AN EVALUATION OF KNOWLEDGE, PERCEPTIONS AND SOCIO-ECONOMIC ASPECTS OF Q-FEVER INFECTION IN A PASTORALIST SYSTEM OF KAJIADO COUNTY, IN KENYA

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DECLARATION

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

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DEDICATION

This thesis is dedicated to my mother Mrs. Rose K'oboge who was one of my financial supporters during my study and was also a source of encouragement all through.

This work is also dedicated to my siblings; Kevin, Cecil, Sheila, Nama and Steve who gave me spiritual and emotional support.

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LIST OF ABBREVIATIONS

ALRI	Acute Lower Respiratory Illness
APSW	Abortion, Premature delivery, Still birth & Weak offspring
ASAL	Arid and Semi-Arid Land
CDC	Centre for Diseases Control and Prevention
CDHS	County Director of Health Services
CDVS	County Director of Veterinary Services
CGK	County Government of Kajiado
DMC	Division of Malaria Control
EIA	Enzyme Immuno Assay
ELISA	Enzyme Linked Immunosorbent Assay
FDGs	Focus Group Discussions
IFA	Indirect Fluorescent Antibody test
IgM	Immunoglobulin M
KEMRI	Kenya Medical Research Institute
KIIs	Key Informant Interviews
KNBS	Kenya National Bureau of Statistics
KPHC	Kenya Population and Housing Census
LCV	Large Cell variants
MoWNR	Ministry of Water & Natural Resource
NO	Number
OIE	World organization for animal health
RDT	Rapid Diagnostic Test
SCV	Small Cell variants

SDC	Small Dense Cells
UNDP	United Nations Development Program
URT	United Republic of Tanzania
UoN	University of Nairobi
WHO	World Health Organization
WFP	World Food Program

ABSTRACT

Q fever is a zoonotic disease caused by *Coxiella burnetii* which poses a substantial public health concern. The disease has potential to cause detrimental effect on human health and results to substantial economic losses in affected households. Livestock is the main source of infection to humans. The overall objective of this study was to assess the knowledge and perception of pastoralists on Q-fever infection and to estimate its economic impact at the household level to inform decision on whether there is a need for surveillance of this infection within pastoral systems by the relevant health delivery systems in Kenya. The study was undertaken between 2015-2017 with field data collection conducted in the month of August 2015 in Namanga, Mashuru and Ngong sub counties of Kajiado County. However, additional data were obtained through document review of the available literature, based on relevant studies undertaken after August 2015 to obtain the status of the disease within the affected systems.

To assess the Knowledge and perception of Q fever in the study area, seven focus group discussions were conducted with pastoralists and nine key informant interviews were held at the local health facilities with the health workers in-charge by use of interview guides. Additionally, data were collected from secondary sources on pastoralist's knowledge and perceptions of Q fever in Kajiado County, prevalence of Q fever in Kenya and Kajiado county in particular; household monthly incomes; estimated outcomes of primary Q fever infections in humans.

Based on the data collected, pairwise ranking and scoring methods were used to determine the most common diseases affecting the community. Further statistical analysis was done using Kruskal-Wallis one-way analysis of variance to determine if there was a significant difference in the mean ranks of diseases across the focus group discussions held with pastoralists/farmers

and Key informant interviews held with health workers. The economic cost of Q fever infection in humans was estimated using a deterministic model which was developed in Microsoft Excel spreadsheet. The estimation of economic cost was based on the reported prevalence of Q fever infection among pastoralist households, average monthly incomes, average treatment costs and the number of days' people stayed away from work due to illness with Q fever.

From the focus group discussions with pastoralists, common cold and malaria were ranked highest as the most prevalent diseases, while pneumonia, malaria, upper respiratory tract infections and typhoid fever were ranked highly by health workers as the most common diseases. Even though the presence of Q fever has been established in Kajiado County as revealed through document reviews, this study reveals inadequate awareness and knowledge among the pastoralists and heath personnel. Due to inadequacy of awareness, Q fever is most likely being diagnosed as other febrile illnesses with similar clinical symptoms such as flu, pneumonia and malaria. Based on previously estimated human prevalence of 26.7% of Q fever in Kajiado County from documented literature, the economic impact of Q fever infection in a typical pastoralist's household was estimated to be Ksh 4,600 per month. This a heavy economic burden on a typical pastoralist's household. The direct costs attributed to the number of working days lost were greater than the indirect costs such as treatment and transport. The results from this study and Q fever document reviews show that there is need for creating awareness for Q fever among health workers, veterinary practitioners and pastoralists. Since the presence of *Coxiella burnetii* has been established in previous studies conducted in Kajiado County and Kenya at large, and since it is of economic significance, there is need for surveillance of Q fever infection by the relevant health delivery systems in Kenya.

CHAPTER ONE: INTRODUCTION

1.1 Background information

Q fever is a zoonotic disease caused by *Coxiella burnetii* which ubiquitous in nature (World Organization for Animal Health, 2010). The main pathway for transmission in humans and animals usually associated with parturition and abortions in domestic ruminants especially goats and sheep (Arricau-Bouvery *et al*., 2006). Infected domestic animals contaminate the environment by shedding *Coxiella burnetii* mostly through the birth products such as vaginal secretions, placenta and amniotic fluids (Lang *et al*., 1990). Other sources of infection that are less common include milk, feces, urine and saliva of infected animals (Hirai et al., 1998). Livestock is a great source of livelihood in pastoralists' communities translating to daily contact with livestock which are reservoirs for the pathogen. Pastoralist communities are therefore at a higher risk of Q fever infection due to their lifestyle. In dry seasons they move with their livestock in search of pasture promoting spread of the pathogen to other regions.

1.2 Statement of the Problem

Although many studies conducted in Kenya have reported presence of Q fever with significantly high prevalence in humans and animals, it has not been prioritized as one of the significant disease affecting humans and animals. In human medicine, Q fever is normally not considered as a differential diagnosis of febrile diseases in humans or as a reproductive disease in livestock in veterinary medicine. Q fever has therefore been neglected as an important zoonotic diseases in Kenya even though it is considered a re-emerging infection in many countries (Arricau-Bouvery *et al*., 2005). Limited importance given to Q fever in the health sector demonstrates the need to assess knowledge and perception of Q fever infection by health practitioners and pastoralists. To illustrate the burden of the disease at household level so as to emphasize on its relevance, there is need to conduct its economic impact

assessment. This information will justify the need to include Q fever as a priority disease in Kenya so that government ministries of medical services, livestock and environment can allocate more resources to support its surveillance and control.

1.3 Objectives

1.3.1 Overall objective

To assess the knowledge and perception of the pastoralists and health officers on Q-fever infection and its economic impact at household level, and whether there is need to prioritize surveillance of this infection within pastoral systems by the relevant health delivery systems in Kenya

1.3.2 Specific objectives :

1. Document what is known about Q-fever infections of humans and livestock in pastoralist systems in Kenya
2. To assess the knowledge and perception of pastoralists and health officers on infectious diseases which affect households in Kajiado County in general and Q-fever infection in the County in particular
3. To estimate the socio-economic impact of Q-fever in the pastoralist households in Kajiado County

1.4 Justification

Q fever remains an underestimated cause of febrile illness in Kajiado County and Kenya at large. Most hospitals are likely not to be able to diagnose Q fever due to inadequate awareness among the health practitioners. There is also very limited and scarce data on this disease attributing to it having very low relevance in human medicine. Q fever is however considered a notifiable disease in most developed countries notifying it as an occupational hazard.

Individuals who are in close contact with infected animals and animal products are at a higher risk of infection, and such is the case in pastoralist communities. The present study aims to assess the knowledge and perceptions of Q fever infection among pastoralist communities and health professionals and estimate its economic impact within pastoralist households in Kajiado County. The information obtained from the study is important for policy formulation on disease control within these resource scarce communities, besides increasing the level of awareness of Q fever infections amongst medical and veterinary fraternity in Kenya. Finally, pastoralists are also expected to become aware of this disease which has substantial economic impact on their medical expenses and on livestock productivity.

CHAPTER TWO: LITERATURE REVIEW

2.1 Q Fever

Q fever is a febrile illness that was first described in 1935 in Queensland, Australia, where an outbreak occurred among abattoir workers (Derrick *et al*., 1983). In developed countries it is prioritized as one of the notifiable disease by OIE. However, in developing countries it remains underreported with no effort put into its surveillance. It has a wide range of hosts including mammals, reptiles and arthropods. Livestock (cattle, sheep and goats) are the main source of infection for humans. Infection occurs through increased rate of contact with contaminated animal bedding, vaginal discharges/birth fluids, placenta, fetal membranes, urine and feces (Gwida *et al*., 2012). However, no clear evidence is available to support its transmission through milk consumption (Whitney *et al*., 2009).

2.2 Etiology of Q fever

The causative agent for Q fever disease is an obligate intracellular organism known as *Coxiella burnetii*. It is a small pleomorphic organism about 0.2- 0.4 mm in width, 0.4 -1.00 mm long with a membrane like gram negative bacterium. *Coxiella burnetii* was previously classified as a Rickettsia due to its morphological similarities to rickettsia organisms. It is currently classified in the family Coxiellacea and order Legionellae's in gamma division of proteobacteria (Seshadri *et al*., 2003). This organism has adaptive features for thriving in phagocytes and in the environment. Its stability in the environment is attributed to having highly resistant spore-like form (McCaul *et al*., 1981) and having developmental cycle variants; large-cell variants, small-cell variants, and small dense cells (Coleman *et al*., 2004). The small cell and small dense cells survive extracellularly as infectious particles. The small cell variant is resistant to heat, pressure and chemical agents, while the large cell variants are the metabolically active cells of this organism. *C. burnetii* has two antigenic forms;

pathogenic phase isolated from infected animals or humans and attenuated phase obtained by in-vivo or in-vitro passages. A single *C. burnetii* organism can cause infection making it a very pathogenic organism. It is therefore considered a potential weapon for bioterrorism and it is classified in category B by the Center for Diseases Control and Prevention (McCaul *et al*., 1981).

2.3 Epidemiology

2.3.1 Q fever in the World

C.burnetii is widely distributed throughout the world with exception of New Zealand (Hilbink *et al*., 1993). Q fever disease can occur in any month of the year, but most cases have been reported during spring and early summer coinciding with increased outdoor activities and birthing season among most domestic animals (CDC, 2011). The largest Q fever outbreak in human cases in history occurred in Netherlands between the years 2007 and 2008 (Schimmer et al., 2010), where 3,921 human cases were reported in 2007 and 600 human cases reported in 2008. The decrease in reported cases was explained by an increase in awareness of Q fever infection amongst the general practitioners, specialist and laboratory microbiologists. Hospitalization rate during the outbreak of 2008 was estimated at 22% as compared to 43% which was reported in 2007. The area in Southern Netherlands which experienced the outbreak was associated with a high density of dairy goat production and the study concluded that dairy goats were the main source of infection (Schimmer *et al*., 2010). The incidence and prevalence of Q fever infection in other countries are believed to be underestimated. This is attributed to inadequate knowledge of Q fever resulting to under diagnosis and underreporting of cases. A study by Whitney *et al* (2009) on 508 American veterinarians reported a seroprevalence rate of 22.2%. The large animal veterinary practitioners were reported to be more likely to be infected than small animal practitioners. A study conducted by McQuiston *et al* (2002) reported 7.8 % Q fever seroprevalence among animal and animal products handlers. Another study in Northern Irish reported a higher seropositivity among farmers than

in the general population (McCaughey *et al*., 2008). These findings indicate that Q fever infection in humans is an occupational hazard with higher risk rate in those in close contact with livestock.

