Quantifying the burden of Rift Valley Fever in humans using Disability adjusted life years, 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 work is dedicated to my beloved wife Esther and my son Roy Bitek for their holistic support, perseverance, motivation and encouragement throughout the entire course.

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LIST OF ABBREVIATIONS

CDC	Centers for Disease Control and Prevention
DALY	Disability adjusted life years
ELISA	Enzyme linked Immunosorbent Assay
FAO	Food and Agriculture Organization
IgM	Immunoglobulin M
IgG	Immunoglobulin G
KEMRI	Kenya Medical Research Institute
KNBS	Kenya National Bureau of statistics
MOPHS	Ministry of Public Health and Sanitation
NICD	National Institute for Communicable Diseases
OIE	World Organization for Animal Health
PCR	Polymerase Chain Reaction
RVF	Rift Valley Fever
RNA	Ribonucleic acid

RVFV	Rift Valley Fever Virus
RT-PCR	Reverse Transcription-Polymerase Chain Reaction
WHO	World Health Organization
WB	World Bank
YLL	Years of life lost to premature death
YLD	Years lived with disability

ABSTRACT

Rift Valley Fever (RVF) virus causes severe epidemics in livestock and humans resulting in considerable economic losses from disruption of livestock production, market chain and morbidity and mortality in humans. Public and private sector costs were incurred through service delivery for prevention and control. At the public health sector, RVF epidemic resulted in severe public health consequences of high morbidity and mortality (a total of 684 human cases with 155 deaths in Kenya). The losses are primarily incurred by households in terms of lost income due to illness, loss of human life and household's expenditures in caring for the patients. This study estimated the burden of disease due to RVF in humans using Disability adjusted life years (DALYs), assessed human health RVF epidemiological parameters and private and public health costs during the last RVF epidemic in the 2006/2007 in Kenya. Family members who cared for an infected person in an eligible household and key informant in the public health sector in Garissa, Baringo and Kilifi districts and public health leaders at the national level were interviewed to aid in estimation of the private and public health costs. An eligible household was a household that had an RVF cases during the 2006/2007 outbreak as identified from the line list. Secondary data from the Ministry of Health and published literature were reviewed for epidemiological parameters including age and sex categorized incidences and mortality rates in order to compute DALYs using methods developed by the World Health Organization and World Bank. A total of 127 eligible households were enrolled into the study and one member interviewed in

each household. Those interviewed in these households included 54% males and their ages ranged from 19 to 81 years old with 40 and 45 years as mode and median age, respectively. The RVF virus predominantly infected males during the outbreak with a crude incidence of 0.7 per 1,000 population compared to females at 0.5 per 1,000 population. Total DALYs lost during the 2006/2007 outbreak was 4,035 (3.4 DALYs per 1000 population) for the reported cases of human RVF, representing 0.7% of the total DALYs for Kenya and estimated household costs of USD 120 for every human case reported. In comparison, HIV/AIDS and malaria are the leading causes of DALYs in Kenya at 24.2% and 7.2% of the total DALYs respectively. Rift Valley Fever is a zoonotic disease and it causes a considerable number of person DALYs yet it has not been considered prioritized by the policy makers' in terms of resource allocation for prevention and control. Results from this study provide vital data on burden of RVF for use by the Government and other institutions to guide in health policy making and resource allocations for prevention and control of RVF to prevent future outbreak in Eastern Africa region.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Rift Valley Fever (RVF) is a mosquito-borne virus associated with epidemics in livestock and humans (Bishop and Calisher, 1980). Transmission to humans is via direct contact through infected animal products or contaminated foods or aborted fetuses and from bites of infected mosquitoes, most commonly the *Aedes* species (Jup *et al*., 2002; Flick and Bouloy, 2005).

Humans infected with RVF virus typically develop a mild, self-limited febrile illness, but retinal degeneration, severe encephalitis, fatal hepatitis, and hemorrhagic fever may also occur (Swanepoel and Coetzer, 2004). Outbreaks of RVF are associated with unusually heavy rainfall, leading to flooding and a synchronous generation of large numbers of infected mosquitoes (Linthicum *et al*., 1999).

The RVF virus was first described in Kenya in 1931 during an epizootic of a fatal hepatic necrosis and abortion in sheep (Daubney *et al*., 1931) and has been reported throughout much of the sub-Saharan Africa (Gerdes, 2004), occurring as irregular epidemics every 3 to 10 years (Linthicum *et al*., 1999). Major epidemics have been reported in Egypt (1977), Saudi Arabia (2000-2001), Yemen in September 2000 (Shoemaker *et al*., 2002) and in Eastern Africa in 1997/1998 and 2006/2007/2008 (OIE, 2006) with the epicentre reported in Northeast Kenya and Southwest Somalia. Rift Valley Fever virus periodically causes outbreaks in humans and in ruminants,

including sheep, cattle, and goats (Mullen and Durden, 2009; Hartley *et al.*, 2011; Ikegami and Makino, 2011; Sindato *et al.*, 2011). Rift Valley fever epidemics are characterized by livestock mortality and abortion in pregnant animals (Woods *et al.*, 2002; Clements *et al.*, 2007). A Rift Valley Fever outbreak results in significant human morbidity, livestock mortality and major economic disruption – largely due to livestock losses and trade restrictions (Clements *et al.*, 2007; Turrell *et al.*, 2008; Hartley *et al.*, 2011; Hughes-Fraire *et al.*, 2011; Sindato *et al.*, 2011). In the Kenya, during the Rift Valley Fever outbreak of 2006/2007, the total economic losses from livestock mortality in this outbreak were estimated to be $7.6 million with national economic losses estimated to be $26 million (Wanyoike and Rich, 2007; MacMillian, 2010). Traders and slaughterhouses are affected by movement bans on livestock and decreased consumer demand for meat, which greatly affects sales of live animals and products (MacMillian, 2010; Mohamed *et al.*, 2010; Sindato *et al.*, 2011).

Public and private sector costs were incurred through service delivery for prevention and control (Clements *et al.*, 2007). At the public health sector, RVF epidemic resulted in high morbidity and mortality with a total of 684 human cases and 155 deaths reported during the 2006/2007 outbreak (WHO, 2007). Losses are primarily incurred by households in terms of lost income due to illness, loss of human life and household's expenditures in caring for patients.

1.2 Problem statement

Although few studies have been conducted to assess the economic impact attributable to human RVF in Kenya and it is thought to be substantial (Laughlin *et al.*, 1981; FAO, 2003; Davies, 2006). RVF burden in terms of disability-adjusted life years (DALYs) and the private and public health costs of RVF management during the 2006/2007 outbreak in Kenya are unknown and this therefore forms the basis for this study.

1.3 Justification

This study is expected to provide vital data on burden of RVF and public and private costs of RVF management that will guide in health policy and resource allocations on the basis of DALY prevented and provide public health sector benefits from livestock interventions. Outputs from this study will be combined with the livestock sector and national economy data for a broader socio-economic assessment to derive cost-effectiveness and economic benefits of different preventive and control measures of RVF. This will lead to evidence-based recommendations on control options for RVF from the societal perspective and improve response capacity to future RVF outbreaks in the Eastern Africa region.

1.4 General objective

To determine the burden of disease due to Rift Valley Fever Virus in selected districts in Kenya

1.5 Specific objectives

- To determine crude estimates of incidence of RVF in humans categorized by sex and age-group
- To determine monetary costs (private and public human health costs) of RVF in selected districts in Kenya.
- To determine non monetary costs mainly the DALY lost due to RVF during the 2006-2007 outbreak.

1.6 Research questions

- What are the crude incidence rates of RVF for different age groups and gender for cases reported during the 2006/2007 RVF outbreak?
- What are the human health costs incurred by households with a RVF case?
- What is the DALY lost due to RVF that would have been averted during the 2006 - 2007 outbreak?

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Etiology of Rift Valley Fever

Rift Valley Fever is an acute, febrile zoonotic disease caused by RVFV, which belongs to the family *Bunyaviridae* of the genus *Phlebovirus* and causes abortion and deaths (Gerdes, 2002; Spickler and Roth, 2006; Clements *et al.*, 2007; Sindato *et al.*, 2011). The virus was first identified in 1931 by Daubney and Hudson during an outbreak investigation of enzootic hepatitis in a herd of ewes which caused abortion and mortality on a farm in the Rift Valley near Lake Naivasha, Kenya, Africa (Flick and Bouloy, 2005; Musser *et al.*, 2006; WHO, 2007; Ikegami and Makino, 2009). Though first isolated out of a lamb during the investigation in 1930, the virus was probably present in tropical Africa as early as the 1800s (Daubney *et al.*, 1931).

The investigators observed a number of abortions in ruminants and the presence of a hyper-acute lethal infection, characterized by necrotic hepatitis in lambs and proposed the name Rift Valley fever for the disease (Easterday *et al.*, 1962; Easterday *et al.*, 1965; Ikegami and Makino, 2009; Hartley *et al.*, 2011). Pregnant ruminants infected with RVFV are subject to high rates of abortion, fetal malformations, and subclinical-to-fatal febrile illness (Bird *et al.*, 2009; Ikegami and Makino, 2011).

The virus is spherical, 80-120 nm in diameter, and is readily inactivated by lipid and acid solvents/conditions <6 pH (Bishop and Calisher, 1980; Gerdes, 2002; Gerdes, 2004). It has a tripartite, negative-stranded RNA, genome consisting of S-, M-, and L-segments each containing a separate nucleocapsid within the virion (Murphy *et al.*, 1999; Gerdes, 2002; Ikegami and Makino, 2009). The nucleocapsids include the S-segment (1,000-3,000 nucleotides), which encodes N and NSs in an ambisense manner, the L-segment (6,500-12,000 nucleotides) that is responsible for the RNA dependent RNA polymerase gene, and the M-segment (3,600-4,900 nucleotides) which encodes the glycoproteins to make up the virus envelope (Figure 2.1) (Gerdes, 2002; Gerdes, 2004; Ikegami and Makino, 2011). This virus replicates in many cell types and antigen has been demonstrated in most areas of the spleen, liver, renal glomeruli, adrenocortical cells, and the walls of vessels (Van Der Lugt *et al.*, 1995; Gerdes, 2002; Gerdes, 2004).

