KNOWLEDGE, ATTITUDES AND PRACTICES REGARDING ANTHRAX AMONG COMMUNITY MEMBERS, HEALTH AND VETERINARY WORKERS IN MARAGUA, KENYA

A Thesis Submitted to the University of Nairobi in Partial Fulfillment of the Requirements for the Degree of Master of Science in Veterinary Epidemiology and Economics

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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

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ABBREVIATIONS AND ACRONYMS

CAVS	College of Agriculture and Veterinary Sciences
CDVS	County Director of Veterinary Services
CHRA	Chromogenic Agar
CHW	Community Health Workers
CSD	Clinical Studies Department
DMS	Director of Medical Services
DVS	Director of Veterinary Services
KAP	Knowledge, Attitude and Practices
KII	Key Informant Interview
MALF	Ministry of Agriculture, Livestock and Fisheries
Med Sup	Medical Superintendent
MOH	Ministry of Health
PHPT	Public Health, Pharmacology and Toxicology
PLET	Polymyxin, Lysozyme, EDTA, Thallium acetate
PCR	Polymerase Chain Reaction
RVF	Rift Valley Fever
SCVO	Sub-County Veterinary Officer
WHO	World Health Organization
ZDU	Zoonotic Disease Unit

DEFINITION OF TERMS

Attitudes: Is a favorable or unfavorable evaluation of something, positive or negative evaluation of people, object or idea. In this study the concept is used to refer to community members' evaluation of anthrax and how it is perceived as a public health problem.

Baraza: A routine public gathering usually in the village and organized by the chief or sub-chief to pass messages to community members or mark a certain function

Community members: Include individuals aged 18 years and above living in Maragua sub-county.

Health workers: Medical practitioners including all cadres of doctors, clinicians and nurses

Knowledge: Awareness of or knowing cause, symptoms, mode of transmission and available prevention strategies of Anthrax disease

Practices: Conscious effort and behaviors of community members undertaking to avoid contracting the Anthrax disease

Veterinary workers: In this study include veterinary professionals, veterinary paraprofessionals and technicians both in government and private institutions supporting animal health and management.

ABSTRACT

Background: Several outbreaks of anthrax in animals and humans have been reported in Maragua Sub-county of Murang'a County in the recent times. There is paucity of information on knowledge, attitudes and practices among this community regarding anthrax. A study was therefore conducted to assess knowledge, attitudes and practices regarding anthrax to provide baseline information to design interventions.

Objectives: This study was conducted with the aim of assessing knowledge, describe attitudes towards, and determine practices regarding anthrax among community members, health and veterinary workers in Maragua Sub-county.

Methodology: A cross sectional study was conducted among heads of household, health and veterinary workers in Maragua Sub-county in August and September 2014. Administered questionnaires were used to collect data from household members and key informant interviews held with health and veterinary workers and other opinion leaders in the community. Purposive sampling was used to obtain participants' knowledge, attitudes and practices. Questions were scored and descriptively analyzed using MS Excel spreadsheet then exported to GenStat Discovery Edition 4.

Results: A total of 293 community members were recruited in this study. They were of different ages from 18 up to above 55 years categorized into four groups with 64.5% being male and 35.5% being female. In this study the overall level of knowledge was 77.9% of all community members regarding cause, transmission, symptoms and prevention of the disease in both humans and animals. More than three quarters of the participants (79.5%) were self-employed doing crop and livestock farming. Majority (88.4%) of the community members owned animals (Chi-square = 0.1550, p-value = 0.6938). Almost all participants (96.3%) had heard about anthrax (p-value = 0.0001). A total of 99 (33.8%) correspondents had seen a person with anthrax. Most people (75.1%) thought that anthrax is very serious, 13.0% of them thought that anthrax is somewhat serious while 12.0% thought that it is not serious in the area. Of the participants, 29.0% preferred awareness by baraza followed by radio (20.4%), Community Health Workers (CHW) then followed (19.7%), church (8.8%)

and least respondents preferred TV (5.4%), neighbors (3.6%), Schools (3.0%) and newspapers and magazines (1.7%).

Of the interviewed respondents, 14.3% of them have had their animals (mostly cattle) suffer from anthrax. Among the respondents, 15.7% had either suffered from anthrax or have had their family member suffer from anthrax. Of the 46 (15.7%) morbidities, 65.2% of them contracted anthrax by consuming meat from a carcass that had died of anthrax. The rest contracted anthrax by contact with infected materials from the carcass.

Livestock keeping, 'cut and carry' mode of grazing (p-value of 0.0623), eating un-inspected meat, poor carcass disposal and some cultural practices were the main practices attributed to anthrax infection in humans.

Conclusion: The study findings indicate above average knowledge on cause, symptoms, transmission and prevention of anthrax among community members. Practices in this study were still risky among community members. Veterinary and Medical health planners should design anthrax awareness interventions as a team, targeting to reach these communities and the public through barazas, radio, CHW and other communication channel on a regular basis.

Keywords: Anthrax, Attitudes, Kenya, Knowledge, Maragua and Practices.

1.0 INTRODUCTION

1.1 Background information

Anthrax is a zoonotic disease of great Public health importance. A zoonotic disease is an infection transmitted between animals and humans and forms approximately 60% of all human infective organisms with a diversity of animal hosts including wildlife, pets and domestic animals (WHO, 2010). Domestic livestock and companion animals are an important source of transmitting anthrax to humans, mostly due to the close interactions between these animals and the people who come into contact with them (Taylor *et al*., 2001). Keeping animals is a major source of rural livelihoods in many developing countries, but these animals pose a risk of exposing the families who keep them to diseases. Understanding the occurrence and transmission of this disease is of vital importance in creating evidence-based control measures and policies that are required to protect both human and animal health (Kunda *et al*., 2008). However, human and financial resources available to support government and institutional veterinary and public health services are becoming more and more limited in many countries world-wide. There is therefore need for evident information, based on research, to convince donors and government institutions to allocate enough resources to support veterinary and public health services (Laura *et al.*, 2007).

This study assessed Knowledge, Attitude and Practices (KAP) of anthrax among community members, Veterinary professionals and Medical workers in Maragua Sub-county of Murang'a County in Kenya by use of questionnaires. The findings of this study might help to give this disease the attention it deserves and aid in formulating measures necessary for its control to prevent frequent occurrence in the area.

1.2 Statement of the problem

Livestock, companion animals and wildlife play a crucial role in our day to day life. They provide food, companionship, socio-cultural activities and are a source of income in various ways as they have an important economic role by sale and services of these animals and their products. However, this dependence on animals makes people vulnerable to zoonotic diseases with anthrax being a number one priority zoonotic disease in Kenya (Munyua et al., 2016). Some of the practices such as direct contact and opening up carcasses without proper protective gears make people to be at greater risk of infection with this disease (Kunda *et al.,* 2008).

Anthrax is usually fatal or may lead to prolonged illness. In most cases someone infected with this disease does not receive immediate and appropriate medical attention because of misdiagnosis and overdiagnosis in the readily available health facilities (Kunda *et al.*, 2008).

Anthrax is endemic in Kenya with frequent occurrence of outbreaks especially in Maragua Sub-county of Murang'a County, despite several control measures in place like annual vaccination and public awareness campaigns (Njenga *et al*., 2006).

It is therefore imperative to study the knowledge, perception, and identify risky practices of this disease in a bid to employ a "One Health" concept. This will lead to establishment of concerted efforts by bringing together especially the veterinary and medical officials in order to develop a strategy for sensitization and efficient correct diagnosis to combat it. The results obtained would provide valuable information to health planners that will guide decisions for interventions, coordination and integration of prevention and control strategies of anthrax before, during and after outbreaks in Maragua Sub-county and can be applied in other related areas and communities.

For the purpose of early recognition, detection and notification, the community needs to have correct knowledge regarding the disease. Health messages have been conveyed to the public through various media and fora but the level of knowledge among community members was not well known. Attitude towards anthrax and practices regarding early recognition, detection and notification and health seeking behavior in this community had not been properly documented too. In the presence of this information gap, this study was undertaken to assess knowledge, attitudes and practices regarding anthrax among community members.

1.3 Research Questions

1. What is the level of anthrax knowledge among community members in Maragua Sub-county?

2. What are the attitudes regarding anthrax among community members in Maragua?

3. What are the existing practices with regard to anthrax prediction, emergency preparedness and health seeking patterns among community members?

1.4 Objectives

1.4 .1 General Objective

The general objective of the study was to assess knowledge, attitudes and practices regarding anthrax disease among community members, health care workers and veterinary professionals in Maragua Sub-county of Murang'a County in Kenya.

1.4.2 Specific Objectives

1. To assess knowledge regarding cause, transmission, symptoms and prevention of anthrax in humans and animals among community members, veterinary professionals and health workers.
2. To describe the attitudes towards anthrax among community members, veterinary professionals and health workers.
3. To determine the risk practices of anthrax among community members, veterinary professionals and health workers.

2.0 LITERATURE REVIEW

2.1 Definition of anthrax

Anthrax is an acute infectious and often fatal disease caused by bacterial infection. Anthrax infects mostly herbivores and it is transmissible to humans and other warm blooded (homeotherm) animals. It is caused by the bacterium *Bacillus anthracis*, which is gram-positive, spore-forming with is rod-shaped appearance under microscopy. Anthrax has several synonyms world over, these include charbon, woolsorters disease, ragpickers disease, malignant carbuncle, malignant pustule (OIE *Terrestrial Manual,* 2008) and in Kenya; kimeta, burasta and muriru. *B. anthracis* is found in areas where there has been contamination with the bacteria or its spores (Moazeni *et al.,* 2004).

2.2 Aetiology

The causative agent for anthrax is *Bacillus anthracis* (*B. anthracis*) bacterium. *B. anthracis* is a large encapsulated, gram–positive and spore-forming rod. Anthrax spore is able to sustain itself in drastic changes in temperature and chemical disinfectants such as 95% ethanol and can germinate in soil at pH 6.5 at proper temperature (Hirsh and Zee, 1999).

Bacillus anthracis is closely related to several species, including *B. cereus* and *B. thurengiensis* (Riedel, 2007). The virulent strains of *B. anthracis* harbour 2 virulent plasmids, toxin-encoding plasmid pX01 which is 181.7 kb (Okinaka *et al*., 1999) and plasmid pX02 which is 96.2 kb and codes for the capsule (Uchida *et al*., 1985). The current routine laboratory diagnostic method for *B. anthracis* is microbiological analysis (Turnbull, 2001). Avirulent *B. anthracis* strain lacks pX01and pX02 plasmids and cannot be distinguished from other related species with these time-consuming microbiological analyses.

Gram-positive and rod-shaped *B. anthracis* bacterium is the only obligate pathogen within the genus *Bacillus.* Most of the other species in this genus are ubiquitous environmental saprophytes. A number of them though, notably *B. cereus, B. licheniformis* and *B. subtilis,* are occasionally associated with food poisoning in humans and with other clinical manifestations in humans and animals (OIE, 2008).

2.3 Diagnosis

2.3.1 Clinical signs and diagnosis in animals

The disease is mediated by exotoxins. It can manifest in four forms; these are peracute (apopletic), acute, subacute and in rare occasions a chronic form of the disease has been reported. Ante-mortem clinical signs are usually absent in peracute and acute and the animal is found dead without showing any sign of disease. Subacute form of anthrax may show progressive fever, dullness, anorexia, lethargy, recumbency and death may follow. Acute, subacute, and chronic forms of the disease will usually show localized swelling, fever, and in chronic disease enlarged lymph glands may be the only sign observed. Generally, anthrax infected animals will be found dead because death usually occur within 24 hours (OIE, 2008).

2.3.2 Clinical signs and diagnosis in humans

In humans, anthrax occur in four forms depending on portal of entry of *B. anthracis*. It can manifest as cutaneous anthrax; whereby symptoms manifest on the skin. This is the most observed form of anthrax and causes mild disease which is cured by appropriate and timely treatment (Fujikura, 1998). Cutaneous form manifests as raised, itchy swelling that looks like an insect bite on the skin which quickly develops to a painless sore with a black center (Christopher *et al.,* 2004). The second, gastrointestinal form affects the digestive system and manifests with symptoms such as vomiting, abdominal pain, diarrhea, fever, in-appetence, sore throat and headache (Sirisanthana and Brown, 2002).

Another form is inhalation anthrax whereby the victim breaths in the anthrax spores and the respiratory system is affected. Inhalation anthrax is usually fatal and it has been used in bioterrorism. Major signs observed in this form of anthrax include coughing blood, difficulty in breathing, fever and muscle aches (Jernigan *et al*., 2001).

The most recently identified form is injection anthrax which is contracted by way of injecting illegal drugs like heroine. Observed symptoms include redness at the area of injection, swelling, shock, multiple organ failure and meningitis (Price *et al.,* 2012).

