

**Rabies-Related Knowledge, Practices and Determinants of Dog
Vaccination among Residents and Dog Owners of
Kakamega County, Kenya**

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Science in Applied Epidemiology in the Jomo Kenyatta
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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university.

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DEDICATION

This thesis is dedicated to my late father, Stephen Mucheru for the foundation he laid for me and for giving me a vision, my mother, Anastasia Wambui who is my source of inspiration and for her continued guidance, support and invaluable prayers and my siblings Charity, Amos and Ruth for their encouragement. To God be the Glory.

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ACRONYMS AND ABBREVIATIONS

CVIL	Central Veterinary Investigations Laboratory
DVS	Director of Veterinary Services
EPI	Expanded Program on Immunization
FAT	Fluorescent Antibody Test
IDSR	Integrated Disease Surveillance and Response
KNBS	Kenya National Bureau of Statistics
KPGH	Kakamega Provincial General Hospital
MoALF	Ministry of Agriculture Livestock & Fisheries
OIE	Office Internationale des epizooties
VIL	Veterinary Investigation Laboratories
WHO	World Health Organisation
ZDU	Zoonotic Disease Unit

Definition of terms

'Dog Ownership' refers to responsible possession of a dog by consistently providing at a minimum food, shelter and medical attention

'Dog keeping and Husbandry' refers to the methods employed in keeping a dog in such a way that guarantees no abuse and ensures provision of protection, companionship and shepherding.

'Household dog' is fully dependent on a household and semi-restricted;

'Restricted dog' is fully dependent and fully restricted or supervised;

'Feral dog' is independent and unrestricted (it may need to forage around households but nobody will take responsibility for it).

Household: individuals living under one roof and who share one cooking pot.

Dog vaccination status: a dog is considered vaccinated if the last vaccination date to current date is not greater than 1 year. This can be verified from the vaccination certificates. If the vaccination certificate is not available, verification can be obtained from concerned veterinary officer; otherwise the dog is considered unvaccinated

ABSTRACT

Rabies, a vaccine preventable disease, is considered a zoonotic disease of great public health importance due to its near 100% case fatality rate once clinical signs develop. The domestic dog is considered the main cause of rabies transmission. The objective of this study was to investigate rabies related knowledge, practices and determinants of dog vaccination among residents and dog owners of Kakamega County. This was a cross-sectional cluster survey with two stages of sampling based on the World Health Organisation Expanded Program on Immunization coverage. A total of 390 study participants were enrolled and data collected using a structured questionnaire. Using a set of six questions, respondents' knowledge of rabies was assessed and scored out of 11. A score above sample mean of 7.0 (± 2.8) was considered significant. Respondents' practices towards rabies were assessed using a set of four questions scored out of 10. A score above sample mean of 6.3 (± 1.2) was considered significant. Data analysis was done using Epi Info version 7.0 for Univariate, bivariate and multivariate analysis. Males recruited for this study made up 52.6% (205/390) of all respondents with 185 (47.4%) Females interviewed. The mean and median ages were 42.64 and 40.5 years respectively with an age range of 18-99 years for all respondents. Forty seven percent of all study participants had attained upper primary education. Majority (61%) were self-employed. In term of dog ownership, 338/390 respondents owned a dog and out of these only 35.2% (119/338) had dogs that had been vaccinated within the last twelve months. Participants who were classified as having adequate knowledge of rabies after scoring were 261/390 (67%). Participants with adequate knowledge on rabies were more likely to have proper health seeking practices (139/390) and proper handling practices of suspected rabid dog (327/390). Bivariate analysis was performed using the dog vaccination status as the outcome variable at 95% Confidence Interval and $p<0.05$ as the level of significance. Factors significantly associated with a respondent having a vaccinated dog on included having formal employment ($p<0.005$), having secondary/tertiary education $p<0.05$), preparing food specifically for the dog $p<0.05$).

Respondents whose dog had ever been implicated to bite someone p<0.05), those who knew location and number of government sponsored rabies vaccination clinics p<0.001) and that a dog can be vaccinated from as early as 3 months (P < 0.05).

Conclusion: Having a vaccinated dog was associated with formal employment and having secondary or tertiary education, vaccination coverage was way below the recommended 70% for herd immunity. Knowledge of good animal welfare, location and number of vaccination clinics and age of first vaccination were significantly associated with having a vaccinated dog.

Recommendation: the county government should increase employment opportunities or other income generating activities and literacy levels among the residents. Dog vaccination services be made more accessible in terms of frequency, and availability of government sponsored veterinary services.

CHAPTER ONE.

INTRODUCTION.

1.0 Background Information

Rabies is an acute viral encephalitis affecting mainly carnivores and insectivorous bats but can affect any mammal. Case fatality rate is nearly always 100% once clinical signs appear. Rabies is widely distributed across the globe and is present in all continents apart from Antarctica and some regions which are mainly Islands and Peninsulas or due to successful eradication programs and enforcement of rigorous quarantine regulations. In Africa, high rabies risk countries include Zambia, Angola, Namibia, Mozambique and Zimbabwe among others (Yousaf *et al.*, 2012). Globally, more than 15 million people receive rabies post exposure prophylaxis treatment (WHO, 2010) with an estimated that 55,000 people dying from rabies annually (Knobel *et al.*, 2005). Africa and Asia record the highest human rabies deaths worldwide with an estimated 24,500 annual human deaths (Gsell *et al.*, 2012).

Rabies has been listed as a notifiable disease by Ministry of livestock and as a new priority disease under the integrated disease surveillance and response. The first case of rabies in Kenya was diagnosed in 1912 and it was not until 1982 that the annual number of cases diagnosed rose to 200 (Karugah, 1999). Transmission is almost always by introduction of virus-laden saliva into the tissues at the bite site by a rabid animal. However, virus from saliva or tissue fluids maybe introduced into fresh wounds or through intact mucus membranes (Yousaf *et al.*, 2012). Vaccination coverage is an important determinant of rabies prevalence in any region and WHO recommends 70 per cent vaccination coverage as adequate to prevent rabies outbreaks. Adequate dog vaccination campaigns have been successful in causing dog rabies decline in high-density urban and rural areas of Kenya and Tanzania (Perry *et al.*, 1995). Despite numerous government and private rabies vaccination campaigns, rabies remains

endemic in some parts of Kenya due to inadequate coverage and high dog turnover rates. A longitudinal study in 150 dog-owning households in Machakos District showed that half of the dogs in the population were replaced within one year indicating their high turnover rate and pointing out that one annual vaccination cycle was inadequate to achieve the 70% requirement by WHO (Kitala *et al.*, 2000)

Dog registration and vaccination against rabies is a legal requirement and compulsory especially for dogs kept in urban areas under the revised rabies act Chapter 365 (Laws of Kenya, 2012). Therefore, evaluation of vaccination coverage is vital to assessing adequacy of the vaccination programs. Studies on Vaccination coverage, dog ecology and models on dog vaccination done in Machakos District predicted that for rabies control to be effective, 59% of the dog population has to be vaccinated at any one time. For an annual vaccination cycle, at least 70% of the dog population needs to be vaccinated but for a bi-annual cycle, coverage of 60% would be adequate (Kitala *et al.*, 2002).

1.1 Statement of the Problem

1. What are the demographic characteristics of residents and dog owners of Kakamega County?
2. What proportion of owned dogs has been vaccinated against rabies within the past twelve months in Kakamega County?
3. What is the level of knowledge and awareness of rabies among residents and dog owners of Kakamega County and does this lead to proper practice of regular dog vaccination, and proper health seeking behavior after a dog bite?
4. What are some of the factors that motivate dog owners to have their dogs vaccinated against rabies in Kakamega?

1.2 Justification of the study

Records reviewed in Kakamega provincial general hospital indicated an upward trend in recorded dog bite cases within Kakamega County from 20% in the year 2006 to 43.1% in the year 2009 (Nelima, 2010). A subsequent facility based study conducted on causes of all vertebrate bites in the County indicated that 71% (148/207) persons sampled in the hospital over a period of 3 months had been bitten by dogs. The study indicated existence of a gap in knowledge on residents health seeking behavior, the need for post-exposure prophylaxis after a dog bite incident and the proportion of dogs vaccinated against rabies within the County (Nelima, 2010). The domestic dog has been the main vector of rabies in Kenya accounting for 89% of human animal-bites (Kitala *et al.*, 1993) with studies indicating that unvaccinated dogs are the source of 99% of human rabies deaths (Shepherd & Grabenstein, 2001). Vaccination coverage is therefore an important determinant of rabies prevalence with the World Health Organisation (WHO) recommending 70% vaccination coverage as adequate to prevent rabies outbreaks. Determinant factors for dog vaccination, estimates of vaccination coverage and knowledge of rabies are useful elements for determining herd immunity and building effective control strategies. Factors that will determine the uptake of these vaccination campaign cycles have however not been evaluated. Studies carried out in Eastern and Southern Africa have shown that for effective rabies control, dog ecological/demographic data are vital. This include the dog population density and the population characteristics of dogs which are mainly dog movements, restriction and dependency (Perry, 1993). These factors were investigated in this study. An assessment of the proportion of dogs vaccinated within the past twelve months in the County and investigation of the factors that motivate households to have their dogs vaccinated will be essential for the development of cost-effective and efficient rabies vaccination campaign programs.

1.3 Objectives

1.3.1 General Objective

To investigate rabies related knowledge, practices and determinants of dog vaccination among residents and dog owners in Kakamega County.

1.3.2 Specific Objectives

1. To determine the social and demographic characteristics of residents and dog owners in Kakamega County.
2. To assess the proportion of owned dogs that have been vaccinated against rabies within the past twelve months in Kakamega County.
3. To assess knowledge of rabies and practices related to dog vaccination and health seeking behavior in case of a dog bite incident among residents and dog owners in Kakamega County.
4. To determine the factors motivating dog owning residents to have their dogs vaccinated against rabies in Kakamega County.

CHAPTER TWO.

LITERATURE REVIEW.

2.1 Definition of Rabies as a disease

Rabies is an infectious viral zoonotic disease that affects domestic and wild animals. It is commonly transmitted to man through bites by an animal that is rabid or through close contact with infectious material, usually the saliva or a scratch from a rabid animal. Once symptoms of the disease develop, rabies is nearly always fatal (WHO 2012, OIE, 2011). Globally, more than 15 million people receive rabies post exposure prophylaxis treatment (WHO, 2010) with an estimated 55,000 people dying from rabies annually (Knobel *et al.*, 2005). Africa and Asia record the highest human rabies deaths worldwide with an estimated 24,500 annual human deaths (Gsell *et al.*, 2012). The first documented lab confirmed rabies case occurred in 1912 in a dog near Nairobi (chong,1993) with the first human case being a woman from South Nyanza bitten by a dog in 1902 (Hudson, 1944). The majority of rabies cases in Kenya have been reported to be caused by dogs (Binepal *et al.*, 1992). Following this, Kenya experienced rabies outbreaks in early 1930s, late 1940s, and early 1950s which precipitated widespread dog vaccinations in the 1950s and 1960s. This controlled rabies such that by 1973, the disease was virtually eliminated from most parts of the country. Laxity in surveillance and vaccination led to renewed widespread outbreaks later which has led to persistence of rabies as a major problem in Kenya since the mid 1950's (Kariuki & Ngulo, 1985).

2.2 Epidemiology of Rabies

Rabies is widely distributed across the globe and is present in all continents apart from Antarctica and some regions which are mainly Islands and Peninsulas. A few countries that have managed to successfully eradicate the disease through strict vaccination and control protocols include Japan, Australia, New Zealand and The British Isles. Africa and Asia accounts for more than 95% of the global human deaths (Yousaf *et al.*, 2012).

