FOOD SAFETY KNOWLEDGE AND PRACTICES AMONG ACTORS IN BEEF CHAIN WITH REFERENCE TO RIFT VALLEY FEVER OUTBREAK IN MARAGUA DISTRICT, KENYA

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I57/12521/04

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER IN PUBLIC HEALTH IN THE SCHOOL OF PUBLIC HEALTH, KENYATTA UNIVERSITY.

NOVEMBER 2012
DECLARATION

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

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DEDICATION

This thesis is dedicated to my children: Ndunge, Mbinya, Wanza, Mwanza and Nzilani for their love, tolerance and understanding during the whole period of my study.
ACKNOWLEDGEMENTS

The compilation of this thesis was made possible through the active participation of many actors. While I may not be able to give recognition to all, some individuals deserve special mention. First, I wish to acknowledge the support of my two supervisors, Dr Michael Gicheru and Dr Philip Kitala for their patience, guidance and encouragement. I am thankful to them for their valuable time and commitment during the work on this thesis and the lessons I learnt from them during the supervision.

I am sincerely grateful to Kenyatta University for offering me the opportunity to study. My gratitude goes to the School of Public Health in the College of Health Sciences for the overall guidance and coordination of the study. Special appreciation to the Department of Veterinary Services for granting me study leave and funding the study. I thank all staff of the Ministry of Livestock Development, Ministry of Health and Provincial Administration in Maragua District for devoting time to guide and expose me to the area of study. Finally yet importantly, I am indebted to Mr. Joe Mutua who read my preparatory questionnaire schedule, offered valuable critique, and later advised on data organization and analysis.

This study would not have been complete without the kind support and cooperation of the numerous respondents in the beef value chain in Maragua District. To the team of research assistants who together we covered miles and miles on foot in search of information in Maragua district, I have no words equal to your contribution but just a word of thank you for your commitment and enthusiasm to the assignment. The total and dedicated inspirational love, tolerance and sacrifices from my children: Ndunge, Mbinya, Wanza, Mwanzia and Nzilani, my dear postgraduate classmates and many friends cannot be forgotten. To all I say a big thank you.
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OPERATIONAL DEFINITIONS

**Actors in beef chain** - All the players in the beef value chain

**Dambos** - Temporary floodwater pools that occur throughout the whole range of the Rift Valley

**Food safety** - A scientific discipline describing the handling, preparation and storage of food in a way that prevent food-borne diseases.

**Mortality** - A measure of the number of deaths in a population

**Morbidity** - Incidence of ill health

**Quacks** - An untrained person who pretends to dispense advice or treatment

**Value chain** - The full range of activities that firms and workers do to bring a product from its conception to its end use and beyond.
### ABBREVIATIONS AND ACRONYMS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AHP</td>
<td>Animal Health Practices</td>
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<tr>
<td>BSE</td>
<td>Bovine Spongiform Encephalopathy</td>
</tr>
<tr>
<td>CAC</td>
<td>Codex Alimentarius Commission</td>
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<tr>
<td>Cap.</td>
<td>Chapter</td>
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<tr>
<td>CBS</td>
<td>Central Bureau of Statistics</td>
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<tr>
<td>CDC</td>
<td>Centre for Disease Control</td>
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<tr>
<td>DAPO</td>
<td>District Animal Production Officer</td>
</tr>
<tr>
<td>DO</td>
<td>District Officer</td>
</tr>
<tr>
<td>DDP</td>
<td>District Development Plan</td>
</tr>
<tr>
<td>DFID</td>
<td>Department of Foreign and International Development</td>
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<tr>
<td>DPHO</td>
<td>District Public Health Officer</td>
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<tr>
<td>DVO</td>
<td>District Veterinary Officer</td>
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<tr>
<td>DVS</td>
<td>Director of Veterinary Services</td>
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<tr>
<td>FAO</td>
<td>Food and Agriculture Organization</td>
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<tr>
<td>GOK</td>
<td>Government of Kenya</td>
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<tr>
<td>GAFP</td>
<td>Good Animal Feeding Practices</td>
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<td>GMP</td>
<td>Good Manufacturing Practices</td>
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<td>GHP</td>
<td>Good Hygiene Practices</td>
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<td>GVP</td>
<td>Good Veterinary Practices</td>
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<tr>
<td>HACCP</td>
<td>Hazard Analysis Critical Control Point</td>
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<tr>
<td>KDHS</td>
<td>Kenya Demographic Household Surveys</td>
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<tr>
<td>KEMRI</td>
<td>Kenya Medical Research Institute</td>
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<tr>
<td>LSD</td>
<td>Lumpy Skin Disease</td>
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<tr>
<td>MMWR</td>
<td>Morbidity Mortality Weekly Report</td>
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<tr>
<td>MoA</td>
<td>Ministry of Agriculture</td>
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<td>MoLD</td>
<td>Ministry of Livestock Development</td>
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<td>MoH</td>
<td>Ministry of Health</td>
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<td>MOH</td>
<td>Medical Officer of Health</td>
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<td>MRA</td>
<td>Microbial Risk Assessment</td>
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<td>NGO</td>
<td>Non-Governmental Organization</td>
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<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>OIE</td>
<td>Office International Epizootics</td>
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<tr>
<td>RCP</td>
<td>Recommended Code of Practice</td>
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<tr>
<td>RVF</td>
<td>Rift Valley Fever</td>
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<td>RVFV</td>
<td>Rift Valley Fever Virus</td>
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<tr>
<td>RVFD</td>
<td>Rift Valley Fever Disease</td>
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<tr>
<td>SPS</td>
<td>Sanitary and PhytoSanitary</td>
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<td>SPSS</td>
<td>Statistical Package for Social Science</td>
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<tr>
<td>SRA</td>
<td>Strategy for Revitalization of Agriculture</td>
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<tr>
<td>USA</td>
<td>United States of America</td>
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<tr>
<td>WHO</td>
<td>World Health Organization</td>
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<td>WTO</td>
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ABSTRACT

Food-borne diseases and zoonoses including Rift Valley Fever continue to burden public health and undermine livelihoods in Kenya despite existing control programmes. The 2006-2007 outbreak of RVF in Kenya caused a total of 560 human morbidities and 185 mortalities in 16 Districts including Maragua District, Central Province which had four human cases. This study assessed the level of beef safety knowledge, practices and constraints among livestock producers, traders, slaughterhouse operators, meat transporters, butchers, consumers and regulators with reference to the RVF disease outbreak in the area. A descriptive cross-sectional study was carried out among 399 randomly selected respondents in four sub locations of Kigumo, Kandara, Makuyu and Maragua location, Maragua District. A semi structured interview schedule was administered among the selected actors while an in-depth interview was conducted with key informants’ in the district. The data was analyzed with the help of Statistical Package Software System version 12. A statistical test using Fisher’s exact test value based on Monte Carlo was used to show relationships and associations. The results were presented in descriptive form using frequency tables, bar charts and pie charts. To determine the level of knowledge on beef safety standards, five Rift Valley fever disease characteristics were assessed; beef-borne diseases, susceptible species, transmission, clinical signs and prevention. The study found that level of knowledge on beef safety standards was generally low and depended on the characteristic being evaluated and in some cases differed significantly among the actors in the study categories. For example 98.5% of the respondents had good knowledge of beef-borne diseases and statistically there were no significant differences (p=0.404) among the actors. On species susceptibility knowledge, cattle (46.4%), man (26.6%) and there is a significant difference (p=0.010) among actors. Actors differed significantly (p=0.002) on transmission knowledge by tick bites (30.8%) followed by mosquito bites. The most conspicuous clinical sign in cattle were nasal discharge (29%) and fever (16.4%) according to the actors but analysis showed there were no significant differences (p=0.379) among actors knowledge on clinical signs of RVF in cattle. On the prevention in cattle, the results showed knowledge on vaccination was (41.9%), dipping (13.4%) and quarantines (12.2%) and there was a significant difference (p=0.001) in the levels of knowledge among the actors. Results on prevention in humans, consumption of inspected beef was 36.3% and consumption of cooked beef was 28.3% showing a significant difference (p=0.001) among actors knowledge. Most of the actors identified seeking veterinary advice (58.5%) and treatment by self (33.6%) as the best practices on management of RVF cases. There were no significant differences (p=0.5), between the actors’ practices on when cattle got sick. Practices on dead cattle, 57.7% would bury, 20.7% remove hide, 11.7% burnt and 9.6% call veterinary doctor which had no significant difference (p=0.472) among actors. On health seeking practices, those who visit hospital were 75.2%, visit to herbalist (3.8%) and bought drugs were 2.3% and there were no significant difference (p= 0.116) among actors. The major constraints to beef safety were corrupt inspecting officers (29.7%) and insufficient policy (23.1%) which showed there was a significant difference (p=0.001) among the actors on the understanding of these constraints. The results showed there was need to increase public education (30.5%) and training of all actors (25.6%) which was corroborated by the key informants. The study recommended that the government should develop a multi stakeholder public health education programme with simple messages to tackle the spread of RVF. In addition, the government should employ more veterinary personnel and formulate a beef safety policy with relevant legislation to guide the sector.
CHAPTER 1: INTRODUCTION

1.1 Background

Food borne diseases, intoxications and zoonoses are important public health problems that affect health and disrupt community, business and economic activities in both developed and developing countries (OIE, 2006). The foods most frequently involved in disease outbreaks are those of animal origin especially beef, poultry, pork, milk, fish and eggs (CDC, 1996). One third of the human population in developed countries is affected by food-borne diseases every year and, the problem is likely to be even more widespread in developing countries (WHO, 2002). Globally, unsafe food causes disease in at least one person in three every year (WHO, 2002). Mead et al., (1999) reported that, in the USA, some 76 million food-borne cases occur annually. According to a report by the WHO/DFID-AHP conference, the impact of food-borne diseases, intoxications and zoonoses on health and well-being is greatest among the 800 million food-insecure livestock keepers, traders, labourers and consumers (WHO/DFID – AHP, 2005).

The public is also increasingly becoming aware of the risks posed by pathogenic microorganisms and chemical substances in beef chains; this followed the widely reported outbreaks of Bovine Spongiform Encephalopathy (BSE) and Dioxin contamination in Europe in the early 1990’s (WHO, 2002). The WHO (2002) believes that changes in Agricultural and Animal husbandry practices, environmental manipulation, increased preference for meat and poultry in developing countries, increased population, urbanization, higher incomes and increased nutritional needs of the Human immune virus/Acquired immune deficiency disease syndrome infected people, account for the
emergence of new and re-emerging pathogens of food borne zoonoses. Diseases such as Rift Valley Fever disease (RVF), BSE and E. Coli H\textsubscript{0157} are commonly reported (WHO, 2002). These changes present new challenges to safe food production, processing and distribution.

As a result of these challenges, the WHO’s global food safety strategy was developed (WHO, 2002). The strategy advocates for a holistic integrated approach to the control of food related risks where beef safety is managed from primary production to consumption through risk analysis and process controls that are provided in international beef safety standards, codes of practice, guidelines and recommendations (FAO, 2006).

Until recently, most food control systems were based on legal definitions of unsafe food, legal enforcement programmes for the removal of the unsafe food from the markets and punishment that cannot respond to the emerging challenges of food safety requirements as they do not provide a preventive approach and have no risk analysis provision. In Kenya, the beef safety control system is implemented and verified by the Ministry of Livestock Development (MoLD) and Ministry of Health (MoH) through legislations including the Public Health Act Chapter 242 and the Food, Drugs and Chemical Substances Act Chapter 254 which provides for securing and maintaining of health of the premises and workers, while the Meat Control Act Chapter 356 provides requirements for safe meat and meat products, where it is produced, transported and processed. The Animal Diseases Act Chapter 364 provides for the control of animal diseases. These legislations are either insufficient or outdated and not in line with international requirements (GOK, MoA, SRA, 2004-2014).
According to the WHO (2002), developing countries, including Kenya, have many competing priorities in health agendas and food safety has not in the past been recognized as a priority public health issue. However, serious outbreaks of food-borne diseases and zoonoses including RVF have been documented on every continent in the past decade (WHO, 2002).