2.3.2 Q Fever in Africa

The prevalence of Q-fever antibodies in Sub-Saharan Africa was reported to range between 17-37% (Kelly *et al*., 1993 and Mediannikov *et al*., 2010), which suggest a high level of exposure to this pathogen. A serosurvey conducted by Dean *et al* (2013) in Togo reported seven seropositive cases out of 683, the seropositive individuals were occupationally associated with *C.burnetii* infection. Q fever infection in humans has febrile symptoms as shown in a study conducted by Steinmann *et al*., (2005) in Mali which reported febrile symptoms in individuals who had been exposed to the organism. A study by Prabhu *et al* (2011) reported acute Q fever in 5% of the 870 who had acute febrile symptoms. Q fever is a more common cause of febrile illnesses than malaria (Crump *et al*., 2013).

2.3.3 Occurrence of Q fever in Kenya

A systematic review of Q fever in Kenya conducted by Njeru *et al.,* (2016) between 1950 and 2015, where 15 published studies and reports were reviewed, revealed human seroprevalence of *C. burnetii* infections ranging from 3 to 35.8 % in all regions. A study by Potasman *et al* (2000) reported 8% (4 out of 50) Q fever prevalence in travelers who had visited Maasai Mara in Kenya. Of the four who had the infection, two developed symptomatic infection and the other two had asymptomatic illnesses. A Q fever seroprevalence study by Knobel *et al* (2013) in Western Kenya, from patients who visited a rural clinic from 2007 to 2010, reported *C. burnetii* antibodies detection in 30.9% of the archived patient sera. 3% of these patients had acute lower respiratory tract illness. The Knobel study concluded acute lower respiratory tract illnesses among the rural residents in Western Kenya were likely to be caused by Q fever. The Knobel study acknowledged that >50% of the febrile illness in the study area may have been

caused by malaria. However, the findings in the study showed that Q fever infections amongst these patients was significant. Misdiagnosis of Q fever infection in Kenya, in patients with febrile and respiratory symptoms, could be rampant. Q fever outbreak was also reported in Baringo in 2014, where 6 deaths were reported (Kenya ZDU, 2014). The individuals who died manifested symptoms of headache, chest pain, epigastric pain, and vomiting. Follow up study by Walter Reed project in Baringo revealed 54.8% acute Q fever infection from 31 participants. It was proved that of the 34 households that enrolled for the study, 33 households (97%) had at least one individuals meeting the case definition for Q fever infection.

2.4 Transmission of *Coxiella burnetii*

The main mode of transmission is inhalation of the infectious agent (*C. burnetii*). This pathogen resistant spore form can survive harsh weather conditions enabling long time survival in the environment (Dean *et al*., 2013). Transmission by oral route through consumption of infected food is possible, although this may lead to seroconversion but not clinical disease (Thomas *et al*., 1995). The organism is spread in the environment by wind, causing infections some distance from the initial source. Sources of *C. burnetii* infection include contaminated soil, milk, feces, urine, saliva, and afterbirths of infected animals such as vaginal secretions, placenta, and amniotic fluids. In humans, there is a possibility of transmission following contact with parturient women, even though this is not very common. Sexual transmission has also been reported so has possible risk of infection through blood transmission (Porter *et al*., 2011). Apart from livestock, a study by Bosnjak *et al* (2010) reported ticks as a source of infection in animals, but no study has reported possibility of tick transmission in humans.

2.5 Pathogenesis of *C. burnetii*

Once the extracellular form of *C. burnetii* small cell variants is inhaled, it attaches itself to the host cell membrane and is engulfed by phagocytes to form a phagosome. Several phagosomes

merge to form phagolysosome and several phagolysosome fuses to form a large vacuole. The organism has adaptation to the acidic environment inside the host cell and can multiply. Though the mechanism of multiplication is poorly understood. The large vacuole induces metabolism of small cell variants which then develops into Large Cell Variants (Coleman *et al*., 2004). The large cell variants undergo further development and metabolic changes transforming to small cell variants which exits the host cell by bursting the cell thereby releasing resistant bacteria to other cells. Factors responsible for the spreading of the organism are not known (Porter *et al*., 2011).

2.6 Clinical manifestation of Q fever in humans

Q fever infection in humans has two main clinical forms; acute and chronic forms, but most cases are subclinical. First acute Q fever infection is presented as a self-limited febrile illness with flu-like symptoms characterized by sudden onset of fever of 40^{o}C, severe headache, weight loss, sweat, chill, myalgia and cough. If not treated, the fever can last 1-3 weeks or even more in some cases (Marrie *et al*, 1990). Acute Q fever infection can manifest is as typical pneumonia which is characterized by fever, headache, myalgia and may be a non-productive cough (Marrie *et al*, 1995). The third presentation of acute Q fever is asymptomatic hepatitis characterized by a rise in the transaminase levels alone, prolonged fever of unknown origin and maybe jaundice (Fournier *et al*., 1998) with most cases having hepatomegaly. Other acute Q fever symptoms include; meningoencephalitis, severe headache, pericarditis, pancreatitis and abortion (Kagawa *et al*., 2003; Maurin *et al*., 1999).

About five percent of the acute cases develop into chronic Q fever which is characterized by endocarditis, chronic fatigue and repeated abortions. Most Q fever cases are characterized by fatigue (post-Q fever fatigue syndrome) associated with myalgia, arthralgia, night sweats, mood swings and change in sleep patterns. The fatigue syndrome may persist for several months or even years (Ayres *et al*., 1998). Q fever infection is a reproductive health hazard in

women as it is known to cause placentitis resulting in pregnancy losses such as abortion, neonatal death, premature birth and low birth weight (Dindinaud *et al*., 1991 and Raoult *et al*., 2002).

2.7 Diagnosis of Q fever infection in humans

In the first 8 to 10 days after onset of Q fever infection, patients are bacteraemic but still antibody-negative. At this stage *C. burnetii* can be detected most rapidly by PCR assay of the serum or plasma. Over 80% of specimens taken during this stage are PCR positive (Dupont *et al*., 1994). Although PCR can be used in early detection of Q fever infection, serological testing is the most widely used with PCR as a complement test to serology. The Indirect Fluorescent Antibody test (IFA) is the most commonly used serological test for Q fever diagnosis (Dupont *et al*., 1994). Although ELISA is equally as sensitive as IFA. From onset of Q fever infection, day 10 to day 203, IgM class antibody to phase 2 antigen appears, while IgM to phase 1, appears at day 15 to 20. IgG class antibodies to phase 2 antigen are detected first followed by IgG to phase 1 antigens. Demonstration of acute Q fever in people exhibiting clinical signs of Q fever requires a fourfold rise in antibody titer (Maurin *et al*., 1999). Isolation of the organism in animals or cell culture requires Level 3 bio-containment facilities though this is slower and more expensive.

2.8 Treatment of Q fever infection in humans

Doxycycline has the highest therapeutic efficacy against *C. burnetii* and is mainly used in adults, children over age 8, and in severe illness for all ages (Anderson *et al*., 2013 and CDC, 2011). Oral Doxycycline is administered at a dosage of 100mg twice daily in adults and 2.2 mg/kg body weight twice daily to children under 45kgs for a period of 14 to 21 days. In cases where tetracycline are contraindicated (children under 8 years of age, pregnant women and individuals allergic to tetracycline), other antibiotics such as trimethoprim/sulfamethoxazole, fluoroquinolones or macrolides may be used (Anderson *et al*., 2013).

2.9 Economic impact of Q fever infection

Apparently, 20% of all human illness and death in the least developed countries are attributable to endemic zoonoses (Grace *et al*., 2011). Q fever being one of the many zoonotic diseases has a potential to cause significant economic impact at household level on both humans and livestock (Porter *et al*., 2011). The zoonotic potential of Q fever infections renders it even more important especially with advances in human medicine, immuno-suppressed, premature, elderly, and chronically ill individuals, where the organism can be opportunistic, causing severe outcomes including death. Q fever causes a persistent long-term burden on human patients and society resulting in direct and indirect socio-economic losses. Disease burden leads shift in expenditure patterns in households where health services and goods are given priority. The burden of sickness causes disability in affected individuals leading to low productivity translating to reduction in household incomes. An economic impact analysis on Q fever conducted in the Netherlands during the Q fever outbreak reported a diseases burden that cost approximately 336 million Euros. In the Netherlands study, burden of the disease attributed to disability in affected people amounted to between 67 to 145 million Euros and the consequences of work days lost amounted to 12.5 to 96.5 million Euros (Tempelman *et al*., 2011). A study by Garner *et al* (1997) on Q fever in Australian meat Industry reported $ 1 million work cover claims annually, having lost 1700 weeks of work days. Another study by Kermode *et al* (2003) reported an estimated medical costs of $3,800 per Q fever fatigue syndrome case and $20,500 per endocarditis case with valve replacement surgery. From these reviews, it is evident that Q fever being a zoonotic disease, should be given priority in the health sector. With increased awareness, Q fever is emerging as new public health priorities (Crump *et al.*, 2013). Febrile diseases such as malaria in developing countries have received adequate awareness which has resulted in consistent decrease in their incidences (Geiger et al., 2013). Similar awareness strategies should be adopted to increase Q

fever infection awareness especially in regions like Kajiado where the risk of infection is high. Q fever related studies conducted in African countries have given evidence of presence of Q fever in many production systems. However, there is a gap in establishing the incidence of Q fever in humans and animals in African countries and Kenya specifically. This study was undertaken specifically to focus on level of Q fever awareness and its economic impact at the household level in Kajiado County in Kenya. The aim being assessment of need for support of Q fever surveillance activities within pastoral systems. The study also reviewed available literature to document what is known about occurrence of Q-fever infections in Kenya.

CHAPTER THREE: MATERIALS AND METHODS

3.1 Study area

This study was conducted among pastoralist communities in Kajiado County in three sub-counties: Mashuru, Namanga and Ngong. Kajiado County occupies an area of 21,902 square kilometers with an altitude ranging between 500 and 2,500 meters above sea level. The County is classified as a semi-arid area receiving annual rainfall of between 300 and 1,250 mm and average daily temperature ranging between 10-34°C (County Government of Kajiado, 2013). The area has seven sub counties: Central, Isinya, Loitoktok, Magadi, Mashuru, Namanga, and Ngong. The three Sub counties; Mashuru, Ngong and Namanga were purposively selected based on availability of livestock at the time of the study. Figure 1 is the map of Kajiado County showing the selected study areas. Data were collected using a cross sectional study design. The study participants included pastoralists and health personnel, and additional data were obtained through review of published and grey sources of literature.

3.2 Study population

According to recent national reports by KNBS (2013), Kajiado County has an estimated human population of 687,312 people comprising of 342,166 females and 345,146 males. The inhabitants of Kajiado County are mainly the Maasai community, but there are other ethnic groups who have recently settled in the area, especially within town centers. The main economic activity practiced by the community is livestock keeping mainly of goats, sheep and cattle. Within Kajiado County, there are about 411,840 heads of cattle, 699,658 goats and 718,950 sheep (KPHC, 2009). This translates to 0.7 head of cattle per person, 1.02 goats per person and 1.1 sheep per person. This project targeted the pastoral communities in Kajiado County.