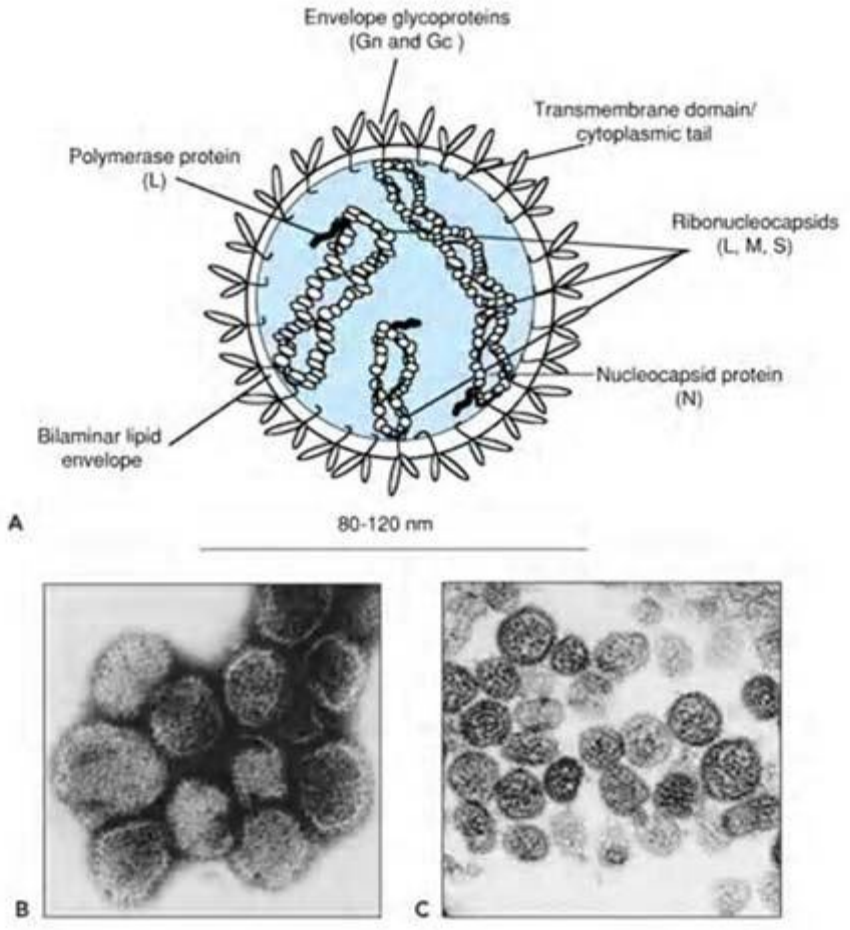

Figure 2.1: Morphology of RVFV adapted from Geisbert *et al*., 2001

2.2 Epidemiology of Rift Valley Fever

Relatively little is known about the natural history of RVFV transmission and infection because natural outbreaks are sporadic and explosive (CDC, 2000; Woods *et al*., 2002). However, epizootic outbreaks do not occur at random, but instead are strongly linked to excessive rainfall and local flooding events. Eastern Kenya experienced unusually heavy rainfall during October - December 2006, three times the average for that period during

the preceding 8 years and 13 times the rainfall in 2005 (Kenya Meteorological Department, unpublished data, 2007).

Rift Valley Fever Virus is maintained in nature at least in part by transovarially transmission in flood-water *Aedes* mosquitoes (Davies and Highton, 1980; Linthicum *et al*., 1985). Certain floodwater *Aedes* mosquito species allow RVFV to become embedded in endemic ecosystems by means of vertical transmission to their offspring. The transovarially-infected mosquito eggs can then remain viable for many years during dry spells (Davies and Highton, 1980; Linthicum *et al*., 1985). When rainfall occurs, shallow depressions in the landscape, called *dambos*, fill with water and allow the eggs to hatch. The newly hatched transovarially RVFV-infected mosquitoes then feed on livestock that come to the dambos to drink, and an RVFV epizootic is initiated. These sites also later breed *Culex spp.* mosquitoes, which are competent to transmit RVFV from animal-to-animal and from animal-to-human (Meegan and Bailey, 1989; CDC, 2000) thus, amplifying the outbreak as 'epidemic' vectors.

2.3 Rift Valley Fever occurrence

The disease is endemic to countries of East Africa, South Africa, and the Senegal River valley (Morrill, 1991) as shown in Figure 2.2. Rift Valley Fever Virus was introduced into Egypt since the 1970s and most recently to the Arabian Peninsula (Yemen and Saudi Arabia) in 2000

(El-Akkad *et al*., 1978; CDC, 2000). The latest Kenyan RVF outbreak occurred in association with *El Nino* rains in November 2006- April 2007 (CDC, 2007). The

previous and largest RVF outbreak in Kenya took place in a similar *El Nino*-related flooding period in 1997-1998 (Woods *et al.*, 2002).

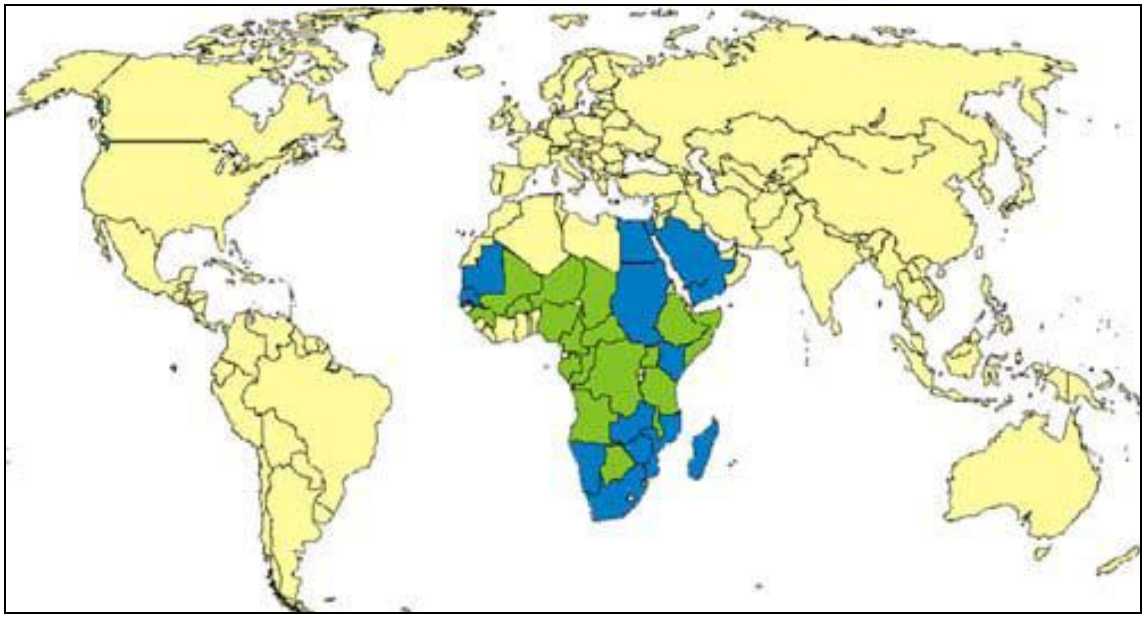

Figure 2.2: Map of the world showing distribution of RVFV

Source: CDC, 2007

Key:

Countries with endemic disease and substantial outbreaks of RVF (Gambia, Senegal, Mauritania, Namibia, South Africa, Mozambique, Zimbabwe, Zambia, Kenya, Sudan, Egypt, Madagascar, Saudi Arabia, Yemen)

Countries known to have some cases, periodic isolation of virus, or serologic evidence of RVF (Botswana, Angola, Democratic Republic of the Congo,

Congo, Gabon, Cameroon, Nigeria, Central African Republic, Chad, Niger, Burkina Faso, Mali, Guinea, Tanzania, Malawi, Uganda, Ethiopia, Somalia)

2.4 Transmission of Rift Valley Fever

Rift Valley fever virus is transmitted to human hosts and livestock primarily by biting vectors – mosquitos, culicoides, and sand flies – and handling of infected animals by individuals (Gerdes, 2002; Mullen and Durden, 2009; Archer *et al.*, 2011; Hartley *et al.*, 2011; Sindato *et al.*, 2011). This occurs through direct exposure to infected animals during slaughter or through veterinary and obstetric procedures and disposal of carcasses or foetuses (Chambers and Swanepoel, 1980; Abu-Elyazeed *et al.*, 1996; Archer *et al*, 2011; CDC, 2012;).

Certain occupational groups such as herders, farmers, slaughterhouse workers and veterinarians are therefore at higher risk of infection**.** Additionally, aerosol transmission has occurred in the laboratory setting (CDC, 2012). The disease caused by RVFV in humans is self-limiting and humans rarely die of infection; however, they may develop severe illness (Mullen and Durden, 2002; Mullen and Durden, 2009). To date no human-to-human transmission of RVFV has been documented (NICD, 2011).

2.5 Rift Valley Fever in animals

Clinical signs in animals vary with age, species, and breed of animal and are most severe in young animals (Sindato *et al.*, 2011). The incubation period is 12-36 hours in newborn lambs (who are most susceptible) and up to 72 hours in sheep, cattle, and dogs

(Easterday *et al.*, 1962; Murphy *et al.*, 1999; Spickler and Roth, 2006). Lambs experience pyrexia (40-42ºC), anorexia, lymphadenopathy, weakness, and usually death within 36 hours of inoculation (Murphy *et al.*, 1999; Mandell and Flick, 2011; Sindato *et al.*, 2011). It is not unusual to observe 90-100% mortality in affected animals (Murphy *et al.*, 1999; Mandell and Flick, 2011; Sindato *et al.*, 2011). Adult sheep also experience pyrexia (40-42ºC); however, mucopurulent nasal discharge, hemorrhagic, and/or foul-smelling diarrhea, jaundice, unsteady gait may also be observed; mortality is typical in 20-60% of adults (Spickler and Roth, 2006; Sindato *et al.*, 2011). Abortion occurs in 90-100% of affected ewes (Murphy *et al.*, 1999; Mandell and Flick, 2011). The disease is similar in goats but is considered milder in cattle (Murphy *et al.*, 1999). Calves experience pyrexia (40-41ºC), anorexia, depression, and death within 36 hours of inoculation, and 10-70% mortality is observed in affected animals (Murphy *et al.*, 1999; Sindato *et al.*, 2011). Adult cattle also experience pyrexia (40-41ºC); however, it is not uncommon to observe excessive salivation, anorexia, weakness, fetid diarrhea, and decrease in milk production (Murphy *et al.*, 1999; Gerdes, 2002; Mandell and Flick, 2011). Like ewes, abortion in cattle is expected in 90-100% of dams (Murphy *et al.*, 1999; Gerdes, 2002; Mandell and Flick, 2011). The mortality rate in adult animals is usually less than 10% (Murphy *et al.*, 1999; Sindato *et al.*, 2011).

Other causes for these clinical signs must be considered to facilitate timely treatments, prevention, and control for other infections including Bluetongue virus (BTV), Wesselsbron, ephemeral fever, enterotoxemia of sheep, ovine enzootic abortion,

Campylobacter or *Salmonella* infection, brucellosis, vibriosis, trichomoniasis, Nairobi sheep disease, heartwater, or other causes of abortion (Spickler and Roth, 2006; NICD, 2011; Sindato *et al.*, 2011).

2.6 Rift Valley Fever in humans

Epizootics and epidemics can result in massive loss of livestock, consequent export embargoes, and significant human morbidity and mortality, all of which can be economically devastating to affected areas (Laughlin *et al.*, 1979; CDC, 2002; WHO, 2007). During large RVF animal outbreaks, significant numbers of human infections occur as well, leading to substantial healthcare challenges in resource-limited settings. Because of RVFV's ability to cause retinitis, encephalitis, and hemorrhagic fever, episodic epidemics of RVF present a significant natural threat to human health in endemic countries (Isaacson, 2001; CDC, 2002)

Human RVF disease is not well characterized, but the best estimates are that most infections may be asymptomatic (NICD, 2011; Sindato *et al.*, 2011). The incubation period ranges from 2-6 days, but can be as short as 12 hours (Murphy *et al.*, 1999; Spickler and Roth, 2006). Humans experience influenza like syndromes, hemorrhagic pyrexia (37.8-40ºC), strong headaches, body pain, dizziness, nausea, epigastric discomfort, photophobia-retinitis, anorexia, petechia, and hemorrhage from body cavities (Deutman and Klomp, 1981; Swanepoel and Coetzer, 2004; Spickler and Roth, 2006; Sindato *et al.*, 2011).

