Epidemiology, Economic and Public health significamce of Rift Valley Fever, Jimma, Ethiopia: A Review

Derara Birasa, Feyissa Benga, Tolasa Negasa

Jimma University, College of Agriculture and veterinary medicine, P.O. Box-307, Jimma, Ethiopia
Corresponding author: derarab2017@gmail.com

Abstract: Rift Valley fever (RVF) is an acute vector-borne emerging viral zoonotic disease, adversely affecting domestic animals and humans. The disease is caused by Rift Valley Fever Virus (RVFV) of the genus *Phlebovirus* and the family *Bunyaviridae*. It was first reported in Rift valley of Kenya in 1930-31 with an experienced outbreak of abortion and death in exotic wool sheep and illness in humans. Nowadays, it has expanded to different geographical regions both inside and outside Africa, particularly sub-Saharan Africa and Arabian Peninsula. The disease is currently an economical concern in its endemicity because of trade restriction on importation and exportation of animals and animal products and the cost incurred to control and prevention measures. The desease is transmitted in domestic animals either through bites from different species of infected mosquitoes, mainly the *Aedes* and *Culex* genera or by direct contact with infected animal tissues, bodily fluids and fomites. In humans, transmission of the RVF is thought to be through arthropod vectors, aerosol, direct contact with infected animals or animal products. The disease adversely affects a wide range of vertebrate hosts including humans, but Susceptibility varies among the species. Ecological factors, human behavioral and Climatic factors significantly effect vector distribution and RVF transmisions. Nowadays, the disease is not introduced to Ethiopia. However, the objectives of current review is focused on understanding the epidemiology, economic and public health significance of the disease and ready to take action in preventing the disease prior to its introduction to Ethiopia, since Ethiopia is bordered by some RVF endemic countries.

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1. Introduction

The livestock sub-sector plays a crucial role in national economy of developed and developing countries by providing the national gross domestic economy through benefits from rearing (cattle), exporting of live animals, meat, hide as well as skin and others and earn huge amount of money for the country. However, not all countries are equally understanding and self-sufficient in livestock productions while livestock still remains an integral part of their national economy. The most critical contribution and value of livestock for livelihood of the poor people are enormous. For instance, source of food, drought power, social and cultural assets, source of income and means of transportation are some of their contribution for human life (Awgchew, 2004). Although live stock has many contributions to the livelihoods of human life in different ways, many diseases have adverse affect on the survival and reproduction of animals. Of these diseases, Rift Valley Fiver (RVF) has a significant global threat to both humans and livestock sub-sector (Arishi *et al*., 2000; Woods *et al*., 2002).

Rift Valley fever (RVF) is an acute vector-borne viral zoonotic disease, affecting domestic animals and humans adversely (Davies and Martin 2006). The disease is caused by the Rift Valley fever virus (RVFV), a zoonotic arboviral infection of the genus *Phlebovirus* and the family *Bunyaviridae*. The transmission of RVFV in domestic animals is either through bites from different species of infected mosquitoes, mainly the *Aedes* and *Culex* genera or by direct contact with infected animal tissues, bodily fluids and fomites, particularly if associated with abortions (Davies and Martin 2006; Soti *et al.,* 2013). In humans, Transmission of the virus is thought to be through arthropod vectors, aerosols of blood or amniotic fluid, handling of the blood or tissues of infected animals or other direct contact with infected animals (Woods *et al.* 2002). The relative importance of each mode of transmission varies according to the stage of the epizootic. In the first stage, the bites of infected mosquitoes are the predominant mode of transmission while direct contact of animals with infected tissues (foetal or otherwise) may become predominant during the amplification stage of the epizootic (Pepin *et al.,* 2010).

Rift Valley Fever was first reported in Rift valley of Kenya after heavy rain fall in 1930-31 with an experienced outbreak of abortion and death in exotic wool sheep and illness in humans.

Since then, the out breaks occurred in the high lands of Kenya at irregular intervals of 3-15 years (Swanepoel, 2004). Nowadays, it exists and occurs as epizootics through sub Saharan Africa with recent expansion into Egypt, Madagascar, Mauritania and recently further expansion was reported in the Arabian Peninsula (Radostitis *et al.,* 2007).