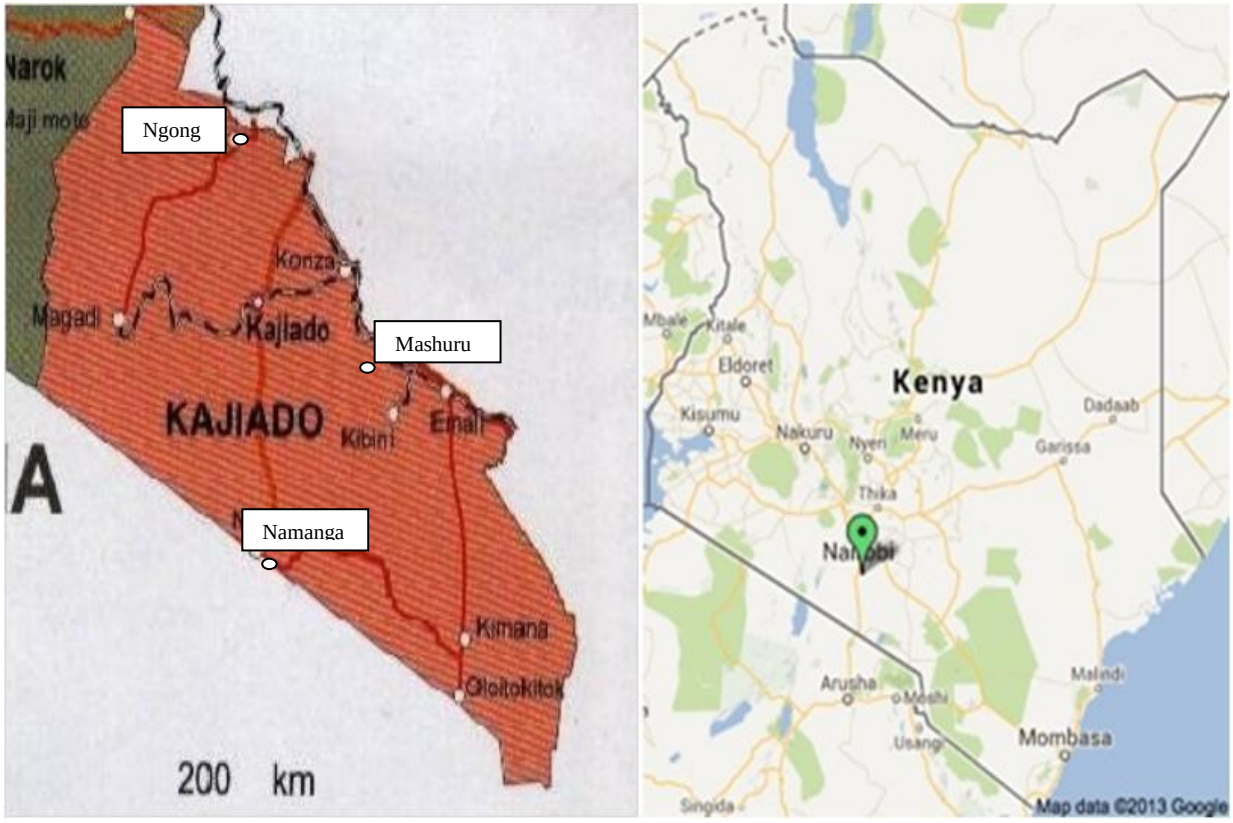

Figure 1: A map of Kajiado County in Kenya (Namanga, Ngong and Mashuru)

(Source; www.kenya-information –guide.com).

3.3 Selection of study participants

This study was part of a larger study conducted by ILRI, where field work was conducted in November to December of 2013. The project aimed to assess the importance of diseases affecting dairy cow performance and presenting a public health risk, including prevalence of Q fever infection in cattle. The study areas: Mashuru, Namanga and Ngong were purposively selected based on the availability of livestock at the time of the study. Villages were listed based on information obtained from Chiefs and village elders with the assistance of the local Veterinary practitioners. From the list generated 10 villages from each location were randomly selected using computer-generated random numbers. Households with cattle herds from the selected villages were identified and compiled with the help of the local extension officers and village elders whereby approximately 8 households with cattle herds in each village were randomly selected using computer generated random numbers. Part of data used in this study were derived from this larger project study courtesy of ILRI.

The main part of this study was conducted in August 2015, where field work was conducted in the same study areas as the previous study (larger project) in: Mashuru, Namanga and Ngong to collect supplementary data on knowledge and perception of pastoralists and health officers on infectious diseases which affected household members. The local veterinary practitioners who had initially assisted in the previous study assisted again in the identification and recruitment of pastoralists/livestock farmers in the study areas to take part in the study, while the County Director of Health Services Kajiado County assisted in the selection of health facilities and recruitment of heads of health facilities. Livestock farmers were conveniently selected from farmers groups participating in livestock improvement projects, personal development groups, and dairy farmers group.

3.4 Data collection

Focus Group Discussions: With verbal consent from the selected FGDs participants (livestock farmers/pastoralists), a total of seven FGDs with an average of 12 participants per group were organized. These discussions were facilitated by the author/researcher with the assistance of a translator from the community. The guiding questions included; (1) list of diseases that affected household members, (2) the livestock farmer's perception on the most prevalent diseases affecting household members from the diseases they had listed, (3) the livestock farmer's knowledge of Q fever infections, (4) how farmer's household members responded when a family member was sick, (5) the medical costs incurred by household members for treatment of the common infectious diseases. Data were elicited using various participatory epidemiology methods; listing, pairwise ranking and probing (Catley *et al*., 2012). The steps for collecting data in FGDs were as follows:

I. Participants of FGDs listed the diseases that are affecting their household members currently and in the past.
II. The listed diseases were then subjected to pairwise ranking process to determine which of the diseases were commonly encountered in pastoralists' households. This process called pairwise ranking is described by Catley *et al* (2012). Briefly this process involves comparing entities in pairs to judge which of the entities are preferred according to the perception of the participants. This was obtained from the participants through probing.

Key informant interviews: Verbal consent was given by the Key Informant Interview (KII) participants (health facility heads) who participated in the interviews. A total of nine health facility heads were interviewed using interview guides. From each study area, three KIIs were conducted in different health facilities. The guiding questions used to interview the health personnel were; (1) list of common febrile diseases encountered in the health facilities, (2)

health personnel's perception on the most common diseases among the ones they had listed, (3) health personnel's knowledge and perceptions of Q fever, and (4) the medical costs incurred by patients for treatment of the common infectious diseases. The same approaches for data elicitation (pairwise ranking) used in the FGDs were used in the Key informant interviews.

Secondary data: Household data were obtained from the larger study (Wakhungu 2015, Unpublished) where household questionnaires were used to collect data by engaging the household heads in interviews. Data obtained included: Household demographics, knowledge, attitudes and perception of livestock farmers/pastoralist of Q fever in humans and animals. Data were also collected from published literature: Q fever prevalence studies conducted in Kenya and Q fever studies conducted in Kajiado County, clinical outcomes of primary Q fever infection, duration of illness for acute Q fever infection, average monthly income for pastoralists' households and average household sizes in Kajiado County. Data collected from literature sources were mainly used in the estimation of economic impact of Q fever.

3.5 Data management and analysis

3.5.1 Knowledge and perception of pastoralists and health officers on diseases which affect households

Quantitative data were analyzed using Microsoft Excel 2007 Software to obtain descriptive statistics measures including the mean, minimum and maximum values. Pair wise ranking was used to analyze qualitative data obtained from the FGDs and Key Informant Interviews (KII) as described by Catley *et al* (2012). For each disease listed in FGDs and KIIs, scores were calculated and obtained as follows: First, for each disease a proportional score was calculated based on the number of times the disease was mentioned by the participants as most common compared to the others (called "disease weight"). Second, all the "disease weights" were added to obtain an "overall weight". This procedure was followed for all

diseases mentioned in the FGDs and KIIs. Finally, for each disease the final score was estimated by dividing its "disease weight" by the overall weight". The scores were analyzed in Genstat 13th Version International statistical package using Kruskal-Wallis One-way analysis of variance. This entailed conversion of disease score into ranks. This method was used to determine if there was a significant difference in ranks given for the diseases across the FGDs and across the KIIs. A complementary analysis was conducted using Kendall's Co-efficient of Concordance test. This was used to measure the level of agreement for the rank orders obtained for diseases across the FGDs and across KIIs. Kendall's co-efficient of concordance test measures how much the raters (participants of FGDs and KIIs) agree with each other in the ranking of diseases which affected households' members. For all analysis, the level of significance was set at 5%. The results from Kruskal Wallis and Kendall's co-efficient of concordance tests were used to prioritize diseases representing the perception of participants of both FGDs and KIIs.

3.6 Estimation of economic impact of Q fever in pastoralist households

A frame work was developed showing the clinical outcomes of Q fever infection in humans. The proportional estimates of the clinical outcomes were obtained by reviewing various documented literature sources. The clinical outcomes of Q fever included in the framework were; acute infections, chronic infections, post Q fever fatigue syndrome, endocarditis, granulomatous lesions and self-resolving lesions. A deterministic model was developed on Microsoft Excel 2007 with reference to the clinical outcome framework. The data used in the model were obtained from primary and secondary sources including: (1) proportional estimates of the clinical outcomes of Q fever infection, (2) Sero-prevalence of Q fever in Kajiado County, (3) Average cost of treatment for febrile illnesses, (4) Average household size in Kajiado, (5) working days lost due to Q fever illness, (5) minimal monthly wage in Kenya. These were presented as average estimates.

The estimated economic impact of Q fever was derived in two stages: The first stage involved determining the probability of having Q fever infection in pastoralist's household considering the prevalence of Q fever in Kajiado county, and probabilities of the mentioned Q fever clinical outcomes following a primary infection (the first time an individual is infected with *Coxiella burnetii*) in pastoralist's households. The probabilities of the clinical outcomes of Q fever infection were derived using the following parameters; Q fever Sero-prevalence in Kajiado County, proportional estimates of Q fever outcomes (shown in Figure 3) and the average household size in Kajiado County. In the second stage of the economic analysis, a framework developed by Rushton et al. (1999) was adopted. This framework classifies diseases' impacts into two categories; 1) direct impact which are impacts caused by disease and health problems, and 2) indirect impacts which are impacts caused by reaction of humans to the presence of disease. Direct impacts in this case were attributed to number of working days lost due to Q fever, while indirect impacts were financial expenses incurred in seeking medical attention for Q fever infection including medical costs and transport costs.