Additionally, blindness and encephalitis have been documented to occur in 1-2% of affected individuals with a case fatality risk of 10-20% (Schamljohn and Hooper, 2001; Otte *et al.*, 2004; Swanepoel and Coetzer, 2004; Sindato *et al.*, 2011). Asymptomatic infection or a relatively mild illness can be observed with pyrexia, chills, headache, "back breaking" myalgia, diarrhea, vomiting, hemorrhages, and hepatitis (Murphy *et al.*, 1999; Swanepoel and Coetzer, 2004; Sindato *et al.*, 2011).

Recovery from Rift Valley fever is considered to occur within 4-7 days (Murphy *et al.*, 1999; Spickler and Roth, 2006). A small percentage of cases – less than two percent – can progress from illness to death; however, in patients with hemorrhagic disease fatalities are considered to reach 10% (Murphy *et al.*, 1999; Sindato *et al.*, 2011). A small percentage of cases – less than one percent – can progress to meningo-encephalitis with a subsequent extremely low case-fatality rate (Murphy *et al.*, 1999). Other causes for these symptoms must be considered to facilitate timely treatments, prevention, and control for other infections including malaria, brucellosis, and Crimean-Congo hemorrhagic fever (Murphy *et al.*, 1999; NICD, 2011; Sindato *et al.*, 2011).

2.6.1 Eye complications

The most common complication following RVF recovery is eye injury (Siam and Meegan, 1980). Rift Valley Fever Virus affects the uvea and posterior chorio-retinal area and is associated with permanent visual loss resulting from macular and paramacular scarring, vascular occlusion, and optic atrophy.

In a recent Saudi outbreak, 15% of severe RVF cases had retinal disease and 31% of mild cases had anterior uveitis (Al-Hazmi *et al*., 2005). The mean interval between the onset of RVF and visual symptoms ranged from 4 to 15 days. Macular or paramacular retinitis was identified in all the affected eyes at the time of initial assessment. Lesions included retinal hemorrhages (40%), vitreous reactions (26%), optic disc edema (15%), and retinal vasculitis (7%). Anterior uveitis was present in 31% of outpatients. Initial visual acuity was less than 20/200 in 80% of eyes in the outpatient group; their vision improved, deteriorated, or remained the same in 13%, 15%, or 72%, respectively. Evaluation at the last follow-up showed macular (60%) or paramacular (9%) scarring, vascular occlusion (23%), and optic atrophy (20%) in the outpatient group.

The Saudi study demonstrated that RVF was associated with major ocular morbidity. The ocular manifestations of RVF occurred with a relatively higher frequency than reported previously and were not limited to severe infections. The study also demonstrated for the first time that transient non-granulomatous anterior uveitis is associated with RVF (Al-Hazmi *et al*., 2005).

2.7 Diagnosis of Rift Valley Fever

Due to the potential of RVFV to impact a wide geographic area, especially in areas where animal husbandry is extensive, the laboratory confirmation of the virus is treated as a diagnostic emergency (Murphy *et al.*, 1999; Clements *et al.*, 2007; Archer *et al.*, 2011). Humans and animals of all ages and production systems can be impacted by this hemorrhagic fever (Clements *et al.*, 2007). Diagnosis depends on detection of live virus or viral nucleic acids by real time polymerase chain reaction (RT-PCR) or isolation in mice or cell culture (Murphy *et al.*, 1999; Clements *et al.*, 2007; NICD, 2011). Rift Valley fever virus has the ability to replicate in a variety of cell cultures (Murphy *et al.*, 1999; Spickler and Roth, 2006).

The general method for isolation of RVFV is either intracranial inoculation of suckling mice or infection of susceptible cell culture lines (Schamljohn and Hooper, 2001; Spickler and Roth, 2006). Common cell cultures include Vero E6 (African green monkey) and BHK-21 (baby hamster kidney) cells (Murphy *et al.*, 1999; Ikegami and Makino, 2009). Due to the rapid cytopathic nature of the virus, plaques form quickly in cell cultures and fatal infections in mice occur after intracranial challenge (Ikegami and Makino, 2009; Schamljohn and Hooper, 2001). Thin section electron micrographs show the virus to have a typical overall morphology with predominantly spherical or ovoid particles of about 90 - 100 nm in diameter with surface fringe projections of about 6 -7.5 nm (Schamljohn and Hooper, 2001). The virus is distinct when viewed by negative

staining with sharply defined surface structures of small round morphologic units about 9.5 nm in diameter with a visible central hole (Martin *et al.*, 1985).

The use of immunoassay methods are used to confirm the identity of isolates (Murphy *et al.*, 1999; Mohamed *et al.*, 2010). Serologic diagnosis is done by IgM or IgG capture enzyme-linked immunoassay (ELISA) on acute sera or by ELISA or hemagglutination inhibition (HAI) assays on paired sera from surviving animals (Murphy *et al.*, 1999; Mohamed *et al.*, 2010; NICD, 2011). In the absence of hemorrhages or specific organ manifestations, Rift Valley fever is clinically difficult to diagnose (Murphy *et al.*, 1999). Rapid laboratory confirmation of cases is therefore essential for timely execution of supportive treatment, appropriate case management, infection control, and tracing of exposed contacts (Mohamed *et al.*, 2010; Archer *et al.*, 2011).

Differential clinical diagnosis of RVFV varies depending on the region in question (Schamljohn and Hooper, 2001). The disease should be suspected in RVFV endemic regions following abnormally high precipitation, in outbreaks of increased rates of abortion in livestock, and in outbreaks of acute influenza-like illness in individuals with close contact with potentially infected livestock (Schamljohn and Hooper, 2001; Spickler and Roth, 2006; Archer *et al.*, 2011). Veterinarians, as well as field and laboratory workers, should use caution during post-mortem examination of animals or while processing diagnostic materials in the laboratory in order to not become infected with the virus (Murphy *et al.*, 1999; NICD, 2011; Archer *et al.*, 2011). Some researchers

believe a human becomes infected primarily from contact with infected tissues of livestock or wild (game) animals, and less frequently from mosquito bites (NICD, 2011).

Virologic diagnosis is usually quite simple given the high viremia present throughout the acute phase of illness and the ease of growth of the RVFV when inoculated intracranially into suckling mice or in susceptible cell cultures (Swanepoel and Coetzer, 2004). Serologic testing is also straightforward, particularly if paired sera (one taken acutely and the other 1-2 weeks later) are available (Schamljohn and Hooper, 2001; Swanepoel and Coetzer, 2004; Mohamed *et al.*, 2010). IgM and IgG ELISA tests using inactivated RVFV infected cell lysates or slurries have shown to be highly beneficial in outbreak investigations (Morvan *et al.*, 1992; Woods *et al.*, 2002; NICD, 2011).

2.8 Prevention and control of Rift Valley Fever

2.8.1 Control in animals

Immunization of livestock is considered to be the most effective way to prevent human infections. Rift Valley fever cases and epizootic outbreaks (Schamljohn and Hooper, 2001; Spickler and Roth, 2006; NICD, 2011). Vaccines for veterinary use are available however; these may cause birth defects and abortion in sheep and induce only low-level protection in cattle (Schamljohn and Hooper, 2001; CDC, 2012).

There are attenuated and killed vaccines produced in mice brains and embryonated eggs, which are considered effective and inexpensive, but are thought to cause abortion in pregnant ewes (Murphy *et al.*, 1999; Hartley *et al.*, 2011). Killed vaccines, such as the Smithburn Attenuated vaccine, Clone 13 Attenuated vaccine, Onderstepoort Biological Products (major deletion in NSs gene that inhibits interferon), and the costly GALVmed Vaccine out of Kenya, confer lifelong immunity to vaccinated animals (Sindato *et al.*, 2011; CDC, 2012). Inactivated vaccines, such as the formalin-inactivated wild-type virus used in Egypt and South Africa, produced in cell cultures avoid the problem of abortion, but are considered expensive and induce only short-lived immunity (El-Karamany *et al.*, 1981; Murphy *et al.*, 1999). Ideally, to be effective, the RVFV vaccine must be delivered in a systematic way to entire animal populations, preferably on a regular schedule, before the start of the mosquito season (Murphy *et al.*, 1999; Hunter *et al.*, 2002). However, vaccination for RVFV is problematic because: 1) viral movement can be so rapid that once an epidemic has spread and if not impossible – to administer enough vaccine fast enough, 2) even when vaccine is delivered quickly, there is often not enough time for protective immunity to develop in the animals – need fourteen days minimum.

Restricting or banning the movement of livestock may be effective in slowing the expansion of the virus from infected to uninfected areas. It is also recommended that carcasses of previously infected animals be buried or burned (Murphy *et al.*, 1999; Spickler and Roth, 2006). As outbreaks of RVF in animals precede human cases, the establishment of an active animal health surveillance system to detect new cases is

essential in providing early warning for veterinary and human public health authorities (WHO, 2007).

2.8.2 Public health education and risk reduction

During an outbreak of RVF, close contact with animals, particularly with their body fluids, either directly or via aerosols, has been identified as the most significant risk factor for RVF virus infection (Anyangu *et al*., 2007). There is no current medical treatment available for humans infected with RVFV; often only supportive care is available (Schamljohn and Hooper, 2001; NICD, 2011). In the absence of specific treatment and an effective human vaccine, raising awareness of the risk factors of RVF infection as well as the protective measures individuals can take to prevent mosquito bites, is the only way to reduce human infection and deaths. Public health messages for risk reduction should focus on reducing the risk of animal-to-human transmission as a result of unsafe animal husbandry and slaughtering practices. Workers at risk for exposure should wear personal protective equipment (PPE) to avoid contact with potentially infectious materials and aerosols (Murphy *et al.*, 1999; Schamljohn and Hooper, 2001; Hartley *et al.*, 2011). The public health messages should also focus on reducing the risk of animal-to-human transmission arising from the unsafe consumption of fresh blood, raw milk or animal tissue. In the epizootic regions, all animal products (blood, meat and milk) should be thoroughly cooked before eating (WHO, 2007). The importance of personal and community protection against mosquito bites through the use of impregnated mosquito nets, personal insect repellent if available, by wearing light

colored clothing (long-sleeved shirts and trousers) and by avoiding outdoor activity at peak biting times of the vector species (WHO, 2007).

2.8.3 Infection control in health care settings

Although no human-to-human transmission of RVF has been demonstrated (NICD, 2011), there is still a theoretical risk of transmission of the virus from infected patients to healthcare workers through contact with infected blood or tissues (CDC, 2002). Healthcare workers caring for patients with suspected or confirmed RVF should implement Standard Precautions when handling specimens from patients (Hartley *et al.*, 2011; Mandell and Flick, 2011; NICD, 2011).

Standard Precautions define the work practices that are required to ensure a basic level of infection control. Standard Precautions are recommended in the care and treatment of all patients regardless of their perceived or confirmed infection status. They cover the handling of blood (including dried blood), all other body fluids, secretions and excretions (excluding sweat), regardless of whether they contain visible blood, and contact with non-intact skin and mucous membranes.

Sanitation and vector controls should be attempted when dealing with RVFV, but often do not control the spread of disease (Spickler and Roth, 2006; NICD, 2011). Rift Valley fever virus is inactivated by ether, chloroform, strong solutions of sodium or calcium

hypochlorite (chlorine should exceed 5000 ppm), low pH (<6.8), and detergents that break up the virus (Spickler and Roth, 2006).