Rift Valley Fever disease was first diagnosed in the Rift Valley Province of Kenya in the year 1931 (Daubney et al., 1931) and later in the rest of Africa (Egypt 1993, 1997, Mauritania and Senegal 1987, 1993, 1998, Eastern Africa 1997-98) with recent extensions into the Arabian Peninsula. The disease is endemic in Kenya and outbreaks have occurred in 5–15 year cycles since 1962 causing serious Veterinary and Public health consequences. During the 1997-1998 RVFD epidemic in East Africa, there was a cessation of the lucrative trade in small ruminants to Middle East countries; the loses were estimated to have been USD 250- 350 million. In the 2006-2007 outbreaks, Kenya lost an estimated USD 51,867,512.70, excluding the value of human lives lost (Kasiti, 2009).

According to the Ministry of Livestock Development district annual reports, 16 farmers’ education field days were conducted, 22,421 heads of livestock were vaccinated against various diseases including Anthrax, Rabies, Foot and Mouth disease and a total of 232,352 food animals were slaughtered, inspected, and passed fit for human consumption in Central Province of Kenya (GOK, MoLD, 2005). In the year 2005, the Ministry of Health conducted 21 Public Health education meetings and demonstrations jointly with the Provincial administration. During the same period, the ministry inspected, approved and
licensed a total of 54 butcheries and issued 156 food handlers with medical certificates (GOK, MoH, 2005).

1.2 Problem Statement

Increased public awareness of food-borne diseases and zoonoses for example RVF, BSE and E. Coli H\textsubscript{0157} has shown that food safety is an important issue to producers, processors, distributors, regulatory authorities and consumers (WHO, 2002). In addition, the establishment and implementation of adequate measures for livestock and consumer health protection against zoonoses especially those new and re-emerging have been difficult in developing countries. Thus, food-borne diseases and zoonoses continue to burden public health and undermine livelihoods (WHO/DFID-AHP, 2005).

The outbreak of RVF disease in Kenya in the year 2006-2007, caused a total of 560 morbidities and 185 human mortalities and thousands of livestock deaths in 16 Districts including four human cases in Maragua District, Muranga county. As a result, the veterinary and health authorities imposed livestock quarantines and banned slaughter activities in the district (CDC, 2007).

There was also little or no information available on the level of food safety knowledge and practices on beef-borne zoonotic disease outbreaks among actors in the beef chain in Maragua District despite continuous public health education programmes in the area. These could therefore continue to hinder the development of appropriate disease prevention and public health intervention strategies. This study, therefore, assessed the level of knowledge on beef safety standards, practices, attitude and the degree to which the
technical and social changes have been achieved among livestock producers, livestock traders, slaughterhouse operators, meat transporters, butchers, consumers and regulators with reference to Rift Valley Fever disease outbreak in a rural community in Maragua District.

1.3 **Research questions**

(a) What is the level of knowledge of RVF related beef safety standards among actors in the beef chain in Maragua District?

(b) What are RVF related beef safety practices among the actors in the beef chain?

(c) What are the constraints to implementing RVF related beef safety standards in Maragua District?

1.4 **Null hypothesis**

There is no significant association between level of knowledge on beef safety standards among actors in the beef chain and outbreaks of RVF disease.

1.5 **Broad objective**

To determine the level of knowledge and practices on beef safety standards among actors in the beef chain with reference to RVF disease outbreak in Maragua District, Kenya.

1.6 **Specific objectives**

(a) To determine the level of knowledge on beef safety standards among actors in the beef chain with reference to RVF disease in Maragua District.
1.7 Significance of the study

Rift Valley Fever disease is one of the most significant zoonotic disease problems in Africa (FAO, 2003). It is endemic in Kenya and has recurred at irregular intervals since it was first diagnosed in Kenya (GOK, MoLD, 2007). There have been two major outbreaks of RVF disease in Kenya over the last 10 years including 1997-1998 when 170 human mortalities and 27,500 infections occurred in Garissa District (CDC, 2002) and in the year 2006-2007 where 185 human mortalities occurred in 16 districts (CDC, 2007). The two outbreaks had serious economic, social and trade impacts (GOK, MoLD, 2007). Consumers boycotted meat consumption in a wave of panic thereby disrupting livelihoods (GOK, MoH, 2007).

Therefore, the probability of recurring outbreaks in East Africa and the potential for spread, by natural or intentional means to non-disease endemic areas necessitates the development of methods to predict and prevent the disease. The current food safety control legislations in Kenya are scattered among many agencies; are outdated and have not been revised to be in line with international standards and food safety practices (WHO, 2002). There is also no unified policy on food safety in the country, which hinders coordinated response to food related disasters. Despite the widespread RVF disease public awareness campaigns in the district, the knowledge on beef safety standards, attitude and practices of
the major actors in the beef chain has never been determined. It is hoped that the study findings will be used as a catalyst in initiating beef safety policy, change of strategy and programme review in Kenya and other countries in the region which have similar livestock economic sub sector challenges.

1.8 Limitation of the study
The study faced several limitations including the coincidence with the rainy season as per the time plan in an area where the road network was poor. In addition, funding was low. Since the study was conducted in an area dominated by the Kikuyu community translation through interview assistants was used with a likelihood of interpretation error. The study focused only on the seven selected actors in the beef chain, namely, the livestock producers, livestock traders, slaughterhouse operators, and meat transporters, butchers, consumers and regulators.
CHAPTER 2: LITERATURE REVIEW

2.1 Food safety

Food safety is the assurance that food will not cause any harm to the consumers when taken in its current state and as it is (FAO/WHO, 2001). Food-borne diseases and zoonoses exerts a major toll on health as thousands of millions of people fall ill and many die as a result of unsafe food. Serious outbreaks of food-borne diseases and zoonoses have been documented on every continent illustrating both their public health and social significance. Due to this, WHO (2000) recognized food safety as an essential public health priority and later on adopted the WHO Global food safety strategy (WHO, 2002).

According to the WHO (2000) Global food safety strategy, traditional food safety management systems have not been effective in preventing food-borne diseases and zoonoses over the last decades. The strategy therefore, advocates food safety programmes based on a broader science based concept of risk assessment, risk management through process controls along the entire production chain and risk communication. This is a farm to table approach and involves considerations of every step in the chain, the community and all actors from raw material to consumption. The strategy also advocates sustainable agriculture production systems and redirection of some of the existing approaches to ensure they meet the challenges of global food safety (WHO, 2002).

The primary responsibility for beef safety therefore lies with those who produce process, distribute, trade and consume food (WHO, 2002). These include the livestock producers, livestock traders, slaughterhouse operators, meat transporters, butchers and the consumers. They should operate according to the principles of Good Agricultural Practices, Good
Animal Feeding Practices, Good Veterinary Practices, Good Hygienic Practices, Good Manufacturing Practices and Hazard Critical Control Points (Slorach, 2002). Traceability of feed, food producing animals and beef should be established at all stages of production, processing and distribution.

2.2 Food-borne diseases and zoonoses

About 75% of the new communicable diseases that have affected humans over the last 10 years were caused by pathogens originating from animals or animal products (WHO, 2007). Zoonotic pathogens are a major contributor to human food-borne diseases in both developed and developing countries (Schlundt, 2002). They are transmitted during handling of infected livestock at the farm, markets, slaughterhouse, processing and transportation, at the butchery or during preparation of food (Hubbert, 1996). In many countries and especially in developing ones, millions of people are affected by preventable zoonoses such as Rabies, Rift Valley Fever, Brucellosis, Leishmaniasis, Echinococcosis, Tularemia, amongst others (WHO, 2002).

The burden of zoonoses falls disproportionately on poor rural communities which have poor sanitary living conditions and low education that are considered as potential risk factors in many developing countries (Perry et al., 2002). The close association between poor rural people and domestic livestock in large areas of developing countries promotes an opportunity for multiple infections with zoonotic diseases through direct exposure or vector- borne transmission route (Coleman, 2002). As the level of awareness of food-borne zoonoses pathogens grow, demand for safer livestock and their products will increase from consumers locally and internationally (Correa and Gerster, 2003). Producers, processors
and traders would therefore be called upon to assure the safety and quality of these products (WHO, 2002).

2.3 Rift Valley Fever Disease

2.3.1 Epidemiology

Rift Valley Fever is arthropod-borne viral haemorrhagic zoonoses that cause disease in both animals and humans leading to high morbidity and mortality (WHO, 2000). The disease is caused by the RVF is an arbovirus of the genus Phlebovirus in the family Bunyaviridae. For the disease to occur there must be a susceptible livestock population, a massive build up of vector population and the presence of the RVF virus (FAO, 2003).

The disease affects mainly cattle, sheep, goats, camels and buffaloes during climatic conditions favouring hatching of virus- infected eggs of flood water mosquitoes; the Aedes from their endemic sites, dambos (Linthicum et al., 1983). Rift Valley Fever disease was first reported in 1931 in a government farm in the Rift Valley Province of Kenya in sheep (Daubney et al., 1931) and has continued to recur at irregular intervals disrupting human health and livelihoods. The disease has been reported in the North eastern, Eastern, Central and parts of the Rift valley province of Kenya ever since. Extensive reports were made in 1951 when about 20,000 people were infected in an epizootic of cattle and sheep in South Africa (Mundel et al., 1951). Outbreaks outside sub-Saharan Africa were reported in 1977-1978 in Egypt where 18,000 morbidities and 598 mortalities occurred (El-Akkad, 1977). The disease has also been recorded across the continent of Africa including Madagascar with recent spread to Saudi Arabia and Yemen in 2000-2001 where over 400 human fatalities occurred (Madani et al., 2003). This led to a ban of Livestock and livestock
products export into Saudi Arabia. The disease has been recognized in an enzootic or epizootic form in many tropical African countries and is highly contagious for humans if animals are viraemic at the time of slaughter (FAO, 2003).

### 2.3.2 Importance of RVF disease

The disease causes heavy economic losses and disrupts livelihoods for livestock producers through abortions, animal deaths, restrictions of trade which may last several years through quarantines, consumer boycotts of meat and costs of controlling the disease (Garret, 1995).

It is also of Public Health importance (WHO, 2000). In humans, the disease manifests itself as retinitis (0.5 –2%), meningoencephalitis (1-3%) and haemorrhagic fever (Meegan et al., 1979). Those with haemorrhagic fever may remain viraemic for up to 10 days and the case fatality rate for those with haemorrhagic disease is approximately 50%. The total case fatality rate is less than 1% (WHO, 2000).

### 2.3.3 Transmission in animals

RVF is a vector propagated virus disease in animals. It is biologically transmitted by mosquitoes of the genera *Aedes* that breed in low depressions which flood after heavy rainfall. It is endemic in sub-Saharan Africa because of transovarian transmission in *Aedes* mosquitoes (Lithicum et al., 1983). The *Culex* and *Anopheles* mosquitoes also breed in the same depressions and subsequently propagate the disease further (McIntosh, 1972), even though other variety of mosquito species and biting flies including *Stomoxys* may be involved. Although any viraemic susceptible animal can pose a threat for animal-to-human
transmission of the virus, sheep and cattle are the most affected. The incubation period is 2-4 days after which the young lambs die with up to 90-100% case fatalities, while up to 90% adult pregnant sheep abort.

2.3.4 Transmission in humans

In humans, RVF virus is thought to be arthropod vector based and propagated during epizootics or in endemic regions (Woods et al., 2002). Other human exposures to the virus is occupational including in laboratory workers, through intensive contacts with and handling of infected livestock (housing animals indoors with household members or their products), by aerosols of blood or amniotic fluids during parturition, slaughter, autopsy, bleeding, evisceration, preparation of food, processing tissues, and hides and skins or hand milking and consumption of raw milk (Wood et al., 2002). It may also be transmitted through inoculation via a broken skin (WHO, 2007). High attack rates have been demonstrated among abattoir workers, herdsmen and veterinary personnel all who have extensive contacts with animal tissues during their work (Mundel et al., 1951).

2.3.5 Clinical signs of RVF in animals

The clinical signs of the disease are sudden onset of abortions in many sheep, cattle and camels, up to 100% mortality in lambs under six days age, high fever, lymphadenitis, nasal and ocular discharges, in adult animals, profuse haemorrhagic diarrhea, vomiting, abdominal colic, prostration and jaundice in an epizootic lasting up to 8-16 weeks (FAO, 2003). The signs are either in the form of acute, sub acute, in apparent in all species or hyper acute in cattle.
2.3.6 Diagnosis of RVF

A single case of RVF can be confused with many viral diseases that cause sudden death in sheep and produce generalized petechial and ecchymotic haemorrhages. Diseases like Nairobi sheep disease, Bluetongue in sheep, Ephemeral fever in cattle, Heartwater, Wesselbron virus, Toxoplasmosis, Salmonellosis, Q-fever, Brucellosis and Leptospirosis all are possible differential diagnosis for RVF. Rift Valley Fever disease can be diagnosed through RVF antigen detection using ELISA test, Agar gel diffusion test, RT-PCR identification of RVF virus among others or through RVF antibody detection using ELISA tests for IgM/IgG, Indirect immunofluorescent/peroxidase tests, plaque reduction assays among others. The samples are collected from outbreak sites where sheep, cattle or camels are aborting and there are deaths of neonates. Serum from clotted blood, Blood in EDTA or heparin, Foetal liver and spleen on ice, portions of liver, spleen or lymph nodes on ice and liver, spleen and lymph node tissues on buffered formalin are the main specimen for laboratory diagnosis (FAO, 2003).