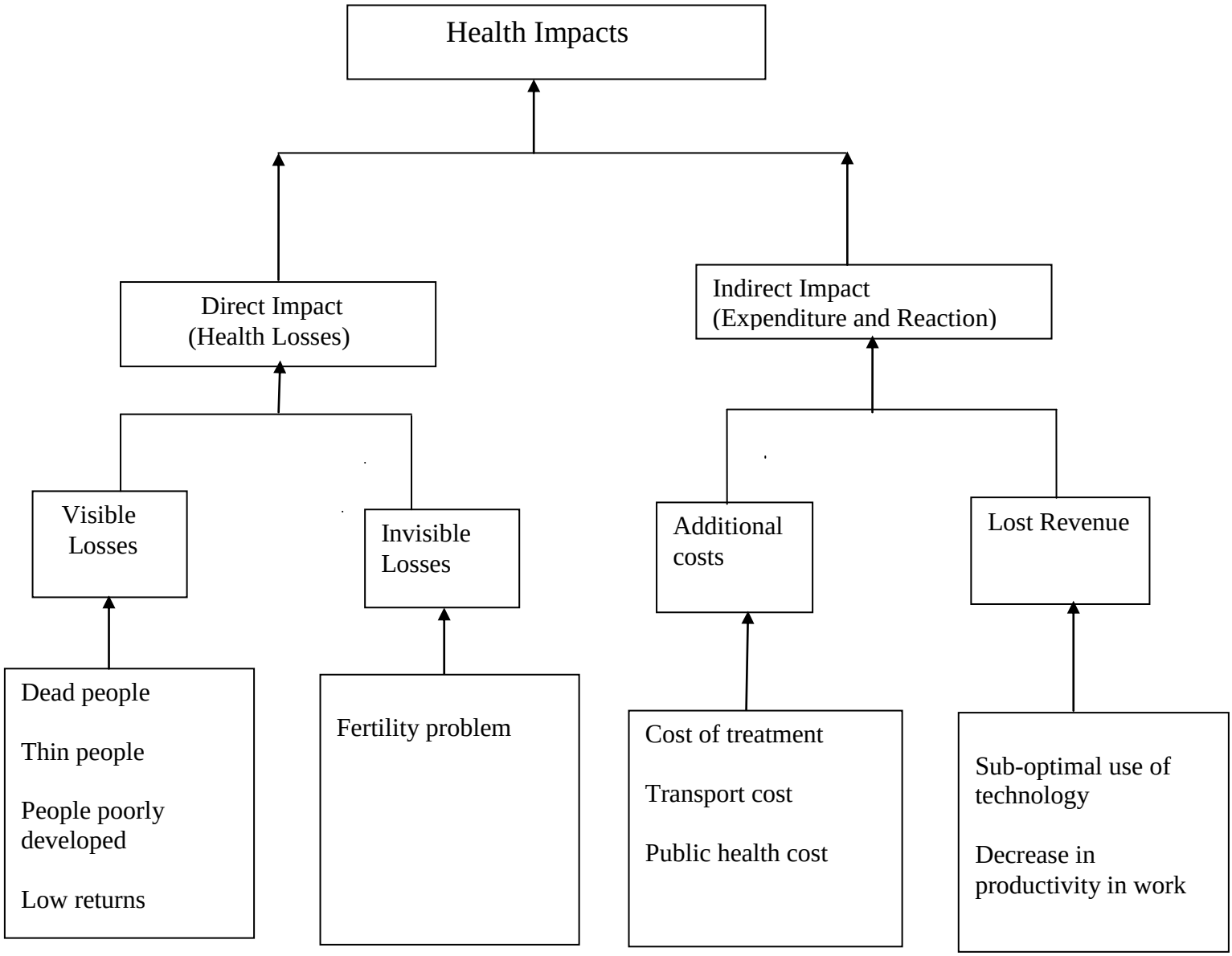

Figure 2: Burden of disease in humans (Rushton *et al*, 2009)

CHAPTER FOUR: RESULTS

4.1 Review of studies on Q-fever Infection in Pastoralist Systems in Kenya

Q-fever (*Coxiella burnetii)* infection is a zoonotic disease that produces very variable and non-specific symptoms in people. The infection is generally believed to be hugely under reported, mainly due to it being confused with malaria in developing countries where 50–80% of malaria cases may be associated with fevers resulting from other causes (Maichomo *et al*., 2000). The exposure of livestock to *Coxiella burnetii* poses a risk of Q fever infection in humans. Available literature shows that Q-fever is so highly infectious that one *Coxiella burnetii* organism is capable of causing a clinical infection in humans (Madariaga *et al*., 2003). Humans commonly contract Q fever through the inhalation of air that is contaminated with *Coxiella burnetii* organisms from aborting or birthing animals or through contact with infected material, e.g. tissues, fluids, wool, straw (Hirai *et al*.,1998 and Lang *et al*., 1990). Benson *et al.* (1963) stated that the Q-fever pathogen could also be transmitted to humans through the drinking of contaminated milk. A study conducted by Njeru *et al (*2016) concluded that *Coxiella burnetii* infections are common in human and in a wide range of animal populations but are still unrecognized and underestimated thus presenting a significant human and animal health threat in Kenya. Therefore, integrated disease surveillance and prevention/control programs are needed in Kenya. The burden of such diseases in humans and animals aggravates poverty especially amongst marginalized pastoralist communities. Q fever, just like other febrile diseases such as malaria, has a potential to cause detrimental economic impact in affected pastoralists who have limited resources. Generally, zoonotic diseases have been estimated to have cost the global economy over $20 billion in direct costs and a further $200 billion in indirect costs over the past decade (The World Bank, 2010). Therefore, an understanding of the epidemiology of Q-fever which is a zoonotic disease is an important veterinary issue, firstly because it relates to livestock abortions and production

losses and secondly because the zoonotic nature of the disease makes the disease to be of importance to medical professionals who need to understand the extent and prevalence of such a disease in the livestock reservoir.

One of the objectives of the current study was to review what is known about Q-fever infections in pastoralist systems in Kenya in general and Kajiado County in particular. Since the main part of the study was conducted in Kajiado County in the month of August 2015 with its contents being updated between October 2016 and August 2017, this study could review and report on the findings from other studies that have been carried out on the status of the Q fever infection in Kenya in June 2015, August 2017 period and also in the past 10 years as shown in Table 2. In Kenya, Q fever infection has been reported and documented in the pastoralist communities of Kajiado, Baringo, Garissa, and Tana River Counties whose main source of livelihoods is livestock. For example, Depuy *et al*., (2014) estimated seroprevalence rates for Q-fever in Laikipia County at 4%, 31% 20% and 46% for cattle, goats, sheep and camels respectively, while a serological study of *Coxiella burnetii* on a sample of 300 cattle in Kajiado County in 2015 (Wakhungu *et al*, 2014) gave a relatively low seroprevalence rate of 3.4 %. A more recent study to assess the status of Q-fever infection among humans and the prevalence of the infection in domestic ruminants in Kajiado County was carried out by Nakeel in 2016.

The Nakeel *et al* (2016) study involved serological tests covering 229 cattle, 149 sheep and 140 goats from Mashuru, Kajiado-Central and Magadi Sub-Counties of the County and 240 patients from three health facilities in the County (Sultan–Hamud, Magadi and Kajiado referral hospitals). The study indicated that the overall prevalence of Q-fever in humans was 26.7%, while the overall prevalence of Q-fever in the livestock was 89.7%, 57.5% and 83.1%

for cattle, sheep and goats respectively (Nakeel *et al*., 2016). The Nakeel *et al* (2016) study also evaluated the significance of the factors associated with occurrence of sero-positivity of Q-fever in human and livestock. Among the potential risk factors considered the type of occupation ($p<0.05$), method of processing meat ($p<0.01$), whether people processed blood before consumption ($p<0.001$), contact with aborted foetuses ($p<0.029$), and method of disposal of aborted foetuses and placenta ($p<0.028$) were significant at the levels indicated in brackets. However, whether there was contact with contaminated water and whether people consumed milk or not were not significant (Nakeel *et al*, 2016). Despite the confirmation of the prevalence of Q fever in both humans and livestock in Kajiado County, the Nakeel *et al* (2016) study found that there was a complete lack of awareness of the Q-fever disease, its risk factors and the methods of its prevention and control among the community in the study area, not even among the veterinary and medical workers. The Nakeel *et al* (2016) study thus concluded that there was a high likelihood of the Q-fever being enzootic in the study area, thereby presenting a serious public health problem among the inhabitants of Kajiado County.

Another study conducted in Kajiado County in 2016 to examine the pathways that can be used to characterize the risk of Q fever infection to humans in Kajiado County concluded that inhalation was the main pathway for the transmission of Q-fever infection in the County because of the high likelihood of exposure to Q-fever through this pathway (Peter *et al*, 2016). The same study also concluded that the risks associated with exposure of humans to *Coxiella burnetii* from infected cattle among the pastoralists in Kajiado County were substantial, given their livestock keeping and milk consumption patterns. The County is a pastoralist area that is predominantly inhabited by Maasai people whose food consumption habits allow the consumption of raw milk. Of the households surveyed in three sub-Counties of the Kajiado County in the Peter *et al* (2016) study, about 90%, 66% and 30% of the households in

Namanga, Mashuru and Ngong' sub-Counties respectively consumed raw milk. Therefore, the Namanga and the Mashuru residents were at a higher risk of exposure to the *Coxiella burnetii* through the raw-milk-consumption when compared to the Ngong' residents. However, Q-fever in Kenya is not confined to pastoralist areas. Maina *et al* (2012) reported Q-fever seroprevalence rates of 28.3% in cattle, 32.0% in goats and 18.2% in sheep that are kept by the smallholder farmers in Western Kenya. The same study estimated a Q-fever seroprevalence rate of 30.9% in humans among the smallholder farmers in Western Kenya.

The Nakeel *et al* (2016) study showed that Q-fever in pastoral communities is of great public health and economic importance in both humans and livestock. Peter *et al* (2016) noted that the clinical symptoms of Q fever manifest themselves as a non-specific febrile illness associated with pneumonia or hepatitis, sudden onset of fever, chills, profuse sweating, and severe headache, among others and qualitatively rated the impact of the Q fever infection among the pastoralists in Kajiado County as "medium". The available literature shows that the clinical form of the disease is associated with inability to work and its subsequent impact on livelihoods. However, the clinical form of Q-fever is not very common in infected people; the subclinical form is more common. Some studies conducted to assess the impact of Q fever one year onwards after the infection show that this disease causes a decrease in the quality of life of the patients as well as severe fatigue (Limonard *et al*., 2010 and Morroy *et al*., 2011).
Even though the results from the Wakhungu *et al* (2014) study suggest that the absolute risk of Q fever transmission from cattle to humans among the pastoralists in Kajiado County was relatively low, both Wakhungu *et al* (2014) and Peter *et al* (2016) show that Q fever transmission from cattle to the pastoralist communities in Kajiado County is likely. This conclusion is supported by the fact that infected animals (especially cattle) tend to shed high numbers of the Q-fever pathogens (*Coxiella burnetii*) in the placenta and birth fluids at the

time of an abortion or delivery (Rodolakis, 2006; Rousset *et al*., 2009), yet the pastoralists do not use protective clothing when handling and assisting their cattle to calve and due to the fact that they tend to consume raw milk. Almost all the respondents in the Peter *et al* (2016) study stated that they had assisted in some livestock reproduction events (such as calving, stillbirth, abortion), some of which could be attributed to Q-fever (*Coxiella burnetii*) infections. For these reasons, the Peter *et al* (2016) study recommended that the veterinary personnel in Kajiado County should try to investigate all cases of abortions and retained placentas in livestock that are included in their disease surveillance reports. Further, the study called for concerted efforts for the disease control by both veterinary and health personnel and recommended that awareness on the seriousness of the Q-fever infection, etiology, mode of transmission, risk factors and methods of prevention be created among the pastoralist people, especially through public health education.

Based on the above findings, it made sense for the current study to estimate the economic impact of Q fever in Kajiado County to be able to enlighten policy makers, veterinary doctors and medical doctors on the need for Q fever surveillance in the County.

Table 1: Documented Q fever epidemiological parameters in Kenya in the past 10 years

Year	Study area	Species	Prevalence estimate	Sample size	Diagnostic test	Livestock system	Sources of data
2013	Siaya County (Rarieda)	Cattle Sheep Goats Humans	28.3% 18.2% 30.0% 30.9%	378 159 378 246	ELISA and IFA	Smallholder	Knobel *et al*
2014	Laikipia County	Cattle Sheep Goats Camels	3% 16% 25% 20%	214	ELISA	Pastoral system	Depuy *et al*
2014	Tana-River County	Humans Adults Children Adolescents	26.8% 34.2% 23.2%	200	ELISA	Pastoral System	Mwololo *et al.*
2014	Baringo county	Humans	54.8%	31	ELISA	Pastoral system	ZDU, Kenya
2014	Western	Humans	4.5%	738	ELISA	Smallholder	Cook, E.A. *et al*
2016	Kajiado County	Cattle Sheep Goats Humans	89.7% 57.5% 83.1% 26.7 %	156 80 83 90	ELISA	Pastoral system	Nakeel *et al*
2017	Baringo County	Sheep Goats	12.2% 26%	840	ELISA	Pastoral system	Muema *et al*

4.2 Demographic factors, Knowledge, attitudes and perception of Q fever infection

Eighty-four (84) household heads were interviewed in the 'larger' study in which 86.9% were males while 13.1% were females. Of these participants 61.9% were aged below 50 years and 38.1% were above 50 years of age. Of all the participants, 44.05% had no formal education with the rest of the participants having at least lower primary education as shown in Table 2 below.