In ruminants, particularly sheep and cattle, the disease is characterized by high mortality (100 % in neonatal animals and 10 % to 20 % among adult animals) and high abortion rates especially in infected pregnant animals (Corso *et al.*, 2008). The symptoms of the disease in human is characterized by high fever, strong headaches, body pain, dizziness, nausea, pain within the eyes, loss of weight and bleeding through body cavities (Swanepoel and Coetzer, 2004). This disease is reported as the major cause of the most explosive zoonotic outbreak ever seen recently in Africa. The number of confirmed cases during this period in humans is estimated to be 10,000 per year globally (LaBeaud *et al*., 2008). In east Africa, RVF epidemics occur in arid and semi arid areas at intervals of 10 years. The derivers for occurrence of the epidemics is related with climatic changes with increased rainfall resulting in widespread flooding and resultant swarms of mosquitoes populations (Anyamba e*t al*., 2002; Woods *et al*., 2002; Martin *et al*., 2007).

The most recent epizootics in East Africa was occurred in 1997- 1998 in the dried areas of North East Kenya and South West Somalia which was associated with heavy rains. This cause's human death and some livestock lose, particularly of camels, but more significantly disruption to livestock exportation to the Middle East from the Horn of Africa (Bonnet *et al.,* 2001). The disease is currently an economical concern because of the cost associated with preventive measures in endemic areas, monitoring for introduction of disease in neighboring unaffected areas and trade restriction on import and export to and from countries (Melkamu, 2018). Even thought the disease is currently not introduced to Ethiopia, this review is aimed to understan the nature and epidemiology of the disease to make prevention and ready to take action in controlling the disease since Ethiopia is bordered by some RVFV endemic countries. Therefore, the objectives of this literature are to review on;

- Epidemiology and factors associated with RVF transmission.
- Economic and public health significance of the disease.

2. Literature Review

2.1. Etiology and nature of the virus

The causative agent of Rift Valley Fiver (RVF) is Rift Valley Fever Virus (RVFV) belongs to the family *Bunyaviridae* and the genus *Phlebovirus*. It is single stranded Ribose Nucleic Acid (RNA) virus which has a lipid envelope and two surface glycoprotein, G1 and G2 and possess spherical virions with diameter of 80-120 nanometers (Kahen, 2005). The genome has three segments, L (Large), M (Medium) and S (Small) and the virus replicates in the mosquitoes as well as in the vertebrate animals. Organs like liver, spleen and brain are the predilection sites for viral replication. The Virus has the ability to resist an alkaline environments but inactivated at PH <6.8 and by disinfectants such as calcium hypochlorite, sodium hypochlorite and acetic acid and can be maintained for many years (8 years) when stored at lower temperature (below $0^{o}C$) (Davis *et al.,* 2003).

2.2. Epidemiology and risk factors associated with RVF transmission

Although relatively little is known about the natural history of RVFV transmission and infection, natural outbreaks are sporadic and explosive (CDC, 2000; Woods *et al.,* 2002). However, epizootic outbreaks do not randomly occur by itself, hence there might be strong linkage between the occurrence of the outbreak and excessive rainfall and local flooding events. The virus is maintained in nature even by trans-ovarian transmission in flood-water *Aedes* mosquitoes. Certain mosquito species (flood water *Aedes*) allow RVFV to be embedded in endemic ecosystems by means of vertical transmission to their offspring (Mhina, 2016). Then the trans-ovarially infected mosquito eggs can remain viable for many years during dry seasons. At the time of the occurrence of rainfall, the shallow depressions in the landscape called dambos, fill with water and allow the eggs to hatch. Then after, the newly hatched transovarially RVFV-infected mosquitoes feed on livestock that come to the dambos to drink and a RVF epizootic is initiated. After a moment, *Culex spp.* Mosquitoes are reproduced at these sites and competent to transmit RVFV from animal to animal and from animal to human which can lead further amplification of the outbreak as 'epidemic' vectors (Turell *et al*., 2008).

Rift Valley Fiver Virus (RVFV) was reported as endemic to many countries like East Africa, South Africa, the Senegal River valley (CDC, 2002) and has been introduced repeatedly into Egypt in the 1970s, and recently to the Arabian peninsula (Yemen and Saudi Arabia) in 2000 (CDC, 2000).

2.2.1. Geographical distribution and occurrence of the disease

Since its first isolation in Kenya in 1930-1931, RVF has expanded to different geographical regions both in side and outside Africa (Himeidan *et al.,* 2014; Freire, 2015). The virus has known to cause outbreaks with adversely significant affect on health and socio economic impacts in different parts of Africa and also in some regions out side Africa. Geographic distribution of RVF could take place by crossing borders, for instance, via livestock trade (Sutherland, 2013) and through mosquito expansion favored by climate change (Gould, 2009). The following table illustrates geographical distribution and affected countries by RVFV.