A variety of animal species, mostly wild, are involved in the maintenance and transmission of the disease in nature. Fox rabies has been well controlled in Western Europe, but skunk, raccoon and fox rabies remain prevalent in parts of Canada and the United States. In Africa, Jackals, bat-eared foxes and mongoose are involved in rabies transmission mostly in the south-eastern part of the continent. A range of bat species have been shown to maintain rabies and rabies-related viruses in Africa, Central and south-east Asia, Europe and the Americas. Cases of Human rabies resulting from Infected wildlife species, including bats, have been isolated but the total number of such cases remains limited compared with the annual number of human deaths caused by dog-transmitted rabies (Gsell *et al.*, 2012; WHO, 2012). In developing countries of central and South America, Africa and Asia, Canine rabies is predominant. These regions also account for bulk of global human rabies cases. Africa and Asia account for half of global human rabies cases with the domestic dog being implicated in 90% of these cases (WHO, 2012).

Rabies disease is caused by the rabies virus which belongs to the genus Lyssavirus, the family Rhabdoviridae and the order Mononegavirales (WHO, 2004). The virus is enzootic throughout Africa with the domestic dog being the main vector for transmission (Sambo, 2012). The lyssaviruses have common host range which includes dogs, cats, man, bats, and wild carnivores like foxes, skunks and jackals (OIE, 2011). The duvenhage virus has been isolated from a Dutch woman (died of rabies long after she had left Kenya) who visited caves in Tsavo and was suspected to have been bitten by a bat (Van Thiel *et al.*, 2009). There are two clinical forms of rabies in man: the furious and the paralytic form, both forms are fatal once clinical signs develop (WHO, 2012).

2.3 Rabies in dogs

The primary sources of animal-to-human rabies transmission are dogs, Raccoons, skunks, bats and foxes (WHO, 2012). Dogs are the main host and transmitter of rabies and have been implicated to be the source of infection in all of the estimated 50 000

annual human rabies deaths in Asia and Africa (Knobel *et al.*, 2005). Infected animals may have the virus in their saliva and transmit to other animals several days before the onset of clinical signs. The virus normally replicates within muscle cells and connective tissue at the site of inoculation and enters the peripheral nerves through the neuromuscular junction where it travels centripetally to the spinal cord and ascends to the brain where replication occurs. This is followed by centrifugal spread via peripheral nerves to many organs of the body including the salivary glands. If an animal is capable of transmitting rabies through saliva, it is possible to detect the virus in the brain (Linda, 2006). The Domestic dog is the main vector of rabies in Kenya accounting for 63% of confirmed cases and 89% of human animal-bites (Kitala *et al.*, 1993). In countries where domestic animals are not vaccinated against rabies, dogs are a source of 99% of human rabies deaths (Shepherd & Grabenstein, 2001). Most rabies cases are under diagnosed and under reported especially in the developing countries (WHO, 2010, Knobel *et al.*, 2005) with studies in Kenya indicating that the number of confirmed animal cases was 40 times the number revealed by passive surveillance (Kitala *et al.*, 1994) Rabid dogs are responsible for causing more than 98 % of human rabies cases (David *et al.*, 2012). In Kenya, the number of confirmed dog rabies cases at the kabete Central Veterinary Investigations Laboratories between the years 2010 to 2012 was 120 cases (CVIL, 2012). Between the years 1981 to 1990, 8,027 people were bitten by dogs but only 4,947 received post-exposure treatment in Machakos District alone. Many cases therefore went unreported (Kitala *et al.*, 2000).

2.4 Rabies in man

Globally, more than 15 million people receive rabies post exposure prophylaxis treatment (WHO, 2010) with an estimated 55,000 people dying from rabies annually (Knobel *et al.*, 2005). Africa and Asia record the highest human rabies deaths worldwide with an estimated 24,500 annual human deaths (Gsell *et al.*, 2012). Rabies is spread to man through close contact with infectious material, usually saliva of rabid animals,

through bites or scratches. Although bats are a source of most human rabies deaths in the United States of America and Canada, the number of human rabies deaths due to bats remains small compared to dog bites. Human deaths following exposure to foxes, raccoons, skunks, jackals, mongooses and other wild carnivore host species are very rare (CDC, 2011). Transmission can also occur when infectious saliva comes into direct contact with human mucosa or fresh skin wounds. Rarely, rabies may be contracted by inhalation of virus-containing aerosol or via transplantation of an infected organ. Ingestion of raw meat or other tissues from animals infected with rabies cannot result in human rabies (WHO, 2010, WHO, 2012). Human-to-human transmission by bite is theoretically possible but has never been confirmed (CDC, 2011). Infection normally occurs following a deep bite or scratch by an infected animal without proper wound management or post-exposure prophylaxis treatment. The incubation period is normally prolonged and variable. Typically, the virus remains at the inoculation site for a considerable time period. This forms the basis for success of post exposure prophylaxis immediately after being bitten.

In Kenya, from 1982 to 1987 a total of 5,264 human animal bite cases and 11 human deaths from rabies were recorded with an estimated a human dog bite prevalence of 40 per 100,000 people in 12 months (Kitala *et al.*, 1993). Rabies poses a substantial threat to human health, killing more than 150 people every day and approximately 40% of bite victims are children. The psychological impacts following bites by a rabid animal can be traumatic. Once clinical sign develop, the disease is fatal. The initial symptoms of rabies include listlessness, general weakness and discomfort, fever, pains or headache which may last for several days. Later, an itching or prickling sensation at site of bite progresses to symptoms of cerebral dysfunction, agitation, anxiety and confusion. The person may experience abnormal behavior, delirium, hallucinations, insomnia and respiratory failure. (Jackson & Wunner, 2007) (Kumar, 2009). There is a documented case of an 8 year old girl who recovered from the clinical form of rabies in California in year 2011 after receiving advanced supportive care, including treatment with therapeutic

coma. She had a one week history of progressive sore throat, difficulty swallowing, and weakness. Rabies was diagnosed from the cerebrospinal fluid after flaccid paralysis and encephalitis developed (CDC, 2012).

2.5 Clinical signs and symptoms of rabies

2.5.1 Clinical symptoms in Man:

The incubation period for rabies is widely variable and dependent on the bite site and volume of viral load in the saliva of the rabid animal. It normally ranges from one to three months, but may vary from less than one week to more than one year.

The initial symptoms of rabies are:

Fever,

Pain or an unusual or unexplained tingling,

Pricking or burning sensation (paresthesia) at the wound site,

Progressive, fatal inflammation of the brain and spinal cord develops as the virus spreads through the central nervous system, (WHO, 2012; OIE, 2011).

Two forms of the disease can then follow and these are:

- i) The furious/encephalitic form: people with furious rabies exhibit signs of

Hyperactivity,

Excited behavior,

Hydrophobia and aerophobia.

Central nervous system signs:

Aggression,

Agitation,

Hyper-excitability,

Hydrophobia and aerophobia,

Impaired swallowing after a few days,

Death occurs by cardio-respiratory arrest (CDC, 2011; WHO_a, 2010; WHO_b, 2010).

- ii) The paralytic/dumb form:

Paralytic rabies accounts for about 30% of the total number of human cases. This form of rabies runs a less dramatic and usually longer course than the furious form.

The muscles gradually become paralyzed, starting at the site of the bite or scratch,

A coma slowly develops, and eventually death occurs. The paralytic form of rabies is often misdiagnosed, contributing to the under-reporting of the disease.

Paralytic symptoms include:

Flaccid paresis,

Myalgia,

Muscle weakness,

Drooling of saliva and deafness.

Non-specific signs of rabies include:

Fever,

Malaise,

Anorexia,

Tingling sensation at site of bite,

Headache and other aches,

Numbness at site of bite and

Anxiety (CDC, 2011; WHO_a, 2010; WHO_b, 2010).

2.5.2 Clinical symptoms in Dogs

Rabies is considered a fulminating disease meaning that once clinical signs appear, treatment is almost certainly hopeless. The paralytic form is characterized by flaccid paralysis in the bitten limb which may ascend either symmetrically or asymmetrically. Encephalitic rabies is characterized by hyper excitability, autonomic dysfunction and aerophobia (Drew, 2004).

Rabies virus causes acute encephalitis in all warm blooded hosts and the outcome is almost always fatal.

Initial symptoms of rabies may be nonspecific and include:

Lethargy,

Fever,

Vomiting,

Anorexia.

These may progress within days to:

Cerebral dysfunction,

Cranial nerve dysfunction,

Ataxia,

Weakness,

Paralysis,

Seizures,

Difficulty breathing,

Difficulty swallowing,

Excessive salivation,

Abnormal behavior,

Aggression, and

Self-mutilation (WHO, 2004; CDC, 2011).

Diagnosis of rabies is done on the basis of clinical signs observed in animals and man (Macharia *et al.*, 2001). Rabid animals of all species exhibit typical signs of central nervous system disturbance (Karugah, 1999). In Kenya, human and animal Specimens are submitted to Kabete or Mariakani Veterinary Investigation Laboratories (VIL), these two being the only laboratories that carry out rabies diagnosis (Karugah, 1999).

2.6 Rabies Virus Diagnostic techniques

2.6.1 Fluorescent Antibody Test (FAT)

The sample for rabies diagnosis is the head of the suspected animal. The brain is extracted for sampling. Animals submitted for rabies testing should be euthanized while maintaining the integrity of the brain for recognition of the anatomical parts by lab

personnel. For prompt laboratory testing, submitted specimens should be stored and transported under refrigeration (Cathrine, 2011). The gold standard confirmatory test is the Fluorescent Antibody Test (FAT). Biosafety level 2 facilities are adequate for routine diagnosis. Personnel working with the virus should receive pre-exposure prophylaxis (WHO, 2004). FAT is the gold standard test and the standard procedure in public health labs around the world (OIE, 2011). It provides a reliable diagnosis in 98–100% of cases for all rabies virus strains if a potent conjugate is used. FAT is normally positive after inoculation of brain tissue, saliva or CSF in cell culture, or after intracerebral inoculation in mice or in suckling mice (Veera *et al.*, 2005). It uses a fluorescent dye conjugated to rabies antiserum and a fluorescent microscope and is the quickest (2 hours), most reliable method available, both for diagnostic and research purposes. Results normally display oval apple-green negri bodies diagnostic of rabies (Bishop *et al.*, 2003). Results of FAT can be available within two hours of submission of the specimen while results of mice inoculation can take up to 28 days (OIE, 2011).

2.6.2 Mouse Inoculation Test (MIT)

All samples are subjected to the Fluorescent Antibody Test (FAT) as a first procedure and subsequently, all cases which are suspicious and all cases with a history of human contact are inoculated into mice (Bishop *et al.*, 2003). This test only uses fresh samples including brain, salivary glands, liver, spleen pancreas and nuchal skin (Yousaf *et al.*, 2012) It is used in cases of inconclusive FAT tests and Involves intra-cerebral inoculation of brain tissue from rabies-suspect animals into infant mice. When the test is positive, a large amount of virus can be isolated from a single mouse brain for strain identification purposes (OIE, 2011). It takes long (28 days). To reduce this time, the World Health Organization Expert Committee on Rabies recommends that sufficient animals should be inoculated to allow for the sequential daily euthanasia of one or two of these mice (WHO, 2004).

2.6.3 Tissue Culture Inoculation

The test utilized fresh samples including the brain which is the most appropriate, salivary glands, liver, pancreas and nuchal skin (Yousaf *et al.*, 2012). It is also used in cases of inconclusive FAT and Involves inoculation of the brain tissue from the suspect animal into tissue culture- mouse neuroblastoma cells. Although it takes a shorter time, it is still as sensitive as the mouse inoculation test (Yousaf *et al.*, 2012).

