Haijulikani

6.4 **Mnyama aliyekuuma alikuwa na dalili za ugonjwa kama ifuatavyo**

❑ Alikukukimbiza ndiyo akakuuma ❑ Alikuwa akimwaga mate❑ Macho yake ilikuwa mekundu ❑ Alikuwa amepooza ❑ Dalili zingine----------

7 Mambo uliyofanya ndiyo ukaumwa na mnyama

7.1 **Ni nini ulifanya mnyama akakuumwa?**

❑ Nilikuwa na cheza na yeye

❑ Mnyama alikuwa na watoto wake wandogo

❑ Mnyama alichokozwa

❑ Nilikuwa na cheza ama kuumpa chakula

❑ Mnyama aliamlishwa aniumize

❑ Hau kuwa karibu na Mnyama

❑ Mengine

7.2 **Ulipeana ripoti ya kuumwa na mnyama kwa ofisi gani**

❑ hospitali ❑ ofisi ya veterinary ❑ ofisi ya chifu ❑ polisi

7.3 ofisi ya veterinary ,chifu ama polisi walikupea ushauri gani

❑ nitafute matibabu hospitalini haraka ❑ daktari wa mifugo alitumwa kumuchunguza mnyama ❑ nilishauliwa ni uwe ule mnyama ❑ nilishauliwa ni mfuge mnyama wenye kuniuuma kando na wengine ❑ chanjo dhidi ya kichaa chaa

mbwa ilipendekwazwa kwa wanyama wa boma makao ya yenye kunipa jeraha ❑ baraza za kijiji zitapangwa ya kufundisha umma.

8 Habari za jinsi mgonjwa alivyotibiwa

8.1 **Je ulipata matibabu ya dharura kabla ya kwenda hospitalini**

❑ Niliosha kidonda na maji na sabuni ❑ Nilikunyua dawa za kutuliza uchungu❑ Nilikuwa dawa ya kuuwa viini

8.2 **Je ulipewe matibabu ya aina gani hospitalini**

❑ Kindonda kilisafiswa ❑ Nilipewa chanjo ❑ Nilipewa dawa za kuuwa viini

❑ Nilipewa dawa za uchungu

❑Kindonda kilishonwa na kufungwa na bandage

8.3 **Je ulipewa chanjo dhidi ya ugonjwa wa kichaa cha mbwa**

❑ Ndiyo ❑ La ❑ Sina Habari

8.4 Ulipewa sindano ya kuuzuia kichaa cha mbwa baada ya siku ngapi

❑ chini ya masaa 24 ❑ baada ya masaa 48❑ ilipita masaa 72

8.5 umepata shindano ngapi za chanjo ya kuuzuia kichaa cha mbwa

❑ sinjapata ❑ Moja ❑ Mbili ❑ Tatu ❑ Nne ❑ Tano

8.6 Ulipata **chanjo ya ugonwa wa kichaa wapi**

❑ Duka ya kuuza dawa ❑ Hospitali ya umma ❑ Hospitali ya kibinafsi

8.7 Matokeo ya matibabu ni gani ?

- ninatibiwa kama natoka nyumbani
- Nimelazwa hospitalini
- Kifo
- Mengine ----------

Appendix V Dummy Table

Key variable data to be collected from an animal bite victim	**Bite victim information characteristics**	**Frequency n= 127**	
		Counts	Percent
Sex	Male		
	Female		
Age in years	Age in years		
	≤ 5 years		
	6-10 years		
	11-15 years		
	16-20 years		
	21-25 years		
	26-30 years		
	31-35 years		
	36-40 years		
	41-45 years		
	46-50 years		
	51-55 years		

Key variable data to be collected from an animal bite victim	**Bite victim information characteristics**	**Frequency n= 127**	
	56-60 years		
	≥ 60 years		
County	Kiambu		
	Muranga		
	Machakos		
	Others		
Sub County	Thika		
	Gatundu		
	Others		
Education level	No formal education		
	Primary education		
	Secondary education		
	College and university		
Employment status	Unemployed		
	Self-employed		

Key variable data to be collected from an animal bite victim	**Bite victim information characteristics**	**Frequency n= 127**	
	Casual employment		
	Formal employment		
Time of the bite occurrence	6.00AM- 10.00 AM		
	10.01AM- 12.00PM		
	12.01- 4.00 PM		
	4.01PM- 6.00 PM		
	6.01PM- 10.00 PM		
Duration taken before seeking medical treatment	24 hours		
	48 hours		
	72 hours		
	Over 72 hours		
Number of bites reported per month	First month		
	Second month		
	Third month		
	Other months		

Key variable data to be collected from an animal bite victim	**Bite victim information characteristics**	**Frequency n= 127**	
Place of bite	Home		
	Along the road		
	Trading Centre		
	Forest and farm		
Nature of bite	Lick		
	Laceration		
	Scratch		
	Puncture		
Circumstances that led bite to occur	Playing or petting the animal		
	Attacked by an animal which had young ones		
	You provoked the animals		
	Socializing with the animal		
	Animal was commanded to attack the bite victim		
	No interaction with the animal		

Key variable data to be collected from an animal bite victim	**Bite victim information characteristics**	**Frequency n= 127**	
	Others		
Where was the bite incident reported first	Medical facility		
	Veterinary office		
	Administration office		
	Police		
Animal species involved	Dog		
	Cat		
	Donkey		
	Cow		
	Sheep or goat		
	Wild animal		
	Human		
	Other species		
Ownership of animal responsible for the bite	My family		
	Person known to me		