Table 1 Geographical distribution and occurance of Rift Valley Fever

Geographical Regions	**Affected Countries**	**authors**
In side Africa		
East Africa	Kenya, Tanzania and Somalia	Butcher *et al*., 2012
West Africa	Senegal and Mauritania	Chevalier *et al.,* 2009; Sow, 2014
Central and some of North Africa	Sudan and Egypt	Aradaib, 2013; Kamal, 2011
Southern parts of Africa	Zambia, Zimbabwe, and the Republic of South Africa	Davies, 2010
Out side Africa		
Indian Ocean regions	Madagascar, Mayotte and Comoros	Balenghien, 2013
Arabian Peninsula	Saudi Arabia and Yemen	Abdo-Salem, 2006
Some of unaffected regions	Most of North African countries, Europe, Mediterranean regions, Australia, Canada, U.S.A. and some Asian countries	Rolin *et. al*., 2013

Rift Valley Fever Virus is adapted to a variety of ecological zones, such as semi-arid or wetlands (dambos) in Kenya and South Africa, irrigated land in Egypt, Sudan and the Senegal River, forest areas in Madagascar and arid zones in Yemen and north of Senegal (Arum, 2015).

2.2.2. Host range and Susceptibility

A wide range of vertebrate hosts including cattle, sheep, goats, dromedaries, wild ruminants, buffaloes, waterbucks, humans, horses, dogs, cats, bats, several rodents and nonhuman primates are infected by RVF (OIE, 2009). However, Susceptibility varies amongst these species. Younger animals including lambs, kids, puppies and kittens are extremely susceptible. Cattle, buffalo, humans and Asian monkeys are moderately susceptible. Camels, horses, and pigs are less susceptible and develop a mild form of disease and viremia. But, Birds, reptiles and amphibians are resistant to the disease (OIE, 2009). Although Cattle and humans are moderately susceptible, the RVF has been reported to cause significant mortality and morbidity in sheep, cattle and even in man (Kahen, 2005).

2.2.3. Ecological factors

RVF epidemiology in East Africa is closely associated with the ecological factors prevalent in the Great Rift Valley (along depression in the earth that runs down the eastern side of Africa, which traverses Ethiopia and Kenya to northern Tanzania with two branches that form the eastern and western drainage ecosystems). The western branch runs through Tanzania and Uganda while the eastern branch runs through Kenya and Tanzania (Baba *et al.,* 2016). Unlike sandy soil, clay soil texture supports the retention of water for long periods of time, and thereby contributes to the flooding and wetness of the habitat, making it suitable for the breeding and survival of mosquito vectors (Himeidan *et al.,* 2014). Unlike the majority of arboviruses, which adapt to a narrow range of vectors, the RVFV infects a wide range of mosquito vectors like *Aedes* and *Culex*as (the major), flies and ticks (Pepin *et al.,* 2010). Moreover, different species of vectors have different roles and potentials in sustaining the transmission of RVFV in an environment (Tchouassi*et al.,* 2014). Usually, flooded dambos (low-lying areas of soil) in East Africa induce the hatching of transovarially infected eggs of *Aedes* mosquitoes that are dormant in the soil, which serve as primary vectors (eggs can remain viable for several decades). Hatched infectious mosquitoes transmit the virus to nearby livestock and wildlife vertebrate hosts, which serve as amplifiers of the virus by infecting more mosquitoes and thereafter, secondary vectors of the virus (*Culex, Anopheles* and *Mansonia* mosquitoes) amplify the transmission of the virus to non-infected domestic animals and humans (Nderitu *et al.,* 2011). Flooding in areas with a high density of livestock and/or wildlife creates conducive environment for RVF transmission (Nguku *et al.,* 2010) and under such conditions the virus is maintained within the ecosystem. Other environmental factors such as canopy cover, dissolved oxygen, pH, turbidity, organic matter, salinity and temperature also influence the abundance of various mosquito vector species and arbovirus transmission (Ofulla *et al.,* 2010).

2.2.4. Climatic factors

Climatic factor determines the geographic and temporal distribution and the life cycles of arthropod vectors as well as the dispersion and evolution of associated arboviruses. It also influences the efficiency with which arboviruses are able to be transmitted from arthropods to vertebrate hosts (Gould and Higgs, 2009). In addition, Climatic variables indirectly affect vector abundance and distribution and the ability of vector to cause diseases (Tabachnick and Day, 2014). One vector species may be displaced by another with a different vectorial capacity in response to environmental changes, such as deforestation, expansion in irrigation or increase in brackish water breeding sites due to rises in sea level (McMichael*et al.,* 2006).