From the 84 interviews conducted, 1.2% (1 out of 84) pastoralists expressed awareness of Q fever, as shown in Table 2, but they had no knowledge of its clinical presentation in both humans and animals. The rest of the pastoralist had never heard of Q fever infection.

Table 2: Q fever knowledge and Measures of demographic factors of Household interviews

Knowledge of Q Fever Infection	**Frequency**	**Percentages**
Yes	1	1.2%
No	83	98.8%
Demographic factors	**Frequency**	**Perception**
1. Sex		
Male	73	86.9%
Female	11	13.1%
2. Age		
≥ 50 Year	32	38.1%
Below 50 Years	52	61.9%
3. Highest Level of education		
College	6	7.1%
Secondary	25	29.8%
Lower Primary	16	19.05%
No formal education	37	44.05%

Seven FGDs were conducted with pastoralists composed of both men and women; while nine KIIs were conducted with the heads of health facilities in Kajiado County. There was low knowledge of Q fever disease from both the FGDs and KIIs participants. None of the participants of FGDs (pastoralists) had ever heard of Q fever. However, KIIs conducted with health workers revealed that 66.7% (4 out of 9) of the participants were aware of Q fever disease, but they had limited knowledge on its clinical manifestation, diagnosis, treatment and prevention.

Table 3: Composition of Focus Group Discussions held in Kajiado County

Sub counties	**Name of FGDs Locations**	**No. of men**	**No. of women**	**Total No. of participants**
Namanga	Ngatataek	10	5	**15**
Namanga	Namanga Town	9	1	**10**
Mashuru	Aaroi	2	8	**10**
Mashuru	Nkama	5	1	**6**
Ngong	Ewuaso Kedong	5	5	**10**
Ngong	Ewuaso Kedong	0	8	**8**
Ngong	Ewuaso Kedong	5	4	**9**

4.3 Prioritization of diseases according to participants of FGDs using Kruskal-Wallis method

Common cold and malaria were highly ranked by participants of FGDs/pastoralist. Between the two, common cold being ranked higher as the most commonly occurring disease (Table 4). There was a significant statistical difference in the mean rank orders for diseases reported by pastoralists ($P < 0.05$), showing that the diseases were ranked differently across the seven FGDS. Some diseases had significantly high scores: common cold (Z-score = 3.95) and Malaria (Z-score 3.75). Other diseases had marginally significant high scores with positive Z value scores. These diseases included brucellosis, arthritis, typhoid, tuberculosis, eye infections, skin diseases, and pneumonia

Table 4: Ranking of diseases affecting household members according to pastoralists' perception

Diseases affecting households	Median rank	Mean sum rank	Z-score
Common cold	0.18	168.6	3.95
Malaria	0.13	165.4	3.78
Diarrhoea	0.07	129.4	1.94
Brucellosis	0.07	126.9	1.81
Arthritis	0.05	123.7	1.65
Pneumonia	0.06	118.9	1.40
Typhoid	0.04	115.5	1.23
Skin disease	0.05	112.3	1.06
Eye infection	0.07	109.9	0.94
Stomach	0.06	108.1	0.85
Allergies	0.00	97.9	0.33
HIV/AIDs	0.00	84.3	-0.37
Tuberculosis	0.00	82.1	-0.48
Worm infestation	0.00	81.7	-0.50
Tonsilitis	0.00	79.4	-0.62
Diabetes	0.00	78.9	-0.64
Back pain	0.00	70.3	-1.09
Toothaches	0.00	64.9	-1.36
High Blood Pressure	0.00	64.4	-1.39
Anthrax	0.00	62.1	-1.51
Trachoma	0.00	61.8	-1.52
Menengitis	0.00	60.6	-1.58
Breast pain	0.00	53.0	-1.97
Cancer	0.00	53.0	-1.97
Ear infection	0.00	53.0	-1.97
Urinary tract Infection	0.00	53.0	-1.97

Kruskal-Wallis H value = 88.72 (adjusted for ties) with 25 d.f. (degree of freedom) and P value < 0.05. The first column shows the diseases listed in the FGDs, the second column is the median ranks, the third column is mean rank calculated by the ranking each disease per FGDs and finding its overall mean in the focus group discussion, the forth column is the Z-score (giving the statistical significance) of each disease in all the FGDs.

4.4 Prioritization of diseases according to the participants of KIIs using Kruskal-Wallis method

According to the KII conducted with health facilities' heads, pneumonia, malaria and upper respiratory infections were highly ranked with their Z-score as 3.92, 3.07 and 3.12 in the respective order (Table 5), while brucellosis, tonsillitis and typhoid fever had marginally

significant ranks. There was a significant statistical difference observed for the mean rank orders for these diseases ($P < 0.05$) showing that the diseases were ranked differently across the nine KIIs.

Table 5: Ranking of diseases that affect pastoralists' household members according perception of health officers

Diseases affecting pastoralists	Median Rank	Mean sum rank	z-score
Pnuemonia	0.18	156.8	3.92
Malaria	0.12	143.4	3.12
Upper Respiratory Infections	0.20	142.4	3.07
Typhoid	0.07	137.1	2.75
Brucellosis	0.04	113.1	1.34
Tonsilitis	0.09	110.7	1.19
Dysentry	0.02	99.6	0.53
Common cold	0.00	89.7	-0.05
Urinary Tract Infections	0.00	85.3	-0.31
Diarhhoea	0.00	84.6	-0.35
HIV/AIDS	0.00	80.6	-0.58
Tuberculosis	0.00	80.4	-0.60
Ear infection	0.00	73.6	-1.00
Eye infection	0.00	66.2	-1.44
Stomach infection	0.00	62.5	-1.65
Trachoma	0.00	59.8	-1.81
Menengitis	0.00	59.4	-1.84
Skin diseases	0.00	58.9	-1.87
Arthritis	0.00	53.0	-2.22
Unspecific fever	0.00	53.0	-2.22

Kruskal-Wallis H value = 85.08 (adjusted for ties) with 19 d.f. and P value <0.05, the first column shows the common diseases listed by Key informants in the health facilities, the second column shows median rank for the diseases and the third column shows the mean rank for the diseases in all the hospitals and the forth column shows the Z-score of each diseases in the hospitals visited.

4.5 Assessing the level of agreements on rank orders for diseases given by participants using Kendall's co-efficient of concordance

The level of agreement on the diseases' rank orders was weak ($P > 0.05$) for the various diseases which were affecting livestock farmers/pastoralists as ranked by participants in FGDs and KIIs. The level of agreement assessed using Spearman's rank correlation coefficients also showed weak agreement; $r = -0.153$ and $r = -0.115$ for the FGD and KII respectively as

shown in Table 6 below. This shows that the diseases were ranked differently across the FGDs and across the KIIs. The scale of measurement is as follows; *W* value represents the level of agreement, the scale of agreement ranges from $0 \leq W \leq 1$; 0 is no agreement, ≤ 0.4 is weak agreement, 0.5 to 0.7 is moderate agreement and 0.8 to 1.0 is strong agreement (Legendre *et al*., 2010).

Table 6: Assessment of level of agreement amongst pastoralists and health personnel perception on prevalent diseases

Tests	**FGDs**	**KII**
Kendall's coefficient of concordance (W)	0.012	0.009
Adjusted for ties	0.019	0.014
Sample size	7	9
Spearman rank correlation	-0.153	-0.115
Number of diseases	26	20
Sum of squares	233.50	213.00
P- value	> 0.05	> 0.05

4.6 Response of the pastoralist to diseases affecting the household according to the FGDs

According to the FGDs conducted in Ngong and Mashuru sub-counties; the first response of the pastoralists to diseases within their households was use of local herbs, while according to the FGDs conducted in Namanga, pastoralists either opted for self-medication from local pharmacies (self-medication entails buying medicine from the local chemists without prescription from a health officer) or the sick individuals were taken to faith healers (religious leaders). The FGD participants also reported visiting health facilities for medical intervention, but this was resorted to when other options such as traditional medicine/herbs and spiritual healers failed since most health facilities were located more than 5 Kilometers from the homesteads. Interviews conducted with household heads indicate that 99% of the participants visited health facilities such as government hospitals and dispensaries, private and faith-based clinics. According to the household interviews 90.5% of the participants also reported that their homes were located more than 5 Kilometers from the health facilities

Table 7: Distance to nearest health facility

Distance to nearest health facility	Frequency	Proportion
< 5 kilometers	8	9.5%
>5 kilometers	76	90.5%

4.7 Estimating the Economic Impact of Q fever infection in humans

4.7.1 The clinical outcomes of Q fever infection

Results from literature review conducted show that in case of primary infection with *Coxiella burnetii*, 60 % of individuals show no clinical signs of the disease (regarded as subclinical Q fever infection), while 40% develop into acute Q fever infection. Literature reviews also indicated that from individuals who develop acute Q fever; approximately 70% of acute cases were self-resolving, while about 30% of the acute Q fever cases escalate to chronic form of Q fever infection; 15% of these individuals who have acute Q fever infection would develop post Q fever fatigue syndrome and only 2% of the acute Q fever cases would develop into endocarditis cases (Figure 3). Recurrent granulomatous lesions is manifestation of chronic Q fever infection, characterized by granulomas (tissue collection of macrophages) in the event of chronic infection, affecting mostly the liver. It is however very rare in occurrence compared endocarditis in chronic Q fever infection.

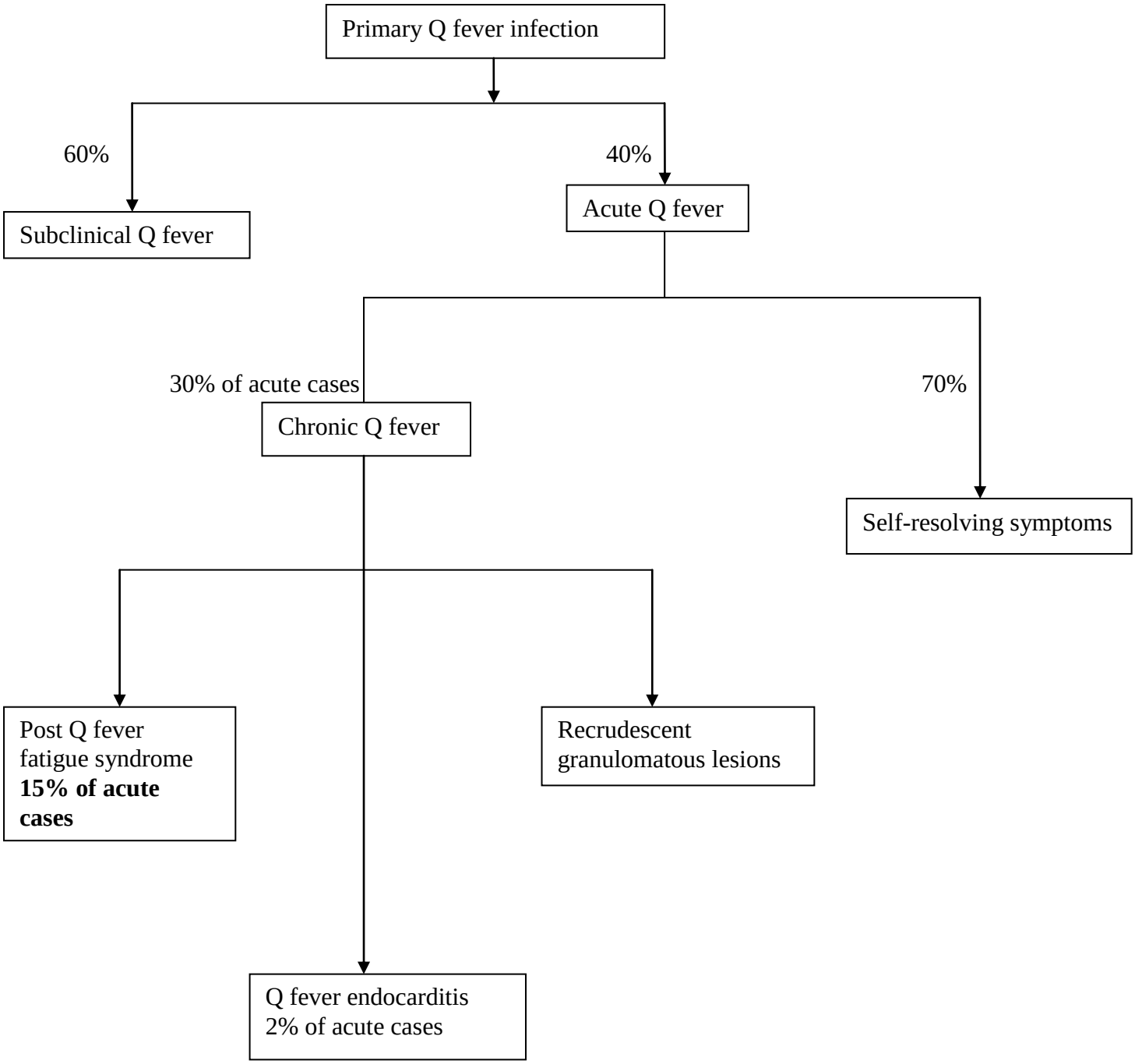

Figure 3: Framework of Q fever clinical outcomes based on review of literature sources

4.7.2 Parameters used in the deterministic economic model

Table 7 shows a compilation of parameters that were used in estimation of economic impact of Q fever. The data presented from this table were obtained from both the primary and secondary sources.