2.6.4 Enzyme-Linked Immunosorbent Assay (ELISA)

ELISA that detects rabies antigen is useful for large surveys and is a variable of the immunochemical test (Xu *et al.*, 2007). Principles of the Rapid Rabies Enzyme-Immunodiagnostic (RREID) test are similar to FAT. Rabies antiserum is conjugated to an enzyme which gives a color reaction when reacted with its substrate. Specificity and sensitivity should be investigated before use and should be combined with other tests such as FAT for confirmation (OIE, 2011).

2.6.5 Polymerase Chain Reaction (PCR)

For a large number of samples, as in an epidemiological survey, the polymerase chain reaction (PCR) can provide rapid results in specially equipped laboratories. Samples used include saliva, urine or cerebrospinal fluid (Veera *et al.*, 2005). The test is suitable for the typing of rabies virus isolates and for describing their variability within and among regions. Although it is expensive and requires experienced technicians, it utilizes tissue samples in any condition (Yousaf *et al.*, 2012).

2.7 Management of Rabies

2.7.1 Wound Management

A dog bite wound should initially never be dressed and should be treated as an open wound by washing with adequate amounts of soap and water then applying iodine. Removing the rabies virus at the site of the infection by chemical or physical means is

an effective means of protection. Therefore, prompt local treatment of all bite wounds and scratches that may be contaminated with rabies virus is important. Recommended first-aid procedures include immediate and thorough flushing and washing of the wound for a minimum of 15 minutes with soap and water, detergent, povidone iodine or other substances that kill the rabies virus (CDC, 2011; WHO 2010_a; WHO_b 2010).

i) Pre-exposure prophylaxis:

This is recommended for all at risk individuals. Children living in rabies enzootic areas of developing countries are the most vulnerable, laboratory staff, veterinarians, animal handlers, wildlife officers and visitors to high rabies risk areas. It involves intramuscular injection of rabies vaccine, 1ml or 0.5 ml, depending on vaccine type on days 0, 7, and 28 in the deltoid muscle of the arm or the anterolateral area of the thigh in children below the age of 2 years (Bishop *et al.*, 2003, WHO_a 2010; WHO_b 2010).

ii) Post- exposure prophylaxis

Lack of post exposure prophylaxis after a rabid dog bite has a 5% chance of developing to clinical rabies if bitten on the hand and a 70% chance if bitten on the face (Cleaveland *et al.*, 2002). Human Rabies immunoglobulin (HRIG) should be administered at the bite site at 20 international units per kilogram (20 I.U/kg) or equine rabies immunoglobulin (ERIG) at 40I.U./KG on days 0 (zero). Post-exposure injections should then be given on days 0, 3, 7, 14 and 28. Tetanus toxoid and antibiotics should also be given (Bishop *et al.*, 2003, WHO weekly record, 2010, WHO Guide, 2010).

2.8 Prevention and Control of Rabies

Rabies is a vaccine-preventable disease. The most cost-effective strategy for preventing rabies in people is by eliminating rabies in dogs through vaccination. Vaccination of animals (mostly dogs) has reduced the number of human (and animal) rabies cases in several countries, particularly in Latin America. However, recent increases in human rabies deaths in parts of Africa, Asia and Latin America suggest that rabies is re-emerging as a serious public health issue. Preventing human rabies through control of

domestic dog rabies is a realistic goal for large parts of Africa and Asia, and is justified financially by the future savings of discontinuing post-exposure prophylaxis for people (CDC, 2011; WHO_a, 2010; WHO_b, 2010). Comprehensive guidelines on control in dogs have been prepared by the World Health Organization (WHO, 2004) and include notification of suspected cases to authorities, destruction of dogs with clinical signs and dogs bitten by a suspected rabid animal, reduction of contact rates between susceptible dogs by leash laws, dog movement control and quarantine, mass vaccination of young dogs, stray dog control and destruction of unvaccinated dogs with low levels of dependency or restriction by man and dog registration (Linda, 2006). In Kenya the attempted control measures are a combination of dog vaccination, destruction by baiting of "stray" dogs and restriction of dog movement. These have failed due to inadequate funding leading to shortage of vaccines, the extremely high dog turnover rate and inadequate public education on rabies (Karugah, 1999).

CHAPTER THREE.

MATERIALS AND METHODS.

3.0 Study area

The study was carried out in Kakamega County which is located in the Western Part of Kenya whose geographical coordinates are 0.2833° N, 34.7500° E, bordering Bungoma to the North, Trans Nzoia to the North East, Uasin Gishu and Nandi Counties to the East, Vihiga to the South, Siaya to South West and Busia to the West. The sub counties within the county that were sampled include Kakamega central, Kakamega North, Kakamega South, Kakamega East, Mumias, Lugari and Bembutere (Appendix 1). The county has a Total Population of 1,660,651 with 800,989 males and 859,662 females and has a total of 398,709 Households according to the two thousand and nine census report. It covers an area of 3,244.9 square kilometers. The Population density is 515 per square kilometer with 57% of the population considered to live below the poverty line (Nelima, 2010; KNBS, 2009). There are seven dog markets in the County namely: Nambacha, Lubao, Shikulu, Kakunga, Butali, Shinyalu and Matete. The markets are active all year round selling over 200 dogs per week with Lubao market selling the highest number of about 80 dogs per week. Each market has one market day in a week selling dogs in an open auction yard set aside for this purpose. The dog population distribution in the district is such that more dogs are concentrated around the municipality as a result of increased stray dog population with dog ownership further in the homesteads being evenly distributed (Nelima, 2010)

3.1 Study design

A cross-sectional study was conducted

3.2 Study population

Any Resident or dog owner living in Kakamega County.

3.2.1 Inclusion Criteria

Any household member present and above eighteen years of age residing in Kakamega County and who consented to participate in the study was interviewed. If all household members were present, the head of the household was interviewed. If there was no household member above eighteen years, or the member did not consent, the house immediately next to it will was selected.

3.2.2 Exclusion Criteria

Non consenting residents and dog owners living in Kakamega County and households without a member above eighteen years of age were excluded from the study.

3.3 Sample size determination

The minimum sample size required for residents representing households to be interviewed was estimated assuming an expected prevalence of 50% to achieve maximum sample size as there was no existing prevalence, a ninety-five per cent confidence interval and desired accuracy of 5% (Kongkaew *et al.*, 2004).

$$n = Z^2 P (1-P) / d^2$$

Assumptions made:

n= required sample size

Z= confidence level of 95% (standard value 1.96)

p = prevalence 50% (0.5)

d= level of precision at (5%)

$$n = [(1.96)^2 * (0.5 * 0.5)] / (0.05)^2$$

$$n = 385$$

3.4 Sampling design

A cross sectional cluster survey technique based on the WHO Expanded Program on Immunization coverage was conducted in two stages:

1st stage: 30 clusters were selected from the master frame containing a total of 1,298 clusters for Kakamega County using simple random sampling. The Clusters were obtained from the Kenya National Bureau Statistics (KNBS) records where a cluster was the equivalent of an Enumeration Area (EA) with one KNBS Enumerator in-charge of one or more EA's.

2nd stage: Three hundred and Ninety residents representing Three hundred and Ninety households were selected within clusters using systematic random sampling. The sampling interval (N/n) for each cluster was determined by dividing the total number of households (N) in each cluster (which was uneven and ranged from 50 to 149 Households) by number of households to be interviewed for each cluster (n) which was thirteen (Appendix 2). At least 13 households and 7 dog owning households selected per cluster were sampled (requirement follows WHO EPI scheme to reduce effect of clustering in case some households owned ≥ 2 dogs). Using this criterion and formula, the selection of the households was computer generated using SPSS version 19.0.0 in conjunction with staff from the KNBS headquarters. This follows their cluster survey protocol on generating sampling units for surveys in order to safeguard household members' personal data/information and for their security purposes.

3.5.0 Data Collection

A structured questionnaire was used to seek information on demographic characteristics of residents and dog owners, determinants of dog vaccination practices such as dog restraint methods, time of vaccination campaign, frequency of vaccinating dog, accessibility of vaccination centers, dog vaccination status and other related dog demographic characteristics (Appendix 5). Any available household member above 18 years was interviewed. For purposes of assessing and scoring participants knowledge on rabies, six questions were used and covered a description of rabies, its mode of

transmission and the outcome of disease, the range of species affected and how it can be either prevented or controlled. The questions were had a maximum score of 11 and any respondent who scored above the sample mean of 7.0 was classified as having adequate knowledge of rabies (Appendix 6). To assess whether the practices of participants reflected their knowledge of rabies, four questions were used covering length of time taken to present to hospital, practice towards suspect rabid animals and practice to carcass of suspect rabid animal. Participants were scored according to the completeness and accuracy of answers with correct answers scoring a maximum of 10. Respondents who scored above the sample mean of 6.3 were classified as having proper practices towards rabies (Appendix 6). The questionnaire was administered in English.

3.5.1 Data Management:

Data Entry: data collected using the questionnaires was cleaned and validated to minimize error.

Data Security: Data was coded, password protected and backed in a CD-ROM and flash disk.

3.5.2 Data analysis

Data was analyzed using Epi-Info version 7 and Ms Excel 2007 (Microsoft, Seattle, WA, USA) to generate frequencies, proportions, graphs and charts. Univariate analysis was performed where proportions were calculated for categorical variables and means and medians for continuous variables. Bivariate analysis of the data was performed using the dog vaccination status (vaccinated and unvaccinated) as the dependent variable and the determinants of vaccination (dog restraint method, dog feeding method, employment status, education level knowledge of location of veterinary clinics, knowledge of age of first dog rabies vaccination and rabies transmission modes as the independent variables. Odds ratios, Confidence intervals at 95% and p value < 0.05 were used to determine levels of significance with factors with p-value of ≤ 0.05 considered as significant. Multivariate analysis was carried out for independently significant factors.

3.6 Ethical consideration

Approval of the study was obtained from the Board of post graduate studies of Jomo Kenyatta University of Agriculture and Technology (BPS-JKUAT) and ethical clearance was obtained from the Kenyatta National Hospital/ University of Nairobi Research ethics committee (KNH/UoN-ERS) (Appendix 3). Informed written consent was obtained from residents before administering the questionnaire. Confidentiality of information availed was upheld (Appendix 4).

CHAPTER FOUR.

RESULTS.

4.1 Socio-Demographic Characteristics of Respondents

A total of 390 study participants were enrolled during the study period and interviewed. Table 4.1 shows the location of respondents interviewed by Sub County with most study participants interviewed from Mumias and Kakamega Central Sub Counties.

Table 4.1 Location of respondents Interviewed by Sub County

Sub County	No. of Respondents
Butere	13
Kakamega Central	103
Kakamega East	39
Kakamega North	27
Kakamega South	13
Lugari	52
Mumias	143
Total	390

4.1.1 Distribution of study respondents by Age and Sex

Males interviewed during the study period were 52.6% (205/390) and females were 47.4% (185/390). The mean and median ages were 42.6 and 40.5 years respectively with an age range of 18-99 years for all respondents. Figure 4.1 shows the age group distribution of study participants interviewed with the majority belonging to the age group 20-29 years.