2.8.4 Vector control

Close monitoring and surveillance of vectors is essential for control of the Rift Valley fever infection in animal and human populations (Mandell and Flick, 2011; NICD, 2011; CDC, 2012). Vector control measures through widespread use of mosquito repellants in the human population to protect against their bites and use of larvacides at mosquito breeding sites are considered the most effective form of vector control as long as these sites can be clearly identified and are limited in size and extent (Murphy *et al.*, 1999; Hartley *et al.*, 2011; NICD, 2011) however during periods of flooding, the number and extent of breeding sites is usually too high for larviciding measures to be feasible (WHO, 2007)

2.8.5 Rift Valley Fever forecasting and climatic models

Forecasting can predict climatic conditions that are frequently associated with an increased risk of outbreaks, and may improve disease control. In Africa, Saudi Arabia and Yemen RVF outbreaks are closely associated with periods of above-average rainfall. The response of vegetation to increased levels of rainfall can be easily measured and monitored by Remote Sensing Satellite Imagery. In addition RVF outbreaks in East Africa are closely associated with the heavy rainfall that occurs during the warm phase of the *El Niño*/Southern Oscillation (ENSO) phenomenon (Linthicum *et al.*, 1999). These findings have enabled the successful development of forecasting models and early

warning systems for RVF using satellite images and weather/climate forecasting data. Early warning systems, such as these, could be used to detect animal cases at an early stage of an outbreak enabling authorities to implement measures to avert impending epidemics (WHO, 2007).

2.9 Measuring burden of disease

2.9.1 Disability adjusted life years (DALYs)

The DALY is a health gap measure that extends the concept of potential years of life lost due to premature death to include equivalent years of healthy life lost by virtue of individuals being in states of poor health or disability (Murray, 1996).

The DALYs has emerged in the international health policy lexicon as a new measure of the burden of disease. Developed as an input into World Bank's Development report 1993: Investing in Health, DALYs are being used as a tool for policy making in a wide range of countries (Bobadilla and Cowley, 1995).

According to some, the DALY concept has the potential to revolutionize the way in which we measure impact of disease, how we choose interventions and how we track the success or failure of our interventions (Foege, 1994). The DALY combines time lived with disability and time lost due to premature mortality (Murray, 1994). Years lost from premature mortality are estimated with respect to standard life expectancy for each age. Years lived with disability are translated into an equivalent time loss by using a set of weights which reflect reduction in the functional capacity with higher weights corresponding to a greater reduction. In both cases, time spent in the state is adjusted

using a set of value of choices (Murray, 1994) which weight time lived at different ages and at different periods differently (through age weighting and discounting respectively). Proponents of DALYs use the metric for at least two separate exercises: (1) the "positive exercise of measuring" the burden of disease; and (2) the "normative exercise" of resource allocation (Murray, 1994). The burden of disease is measured as a sum of DALYs attributable to premature mortality or morbidity whereas for resource allocation, DALYs are used in conjunction with literature on cost effectiveness of health interventions so as to facilitate using estimates of burden of disease in determining health resource allocations.

The DALY approach measures burden of illness through the reduction in "human function" (Murray, 1994). The multiple dimension of human function are mapped onto unidimensional scale between 0 (perfect health) and 1 (death) along with six discrete disability classes as distinguished (Colin *et al*., 2001; WHO, 2004). Human function is represented by ability to perform certain activities of daily living e.g. learning, feeding and clothing oneself. The space in which ill health is assessed is limitation in these activities rather than for example, that of pain or suffering which would be relevant categories in utility based framework (Evans and Ranson, 1995). The DALYs use standard maximum life expectancies (80 years for men and 82.5 years for women) which are considerably higher than the level of life expectancy currently achieved in the developing countries (Murray, 1994). This is the standard life expectancy used by the WHO and World Bank that enables for comparison of disease burden across the globe.

2.9.2 Global burden of Disease

DALYs from all causes globally is estimated to be 1,523,259,000 (WHO, 2008). Out of these, the leading causes of DALYs worldwide are caused by non-communicable diseases (49%), communicable diseases, maternal, perinatal and nutritional conditions (41%) and injuries (10%) as shown in Figure 2.3

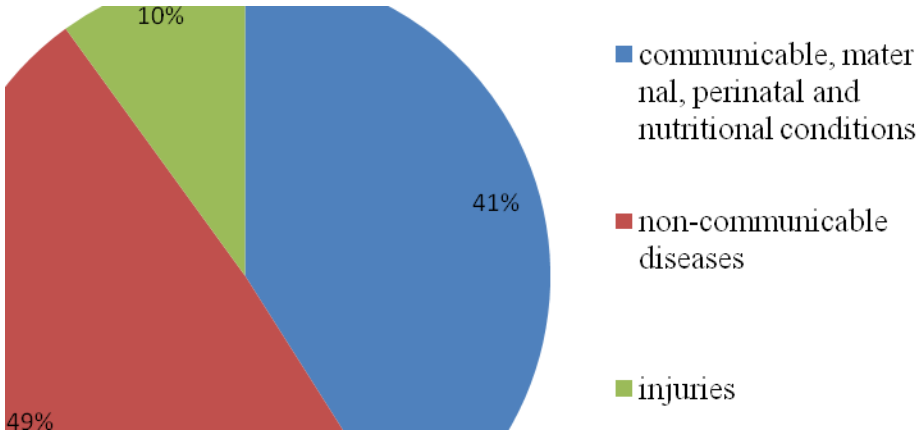

Figure 2.3: Global DALYs leading causes (*Source: WHO, 2008*)

In the Africa, HIV/AIDS is the leading cause of burden of disease in the World Health Organization African Region followed by lower respiratory infections, diarrhoeal diseases and malaria (WHO, 2008). Table 2.1 shows the leading causes of DALYs in Kenya with total DALY rates from all causes is estimated at between 43,000 – 49,750

DALYs (per 100,000 population) although communicable diseases constitute the largest burden, non communicable diseases e.g. Diabetes, Cardiovascular diseases and Cancers and their related risk factors as high blood pressure, high cholesterol and excessive body weight, are on the increase (MOPHS, 2010)

Table 2.1: Leading causes of DALYs in Kenya

Rank	Disease or injury	% total DALYs
1	HIV/AIDS	24.2
2	Perinatal period conditions	10.7
3	Malaria	7.2
4	Lower respiratory infections	7.1
5	Diarrheal diseases	6.0
6	Tuberculosis	4.8
7	Road traffic accidents	2.0
8	Congenital anomalies	1.7
9	Violence	1.6
10	Unipolar depressive disorders	1.5

Source: WHO, Kenya Health Statistics Profile 2010

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Study areas

The study was conducted from February – August 2012 in three districts namely; Garissa in the North Eastern Province, Baringo in Rift Valley Province and Kilifi in Coast Province as shown in Figure 3.1. These were the three districts that were most heavily affected during the 2006/2007 RVF outbreak and were chosen because they had the highest number of human cases of acute RVF with severe disease.

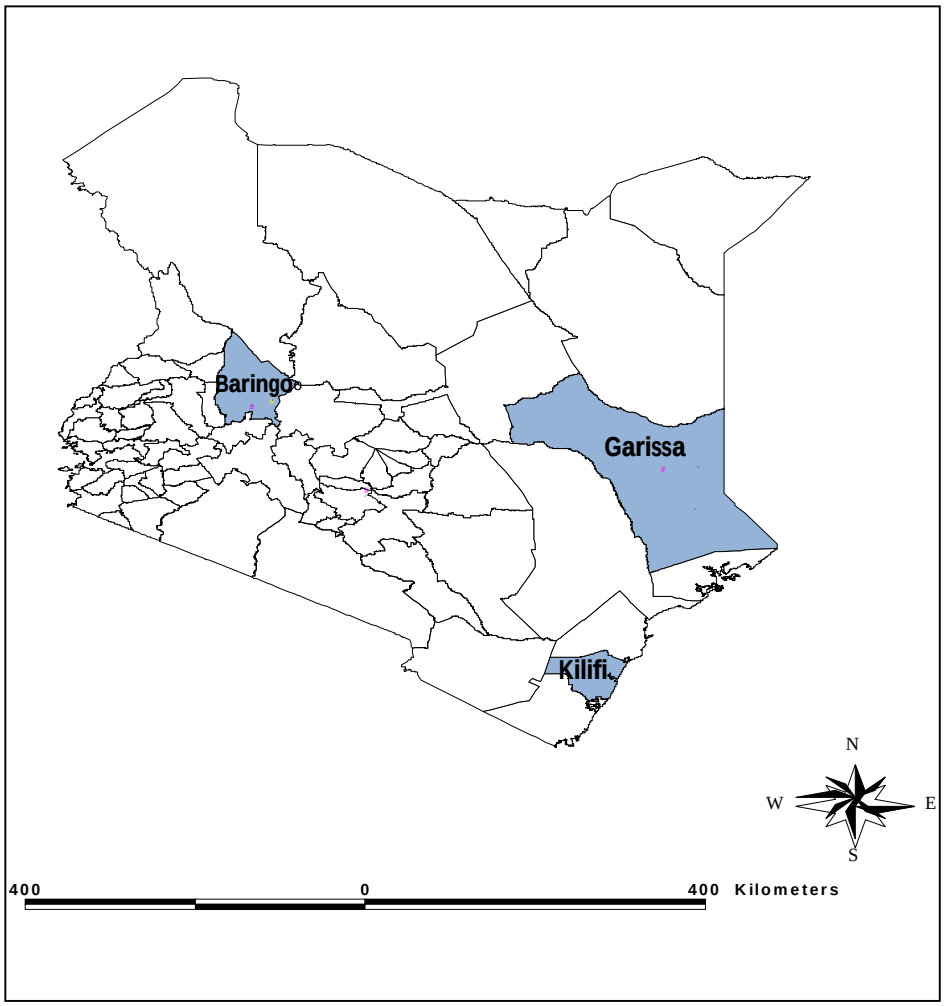

Figure 3.1: Map of Kenya showing the study areas

3.2 Study design

The study design was a mixed study design involving a desk review of the RVF line listing data and a cross sectional survey.

3.3 Study population

The study was carried out among households with the line listed cases of human RVF in the above districts that recorded the highest number of cases during the 2006-2007 outbreak in Kenya.

3.3.1 Case definition

A suspected case in a household was defined as a person of any age who had presented with symptoms of fever (or axillary temperature > 37.5^{o}C), headache, muscle pain or nausea and or direct contact with sick or dead animals or animal products; or direct contact with body fluids of an infected person during the 2006/2007 outbreak.

A probable case in a household was defined as a suspected case that presented with unexplained bleeding (bloody stool, vomiting blood, coughing blood, bleeding from the gums, nose, vagina, skin or eyes), deterioration of vision, or decreased consciousness.

A confirmed case was any suspected or probable case that had laboratory confirmation of RVF by detection of viral immune-globulin M (IgM) antibodies by ELISA, or detection of viral RNA by RT-PCR; or detection of viral antigens in biopsy tissues by immunohistochemistry.

3.3.2 Inclusion criteria

Any household which had a confirmed case(s) and or deaths from human RVF during the 2006-2007 outbreak and who consented to be enrolled in to the study.

3.3.3 Exclusion criteria

Any household which had no confirmed case (s) of RVF during the 2006-2007 outbreak in the affected districts.

3.4 Sample size determination

For computation of DALYs, all the line-listed human cases were included in to the study however, for interviews with the affected households the minimum sample size was calculated as shown below.

A rapid appraisal study of the 2007 RVF outbreak in Kenya to assess the human and animal health response capacity and costs interviewed 10% of the affected households (ILRI, 2008)

Using the formula for Sample size, $n = [DEFF*Np(1-p)]/ [(d^2/Z^2_{1-\alpha/2}*(N-1)+p*(1-p)]$

(*source: www.openepi.com/OE2.3/SampleSize/SSPropor.htm*)

Where *n* is the required sample size,

$Z\alpha=1.96$ is the standard normal deviate that provide 95% Confidence Intervals,

N= 684 cases obtained from the human RVF line listing data,

Design Effect (DEFF) = 1.0,

p is the estimated proportion at 10% and

d= Absolute precision %.