2.3.7 Prevention and control of RVF

Effective prevention and control of RF depends on early detection of the disease. Sentinel herds are used to monitor viral circulation in susceptible populations. Active disease surveillance should be undertaken to build baseline information on inter-epidemic virus transmission patterns in high risk areas and identify any increase in vector populations (FAO, 2003). Remote sensing using satellite technology to predict rainfall patterns has been suggested as a means to monitor RVFV activity and use of the data to target areas for animal vaccination (Linthicum et al., 1999). Implementing disease control strategies have two options. One can either control the disease itself through livestock case reduction or to
mitigate the impact of disease on the livelihoods and health of stakeholders. These strategies target vector control through strategic treatment of the mosquito breeding habitats, reduction in the size of the susceptible livestock population through vaccination or ban on movement of viraemic animals or reduction of human exposure to major risk factors: contact with sick livestock and reduction of high risk activity such as livestock slaughter (FAO, 2003). Epidemics can be prevented through a sustained vaccination programme of domestic animals which serve as virus amplifiers for arthropod transmission before the onset of predicted heavy rainfall (WHO, 2007).

Simple public health education programmes during epizootics also protects people from exposure to risks. Control of mosquito populations during and after heavy rains should also be pursued (Woods *et al.*, 2002). Livestock producers and herders should not share housing with livestock, touch or slaughter sick or dead livestock without protective materials (WHO, 2000). In addition, they should never assist animals with parturition nor handle aborted foetal materials. Livestock producers should report sick or dead animals to veterinary officials, comply with livestock disease quarantines and obtain inspection certificates and permits for all animals being moved (GOK, Cap.364). Kenyan laws prohibit consumption of uninspected meat therefore all food animals should be slaughtered in an authorized slaughterhouse where an inspecting officer must conduct ante-mortem and post-mortem inspection (GOK, Cap. 356).

All inspected meat should be officially marked and transported from the slaughterhouse in a licensed and registered meat carrier accompanied by a certificate of meat transport from the inspecting officer (GOK, Cap. 356). In the butchery, the meat should be handled and
kept in a safe hygienic condition in a licensed premise while the butcher should be medically fit and keep a record of the source of the meat (GOK, Cap. 242). All meat inspectors should wear protective uniforms including hand glove and masks during inspection while laboratory staff should also wear protective attire and ensure proper disinfection of the surfaces. Abattoir workers should ensure proper protection including aerosol exposures during bleeding, evisceration and processing of viscera (Yedloutschnig et al., 1981). It has also been recommended that beef be allowed to undergo maturation at +2°C for 24 hours after slaughter to allow PH setting to 6.8 (Davis and Martin, 2003). Consumers should cook the meat well and avoid touching it if they have broken skins on their hands or should use a protective barrier like gloves (GOK, MoH, 2007). They should also wash hands properly and then clean all working area and utensils with soap after handling meat (Cap. 254).

2.3.8 Interventions and food safety practices

The Government through MoH and MoLD in conjunction with the Provincial administration undertakes joint public education and awareness meetings (GOK, MoH. 2007). The print and electronic media are also used to reach out to livestock farmers, livestock traders, slaughterhouse operators, meat transporters, butchers and consumers. Special programmes are often undertaken for example in Maragua District after previous outbreaks of Anthrax; a food- borne disease usually contracted through handling of infected live or dead animals (Njenga et al., 2006), the Ministry of Livestock and Ministry of Health with support from the Provincial administration conducted public education meetings to raise awareness. Mosquito nets are routinely distributed, water pools and dambos sprayed with insecticides by MoH officials during the rain season.
Food handling premises and handlers are inspected and medically approved every six months (GOK, MoH, 2005). The MoLD routinely vaccinates susceptible livestock and if there is an outbreak of notifiable disease like RVF, quarantine is imposed. Supervision of livestock traders, animals’ movement and ante-mortem inspection is done before livestock slaughter and meat inspection. Meat transporters are routinely licensed as well as the slaughterhouses in the district (GOK, MoLD, 2007).

In the year 2005, a total of 18,127 cattle, sheep and goats were inspected for human consumption during routine meat safety control programmes in Maragua, while 143 meat transporters and 21,907 certificates of transport were issued (GOK, MoLD, 2005). Even though in developed countries, farmers keep records at farm level for traceability and also implement HACCP (MacKenzie, 1999), Slorach, (2003), reported that in developing countries, the adoption of an integrated food safety along the beef chain is very slow.

2.3.9 Constraints to prevention and control

The previous and recent interventions by the government were based on the traditional legislative food control system of hazard identification and removal (Cap 242; 254; 356; 364). This does not provide a preventive approach. The current legislations are many and policy on beef safety in Kenya is inadequate and has not been reviewed to include risk analysis and process controls along the chain (GOK, MoA, SRA, 2004-2014). Responsibilities are shared among many agencies leading to duplication of efforts (GOK, MoA, SRA, 2004 -2014).
These approaches have not deterred nor reduced the burden of beef-borne disease outbreaks in the rural community in Maragua District where farmers have special attachment to cattle as a source of livelihood and traditional beliefs that, if a dead cattle is buried with the hide the owner will never have another one (GOK, MoLD, 2006).

2.3.9 Knowledge of beef safety

Knowledge of beef safety standards has a significant influence on disease outbreaks among rural livestock producing communities (WHO, 2002). Actors along beef chains tend to be compliant when they understand the importance of beef safety, seriousness of diseases and the socio-economic impacts of disease outbreaks (Slorach, 2002). Awareness on the part of food animal producers and the beef industries that food-borne diseases and zoonoses exist is the first step towards their control (Collins and Wall, 2004). Knowledge goes with the level of education. Non-compliance tends to be high among actors with low education (Perry et al., 2002). Education and outreach are often designed as mass campaigns, even though a long term process of stakeholders’ engagement is necessary to change human behavior (Ruchton and Viscerra, 2003).

Attitude of beef chain actors and regulatory authorities play a significant role in determining compliance level. Producers also must adopt a positive approach to animal health on the farm in order to minimize exposure of the animals to zoonotic agents. Studies show that some actors in beef chain refuse to comply with safety requirements due to cultural beliefs (Coleman, 2002). The District Veterinary Officer, Ministry of Livestock Development (2006) reported that some regulatory staff like Veterinarians and Public Health Officials have negative attitude towards their client.
CHAPTER 3: MATERIALS AND METHODS

3.1 Study area

This study was carried out in Maragua District, Muranga County, Kenya. Maragua district is one of the seven districts of Central Province, Kenya. It borders Kirinyaga and Mbeere Districts to the Northeast, Machakos District to the East, Murang’a District to the North, Thika District to the South and Nyandarua District to the West (Figure, 3.1).

The District comprises of four divisions, namely, Kandara, Kigumo, Maragua and Makuyu. There are sixteen locations and sixty seven sub-locations, which make up a landmass of 1,065 km$^2$ of which 226 km$^2$ is Gatare forest (CBS, KDHS, 2004). Rainfall is bimodal and ranges from 900mm in the lower cotton zone to 2500mm in the high sheep and dairy zone. The long rains occur from mid-March to June while the short rains occur from mid October to December (GOK, MoLD, 2005).

There was an outbreak of RVF disease in Kenya in the year 2006-2007, that caused a total of 560 morbidities and 185 human mortalities and thousands of livestock deaths in 16 Districts including four human cases in Maragua District, Muranga county (CDC, 2007).
Figure 3.1: Map of Kenya showing the location of Maragua District indicating area of Study (Source: Veterinary Epidemiology Unit, Kenya, 2008).
3.2 Study design

The study was a cross sectional survey to assess the influence of food safety knowledge and practices on RVF disease outbreak. The study design was selected because of its low costs and ability for quick completion.

3.3 Target population and study population

The target population was all the actors in the beef chain in Maragua District. The study population was all the participating adults between 18 and 65 years of age, both females and males. The selected strata in the beef chain included livestock producers, livestock traders, slaughterhouse operators, meat transporters, butchers, consumers and food safety regulators mainly public health officials, veterinary inspectors and provincial administration officials. The district has a human population of 387,778 with an annual growth rate of 1.8% (CBS, 1999 census). In 2004, the Kenya Demographic Household Survey (KDHS) estimated the population to be 411,434 with 90,744 households. The human population is largely made up of small-holder subsistence farmers who practice mixed crop-livestock production systems in the upper midlands (CBS, KDHS, 2004). Some large-scale ranching and farming is practiced in the lower parts of the district.

The cattle population is estimated at 73,757 dairy cattle and 14,086 beef cattle. Beef is primarily from culled, infertile dairy cows and bulls, while local Zebu cattle, with some of them imported from other districts, form the bulk of the beef animals in the district (GOK; MoLD; DAPO, 2006).
3.4 Variables

The parameters that were investigated as independent variable was the knowledge and practices of beef safety standards while the dependent variable were the RVF disease outbreak. The proximate variables were rumours, beliefs, customs and perceptions.

3.5 Conceptual framework

The conceptual framework was developed from reviewed literature on knowledge of food safety standards, and practices of beef safety on RVF disease outbreak as illustrated in the chart below.

---

**Independent variables**

- **Beef safety Knowledge**
  - Cause
  - Transmission
  - Signs
  - Prevention
  - Treatment
  - Occupation

- **Beef safety Practices**
  - Prevention
  - Treatment
  - Promotion
  - Occupation

**Dependent variables**

- RVF disease outbreak

**Proximate variables**

- Beef safety Attitudes
  - Perception
  - Belief
  - Customs
  - Rumours
3.6 **Inclusion criteria**

Sampling units were the respondents in the selected beef chain strata and who consented to the study.

3.7 **Exclusion criteria**

Sampling units were the non-respondents in the selected beef chain strata and who did not consent to the study.

3.8 **Sampling method and sample size**

The sample size was estimated based on the following formula (Dahoo *et al.*, 2003):

\[ n = \frac{Z^2pq}{L^2}, \]

Where \( n \) = the required sample size

\( Z = \) is the 95% confidence interval, 1.96

\( p = \) a priori estimate of the proportion

\( q = 1-p \) and

\( L = \) the precision of the estimate (allowable error)

Since there is no available literature on any previous work on the levels of beef safety knowledge on the beef chain, \( p \) was set at the highest maximum of 0.5 (Dahoo *et al.*, 2003). With an \( L \) of 0.05 (5%), the sample size required was:

\[ n = \frac{1.96^2 \times 0.5 \times 0.5}{(0.05)^2} = 384. \]

The sample was then proportioned according to the six selected strata of actors in the beef
chain. The number of selected units from each study stratum depended on the sample frame of each stratum as per sampling determination. The sampling strategy was a probability proportional to size.

3.9 Construction and research instruments

Data were collected using interview schedules administered via personal interviews (face to face) and semi-structured interview guides to enable probing by interviewers (Appendix I) and In-depth interviews (Appendix II). The variables used were the social-demographic characteristics. Data were collected on beef safety Knowledge, Practices and Attitudes and the Constraints to implementation of safety measures on RVF disease outbreak among the selected actors in the beef chain stratum.

The in-depth interview was conducted with key beef safety regulators as informants including Veterinary and Public health officials and focused on Knowledge, Practices and Attitudes of beef safety standards and their constraints with reference to RVF disease outbreak in Maragua district.

3.10 Reliability and validity

To increase reliability of the results the research assistants were selected from amongst the Public Health and Veterinary skilled personnel in the study area. They were trained on the administration of the interview schedule in local language (Kikuyu) to minimize errors due to presentation. The interview schedule was pre-tested with 10% of the respondents who did not participate in the study and corrections were done. There was very close supervision of the research assistants on daily basis to ensure process and procedure were
followed. To improve on validity the interview schedules were checked for omissions and consistency then counted and numbered before end of every day and later the records were kept in safe custody. The data were cleaned by running frequency distributions and corrected for any missing data before analysis.