2.3.3 Laboratory diagnosis

It is easy to isolate the bacterium *B. anthracis* from infected or contaminated biological samples. It grows well on sheep blood agar. It forms white colonies which are slightly opaque, non-hemolytic, a pasty consistency, and margins slightly indented giving an impression of the typical "*caput medusae*" (Fasanella *et al*., 2012).

Bacillus anthracis isolation from the soil is much more difficult due to the presence of telluric contaminants such as yeasts and bacteria, more so similar spore-forming bacteria such as *B. cereus, B. thuringiensis* and *B. mycoides* (Turnbull, 1999). Because there are other conflicting bacteria that forms contaminants, the sample is heat treated to reduce the vegetative forms of the existing microbial load (Kauffman, 1990). But it should be noted that heat treatment is not effective against spores that are closely related to *B. anthracis*, thus selective media is used to differentiate in this case (Marston *et al*., 2008). The "PLET medium" (Polymyxin, Lysozyme, EDTA, Thallium acetate) and subsequently the Anthracis Chromogenic Agar (CHRA) can be used as semi-selective media which inhibits the growth of several bacteria but encourage the *Bacilli* that belongs to the *Cereus* group (Marston *et al*., 2008).

As compared to molecular methods of *B. anthracis* diagnosis such as PCR, cultivation of spores from samples obtained from the environment and direct isolation is more sensitive even though it is time consuming (Gulledge *et al*., 2010). The biomolecular methods whereby amplification of DNA that was directly extracted from the environmental samples are usually insensitive because extraction of DNA from spores is difficult and thus the sample under examination may contain chemicals or organic substances which might interfere with the amplification processes (Ryu *et al*., 2003).

2.3.4 Post mortem diagnosis

Post mortem examination of anthrax related carcasses is usually discouraged so as to avoid environmental contamination. However, a carefully done post mortem will show several or no lesion at all. Of the lesions observed, none of them seem to be pathognomonic or entirely consistent. Common lesions observed include; poorly clotted blood, hemorrhage from nose, mouth, vagina and/or anus at death, septicemia and an enlarged spleen having a 'blackberry jam' consistency (OIE, 2008).

2.4 Transmission

The most common mode of anthrax transmission to herbivores is through ingestion of anthrax spores in contaminated feed and water especially when there is drought or overgrazing thus increasing chances of spores exposure on the ground (Watson and Kier, 1994). Other modes of anthrax transmission that have been described include biting flies or contact with contaminated feces (Sjostedt, 1997). The common phenomenon of soil contamination is from a carcass of an animal that had been infected by anthrax (Manchee, 1981; Watson and Keir, 1994; Dragon and Rennie, 2001), contaminated effluents from industrial plants that deal with animal products; for instance wool and leather tanneries (Sjostedt, 1997).

Hugh-Jones and Blackburn, (2009) observed that depressions on the ground would accumulate materials and soil with humus and minerals after heavy rains. The sample from these depressions were higher in minerals because the study showed that they were composed of 6-10 times phosphorus, 2-3 times calcium and 2 times magnesium concentrations as compared to samples from the surrounding environment. These conditions therefore becomes favorable for survival of the anthrax spores even where the soils are unfavorable (Hugh-Jones and Blackburn, 2009). The fact that the ground surface has strong hydrophobicity and the spores have high buoyance brings about exposure of the spores to the ground surface in dry months that follow a prolonged rainy season leading to outbreaks. And because the spore floats on water, they are easily washed away and they end up concentrating at the lower ground. Once herbivores graze here they easily ingest the spores leading to infection. These factors are important in the ecology of the bacterium, however it takes special natural events and time for a proper concentration of spores to be created that can form infective dose to cause disease in a grazing animal (Van Ness, 1971).

Humans can be infected by anthrax through eating or contacting infected animals or contaminated animal products and materials (Turnbull, 2001). Therefore, monitoring and survey of anthrax should be of great importance in public health.

According to the OIE terrestrial manual of 2008, 95% of human cases manifest as cutaneous anthrax and are acquired through contact of anthrax related carcasses by skinning or moving its products like meat, hides, bones, wool or hairs. People who are at risk of infection include veterinarians, industrial workers dealing with animal

products and animal handlers. These people should protect themselves by use of gloves and other protective gears when dealing with specimens suspected to be anthrax infected. Gastrointestinal anthrax occurs when a person eats meat from an animal or carcass that died of anthrax. On the other hand, inhation anthrax has mostly been reported from animal products processing plants (industrial anthrax) such as bone processing, tanning, wool processing and others, whereby substantial amount of spores are released to the air thus increases risk of exposure by breathing in the spores (OIE, 2008).

2.5 Epidemiology

The spores can stay viable in the environment, animal products and industrial materials for a very long period of time and this factor is important in the epidemiology of this disease and explains why it has had predominant occurrence all over the world especially in grazing animals (Titball *et al.*, 1991; Watson and Keir, 1994). Epidemiologically, anthrax has shown evidence of maintaining an organism-spore–organism cycle in suitable soils for years without necessarily infecting animals (Van Ness, 1971).

In many Asian and African countries, anthrax is still a major problem of great public health concern though it is almost being eradicated in industrialized countries (WHO, 2008).

When in suitable soils, anthrax spores can survive for many years. In Kruger National Park (South Africa) for example, *B. anthracis* spores were isolated from animal bones estimated to be 200 years. This shows therefore that the spores are very robust. Combined with their ability to survive outside an animal body, these factors makes this pathogen critically important for the ecology and evolution of anthrax disease (Smith *et al*., 2000). Observations have indicated that spores survive well in soils that have high amount of organic materials, calcium, above 6.0 PH and average temperature of about 15°C (Van Ness, 1971).

Several investigations involving deposition of anthrax in soils have been done. In a particular example, there was a deliberate contamination of the Gruinard Island during the Second World War. For the 40 years that sampling was regularly done, spores where isolated almost without exception 6cm from the top of soil (Manchee, 1981).

Other similar investigations done in South Sudan and Northern Canada (Dragon and Rennie, 2001) were consistent to this finding.

Anthrax disease mostly infects grazing animals. Infection in humans is usually obtained from animals or their products either directly or indirectly (WHO, 2008) mainly through eating and contact of infected animal food products, contaminated environment or industrial animal products processing plants. The occurrence of anthrax in animals is therefore important, not only for livestock production, but also for public health (Fujikura, 1998).

2.6 Anthrax in Kenya

Anthrax outbreaks are frequent in Kenya especially in Maragua in Murang'a county and more so in Ichagaki and Kihumbu locations which were the areas highly affected by animal and human outbreaks in December, 2005 (Njenga *et al*., 2006). The outbreak occurrence was contributed by low coverage of animals during the vaccination campaign conducted by the Director of Veterinary Services (DVS) in collaboration with Kenya Veterinary Association (KVA) and general lack of information necessary to combat Anthrax outbreak in the community.

The spread of anthrax was highly facilitated by human movement, poor handling of meat possibly by scavenging dogs, low knowledge base on value of vaccination, disposal of dead carcasses, kinship insurance and poverty (Njenga *et al*., 2006).

In their report Njenga (2006) attributed spread of infection from the carcasses to free ranging chicken, scavenging dogs, weighing scales used to weigh meat and the cost-sharing custom in the community. Future outbreaks are likely to occur, thus the recommendations to prevent this included annual and mandatory vaccination of all ruminants, constant surveillance for humans as spores pose a risk in the environment, intensive and sustained awareness campaign.

Elsewhere in Kenya, there was an outbreak of anthrax in wildlife in Samburu, Kenya from the month of December 2005 up to the month of March 2006 whereby equids were infected with the disease. The most affected where the plain zebras (*Equis Burchelli*), the endangered Grevy's zebras (*Equus grevyi*) and the donkeys (*Equus asinus*). In this outbreak, 26 plains zebras and 53 Grevy's zebra succumbed to anthrax (Muoria *et al*., 2007). From May 2011 to July 2011, there was another outbreak of

anthrax in wildlife at the Mwea National Reserve that affected the endangered Rothschild's giraffes (*Giraffa camelopardalis ssp. rothschildi*). Eleven giraffes and one lesser kudu (*Ammelaphus imberbis*), died (Kaitho *et al*., 2013). There are other numerous reports of unpublished outbreaks of anthrax in livestock and humans in Bomet, Narok Vihiga (ZDU, 2013) and Nakuru (ZDU, 2014 and KWS, 2015) Counties in Kenya.

2.7 Prevention and control

Anthrax and most zoonotic diseases, are transmitted to people from animal sources. Therefore, controlling animal reservoirs would be cheap and effective as opposed to the costs of providing medical care for human patients (Meslin *et al*., 2000). However, this requires collaboration and constant communication between the veterinary and medical sectors. Currently there is increased awareness in both sectors due to the higher profile that this disease has now achieved, but the resources required to translate this awareness into action are either missing or limited. The effective surveillance, control and prevention of anthrax are a significant challenge and should be an example to be followed by physicians and veterinarians worldwide (Meslin *et al*., 2000).

Success in the prevention and control of anthrax and other zoonotic diseases depends on the capability to mobilize resources in different sectors, coordination and intersectoral approaches, especially between national and international veterinary and public health services (Abdou, 1998). However, a study in Wisconsin by Grant and Olsen (1999), indicated that not only physicians and veterinarians held very different views about the disease risks from certain animals and infections agents, but also that they communicated very little to each other about zoonotic diseases and their prevention.

Understanding the trend of occurrence, incidence and prevalence of anthrax forms are the initial critical stages for creating efficient and sustainable measures for control given that there are minimal data and facts as far as Kenya is concerned (Turnbull, 2001). Animal vaccination is the most effective method of prevention used although reporting vaccination figures is not fully done to the Director of Veterinary Services. In 1881, Pasteur attenuated *B. anthracis* and conducted a field test of his vaccine for

livestock; at approximately the same time, Greenfield performed similar work (Turnbull, 1991). Sterne developed live, attenuated strains ("live-spore vaccines") in the 1930s, which are still used worldwide to immunize domesticated animals (Stanley and John, 2008). Russian and Chinese investigators used this approach for both veterinary and human vaccines. Human anthrax vaccine has been developed in the United States and the United Kingdom and consist of proteins isolated from anthrax cultures and mostly people at risk of infection are vaccinated, like defense forces and industrial workers handling animal products (Parish, 1965)

2.8 Meat hygiene in Kenya

The main beef value chain actors include livestock producers, animal health service providers, livestock traders, slaughterhouse operators, meat transporters, butchers, consumers and the regulators of meat (Musyoka et al., 2012). All these players are responsible in one way or another to the quality and safety of the meat we eat and can influence presence or absence of food borne zoonotic diseases like anthrax (Slorach, 2003). Livestock producers determine the environment, production system, veterinary services provision, feeds and nutrition all of which lead to some level of production and health of the animal. Animal health service providers ensure proper health of the animals by offering advice, herd health services, routine activities like vaccination and deworming, record keeping and treatments (Hubbert, 1996). The animal health service providers have a great role in controlling anthrax mainly by awareness creation, surveillance and routine vaccination of animals against anthrax including prophylactic treatment. Traders on the other hand enhance business between the farmers and the butchers or the consumers is maintained (Musyoka et al., 2012).

Slaughterhouse operators, meat transporters, butchers and regulators of meat are very crucial in regard to anthrax control. These actors can control the disease at the time of an outbreak if they all do their work diligently and with integrity (Haile Selassie et al., 2013).

The regulators of meat must enforce all the laws that govern meat along the whole value chain by referring to the Kenyan existing laws and regulations. These regulations aim to improve hygiene standards, eliminate contamination of meat,

control spread of diseases and protect workers from occupational hazards such as zoonotic diseases like anthrax (Musyoka et al., 2012). The meat industry in Kenya is regulated by the Directorate of Veterinary Services under the State Department of Livestock in the Ministry of Agriculture, Livestock and Fisheries (GOK, 2012). The Meat Control Act Chapter 356 was revised in the year 2012 to standardize the slaughter industry throughout the country in a bid to reduce risks of food borne diseases, improve hygiene and protect the consumer (GOK, 2012). Other laws in Kenya that directly touches on the meat industry include the Public Health Act Chapter 242 (GOK, 1982) and the Animal Diseases Act Chapter 364 (GOK, 1972). However, these legislations are either insufficient or outdated and not in line with the current international requirements (GOK, 2004).