The impact of rainfall on the presence, absence, size and persistence of breeding sites depends upon the local evaporation rates, soil type, land slope and the proximity of large bodies of water (rivers, lakes and ponds), whereas wind has also a significant effect on vector distribution (Mellor and Leake, 2000). Generally speaking, high relative humidity favors most metabolic activities in vectors and enhances their prolonged survival, whereas low humidity tends to decrease their daily survival rate due to dehydration and desiccation (Mellor and Leake, 2000). In some cases, high temperatures and low humidity accelerates the metabolic rate of vectors, increasing biting rates and frequency of blood feeding, which lead to enhance egg production and increases vector populations. However, extremely high temperatures may adversely influence vector populations (Mellor and Leake, 2000). Consequently, the geographical range has impact on distribution of vectors which tends to be limited by a minimum and maximum temperature/humidity. Although there is no clearly defined pattern of average annual maximum or minimum temperatures associated with RVF outbreaks, they have shown a tendency to cease as the maximum and minimum monthly temperatures decline (Sindato *et al., 2014*).

2.2.5. Human behavioral factors

Changes in Land use, such as deforestation, irrigation for farming, construction of the dam, application of fertilizer in farms and the building of residential houses are strongly associated with the emergence and re-emergence of arboviral disease (Hassanain *et al.,* 2010). Similarly, one of the RVF outbreaks in Sudan was reported as linked to the construction of the dam of Merowe on the Nile River basin, as it provided new breeding sites for RVF vectors (Hassan *et al.,* 2011). The inability of mosquitoes (vectors) to fly beyond a few hundred meters during their lifetime may limit their role in long-range disease dissemination (Yamar *et al.,* 2005). However, uncontrolled livestock and human movement or the importation of animals can contribute to the spatiotemporal spread of RVF outbreaks from endemic to naive areas. As reported by Sindato *et al.,* 2014, human RVF cases are not common in the absence of animal disease occurrence.

Other human behavioral factors that contribute to RVF dissemination during outbreaks include poor inter-ministerial collaboration and inadequate surveillance of livestock and human populations due to scarce resources (Balkhy and Memish, 2003). Lack of recognition of the risk factors and making poor decisions timely to prevent and control the disease exacerbates the severity of RVF epidemics (Munyua *et al.,* 2010). In addition, inadequate data on the herd immunity level in both animal and human populations and the insufficient entomological surveillance to identify areas at risk in vulnerable ecologies (Breiman *et al.,* 2010) may contribute to frequent RVF outbreaks.

2.2.6. Mode of transmission

Rift Valley Fever Virus is capable of vertical transmission between generations of mosquitoes without cycling through a vertebrate host. In human infections, exposure to the virus can occur through the bite of a mosquito or more likely through contact with infected animal tissue or blood. Mechanical transmission, aerosol exposure in the laboratory, fomites and consumption of animal products such as uncooked meat and unpasteurized milk represent other transmission risks (McDaniel *et al*., 2014). It was understood that the virus can be transmitted via transovarially among flood water Aedes species of mosquitoes. The virus can survive for a long period of time in mosquito eggs and laid at the edge of usual dry depression, called dambos, which are common through grassy plateau regions. When the rain comes and these dambos flood, the egg hatch and affected mosquitoes emerge and infect nearby wild and domestic animals (Quinn *et al*., 2002).

The introduction of infection in to animals and humans follows the bites of many species of mosquitoes. The virus survives for very long periods in the mosquito eggs. Cattle and sheep are primary taken as amplifiers of the virus. The capacity of RVF virus to be transmitted without the involvement of an arthropod vectors raises concern over the possibility of the virus for its importation in to non-enzootic areas through contaminated materials, animal products, viremic humans or non livestock animal species (Edward *et al.,* 2011). Low concentration of RVF virus in the milk of sick animal may pose health risks to man if the milk is consumed raw or unpasteurized (LaBeaud *et al.,* 2008). Humans have the potential to introduce RVF virus through mosquitoes bite to animals in uninfected areas. Certain occupational groups such as farmers, slaughterhouse workers, laboratory workers and veterinarians are therefore at higher risk of infection (Kahen, 2005).