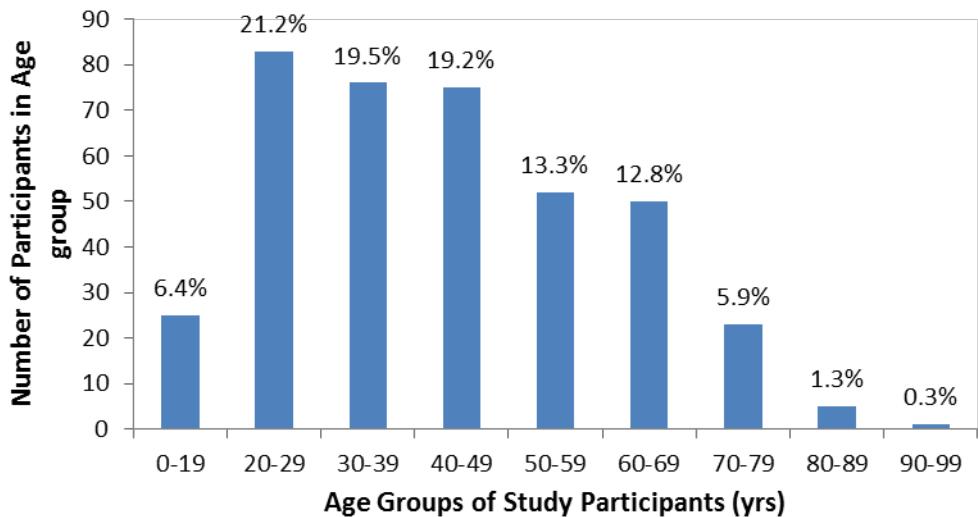


Figure 4.1 Shows the Age group distribution of study participants interviewed

4.1.2 Distribution of study participants by level of Education

Most study participants (47.4%) had attained upper primary education followed by secondary level (25.3%). Table 4.2 shows the distribution of study participants by level of Education.

Table 4.2 Highest Level of Education Attained by Study Participants

Education Level	No. of respondents	Percent	95% CI
Lower Primary	38	9.74	7.07-13.24
Upper Primary	185	47.44	42.4-52.52
Secondary	99	25.38	21.2-30.06
College	24	6.15	4.07-9.14
University	7	1.79	0.79-3.83
Currently student	1	0.26	0.01-1.65
No School	36	9.23	6.63-12.66
Total	390	100.0	

4.1.3 Occupation and religious affiliation of Study Participants

A majority 237 (60.7%) of study participants interviewed were self-employed followed by formally employed 50 (12.8%). Participants who reported to be casually employed were 17 (4.3%). Majority of self-employed respondents were farmers. Among all study participants interviewed, 346 (88.7%) were Christians, 43 (11.0% were Muslim and 1 reported to be an atheist.

4.2 Proportion of Respondents owning dogs Vaccinated within the Past Twelve Months

Out of all respondents interviewed, 338/390 (86.7%) owned a dog. All dogs that had been vaccinated regardless of the date of vaccination were 186/338 (55.0% 95% CI 49.5-60.4%). Dogs that had been vaccinated within the last twelve months were 119/338 (35.2%) making up the vaccination coverage for this study.

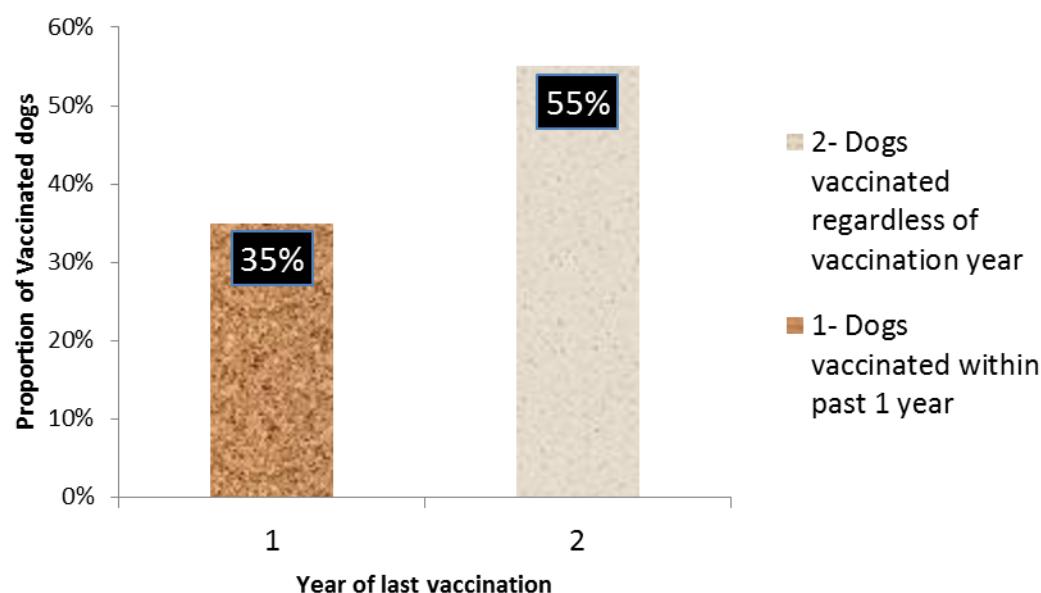


Figure 4.2 shows the rabies vaccination coverage for the past year 2012/2013

4.3 Knowledge of Rabies among the Study Participants

Respondents' knowledge of rabies was evaluated based on the following six categories with an overall score of eleven. Respondents who scored seven and above which was the sample mean were classified as having adequate knowledge (Appendix 6).

On description of rabies, study participants who correctly described rabies as a disease were 191 (48.9%) with 127 (32.5%, 95% CI 27.98-37.5%) describing rabies as a change in the behavior of dog/animal. The source of information on rabies for 40 (10.26%) respondents was brochures, posters and other printed material, 21 (5.3%) got from the radio, 16 (4.1%) learned of rabies from community health workers while 13 (3.3%) learned from veterinary officials.

Responses on the range of species that can be affected by rabies are as shown in Fig 4.3.

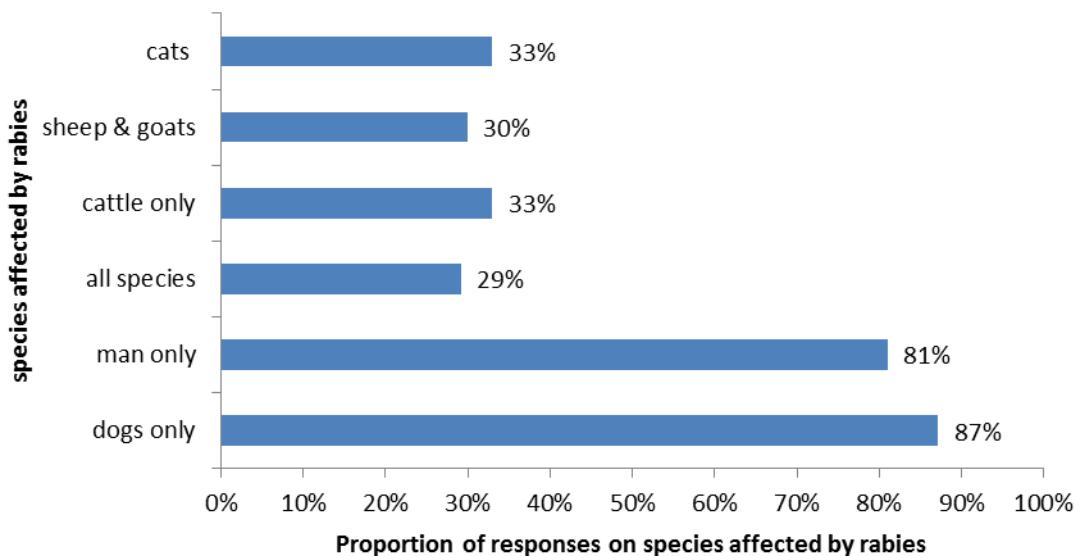


Figure 4.3 shows the Responses on the range of species affected by rabies

On rabies mode of transmission, respondents who said rabies is transmitted through bites were 309 (79.2%) and those who responded rabies can be transmitted through scratches were 14 (3.5%). The rest 73 (18.7%) said they don't know.

On outcome of rabies after exposure, for all respondents interviewed, 348 (88.7%) reported that exposure to rabies without treatment is fatal with 192 (49.2%) reporting that rabies is curable, while 60 (15.3%) said they didn't know.

On management of rabies, respondents who reported that post exposure anti-rabies injection is given were 190 (48.7%) with 84 (21.5%) reporting tetanus injection is given, 18 (4.6%) said antiseptics are applied to the bite wound, 12 (3.0%) said the wound is washed with soap and water while 167 (42.8%) didn't know any treatment given.

On rabies prevention and control, the pie chart in Figure 4.4 shows the distribution of responses on rabies prevention methods respondents preferred.

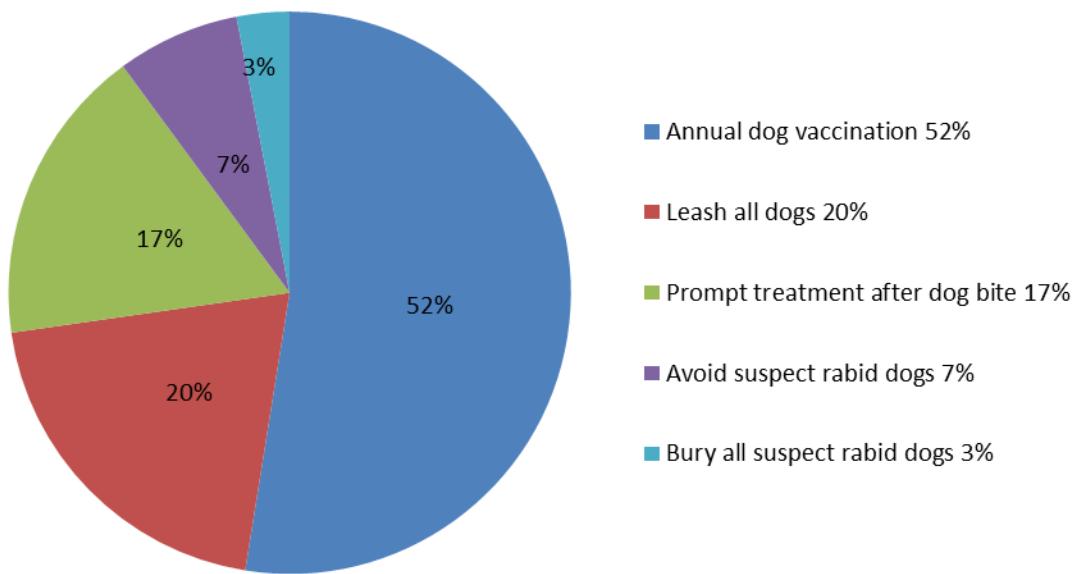


Figure 4.4 Distribution of responses on Rabies prevention methods by study participants

Overall, respondents who were classified as having adequate knowledgeable on rabies after attaining a score ≥ 7 from the above categories were 261/390 (66.9%, 95 % CI 61.98-71.53%) while those who didn't meet the threshold for adequate knowledge on rabies were 129/390 (33.0%, 95% CI 28.47-38.02%).

4.4 Practices Related to Rabies

Respondents' practices related to rabies were evaluated based on the following four categories with an overall score of ten. Respondents who scored 6.3 and above which was the sample mean were classified as having good practices on rabies (Appendix 6).

On first aid and medical attention, for respondents who had ever been bitten by a dog 71 (18.2%) or who had a family member ever bitten by dog 116 (29.7%), only 125/187 (66.8%) went to hospital after the bite incident. Respondents who reported that lack of hospital presentation was because the cost of treatment was high were 266 (68.2%). Fig 4.5 shows course of action respondents took or reported they would take.