3.11 Data collection techniques

The four administrative divisions of Kandara, Kigumo, Maragua and Makuyu in Maragua District were selected purposively to increase geographical spread for the study (Fig. 3.1). One administrative sub location was randomly selected from each division comprising; Kiiri sub location in Kandara, Kangari sub location in Kigumo, Gakuyu sub location in Maragua and Kimorori sub location in Makuyu. A sampling frame of all livestock producers was obtained with support from the assistant chief in each sub-location. Data from the livestock producers were collected from the randomly selected proportion of the households in each sub location. To obtain a proportion of the consumers in the sub location, a sampling frame of all adult residents per household in each sub-location was also obtained through the help of the area assistant chiefs and from it the respondent consumers were randomly selected. Sampling units were the heads of household or any responsible adult in the household at the time whether male or female.

A proportion of the livestock traders, slaughterhouse operators and meat transporters were randomly selected from the sample frame in the listed order of those licensed by DVO within the study sub locations in the year 2007. In addition, a proportion of the butchers were randomly selected from the sample frame of those licensed in each sub location by the public health department in the same year in the year 2007. An in depth interview was
conducted with key informants in the study area who included the District Veterinary Officer (DVO) and the District Public Health Officer (DPHO) responsible for beef safety standards, public awareness programmes, inspections and certification compliance in the study locations.

3.12 Data analysis

The completed interview schedules were checked for correct entries, errors and missing data. Then they were numbered and pooled before entry into the computer software SPSS. The results are presented in descriptive form using frequency tables, bar charts and pie charts. The Fisher’s exact test value based on Monte Carlo was used to assess relationships and associations. Data from in-depth interviews with key regulatory informants was also transcribed, coded and summarized as per the theme and presented using frequency distributions tables.

3.13 Ethical and logistical considerations

Permission, approval and introductory letters to conduct the study were given by the School of Public Health, The Board of postgraduate studies of Kenyatta University (Appendix III) and The Ministry of Education and Technical Training (Appendix IV). At the district level, the District commissioner (Appendix V), The MOH and the DVO (Appendix VI) were requested permission for the study to be carried out in the district. At the household and respondents levels, the interviewers obtained informed consents and confidentiality was guaranteed. Cultural norms and beliefs were respected during the study.
CHAPTER 4: RESULTS

4.1 Characteristics of the study population

The distribution of the survey respondents by the divisions and sub locations is shown in Table 4.1. The bulk of the 399 respondents were from Kimorori sub location (110) in Makuyu Division. Even though males (52%) were slightly more than females (48%), the distribution was fairly representative and gender sensitive and the majority (77%) were aged between 26-55 years (Figure 4.1). Almost all the respondents (98%) reportedly consumed meat of various livestock species.

Table 4.1: Distribution of survey respondents in the beef chain by study area in Maragua District, Kenya

<table>
<thead>
<tr>
<th>Division</th>
<th>Sub location</th>
<th>Number of respondents</th>
<th>Proportion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Makuyu</td>
<td>Kimorori</td>
<td>110</td>
<td>28</td>
</tr>
<tr>
<td>Kigumo</td>
<td>Kangari</td>
<td>100</td>
<td>25</td>
</tr>
<tr>
<td>Maragua</td>
<td>Gakuyu</td>
<td>93</td>
<td>23</td>
</tr>
<tr>
<td>Kandara</td>
<td>Kiiri</td>
<td>96</td>
<td>24</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>399</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
Figure 4.1: Age (years) distribution of the respondents in the beef chain in Maragua District, Kenya

The vast majority of the sample population consisted of Livestock producers (45.4%) and Consumers (44.1%). Other actors in the beef chain who were sampled are displayed in Table 4.2.
Table 4.2: Sampled categories of actors in the beef chain in Maragua District, Kenya.

<table>
<thead>
<tr>
<th>Category of actors</th>
<th>Frequency (n)</th>
<th>Proportion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livestock producers</td>
<td>181</td>
<td>45.4</td>
</tr>
<tr>
<td>Livestock traders</td>
<td>11</td>
<td>2.8</td>
</tr>
<tr>
<td>Slaughter house operators</td>
<td>8</td>
<td>2.0</td>
</tr>
<tr>
<td>Meat transporters</td>
<td>10</td>
<td>2.5</td>
</tr>
<tr>
<td>Butchers</td>
<td>13</td>
<td>3.3</td>
</tr>
<tr>
<td>Consumers</td>
<td>176</td>
<td>44.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>399</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Over half (52%) of the respondents had attained primary education (52%) and 32% secondary education (Figure 4.2). Only 1% of the sampled population had attained university level education.
Figure 4.2 Distribution of education levels among respondents in the beef chain in Maragua District, Kenya

Respondents from Kimorori Sub location (Makuyu division) were the most educated (28%) with majority having attained primary level (15%), secondary (9%) and college education (1%). The least educated respondents were from Gakuyu Sub location (23%) in Maragua Division where only 14% had attained primary and 5% secondary education (Table 4.3). However, the differences in the education levels were not statistically significant at 5% level of significance.
Table 4.3: Distribution of education levels per sub location among respondents, in Maragua District, Kenya

<table>
<thead>
<tr>
<th>Sub-location</th>
<th>None</th>
<th>Adult</th>
<th>Primary</th>
<th>Secondary</th>
<th>College</th>
<th>University</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kimorori</td>
<td>2%</td>
<td>1%</td>
<td>15%</td>
<td>9%</td>
<td>1%</td>
<td>0%</td>
<td>28%</td>
</tr>
<tr>
<td>Kangari</td>
<td>1%</td>
<td>1%</td>
<td>11%</td>
<td>9%</td>
<td>3%</td>
<td>1%</td>
<td>25%</td>
</tr>
<tr>
<td>Gakuyu</td>
<td>2%</td>
<td>1%</td>
<td>14%</td>
<td>5%</td>
<td>1%</td>
<td>0%</td>
<td>23%</td>
</tr>
<tr>
<td>Kiiri</td>
<td>1%</td>
<td>1%</td>
<td>13%</td>
<td>9%</td>
<td>1%</td>
<td>0%</td>
<td>24%</td>
</tr>
</tbody>
</table>

4.2 Knowledge on beef safety standards among actors in Maragua District

4.2.1 Knowledge of RVF-related beef borne diseases

A high proportion (98.5%; 387 out of 393) of the respondents knew that consumption of beef could cause diseases in humans. Only 1.5% (6) of the respondents did not respond to this question.
Among the beef-borne diseases mentioned, Anthrax (37.5%) was consistently ranked by all actors of both genders as the most common beef borne disease in Maragua District followed by Rift Valley Fever Disease (31.7%) and Brucellosis (17.5%) (Figure 4.3).

Slightly more men (19.9%) than women (17.6%) reported Anthrax as the commonest beef borne disease while more women (16.7%) considered RVF as the second commonest beef borne disease as opposed to 15.6% of the men. However, the differences were not statistically significant at 5% level of significance.

![Bar chart showing commonest beef-borne diseases by gender in Maragua District, Kenya](image)

**Figure 4.3: The reported commonest beef borne diseases by gender in Maragua District, Kenya**

The level of knowledge on whether beef can cause human disease varied by the administrative divisions and sub locations. The highest level of knowledge (27%) was in Kimorori Sub location in Makuyu Division while the lowest level (22%) was in Gakuyu Sub location (22%) in Maragua Division. Only 1% of the respondents in Kiiri Sub location Kandara Division) did not know if beef causes any human disease (Figure 4.4). The differences in the proportions were not significant at 5% level.
Figure 4.4: Responses on whether beef causes human diseases per sub location in Maragua District, Kenya.

The Knowledge levels on the various beef-borne diseases among actors in the beef chain are shown in Figure 4.5. Anthrax was ranked as the most common by livestock producers (18.3%) and consumers (16.2%) but was ranked least common by meat transporters (0.6%). Rift Valley Fever Disease was reported as the second most common by livestock producers (15.2%) and consumers (13.8%). Meat transporters had the least knowledge on all the beef-borne diseases.
4.2.2 Knowledge on species susceptibility to RVF

The results in Figure 4.6 revealed that cattle were reportedly the most susceptible species according to majority (46.4%) of the actors followed by man (26.6%). Cattle were the most susceptible according to 21% of Livestock producers, 20.2% of Meat consumers while only 1% of the Slaughterhouse operators cited cattle as susceptible. The differences in the proportions of the actors and the animal species affected by RVF were statistically significant ($p<0.05$).
Figure 4.6: Distribution of knowledge on the animal species most susceptible to RVF infection among actors in the beef chain in Maragua District, Kenya.

4.2.3 Knowledge on transmission of RVF

4.2.3.1 Knowledge of RVF transmission in cattle

According to results in Table 4.4, all the actors knew that ticks (30.8%) were the major mode of transmission of RVF in cattle followed by mosquito bites (22.8%) and biting insects (11.4%) while the other factors accounted for 15% of the responses. Twenty percent of the actors indicated that they had no idea on how RVF was transmitted in cattle. Overall, the highest level of knowledge was among livestock producers (47%) followed by Consumers (44.6%). The lowest level was among slaughterhouse owners (1.4%). Analysis using Fisher's exact test was 106.238 with an exact p value of 0.002 meaning there is a significant difference in the knowledge levels among the actors on how animals get infected.
Mosquito bites was correctly identified as the main mode of transmission by 12% of livestock producers and 10.2% of the meat consumers but was considered less significant by the other actors in the beef chain ($p<0.05$).

Table 4.4: Responses on knowledge among actors in the beef chain on transmission of RVF in cattle in Maragua District, Kenya

<table>
<thead>
<tr>
<th>Actors in the beef chain</th>
<th>RVF transmission in cattle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Livestock producers</td>
</tr>
<tr>
<td>Ticks</td>
<td>14.3</td>
</tr>
<tr>
<td>Mosquitoes</td>
<td>12</td>
</tr>
<tr>
<td>Don’t know</td>
<td>8.6</td>
</tr>
<tr>
<td>Other</td>
<td>6.1</td>
</tr>
<tr>
<td>Overall (%)</td>
<td>47</td>
</tr>
</tbody>
</table>

4.2.3.2 Knowledge on transmission of RVF infection in humans

The responses on mode of RVF transmission in humans are presented in Figure 4.7. The major transmission route for RVF in humans was reportedly consumption of poorly cooked beef (28.2%) followed by consumption of infected milk which was not boiled (21.9%), slaughtering infected cattle (21.6%) and slaughter of dead cattle (12.7%). Staying
in same house with infected cattle was considered not an important mode of transmission (2.8%). The highest level of knowledge was among Livestock producers (47.5%) and Consumers (43.4%) respectively while the lowest was among Meat transporters (1.7%) and Livestock traders (1.8%). Analysis using Fischer’s exact test showed there were differences in the proportions were significant ($p<0.05$) indicating different levels of knowledge among actors in the beef chain on the mode of RVF transmission in humans. Thus knowledge was more among Livestock producers and Meat consumers than in other actors (Figure 4.7).

4.2.4 Knowledge on clinical signs in cattle

Over 29% of the respondents knew the most conspicuous clinical signs of RVF in cattle were nasal discharges followed by fever (16.4%), death (14.1%), bleeding (12.3%) and...
those who had no idea (13%) (Table 4.5). The livestock producers (47.2%) were the most knowledgeable followed by consumers (43.8%) while the least knowledgeable were Slaughterhouse operators (1.6%). The Fisher’s exact test value based on Monte Carlo was 124.624 with an exact \( p \) value of 0.379, showing that there were significant differences in knowledge among actors on clinical signs of RVF in cattle.

Table 4.5: Responses on knowledge of RVF clinical signs in cattle by actors in the beef chain in Maragua District, Kenya

<table>
<thead>
<tr>
<th>Clinical signs of RVF</th>
<th>Actors in the beef chain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Livestock producers</td>
</tr>
<tr>
<td>Nasal discharge</td>
<td>14.6</td>
</tr>
<tr>
<td>Fever</td>
<td>7.6</td>
</tr>
<tr>
<td>Abortion</td>
<td>2.1</td>
</tr>
<tr>
<td>Bleeding</td>
<td>5.7</td>
</tr>
<tr>
<td>Body swelling</td>
<td>0.5</td>
</tr>
<tr>
<td>Others</td>
<td>4.7</td>
</tr>
<tr>
<td>Overall (%)</td>
<td><strong>47.2</strong></td>
</tr>
</tbody>
</table>
4.2.5 Knowledge on prevention of RVF

4.2.5.1 In Cattle

Various prevention and control measures were ranked by the actors in the beef value chain and found that vaccination (41.9%) was the most known measure used followed by dipping (13.4%), quarantine restrictions (12.2%) and treatment (10.7%). The issuance of movement permits was considered important by only 6.8% of the respondents (Table 4.6).