Setting p = 0.1 and d at 5%, the required minimum sample size will be **116** affected households.

3.5 Sampling

Residents were randomly selected from the three districts most affected by the outbreak. Line lists of reported probable and confirmed cases was obtained from the Ministry of Health and was used to identify the geographical units (usually villages) where clustering of human cases occurred within these three districts. According to the line list of 2006/2007, 161 villages were affected within these three districts (Garissa 62, Baringo 52, and Kilifi 47).

3.6 Sampling procedure

Both primary and secondary data were collected for this study. Primary data on diagnostic, treatment and hospitalization costs of public health sector (in-patient and out-patient costs); out of pocket expenditures and opportunity costs (loss of income, coping costs) of households as described by (Roth *et al*., 2003) were collected through key informant interviews to quantify in monetary terms the human health costs of a RVF outbreak.

Secondary data were obtained from all available sources (inventory of existing data and literature) and the rapid appraisal study carried out just after the outbreak in 2006/2007 (which covered 5 out of 8 Kenyan Provinces) through interviews with key informants from the health sector at national, district levels and affected households (e.g. out of pocket expenditures of households with human case) and synthesized secondary data from past outbreaks.

Age and gender stratified human incidences, morbidity and mortality were compiled from different data sources such as CDC-KEMRI (Shieh *et al*., 2008) Ministry of Public Health and Sanitation and the census data at the Kenya National Bureau of Statistics (KNBS)

The rapid appraisal study contained valuable information on underreporting of cases by interviewing several health practitioners and public health sector specialists who have been involved in RVF control at central and local levels in the districts that have been hardest hit by the disease. These interviews were focused on observed clinical features of RVF such as occurrence of encephalitis/blinding or haemorrhagic fever in patients. The burden of the disease in terms of disability-adjusted life years (DALYs) estimates for RVF was computed using methods developed by World Health Organization and World Bank (Murray and Acharya, 1997).

3.7 Data collection and management

3.7.1 Data collection

Data collection involved administering questionnaires via personal interviews with the affected households. After establishing eligibility for enrolment and tracing the participant, the study purpose, risks and benefits were explained and a written consent obtained from each and every participant or guardian in form of a signature for those who could write and witnessed right thumbprint for the illiterate (Appendix 3). Variables collected included socio-demographic characteristics, general access to healthcare services and the private health costs incurred when a household member becomes ill (Appendix 4). The geographic locations of the villages were recorded using a hand-held Global positioning system and used to obtain a map of the sites visited.

3.7.2 Data management

The questionnaires were scanned, data cleaned and stored in a Microsoft Access database. Data analysis was done using *Epi Info version 3.5.1* statistical software (free software provided by WHO/CDC for developing countries).

3.7.3 Data analysis

Epi-info 3.5.1 computer software was used in the data analysis. Univariate analysis was done to describe the frequencies of various variables including age, gender, level of education, position in household for descriptive statistics.

3.8 Estimation of DALYs

DALYs was computed using Microsoft Excel template developed by the World Health Organization. One DALY can be thought of as one lost year of healthy life and the burden of disease as a measure of the gap between current health status and an ideal situation where everyone lives into old age free from disease and disability. DALYs for a disease or health condition are calculated as the sum of Years lost due to premature death (YLL) in the population and Years lived with disability (YLD) for incident cases of the health condition. Years lost due to premature death (YLL) is calculated from the number of deaths at each age multiplied by a global standard life expectancy for the age at which death occurs. To estimate YLD for a particular cause for a particular time period, the number of incident cases in that period is multiplied by the average duration of the disease and a weight factor that reflects the severity of the disease on a scale from 0 (perfect health) to 1 (dead).

The formula is given by;

DALY = Years of life lost to premature death (YLLs) + Years lived with disability (YLD)

For a single individual;

YLL = life expectancy – age at death.

In a population;

YLL_x = number of deaths at age_x X standard years of life lost at age

YLD = Incidence of cases x average duration x disability weight.

Since RVF does not have a unique disability weight, the disability weight for Dengue Hemorrhagic Fever was used which is 0.545 (WHO, 2004). RVF and Dengue Haemorrhagic Fever present similar symptoms and sequeale thus allowing for use of disability weight for Dengue Haemorrhagic Fever (Hughes-Fraire *et al*., 2011). The number of deaths and incident cases were obtained from the line lists at the Ministry of Health and CDC and population estimates were obtained from the Kenya National Bureau of Statistics (KNBS). The average duration of illness of RVF is 3-7 days (WHO, 2007) and used an average of 5 days and divided by 365 to get on a scale of years. Microsoft Excel template developed by World Health Organization was used for computation of YLL, YLD and DALYs respectively.

3.8 Ethical considerations

Approvals were obtained from the following institutions to conduct the study:

- Board of Postgraduate Studies of Jomo Kenyatta University of Agriculture and Technology (JKUAT).
- Scientific Steering Committee (SSC) of KEMRI (Appendix 1).
- Ethical Review Committee (ERC) of KEMRI (Appendix 2).

Informed written consent and/or assent were obtained from all study participants / guardians and or caretakers before the interview. The consent forms provided information on risks, benefits and assurance of confidentiality to the study participants.

3.9 Study limitations

- Tracing some of the affected households was difficult especially in Garissa due to their nomadic lifestyle.

- Recall bias – some of the participants interviewed could not recall well some of the household costs incurred, however attempts were made to reduce the problem by asking for the usual costs that they incur when there is a sick member of a household to estimate the costs.

CHAPTER FOUR

4.0 RESULTS

4.1 Socio-demographic characteristics of the study participants

4.1.1 Distribution of study participants by sex and age

A total of 127 study subjects from Garissa, Kilifi and Baringo districts were enrolled into the study conducted from February to August 2012 (Table 4.1). Males constituted 54% (68) as shown in Table 4.2. The ages of the participants ranged from 19 to 81 years old and 45 years median age (IQR=22).

Table 4.1: Distribution of study participants by districts

District	Frequency (n=127)	Percent	95% CI
Garissa	62	49	40.2 – 57.5
Kilifi	33	25	18.9 – 34.1
Baringo	32	26	18.2 – 33.3

Table 4.2: Distribution of study participants by age

Sex	Frequency (n=127)	Percent	95% CI
Male	68	54	44.1 - 62.1
Female	59	46	37.9 - 55.9

The majority of the study participants were between the ages 30 and 60 years as shown in Figure 4.1.

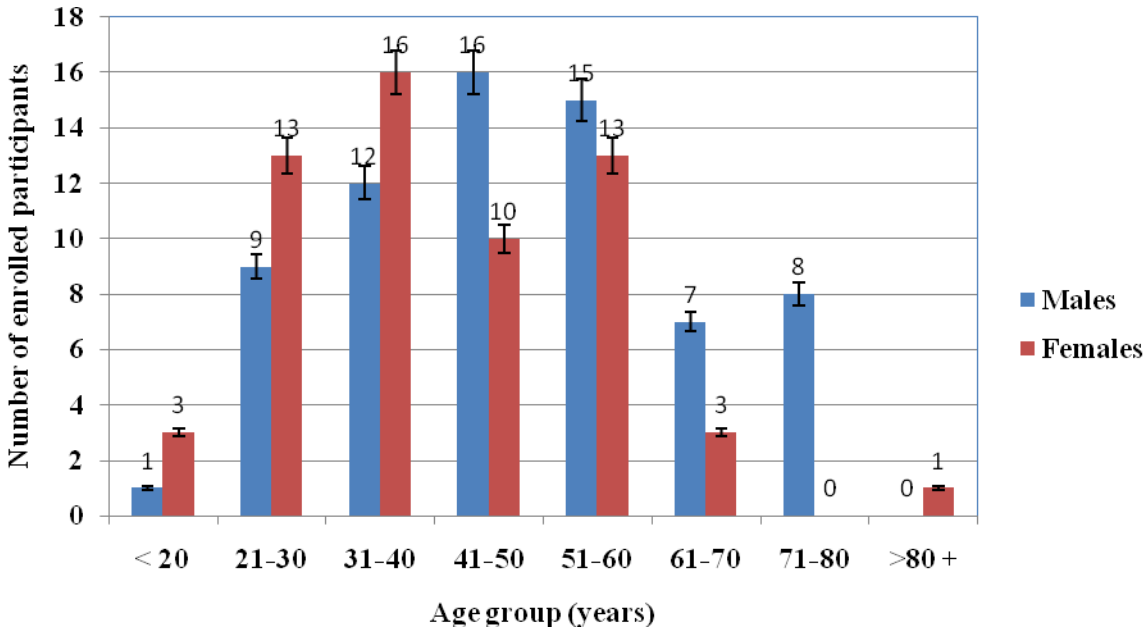

Figure 4.1: Distribution of study participants by age and sex

4.1.2 Highest education level

Most of the study participants (74%) had no formal education followed by those with primary education (18%) as shown in Table 4.3.

Table 4.3: Distribution of study participants by highest education level

Education Level	Frequency (n=127)	Percent	95% CI
No formal education	95	74	65.5 - 81.4
Primary	23	18	11.8 - 25.9
Secondary	7	6	2.2 – 11.0
Tertiary	2	2	0.2 - 5.6

4.1.3 Marital status

Table 4.3 shows the distribution of the study participants by marital status. Majority were married (68%) followed by those who were single (16%).

Table 4.4: Distribution of study participants by marital status

Marital status	Frequency (n=127)	Percent	95% CI
Single	20	16	9.4 – 23.0
Married	86	68	59.2 – 77.9
Widowed	12	9	4.6 – 16.8
Divorced	9	7	3.4 – 12.5

4.1.4 Occupation

Most of the study participants were pastoralists by occupation (86%) as shown in Table 4.5

Table 4.5: Distribution of study participants by occupation

Occupation	Frequency (n=127)	Percent	95% CI
Unemployed	10	8	6.4 - 14.5
Informal (Pastoralists)	109	86	77.2 - 94.1
Formal employment	4	3	1.2 - 8.4
Student	4	3	1.3 - 8.4

4.1.5 Position in household

Most of the study participants were fathers (52%) followed by mothers (44%) as shown in Table 4.6.

Table 4.6: Distribution of study participants by position in a household

Position	Frequency (n=127)	Percent	95% CI
Father	66	52	0.5 - 6.7
Mother	56	44	34.5 - 56.7
Son	5	4	0.5 - 6.7

4.2 Estimation of crude incidence of RVF in humans

Number of incident cases of RVF in humans was obtained from the line listed cases and denominator (population) obtained from the census data of the KNBS. Overall, males had the highest crude incidence per 1000 population at 0.7/1,000 population compared to females at 0.5/1,000 population. Among males, the crude incidence per 1000 population was highest in the age category 30 – 44 years while among females; it was highest in the age category 70 – 79 years. The number of cases in both males and females was highest in the age category 15 – 29 years followed by 30 – 44 years as shown in Table 4.7.