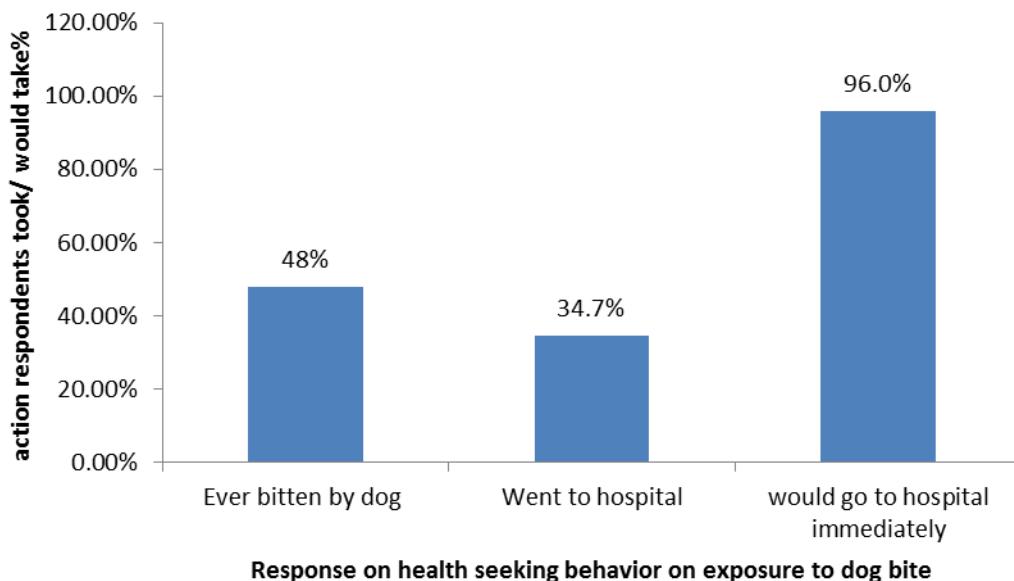


Figure 4.5 Participants health seeking behavior on exposure to dog bite

For length of time taken to present to hospital, respondents who reported that they would present to hospital immediately after a dog bite incident were 374 (95.9%) while 11 (2.8%) said they would present the following day, 1 (0.2%) said he would present to hospital between 2-14 days.

For practices to suspected rabid animal, in the case of a suspected rabid dog, 184 (47.1%) of the respondents reported that they would immediately kill the animal, 146 (37.4%) said they would report it to the veterinary officer while 12 (3.0%) said they would do nothing.

For practices towards a rabid carcass, responses for actions respondents who reported that they would immediately kill a suspected rabid dog would take are shown in Figure 4.6.

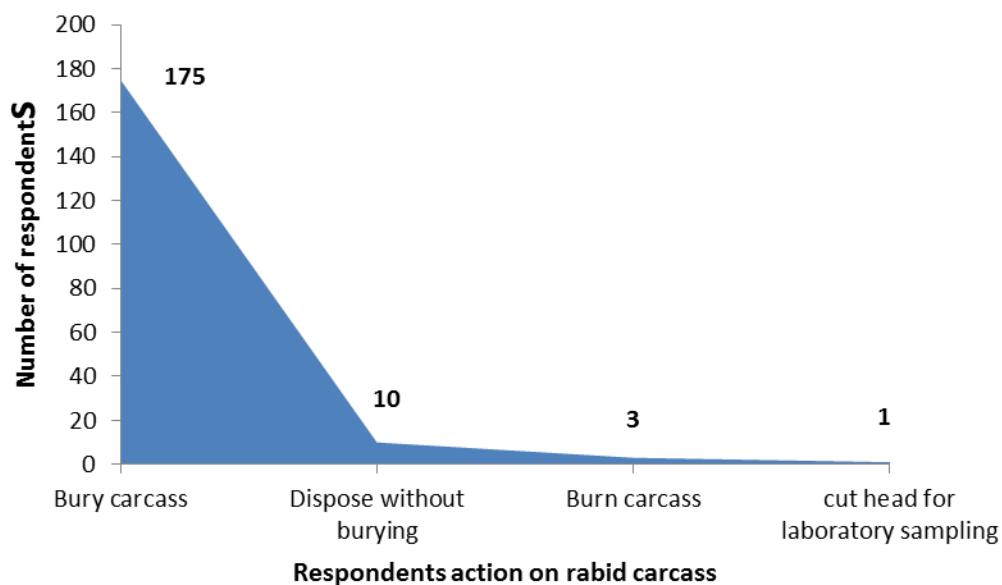


Figure 4.6 Participants practices towards a carcass that died from rabies

Overall, Respondents who attained a score ≥ 6.3 were classified as having proper practices on a suspected rabid animal 327/370 (88.3%, 95% CI 84.5-91.4%), on first aid and medical attention 139 (80.3%, 95% CI 73.6-85.9%), on hospital presentation after dog bite 387 (99.2%, 95% CI 97.58-99.8%) and on the carcass of a suspected rabid dog were 177/185 (95.6%, 95% CI 91.7-98.1%).

4.5 Association of Knowledge with practice

Bivariate analysis was done to associate knowledge to practice with all the four practices as the independent variables and knowledge of rabies as the dependent variable. The results indicated that participants with adequate knowledge on rabies were more likely to have proper health seeking practices 139 (80%) ($OR=3.0$, 95% CI=1.4-6.8) and proper handling practices of suspected rabid dog 327 (88%) ($OR=5.4$, 95% CI=2.7-10.6). Table 4.3 shows the association of knowledge to proper practice.

Table 4.3: Association of Knowledge of rabies with proper practices among study participants

Practices on rabies	ODD S	95% CI	p-Value
practice on rabid carcass (yes)	0.45	0.05-3.8	0.75
(no) medical attention/first aid practice (yes)	3.0	1.36-6.8	0.01*
(no) practice on suspect rabid dog (yes)	5.4	2.7-10.6	0.000001*
(no)			

4.6 Determinant factors for dog Vaccination among dog owners interviewed.

Bivariate analysis was carried out on the factors summarized in the tables below to find out whether they determined the vaccination status of the respondent's dog.

Table 4.4: Education level and employment status as vaccination determinant factors

Determinant Factor	OR	95% CI	p-value
HIGHEST EDUCATION			
Secondary/tertiary	2.8	1.67-4.6	0.00008

(yes)			
(no)			
EMPLOYMENT STATUS			
Formal employment	2.5	1.17-5.3	0.02
(yes)			
(no)			

SOURCE OF DOG	odds	95% CI	P-value
Bought	0.55	0.35-0.84	0.0079
(yes)			
(no)			
Born in household	1.42	0.91-2.2	0.14
(yes)			
(no)			
DOG RESTRAINT method			
Leashed whole day	1.6	1.0-2.6	0.04
(yes)			
(no)			
Partly leashed	1.88	1.18-2.98	0.009
(yes)			
Not leashed			
(no)			

For source of respondents dog, those who reported they bought their dogs were 47.8%, (n=185), while those whose dog was given by a neighbor were 51 (13.1%) and those who adopted a dog from the stray population were 9 (2.3%). Respondents who had dogs born in the household were 142 (36.7%).

For dog restraint methods, respondents who let their dogs roam freely were 156 (46.1%), those who reported to leash their dog the whole day were 150 (44.3%) and those who leashed their dog for only part of the day were 11 (3.2%). The rest 21(6.2%) did not leash their dogs but reported that the dog stayed within the compound.

Table 4.6: Dog feeding and availability of vaccination services as determinant factors

DOG FEEDING	odds	95% CI	P-value
Food prepared for dog(yes)	2.9	1.6-5.2	0.0004
(no)			
AVAILABILITY OF VACCINATION SERVICES			
Vet always available	8.84	3.4-22.9	0.000001
(yes)			
(no)			
AGE OF FIRST RABIES VACCINATION			
<6months	1.78	1.16-2.73	0.01
(yes)			
At 1yr/ >1yr/don't know			
(no)			

On dog feeding, respondents who reported that they prepared food specifically for their dog were 92 (20.9%). Dog owners who reported feeding their dogs on leftovers from the house were 162 (36.9%), those who shared food cooked for the household with their dog were 158 (35.9%) while 12 (2.7%) reported their dog scavenges for food.

On availability of dog vaccination services, out of all respondents with vaccinated dogs (55.0%, n=186), 134 (72.0%) took their dogs to government designated vaccination centers while 52 (27.9%) had their dogs vaccinated in their homesteads by a veterinary officer, 40 (26.3%) reported not to know where to seek for vaccination services. Annually, respondents who reported knowledge of only one government vaccination campaigns/clinics were 36.1% (n=141) or two were 24.8% (n=97), and those that reported the veterinary personnel are always available when they need to have their dogs vaccinated were 12.8% (n=50). Respondents who reported that the first rabies

vaccination should be done when the dog is less than one year were 60.1% (n=234) and those who reported it should be done at 1 year were 20.0% (n=78).

Table 4.7: Dog bite incidents as vaccination determinant factors for vaccination

DOG BITE INCIDENTS	odds	95% CI	P-value
History of Dog biting someone (yes)	2.1	1.1-3.9	0.03
(no)			
Charged for victim treatment (yes)	0.7	0.007-6.7	0.8
(no)			
Ever bitten by dog (yes)	2.1	1.1-3.8	0.02
(no)			
Family member ever bitten (yes)	2.5	1.5-4.2	0.0005
(no)			

On dog bite incidents, on a daily basis, 295 (75.6%) respondents reported seeing more than one stray dog in their neighborhood, Of all dog owners, 64 (18.9%) had their dog implicated to have bitten someone and out of these, 60 (90.9%) respondents were charged for the victim's treatment. Respondents bitten by a dog at one point in their life were 71 (18.2%) while 116 (29.7%) reported having someone in their family having been bitten by a dog at some point in their life.

4.7 Multivariate analysis of significant dog vaccination determinants

Unconditional Logistic Regression was done for factors significant on bivariate analysis ($P < 0.05$). The dependent /outcome variable was the dog vaccination status while the independent/covariates included having formal employment, knowledge of rabies disease, age of first rabies vaccination among others. Factors that were found to be independently and significantly associated with having a vaccinated dog on running the Logistic model ($P < 0.05$) are summarized in table 4.8.

Table 4.8 Independently significant factors on Multivariate analysis

Determinant factors	odds ratio	Z-statistic	P-Value	95% CI
Formal employment	2.35	2.09	0.03	1.05-5.24
Know rabies disease	0.23	-3.3	0.001	0.09-0.54
Age of 1 st vaccination	2.76	3.19	0.001	1.47-5.14
Know of 2 annual rabies clinics	3.80	4.25	0.0000	2.05-7.01
History of dog biting someone	2.54	2.71	0.006	1.29-4.99
Preparing food specifically for dog	2.32	2.87	0.004	1.30-4.11
Would report rabies to veterinarian	1.92	2.49	0.01	1.14-3.22

CHAPTER FIVE.

DISCUSSION, CONCLUSIONS & RECOMMENDATIONS.

5.1 DISCUSSION

5.1.1 Demographic characteristics

This study reveals that 86.7% of the households interviewed were found to own one or more dogs with an owned dog population of 754 dogs. These findings are consistent to those of a study of dog ecology and demography conducted in Machakos district in Kenya where 150 dog owning households were sampled and it was shown that dog ownership was common with 53.8% of households owning dogs (Kitala *et al.*, 2001) but different from findings of studies done in Ethiopia with 40.5% dog owning households (Eshetu *et al.*, 2012), Thailand with 54% households owning dogs (Kongkaew *et al.*, 2004) and Tanzania with 22% dog ownership (Sambo, 2012). Almost an equal number of households were interviewed from urban and rural areas with more males interviewed during the study. A study done in Tanzania on Knowledge attitude and practices of dog owners had more females (55%) interviewed than males and respondents from rural areas made up 68% of the study participants (Sambo, 2012). The difference could be as a result of the cultural practices where more women stay at home in Tanzania as compared to Kenya.