Table 4.6: Responses on Knowledge on prevention and control of RVF in cattle as among actors in the beef chain in Maragua District.

<table>
<thead>
<tr>
<th>Prevention and control measures of RVF in cattle</th>
<th>Actors in the beef chain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Livestock producers</td>
</tr>
<tr>
<td>Vaccinations</td>
<td>20.1</td>
</tr>
<tr>
<td>Dipping</td>
<td>5.8</td>
</tr>
<tr>
<td>Quarantines</td>
<td>5.6</td>
</tr>
<tr>
<td>Treatment</td>
<td>5.6</td>
</tr>
<tr>
<td>Insecticides</td>
<td>5.3</td>
</tr>
<tr>
<td>Movement permits</td>
<td>2.9</td>
</tr>
<tr>
<td>Others</td>
<td>1.9</td>
</tr>
<tr>
<td>Overall (%)</td>
<td>47.2</td>
</tr>
</tbody>
</table>
The actors in the beef chain had different levels of knowledge on prevention and control of RVF disease. For instance, 47.2% of the livestock producers, 44.7% of the consumers were more knowledgeable on the control measures compared to the other actors thus livestock producers and consumers were more knowledgeable and the least knowledgeable actors being the meat transporters. There was a significant difference \( p < 0.05 \) in the levels of knowledge on prevention of RVF in cattle among the actors.

4.2.5.2 In humans

According to the results presented in Table 4.7, consumption of inspected beef (36.3%) was reportedly the best way of prevention against RVF infection followed closely by consumption of well cooked beef (28.3%). All the other control measures cumulatively were 19.3%. Meat Consumers (46.3%) followed by livestock producers (46.1%) had the hightest knowledge on the best prevention and control measures of human RVF. Livestock traders had 1.5% knowledge on all prevention and control measures. Statistical analysis using Fisher's exact \( p \) was 0.154, showing that there was no significant difference in the knowledge levels among actors on prevention and control of human RVF.
Table 4.7: Responses on Knowledge on prevention and control of RVF in humans among actors in the beef chain in Maragua District.

<table>
<thead>
<tr>
<th>Prevention and control measures of RVF in humans</th>
<th>Livestock producers</th>
<th>Livestock traders</th>
<th>Slaughterhouse operators</th>
<th>Meat transporters</th>
<th>Butchers</th>
<th>Consumers</th>
<th>Overall (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption of inspected meat</td>
<td>15.9</td>
<td>0.7</td>
<td>0.8</td>
<td>0.7</td>
<td>1.0</td>
<td>17.1</td>
<td>36.3</td>
</tr>
<tr>
<td>Eating well cooked beef</td>
<td>12.7</td>
<td>0.4</td>
<td>0.4</td>
<td>0.5</td>
<td>0.6</td>
<td>13.8</td>
<td>28.3</td>
</tr>
<tr>
<td>Public education</td>
<td>4.4</td>
<td>0.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.0</td>
<td>8.6</td>
</tr>
<tr>
<td>Obtain movement permit</td>
<td>2.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.2</td>
<td>3.4</td>
</tr>
<tr>
<td>Others</td>
<td>10.2</td>
<td>0</td>
<td>0.2</td>
<td>0.4</td>
<td>0.5</td>
<td>7.9</td>
<td>19.3</td>
</tr>
<tr>
<td>Overall (%)</td>
<td>46.1</td>
<td>1.4</td>
<td>1.9</td>
<td>1.7</td>
<td>2.5</td>
<td>46.3</td>
<td>100.</td>
</tr>
</tbody>
</table>

4.3 Safety practices and attitude on RVF outbreak among actors in beef chain

4.3.1 Beef safety practices

Over fifty-eight percent (58.5%) of the respondents interviewed reported that they would
seek Veterinary doctor’s advice when animals got sick while 33.6% preferred to treat the animals themselves (Table 4.8). A small proportion preferred to slaughter (4.3%), sell to butchers (2.9%) or isolate them (0.7%). There was no significant difference ($p<0.05$) between the actors practices when cattle got sick.

Table 4.8: Responses among actors in the beef chain on beef safety practices in relation to sick cattle

<table>
<thead>
<tr>
<th>Prevention and control measures of RVF in humans</th>
<th>Livestock producers</th>
<th>Livestock traders</th>
<th>Slaughter house operators</th>
<th>Meat transporters</th>
<th>Butchers</th>
<th>Consumers</th>
<th>Overall (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Call veterinary doctor</td>
<td>25.8</td>
<td>1.7</td>
<td>1.2</td>
<td>1.7</td>
<td>2.4</td>
<td>25.6</td>
<td>58.5</td>
</tr>
<tr>
<td>Treat</td>
<td>15.4</td>
<td>1.0</td>
<td>0.2</td>
<td>0.5</td>
<td>0.5</td>
<td>15.7</td>
<td>33.6</td>
</tr>
<tr>
<td>Slaughter for meat</td>
<td>1.4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2.9</td>
<td>4.3</td>
</tr>
<tr>
<td>Sell to butchers</td>
<td>1.4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.4</td>
<td>2.9</td>
</tr>
<tr>
<td>Isolate the sick</td>
<td>0.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.5</td>
<td>0.7</td>
</tr>
<tr>
<td>Overall (%)</td>
<td>44.7</td>
<td>2.7</td>
<td>1.4</td>
<td>2.2</td>
<td>2.9</td>
<td>46.1</td>
<td>100.0</td>
</tr>
</tbody>
</table>
When cattle died, the majority (57.7%) of the respondents preferred to bury them (Table 4.9), while others removed the hide (20.7%), burnt (11.7%), reported to Veterinary doctors (9.6%) or sold it to butchers (0.3%).

Table 4.9: Responses among actors in beef chain on beef safety practices in relation to dead cattle

<table>
<thead>
<tr>
<th>What actors do when cattle die of RVF</th>
<th>Live-stock producers</th>
<th>Live-stock traders</th>
<th>Slaughter house operators</th>
<th>Meat transporters</th>
<th>Butchers</th>
<th>Consumers</th>
<th>Overall (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bury</td>
<td>23.8</td>
<td>0</td>
<td>8.1</td>
<td>0</td>
<td>0</td>
<td>25.9</td>
<td>57.7</td>
</tr>
<tr>
<td>Removed the hide</td>
<td>2.3</td>
<td>0</td>
<td>0.3</td>
<td>0</td>
<td>0</td>
<td>18.1</td>
<td>20.7</td>
</tr>
<tr>
<td>Burn</td>
<td>10.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.2</td>
<td>11.7</td>
</tr>
<tr>
<td>Report to veterinary doctor</td>
<td>7.8</td>
<td>0.8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.0</td>
<td>9.6</td>
</tr>
<tr>
<td>Sell to butchers</td>
<td>0.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.3</td>
</tr>
<tr>
<td>Overall (%)</td>
<td>44.7</td>
<td>0.8</td>
<td>8.4</td>
<td>0</td>
<td>0</td>
<td>46.2</td>
<td>100.0</td>
</tr>
</tbody>
</table>

On health seeking behavior and practices upon contracting RVF disease, a vast majority (75.2%) of the respondents reportedly sought attention at the nearest hospitals while 3.8% went to herbalists and a paltry 2.3% bought drugs from pharmacists (Table 4.10).
Table 4.10: Responses on beef safety practices in relation to health seeking behavior among actors in the beef chain in Maragua District.

<table>
<thead>
<tr>
<th>What actors do when cattle die of RVF</th>
<th>Overall (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livestock producers</td>
<td></td>
</tr>
<tr>
<td>Livestock traders</td>
<td></td>
</tr>
<tr>
<td>Slaughterhouse operators</td>
<td></td>
</tr>
<tr>
<td>Meat transporters</td>
<td></td>
</tr>
<tr>
<td>Butchers</td>
<td></td>
</tr>
<tr>
<td>Consumers</td>
<td></td>
</tr>
<tr>
<td>Overall (%)</td>
<td></td>
</tr>
<tr>
<td>Go to hospital</td>
<td>33.4</td>
</tr>
<tr>
<td>Visit herbalist</td>
<td>1.7</td>
</tr>
<tr>
<td>Buy drugs</td>
<td>15</td>
</tr>
<tr>
<td>Complain to butchers</td>
<td>0.2</td>
</tr>
<tr>
<td>Do not know</td>
<td>7.6</td>
</tr>
<tr>
<td>Overall (%)</td>
<td>100.0</td>
</tr>
</tbody>
</table>

4.3.2 Beef safety attitude

According to actors in the beef chain, meat consumers (23.6%) were viewed as the most at risk of contracting RVF followed by slaughterhouse workers (20.6%), Veterinary personnel though directly involved in handling animals during routine work were viewed as at less risk (9.6%). Over 48% of the livestock producers and 40.8% of the meat
consumers knew which occupational workers were at higher risk of RVF infection compared to only 1.8% of the meat transporters (Table 4.11).

Figure 4.11: Responses on beef safety attitude among actors in the beef chain on who can easily get RVF in Maragua District

<table>
<thead>
<tr>
<th>Actors in the beef chain</th>
<th>Livestock producers</th>
<th>Livestock traders</th>
<th>Slaughter house operators</th>
<th>Meat transporters</th>
<th>Butchers</th>
<th>Consumers</th>
<th>Overall (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat consumers</td>
<td>9.9</td>
<td>0.8</td>
<td>0.5</td>
<td>0.4</td>
<td>0.9</td>
<td>11.2</td>
<td><strong>23.6</strong></td>
</tr>
<tr>
<td>Slaughterhouse workers</td>
<td>9.4</td>
<td>0.3</td>
<td>0.8</td>
<td>0.9</td>
<td>1.3</td>
<td>8.1</td>
<td><strong>20.6</strong></td>
</tr>
<tr>
<td>Livestock producers</td>
<td>9.6</td>
<td>0.8</td>
<td>0.9</td>
<td>0.1</td>
<td>0.4</td>
<td>7.7</td>
<td><strong>19.4</strong></td>
</tr>
<tr>
<td>Butchers</td>
<td>7.3</td>
<td>0.3</td>
<td>0.4</td>
<td>0.3</td>
<td>0.2</td>
<td>5.9</td>
<td><strong>14.7</strong></td>
</tr>
<tr>
<td>Veterinary staff</td>
<td>4.9</td>
<td>0.1</td>
<td>0.4</td>
<td>0.1</td>
<td>0.4</td>
<td>3.6</td>
<td><strong>9.6</strong></td>
</tr>
<tr>
<td>Overall (%)</td>
<td>48.7</td>
<td>2.1</td>
<td>3.1</td>
<td>1.8</td>
<td>3.5</td>
<td>40.8</td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

The study also sought to know why the respondents practiced slaughter of dead cattle. Over half (55.3%) of the respondents slaughtered dead cattle to remove the hide and sale it. Twenty four percent of the livestock producers and consumers gave this as the major reason (Table 4.12). Another reason given for removing the hide by 32% of the
respondents was cultural belief that it will guarantee continued survival of the remaining herd. This reason was given by all actors even though more frequently by the Livestock producers (15.7%). Only 9.3% said they slaughtered dead cattle to establish the cause of death. A small number of respondents (3.5%) said they slaughtered the dead cattle to eat the meat. Analysis using Fischer’s exact test showed a value of 13.153 with a p value of 0.472. There was no significant difference (p<0.472) on the practice as to why people removed the hide of dead cattle among the respondents in Maragua District.

Table 4.12: Responses on why actors in the beef chain removed the hide of dead cattle in Maragua District.