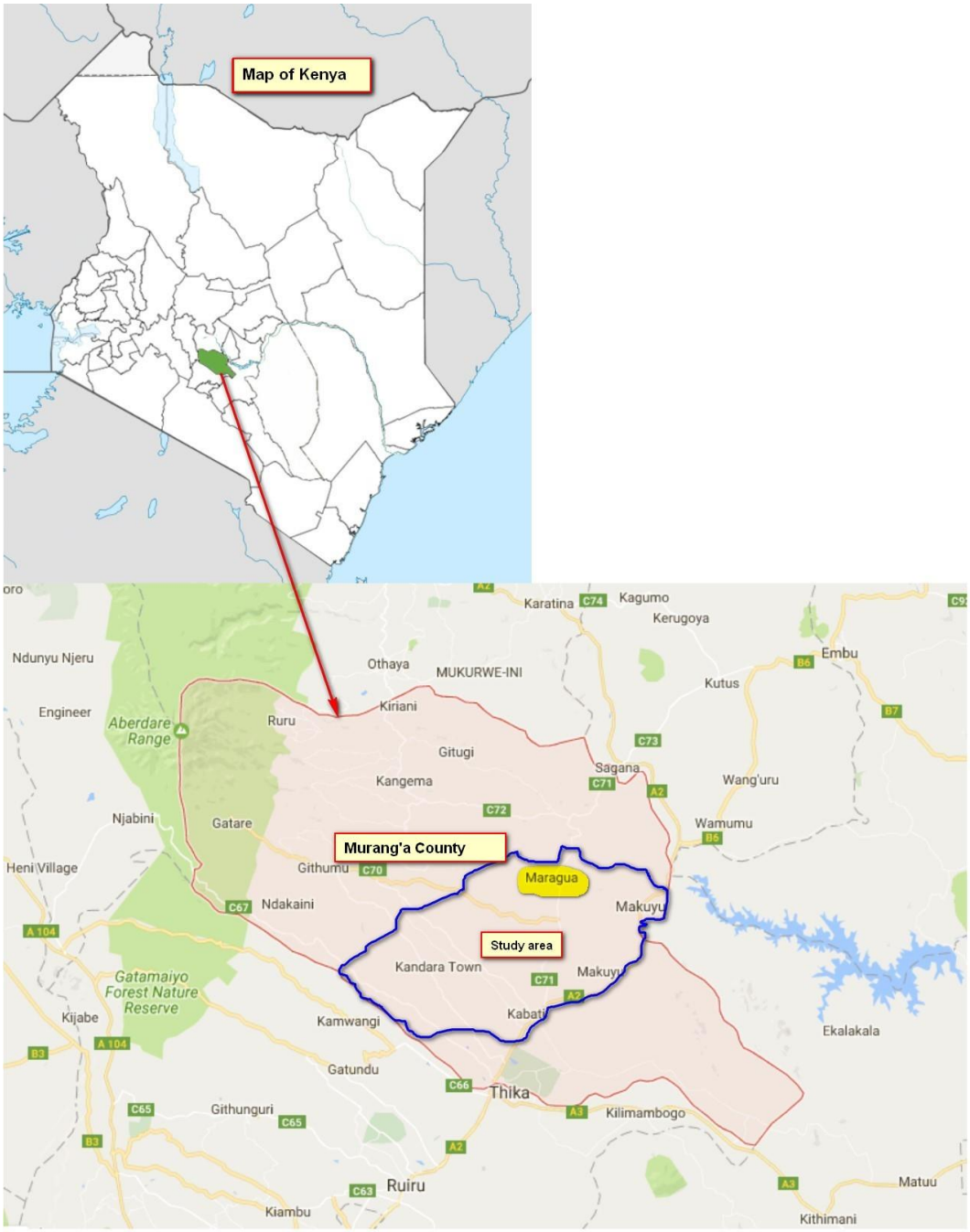
3.0 RESEARCH METHODOLOGY

3.1 Description of the study area

Maragua is a sub-county in Kenya situated in Murang'a County of former Central province. Maragua's population stood at 432,701 according to the 2009 Population and Housing Census (District's Statistics Office, Maragua, 2011).

The sub-county covers an area of 1,065 KM² (including the Gatare Forest). It is bordered by Murang'a sub-county to the North, Thika sub-county to the South, Nyandarua sub-county to the West, Machakos to the East and Kirinyaga and Mbeere sub-counties to the Northeast (Fig. 3.1). It lies between latitudes 0°46′ South and 1° 07′ South and longitudes 36° East and 37° 27′ East. It has an altitude of 1323M above sea level.

The Sub-county has six administrative wards namely Maragua, Kigumo, Kamahuha, Kandara, Wempa and Gatare forest. There are 17 locations and 70 sub-locations. There are cases of high absolute levels of poverty in Maragua. They include the landless mostly found in the arid and semi-arid areas of Kamahuha ward where there are several squatters.



Source: *District's Statistics Office, Maragua, 2011*

Figure 3. 1: Location and administrative areas of Murang'a County showing study area

3.2 Study design

This was a cross sectional study conducted between August and September 2014 in Maragua sub-County of Murang'a County.

The purpose of collecting this information was to compare level of knowledge, attitudes and practices among community members who raised livestock.

To complement the survey, Key Informant Interviews (KII) were also conducted which helped the research team clarify some complex phenomena like behaviors that emerged during this study.

Nine key informants were drawn from the three wards using purposive sampling method. Respondents included: two veterinary workers (a veterinarian and a veterinary paraprofessional), two health workers (a nurse and a laboratory technician), a local leader (assistant chief), a teacher, an elderly man, a community health worker and a farmer.

The relationship between the dependent and independent variables indicating factors relating to anthrax prevention and control were described by a conceptual framework (Appendix 1).

3.3 Study population

The population in this study were adult community members aged 18 years and above, veterinary workers (Sub-county veterinary officer/veterinary paraprofessionals and extension officers) and health workers (Sub-county medical/health officer and those in charge of health facilities) who had lived in Maragua for more than one (1) year before commencement of this study.

3.3.1 Sample size calculation

In order to generate sufficient information of the knowledge, attitudes and practices regarding anthrax among community members in Maragua, sample size was determined by using Cochran formula (1977). A known knowledge prevalence of 71.5% (Chikerema *et al.*, 2013) was used as shown below;

$\mathbf{n = Z^2 P (1\text{-}P) / d^2}$ (Cochran formula, 1977)

Where: n = Required sample size

Z = Confidence level at 95% (standard value 1.96)

P = Proportion (0.715)- is the expected proportion of community members with knowledge on cause/symptom or mode of transmission of anthrax.

d = Level of Precision at 5%

$$\frac{1.96^2 * 0.715 * 0.285}{0.05^2} = 313.13$$

Therefore, n= 313 Persons

3.4 Data collection

Before data collection, two (2) research assistants were oriented on the purpose of the study, methods of data collection and how to fill the questionnaires. This was done by the investigator to ensure quality field operation.

Structured questionnaire with semi-open questions was used to collect data (Appendix 2). The questionnaire was designed to capture demographic characteristics of respondents (age, sex, education level, religion and occupation), knowledge (cause, transmission, symptoms and prevention), attitudes, and practices. The questionnaire was administered by the researcher assisted by two research assistants.

This questionnaire was used to interview community members, medical and veterinary professionals. A purposive sampling method was used to select Maragua Sub-county which is in Murang'a County as the study area. The reason for the choice of Maragua Sub-county was that there had been repeated reports of anthrax cases in humans and animals in the previous years (Njenga *et al*., 2006).

Three (3) wards (Maragua, Kamahuha and Wempa) were purposively selected based on the reported frequency of anthrax occurrence and the availability of resources, by the principal investigator. Two (2) locations were randomly selected per ward where on average about 50 questionnaires were administered per selected location to the community members targeting 313 respondents. Households were selected systematically whereby every fifth homestead was interviewed counting both sides of a chosen path.

The questionnaire sourced for information on bio-data of the participants, socio-demographic information including age, gender, level of education, occupation and religion, number of animals kept and their dependency to these animals.

Nine key informant interviews were also held; three from each ward with interviewers selected purposively.

An informed consent was obtained from study participants and a quantitative methodology was used. Face-to-face interviews were conducted to collect information from heads of household or representative member where the head was not available at the time of the interview. After the consent was given the interviewer and interviewee sat in a quiet environment and carried out the interview.

Those that did not understand English were interviewed in Swahili or their local language by the assistant investigators who came from the study area.

A structured questionnaire was used to collect demographic characteristics, knowledge, attitudes and practices from individual participant and an interview lasted between 10 and 20 minutes depending on ability to respond to posed questions. After the interview, the participants were provided with relevant disease-related information and were given opportunity to ask questions about anthrax and its effect in animals and humans, a description of its cause, symptoms, potential routes of transmission, treatment, and measures to prevent infection.

3.5 Data management, processing and analysis

At the end of each day of data collection, all questionnaires were handed over and reviewed by the investigator to ensure that all variables were correctly filled. Data from household questionnaires were entered into Microsoft Excel 2010 by the Principal Investigator and exported to GenStat Discovery Edition 4. Descriptive statistics (frequencies, means and standard deviations) were used to summarize the data. Variables were presented as proportions and associations of anthrax and management factors for livestock keepers determined by Fisher's exact test and Chi-square.

Data collected through key informant interviews were analyzed using thematic analysis procedures. The data were used to compliment and elaborate quantitative findings and clarify relevant aspects of anthrax related practices and behavior.

3.6 Ethical considerations

Participation for this study was voluntary; informed consent was obtained from each individual participant before the commencement of face to face interview. The study was cleared by The University of Nairobi, Board of Postgraduate Studies (BPS) (Appendix 3) and the Bio-safety, animal use and Ethics committee of the University of Nairobi (Appendix 4). Authority was sought from the Ministry of Agriculture, Livestock and Fisheries (MALF), State Department of Livestock by the Director of Veterinary Services (DVS) (Appendix 5), the County Director of Veterinary Services (CDVS) of Murang'a County Government and the Sub-County Veterinary Officer (SCVO) of Maragua. The study also got authorization from the Ministry of Health (MOH) from the Director of Medical Services (DMS) (Appendix 6) and the Medical Superintendent (Med Sup) of Maragua District Hospital to interview Medical professionals in the area.

3.7 Limitation, validity and reliability of the study

Triangulation of methods of data collection enriches the quality of data findings. The questionnaire was designed, redesigned and modified with keen consideration of the area before the actual data collection, purposely to improve the accuracy or quality of data.

Key informant interviews were also held to gather more information thus improving the study.

The study was conducted in an area with frequent outbreaks of anthrax. The results therefore may not be generalized to areas with low or which have never experienced anthrax outbreaks.

The last outbreak in the area was four (4) months before the time this study was carried out and therefore this could have introduced recall bias. However, most participants could remember what happened in all the recent outbreaks due to the scale of the impact.

The questionnaire basically targeted the head of household to provide information on Knowledge, Attitudes and Practices. The head of the household's view does not necessarily represent every adult member of the family and thus the results may not accurately represent the view of all the community members.

The Key Informant Interviews and the questionnaires captured self-reported information and relied primarily on respondents providing the right information. Misreporting by respondents cannot be ruled out.

4.0 RESULTS

4.1 Quantitative data

In this study, 315 participants were interviewed by the Principal Investigator with the support of two assistants. Following the individual interview process, 22 questionnares were dropped from the study due to various reasons such as incompleteness, and wrongly filled details. Therefore 293 questionnaires passed for analysis.

4.2 Socio-demographic characteristics of study participants

4.2.1 Age groups of respondents

A total of 293 community members participated in the study, with 64.5% being male and 35.5% being female. The respondents were of different age groups, with age group of above 55 years being 32.8%, 41-55 years were 29.4%, 31-40 years 21.8% and the group with least participants was 18-30 years with 16.0% participants (Figure 4.1).

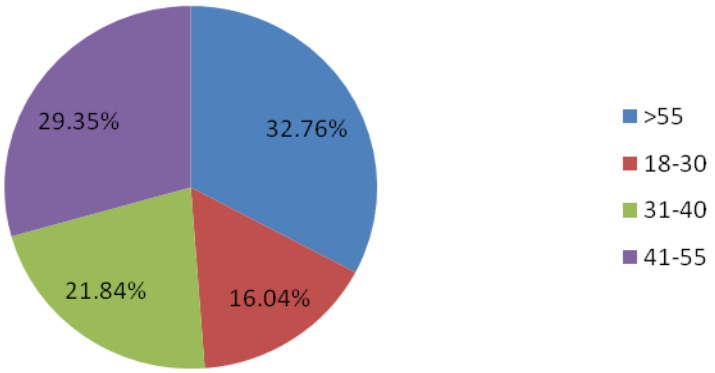


Figure 4. 1: Various age groups of people sampled during the study

4.2.2 Level of education of respondents

One hundred and twenty five respondents (42.7%) had completed primary education, with male representing 65.6% and females 34.4%. One hundred and five (35.8%) had completed secondary education, 12.0% (35/293) had tertiary education while only 9.6% (28/293) were illiterate (Figure 4.2).