Most study participants for this study had primary and secondary education. Respondents who reported they never went to school were 9%. A study done by Sambo in Tanzania had more participants having only primary education (74%) and more respondents with no education (16%) probably due to the fact that most of his study participants came from rural areas (Sambo, 2012). In this study, having a secondary/tertiary education was found to be significantly associated with having a vaccinated dog in the household ($p<0.05$). A similar study conducted in Tanzania (Sambo, 2012) and Pakistan (Wasay *et al.*, 2012) found that respondents with secondary

education were associated with having better knowledge of rabies. This is probably due to awareness and access to information on rabies and the importance of dog vaccination.

Majority of the study participants were self-employed with 13% being formally employed. Having formal employment was significantly associated with having a vaccinated dog in the household ($p<0.05$). This could probably be due to having a stable income and therefore being more likely to pay for vaccination services.

5.1.2 Rabies vaccination coverage

Vaccinated dogs in this study made up 35% of the total dog owning households interviewed. These findings are consistent to those of a study done in Ethiopia where 33.3% of dogs from dog owning households had been vaccinated (Eshetu *et al.*, 2012) and another study done in Kenya (Machakos District where 29% of the owned dogs had been vaccinated (Kitala *et al.*, 2001).

5.1.3 Knowledge and awareness of rabies

Overall, those who were classified as having adequate knowledge about rabies using the set criteria for this study had proper practices of seeking medical attention after dog bite incident and proper handling practices of a suspected rabid animal that were related to their knowledge of rabies.

Knowledge of rabies as a disease was evaluated using six questions as shown in Appendix 6.

Households that knew of a disease called rabies were significantly associated with having a vaccinated dog ($p<0.05$) probably because most of them (88.7%) knew that the disease is fatal if untreated compared with respondents in Sri Lanka (89.5%) and New Delhi (84.0%), who knew of the fatal nature of rabies (Matibag *et al.*, 2009; Agarwal and Reddaiah, 2003). This knowledge of the fatality of rabies was also significantly associated with having a vaccinated dog ($P<0.05$). In this study, 85.6% of the respondents' source of knowledge on rabies was from family, friends neighbors and

colleagues with a study done in Tanzania having 70% of respondents report neighbors, parents and friends as their main source of rabies knowledge. Only 56% and 28.5% in Pakistan and Sri Lanka respectively reported friends and neighbors as their source with 36% of respondents in Thailand study reporting verbal propaganda as their source of knowledge on rabies (Sambo, 2012; Wasay *et al.*, 2012; Matibag *et al.*, 2009; Kongkaew *et al.*, 2004). Radio and TV had low response rates of 6.15% for this study, 17% in Pakistan and 37% in Thailand. This shows that the media (Radio and TV) which is more accessible to a wider population has not been well utilized as a source of dispersing knowledge and awareness of rabies.

Respondents who knew that rabies can affect dogs and man were significantly associated with having a vaccinated dog ($P<0.05$) with respondents who said rabies can affect all animals also being significantly associated with having a vaccinated dog ($p<0.05$). A study done in Thailand by Kongkaew found that 90% of respondents knew rabies affects dogs with 16% reporting rabies can affect all mammals. The study in Tanzania found 70% of respondents knew that dogs and man can suffer rabies with only 7% of respondents able to name more than three animals that can be affected by rabies (Kongkaew *et al.*, 2004; Sambo, 2012).

Respondents who thought rabies was mainly transmitted through animal bites were significantly associated with having a vaccinated dog ($p<0.05$). This is probably due to the awareness that if their dog was unvaccinated and ended up biting someone, they would have to pay for the victims treatment. A similar study done in Ethiopia found that 73.4% of respondents reported animal bites as main mode of rabies transmission and in Tanzania 81% reporting the same. (Eshetu *et al.*, 2012; Sambo, 2012)

5.1.4 Practices related to rabies

Practices related to rabies were assessed using four questions scored as shown in Appendix 6. In terms of prevention, household respondents who thought annual vaccination of dog, seeking medical attention immediately after dog bite incident and

that the treatment for dog bite was anti-rabies were significantly associated with having a vaccinated dog. Knowledge of rabies prevention could stem from having experienced a dog bite incident either in the household or neighbors. In a similar study conducted in Tanzania, 67% of respondents reported vaccination of dogs as the major mode of rabies prevention with 88% reporting the same in Sri Lanka. However more respondents (83%) in Tanzania reported they would seek medical attention immediately after dog bite incident (Sambo, 2012). For this study, respondents who reported washing the bite wound with soap and water as the first step were only 2.5% which is the lowest compared to respondents from Sri Lanka 8.4%, respondents from the New Delhi community based study 31.9% and respondents from Thailand 70.2% (Matibag *et al.*, 2009; Agarwal and Reddaiah, 2003; Kongkaew *et al.*, 2004). The high response on these preferred first aid measure recommended by the WHO is possibly due to the fact that the studies were done in regions that had received some awareness campaigns.

In this study, 28.7% of respondents said they would leash their dogs as a way of rabies prevention while in Thailand 20.1% reported they would leash their dogs for observation. Household members who said that they would report a rabid dog to the veterinary officers were significantly associated with having a vaccinated dog. In the study done in Tanzania, only 7% responded they would report a rabid case to livestock officer.

In this study, 47% reported that they would kill the suspected rabid dog, a community based study done in New Delhi reporting 50.0% of the respondents would kill the dog (Agarwal and Reddaiah, 2003), 16.7% of respondents in Thailand reporting that they would kill the animal and take it to the lab for sampling while in Tanzania, 79% of respondents claimed they would kill the suspected rabid animal. This high response in Tanzania may be due to the fact that the study was done in an area where rabies intervention is carried out on a regular basis and the respondents are thus more likely to know how to deal with a rabid dog. However, this makes it difficult for veterinary services to realize the magnitude of the rabies problem and take the appropriate course

action to avert spread and transmission. For this study, most of respondents reported burying the carcass as the action they would take after killing the dog with 75 % of respondents in Tanzania reporting that they would burn or bury the carcass. Only one person in this study reported they would cut the head and submit it to the vet for lab analysis while 43% of the respondents in Sri Lanka reported to take similar action (Sambo, 2012; Matibag *et al.*, 2009).

5.1.5 Determinant factors for dog vaccination in Households

Several factors were found to determine the dog vaccination status in a household where the respondent interviewed owned a dog. In terms of dog acquisition and ownership, having a dog born in the household was significantly associated with having a vaccinated dog ($p<0.05$) probably due to lengthy dog ownership leading to better awareness of the benefits of regular dog vaccination.

Dog owners who prepared food specifically for their dog (21%) were significantly associated with having a vaccinated dog ($p<0.05$). A study done in Thailand found that 56% of households prepared food specifically for the dog (Kongkaew *et al.*, 2004). Dog vaccination by these households could therefore be an extension of the humane dog treatment through proper dog food preparation and feeding.

Respondents who had knowledge of one or two annual government vaccination clinics and those who claimed the veterinary personnel are always available to vaccinate their dogs anytime were significantly associated with having a vaccinated dog in their household ($p<0.05$). This knowledge could stem from the owner having keen interest to vaccinate their dog.

Household respondents who thought that the first rabies vaccination should be done when the dog is less than one year old and those who thought that it should be done at less than one year were significantly associated with having a vaccinated dog. This could be as a result of lengthy dog ownership which leads to knowledge of the

appropriate age of first vaccination. Only 36.2% of respondents in the KAP survey done in Sri Lanka responded first rabies vaccination be done when the dog is less than one year (Matibag *et al.*, 2009).

Households that reported their dog had at some point been implicated to have bitten someone were significantly associated with having a vaccinated dog ($p<0.05$) probably due to having to deal with the bite victim. The households which were charged for the victim's treatment after the bite incident were similarly significantly associated with having a vaccinated dog. This could stem from the fact that post exposure prophylaxis is quite expensive and having to pay a bite victim means taking precautions in future through regular dog vaccination.

5.2 CONCLUSIONS

1. For this study, respondents who had formal employment and secondary or tertiary education were associated with having a vaccinated dog
2. During the study period, only 35% of the total owned dogs sampled had been vaccinated which is way below the WHO recommendation for herd immunity and to prevent outbreaks. This therefore means that a rabies outbreak within this dog population would be disastrous.
3. From all respondents interviewed, those who met the threshold on adequate knowledge of rabies were associated with having a vaccinated dog and good health seeking behavior in case of a dog bite incident.
4. Factors that were found to encourage households to vaccinate their dogs included:
 - Having formal employment which translates to a steady income
 - Respondents who reported good dog animal welfare practices such as preparing a meal for their dog rather than feeding on leftovers.

- Respondents who had knowledge of frequency of government sponsored dog clinics and location of veterinary officers in the area.
- Respondents whose dog had bitten someone and they paid for the treatment of the bite victim.
- Respondents who knew dogs as young as 3 months can be vaccinated against rabies.

5.3 RECOMMENDATIONS

1. The county government needs to create employment or other income generating activity to residents to enable them get a steady income and therefore be able to pay for rabies vaccination services.
2. To increase vaccination coverage from the current 35% to at least 70%, all dog owners with dogs aged three months and above should be encouraged to take their dogs for rabies vaccination.
3. To increase the level of knowledge and awareness of rabies, awareness campaigns should be carried out in schools, churches and through media (radio and TV) to sensitize the community on rabies etiology, modes of infection, clinical symptoms in man and animals, critical first aid measures and proper health seeking behavior to be taken in case of a dog bite.
4. To encourage dog owners to take their dogs for vaccination, sensitization on good animal welfare practices which include preparing proper meals for dogs to avoid scavenging and vaccination needs to be enhanced. The county government should increase the number of veterinary officers to be present consistently across the county, and ensure the community is aware of the frequency, location and availability of veterinary services, government sponsored vaccination centers and encourage all residents to report all rabid or suspected rabid cases to the veterinary officers.