Table 4.7: Age and sex incidence of RVF in humans during the 2006/2007 outbreak in Kenya

Sex	Age-group	Population	Cases of RVF	Incidence / 1,000 population
Males				
	0-4	102,883	7	0.07
	5-14	190,049	25	0.13
	15-29	160,535	178	1.10
	30-44	75,528	111	1.50
	45-59	40,003	46	1.10
	60-69	14,171	20	1.40
	70-79	7,161	6	0.84
	80+	3,313	4	1.21
	Total	**593,643**	**397**	**0.7**
Females				
	0-4	99,350	4	0.04
	5-14	178,200	24	0.13
	15-29	173,701	106	0.61
	30-44	88,863	99	1.11
	45-59	40,947	32	0.78
	60-69	14,465	11	0.76
	70-79	6,972	9	1.29
	80+	3,529	2	0.57
	Total	**606,027**	**287**	**0.5**

4.3 Estimation of private and public human health costs of RVF

4.3.1 Access to healthcare services

When a member of a household falls ill, majority of the households (87%) reported that they visit a dispensary / health centre or a hospital where they sought for treatment as shown in Figure 4.3. Other households use family medicine/herbs (9%) and traditional healers (3%).

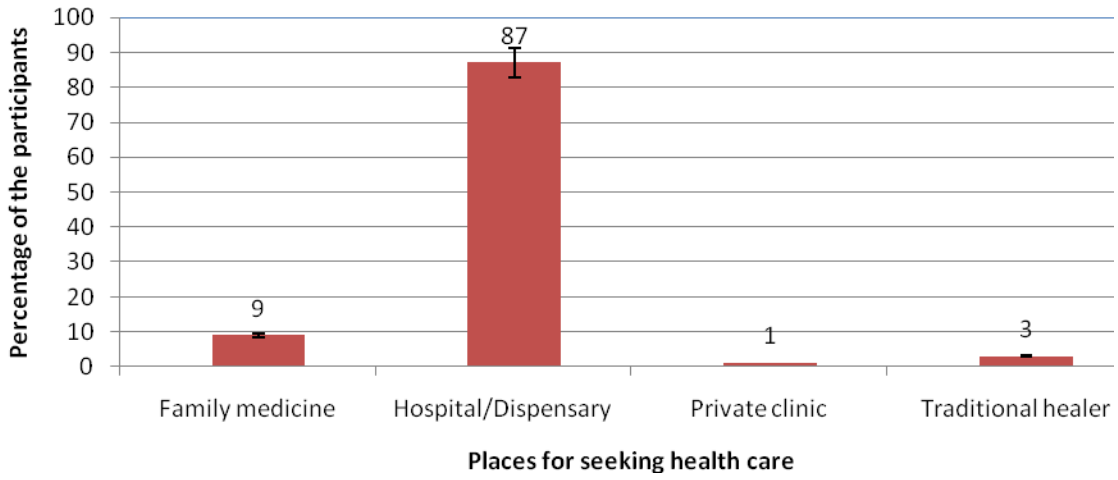

Figure 4.2: Distribution of places for seeking healthcare services

4.3.2 Mean distance, time and costs of patient to arrive at a preferred health facility

The participants listed their preferred health facilities and these included Dispensaries / Health centres both private and publicly owned, district hospitals and Provincial General Hospital which are mainly a referral facilities. The mean distance of households to a preferred health facility was 13.2 km and 96.3 km for health centre / Dispensary and hospitals respectively as shown in Table 4.8.

Table 4.8: Distances and Time to access a health facility

Facility	Distance (km) n	Mean	Time (hours) Mean	km/hour
Dispensary / Health center	127	13.2	1.2	11
Hospital	127	96.3	3.6	27

4.3.3 Preferred means of transport and mean costs in Kenya Shillings to reach a health facility

Table 4.9 shows transport costs to reach a preferred health facility. Most of the participants (89%) walked while visiting their first choice health facility but preferred to use a vehicle to second and third choice facilities. Participants also used donkey carts when there was a sick member of a household not able to walk or when the roads were impassable due to flooding while visiting their first, second or third choice preferred health facilities.

Table 4.9: Transport costs (KES) to reach a preferred health facility

	1st choice facility			2nd choice facility			3rd choice facility		
Means	n	95% CI	mean cost	n	95% CI	mean cost	n	95% CI	mean cost
Walking	113	83.0-94.4	0	10	3.9-14.1	0	2	0.3-9.7	0
Donkey cart	13	5-16	287	43	25.9-43.1	365	18	15.5-36.6	420
Vehicle	1	0.0-4.4	200	74	48.8-66.7	365	53	60.4-82.1	394

4.3.4 Estimates for out of pocket expenditures

Participants listed household's expenditures estimates while caring for a sick member of the household and the summary is shown in Table 4.10.

Table 4.10: Estimates for out of pocket expenditures

Estimates for out of pocket expenditures for patients	Unit cost (KES)	units	Total
Diagnosis			
Transport	365	4	1,460
Accommodation			2,000
Food			500
Hospitalisation fee	250	10	2,500
Card/prescription	50	1	50
Material (Needles\syringes\gloves)	500	1	500
Diagnosis (including lab fee)	100	1	100
Special tests (X-rays, liver function tests)	1,200	1	1,200
Subtotal			**8,310**
Treatment			
Drugs			1,200
Total			**9,510**

A household incurred estimated costs of Kenya Shillings (KES) 9,510 while caring for a sick member of the household and this translated to United States $ 120 (2011 Exchange Rate of KES/USD).

4.5 Estimation of the Disability Adjusted Life Years

Microsoft Excel template developed by the World Health Organization was used for computation of the YLL, YLD and DALYs

4.5.1 Years of life lost to premature death (YLL) estimation

The total YLLs obtained were 1523.22 (2.5 YLL per 1,000 population) as shown in Table 4.11. Overall, males had the highest YLLs at 2475.18 (4.2/1,000 population) compared to females at 1523.22 (2.5/1,000 population). Age group 15 - 29 years in males had the highest YLL followed by 30 - 44 year category. In females, YLLs was highest in age-group 30-44 years followed by 15 -29 years.

Table 4.11: Years of life lost to premature death (YLL) calculation

Sex	Population	Deaths	Deaths per 1,000	Av. Age at death	YLLs	YLL per 1000
Males						
0-4	102,883	1	0.0	4.0	29.96	0.291
5-14	190,049	4	0.0	10.3	117.01	0.616
15-29	160,535	58	0.4	24.2	1573.21	9.800
30-44	75,528	23	0.3	34.5	573.16	7.589
45-59	40,003	5	0.1	48.4	103.47	2.587
60-69	14,171	4	0.3	63.0	58.45	4.124
70-79	7,161	2	0.3	72.5	19.91	2.781
80+	3,313	0	0.0		0.00	0.000
Total	**593,643**	**97**	**0.2**	**29.7**	**2475.18**	**4.169**
Females						
0-4	99,350	1	0.0	0.0	30.53	0.307
5-14	178,200	6	0.0	9.3	177.98	0.999
15-29	173,701	19	0.1	21.7	531.27	3.059
30-44	88,863	25	0.3	34.8	637.63	7.175
45-59	40,947	6	0.1	41.7	136.80	3.341
60-69	14,465	0	0.0		0.00	0.000
70-79	6,972	0	0.0		0.00	0.000
80+	3,529	1	0.3	77.0	9.01	2.554
Total	**606,027**	**58**	**0.1**	**28.7**	**1523.22**	**2.513**

4.5.2 Years lived with Disability (YLD) estimation

The total YLD obtained was 15.62 (0.026 /1,000 population) as shown in Table 4.12. Overall, males had a higher YLD at 21.6 (0.036/1000 population) than females which had 15.62 YLD (0.026/1000 population). Age groups 15 -29 years in males and females had the highest YLD followed by age-group 30 -44 years.

Table 4.12: Years lived with Disability (YLD) estimation

Sex	Population	Incidence	Incidence per 1,000	Av. age at onset	Duration (years)	YLDs	YLD per 1000
Males							
0-4	102,883	7	0.07	3.7	0.1	0.38	0.004
5-14	190,049	25	0.13	9.7	0.1	1.36	0.007
15-29	160,535	178	1.10	21.2	0.1	9.69	0.060
30-44	75,528	111	1.50	34.7	0.1	6.04	0.080
45-59	40,003	46	1.10	49.7	0.1	2.50	0.063
60-69	14,171	20	1.40	63.4	0.1	1.09	0.077
70-79	7,161	6	0.84	72.3	0.1	0.33	0.046
80+	3,313	4	1.21	82.0	0.1	0.22	0.066
Total	**593,643**	**397**	**0.7**	**30.8**	**0.1**	**21.60**	**0.036**
Females							
0-4	99,350	4.00	0.04	2.8	0.1	0.22	0.002
5-14	178,200	24.00	0.13	10.0	0.1	1.31	0.007
15-29	173,701	106.00	0.61	22.2	0.1	5.77	0.033
30-44	88,863	99.00	1.11	35.1	0.1	5.39	0.061
45-59	40,947	32.00	0.78	50.4	0.1	1.74	0.043
60-69	14,465	11.00	0.76	62.0	0.1	0.60	0.041
70-79	6,972	9.00	1.29	72.4	0.1	0.49	0.070
80+	3,529	2.00	0.57	85.0	0.1	0.11	0.031
Total	**606,027**	**287**	**0.5**	**32.0**	**0.1**	**15.62**	**0.026**

4.5.3 Total Disability Adjusted Life Years (DALYs)

Total DALYs was obtained by getting the sum of Years of life lost to premature death (YLLs) and Years lived with disability (YLD). Total person DALYs lost during the last RVF outbreak was 4,035.618 (3.4 DALYs per 1,000 population) as shown in Table 4.13. Age-group 30 – 44 years in both males and females had the highest DALYs lost due to RVF at 7.4 DALYs/1,000 population.

Table 4.13: Total Disability adjusted life years lost (DALY= YLL + YLD)

	Males			*Females*		*Persons*		
	Population	**DALYs**	**DALYs per 1,000**	**Population**	**DALYs**	**Population**	**DALYs**	**DALYs per 1,000**
Age								
0-4	102,883	30.34	0.3	99,350	31	202,233	61.089	0.3
5-14	190,049	118.38	0.6	178,200	179	368,249	297.663	0.8
15-29	160,535	1582.89	9.9	173,701	537	334,236	2119.931	6.3
30-44	75,528	579.20	7.7	88,863	643	164,391	1222.222	7.4
45-59	40,003	105.97	2.6	40,947	139	80,950	244.509	3.0
60-69	14,171	59.54	4.2	14,465	1	28,636	60.134	2.1
70-79	7,161	20.24	2.8	6,972	0	14,133	20.730	1.5
80+	3,313	0.22	0.1	3,529	9	6,842	9.339	1.4
Total	**593,643**	**2496.78**	**4.2**	**606,027**	**1,539**	**1,199,670**	**4035.618**	**3.4**

4.5.4 Disability adjusted life years stratified by Districts

Table 4.14 shows DALYs stratified by Districts. Garissa District had the highest number of person DALYs lost (3,142 DALYs), followed by Kilifi District (546 DALYs).

Table 4.14: Total DALYs stratified by districts

District	Population	Person DALYs	DALYs / 1,000 population
Garissa	391,723	3,142	8.0
Kilifi	543,211	546	1.0
Baringo	264,736	351	1.3
Total	**1,199,670**	**4,039**	**3.4**

CHAPTER FIVE

5.0 DISCUSSION

This study aimed at assessing the crude age and sex categorized incidence of RVF during the 2006/2007 outbreak. Results showed that there was a gender difference with regard to RVFV infection. The RVFV predominantly affected males with a crude incidence of 0.7 per 1,000 population compared to females at 0.5 per 1,000 population. The ages between 30 – 44 years old had the highest incidence per 1,000 population followed by 60 – 69 years old category for males while in females, incidence per 1,000 population was highest in the 70 – 79 years old category. The higher crude incidence in males compared to females may be due to higher exposure to RVFV vectors or to infected animals. This concurs with findings of a study done in Saudi Arabia in the year 2000 during a RVF epidemic in Saudi Arabia where the disease predominantly affected male patients, with a ratio of male to female patients of 4:1(Tariq *et al*., 2003).