Table 8: Parameters used in the estimation of economic impact of Q fever

Parameters	**Mean Values**	**Range**	**Sources**
Maximum cost of treating febrile diseases (Ksh)	1850	100 - 3,000	FGDs & KIIs
Average cost of transport (Ksh)	400	300 - 1100	FGDs
Average time taken while seeking health services (hours.)	0.7	0.3 - 1.5	FGDs
Average distance to the hospital (Kilometers)	7	4 - 20	FGDs
Household size	6	6 -10	(UNDP, 2012)
Working days lost (days)	14	14 -21	(Marrie *et al*., 1990)
Minimum monthly wages in Kenya (Ksh)	11,000	-	(Grant Thornton, 2015)
Prevalence of Q fever in Kajiado County (%)	26.7	-	(Nakeel et al., 2016)

4.8 Probabilities of outcomes of Q fever infection within households in Kajiado County

The probabilities of the clinical outcomes of Q fever infection were analyzed in a deterministic model using the formulas shown in the Table 8. Q fever infection was found likely to develop in 1.56 persons in pastoralists households. From the individuals infected 0.96 persons are likely to develop sub-clinical/asymptomatic Q fever infection, while 0.64 persons are likely to develop acute Q fever. From individuals who develop acute Q fever infections within households; 0.19 persons are likely to develop chronic Q fever infection, 0.45 persons are likely to have self-resolving condition, while 0.03 persons are likely to develop post Q fever fatigue syndrome. If chronic Q fever develops, it could be manifested either as granulomatous lesions which is likely to affect only 0.16 persons or endocarditis which is likely to affect 0.012 persons. The results above are shown in Figure 4.

Table 9: Formulas used in the economic model to derive probabilities of outcomes of Q fever infection

Outcomes of Q fever infection estimated	**Formulas used in the model**	**Predicted value of parameter**
Primary Q fever infection	Q fever prevalence*household size	1.56
Sub-clinical Q fever	Sub-clinical Q fever * Primary Q fever infection	0.96
Acute Q fever	(Primary Q fever infection) – (Subclinical Q fever)	0.64
Chronic Q fever	Chronic Q fever * Acute Q fever	0.19
Self-resolving Infections	(Acute Q fever) – (Chronic Q fever)	0.45
Post Q fever fatigue syndrome	Post Q fever syndrome * Chronic Q fever	0.03
Granulomatous lesions	(Chronic Q fever) – (Post Q fever syndrome)	0.16
Q fever endocarditis	Q fever endocarditis *Acute Q fever	0.012
Cost of acute disease (Ksh)	(Direct costs) + (Indirect costs)	4,450
Cost Post Q fever syndrome (Ksh)	(Direct costs) + (Indirect costs)	150
Estimate of impact for Q fever infection in pastoralist households (Ksh)	(Cost of acute disease) + (Post Q fever syndrome)	4,600

Key
(*) is Multiplication sign,
(+) is Addition sign,
(-) is subtraction sign

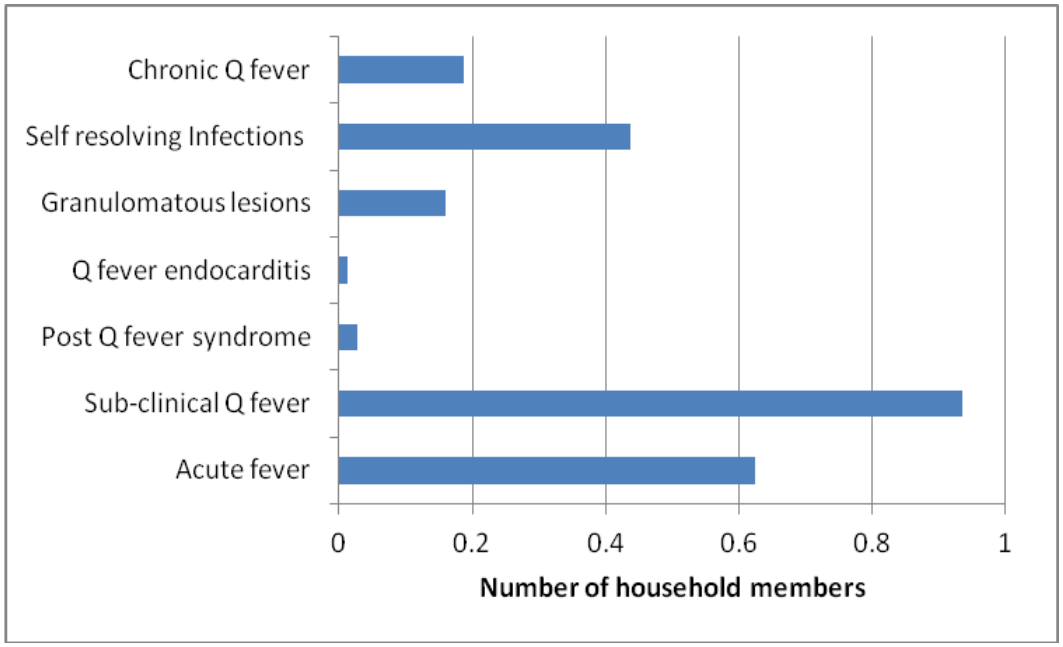

Figure 4: Predicted health outcomes from primary Q fever infection in typical pastoralists' household

4.9 Economic impact of Q fever infection in a typical pastoralist household in Kajiado County

Q fever infection is mostly subclinical as shown in Figure 3 above. The economic impact assessment was therefore conducted based on acute and post Q fever fatigue syndrome. This is because Q fever infection is first manifested as an acute infection and most recoveries are accompanied by post Q fever fatigue syndrome. Based on the results shown on Figure 5, within a household the costs for a single case of acute Q fever was estimated at Ksh 4,400, while the cost of post Q fever fatigue syndrome was estimated at Ksh 200. These costs were calculated based on the medical expenses and the number of working days lost per infected household member. Therefore, overall estimated economic impact of Q fever in pastoralist household was Ksh. The direct cost of Q fever was estimated at Ksh 3,300 while indirect cost of Q fever infection was estimated at Ksh 1,200. The direct cost of Q fever infection therefore had a greater impact than indirect cost considering the overall estimated economic impact of

Q fever, and that infected household members are likely to stay away from work for a number of days, which is translated to lost income to these households (Figure 6).

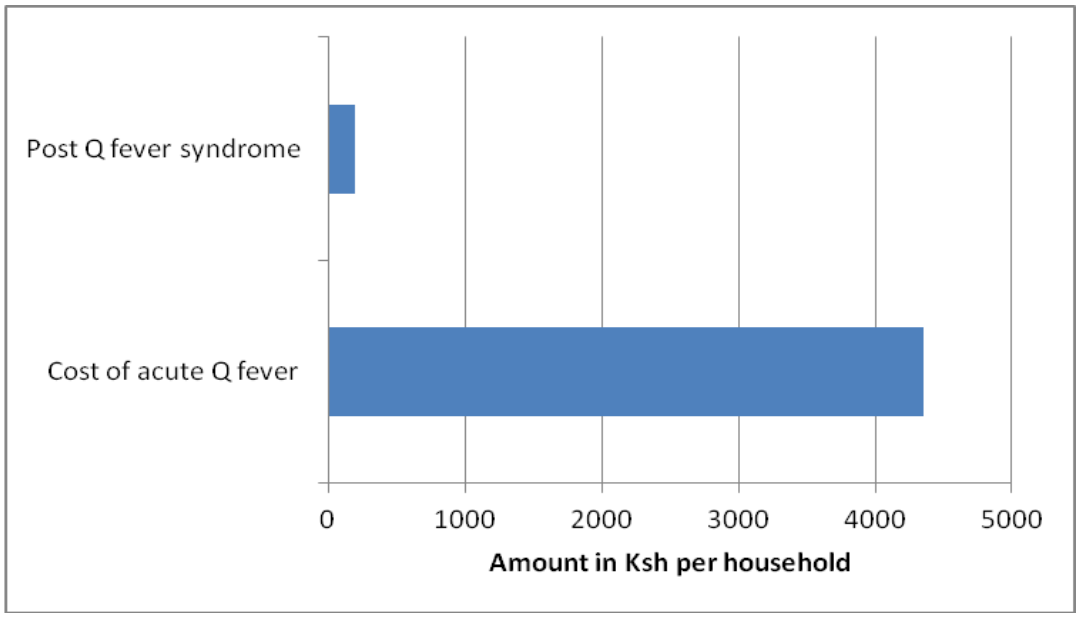

Figure 5: Predicted costs of Q fever infection in a typical pastoralist's household

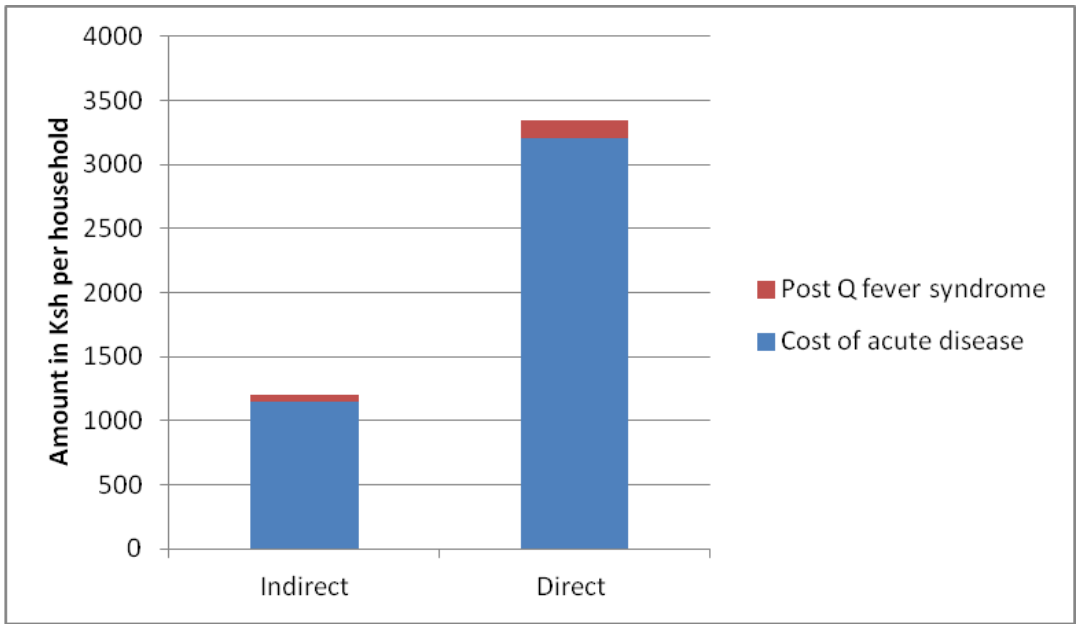

Figure 6: Estimated impact of Q fever infection in a typical pastoralist's household

CHAPTER FIVE: DISCUSSION

Participants of household interviews were mainly males, compared to FGDs and KIIs which had both males and females with relatively balanced gender distribution. Household interviews had more male participants attributed to the fact that pastoralists household are headed by males. FGDs and KIIs allowed equal opportunity for all genders to participate in the study, except for one women's self-help group that was recruited to participate in FGD. Most of the participants of the household interviews were below 50 years of age with majority having formal education up to at least lower primary education, showing a significant level of literacy among the participants in the study area.