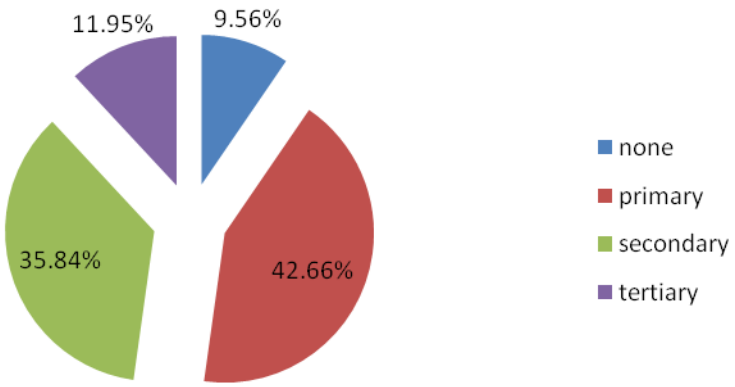


Figure 4. 2: Level of education of participants

4.2.3 Other socio-demographic data

Majority of the participants (85.0%) were self-employed doing crop and livestock farming as the main economic activity with males comprising 56.3% and females 28.7% (Chi-square=2.2431 p-value= 0.1710). Majority of the interviewed participants were Christians with only one (0.3%) Muslim. Of the interviewed community members 88.4% own animals (Table 4.1).

Table 4. 1: Socio-demographic characteristics of study participants by gender

Variable	Gender		Total	p-value
	Male n= 189 (64.5%)	**Female n=104 (35.5%)**	**n= 293 (100%)**	
Occupation				
Employed	24 (8.2%)	20 (6.8%)	44 (15.0%)	0.1710
Self-employed	165 (56.3%)	84 (28.7%)	249 (85.0%)	
Religion				
Christian	189 (64.5%)	103 (35.2%)	292 (99.7%)	0.3549
Muslim	0 (0.00%)	1 (0.3%)	1 (0.3%)	
Animal ownership				
Yes	168 (57.3%)	91 (31.1%)	259 (88.4%)	0.7077
No	21 (7.2%)	13 (4.4%)	34 (11.6%)	

4.2.4 Relationship between animal keeping and anthrax

Out of 293 participants, 88.4% of the study respondents were involved in animal keeping (cattle, goats, pigs and sheep). Animal ownership against occurrence of anthrax in animals in the area did not show statistically significant association with Chi-square = 0.1550 and p-value = 0.6938 (Table 4.2).

Table 4. 2: Relationship between animal keeping and anthrax

	Animal anthrax	**No**	**Yes**	**Grand Total**	**P-value**
Owns animal	Yes	39	220	259	0.6938
	No	6	28	34	
	Grand Total	**45**	**248**	**293**	

4.2.5 Knowledge on anthrax

4.2.5.1 Respondents who knew anthrax

Almost all the community members have heard about anthrax as represented by 96.3% of the interviewed respondents.

Most respondents interviewed knew about anthrax disease. There was a strong association between knowing anthrax and the level of education (p-value = 0.0001 at 95% confident interval). More people with secondary and tertiary education knew about anthrax than those with primary and without formal education (p-value = 0.045) thus showing a strong association (Table 4.3).

The relationship between gender and knowledge of anthrax had no statistical significance (p-value = 0.2062 at 95% confidence interval).

Table 4. 3: Respondents who knew anthrax by level of education

Education	Educated	Illiterate	Total	P-value
Yes	244 (83.3%)	38 (13.0%)	282 (96.3%)	0.0001
No	3 (1.0%)	8 (2.7%)	11 (3.7%)	
Total	247 (84.3%)	46 (15.7%)	293 (100.0%)	

4.2.5.2 Sources of information about anthrax

Some of the respondents (43.7%) heard about anthrax from neighbors, friends and relatives within the community area, 21.0% from veterinarians and veterinary Para-professionals, 15.1% from the radio, and the rest from schools, television, hospital, newspapers and magazines. Only one person (0.3%) heard about anthrax in church (Figure 4.3).

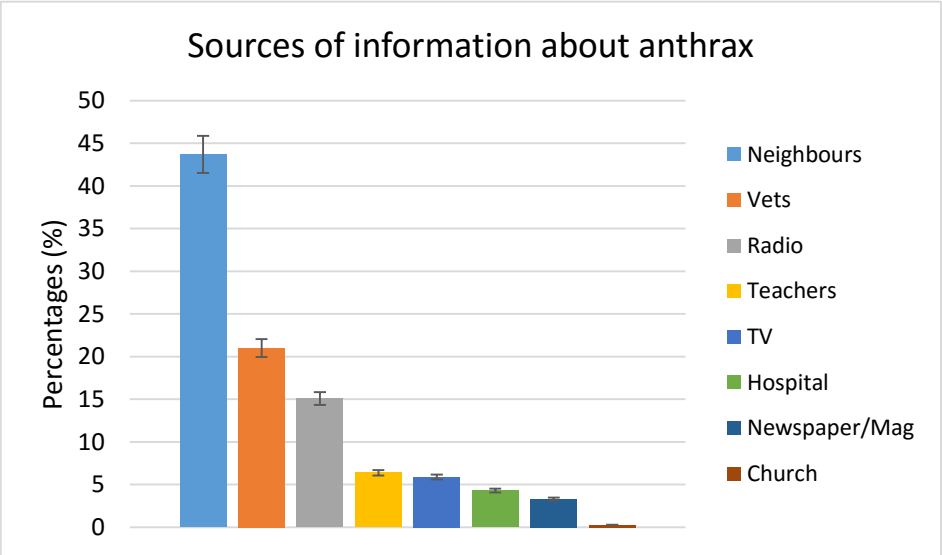


Figure 4. 3: Sources of information about anthrax

4.2.5.3 Knowledge on cause of anthrax

About three quarters of the interviewed participants (74.6%) knew that the cause of anthrax was germs related. Only one (0.3%) participant mentioned heredity while the rest (25.1%) said they did not know (Figure 4.4).

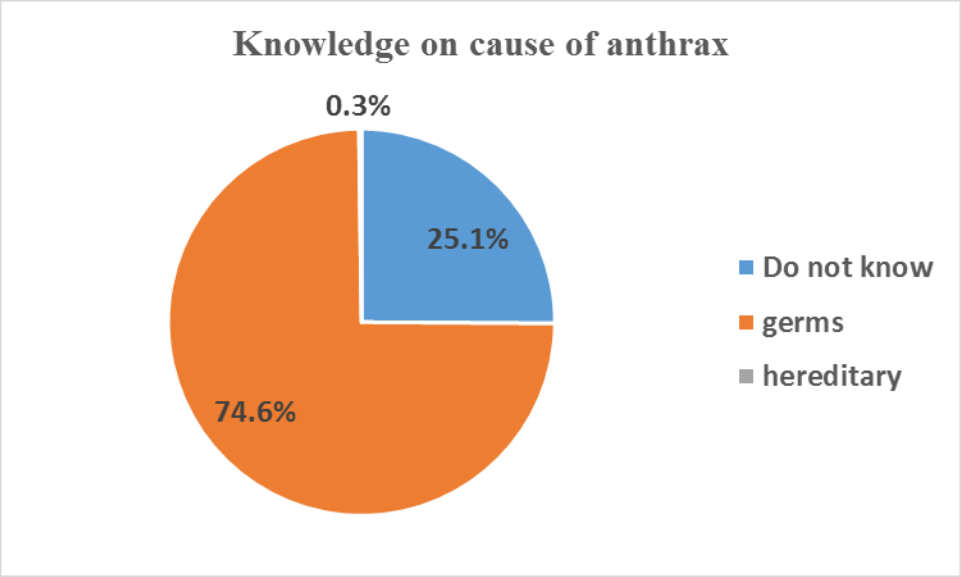


Figure 4. 4: Knowledge on cause of anthrax

4.2.5.4 Knowledge on transmission

Majority of the community members (60.5%) knew that the most common means of anthrax transmission to humans as eating infected meat while 20.3% of the participants knew that it was by contact and 7.3% mentioned contaminated soil. Only 11.9% of the participants admitted as not knowing the transmission mode of anthrax to humans (Figure 4.5).

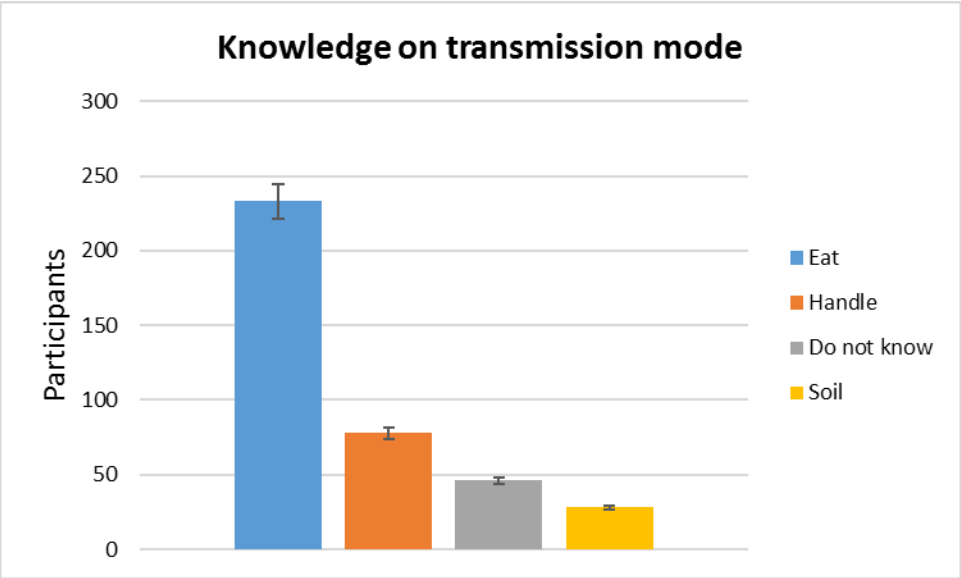


Figure 4. 5: Knowledge on transmission

4.2.5.5 Knowledge on animal symptoms

Majority of the community members (70.8%) could correctly identify one or more signs of anthrax in animals while 29.2% did not know any sign of anthrax in animals (Figure 4.6).

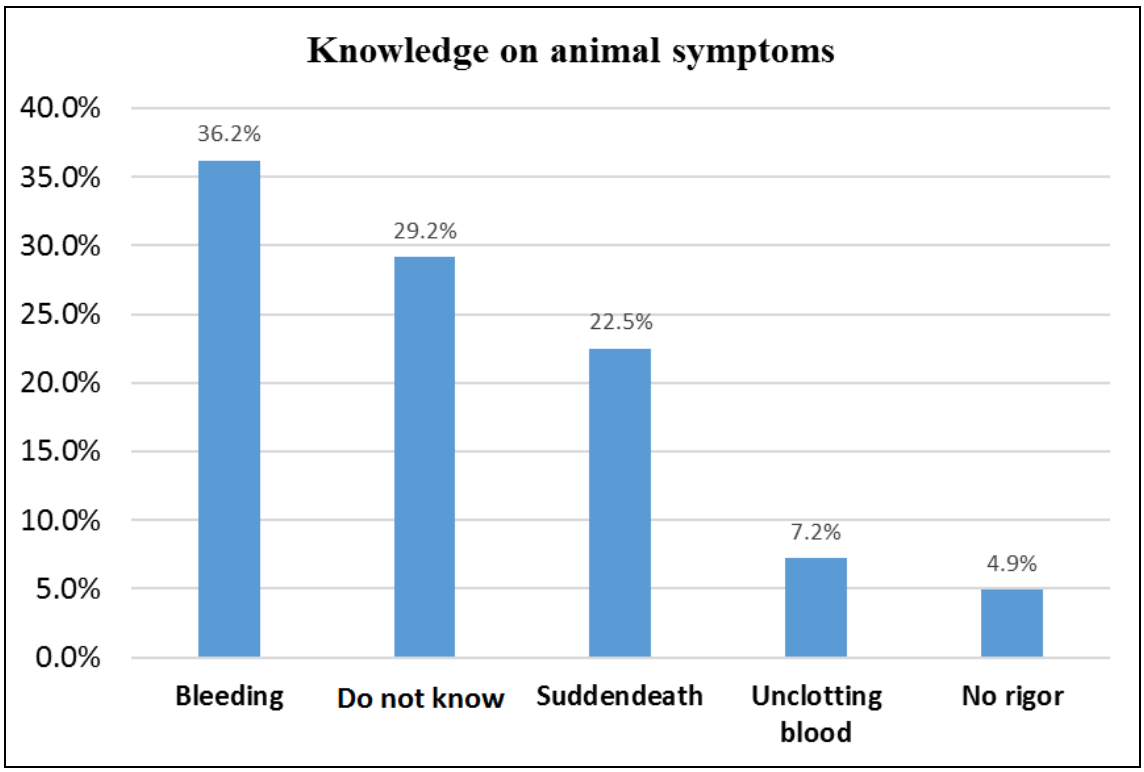


Figure 4. 6: Knowledge on animal symptoms

4.2.5.6 Knowledge on human symptoms

The interviewed participants who could correctly identify one or more symptoms of anthrax in humans were 73.6% of the total interviewees while 26.4% could not identify any symptom in humans (Table 4.4).