A study conducted in Kenya during the 2006-2007 outbreaks also found association of male gender with acute RVF infection and severe disease (Anyangu *et al.*, 2007). In the study, association of male gender with acute RVF infection was likely related to the occupation of herding, predominantly performed by males, which involves increased animal-related exposures such as consuming or handling sick animal products during slaughter, milking or skinning and handling of the aborted foetuses. Because of their close proximity to animal herds, herdsmen may also be at a greater risk of being bitten by mosquitoes that have bitten infected animals (Anyangu *et al.*, 2007).

Older age groups in this study for both males and females had higher incidence per 1,000 than younger age groups. The reasons of the RVFV incidence increase according to age are unknown, however, this could be compatible with a continuous exposure of these populations to RVFV but also to a higher rate of exposition to mosquito vector bites infected with RVFV of the older age groups. This is in agreement with findings of a RVFV seroprevalence study in human rural populations of Gabon which found that RVFV IgG seroprevalence increase with age (Pourrut *et al.*, 2010). In addition, the ages between 15 – 29 years particularly of male gender had the highest number of cases of RVF and mortality compared with other age groups. This was perhaps related to more-intense exposure to infected mosquitoes or animals, because people in this age group were more likely to be involved in farming, fieldwork, and care and handling of animals. This is concurs with studies done in Saudi Arabia (Tariq *et al.*, 2003). Moreover, many of them had no shelter and thus had to sleep outdoors, exposing themselves to intense mosquito bites and, thus, higher infective doses of the virus.

This study assessed human health costs of RVF and on transport, results showed that most of the households prefered walking to the nearest health facility, this was likely due to unavailability of other means of transport during the period. Usually epizootic outbreaks of RVF are strongly linked to excessive rainfall and local flooding events as was the case in 2006/2007 scenario. Eastern Kenya experienced unusually heavy rainfall during October - December 2006, three times the average for that period during the preceding 8 years and 13 times the rainfall in 2005 (Kenya Meteorological Department, unpublished data, 2007) that led to massive flooding thereby rendering most of the roads

impassable. Use of donkey carts was commonly used means of transport due to the flooding for most of the households who participated in the study.

Data from this study showed that people often seek basic health services from more than one source, for example in a health centre, a dispensary and or a hospital especially in case of a referral from the lower health facilities (health centre or dispensary) and occasionally from traditional healers. This agrees with findings of a study done to quantify the burden of Rhodesiense sleeping sickness in Uganda (Odiit *et al.,* 2004; Bukachi *et al.,* 2009) on health services seeking behavior.

This study also showed that families incurred very substantial costs to maintain their sick family members in the health system while being treated for RVF illness or related complications. Estimated out of pocket expenditures in caring for a sick member of a household was found to be United States $ 120. This is considerably high since most of the affected communities or households are poor and live below poverty line. In Kenya, a recent nation-wide survey, the 2006 Kenya Integrated Household and Budget Survey, (KIHBS) found that 46% of the total Kenyan population is absolutely poor, i.e. below the poverty line subsisting on less than United States $ 1.25 per person per day whereas 49% of the rural population is absolutely poor (Kenya National Bureau of Statistics, 2007 and World Bank 2005). For families who spent that amount of money on transport, diagnosis and treatment of a family member is a serious financial burden.

That burden is likely to be severe if the patient is the breadwinner as other family members will need either to do their work on farm or produce earnings to cover the gap caused by the sick member of the household and this is not easy especially in the rural settings where employment is scarce (KNBS, 2006). In comparison, a study done in Kenya to assess household costs of malaria found that direct and indirect costs of malaria control constituted an average of 28% of monthly income of the households (Chuma *et al.,* 2010) and for Tuberculosis patients US $350 (Mauch *et al*., 2011) for the entire duration of illness. The indirect costs of Tuberculosis are usually higher than those for malaria because of the long duration of the disease, long delays before proper diagnosis, and its prevalence among the economically active population (Kamolratanakul *et al.,* 1999). Similarly, a study done in Uganda to estimate out of pocket costs borne by Human African Trypanosomosis (HAT) patients was US $147 per patient (Fèvre *et al.,* 2008) whereas in Tanzania, the cost of indirect medical costs for travel, meals and accommodation was US $68.40 and US $25.50 for direct medical costs (treatment and diagnosis) per patient, respectively (Matemba *et al.,* 2010).

In assessing the burden of RVF disease in Kenya during the 2006/2007 outbreak in terms Disability Adjusted Life Years (DALYs), the total DALYs lost due to RVF was 4,035 DALYs (3.4 DALYs / 1,000 population) representing about 0.7 percent of the total DALYs for Kenya. Kenya's total DALY rates from all causes is estimated to be 43,000 – 49,750 DALYs (per 100,000 population) (WHO, 2008). This number of DALYs lost due to RVF is considerably a high burden which impact on the health

systems as well as the communities besides the DALYs lost due to HIV/AIDs, Malaria and Diarrhoeal diseases which are the leading causes of DALYs in Kenya. The burden in terms of DALYs was highest in Garissa District at 3,142 DALYs, followed by Kilifi District at 546 DALYs and lastly Baringo District at 350 DALYs. Similarly, a study done in the United States of America showed that if RVF were to be introduced into the country and follow the path of West Nile Virus which reached over 6,000 reported cases in 2003, the total DALYs lost would be 71,216 for 6,000 reported cases of RVF (Hughes- Fraire *et al.,* 2011).

DALYs are used for identifying national control priorities and allocation of resources for health interventions (Murray, 1994). Rift Valley Fever is one of the priority zoonotic diseases because of the potential to be both financially and epidemically devastating effects (Clements *et al.*, 2007; Sindato *et al.*, 2011). From these results, it causes a considerable number of person DALYs yet it has not been considered prioritized by the policy makers' in terms of resource allocation for its prevention and control compared to other leading causes of DALYs in Kenya for example, HIV and AIDS, Malaria and Diarrhoeal diseases among others. This is supported by findings of a rapid appraisal study done following the 2006/2007 outbreak in Kenya that cited lack of contingency plans and funds among many others factors that contributed to severe impacts of the RVF disease (Nzietchueng *et al.*, 2007; Schelling and Kimani, 2007; Wanyoike and Rich, 2007). Therefore, there is need for the policy makers to consider using useful

epidemiological data especially DALYs in planning prioritisation and proper allocation of limited resources towards prevention and control of diseases and conditions.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

- There was age and gender difference with regard to RVFV infection during the 2006/2007 outbreak. RVF disease predominantly affected males with a crude incidence of 0.7 per 1,000 population compared to females at 0.5 per 1,000 population. In males, the age category 30-44 years had the highest incidence compared to females which was highest in the age category 70 -79 years.

- There were very high substantial costs incurred by the families to maintain their sick family members in the health system while being treated. An estimated out of pocket expenditures of United States $ 120 was considerably high since most of the affected communities or households are poor and live below poverty line.

- 4,035 DALYs lost due to RVF was high and yet it has not been considered prioritized by the policy makers in terms of resource allocation for prevention and control unlike for other diseases like HIV/AIDS, Malaria in Kenya which receive funding from the Government and Development partners. The burden of RVF is high impacting on the healthcare system and the community.

6.2 Recommendations

6.2.1 Policy

- Policy makers should prioritize RVF and consider allocating resources towards prevention and control of Rift Valley Fever so as to prevent future anticipated outbreaks.
- Enhancing the One Health (OH) approach that would improve preparedness for Rift Valley Fever outbreaks.

6.2.2 Further research

- Further studies needs to be done on economic analysis of RVF control options from a multisectoral perspective. This will lead to evidence-based recommendations on control options for RVF thus expected to improve response capacity to future RVF outbreaks in Eastern Africa region.

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APPENDICES

Appendix 1: KEMRI Scientific Steering Committee (SSC)

KENYA MEDICAL RESEARCH INSTITUTE

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ESACIPAC/SSC/9907 **15th November, 2011**

Austine Bitek Orinde

Thro'
Director, CVR
NAIROBI

DIRECTOR
CENTRE FOR VIRUS RESEARCH
P. O. Box 54628
NAIROBI

REF: SSC No. 2140 (2nd Revised) – Estimation of Rift Valley fever disease burden in Kenya using the disability adjusted life years. PI: Austine Bitek (CVR).

Thank you for your letter dated 11th November, 2011 responding to the comments raised by the KEMRI SSC.

I am pleased to inform you that your protocol now has formal scientific approval from SSC.

The SSC however, advises that work on the proposed study can only start after ERC approval.

Sammy Njenga, PhD
SECRETARY, SSC

CENTRE FOR VIRUS RESEARCH
16 NOV 2011
P.O. Box 54628 - NAIROBI

In Search of Better Health

Appendix 2: KEMRI National Ethical Review Committee (ERC)

KENYA MEDICAL RESEARCH INSTITUTE

P.O. Box 54840-00200, NAIROBI, Kenya
Tel (254) (020) 2722541, 2713349, 0722-205901, 0733-400003; Fax: (254) (020) 2720030
E-mail: director@kemri.org info@kemri.org Website:www.kemri.org

KEMRI/RES/7/3/1 **December 21, 2011**

TO: **AUSTINE B. ORINDE,**
PRINCIPAL INVESTIGATOR

THRO': **DR. FREDERICK OKOTH**
DIRECTOR, CVR,
NAIROBI

DIRECTOR
CENTRE FOR VIRUS RESEARCH
P. O. Box 54628
NAIROBI

Dear Dr. Orinde

RE: **SSC PROTOCOL NO. 2140 – REVISED (*RE-SUBMISSION*): ESTIMATION OF RIFT VALLEY FEVER DISEASE BURDEN IN KENYA USING DISABILITY ADJUSTED LIFE YEARS.**

Reference is made to your letter dated December 20, 2011.

We acknowledge receipt of the following documents on December 21, 2011.

a. The Revised Study Protocol;
b. The Revised Informed Consent Document – English Versions.

This is to inform you that the Ethics Review Committee (ERC) finds that the issues raised at the 196th meeting of December 13, 2011 have been adequately addressed. Consequently, the study is granted approval for implementation effective this **21st day of December 2011**.

Please note that authorization to conduct this study will automatically expire on **December 20, 2012**. If you plan to continue with data collection or analysis beyond this date, please submit an application for continuing approval to the ERC Secretariat by **October 7, 2012**.

Any unanticipated problems resulting from the implementation of this protocol should be brought to the attention of the ERC. You are also required to submit any proposed changes to this protocol to the SSC and ERC prior to initiation and advise the ERC when the study is completed or discontinued.

You may embark on the study.

Sincerely,
Caroline Kithinji,
FOR: SECRETARY,
KEMRI ETHICS REVIEW COMMITTEE

CENTRE FOR VIRUS RESEARCH
21 DEC 2011
P. O. Box 54628 - NAIROBI

In Search of Better Health

Appendix 3: Consent Form - English

Title of Study: Estimation of Rift Valley Fever disease burden using Disability Adjusted Life years

Investigator: Orinde, Austine Bitek

Institution: Jomo Kenyatta University of Agriculture and Technology/KEMRI

Sponsor: KEMRI / CDC

Request: We hereby request your participation in a research study. The study aims at assessing the monetary and non monetary costs of the disease mainly the DALYs of RVF in Kenya and to evaluate public health sector and private costs of RVF management.