According Taylor *et al* (2001) and Graham *et al* (2008), zoonotic diseases comprise about 61-75 % of diseases that affect humans. Q fever being a neglected zoonotic disease poses a public health problem especially to communities at risk such as the pastoral communities who live closely with livestock and since it is an occupational hazard. Q fever has a very pleomorphic and non-specific clinical presentation which contributes to it being misdiagnosed. Lack of adequate knowledge of Q fever among Pastoralists and Health Officers in Kajiado County as shown in this study is supported by findings from Nakeel (2016), who reported that there was a complete lack of awareness of the Q-fever as an infectious disease, its risk factors and the methods of its prevention and control in the Kajiado County study area, not even among the veterinary and medical workers. Apparently, Q-fever was not suspected and routinely tested for in any of the health facilities in the County, despite the common symptoms it shares with other diseases such as malaria, typhoid and brucellosis. However, the Nakeel (2016) study concluded that there was a high likelihood of Q-fever being enzootic in the study area, thus presenting a serious public health problem among the inhabitants of the Kajiado County. After hearing about Q fever for the first time, participants were interested in acquiring more knowledge about the disease. However, further discussion showed that

pastoralists perceived Q fever to be a disease of less significance in livestock after they learnt that it causes no mortalities in livestock. The finding of lack of awareness of Q fever among pastoralist communities is consistent with other studies (Depuy *et al*., 2014), which reported no knowledge of Q fever among pastoralists in Laikipia County. In the Depuy *et al* study most of the interviewees that included conservation professionals, human healthcare providers, veterinary practitioners and rangeland management experts expressed both awareness and concern about Q fever. Limited knowledge of Q fever among the health workers causes a major challenge in its treatment and prevention and possibly explains why there were no cases of Q fever reported in health facilities in Kajiado County. Inadequate Q fever awareness and knowledge among health personnel may results in its misdiagnosis posing a risk of high Q fever prevalence. This is consistent with Chipwaza *et al* (2014) study which reported that wrong perception and lack of knowledge posed challenges to the health workers in obtaining comprehensive history from patients, with regard to diseases that affected them.

Q fever accounts for a significant proportion of undifferentiated human febrile illness including flu, pneumonia, malaria, typhoid fever and brucellosis (Vanderburg *et al*., 2014). These diseases were highly ranked to be prevalent by the health officers and pastoralist. Other studies conducted in Kajiado and other parts of Kenya have proven that the prevalence of Q fever in humans and livestock is high. The prevalence of Q fever could be higher than deemed in the study area. In this study, common cold and malaria were highly ranked by pastoralists as the most prevalent diseases, which was consistent with the findings in a past study where the most prevalent diseases recorded in health facilities in Kajiado were Upper Respiratory Tract Infection (URTI), malaria, diarrhea, pneumonia and skin diseases in that order (MoWNR, 2013). Q fever is a disease which has flu-like clinical symptoms and could easily be passed for flu if confirmatory medical examination is not conducted. This is supported by

Knobel *et al* (2013) study which showed that Q fever was a significant yet underdiagnosed cause of human respiratory illnesses. In this study, malaria was considered to have a very high prevalence by the pastoralists. This was in contrast with the findings from the health officers who perceived malaria to be of low prevalence in Kajiado County. The report of the health officers were supported by a study conducted by Division of Malaria Control (2011) where malaria was found to have low prevalence in semi-arid lands. Malaria is believed to be systematically over-reported according to a past study (Reyburn *et al* 2004), especially in settings where there is no appropriate capacity or tools for definitive differential diagnosis. Most febrile conditions are likely to be perceived as malaria as was the case in this study and this poses a danger of malaria prevalence being exaggerated. Q fever therefore should be considered as a possible cause of febrile illness when response to malaria treatment is poor or when there are no facilities for confirmatory diagnosis (Brouqui *et al.,* 2005). In the current, study pneumonia was highly ranked by health workers as a prevalent disease in the study area. However, pneumonia was reported to be a common occurrence in children aged 1-5 years. This was consistent with the finding of Rudan *et al* (2004), which showed that pneumonia was a major public health problem in children less than 5 years globally. Pneumonia has many etiologies, *Coxiella burnetii* being one of the bacterial causes. More conclusive tests are essential to know the cause of pneumonia in the study area. This finding is consistent with a study that showed Q fever as common cause of community-acquired pneumonia and a significant yet underdiagnosed cause of human respiratory illnesses (Vanderburg *et al*., 2014; Knobel *et al*., 2013). Although pneumonia was among the diseases listed by the pastoralists, it was not prioritized as a common occurrence. This was in contrary to the health officers who prioritized pneumonia as a common disease in children of five years and below. The pastoralists/farmers purported that they somehow had unknown resistance to pneumonia. Q fever is a common cause of community-acquired pneumonia (Vanderburg *et*

al., 2014), but most pneumonia cases in the study area were diagnosed based on history and clinical signs, which was neither confirmatory nor conclusive. Therefore, etiologies of pneumonia in most cases remain unknown and Q fever remains a suspected cause of pneumonia in adults.

There was a difference in the ranking order of diseases of diseases between the pastoralists and health workers. This was attributed to difference in knowledge and perceptions between the two groups. The health workers had a background in human medicine and thus were well equipped to easily identify common infectious diseases by name. The pastoralists used the presenting symptoms of diseases to describe diseases they did not know by names. Results from the two groups, FGDs and KIIs, could not be accurately compared due to lack of heterogeneity of results of the two groups in terms of type of diseases and number of diseases listed and ranked. Q fever was not among the diseases prioritized by both health workers and pastoralist due to inadequate knowledge of the diseases. Q fever falls in the category of underreported and misdiagnosed zoonotic diseases. Such diseases tend to be dismissed in prioritization of diseases, yet they have a potential to cause greater impact if present within household than other easily identifiable diseases. Pastoralist awareness and knowledge of diseases such as malaria, pneumonia, flu and common cold could have resulted to exaggeration of reported cases, while underreporting other unknown diseases, since they are likely to emphasize only on those diseases they know.

Acute Q fever infection is one of the significant clinical outcomes of Q fever infection in which it can either resolve without treatment in 2-3 weeks or escalate to chronic infection. Acute infections are also accompanied by post Q fever fatigue syndrome which causes impairment of general and social functioning. Q fever outbreak that occurred in Netherlands revealed post Q fever fatigue syndrome contributed to major economic losses in the overall impact of the disease. Other clinical outcomes such as chronic Q fever have relatively low

prevalence. According to this study acute Q fever is more likely to occur than other clinical outcomes. This is because acute Q fever symptoms develop within 2-3 weeks of exposure (CDC, 2011) and takes 2-3 weeks to resolve (Maurin *et al*., 1999). Other studies conducted on Q fever have continuously shown that post Q fever fatigue syndrome is a common occurrence in patients who have had acute Q fever infection (Wildman *et al*., 2002). In this study post Q fever fatigue syndrome was found to be more likely to occur than chronic Q fever infection in pastoralists' households. This finding is supported by a studies (Morroy *et al*., 2011; Wildman *et al*., 2002) which showed that the prevalence of Post-Q fever fatigue syndrome was higher than chronic Q fever after acute Q fever illness.

During the 2007-2010 Netherlands Q fever outbreak, one of the greatest losses in relation to impact of Q fever was attributed to Q fever fatigue syndrome (van Asseldonk *et al*., 2013). After the outbreak 50% of the patients had reduced general quality of life (van Loenhout *et al*., 2014) and the estimated income loss was largest due to the duration of sick leave accumulated overtime (Tempelmann *et al*., 2011). In this study the economic impact of Q fever was estimated to cost Ksh 4,600 per episode of Q fever in households with acute Q fever infection costing Ksh 4,400 and Post Q fever fatigue syndrome costing Ksh 200. Considering the minimum monthly wage in Kenya as used in this study (Ksh 11,000), the economic impact of Q fever would account for approximately 40% of the household expenditure. A high proportion of the expenditure is attributed to health-related issues. For pastoral communities, who are basically the poor in the country, the economic impact of Q fever is thus significant. This study shows that the direct cost of Q fever infection is higher than indirect cost. The greater economic impacts of Q fever are attributed to loss of income due to number of working days. Most pastoralist households depend on livestock and livestock products for their livelihood. Failure to work results in lack or inadequate income for families. This is consistent with a study conducted by Onesmo *et al* (2013) which showed

that time spent on treating diseases and caring for sick members of the household had an impact on the household income. In addition, pastoralist depend on manual work for production of income. Therefore, condition that is likely to affect their capacity to work is detrimental to their livelihood. This is supported by a study conducted by Bloom *et al* (2004) and Strauss *et al* (1998) which showed that productivity depends on the capacity of an individual to work and thus the ability to generate income. Q fever mostly occurs in individuals directly in contact with infected animals excretions and products making it an occupational hazard to livestock keepers such as pastoralist communities, with a higher risk in men than women as revealed in Maurin *et al* (1999) study. Since men are at a higher risk, household are in danger of severe poverty considering men are usually the breadwinners in their homes. The main sources of income as reported by pastoralist were; sale of livestock and borrowing from friends and relatives. Debts and selling of assets in this case livestock and pieces of land to meet the medical expenses would results in a shift of expenditure patterns where most of the finances would be used to cater for the needs of the sick. These shifts generally affect households' social stability. The study findings show that Q fever is of great economic importance in Kajiado County and Kenya in general. Hence there is need for Q fever surveillance in Kenya

Diagnosis, treatment and management of zoonotic diseases such as Q fever is a challenge to health personnel. Apart from inadequate knowledge of Q fever among the health personnel as was established in this study, there are other factors that would possibly cause misdiagnosis and underreporting of diseases in the study area. One of the factors is behavioral patterns of pastoralists in response to diseases' infections in their households where they prefer the use of herbal medicine to visiting health facilities for proper medication in the incident of a disease. Health facilities were only visited if herbal medicine was ineffective. This is contrary to a study by Chipwaza *et al* (2014) which pastoralists participants reported visiting health

facilities as the first response in an attempt to treat diseases. Herbal medicine was popular due to ease of access by the community as compared to conventional drug stores or health facilities located in town centers. Pastoralist from Mashuru Sub County consulted faith/spiritual healers from their local churches to heal their diseases, this was possibly owed to their religious background. Self-medication was also a common practice especially among pastoralists residing near town centers as was the case in Namanga Town. A similar study by Kunda *et al* (2007) found that self-medication as a common practice among participants in that particular study. In the current study most pastoralists when asked, could not differentiate pharmacies from hospitals. Therefore, diagnosis and treatment of diseases was also offered by local pharmacists as observed in Mashuru Sub County where the pharmacist reported treating illnesses. There were patients waiting to be treated by the pharmacist. There is increased danger of drug resistance in individual who get medicine over the counter (self-medicate) in local pharmacies (Kagashe *et al*., 2011). It is most likely that people who could easily access the drug stores, self-medicated unconfirmed malaria cases assuming that most febrile illnesses were malaria (Deressa *et al*., 2003; Hodel *et al*., 2009). The second factor that could be limiting Q fever diagnosis and management is the long distances covered by community members in search for medical assistance. Health facilities in the study area are commonly located in the towns ranging between 5-20 kilometers from homesteads. The long distances covered is attributed to the fact that pastoralists' households are sparsely distributed in the study area. The third factor that limited diagnosis and management of diseases was financial implications which hindered access to health facilities for medical intervention. Discussions with the pastoralists' revealed that health facilities were far and visited only on convenient days, such as market days when public transport was available. On non-market days, one would be forced to use other means of transport such as motorcycles which were relatively expensive with transport cost ranging between Ksh 200-600 to reach the health centers.