Key variable data to be collected from an animal bite victim	**Bite victim information characteristics**	**Frequency n= 127**	
	Unknown		
Vaccination status of the biting animal	Vaccinated		
	Unvaccinated		
	Unknown		
Clinical signs observed on the animals	Aggressive		
	hypersalivation		
	Red eyes		
	Paralysis		
First aid given before seeking treatment	Washed wound with soap and water		
	Took pain killers		
	Antibiotics		
Treatment given at hospital	Wound cleaning		
	Vaccination		
	Wound stitching and bandaging		
	Pain killers		

Key variable data to be collected from an animal bite victim	**Bite victim information characteristics**	**Frequency n= 127**	
Was anti-rabies vaccine administered	Yes		
	No		
	I don't know		
If Yes how many doses were administered	One		
	Two		
	Three		
	Four		
	Five		
On which day post-bite was rabies vaccine administered			
	Day 0		
	Day 3		
	Day 7		
	Day 14		
	Day 28		
Where was rabies vaccine	Private chemist		

Key variable data to be collected from an animal bite victim	**Bite victim information characteristics**	**Frequency n= 127**	
sourced from	Public hospital		
	Private hospital		
What was the outcome of the bite	Discharge with follow up		
	Admitted then discharged with follow up		
	Death		
	Others		

Appendix VI - Institutional Research Ethic Committee Research Approval Letter

INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471/2/3

MOI UNIVERSITY
COLLEGE OF HEALTH SCIENCES
P.O. BOX 4606
ELDORET
Tel: 33471/2/3

Reference: IREC/2020/97
Approval Number: 0003690

15th October, 2020

Dr. Bernard Kinuthia Njau,
Moi University,
School of Public Health,
P.O. Box 4606-30100,
ELDORET-KENYA.

Dear Dr. Njau,

ESTIMATION, CHARACTERIZATION AND MANAGEMENT OF ANIMAL BITE INJURIES REPORTED AT SELECTED HEALTH FACILITIES IN KIAMBU COUNTY, KENYA, 2020

This is to inform you that ***MU/MTRH-IREC*** has reviewed and approved your above research proposal. Your application approval number is ***FAN: 0003690.*** The approval period is ***15th October, 2020 – 14th October, 2021.***

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***MU/MTRH-IREC***.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to ***MU/MTRH-IREC*** within 72 hours of notification.
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to ***MU/MTRH-IREC*** within 72 hours.
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to ***MU/MTRH-IREC.***

Prior to commencing your study; you will be required to obtain a research license from the National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and other relevant clearances. Further, a written approval from the CEO-MTRH is mandatory for studies to be undertaken within the jurisdiction of Moi Teaching & Referral Hospital (MTRH), which includes 22 Counties in the Western half of Kenya.

Sincerely,

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
15 OCT 2020
APPROVED
P. O. Box 4606 - 30100, ELDORET

DR. S. NYABERA
DEPUTY-CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

cc CEO - MTRH Dean - SOP Dean - SOM
Principal - CHS Dean - SON Dean - SOD

APPENDIX VII - National commission for science ,technology & innovation research license

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 323247

Date of Issue: 10/November/2020

RESEARCH LICENSE

This is to Certify that Dr.: Bernard kiaulhia N'jau of Moi University, has been licensed to conduct research in Kiambu on the topic: Estimation, Characterization and Management of Animal Bite Injuries Reported at Selected Health Facilities in Kiambu County, Kenya, 2020 for the period ending : 10/November/2021.

License No: BAHAMAS ABS/P/20/7401

323247

Applicant Identification Number

Director General

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

Appendix VIII: County Director Medical Service Research No Objection Letter

COUNTY GOVERNMENT OF KIAMBU
DEPARTMENT OF HEALTH SERVICES

All correspondence should be addressed to HEAD
HRDU – HEALTH DEPARTMENT
Email address: mndiritu@gmail.com
rekyara@live.com
Tel. Nos: 0721641516
0721974653

HEALTH RESEARCH AND DEVELOPMENT
UNIT
P. O. BOX 2344 – 00900
KIAMBU

Ref. No.: KIAMBU/HRDU/20/11/25/RA_NJAU Date: 25th NOV 2020

TO WHOM IT MAY CONCERN

RE: CLEARANCE TO CONDUCT RESEARCH IN KIAMBU COUNTY

Kindly note that we have received a request by Dr. Bernard Kinuthia Njau of Moi University to carry out research in Kiambu County, the research topic being on "Estimation, Characterisation and Management of Animal Bite Injuries Reported at Selected Health Facilities in Kiambu County, Kenya, 2020"

We have duly inspected his documents and found that he has been cleared by the NACOSTI to carry out the research for a period ending 10th November 2021. He thus does not need any further clearance with another regulatory body in order to conduct research within the county of Kiambu.

However, it is incumbent upon the institution where he is carrying out research to ensure that he receives adequate supervision during the process of conducting the research. This note also accords him the duty to provide a feedback on his research to the county at the conclusion of his research.

DR. MWANCHA KWASA
COUNTY CLINICAL RESEARCH OFFICER
KIAMBU COUNTY