<table>
<thead>
<tr>
<th>Why actors remove the hide when cattle die of RVF</th>
<th>Actors in the beef chain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Live-stock producers</td>
</tr>
<tr>
<td>Sell the hide</td>
<td>24.1</td>
</tr>
<tr>
<td>Cultural belief</td>
<td>15.7</td>
</tr>
<tr>
<td>Eat the meat</td>
<td>0.8</td>
</tr>
<tr>
<td>Determine cause of death</td>
<td>4.1</td>
</tr>
<tr>
<td>Overall (%)</td>
<td>45.2</td>
</tr>
</tbody>
</table>
4.4 Constraints to implementation of beef safety standards in Maragua District

4.4.1 Views of the actors in beef chain

The actors were requested to identify the constraints faced in implementing beef safety standards during the outbreak of RVF. The results are presented on Table 4.13. The greatest obstacles facing the implementation of beef safety standards in Maragua District during the RVF outbreak identified by all the actors were corrupt inspectors (29.7%), insufficient beef policy (23.1%), and poorly trained workers (13.6%). Corruption among inspecting officers was highly rated by 15% of the livestock producers followed by meat consumers (13.9%), butchers (0.5%) and least by slaughterhouse operators and meat transporters at 0.2%. Livestock traders did not consider this as a constraint at all while meat transporters considered this as their only constraint. Insufficient beef policy was identified as a constraint to beef safety by 11% of the livestock producers and 10.8% of the meat consumers. There was a significant ($p<0.05$) difference on the understanding of the constraints to beef safety standards in the district among actors in the beef chain.
Table 4.13: Responses on constraints to implementation of beef safety standards among actors in the beef chain in Maragua District.

<table>
<thead>
<tr>
<th>Constraints to beef safety standards</th>
<th>Livestock producers</th>
<th>Livestock traders</th>
<th>Slaughterhouse operators</th>
<th>Meat transporters</th>
<th>Butchers</th>
<th>Consumers</th>
<th>Overall (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrupt inspectors</td>
<td>15</td>
<td>0</td>
<td>0.2</td>
<td>0</td>
<td>0.5</td>
<td>13.9</td>
<td>29.7</td>
</tr>
<tr>
<td>Insufficient beef safety policy</td>
<td>11</td>
<td>0.2</td>
<td>1.0</td>
<td>0</td>
<td>0.2</td>
<td>10.8</td>
<td>23.1</td>
</tr>
<tr>
<td>Outdated beef safety laws</td>
<td>6.4</td>
<td>0.2</td>
<td>0.7</td>
<td>0</td>
<td>0.2</td>
<td>0.3</td>
<td>13.6</td>
</tr>
<tr>
<td>Poorly trained workers</td>
<td>10.6</td>
<td>0.5</td>
<td>0.2</td>
<td>0</td>
<td>0.2</td>
<td>0.3</td>
<td>13.6</td>
</tr>
<tr>
<td>Others</td>
<td>5.7</td>
<td>0.3</td>
<td>0.3</td>
<td>0.8</td>
<td>0.3</td>
<td>3.0</td>
<td>14.6</td>
</tr>
</tbody>
</table>

Overall (%) 48.7 1.2 2.6 1.0 1.4 45.0 100.0

4.4.2 Views of the District Veterinary Officer and District Public Health Officer on constraints

In an in-depth interview with key informants including the District Veterinary Officer (DVO) and District Public Health Officer (DPHO), revealed that the major constraints facing the implementation of beef safety standards during the RVF outbreaks included
poverty (28%), shortage of staff (19%), presence of unqualified inspectors (11%), poor meat hygiene practices (8%), lack of staff transport (5%) and retrogressive cultural practices (3%) such as removal of hides from dead cattle (Figure 4.8).

Figure 4.8: Constraints to implementing beef safety standards according to the Key informants

4.5 Views on improving beef safety standards and knowledge

4.5.1 Views of the actors in beef chain

Various suggestions on ways of improving beef safety standards and knowledge among the actors in regard to RVF infection in humans and cattle were advanced (Table 4.14). The proposals included: improve public education (30.5%); training of all actors (5.6%); strengthen of legislation on beef safety (19.5%); licensing of all livestock traders (10.3%) and ensuring all actors are held responsible for their actions (7.2%). Significantly, none of the meat transporters and butchers considered licensing of livestock traders as one of the ways of improving beef safety. There were differences on the recommendations by some groups of actors. For example, even though improved overall, public education was the
most preferred way of improving beef safety, meat transporters never considered it as a measure. However, training of all actors on food safety was recommended by all the actors.

**Table 4.14: Recommendations for improving beef safety standards among actors in the beef chain in Maragua District**

<table>
<thead>
<tr>
<th>Recommendations for improving beef safety standards</th>
<th>Livestock producers</th>
<th>Livestock traders</th>
<th>Slaughter house operators</th>
<th>Meat transporters</th>
<th>Butchers</th>
<th>Consumers</th>
<th>Overall (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve public education</td>
<td>16.1</td>
<td>0.9</td>
<td>0.5</td>
<td>0.3</td>
<td>12.8</td>
<td>30.5</td>
<td></td>
</tr>
<tr>
<td>Training of all actors</td>
<td>10</td>
<td>0.4</td>
<td>0.8</td>
<td>0.4</td>
<td>0.4</td>
<td>12.9</td>
<td>25.6</td>
</tr>
<tr>
<td>Strengthen laws on beef safety</td>
<td>9.4</td>
<td>0.1</td>
<td>0.4</td>
<td>0.3</td>
<td>0.6</td>
<td>8.6</td>
<td>19.5</td>
</tr>
<tr>
<td>Review beef safety legislation</td>
<td>5.3</td>
<td>0.3</td>
<td>0.1</td>
<td>0.3</td>
<td>0.6</td>
<td>4.6</td>
<td>10.3</td>
</tr>
<tr>
<td>All actors to be responsible</td>
<td>3.0</td>
<td>0.4</td>
<td>0.5</td>
<td>0.1</td>
<td>0.3</td>
<td>3.0</td>
<td>7.2</td>
</tr>
<tr>
<td>Others</td>
<td>0.4</td>
<td>0.2</td>
<td>0.3</td>
<td>0.5</td>
<td>0.5</td>
<td>2.8</td>
<td>4.7</td>
</tr>
<tr>
<td><strong>Overall (%)</strong></td>
<td><strong>48.7</strong></td>
<td><strong>1.2</strong></td>
<td><strong>2.6</strong></td>
<td><strong>1.0</strong></td>
<td><strong>1.4</strong></td>
<td><strong>45.0</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
4.5.2 Views of the District Veterinary Officer and the District Public Health Officer on recommendations

Two key informants were interviewed, namely, the District Veterinary Officer and the District Public Health Officer. They proposed key multidisciplinary measures that can be adopted to improve beef safety in both cattle and humans as shown in Table 4.15. The most important proposal was enhanced public health education in high-risk areas (22%) which concurred with the strongest views of the actors in the beef chain. Increase in the number of veterinary doctors and meat inspectors (14%) were also given by the DVO and DPHO. Other proposals included provision of transport to health inspectors (11%); and improvement of slaughterhouse and butchery operational hygiene (8%).
Table 4.15: The DVOs and DPHOs’ views on improvement of beef safety in cattle

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Proportion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public health education</td>
<td>22 %</td>
</tr>
<tr>
<td>Increase Veterinary doctors</td>
<td>14 %</td>
</tr>
<tr>
<td>Increase meat inspectors</td>
<td>14 %</td>
</tr>
<tr>
<td>Provide health inspectors transport</td>
<td>11 %</td>
</tr>
<tr>
<td>Improving slaughterhouse and butchery hygiene</td>
<td>8 %</td>
</tr>
<tr>
<td>Revive farmers training centres (FTCs)</td>
<td>5 %</td>
</tr>
<tr>
<td>Subsidize livestock production</td>
<td>5 %</td>
</tr>
<tr>
<td>Revive cattle dips and mosquito sprays</td>
<td>5 %</td>
</tr>
<tr>
<td>Enforce meat safety regulations</td>
<td>3 %</td>
</tr>
<tr>
<td>Enforce medical examination for meat business operators</td>
<td>3%</td>
</tr>
<tr>
<td>Others</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
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</table>

Discussions with the DVOs and DPHOs further revealed that the Provincial administration, Veterinary staff and Ministry of Health personnel had been conducting joint public awareness meetings on RVF disease as well as other beef-borne disease outbreaks including Anthrax in the area. Other public health related programmes were identified including animal health extension services, vaccination of animals, meat inspection services, and disaster management committees meetings.
CHAPTER 5: DISCUSSION

This study assessed the level of knowledge and practices on RVF related beef safety standards among actors in the beef chain. According to the WHO, 2002, knowledge of beef safety standards has a significant impact on disease outbreaks among rural livestock producing communities. The study also established the RVF beef safety standards implementations constraints and the degree to which the technical and social changes have been achieved among livestock producers, livestock traders, slaughterhouse operators, meat transporters, butchers, consumers and meat regulators in Maragua District. This was after massive public awareness programmes conducted by the regulatory agencies following the outbreaks of several beef-borne diseases including anthrax and RVF in the district in the year 2006-2007. Previous studies by Collins and Wall (2004), found that awareness on the part of food animal producers and beef industries that food-borne diseases and zoonoses exist, is the first step towards their control.

The study found that in Maragua District the levels of education were 52% primary and 32% secondary attendance. The study also showed that in Kimorori sub location education level was 28% overall while in Gakuyu sub location it was 23% in the area where the actual RVF outbreak cases occurred. This result agreed with previous work by Perry et al., (2002), that knowledge goes with the level of education as non-compliance tends to be high among actors with low education. In the participatory study of the level of knowledge of RVF- related beef safety standards in Maragua District, the survey showed that anthrax (37.5%) and RVF (31.7%) were rated as the most common beef-borne diseases. The survey found that knowledge varied among the actors depending on the attribute under study. For example, anthrax was ranked as the most common by livestock producers
(18.3%) and consumers (16.2%) but was ranked least common by meat transporters (0.6%). Rift Valley Fever Disease was reported as the second most common by livestock producers (15.2%) and consumers (13.8%). Meat transporters had the least knowledge on all the beef-borne diseases even though the actors knew that other diseases existed in the area. Cattle (46.4%) and man (26.6%) were identified as the most susceptible animal species to RVF as shown by Linthicum (1983). The study showed most of the respondents knew ticks (30.8%) and mosquitoes (22.8%) were the main modes of transmission in cattle. These findings on level of transmission knowledge agrees with the results of Linthicum et al. (1984) who found that the Aedes mosquitoes were the main modes of transmission of the virus via transovarian mode. These findings also confirms the results established by McIntosh (1972) that the Culex, Anopheles mosquitoes, other variety of mosquito species and biting flies and insects including Stomoxys breed and subsequently propagate the disease further when the susceptible species are viraemic.

The majority of respondents reported nasal discharges, fever and death as the most prevalent clinical signs of RVF in cattle, results which agreed with the FAO (2003) observations that RVF manifests as abortions in many sheep, cattle and camels, up to 100% mortality in lambs under six days age, high fever, lymphadenitis, nasal and ocular discharges, in adult animals, profuse haemorrhagic diarrhea, vomiting, abdominal colic, prostration and jaundice in an epizootic lasting up to 8-16 weeks.

Vaccination was the best prevention practice in cattle according to majority of the respondents which was also recommended by the WHO in 2007 at the onset of predicted rains. The Public Health laws in Kenya require that meat be cooked sufficiently to prevent
transmission of diseases (Cap. 242). The actors confirmed this by their responses that consumption of well cooked beef was the best way to prevent RVF transmission in humans. This knowledge was highest among livestock producers and consumers which may be attributed to the fact that they directly deal with the livestock at the farms in addition to being constantly exposed to awareness messages presented during routine control programmes and public education forums unlike the other actors who rarely have time to attend such meetings. All other actors in the study had very low level of knowledge on prevention of RVF. This knowledge gap could explain the frequent outbreaks of beef-borne diseases in Maragua district. It has been shown by Slorach (2002) that actors along the beef chain tend to be complaint and participate in disease control programmes if they understand the importance of beef safety, seriousness of disease and socio-economic impacts of disease outbreaks.

Vaccination programmes were also confirmed by the study as the best practice in protecting animals. This was the same recommendation of the WHO in 2007 that epidemics be prevented through a sustained vaccination programme of domestic animals which serve as virus amplifiers for arthropod transmission before the onset of predicted heavy rainfall. Other strategies found by the study were those that target vectors by control of mosquito populations during and after heavy rains as found by Woods et al. in 2002 and reduction of human exposure to major risk factors: contact with sick livestock and reduction of high risk activity such as livestock slaughter.

The beef safety attitudes that were the proximate variables also affected the outbreak of RVF, through the actions of the people during the outbreak of RVF, which either
accelerated or slowed the spread of RVF. Respondents interviewed in the survey believed that slaughterhouse personnel were the most prone to RVF infection, followed by livestock farmers. These observations concurred with the results of Wood et al., (2002) who found that slaughterhouse workers were more prone to RVF infections as an occupational hazard. Majority of the respondents knew that eating beef that was not inspected could cause RVF infection while treatment of sick cattle was the best practice taken by majority of people in Maragua District when their cattle got infected by RVF as required by the animal diseases Act laws of Kenya (Cap. 364).