The study session with you will last about 15 minutes. During this time, you will be asked some questions which you will be required to respond to.

Risks and benefits: There are no risks whatsoever involved in the study. This study is expected to provide vital data on societal burden of RVF and public and private costs of RVF management that will guide in health policy and resource allocations on the basis of DALY prevented and provide public health sector benefits from livestock interventions.

Confidentiality: Information obtained about you for this study will be kept confidential and will be used only for the purposes of the study. The results of the study may be published or disseminated without revealing your identity.

Consent: Your participation is voluntary. You are free to withdraw from the study at any time. If you choose not to participate, or to withdraw from the study, there will be no penalty.

Note: If you have any questions or concerns about the study, please contact:

Orinde, Austine Bitek

P.O. Box 6514-00100 Nairobi,

Cell phone No. 0721606743

E-mail: bitekorinde @yahoo.com

For any questions pertaining to rights as a research participant, the contact person is;

The Secretary,

KEMRI Ethics Review Committee,

P.O.Box 54840 – 00200, Nairobi.

Telephone numbers: 020-2722541, 0722205901, 0733400003

E-mail: erc@kemri.org

I have been explained and understood the information concerning the research study and voluntarily accept to be part of this study.

Name:…….Signature:……....date:……

Witness name:…….. Signature :……date:…….....

Appendix 4: Household questionnaire

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

Interviewer's name..... Tel No.....

INTERVIEWEE

First name_____ middle name _____ last name_____

Questionnaire Number	**District**	**Division**	**Village**

Position in household: **……**

1. Age (years) _____

2. Sex □ male □ female

3. What is your highest level of education?

□ no formal education □ primary

□ Secondary □ tertiary/middle level colleges/University

□ Others (specify)…….

4. What is your occupation?

□ Unemployed □ informal (pastoralists)

□ Formal employment □ Others (specify)……..

□ Student

5. Marital status?

□ Married □ Single

□Widowed □ Divorced

□ Others (Specify)……

Access to health care services

6. When a member of your household falls ill, where do you normally seek for health services?

□ Family medicine (plants etc) □ Traditional healer

□ Private doctor □ Hospital / dispensary

□ Others (specify)……..

7. Which health facilities are available for you to source health services? Please name and state the approximate distance from your home, and which one do you normally.

Description of facility e.g. dispensary	*Distance in kilometres*	*Select one only*
1.	Distance	
2.	Distance	
3.	Distance	

Transportation costs

8. What are your means of transportation of a patient to the one normally used health facility (in the order of first, second, and third choice) and what are the approximate costs of transportation for one patient?

	Means of transportation	*Costs to nearest health facility*
1. choice		
2. choice		
3. choice		

9. Did a member of your household suffer from RVF infection? If Yes, please specify who it was e.g. position in household, age and sex.

.....
.....
.....

10. Did a member of your community suffer from RVF infection? If yes, how far away was this case from your household; were several people affected?

.....
.....
.....
.....

11. In case of an ill household or community members during the RVF outbreak, were there constraints in transporting the patient to the health facility normally used? If yes, please describe

.....
.....
.....

12. In case of any severe illness of a family member, how do you pass the information to the health providers?

.....
.....
.....

13. Who is the main care-giver for sick children and adults?

	Main care-giver
Children	
Adults	

14. In case of hospitalization of a patient, does a family member stay with the patient – and if yes, what is their main role?

	Who stays with hospitalized patient?	*Role of person staying with / visiting patient*
1.		
2.		
3.		

Diagnostic and treatment costs

15. Was any of your family members hospitalized from RVF infection?

□ Yes □ No

16. Please specify all the costs incurred by the family in caring for the patients whether hospitalized or not?

Items description e.g. food, hospitalization fees e.t.c	*amount*
Total	

19. Who replaced you for your routine work or part of your routine work while you were ill or being treated for RVF?

□ Nobody
□ Relatives living in same household
□ Other relatives not living in the same household
□ Friends
□ Others (specify)……

20. Has your income decreased since you are ill from Rift Valley Fever?

□ Yes
□ No

If Yes, by how much? Here there are two possibilities to answer:

by **1** or **2** or **3** or **4** or **5** or **6** or **7** or **8** or **9** or **10 of 10** ? *(Please underline the answer)*

by _____ KShs. *(Please insert the sum)*

21. What coping strategies were adopted by your household if adversely affected by the RVF outbreak?.....
.....
.....

Appendix 5: Questions for public health key informants on Rift Valley Fever

1. Was there occurrence of human cases of RVF in your health facility / districts during the 06/07outbreak?

2. How many human cases of RVF were reported in your health facility/district/province?

3. According to your opinion, do you think there were RVF cases that were not reported to health personnel? If yes, what was the % of these cases out of all persons ill from RVF?

4. Please state the diagnostic equipments and reagents that are required for diagnosis of a suspected human case? Please state approximate amount of each item (KES)

5. What is the recommended standard guideline for the management of RVF cases? Please state the approximate costs of each for both mild and severe forms of RVF

6. Which other costs occur at a health facility for a suspect case, please list the expenditures and amount incurred for one patient.

Appendix 6: Consent form translation into Somali

Baaraha: Orinde Austine Bitek

Macxadka: Jomo Kenyatta University of Agriculture and Technology / KEMRI

Malgeliyaha: Agricultural Health Research Platform (AHRP) / CDC

Codsi: Maxan kaa codsaneina in ald nagala geb gadhato radhiska goralkena holgalka muxw radhinaya qarashka xagah. Confimad amaba kaan aan cafimad ehen uugelayo bukanka saandiga wadangena Kenya in lagu waiya geliyo cafimadka bushudha guud iyo mida gaaska eeba. Agriskena ama raadhintena muyusoconaya mudu ila shaan iyo taban dagigo mudadhan ayadha ah maxa laguweydinaya sualo sualahayo jawabtodha lagaga bahanyoho in add sawabto.

Qasaro iyo faidho: Majiro qasaro kuimadho qabanqabikena qabangabaha maxa laga rajeynaya inunoata mid bixiyo warbixin caad oo sidha usameyo bulshadha yaga daqalaha cudhurika saandiga inn ayuu uhormaro sii malgelin logusameynlaha sidha loga hortago.

Sirtadha: Warbixintan laga soasaray qabanqabintan waa xafidhaya maxana loistiemalidona oo keliah qabangabintan waxay kusabsantahay. Natijadha kasobaxto qoral baa lobedeli dona mise waa ladafi dona adhigo qofkaadtahay lashegidonin.

Wanoqolade: Kaqebqadha shadhadha waa mid adhi add isasobixisay. Haad dondona waad madhax banantahay in add kabaxto waati walbobo hadaad dondo in add kaqebqadhato mise add babaxto tilabo lagaqadhi dona majireyso.

Hadii ad wax sual kaqabtid barista nagalaxarir;

Orinde Austine Bitek

P.O.Box 6514-00100

Telefonka: 0721606743

E-mail: bitekorinde@yahoo.com

Wixii xuquq ah ee kusaabsan cilmi barista lasameyay iyo ka qeybqadash o kala xarir;

Xoghaynta

KEMRI Ethics Review Committee

P.O.Box 54840-00200,

Nairobi.

Telefinka: 020-2722541, 0722205901, 0733400003

E-mail: erc@kemri.org

Waan fahmay barista waxa ay kakooban tahay waxaana ogolahay in aan ka qeyb qaato hoowlaha barista;

Magaca……
Saxix…….Tariqta……

Magaca
hore…….Saxix……..Tariqta……

Appendix 7: Questionnaire translation into Somali

Sualo qoos oo kusabsan qarashaka haga cafimadka qasatan saandig

Tariqta dd/mm/yyyy ...../...../.....

Intahanka..... Numbarka telefonka.....

INTERVIEWEE

Magaca hore_____ magaca dexe_____ magaca dambe_____

Sualo No.	**Degmo**	**Degmo-yaav**	**Bulo**

Qebti cida: **……**
1. Sanaad (years) _____
2. Sex □ raag □ haween

3. Cilmigadha maxa kuguwen?

□ qofan aquisanin □ dugsiga hose

□ dugsiga sane □ daxda (daxdiis/jamacada)

4. Mahadkashakaisa?

□ Mashaqeye □ Haola daghata

□ Shaqa faias □ Arbay

□ Wakale…….

5. Margurstaya?

□ Walgursadhay □ Keli

□ Lageineay □ Wakela…….

Isbatalki waxa jivo

6. Qof qoskadha kamidah haduu tanunsadho inde cawin uradsaneysa?

□ dawoyinka □ heda iyo kulan

□ Daatarka konigaah □ isbital

7. Enteulahelaa alabta dawowyinka oo afimsdkaa?

Isbatalka	*Melofoq kalamatau*	*Halka braxso*
1.	melofoq	
2.	melofoq	
3.	melofoq	

Transportation costs

8. Maxa la istiemala oo laqu safua safavonyinke magaladha?

	mahalatumiya	*Lacqa kquistca malayadha*
1. kebta		
2. kebta		
3. kebta		

9. Miyujira qof qoskadha kamidah oo saandig kabo haadi jawabtadha lahay haa fadlan sheq sanadkisa iyo jinsikisa?

.....
.....

10. Miyu jira qofnqoladhadha kamidan oo saandig qabo hadii ay jawabto tahay haa intea iskujirtan ma daad badhan aaqaba?

.....
.....
.....

11.Haday dacto qof qoskadha amaba qoladhadha ah haduu saandig kudaca miyujira dib kaimanayo xaga kadhidka qofka laqukeyo isbilalka haday jawabtadha haa ay atho fadhlan fafahin kabixi?

.....
.....
.....

12. Hadii ay dacto qof qoskadha kamidah in uu hanunsadho sidhe codsi ayad ugudibaneysa deeabixiya yasha xaga cafimadka?

.....
.....
.....

13. Datarka ukuwen odaweyo arurta yawaye?

	muhutumiyeya
Arur	
Kufwen	

14. Hadii aydacto in bunakadha isbatalka lasexiyo manqof qoskadha kamid ah lajoqi haa aylahay jawabtadha haa shaqadhisa maxay tahay?

	Ruxa lajoqo daclka?	*Shaqadha qofka daclka xanunsa?*
1.		
2.		
3.		

<u>Cuthurka intudanyahay</u>

15. Majirta qof qoskadha kamidah oo sanding iosexiye?

□ Haa □ Maya

16. Fadhlan cadeh qarashka qoska kagolayo bukanka saandig hadi isbitalka asexiyo iyo hadii kale bo?

Noca qlabta e.g cuno, biyo	*Lala*
Hesabte intaydantoho	

17. Fadhlan cadeh qarashka kale oo kalo bukanga oona daan cafimad ehen?

ilabta	*lala*
warakte	
sheiybar	
wahkale	

18. Shaqadha yaakusihaye intad saandig uxanunsaned?
□ cidna/qofna □ qarabo □ saxibehey

Fadhlan sheq saandig sidhu ayu usababay daqalahadha qoska
……
…….

19. Yaku badalayi gorta aad xanun saneed saandiga?
□ Maleh
□ Qarabo guriga joogta
□ Qarabo guriga naqan
□ Saxido
□ Wakale……

20.Daqalahda mayaradi qorta xanun sanneed saandiga?
□ Haa
□ Mayaa

Iliso leedhaahay imisa

_____bacag

21.Stralejiyehe oo qoskadha laga cadhiyesta sidha loga hortago cudhurka saandiga?
.....
.....