Table 4. 4: Knowledge on human symptoms

CLINICAL SIGN	NUMBER	PERCENTAGE
Skin rash/ ulcer	157	35.7%
Vomiting	32	7.3%
Diarrhea	47	10.7%
Fever	31	7.1%
Headache	18	4.1%
Sweating	24	5.5%
Chills	15	3.4%
Do not know	116	26.4%

4.2.5.7 Knowledge on control of anthrax

Majority of the community members (81.6%) knew the correct methods of anthrax control in this study. Only 18.4% persons did not know the methods of anthrax control (Figure 4.7).

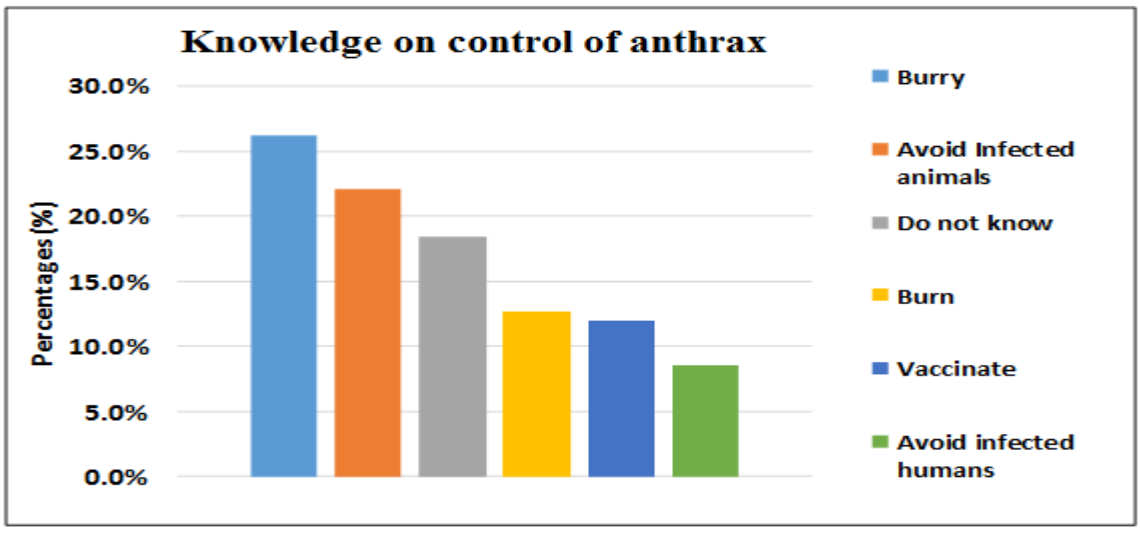


Figure 4. 7: Knowledge on control of anthrax

4.2.2.8 Overall knowledge

The overall knowledge on cause, transmission, animal signs, human symptoms and prevention of anthrax among the community members in Maragua was found to be 77.9% (Table 4.5).

Table 4. 5: Overall knowledge

Variable	Knows	Do not know
Cause	221 (75.5%)	72 (24.5%)
Transmission	258 (88.1%)	35 (11.9%)
Animal signs	207 (70.8%)	86 (29.2%)
Human symptoms	216 (73.6%)	77 (26.4%)
Prevention	239 (81.6%)	54 (18.4%)
Total (%)	389.5%	110.5%
Overall knowledge (%)	**77.9%**	**22.1%**

4.2.6 Attitude regarding anthrax

4.2.6.1 participants awareness on seriousness of disease

Three quarters of the respondents (75.1%) thought that anthrax was a very serious disease in the area, 13.0% of them thought that anthrax was somewhat serious while only 11.9% thought that anthrax was not a serious disease in the area.

Most people in Maragua ward (55.6%) thought that the disease is very serious unlike 27.0% of them in Kamahuha ward and 17.4% of the people in Wempa ward (Table 4.6).

Table 4. 6: Participants perception of seriousness of disease

Ward	Maragua	Kamahuha	Wempa	Total	P-value
Very serious	118 (40.3%)	63 (21.5%)	39 (13.3%)	220 (75.1%)	0.3236
Serious	23 (7.9%)	11 (3.8%)	4 (1.4%)	38 (13.0%)	
Not serious	22 (7.5%)	5 (1.7%)	8 (2.7%)	35 (11.9%)	
Total	163 (55.6%)	79 (27.0%)	51 (17.4%)	293 (100.0%)	

4.2.6.2 Respondents who had seen human Anthrax cases

A total of 33.8% (99/293) respondents had seen a person with anthrax. Maragua ward had the highest with 20.1% followed by Kamahuha ward (8.2%) with Wempa ward having the least representing 5.5% (Table 4.7).

Table 4. 7: Encountered human cases per ward

Ward	Maragua	Kamahuha	Wempa	Total	P-value
Yes	59 (20.1%)	24 (8.2%)	16 (5.5%)	99 (33.8%)	0.6170
No	104 (35.5%)	55 (18.8%)	35 (12.0%)	194 (66.2%)	

4.2.6.3 Respondents whose animals were infected by anthrax

Of the interviewed respondents, 14.3% (42/293) had encountered cases whereby their animals (mostly cattle) were infected by anthrax, 7.9% from Maragua ward, 3.8% from Kamahuha ward and 2.7% from Wempa ward. Of these 42 participants, 73.8% (31/42) reported to the veterinary officer in-charge of the area, 23.8% (10/42) buried the carcass and one person (2.4%) admitted to have consumed meat from the suspected anthrax carcass (Table 4.8).

Table 4. 8: Respondents whose animals were infected by anthrax

Ward	**Yes**	**No**	**Grand Total**	**P-value**
Maragua	23 (7.9%)	140 (47.8%)	163 (55.6%)	0.9544
Kamahuha	11 (3.8%)	68 (23.2%)	79 (27.0%)	
Wempa	8 (2.7%)	43 (14.7%)	51 (17.4%)	
Grand total	**42 (14.3%)**	**251 (85.7%)**	**293 (100.0%)**	

4.2.6.4 Where they saw the person who had suffered anthrax

Among the participants 99 of them had seen a person with anthrax, 82.8% (82/99) had seen through personal observation in the neighborhood while 17.2% (17/99) of them had seen through the television and photographs and therefore they were aware of the signs and symptoms of a person with anthrax (Figure 4.8).

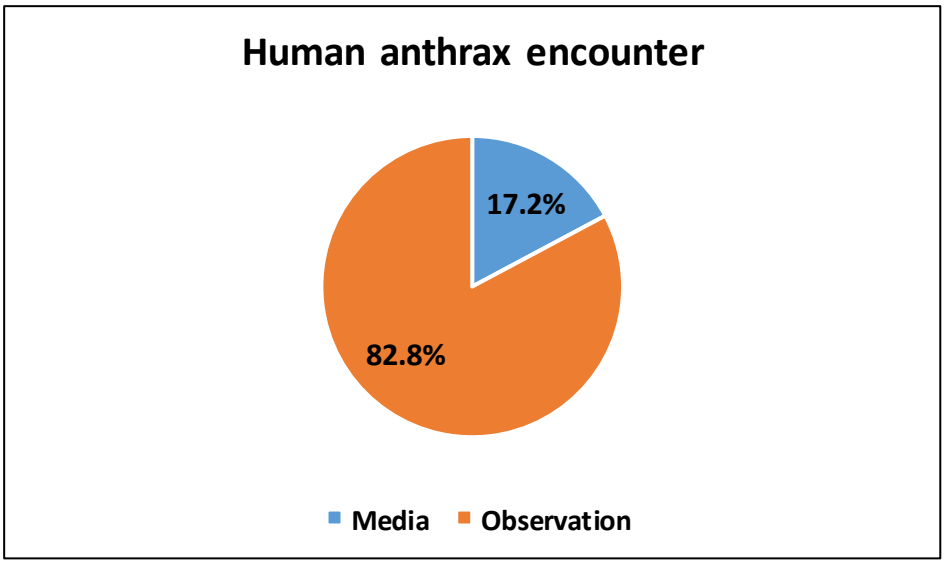


Figure 4. 8: Where they saw the person who had suffered anthrax

4.2.6.5 Preferred sources of information

If the community was to be educated about anthrax, a good number of people (29.0%) preferred awareness by baraza, followed by radio (20.4%), Community Health Workers (CHW) or through the hospital (19.7%), church (8.8%), posters (8.43%) and fewer respondents preferred TV (5.4%) neighbors (3.6%), schools (3.0%) and newspapers and magazines (1.7%) (Figure 4.9).

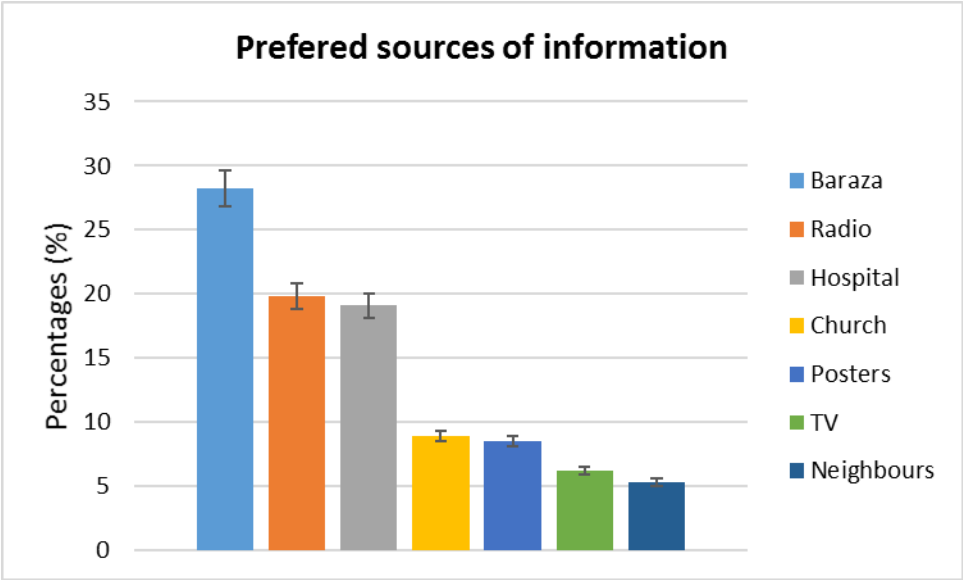


Figure 4. 9: Preferred sources of information

Baraza was preferred (28.2%) mostly by elderly to old participants who were above 40 years of age as opposed to youths to middle aged of 18 to 40 years who mostly preferred TV and print media. This also goes hand in hand with the fact that majority of elderly to old participants preferred radio, hospital and churches as opposed to the youth and middle aged who preferred schools as the best place of creating awareness.

Baraza was preferred more by elderly to old because the educators came to the community member's locality and they mostly use the vernacular (Kikuyu) which members of this age bracket are comfortable with.

In the case of the hospital, Maragua district hospital has assigned Community Health Workers (CHW) who go to the villages and create awareness of various diseases to community members. These CHW also use the vernacular and therefore easy for the above 40 years cluster to understand.

On the other hand, besides Kikuyu language, the youths and middle aged are more educated and understand both English and Swahili therefore able to read and write. Thus they preferred awareness through TV, schools, newspapers and magazines. Wempa ward had the highest number of respondents who chose TV (3.8%) followed by Maragua (1.1%) then Kamahuha (0.6%). This is because Wempa ward is more urbanized and people can afford a TV set as compared to the less urbanized Kamahuha and Maragua wards.

4.2.6.6 Whether vaccination helps

When asked if vaccination of animals helps to prevent their animals against anthrax, almost all (98.0%) participants agreed that indeed vaccination helps. A few (2.0%) said no, while giving reasons of vaccine failure (Table 4.9).

Table 4. 9: Whether vaccination is helpful

Ward	Maragua	Kamahuha	Wempa	Total	P-value
Yes	162 (55.3%)	78 (26.6%)	47 (16.0%)	287 (98.0%)	0.054
No	1 (0.3%)	1 (0.3%)	4 (1.4%)	6 (2.0%)	

4.2.7 Peoples' practice regarding anthrax

4.2.7.1 Animal husbandry and anthrax

Majority of the participants (82.6%) in this study keep their animals in zero-grazing units while 6% were practicing free range system. Animal husbandry showed no statistical significance, therefore no association with occurrence of anthrax in animals (p-value = 0.0623). Thus animal husbandry was not a risk practice in the occurrence of anthrax in this study (Table 4.10).

Table 4. 10: Animal husbandry

		Free range	Mixed	None	Zero-grazing	Total
Know	No	5 (1.7%)	14 (4.8%)	28 (9.6%)	204 (69.6%)	251 (85.7%)
	Yes	1 (0.3%)	3 (1.0%)	0 (0.0%)	38 (13.0%)	42 (14.3%)
Total		6 (2.1%)	17 (5.8%)	28 (9.6%)	242 (82.6%)	293 (100.0%)

4.2.7.2 Sources of feed

A large number of participants (86.1%) practice zero grazing system whereby they source for pasture elsewhere, cut and transport to the cattle in the zero-grazing unit. Another 8.5% homesteads buy commercial feeds while only 5.4% graze their animals in the field. The association between sources of feed and occurrence of anthrax in animals did not have a significant association with p-value = 0.8381(Table 4.11).