The survey established that the respondents slaughtered sick and dead animals in order to sell the hide and also ensuring of cultural belief as farmers have special attachment to cattle as a source of livelihood and traditional beliefs that, if a dead cattle is buried with the hide the owner will never have another one (GOK, MoLD, 2006). These observations were corroborated by studies made by Coleman, 2002 where he found that cultural beliefs also aided disease transmission among livestock producers. Burying was the best way to dispose the cattle which died of RVF disease while seeking help from Veterinary doctors were the most preferred practice for treatment of the cattle when infected as required by the Laws of Kenya, Chapter 364. In the study, the people interviewed concur that seeking help from a hospital was the best practice incase of an infection from RVFD. The Government through MoH and MoLD in conjunction with the Provincial administration undertakes joint public education and awareness meetings.

The greatest constraints facing the implementation of beef safety standards during the RVF outbreak among all the actors were corrupt inspectors (29.7%), insufficient beef policy
(23.1%), poor training of staff (20%). Corruption among inspecting officers was highly rated by 15% of the livestock producers followed by meat consumers (13.9%), butchers (0.5%) and least by slaughterhouse operators and meat transporters at 0.2%. Surprisingly these were not corroborated by the key informants who identified poverty (28%) and staff shortage (19%) as the major challenges in Maragua District. (GOK, MoA, SRA, 2004-2014). The result from actors concur with the observations in the Strategy for Revitalization of Agriculture (GOK, MoA, SRA, 2004-2014) which found that the current legislations are many and policy on beef safety in Kenya is inadequate and has not been reviewed to include risk analysis and process controls along the beef chain. These constraints had a major impact on the RVF outbreak.

This study recommended that improving public health education, strengthening of legislation, licensing of all traders and training of all actors involved in meat trade as the major ways of improving beef safety in Maragua District. This was also as established by Ruchton and Viscera in 2003 that mass education alone was not sufficient to change stakeholders’ behavior but required their continuous engagement for a long period. Previous studies by Njenga et al., 2006 also showed that the print and electronic media could be used to reach out to livestock farmers, livestock traders, slaughterhouse operators, meat transporters, butchers and consumers through special programmes in Maragua District as documented in their study on anthrax outbreak.

In any case, the previous and recent preventions measures by the government were based on the traditional legislative food control system of hazard identification and removal and had no preventive approach (Caps. 242; 254; 356; 364). Therefore, unless such laws are
reviewed the interventions may not work. The study confirmed that current legislations are many; policy on beef safety in Kenya is inadequate and has not been reviewed (GOK, MoA, SRA, 2004-2014). The study also recommended a responsible attitude by all actors in the beef chain. This confirms what Collins and Wall in 2004 recommended that producers also must adopt a positive approach to animal health on the farm in order to minimize exposure of the animals to zoonotic agents.
CHAPTER 6: RESULTS SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Results Summary

This study sought to assess the levels of food safety knowledge and practices as well as the constraints to beef safety standards among actors in the beef chain with reference to RVF outbreak in Maragua District, Central Province, Kenya. The following were the major findings of the study.

a) Majority of the actors had attained primary education (52%) followed by those with secondary education (32%), those with college education (6%), adult (3%) and none at all (6%).

b) Overall, an overwhelming number of respondents (98.5%) knew that consumption of beef could cause human diseases.

c) Anthrax (37.5%) was the most common beef borne disease followed by Rift Valley Fever (31.7%) and Brucellosis (17.5%).

d) Different actors in the beef chain had different levels of knowledge on the various beef-borne diseases for instance; Anthrax was ranked as the most common by livestock producers (18.3%) and consumers (16.2%) but was ranked least common by meat transporters (0.6%). Rift Valley Fever Disease was reported as the second most common by livestock producers (15.2%) and consumers (13.8%). Meat transporters had the least knowledge on all the beef-borne diseases.

e) Majority of respondents knew that cattle (46.4%) followed by man (26.6%) were the most susceptible species to RVF disease in Maragua District. According to 21% of the livestock producers, 20.2% consumers and a paltry 1% of the slaughterhouse operators.
f) All the respondents concurred that tick bites (30.8%) were the major mode of transmission of RVF in cattle followed by mosquito bites (22.8%) and finally biting insects (11.4%). These results were correctly given by 12.5% of livestock producers and 10.2% of consumers. The study showed there were no significant differences among the actors knowledge on the transmission of RVF.

g) The actors’ responses indicated that RVF transmission in humans was caused by consumption of poorly cooked beef (28.2%), consumption of infected milk (21.9%) and slaughter of dead cattle (12.7%). Surprisingly a very small proportion (2.8%) knew that staying in the same house with infected cattle could cause infection of RVF. More livestock producers (47.5%) and 43.4% of consumers responses agreed with these results and only a low proportion of traders (1.8%) and 1.7% of meat transporters.

h) Only 29% of the respondents overall knew the correct clinical signs of RVF as nasal discharge, fever (16.4%), death (14.1%), bleeding (12.3%) and 13% had no idea at all. Livestock producers (47.2%) and 43.8% of the consumers were aware of these signs and a small proportion of slaughterhouse operators (1.6%).

i) Among the measures reported for the prevention and control of RVF in cattle included vaccination, dipping, quarantine, treatment, insecticide sprays and movement permit. Vaccination (41.9%) was highly rated as the best preventive and control measure followed by dipping (13.4%), quarantine (12.2%) and treatment (10.7%). The least used methods were use of insecticides (10.4%) and issuance of movement permits (6.8%) despite the fact that they are the most readily available and cheapest. These results were correctly identified by 47.2% of the producers and
44.7% of the consumers. The least knowledgeable on these results were the meat transporters (1.5%).

j) The measures used to prevent and control RVF in humans included consumption of inspected beef (36.3%) and consumption of well cooked beef (28.3%), public education (8.6%), obtaining veterinary movement permits (3.4%) and slaughtering animals in authorized slaughter houses (2.5%). The respondents who gave these results were mainly producers consumers (46.3%) and 46.1% producers. The least knowledgeable on this were the traders (1.5%).

k) Overall 58.5% of the respondents sought intervention by a veterinary doctor when cattle got sick, while 33.6% treated themselves, a paltry 4.3% slaughtered, 2.9% sold to butchers and 0.7% isolated them as best practice. Over 46% of the consumers and 44.7% producers gave these responses correctly but only a small proportion (1.4%) of slaughterhouse operators gave the same response.

l) He study found that over 57% of the respondents preferred to bury dead cattle while 20.7% removed the hide, 11.7% burnt the dead cattle, 9.6% reported to veterinary doctor and 0.3% sold it to butchers as best practice. A total of 46.2% of the consumers and over 44% of the producers correctly gave theses responses while none of the butchers and meat transporters identified any of these practices.

m) On health seeking practices, over 72% of the respondents reportedly sought care from hospitals, 3.8% from herbalists and only 2.3% bought drugs when infected with RVF. Livestock producers (46.6%) and 44.1% of the consumers gave these responses while only 1.7% of the slaughterhouse operators concurred on these practices.
n) The study found that consumers (23.6%) followed by slaughterhouse workers (20.6%), producers (19.4%), butchers (14.7%) and veterinary personnel (9.6%) were the most at risk of RVFD exposure. Over 48% of the producers gave these results followed by 40.8% of the consumers and least on these attitudes were the meat transporters (1.8%).

o) The study further sought to know why the respondents slaughtered dead cattle and removed the hide and 55.5% of the respondents said they wanted to sell the hide, 32% cultural belief, 9.3% to eat meat and also to determine cause of death. Overall 45.2% of the producers and 44.9% of the consumers gave these attitude responses. The meat transporters (1.9%) were the least on these responses.

p) The respondents identified the greatest constraints on the implementation of beef safety standards during the RVF outbreak as corrupt inspectors (29.7%), insufficient beef safety policy (23.1%), outdated beef safety legislations (13.6%) and poorly trained staff (13.6%). Corrupt meat inspectors were highly ranked by 15% of livestock producers and 13.9% meat consumers, 0.8% meat transporters, 0.3% butchers, slaughterhouse operators and traders.

q) The respondents made recommendations for improvement of beef safety standards towards prevention of RVF infection in cattle. These included improvement of public health education in high-risk areas (30.5%); training of all actors in the beef chain on safety measures (25.6%), strengthening of laws that regulate beef safety (1.5%), review of beef safety policies (10.3%) and ensuring all actors are responsible (4.7%). The Key informants ranked public education as a priority (22%) and gave other recommendations like employment of additional staff (14%) and provision of transport to staff (11%).
6.2 Conclusions

6.2.1 Beef safety knowledge

The overall level of knowledge on beef safety standards among actors in the beef chain in relation to RVF in Maragua District was generally low and varied significantly among the categories of actors depending on the disease characteristic being evaluated. For example, general knowledge on whether beef consumption could cause human disease was over 98%. On beef-borne diseases knowledge, anthrax was overall highly rated at 37.5% and Rift valley fever followed closely at 31.7% and brucellosis (17.5%). Among the actors, anthrax was ranked as the most common by 18.3% of the livestock producers and 16.2% of consumers but was ranked least common by meat transporters (0.6%). Rift Valley Fever disease was rated as the second most common by 15.2% of the livestock producers and 13.8% of consumers. Meat transporters had the least knowledge on all the beef-borne diseases. Knowledge on affected species was for cattle (46.4%) followed by man (26.6%) as reported by 21% of the livestock producers, 20.2% consumers and a paltry 1% of the slaughterhouse operators. On transmission, those who reported tick bites were 30.8% and mosquitoes were 22.8%. On the risk factors for human infection, consumption of poorly cooked beef (28.2%), consumption of infected milk (21.9%) and slaughter of dead cattle (12.7%) by majority of producers and consumers but low proportion of traders (1.8%) and 1.7% of meat transporters. Over 29% of the respondents knew the correct clinical signs of RVF as nasal discharge, fever (16.4%), death (14.1%), bleeding (12.3%) and 13% had no idea at all. Vaccination (41.9%) was highly rated as the best preventive and control measure in cattle followed by dipping (13.4%), quarantine (12.2%) and treatment (10.7%) by mostly producers and consumers with the least knowledgeable category of actors being meat transporters. Consumption of inspected beef (36.3%) and consumption of well
cooked beef (28.3%), public education (8.6%), obtaining veterinary movement permits (3.4%) and slaughtering animals in authorized slaughter houses (2.5%) were the best preventive measures in humans.

6.2.2 Beef safety practices

Beef safety practices established among actors in the beef chain with reference to RVF in Maragua District included seeking veterinary doctors advice by (58.5%) of the respondents while 33.6% treated themselves, a paltry 4.3% slaughtered them, 2.9% sold to butchers and 0.7% isolated them. Burying dead cattle (57%) of the respondents, 20.7% removed the hide, 11.7% burnt the dead cattle, 9.6% reported to veterinary doctor and 0.3% sold it to butchers. Those who sought care from hospitals were over 72% of the respondents, 3.8% from herbalists and only 2.3% bought drugs when infected with RVF. The study found that consumers (23.6%) followed by slaughterhouse workers (20.6%), producers (19.4%), butchers (14.7%) and veterinary personnel (9.6%) were the most at risk of RVFD exposure. On why they removed the hide of dead cattle, 55.5% of the respondents said they wanted to sell the hide, 32% cultural belief, 9.3% to eat meat and also to determine cause of death.

6.2.3 Beef safety constraints

The study found that the constraint of greatest concern to all actors in the chain on the implementation of beef safety standards in Maragua district was corrupt meat inspectors (29.7%). Other major constraints faced included insufficient beef safety policy, outdated beef safety legislation and poorly trained staff. Corrupt meat inspectors were highly ranked by 15% of livestock producers and 13.9% meat consumers, 0.8% meat transporters, 0.3%
butchers, slaughterhouse operators and traders. Key informants identified other constraints as poverty, shortage of veterinary meat inspectors, presence of quack meat inspectors, retrogressive cultural practices on dead cattle and poor hygiene.