Observations during the studies also showed poor roads which were almost inaccessible especially during rainy seasons thus being a hindrance to accessing medical services in the study area.

5.1 Limitation

This study did not include other impacts of Q fever that cannot be quantified such as DALYs (Disability Adjusted Life Years) attributed to emotional burden of the disease on the sick and family members caring for the sick. These have significant impacts which have not been captured in this study. This study did not also include the impact of Q fever on Livestock production; but anything affecting pastoralists' livestock also has impact on their livelihood in general, and therefore future studies should consider investigating the impact this disease has on livestock. The socio-economic impact of Q fever would hence be higher than reported in this study.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

Pastoralist and health officers had no knowledge of Q fever occurrence in Kajiado. More specifically, the pastoralists were not aware of Q fever's existence. The diseases ranked highly by the pastoralist to be common in occurrence were common cold and Malaria, while diseases ranked highly by health officers to be common in occurrence included pneumonia, upper respiratory problems, malaria and typhoid. The first response of the pastoralist to diseases was the use of herbal medicine, and health facilities were only visited if herbal medicine was not effective. The long distances to local health facilities from pastoralist homes, poor terrain and limited transport were some of the factors that hindered pastoralist from obtaining proper medical care. The impact of Q fever was estimated at Ksh 4,600, and this was mainly attributed to direct costs due to loss of income from the working days lost and indirect costs including medical cost and transport cost. Other studies conducted in Kajiado County have established the presence of Q fever. Pastoralists had a perception that any febrile illness was malaria, this poses a danger of over-diagnosis of malaria, especially in those individuals who self-medicate, and under-diagnosis of other febrile diseases such as Q fever which need well informed health worker and well-equipped health facility for confirmatory diagnosis. Most importantly, the results of the estimate of the economic impact of Q fever in Kajiado County show that there is need for Q fever surveillance in the County given that Kajiado County is a high-risk area for Q fever infection attributed to the high densities of livestock and other socio-cultural risk factors that have a potential to increase the risk of Q fever infection.

6.2 Recommendations for future research activities

1. There is need to conduct Q fever Sero-surveillance in both humans and livestock not only in Kajiado County but also in Kenya at large
2. It is a necessity to create awareness on the occurrence and importance of Q fever in Kajiado County among veterinary and health professionals as well as pastoralists.
3. Q fever should be considered a priority disease in pastoral communities such as Kajiado County due to their lifestyle of close interaction with livestock; livestock is the main source of infection in humans.
4. To control and prevent Q fever infection in Kajiado and Kenya at large, there is need for one health approach involving combined efforts of pastoralist, veterinarians, health workers, environmental scientists and the government.

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APPENDIX 1: Individual Farmer Questionnaire

Questionnaire Number…

Farm Code: …….

« What is killing my cow? » Questionnaire – ALL MANDATORY

Name of interviewer: .....

Date of interview: .....

District.....

Division.....

Village.....

Time of interview: .....

GPS point: .....

Demography

I will start by briefly asking you a few personal questions.

1. How old are you? (------write number if they provide a specific figure)
    a) <=20 years old
    b) 21-30 years old
    c) 31–40 years old
    d) 41–50 years old
    e) >50 years old
    f) Don't know / Prefers not to say

2. What is your gender?
    - Male
    - Female

Coxiellosis knowledge

I will now ask you a few questions regarding an animal disease called coxiellosis

a) Have you heard of the disease called Coxiellosis or Q fever in cattle? Yes

b) No (skip and go to **Q fever section**)

a) What do you think is the cause of this disease in animals? Germs

b) Hereditary
c) Witchcraft
d) Don't know
e) Others (specify) …….

3. In your opinion, which animals are affected by Coxiellosis? (multiple choice)
    a) Goats
    b) Sheep
    c) Cattle
    d) Camels
    e) Others (specify)
    ……

4. In your opinion, what are the common signs and symptoms of Coxiellosis in cattle?
    a. Abortions
    b. Retained placenta after birth
    c. Hot, painful, swollen testicles
    d. Metritis
    e. Weak calves
    f. Mastitis
    g. Weakness
    h. Lack of appetite
    i. Aggression
    j. Fever
    k. Producing little milk/no milk
    l. None
    m. Others (specify):
    ……

5. How do you prevent animals from getting Coxiellosis?
    a. Vaccinations
    b. Isolation of animal delivering

c. Isolation of sick or aborting animals from the rest of the herd
d. Reporting to veterinary authority
e. Don't know
f. Other (please explain)

……..**.....**

6. Can animals transmit this disease to humans?
    a) Yes
    b) No (skip to 140)
    c) Don't know (skip to 140)

7. How is this disease transmitted from animals to humans?
    - Helping animals to deliver/abort by bear hands
    - Handling fetal tissues/aborted fetuses with bear hands
    - Drinking raw milk
    - Consuming products processed from raw milk
    - Tick bites
    - Working in Bomas
    - Slaughtering animals
    - Milking animals
    - Living with animals
    - Others (specify):

    ……

Q fever Knowledge

I will now ask you a few questions regarding Q fever disease

8. Have you ever heard of a disease called Q fever in humans?
   a) Yes
   b) No (questionnaire finishes here)

9. Where did you learn about Q fever?
   a) Newspapers and magazines
   b) Radio
   c) TV
   d) Extension officer
   e) Brochures, posters and other printed materials
   f) Community Animal Health workers
   g) Family, friends, neighbors and colleagues
   h) Religious leaders
   i) Teachers
   j) When I was diagnosed with the disease
   k) Community public health officials
   l) Other (please explain): ……

10. What do you think is the cause of this disease in humans?
   a) Germ
   b) Hereditary
   c) Witchcraft
   d) Don't know
   e) Others (specify) …….

11. In your opinion, what are the signs/symptoms of Q- fever in humans? (Check all that are mentioned.)
   a) Fever
   b) Headaches

c) Shivering
d) Malaise
e) Loss of appetite
f) Flu
g) Nausea
h) Vomiting
i) Blurred vision
j) Abortion in women
k) Don't know
l) Others, specify_____

12. Have you or a member of your family ever been diagnosed with Q fever in the past?
a) Yes
b) No
c) Don't know

13. Do you know of any other person with Q fever in the past outside your family member?
a) Yes
b) No
c) Don't know

14. Can Q fever be cured in humans?
a) Yes
b) No (go to question 148)
c) Don't know (go to question 148)

15. If yes above, how can someone with Q fever be cured?
a) Herbal remedies
b) Home rest without medicine
c) Praying
d) Specific drugs given by health facility
e) Do not know
f) Others (specify): ……

16. Do you wish you could get more information about Q fever?

    a) Yes

    a) No

    b) Don't know

Medical services

17. When you SEEK HEALTH CARE, where would you go first?

    a) Private clinic

    b) Religious prayers

    c) Government clinic or hospital

    d) Traditional healer

    e) A clinic owned by a non-governmental or faith based organization

    f) Stay home

    g) Other

    (specify)……

18. IN THE LAST YEAR, how many times have you gone to a clinic or hospital TO GET TREATED YOURSELF?

    a. Never

    b. Once

    c. More than once

19. What is the distance to the nearest clinic or hospital?

    a. <5KMs

    b. 5-10 KMs

    c. 10-25 KMs

    d. >25 KMs

APPENDIX 2: A copy of interview guide for health facility key informants

Facility information

Facility name_____

Type of facility_____ (circle the answer)

- national hospital
- provincial hospital
- district hospital
- missionary hospital

Interviewee information

Name _____

Position in the health facility_____

Knowledge on Q fever

1. What are the most common febrile diseases encountered in this hospital? (give a list)
2. Would you please help compare and rank these diseases considering which one is more common than the other? (Pairwise ranking to be done)
3. Do you know Q fever disease, where did you hear about it?
    - Yes
    - No
4. If yes, have you ever encountered this disease in this hospital?
    - Yes
    - No
5. If yes, how many cases have you encountered in the past one year?

_____

6. What are the common symptoms displayed by this disease in human patients?

a) .....

b) .....

c) .....

d) .....

7. How do you diagnose Q fever in the hospital?

- Clinical signs
- Laboratory diagnosis
- Other _____

9. What are some of challenges encountered in diagnosis of Q fever in the facility?

Treatment cost of Q fever

10. What are the common tests done on a patient with a febrile symptom for diagnosis?

11. What is the overall treatment cost for a patient who has febrile condition following diagnosis e.g. malaria or typhoid?

Item	Drug	Tests	Consultation fee	Other fees	Bed charges	Total
Cost *(put **No,** where the costs indicated were not incurred and **Yes** where incurred)*						
How much are patients required to pay in Ksh?						

12. Do you think Q fever is worthwhile considering as a differential for the common febrile diseases like malaria?

- Yes
- No

13. If yes, why?

APPENDIX 3: A copy of a guide for focus group discussions

NAME OF INTERVIEWER..... QUESTIONNAIRE NUMBER.....

DATE OF INTERVIEW..... TIME OF INTERVIEW.....

DISTRICT.....

DIVISION.....

VILLAGE.....

DISCUSSION QUESTIONS

1. List the diseases that commonly affects people within a household

   (Probe to get as many diseases as possible)

2. Which are the most common amongst the ones mentioned in the household?

   (Among the ones mentioned pairwise ranking to be done with the help of the participants)

   b) Count the number of time subject in comparison has been mentioned.

Diseases	A	B	C	D	**Total**
A	xxxxxxxxx				
B		xxxxxxxxxxx			
C			xxxxxxxxxxxx		
D				xxxxxxxxxxxx	

3. Convert your pairwise ranking into ranks (interviewer).
4. How do you normally respond to the diseases mentioned? (choose three diseases one of them being general febrile diseases)
    - Seek medical treatment
    - Do nothing
5. Where do you seek medical treatment, in case of febrile disease?
    - Health facility
    - Herbalist
    - Traditional/faith healer
    - Self-medication others
    - others
6. What is the approximate cost of treatment of febrile diseases?
7. What is the approximate distance from the homes to the health facility?

    _____

8. What is the common mode of transportation used to get to the health facility? (choose only one)
    - Motorcycle
    - Private (own means)
    - Public transport
    - Walking
    - Bicycle
    - Animal (e.g. donkey)
    - Other (specify)
9. How long does it take to reach the health facility, given the means of transport mentioned?

_____minutes

10. What is the transport cost, one-way?

    _____KMs

11. In case a febrile disease occurs how many people are normally affected?
12. When someone is sick in the household who normally takes care of the sick, including taking them to the hospital and through recovery period?
13. By taking care of the sick does it affect income generation?
    - Yes
    - No
14. What would you have been doing in times you take care of the sick that is income generating

THANK YOU FOR YOUR TIME