Table 4. 11: Sources of feed

Ward	Maragua	Kamahuha	Wempa	Total
Zero grazing	119 (45.9%)	66 (25.5%)	38 (14.7%)	**223 (86.1%)**
Commercial	3 (1.2%)	8 (3.1%)	11 (4.2%)	**22 (8.5%)**
Field grazing	7 (2.7%)	3 (1.2%)	4 (1.5%)	**14 (5.4%)**

4.2.7.3 Cases of outbreaks encountered

A total of 168 (67.6%) participants had encountered one or more outbreaks of anthrax in the area while 32.4% had not encountered any outbreak of anthrax (Table 4.12).

Table 4. 12: Cases of outbreaks encountered

Ward	Maragua	Kamahuha	Wempa	Total
Yes	89 (30.4%)	68 (23.2%)	41 (14.0%)	198 (67.6%)
No	74 (25.3%)	11 (3.8%)	10 (3.4%)	95 (32.4%)

Out of the interviewed respondents, 34.0% (99/293) of them could recall that the most recent outbreak was less than six months earlier, at the time of the interview (Figure 4.10).

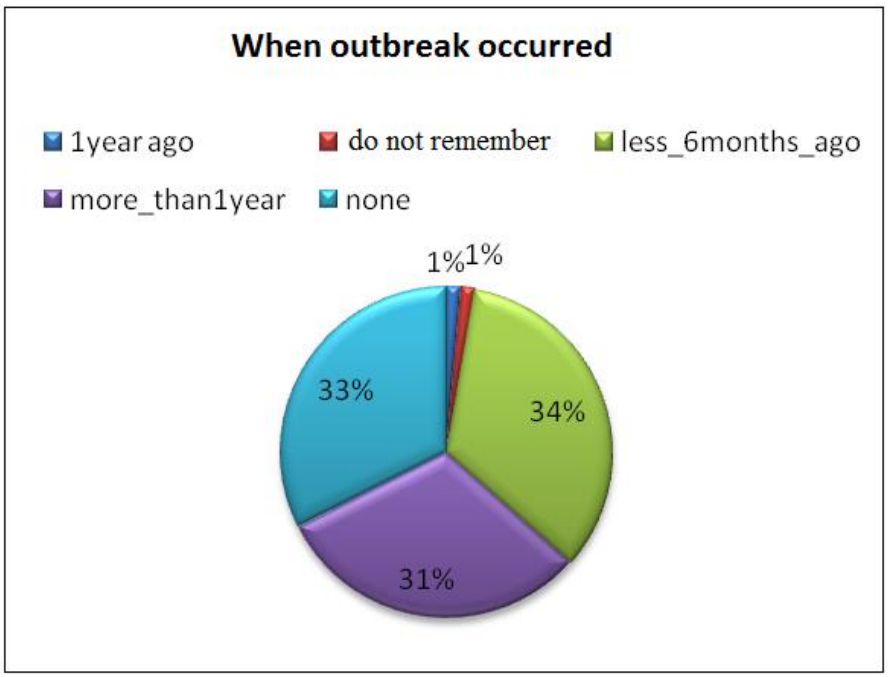


Figure 4. 10: Memory of the period when the outbreak occurred last

4.2.7.4 Action taken by participants after an anthrax outbreak

Most respondents (73.8%) whose animals were infected by anthrax reported the cases to the local veterinary officer while 23.8% buried the carcass without reporting and one (2.4%) person admitted to have consumed meat from the carcass that died of anthrax (Table 4.13).

Table 4. 13: Animal anthrax infection

Action	No. of respondents	
Reported to vet officers	31	73.8%
Buried	10	23.8%
Consumed meat	1	2.4%
Total	42	100.0%

4.2.7.5 Response of veterinary department after outbreak

After an outbreak occurred, the Veterinary department responded by doing a vaccination exercise. This was supported by 58.0% of all the interviewed community members (Table 4.14).

Table 4. 14: Response of veterinary department

Ward	Maragua	Kamahuha	Wempa	Total
Yes	74 (25.3%)	60 (20.5%)	36 (12.3%)	170 (58.0%)
No	15 (5.1%)	9 (3.1%)	4 (1.4%)	28 (9.6%)
Total	**89 (38.8%)**	**69 (23.6%)**	**40 (13.7%)**	**198 (67.6%)**

4.2.7.6 Transmission of anthrax to humans

A total of 46 participants reported to have either contracted anthrax directly or their close relative contracted anthrax. Of these 46 participants, 65.2% (30/46) of them got infected by consuming meat from a carcass that had died of suspected anthrax. The rest contracted anthrax by contact of infected materials from the carcass; 21.7% (10/46) of them where infected during the process of skinning, 8.7% (4/46) by carrying hide from infected carcass and 4.4% (2/46) by carrying meat from infected carcass (Table 4.15)

All the patients were taken to the nearest health facility for medication upon realization of signs and symptoms of anthrax.

Table 4. 15: How humans contracted anthrax

Mode of transmissions	Participants
Consumption of carcass	30 (65.2%)
Skinning carcass	10 (21.7%)
Carrying hide from carcass	4 (8.7%)
Carrying meat from carcass	2 (4.4%)
Total	**46 (100.0%)**

4.2.7.7 Vaccination turnout

A total of 76.1% of the participants who own animals confirmed that they always take their animals for vaccination whenever the exercise is announced while 23.9% do not due to reasons such as long distances to the vaccination centers, high charges of the vaccine, vaccine failure and lack of information when the exercise occurs (Table 4.16).

Table 4. 16: Vaccination turnout

Ward	Maragua	Kamahuha	Wempa	Total
Yes	116 (44.8%)	49 (18.9%)	32 (12.3%)	197 (76.1%)
No	31 (12.0%)	18 (6.9%)	13 (5.0%)	62 (23.9%)
				259 (100%)

4.2.7.8 Frequency of vaccination

A total of 160 persons out of all the interviewed participants in this study agreed that the Veterinary department does vaccination twice a year, while some 27.7% said that it is done once a year while 10.6% of the community members calls the veterinarian to vaccinate their animals when in need (Figure 4.11).

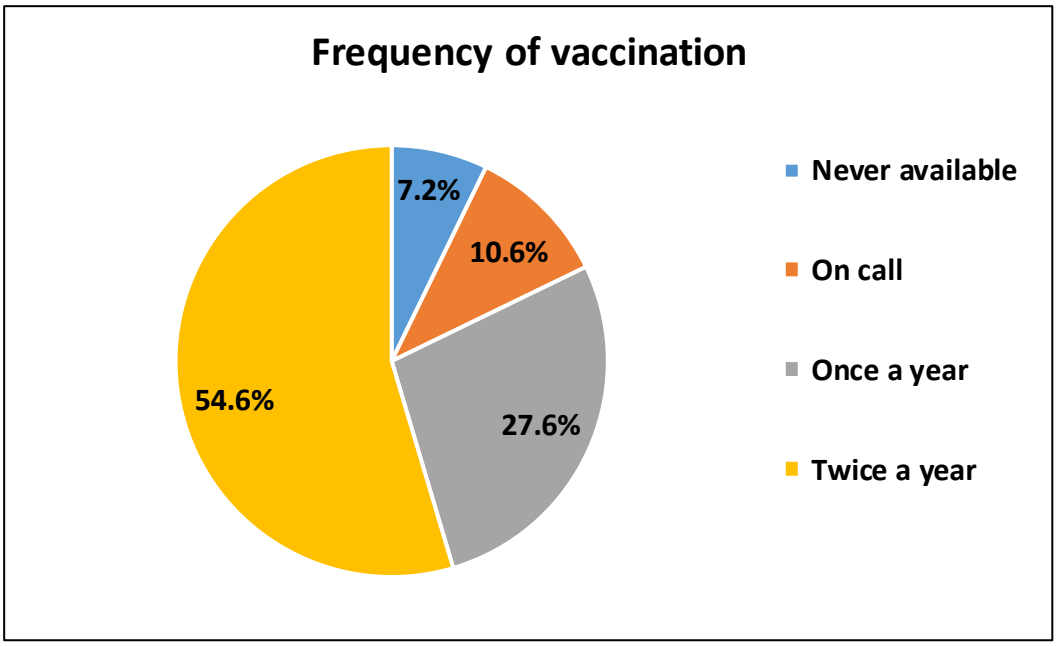


Figure 4. 11: Frequency of vaccination

4.3 Results of the qualitative data

This was achieved by conducting key informant interviews. Nine key informants were drawn from the three wards using purposive sampling method. Respondents included: two veterinary workers (a veterinarian and a veterinary paraprofessional); two health workers (a nurse and a laboratory technician); a local leader (assistant chief); a teacher; an elderly man; a community health worker; and, a farmer.

4.3.1 Qualitative results of knowledge

The veterinary and medical professionals had adequate knowledge of anthrax accurately describing the cause, transmission, signs, symptoms and control measures in both humans and animals. They recognized it as a zoonotic disease that occurs mainly after a season of heavy rainfall and affects majorly cattle in the area causing sudden death and bleeding from the orifices. Humans get the disease mainly by consuming a carcass that died of anthrax.

There was a gap in terms of working relationship and communication between the medical and veterinary professionals whereby the medical team complained that the veterinary professionals were slow in responding to outbreaks, carrying out definitive diagnosis in animals and creating awareness to farmers. Both professionals expressed

challenges such as lack of a laboratory in the sub-county to confirm the disease and that the samples have to be sent to Nairobi and it takes a long time before they get back the results.

Apart from the veterinary and medical professionals, other interviewees had low to medium knowledge. They associated the disease to eating infected meat. They correctly mentioned bleeding from the nostrils of a carcass as the main sign in animals and an ulcerated skin wound in humans. However, they attributed its cause to a virus and they believed that boiling infected meat and pouring out the soup severally would control its transmission if that meat is eaten.

The old man in the Key Informant Interview attributed the cause to a type of snake that dies and then lush grass grows at the area where the snake died after a rainy season. When cattle graze here they contract anthrax. They dispose the carcass by burying in a shallow pit within their compound which also is a great source of transmission especially by scavenging animals like dogs and chicken.

4.3.2 Qualitative results of attitude

The veterinary and medical professionals reiterated that it is a zoonotic disease of great public health importance that needs to be tackled carefully with both the medical and veterinary professionals to bring the outbreaks in the area to an end. Both professionals emphasized their roles in controlling anthrax but mentioned that meagre resources have been downplaying their efforts.

The other key informant interviewees acknowledged that anthrax is a very serious disease and whenever a person is suspected, he or she is rushed to the nearest health facility together with all those the person shared the meal with in a case where infected meat was consumed. They even trace back to find the carcass and all those who came into contact with it are advised to visit a health facility.

All the interviewees felt like it is everybody's responsibility to control this disease, although the medical and veterinary professionals expressed dissatisfaction with both the county and national governments for not doing enough to control the disease in terms of early detection and further investigation. Others felt like the sub-county

authority need to create more awareness about the disease in the area and put more preventive measures in place.

4.3.3 Qualitative results of practice

Members of this community reported that if an animal died of sudden death, the community members would skin it before burying otherwise other animals would die the same way. The hide is then taken to the tannery for sale.

The community also boil suspected meat severally as they pour out soup in a bid to clear the contaminants but they end up contracting anthrax since the *B. anthracis* spores can withstand high temperatures. The method of carcass disposal is usually by burying, but the pit is usually shallow and within the compound where the family lives. This shallow pit can be dug by scavengers like dogs and also when it rains the carcass can be disposed up the ground thus bring about contamination of the environment.

The veterinary professionals expressed dissatisfaction about the low vaccination turnout when they hold a vaccination exercise. Most farmers in this area practice zero grazing livestock production system and therefore they are always reluctant to take out their cattle for vaccination at the set vaccination centers and instead they want the veterinary team to move house to house vaccinating the animals against anthrax. This idea, the veterinary team says is not feasible since it requires more personnel and time yet the resources are limited. Other factors attributed to low vaccination figures turnout include the cost of vaccination, poor publicity of the vaccination exercise by the veterinary team, long distances to the vaccination centers by some community members and some think that vaccination does not really help to combat the disease.

5.0 DISCUSSION

5.1 Knowledge on Anthrax

This study aimed at assessing knowledge, attitudes and practices regarding anthrax among community members, veterinary and health professionals in Maragua Sub-county of Murang'a County. In this study, the overall level of knowledge was 77.9% of all community members regarding cause, transmission, symptoms and prevention of the disease in both humans and animals. This almost compares to a similar study done in Zimbabwe whereby the overall knowledge on cause, transmission, symptoms and prevention of anthrax in humans and animals was 71.5% (Chikerema *et al.,* 2013).