6.3 Recommendations

The study proposes the following recommendations in order to improve the levels of food safety knowledge, practices and address constraints among actors in the beef chain with reference to RVF outbreak in Maragua District, Murang’a County, Kenya:

a) To increase public confidence on the service providers, the government should increase refresher training for its staff aimed at enhancing their integrity.

b) The government should adopt a multi-sectoral RVF control strategy in the district. This should be geared towards an intensive public health education programme in high-risk areas comprising the Provincial administration, Veterinary staff and Ministry of Health personnel. The intervention should use simple messages addressing beef-borne disease risks.

c) The various actors in the beef chain should endeavor to uphold high standards of meat hygiene during the slaughter, transportation, sale and consumption. To this end, intensive sensitization based on study findings and moral persuasion campaigns should be carried out by the regulatory agencies targeting the six study groups of actors.

d) The government should increase the number of veterinary doctors, public health and meat inspection staff and facilitate them to provide efficient and timely services like vaccinations and meat inspection to weed out quacks in the sub-sector.

e) The government should develop a beef policy addressing all the issues including safety of the beef in the sector. In addition, the government should not only update or review but
also harmonize the various pieces of legislation governing the livestock sub-sector on beef safety in regard to management of meat borne diseases, outbreaks of such diseases, penalties and safety management. This would ensure that all actors take responsibility for beef safety along the production chain.

6.4 Recommendations for further studies

Based on the findings of the study, further research is recommended in the following areas:

a) Explore the strategies of coping with challenges faced in the prevention and control of beef-borne diseases particularly in high risk areas of Kenya.

b) Develop a model for the review and harmonization of the various beef safety laws governing the production, transportation, handling and consumption.

c) Determine the factors contributing to variations in knowledge levels in regard to beef safety among the actors in the beef chain.
REFERENCES


APPENDIX I: INTERVIEW SCHEDULE

Interview schedule on Food safety Knowledge, Practices and Attitude in beef chain with reference to RVF disease outbreak in a rural community in Maragua District. The actors in the beef chain are: Livestock producers, Livestock traders, Slaughterhouse operators, Meat transporters, Butchers and Consumers.

Instructions

Introduce your self to the respondent

- Explain the purpose of the interview briefly.
- Assure the respondent on confidentiality and that this data is only for the purpose of learning and no names will be in the interview schedule but only codes.
- Ask the respondent to give you signed consent to proceed
- Mark the answer given

Interview schedule code number ......................................................

Date of interview .................................................................

Name of Division ........................................................................

Name of Sub location ..............................................................

Category of Beef Chain Actor ..................................................

Starting time .......................... End time ..........................

SOCIO – DEMOGRAPHIC DATA (All Actors)

Q1: Sex

1. Male

2. Female

Q 2: Age (Age bracket in years)
1. 18 – 25
2. 26 – 35
3. 36 – 45
4. 46 – 55
5. 56 – 66

Q 3: Education level
   1. None
   2. Adult education
   3. Primary
   4. Secondary
   5. College
   6. University

Q 4: Beef consumption?
   1. Yes
   2. No

**BEEF SAFETY KNOWLEDGE** (All Actors)

Q 5: Does eating beef cause any human disease?
   1. Yes
   2. No

Q 6: If Yes, What are the common beef- borne diseases in this area?
   1. Anthrax
   2. Rift Valley Fever
   3. Brucellosis
   4. None
   5. Other (Specify) 

Q 7: Which animal species are affected by RVF?
   1. Man
   2. Cattle
   3. Sheep
   4. Goats
5. Other (Specify) ---------------------------------------------------------------

Q 8: How is RVF transmitted in cattle?
   1. Mosquito bite
   2. Tick bites
   3. Biting insects
   4. Other (Specify) ---------------------------------------------------------------

Q 9: What is the sign of Rift Valley Fever in cattle?
   1. Death
   2. Fever
   3. Abortion
   4. Nasal discharge
   5. Bleeding
   6. Other (specify) ---------------------------------------------------------------

Q 10: How is RVF prevented in cattle?
   1. Vaccination
   2. Dipping
   3. Insecticide spraying
   4. Treatment
   5. Movement permit issuance
   6. Quarantines
   7. Other (Specify) ---------------------------------------------------------------

Q 11: How is RVF transmitted in humans?
   1. Slaughtering dead cattle
   2. Slaughtering sick animals
   3. Herding
   4. Milking
   5. Eating poorly cooked beef
   6. Touching sick animals
   7. Staying in same house with sick animals
   8. Other (Specify) ---------------------------------------------------------------

Q 12: Rift Valley Fever is preventable in humans.
   1. Yes
2. No

**BEEF SAFETY PRACTICE AND ATTITUDE (All Actors)**

Q 13: Whom do you think gets RVF infection?
1. Slaughterhouse workers
2. Butchers
3. Livestock producers
4. Veterinary staff
5. Men only
6. Women only
7. Consumers
8. Other (Specify) ____________________________________________

Q 14: What do you do when cattle get RVF infection?
1. Sell to butchers
2. Slaughter for meat
3. Administer treatment by self
4. Call Veterinary doctor
5. Other (Specify) ____________________________________________

Q 15: What do you do when cattle die?
1. Sell
2. Burn
3. Bury
4. Remove the hide
5. Report to Veterinary doctor
6. Other (Specify) ____________________________________________

Q 16: Why do people slaughter dead cattle in their homes?
1. To sell the hide
2. Ensure cultural beliefs
3. Avoid veterinary rules to bury dead animals
4. To eat the meat
5. Ignorance of the health risk
Q 17: Where do people go when they get RVF infection?

1. Nearest hospital
2. Health centre
3. Herbalist
4. Buy drugs
5. Other (Specify) -----------------------------------

Livestock producers only

Q 18: How do livestock producers prevent spread of RVF?

1. Vaccination of their Livestock
2. Stay away from sick animals
3. Wear protective materials when handling sick animals
4. Report sick animals to Veterinary doctors
5. Burn or bury all dead animals
6. Do not sell any sick animals
7. Other (Specify) -----------------------------------

Livestock traders only

Q 19: How do Livestock traders prevent the spread of RVF?

1. Buying and selling healthy animals
2. Operating with a livestock trade license
3. Moving animals with a veterinary permit
4. Respecting veterinary quarantines
5. Other (specify)-----------------------------------

Slaughterhouse operators only

Q 20: How do slaughterhouse operators prevent the spread of RVF?

1. Not slaughtering sick animals
2. Operate licensed slaughterhouses by Veterinary
3. Using protective uniform by all workers
4. Ensuring proper sanitation
5. Other (specify)-----------------------------------------------

**Meat transporters only**

Q 21: How do meat transporters prevent spread of RVF outbreak?

1. Obtaining carrier/container licenses from Veterinary department
2. Transporting inspected meat
3. Wearing protective materials during work
4. Transporting meat with a veterinary certificate
5. Other (Specify)-----------------------------------------------

**Butchers only**

Q 22: How do butchers prevent the spread of Rift Valley Fever Disease?

1. Selling inspected meat
2. Wearing protective clothes when handling meat
3. Selling meat in licensed butcheries
4. Proper hygiene in the butchery
5. Ensure medical fitness
6. Other (Specify)-----------------------------------------------

**Consumers only**

Q 23: How do Consumers prevent RVF infection?

1. Buying inspected meat only
2. Cooking meat properly
3. Cleaning all meat handling areas properly
4. Wearing protective clothing when handling raw meat
5. Other (Specify)-----------------------------------------------

**CONSTRAINTS ON BEEF SAFETY STANDARDS (All Actors)**

Q 24: What are your constraints to beef safety standards in this area?

1. Outdated beef safety legislations
2. Insufficient beef safety policy
3. Poorly trained employees
4. Corrupt inspecting officers
5. Others (Specify) ----------------------------------------

Q 25: What are your constraints to knowledge on beef safety standards?
1. Poor animal health education and extension services
2. Inadequate public health education
3. Fear of market closure
4. Cultural beliefs
5. Insufficient beef safety standards
6. Others (Specify) ----------------------------------------

RECOMMENDATIONS ON BEEF SAFETY STANDARDS (All Actors)

Q 26: What do you propose to be done to improve beef safety in this area?
1. Strengthen the laws on beef safety
2. Train all actors involved in the beef chain
3. Improve public education and veterinary extension services
4. License all livestock traders
5. Ensure all actors in the beef chain are responsible for food safety
6. Other (Specify) ----------------------------------------
APPENDIX II: IN DEPTH INTERVIEW GUIDE

Introduction

Good morning/ Afternoon
My name is-----------------------------------------------------------------------------------------------
I am a student from Kenyatta University, School of Health Sciences. I am doing my postgraduate Masters of Public Health degree, which entails the health of the community. I am here to carry out a study in this community on Knowledge, Practices and Attitude on beef safety standards among the various actors in the beef production chain. I would like to request you to participate and be involved in the discussion.

Thank you for you being here.

1. What are the common beef borne diseases in this area?

2. How do people get infected with beef borne diseases like RVF in this area?

3. Why do people slaughter sick or dead cattle in this area?

4. How do people protect themselves from getting beef borne diseases like RVF in this area?

5. Which groups of people are at risk of a beef borne disease infection like RVF in this area?

6. What are the constraints to implementation of beef safety standards in this area?

7. What would you like done to improve beef safety standards?
From: Dean, Graduate School

To: Peter Musyoka Kioko

C/o Public Health Department

Ref: 157/12521/04

Date: 17th July, 2008

Subject: RESEARCH PROPOSAL

This is to inform you that the Graduate School Board at its meeting of 26th June, 2008 approved your research proposal for the Masters degree.

Thank you.

M. C, MAKOKHA
FOR: DEAN, GRADUATE SCHOOL

c.c. Chairman, Public Health Dept.

MCM/cww
APPENDIX IV : Approval letter from Ministry of Education to conduct study

REPUBLIC OF KENYA

MINISTRY OF HIGHER EDUCATION SCIENCE & TECHNOLOGY

When Replying please quote

Ref. MOHEST 13/0017 38C 307/2

Peter Musyoka Kioko
Kenyatta University
P.O. Box 43844
NAIROBI

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on, 'Food Safety Knowledge and Practices in Beef Chain with Reference to Rift Valley Fever Disease Outbreak in Maragua District Kenya.

I am pleased to inform you that you have been authorized to carry out research in Maragua District for a period ending 31st December 2008.

You are advised to report to the District Commissioner and the District Education Officer Maragua District before embarking on your research.

On completion of your research, you are expected to submit two copies of your research report to this office.

M.O.ONDIEKI
FOR: PERMANENT SECRETARY

Copy to:

The District Commissioner
MARAGUA DISTRICT

The District Education Officer MARAGUA DISTRICT
APPENDIX V: Approval letter from the District commissioner to conduct study

OFFICE OF THE PRESIDENT
PROVINCIAL ADMINISTRATION & INTERNAL SECURITY

Telegram: DISTRICTER, MURANG'A SOUTH
Telephone: 097-72472
Fax: 020-2020091

DISTRICT COMMISSIONER
MURANG'A SOUTH DISTRICT
P. O. BOX 8
KENOL

When replying please quote
Ref. No: MAR/CORR.3/3/45

DATE: 30 May 2008

All District Officers
MURANG'A SOUTH

RE: DR. PETER MUSYOKA KIOKO

The above named has been authorized to conduct research on Rift Valley Fever disease outbreak in this District. Areas to be covered include:

- Kimorori Sub-Location
- Kiri Sub-location
- Gakuyu Sub-Location
- Kangari Sub-Location

- Makuyu Division
- Kandara Division
- Maragua Division
- Kigumo Division

The exercise will commence on 5th June 2008 for a period of one month.

Please accord him any assistance he may require.

G. O. ONYANGO
FOR: DISTRICT COMMISSIONER
MURANG'A SOUTH
APPENDIX VI: Approval letter from the District Veterinary Officer to conduct study

REPUBLIC OF KENYA

MINISTRY OF LIVESTOCK AND FISHERIES DEVELOPMENT
(DEPARTMENT OF VETERINARY)

DISTRICT VETERINARY OFFICE
MURANGA SOUTH DISTRICT
P.O. BOX 58 (01020)
KENOL-KENYA

Tel: 020-2012210

REF : VET/MAR/ADMIN/GEN/3/2/219

30th May, 2008.

TO: VETERINARY STAFF
KIIRI, GAKUYU, KIMORORI, AND KANGARI SUB-LOCATION

RE : PETER MUSYOKA KIOKO

The above named person has been given authority to carry out Research on Rift Valley Fever Disease.

Please accord him all the necessary assistance.

DR. JANE N. NJUGUNA
DISTRICT VETERINARY OFFICER
MURANGA SOUTH DISTRICT