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Appendix 1: Map of Kakamega County

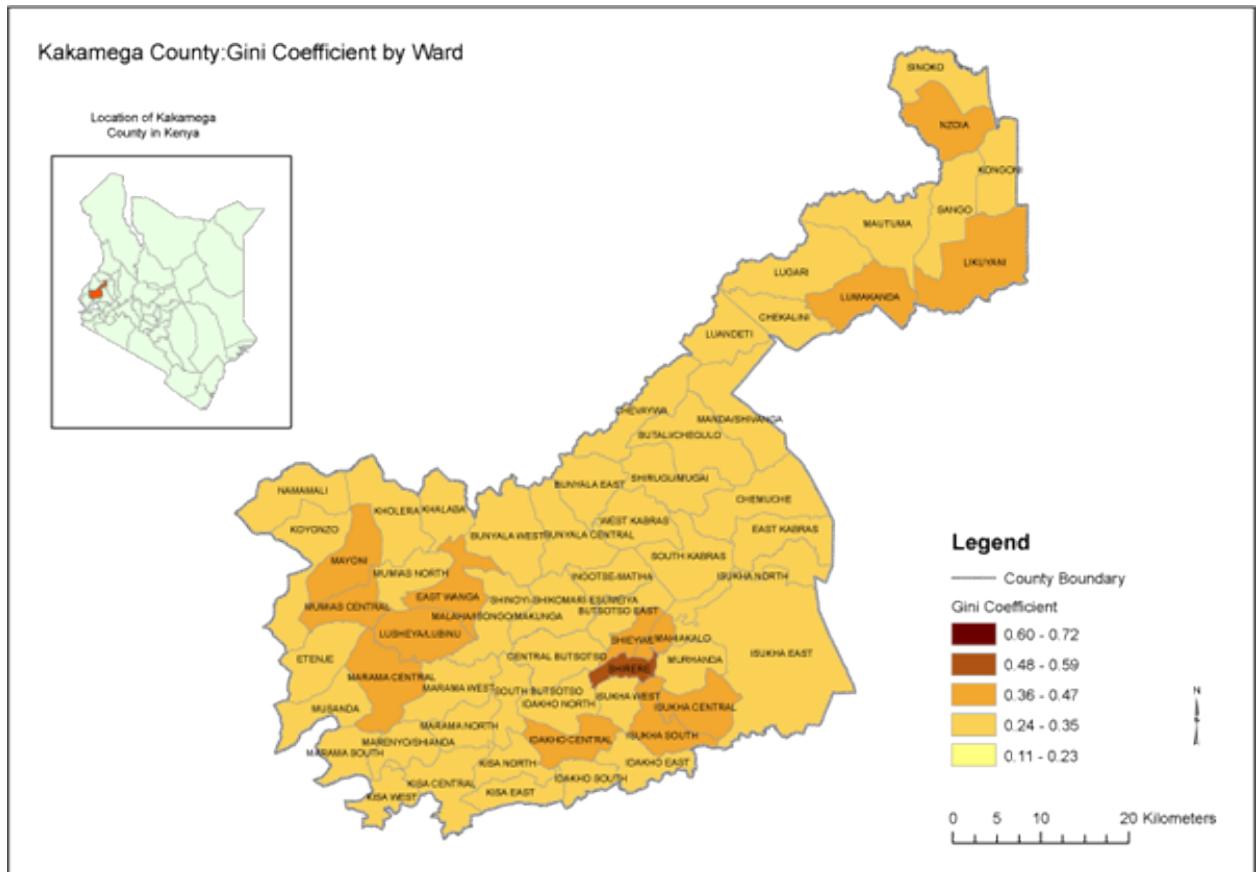


Fig 3.1: Map of Kakamega County (County data Factsheet, 2014)

Appendix 2: Clusters and Households Visited

Sn	Cluster No	County Name	District Name	Division Name	Location name	Sub-Location	cluster/Enumeration Area Name	HOUSEHOLDS TO BE INTERVIEWED															
								1	4	8	12	16	19	23	27	31	35	38	42	46			
1	558	KAKAMEGA	LUGARI	MATETE	LUANDETI	MABUYE	SANGO 'A'	1	4	8	12	16	19	23	27	31	35	38	42	46			
2	553	KAKAMEGA	KAKAMEGA SOUTH	IKOLOMANI SO	IGUHU	IVONDA	IVOLE II	4	9	14	18	23	28	32	37	41	46	51	55	60			
3	1,297	KAKAMEGA	MUMIAS	EAST WANGA	EAST WANGA	ELUCHE	IKHONJE	2	7	12	17	22	27	32	37	42	47	53	58	63			
4	1,115	KAKAMEGA	MUMIAS	MUMIAS	NABONGO	MUMIAS TOWN	LUMINO	1	7	12	18	24	30	35	41	47	52	58	64	69			
5	565	KAKAMEGA	BUTERE	BUTERE	CENTRAL MARAMA	IBOKOLO	IBINDA/SA BATIA	4	9	15	21	27	33	39	45	50	56	62	68	74			
6	560	KAKAMEGA	MUMIAS	MATUNGU	MATUNGU	MUSAMBA	BULE	2	8	14	20	25	31	37	43	49	55	61	67	73			
7	1,296	KAKAMEGA	MUMIAS	MUMIAS	NABONGO	MATAWA	MWIKUND A 'B'	5	11	17	23	29	35	41	48	54	60	66	72	78			
8	1,114	KAKAMEGA	MUMIAS	MUMIAS	NABONGO	MUMIAS TOWN	SHIBALE 'B'	2	9	15	21	27	33	39	45	52	58	64	70	76			
9	1,106	KAKAMEGA	KAKAMEGA CENTRAL	MUNICIPALITY	SHIEYWE	SICHILAYI	LURAMBI	5	11	17	23	30	36	42	48	55	61	67	73	79			
10	564	KAKAMEGA	MUMIAS	EAST WANGA	MUNGANGA	MUNGANGA	BULOMA 'A' I	1	8	14	21	27	34	40	47	53	60	66	73	80			
11	551	KAKAMEGA	KAKAMEGA CENTRAL	NAVAKHOL O	BUNYALA WEST	KOCHWA	SIKOKE 'A'	2	9	16	23	30	37	45	52	59	66	73	80	87			
12	1,295	KAKAMEGA	LUGARI	LIKUYANI	NZOIA	MATUNDA	MAUA 'B'	8	16	23	31	39	47	54	62	70	78	85	93	1			
13	1,109	KAKAMEGA	KAKAMEGA CENTRAL	MUNICIPALITY	BUKHUNGU	MAHIAKALO	MAKHOMO	5	13	21	29	37	45	53	61	69	77	85	93	1			
14	549	KAKAMEGA	KAKAMEGA CENTRAL	LURAMBI	NORTH BUTSOTSO	MATIHA	MUSIACHI 'A'	1	9	17	25	33	41	49	57	65	73	81	89	97			
15	563	KAKAMEGA	MUMIAS	SOUTH WANGA	MUSANDA	BUNGASI	LUGUNGA	4	13	21	29	37	45	53	61	70	78	86	94	102			
16	1,108	KAKAMEGA	KAKAMEGA CENTRAL	MUNICIPALITY	BUKHUNGU	SHIRERE	MATENDE 'A'	8	16	25	33	41	50	58	66	75	83	91	100	108			
17	561	KAKAMEGA	MUMIAS	MATUNGU	KOYONZO	NANYENI	IKULUMW OYO	7	15	24	32	41	50	58	67	76	84	93	101	110			
18	1,113	KAKAMEGA	MUMIAS	MUMIAS	NABONGO	NUCLEUS	EKAMA 'B'	3	12	21	30	39	47	56	65	74	82	91	100	109			
19	1,105	KAKAMEGA	KAKAMEGA CENTRAL	MUNICIPALITY	SHIEYWE	SICHILAYI	MARABA 'A'	9	18	26	35	44	53	62	71	80	89	98	107	116			
20	1,112	KAKAMEGA	MUMIAS	MATUNGU	MATUNGU	MAYONI	MAYONI TOWN 'A'	4	13	21	30	39	48	57	66	75	84	93	102	111			
21	1,107	KAKAMEGA	KAKAMEGA CENTRAL	MUNICIPALITY	BUKHUNGU	SHIRERE	MURRAM	1	10	19	28	37	46	55	64	73	82	91	100	109			

		KAKAME GA	KAKAMEGA EAST	SHINYALU	ILESI	MUGOMARI	MUGOMA RI	2	12	21	30	39	49	58	67	76	85	95	10 4	11 3	
22	555	KAKAME GA	KAKAMEGA EAST	SHINYALU	ILESI	MUGOMARI	BWAYIYA	6	15	25	34	43	52	62	71	80	89	99	10 8	11 7	
23	556	KAKAME GA	KAKAMEGA EAST	SHINYALU	KHAYEGA	MUSENO	SCHEME I / KPLC	6	15	25	34	43	53	62	71	81	90	10 0	10 9	11 8	
24	1,104	KAKAME GA	KAKAMEGA CENTRAL	MUNICIPALI TY	SHIEYWE	TOWNSHIP	MUNDINDI 'B'	2	11	21	30	40	49	59	69	78	88	97	10 7	11 6	
25	562	KAKAME GA	MUMIAS	MATUNGU	KOYONZO	MUNAMI	MUTURI 'B'	6	15	25	35	45	54	64	74	83	93	10 3	11 2	12 2	
26	557	KAKAME GA	KAKAMEGA EAST	ILEHO	IVIHIGA	LUKUSI	TOWNSHI P	4	14	24	35	45	55	66	76	86	97	10 7	11 7	12 8	
27	1,110	KAKAME GA	KAKAMEGA NORTH	KABRAS CENTR	TOWNSHIP	MALANGA	SHICHAVE	1	12	22	32	42	53	63	73	84	94	10 3	11 4	12 5	13 5
28	554	KAKAME GA	KAKAMEGA NORTH	KABRAS NORTH	SIRUNGAI	TOMBO	MUKUVA	8	19	29	40	50	61	71	82	92	10 3	11 3	12 4	13 4	
29	1,294	KAKAME GA	LUGARI	LUGARI	LUMAKANDA	MUNYUKI	TOWNHIP 'D'	3	13	24	34	45	55	66	76	86	97	10 7	11 8	12 8	
30	1,111	KAKAME GA	LUGARI	LUGARI	LUMAKANDA	MUNYUKI															

Appendix 3: KNH/UoN Ethical Approval



UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
(254-020) 2726300 Ext 44355

Ref: KNH-ERC/A/294

Gerald Mburu Mucheru
TM312/0858/2012
JKUAT

Dear Gerald

RESEARCH PROPOSAL: KNOWLEDGE -AN DPRACTICES REALTED TO RABIES AND DETERMIANTS OF DOG RABIES VACCINATION INHOUSEHOLDS IN KAKMEMA DISTRICT, 2013 (P352/05/2013)

This is to inform you that the KNH/UoN-Ethics & Research Committee (KNH/UoN-ERC) has reviewed and approved your above proposal. The approval periods are 17th September, 2013 to 16th September 2014.

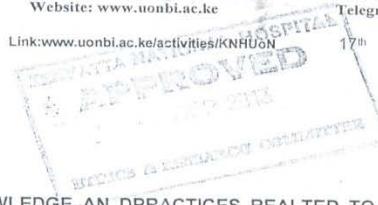
This approval is subject to compliance with the following requirements:

- a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
- b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH/UoN ERC before implementation.
- c) Death and life threatening problems and severe adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH/UoN ERC within 72 hours of notification.
- d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH/UoN ERC within 72 hours.
- e) 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).
- f) Clearance for export of biological specimens must be obtained from KNH/UoN-Ethics & Research Committee for each batch of shipment.
- g) Submission of an executive summary report within 90 days upon completion of the study
This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/or plagiarism.



KENYATTA NATIONAL HOSPITAL
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17th September, 2013



For more details consult the KNH/UoN ERC website www.uonbi.ac.ke/activities/KNHUoN.

Yours sincerely



PROF. M.L. CHINDIA
SECRETARY, KNH/UON-ERC

c.c. Prof. A.N. Guantai, Chairperson, KNH/UoN-ERC
The Deputy Director CS, KNH
The Principal, College of Health Sciences, UoN
AD/Health Information, KNH
Supervisors: Dr. Gideon Kikuvi, Dr. Amwayi Samuel

Appendix 4: Informed Consent Form

Title of the study: Knowledge and Practices related to Rabies and determinants of dog rabies Vaccination in Households in Kakamega District, 2013

Principal investigator: Mucheru Gerald Mburu; Field Epidemiology and Laboratory Training Program_(FELTP), Institute of Tropical Medicine (ITROMID); Study Location: Kakamega District.

Dear Sir/Madam, My name is _____ from the Ministry of Public Health Kenya. I am involved in a study on the determinants of dog vaccination practices and rabies vaccination coverage among households in Kakamega District. Your household has been selected randomly to participate in this study.

If you agree to participate, I will administer to you a questionnaire which has sets of personal questions regarding your age, educational level, job characteristics and questions related to rabies and dog vaccination.

Confidentiality

The information you provide is for research purpose only, will totally be confidential and will not be disclosed to anyone. Your name will not appear anywhere in the questionnaire.