A total of 96.3% of the community members had heard the disease anthrax since there had been efforts by the Community Health Workers from Maragua District Hospital to create awareness whenever there was an outbreak. This finding is similar to a research done in Tanzania by Sasita et al. (2012) regarding KAP on Rift Valley Fever (RVF) which showed that 97.5% of the participants had heard about the disease.

It is important to respond quickly to eliminate anthrax confirmed or suspected carcasses by immediate incineration, since spores are rapidly formed and spread by flies and scavengers, especially vultures, that may transmit anthrax over long distances (Turnbull, 2001).

5.2 Animal anthrax cases

Of the interviewed respondents 14.3% had their animals (mostly cattle) reported to suffer from anthrax whereby 10.6% reported the cases to the veterinary officer in-charge of the area, 3.4% buried the carcass without reporting and 0.3% admitted to have consumed meat from the suspected anthrax carcass.

The figures above may be higher because most of the participants in this study were hiding the truth especially where they were affected negatively or did a wrong thing like consuming and selling meat from a suspected anthrax carcass, or did not report the cases to the relevant authority. The forty-two cases also were those that were either diagnosed by the veterinary officers, suspected or caused human disease or deaths and were therefore widely publicized especially in the media. However, if proper, timely and efficient mode of farmers reporting of animals' sudden deaths is

created and an equivalent mode of diagnosis put in place by the Veterinary services, then there would be an increase of confirmed anthrax cases than expected.

This is consistent with the research by Sasita et al. (2012) regarding KAP on Rift Valley Fever (RVF) which outlined that most participants were not sincere where they were affected negatively, and also where the outbreak was highly publicized with high morbidities and mortalities in both humans and animals.

According to observations in this study, most of the anthrax cases in this area go unnoticed when the scale of impact in animals and humans is low.

5.3 Human anthrax cases

Out of all the interviewed community members, 15.7% were reported to be either infected with anthrax or had a family member who was infected by anthrax. Of the 15.7% morbidities, thirty (10.2%) of them contracted anthrax by consuming meat from a carcass that had died of anthrax. A similar research in Zimbabwe showed that 24.8% of the correspondents would consume meat from carcass whose death was unknown (Chikerema *et al*., 2013). The rest contracted anthrax by contact of infected materials from the carcass since they did not use any protective gear; ten of them where infected during the process of skinning, four by carrying hide from infected carcass and two by carrying meat from infected carcass.

All the patients were taken to the nearest health facility for medication upon realization of signs and symptoms of anthrax, this concurs with a research in Kazakhstan whereby all the patients that had come in contact with anthrax infected materials were hospitalized (Christopher *et al*., 2004).

5.4 Anthrax outbreaks

Sixty seven percent of the participants have encountered one or more outbreaks of anthrax in the area while 33% have not encountered any outbreak of anthrax. Thirty three percent of the participants could recall that the most recent outbreak was four months ago before this study. This confirms that anthrax outbreak in Maragua sub-county is common.

The participants noted that it occurs mostly after rainfall when there are lush pastures. This anchors well with Hugh-Jones (2009) study in Texas which noticed that after heavy rains in depressed areas, locally called *'pot holes'*, accumulate humus and

minerals from the surrounding soil. The pot holes were found to have calcium concentrations 2–3 times, phosphorus 6–10 times and magnesium 2 times higher than the surrounding ground and this creates locally favorable conditions to enable a better survival of spores in places with otherwise unfavorable soil, e.g., sandy loams (Hugh-Jones and Blackburn, 2009). Another study in Serengeti, Tanzania observed a general ecological pattern whereby grazers (zebra, wildebeest, buffalo and livestock) were worst affected after drought, and browsers (impala) following heavy rains (Katie *et al*., 2011).

5.5 Attitude towards anthrax

Seventy five percent of the people of Maragua sub-county thought that anthrax was a very serious disease in the area; thirteen percent of them thought that anthrax is somewhat serious while only twelve percent thought that anthrax is not a serious disease in the area. This concurs with a study by Munyua et al. (2016) that prioritized zoonotic diseases in Kenya and anthrax was prioritized as the number one zoonotic disease out of the thirty-six studied zoonotic diseases. Another study done in Maragua by Musyoka et al. (2012) on the beef value chain identified anthrax as the most common foodborne disease obtained from beef than any other disease.

In this study, attitudes towards preventing and controlling the disease were found positive by most respondents. This observation corresponds to previous findings in Laos on a research which indicated that it was a role of both government and community (Nalongsack *et al.*, 2009) to combat anthrax. This puts emphasis on collaborative efforts from the community members, private sector and the government to manage anthrax. Other studies have also addressed need for multidisciplinary collaboration and engaging community members (Fyumagwa *et al.*, 2011).

This study found out that the community members would skin carcasses for cultural belief so as to prevent the remaining animals from sudden death, and also to sell the hide (GOK, MoLD, 2006). This observation concurs with a study by Coleman *et al*, (2002) where he found that cultural beliefs contribute a lot in disease transmission to the community.

5.6 People's practice

Farming is the main activity in Maragua with 79.5% of the community members doing livestock and crop farming for subsistence and as an economic activity. Livestock farming was dominant in this study as 88.4% of the people are engaged in animal husbandry. At least every visited homestead had a cow or two and in addition some had goats and/or sheep, pigs, chicken and rabbits. Anthrax outbreak here was mainly observed in bovine species, this phenomenon of anthrax manifesting in one or few species at a time was also observed in Samburu, Kenya where it occurred in equids, affecting endangered Grevy's zebras, plains zebras, and donkeys. (Muoria *et al*., 2007). Similarly, the 2011 Mwea National Reserve anthrax outbreak affected only endangered Rothschild's giraffes and one lesser kudu, despite the presence and abundance of other susceptible species in the Reserve (Kaitho *et al*., 2013).

Because anthrax is zoonotic and its main transmission to humans is from animals, then animal keeping becomes one of the major risky practice towards anthrax in animals and humans.

Thirty four percent of the correspondents had either been infected with anthrax or have had their family members infected. Maragua ward had the highest with twenty percent followed by Kamahuha ward with eight percent and Wempa ward having six percent. This could be attributed to the fact that majority of people living in Maragua ward are dependent on livestock and are fully occupied by livestock related activities. Therefore, this dependency and close interaction with animals increases chances of exposure to human anthrax. This compares well with a retrospective study done in Zambia (Victor *et al*., 2006) whereby the highest fatality rate of 19.1% was observed in the districts where the community members depended almost entirely on livestock.

Maragua is also more remote and people are less educated with poor accessibility to faster and efficient communication media like television, radio, internet, newspapers and magazines as compared to the other two wards; same case as reported in Senanga, Kaoma, Mongu, Kalabo and Lukulu Districts in Western Province and Zambezi District in North-Western Province of Zambia (Victor *et al*., 2006).

Despite the fact that 60.5% of the correspondents knew that consumption of meat from a suspected anthrax carcass will cause anthrax, they still consume such kind of meat. In the key informant interview, it was reported that it is common for community

members to buy cheap meat from a carcass that died suddenly despite knowing the consequences. This finding almost corresponds to a similar study which found out that 75.2% of the participants reported that they would not consume meat from cattle found dead, because they were discouraged by veterinary authorities but there were high cases of consumption of meat from an anthrax related carcass (Chikerema *et al*., 2013).

Some who knew about the meat said that they knew how to boil to kill the germs. They would boil then pour out the soup, add more water till it boils again and pour out the soup and do this severally until they were satisfied all the germs are eliminated and killed. This, they said used to be done long time ago and it is borrowed from their fore fathers. They affirmed that it indeed eliminates and kills all the germs that cause anthrax as also observed by Njenga *et al*. (2006).

Some respondents said that once their neighbor's cow died and he decides to sell meat from the carcass, they must respond by buying to economically help their neighbor. If one does not do this, he or she will be noted and when they have problems no one will come to their aid as also observed by a study by Njenga *et al*. (2006).

After an outbreak has occurred, the Veterinary department responds by doing a vaccination exercise as supported by fifty eight percent of all the interviewed community members. Among the interviewed members, seventy six percent of them confirmed that they always take their animals for vaccination whenever the exercise is announced while twenty four percent do not participate in the vaccination. This knowledge by community members on control of anthrax by vaccination contradicts a study done in Tanzania by Sasita *et al.* (2012) whereby vaccination was mentioned by veterinarians and not community members. According to observations made during the study, although seventy six percent agreed to have always been presenting their animals for vaccination, this could not be true because officers in the Veterinary department cited low turnout during vaccinations as a contributing risk factor. A big number of farmers do not present their animals for vaccination and those who do, do not present all their animals. The most common reason mentioned was due to high charges of vaccination which the farmers could not afford at all or could not afford to pay for all the animals. Therefore, the less important ones like bulls, calves, sheep and goats are not vaccinated and the lactating cows will be preferred. Some did not

present their animals for vaccination due to long distances to the vaccination centers, lack of information when and where vaccination is done and some thought the vaccine was not effective since some of their previously vaccinated animals succumbed to the disease. This phenomenon was also observed by a similar study in Zimbabwe (Chikerema *et al*., 2013).

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

a. This study revealed above average knowledge of anthrax in the study area by community members on cause, transmission, signs and control. However, this knowledge is not usually applied and people continue to consume uninspected meat, fail to present their animals for vaccination and embraces risky cultural practices. The knowledge among the community members has been enhanced over time by awareness created by veterinarians and CHW in the area due to frequent anthrax outbreak cases.

b. There was good attitude towards control of the disease among these people. This is because they encountered losses through morbidity and mortality of their animals and family members and hence anthrax had a great scale of impact. The people were willing and ready for more sensitization on the disease through various modes of communication.

c. Practices by the people of Maragua were the major risk factors of anthrax outbreak. Skinning of a suspected carcass, consumption of anthrax related meat, failure to vaccinate their livestock and poor disposal of carcasses contributed to anthrax transmission. There was a gap between medical and veterinary personnel collaboration in terms of anthrax control given the fact that this disease need multidisciplinary approach especially from the two professionals for effective control.

6.2 Recommendations

- The government should develop anthrax policy to address issues of anthrax control measures such as vaccination, surveillance, carcass disposal, animals and humans diagnosis and there should be regular updates and review of this policy.

- In such an area where anthrax outbreak is frequent, the Government or any other donor should offer free animal vaccination to achieve close to 100% turnout. Human vaccinations should also be considered in the area.

- The community members should be educated against traditional beliefs, myths and practices that pose a risk of anthrax like boiling meat severally, skinning

carcass before burying and "supposed neighborliness" of buying meat from the neighbor whose carcass has died.

- The capacity of Veterinary and Medical workers should be strengthened in diagnosis of zoonotic diseases for early outbreak detection and subsequent interventions.

- With availability of resources, additional studies should be extended to other regions of Kenya so as to compare findings and institute wholesome intervention measures of the disease. Further studies can also be done in Maragua to isolate anthrax spores in the soil.

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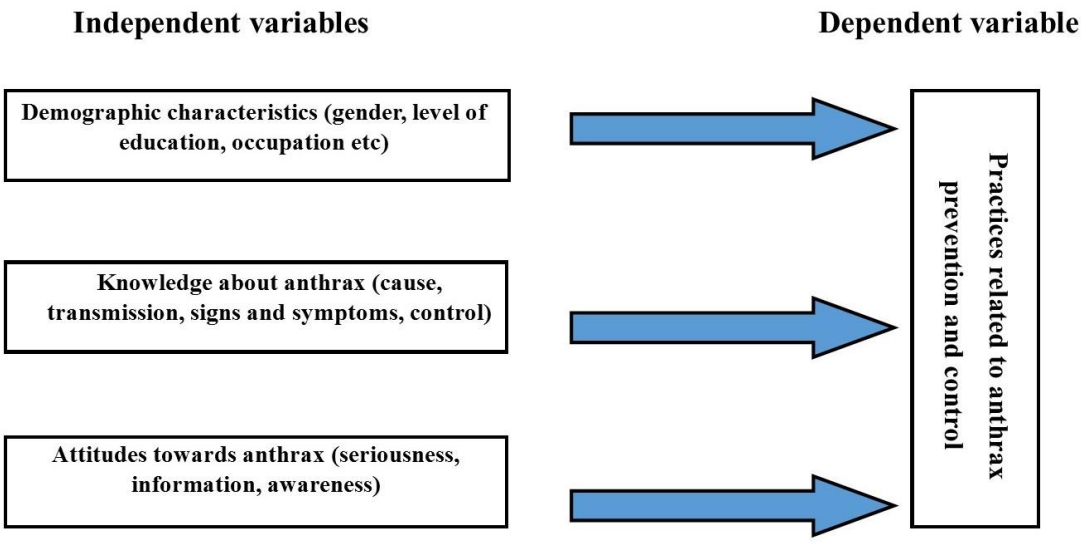
APPENDICES

Appendix 1: Conceptual framework indicating factors relating to anthrax prevention and control



Appendix 2: Questionnaire

Questionnaire No: ……

Title: To determine knowledge, attitude and practice of anthrax in Maragua area of Murang'a county.