Voluntarism

Your participation in the study is completely voluntary and you can withdraw from the study even after having agreed to participate. You are at liberty to refuse to answer any questions you deem invading. The questionnaire will not be identified using your name and therefore your identity shall not be revealed. The questionnaire will take 30 to 40 minutes.

Risks and Benefits: There are no risks in participating in the study. You shall only be required to answer a series of questions. The information you provide will assist the department of veterinary services in planning dog vaccination campaigns and the Ministry of Health in providing appropriate information of steps to take after dog bite injuries and planning on post exposure prophylaxis. There are no direct benefits if you choose to participate.

CONTACT:

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Telegrams: MEDSUP, Nairobi

Contact Person

Esther Wanjiru Mbuba

Email: uonknh_erc@uonbi.ac.ke

Respondent signature.....
date.....

Witness signature.....
date.....

Appendix 5: Questionnaire

Title: Knowledge and Practices related to rabies and determinants of dog rabies vaccination in Households in Kakamega District, 2013

I) IDENTIFICATION INFORMATION:

District: Division:

Location: Sub-location/village:

Region: 1-Urban 2-Rural Cluster name.....

Date of interview: dd/mm/yyyy Time of interview:
.....

II) SOCIO-DEMOGRAPHIC INFORMATION (HOUSEHOLD MEMBERS):

Age (years)

Gender: 1-male..... 2-female

1. Which is the highest level of education you have completed?

1-Lower primary (1-4)

2-Upper primary (5-8)

3-Secondary school

4-College

5-University (professional or post-graduate)

6-Currently a Student

7-No school

2. What is your current employment?

1-Formal employment

2-Self-employed formal

3-Self-employed informal (e.g. farmer, hawker, boda boda rider)

4-Casual employment

5-Student (specify)

6-Other (specify)

3.What is your religious affiliation?

1-Christian

2-Muslim

3-Atheist (None)

4-Other (specify)

4.How far do you live from the nearest health clinic or hospital?

1. 0-5 km

2. 5-10 km

3. >10 km

III) DEMOGRAPHIC DETAILS (OWNED DOG)

Number of dogs owned.....

Age of dog (months/ years).....

Sex of dog: 1-male..... 2-female.....

Approximate age at first rabies vaccination?_____ (months/years)

IV) DETERMINANTS OF RABIES VACCINATION

5.How many of each of the following animals do you have?

- 1-Cattle
- 2-Sheep
- 3-Goats
- 4-Chicken
- 5-Cat
- 6-Other(specify).....

6.For households with cat, has it ever been vaccinated?

- 1-Yes
- 2-No/don't know

7.Where did you get your dog?

- 1-Bought
- 2-Born in household
- 3-Given by neighbor/friend
- 4-Adopted from stray population
- 5-Other (specify)

8.How do you restrain your dog?

- 1-Leashed the whole day
- 2-Leashed half the day
- 3-Not leashed but stays in compound
- 4-Roams freely

9. Do you think that dogs should be leashed?

1-Yes 2-No/don't know

10. If Yes/No, why do you feel that they should be leashed/not be leashed?

11. Are all members of the family able to restrain the dog?

1-Yes 2-No/don't know

12. What do you feed your dog on?

- 1-Food prepared specifically for the dog
- 2-Leftovers from house
- 3-Scavenging
- 4-Other (specify)

13. Has your dog ever been vaccinated against rabies? (If no, skip to 16)

1-Yes 2-No/don't know

14. If yes, when last was it vaccinated?

- 1-6 months ago
- 2-12 months ago
- 3-> 12 months ago

15. Did you receive a vaccination certificate?

1-Yes 2-No/don't know

16. If No, why has your dog never been vaccinated?

- 1-Don't know where to seek for vaccination services

2-No one available at home during vaccination clinics/campaigns

3-The charges for vaccination are high

4-The vaccination center is far

5-Other (specify)

17. Who took it to be vaccinated?

1-Father

2-Mother

3-Children (son, daughter)

4-Househelp

5-Other (specify)

18. How far was the vaccination center?

1-Less than 5 km

2-More than 5 km

19. Were you charged for the vaccination? (If No, skip to 21)

1-Yes

2-No

20. Were the charges too high for you?

1-Yes

2-No

21. How many times in a year are the vaccination clinics/campaigns?

1-Once

2-Twice

3-The veterinary personnel are always available to vaccinate

4-Never available

5-Other (specify)

22. In your opinion, at what age should a dog be first vaccinated against rabies?

1-Less than 1 year

2-At 1 year

3-More than one year

23. On average how many stray dogs do you see in a day?

1-One

3-None

2-More than one

24. Has your dog ever been implicated to have bitten someone?

1-Yes

2-No/ don't know

25. If Yes, were you charged for the victims treatment?

1-Yes

2-No

V) RABIES KNOWLEDGE AND AWARENESS

26. Do you know of a disease called rabies? (if No skip to Q. 34)

1-Yes

2-No

27. How can you describe it?

28. If yes, where did you learn about it? (check all mentioned)

1-Newspapers and magazines

2-Radio

3-TV

- 4-Veterinary officials
- 5-Brochures, posters and other printed materials
- 6-Community Animal Health workers
- 7-Family, friends, neighbors and colleagues
- 8-Religious leaders
- 9-Teachers
- 10-When I was bitten by a dog

29. What do you think causes the disease?

- 1-Virus
- 2-Germs
- 3-Hereditary
- 4-Witchcraft
- 5-Don't know
- 6-Other (specify)

30. In your opinion, which animals are affected by rabies? (Check all mentioned)

- 1-Dogs
- 2-Cats
- 3-Cattle
- 4-Goats
- 5-Sheep
- 6-Man
- 7-All the above
- 8-Other (specify)

31. Can animals transmit rabies to humans?

32. How is rabies transmitted? (Select all that apply)

1-through bites

2-Through scratches

3-Do not know

In your opinion, do you think rabies can be caused by any other method apart from being bitten? E.g. licking or scratching from rabid animal.

33. Have you ever been bitten by a dog?

34. Has any of your family members ever been bitten by a dog? (If No, skip to 37)

**35. What action did you take after you or a family member was bitten by a dog?
(check all mentioned)**

1-Went to the pharmacy to buy drugs (specify drug bought)

2-Immediately washed the wound with soap and water

3-Applied antiseptic to the wound

4-Went to the hospital

5-Went to traditional healer

6-Did nothing

7-Other (specify)

b) Proper practice on first aid? 1-yes 2-no

36. When would you present to hospital after dog bite?

1-immediately after being bitten

2-next day after being bitten

3-between 2 to 14 days after being bitten

4-after 14 days

5-would do nothing

b) Proper practice on Hospital presentation? 1-yes 2-no

37. In your opinion, why would someone bitten by a dog not go to the hospital?

1-Hospital is far

2-Cost of treatment is high

3-It is unnecessary to go

4-Traditional healers are preferred

5-Other (specify).....

38. Have you ever seen a person with rabies?

1-Yes 2-No

39. If yes, where?

1-Television

2-Real Life

3-Other (specify) _____

40. In your opinion, do you think rabies is curable?

41. Could exposure to rabies without treatment lead to death?

42. If Yes, what is the treatment given?

- 1-Cleaning the wound with soap and water
 - 2-Application of antiseptic
 - 3-Given anti-rabies injections
 - 4-Given tetanus injection
 - 5-I don't know

43. How can a person prevent himself from getting rabies? (Select all that apply)

- 1-Avoid all rabid dogs
 - 2-burn all suspected rabid dog carcasses
 - 3-bury all suspected rabid carcasses
 - 4-Vaccinate dogs annually
 - 5-Go for treatment immediately after being bitten by any animal
 - 6-Do not know

44. What would you do if you suspected that a dog was rabid?

- 1-Immediately kill the animal
 - 2-Report to the veterinary officer
 - 3-I would not take any action
 - 4-Other (specify)

b) Proper practice to suspect rabid animal? 1-yes 2-no

45. If your answer above is to kill the animal, what action would you take with the killed animal?

- 1-Throw it away
- 2-Burn
- 3-Bury
- 4-Cut the head and send to the veterinary officer

b) Proper practice to suspected rabid carcass? 1-yes 2-no

46. What are the signs and symptoms of a rabid dog? (Select all that apply)

- 1-Maniacal behaviour
- 2-Salivation
- 3-Biting inanimate objects
- 4-Anxious
- 5-Other (specify)

47. What are the signs and symptoms of a person bitten by a rabid dog? (check all that apply)

- 1-Fever
- 2-Chills
- 3-Fatigue (extreme tiredness)
- 4-Problems sleeping
- 5-Lack of appetite
- 6-Headache
- 7-Irritability
- 8-Anxiety
- 9-Sore throat
- 10-Vomiting
- 11-Aggressive behaviour, such as thrashing out or biting

12-Hallucinations – seeing or hearing things that are not real

13-Delusions – believing things that are obviously untrue

14-Excessive production of saliva

15-Excessive sweating

16-Hair on their skin stands up

48. Overall Knowledge on Rabies

1-Knowledgeable

2-not knowledgeable

50. Rabies knowledge score

51. Practice score

Appendix 6: Scoring Procedures

Reference question in Appendix 1	Question that was asked	answer	Overall score	Binary outcome
#27	Correct description of rabies	Correctly describe rabies as a disease	2	N/A
		Describe rabies as a change in behavior dog/animal	1	N/A
		Say I don't know or give wrong answer	0	N/A
#30	Mention animals that can be infected by rabies	Those who mention more than 3 animals	2	N/A
		Those who mention 1 or 2 animals	1	N/A
		Those who mention none	0	N/A
#32	Mode of transmission of rabies to individual or other animals	Through bites	2	N/A
		Through scratches	1	N/A
		Say I don't know or give a wrong answer	0	N/A
#42	Knowledge that endpoint of rabies is fatal	Those who know fatal nature of rabies	1	N/A
		Those who do not know fatal nature of rabies	0	N/A
#43	Know right treatment when exposed to rabies	Those who mention human post exposure prophylaxis	2	N/A
		Those who mention antibiotics and tetanus without anti-rabies treatment	1	N/A

		Those who say I don't know/ advice from medical practitioner	0	N/A
#44	Knowledge of control of rabies in animal	Those who mention 3 or 4 methods	2	N/A
		Those who mention 1 or 2 methods	1	N/A
		Those who say I don't know or give a wrong answer	0	N/A
	Knowledge of rabies	Those who get 7 of overall score ($\geq 7/11$)	≥ 7	1
	Unknowledgeable about rabies	Those who score 6 ($\leq 6/11$)	≤ 6	0
	Overall score		11	
PRACTICES				
#36	First aid and medical attention	Those who'll claim to clean the wound with soap, water and apply antiseptic	3	1
		Those who claim they'll report to hospital	2	1
		Those who claim they'll report to police, village elder	1	0
		Those who claim they'll do nothing	0	0
#37	Hospital presentation after bite	Those who claim they'll report immediately upon bite	3	1
		Those who claim they'll report to hospital next day after bite	2	1

		Those who claim they'll report to hospital 2 to 14 days after bite	1	1
		Those who claim they'll report after 14 days from day of bite or do nothing	0	0
#45	Practice to suspected rabid animal	Those who claim they'll report to veterinary officer	2	1
		Those who claim they'd kill the animal	1	1
		Those who claim they'd do nothing	0	0
#46	Practice to carcass of suspected rabid animal	Those who they'd cut the head and send it to the veterinary office	2	1
		Those who'd bury or burn the carcass	1	1
		Those who'd do nothing	0	0

Adapted from: (Sambo, 2012)