This study aims to collect information on knowledge, attitudes and practices regarding anthrax among community members living in Maragua. You are being asked to participate in this study as a community member from this area and would be grateful if you are willing to participate by answering questions from this questionnaire.
I assure you that all the information collected from you will be kept confidential. You may refuse to answer any particular question and may stop the interview at any time.
Do you agree to participate and answer questions in this study? Yes [__] No [__]

Name of Enumerator:.....

Telephone number of enumerator:.....

I) PERSONAL INFORMATION:

Name of participant (optional): …….....

Telephone number of participant (optional): .....

Ward: ……..... Location: …….....

Sub-location/village: …… Date of interview: dd/mm/yyyy ……

II) SOCIO-DEMOGRAPHIC INFORMATION:

Age (years) 18-30 [__] 31-40 [__] 41-55 [__] Above 55 [__]

Gender: 1-Male [__] 2-Female [__]

1. Level of education

1-None [__]

2-Primary [__]

3-Secondary [__]

4- College/University [__]

Occupation

1- Employed [__]

2-Self-employed (e.g. farmer, hawker, bodaboda rider) [__]

3-Other (specify) …….

Religion

1-Christian [__] 2-Muslim [__] 3- Other (specify) ….....

ANIMAL OWNERSHIP

Animal type	**No. Female**	**No. Male**	**Total No.**	**Purpose**
Cattle				
Goats				
Sheep				
Donkeys				
Other (Specify)				

III) <u>ANTHRAX KNOWLEDGE AND AWARENESS</u>

2. Do you know of a disease called anthrax?

1-Yes [__] What are the signs/symptoms?.....

2-No [__]

3. 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 books [__]

6-Medical officials [__]

7-Teachers [__]

8-Religious leaders [__]

9- Family, friends, neighbors/colleagues [__]

10-Other (Specify) ……..……...

4. **What do you think causes the disease?** 2-Germs

   3-Hereditary

   4-Witchcraft

5-Don't know

   1- **How is anthrax transmitted to humans? (Select all that apply)**

   2- Eating infected animal product [__]

   3- By handling infected animals without protective clothing

   4- Through contaminated soil [__]

5. Do not know [__]

6. **Have you ever seen a person with anthrax?**

   1-Yes [__] 2-No [__]

7. **If yes, where?**

   1-Through media (TV) [__] 2-Personal observation [__] 3-Other (specify) ……..……

8. **How can a person prevent him/herself from getting anthrax? (Select all that apply)**

   1- Avoid anthrax infected animals [__]

   2- Avoid anthrax infected people [__]

   3- Burn all suspected anthrax animal carcasses

   4-Bury all suspected anthrax carcasses [__]

   5-Vaccinate animals annually [__]

   6-Do not know [__]

9. **What are the signs and symptoms of an animal with anthrax? (Select all that apply)**

   Sudden death [__]

Bleeding from natural orifices [__]

Unclotted dark red blood [__]

Incomplete rigor mortis [__]

5-Other (specify) ……

10. What are the signs and symptoms of a person with anthrax? (check all that apply).

1-Fever [__] 2-Chills [__] 3-Fatigue (extreme tiredness) [__]

4-Skin rash/wounds [__] 5-Coughing [__] 6-Lack of appetite [__]

7-Headache [__] 8-Irritability [__] 9-Diarrhea [__]

10-Vomiting [__] 11-Excessive sweating [__]

11. In your opinion, how serious a disease is anthrax in humans and animals in your area? (Check one.)

12. Very serious [__] 2- Somewhat serious [__] 3- Not very serious [__]

13. What are the sources of information that you think can most effectively reach people in this area concerning anthrax? (Please choose the three most effective sources.)

1- Newspapers and magazines [__]

2- Radio [__]

3- TV [__]

4- Billboards [__]

5- Brochures, posters and other printed materials [__]

6- Health workers [__]

7- Family, friends, neighbors and colleagues[__]

8- Religious leaders [__]

9- Teachers [__]

10- Other (please explain): ……

IV) PEOPLES' PRACTICE

14. What animal husbandry do you practice

1-Zero grazing [__] 4- Mixed free range and zero grazing [__]

2- Free range [__] 5- Other (Specify).....

15. Where do you get fodder for your animals?

1-I graze in the field [__] 4- Buys commercial fodder [__]

2- Cut and carry fodder [__] 5- Other (Specify).....

16. Has any of your animal(s) been infected by anthrax?

1- Yes [__] 2-No [__] 3- Don't know [__]

17. If yes above, what actions did you take?

1- Reported to the Vet officer [__] 2- Buried the dead animal without reporting [__]

2- Consumed meat of the dead animal [__] 3- Other (Specify) ……

18. Has any member of your family suffered from anthrax?

1- Yes [__] 2- No [__] 3- Don't know [__]

19. If yes above, how did the person contract it?

1-Skinning dead animal [__] 4- Carrying hide form dead animal [__]

2- Eating dead animal [__] 5- Other (Specify)

3- Carrying meat from dead animal [__] .....

20. From the above question; what action did you take?

1- Took the person to the nearest health facility [__]

2- Bought medicine from a chemist (Specify drugs bought) …….……

3- Took the person to a traditional healer [__] 4- Did nothing [__]

3- Other (Specify) …….

V) HISTORY OF ANTHRAX VACCINATION

21. Have you had anthrax outbreak in the area? Yes [__] No [__]

22. If yes, when?

Less than 6months ago [__] More than 1year ago [__]

1year ago [__] Other (Specify) ..... Don't remember [__]

23. Was there vaccination during the period? Yes [__] No[__]

24. Were all animals vaccinated? (tick)- Yes [__] No [__]

25. If No which animals were not vaccinated and why?

.....

26. How often is vaccination against anthrax done in your area?

1-Twice a year [__] 2-Once a year [__]

3-The veterinary personnel are always available to vaccinate

4-Never available [__] 5-Other (specify).....

27. What prompts you to take your animals for vaccination?

1-To protect animals [__] 4- Because others do so [__]

2- To protect humans [__] 5- Other (Specify).....

3- Because it is a requirement [__]

28. If you do not always take your animals for vaccination, what are the reasons?

1-No Vet services [__] 4- The vaccination center is far [__]

2- Financial difficulties [__] 5- Other (Specify).....

3 -Don't get informed when it occurs [__]

29. In your opinion, does vaccination of animals help to prevent anthrax?

1- Yes [__] 2- No [__] why? …….

Appendix 3: Approval letter from the University of Nairobi, Board of Postgraduate Studies (BPS)

UNIVERSITY OF NAIROBI
BOARD OF POSTGRADUATE STUDIES

Telephone: 318262 Ext. 28267
Fax Number: 243626
Telegrams: "Varsity of Nairobi
E-mail: bps@uonbi.ac.ke
YOUR REF:
OUR REF: J56/81871/2012

P.O. Box 30197, 00100
NAIROBI, KENYA

4th September 2014

Dr. Chacha Isaiah Nchagwa
c/o Chairman,
Department of PHPT
Faculty of Veterinary Medicine
CAVS

Dear Dr. Chacha,

RESEARCH PROPOSAL AND SUPERVISORS

This is to inform you that the Director, acting on behalf of the Board of Postgraduate Studies has approved your research proposal titled: **"Survey of anthrax in Maragua and estimating its prevalence in Keya".**

She has also approved, **Prof. S.M. Arimi** and **Dr. A.G. Thaiyah** as supervisors of your thesis.

You should therefore begin consulting them and ensure that you submit your thesis for examination on or before 3rd March 2015. The Guidelines on Postgraduate Supervision can be accessed on our website (www.bps.uonbi.ac.ke) while the Research Notebook is available at the University Bookstore.

Yours sincerely,

D. NJUGUNA BERNARD
FOR: DIRECTOR, BOARD OF POSTGRADUATE STUDIES

Cc: Dean, Faculty of Veterinary Medicine
Chairman, Dept. of Public Health, Pharmacology & Toxicology
Prof. S.M. Arimi, (Supervisor) Dept. of PHPT
Dr. A.G. Thaiya, (Supervisor) Department of Clinical Studies

DNB/bwg

Appendix 4: Approval letter from the Biosafety, Animal use and Ethics committee of the University of Nairobi

UNIVERSITY OF NAIROBI
FACULTY OF VETERINARY MEDICINE
DEPARTMENT OF VETERINARY ANATOMY AND PHYSIOLOGY

P.O. Box 30197,
00100 Nairobi,
Kenya.

Tel: 4449004/4442014, 6
Ext. 2300
Direct Line. 4448648

Dr Chacha I. Nchagwa
c/o Dept of Public Health Pharmacol. & Toxicology.

09/07/2014

Dear Dr Nchagwa,

RE: Approval of Proposal by Biosafety, Animal use and Ethics committee

Estimating the prevalence of anthrax, brucellosis and rabies in Kenya and survey of anthrax in Maragua

By Dr Chacha I. Nchagwa Ref: J56/81871/2012

We refer to the above proposal that you submitted to our committee for review and approval. We have now reviewed the proposal and have noted that yours is a retrospective study that will use data from relevant sources and questionnaires to obtain the prevalence of the diseases in the respective areas. Furthermore, we note that your study will **not** involve actual use of animals for experimental purposes.

We therefore approve your proposed work as per the above proposal that you submitted to the committee

Rodi O. Ojoo BVM, M.Sc, Ph.D
Chairman,
Biosafety, Animal Use and Ethics Committee,
Faculty of Veterinary Medicine

Appendix 5: Approval letter signed by the Director of Veterinary Services (DVS), Murang'a County Director of Veterinary Services and the Maragua Sub-county Veterinary Officer

UNIVERSITY OF NAIROBI

COLLEGE OF AGRICULTURE AND VETERINARY SCIENCES
FACULTY OF VETERINARY MEDICINE

Department of Public Health
Pharmacology and Toxicology
P.O. Box 29053,
Kabete, KENYA

Telephone:Nairobi 020-2453621, 020-3592734; 0203592735
Telegraph: Univet, Nairobi
Telex: 22095 VARSITYK
Fax: +254 2 631325
Email: dept-publichealth@uonbi.ac.ke

for: DIRECTOR OF VETERINARY SERVICES
P. O. KABETE

April 8, 2014

Ref: J56/81871/2012

The Director of Veterinary Services
Ministry of Agriculture, Livestock &
Fisheries Department
Veterinary Services

for: DIRECTOR OF VETERINARY SERVICES
P. O. KABETE

County Director of Veterinary Services
Murang'a.
Please ~~allow~~ issued the bearer
collect data from Maragua
Sub County for his studies
Dr. Murekefen w. k.
21/8/2014

Dear Sir/Madam,

REF: DR. ISAIAH NCHAGWA CHACHA – J56/81871/2012

The above named is a MSc student undertaking a Masters degree in Veterinary Epidemiology and Economics at the University of Nairobi, Faculty of Veterinary Medicine, Department of Public Health, Pharmacology & Toxicology. He has finished his course work and has started doing his project on the prevalence of Anthrax, Brucellosis and Rabies in Kenya. He will also investigate occurrence of Anthrax in Maragua in Murang'a County.

This is therefore to request you to allow him access your facilities and relevant data he may require to enable him achieve his intended objectives.

Your assistance will be highly appreciated.

Yours sincerely,

Prof. J.N. Ombui
Chairman,
Dept. of Public Health, Pharmacology & Toxicology

COUNTY DIRECTOR
VETERINARY SERVICES
25 AUG 2014
P. O. Box 599 – 10200,
MURANG'A

To Dr. Njuguna
Kindly assist
Dr. Chacha
Dr. Wahome

DISTRICT VETERINARY OFFICER
MURANGA SOUTH
28/8/2014

Appendix 6: Research authorization letter from the Director of Medical Services (DMS) signed by the Superintendent of Maragua District Hospital.

MINISTRY OF HEALTH
OFFICE OF THE DIRECTOR OF MEDICAL SERVICES

Telegrams: "MINHEALTH". Nairobi
Telephone: Nairobi 2717077
Fax: 2713234
When replying please quote

AFYA HOUSE
CATHEDRAL ROAD
P.O. Box 30016
NAIROBI

Ref: MOH/ADM/1/1/81/VOL.II

16th July 2014

MARAGUA DISTRICT HOSPITAL
P. O. Box 72-10205 MARAGUA
Tel: 0728-336074
Email: maraguahospital@yahoo.com

Received
25/08/2014

Dr. Isaiah Nchagwa Chacha
J56/81871/2012
University of Nairobi
P.O. Box 29053
NAIROBI

REF: RESEARCH AUTHORIZATION

Your research on estimation of prevalence of anthrax, brucellosis and rabies in human and animals refers.

The office has no objection in conducting the research in Maragwa, Murang'a County. The officers In-Charge Maragwa District Hospital is requested to provide necessary support.

DR. NICHOLAS MURAGURI
DIRECTOR OF MEDICAL SERVICES

Copy to: Medical Supt. Maragwa District Hospital

CDH Muranga County