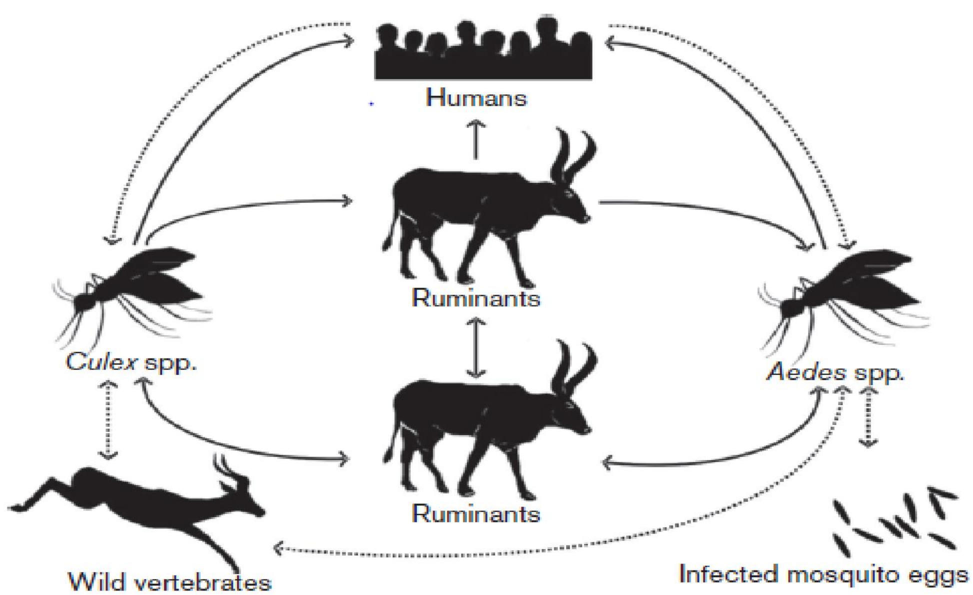
2.2.7. Transmission Cycle

Mosquitoes have been implicated as the transmission vector of RVFV since its identification. As cited by Lumley *et al*., 2017, this virus can infect a broad range of arthropods including Culicoides, biting midges, phlebotomine, sand flies and ticks. However, transmission by arthropods other than mosquitoes is considered mechanical and not biological (Lumley *et al*., 2017). RVFV has been detected in over 50 mosquito species in endemic regions and competency demonstrated in at least 47 (Turell *et al.,* 2008) predominantly within the genera Aedes and Culex.

Epizootic / Epidemic cycle

Rift Valley Fever Virus is maintained by horizontal transmission (HT) between ruminants and mosquitoes during epizootics (Fig. 1). As cited by chevalier *et al.,* 2010, humans are considered dead-end hosts with minimal involvement in viral amplification even though not resolved. Infection of mosquitoes is dose-dependent, so in order to be considered as an amplifying host, titers must be sufficient enough and needs sufficiently long duration to support onward transmission (Bird *et al.,* 2009). Natural viraemias in humans are 1–8 log10 p.f.u. ml^{-1} (on average detected 3 days post onset) (Njenga*et al.,* 2009) and in livestock 6–8 log10 p.f.u. ml^{-1} (chevalier *et al.,* 2010), lasting up to 5 days in calves and lambs. Mean viral titres in engorged mosquitoes are 100-fold lower than in the blood meal although the titers may vary among between mosquito species (Lumley *et al*., 2017).

Flooding of mosquito habitats can introduce RVFV into domestic animal populations by the production of vertically infected *Aedes* mosquitoes. Epizootic/epidemic cycles are driven by the subsequent increment of various *Culex* mosquito populations, which serve as excellent secondary vectors if immature mosquito habitats remain flooded long enough. Apart from the mosquito transmission to domestic animals and humans, during the epidemic cycle, aerosols and contact between infected animals and human can transmit the virus (Anyamba *et al*., 2010) and then the virus is amplified in people and animals. Flat topography, that has potential to hold water, presence of water retaining soil types and dense bush cover are important factors for mosquito breeding and or flooding (Anyangu *et al*., 2010).



(Fig. 1) Transmission cycles of RVFV. Arrows represent transmission direction. Solid lines represent established routes supported by experimental data and dotted lines suspected routes but current data are insufficient to verify (modified from (chevalier *et al.,* 2010).

2.3. Pathogenesis

Rift Valley Fever virus replicates rapidly in target tissues after getting entry into the body by mosquitoes bite, per-cutaneous injury or through the oropharynx via aerosols (Edward *et al.,* 2011). After infection, the virus spread from the initial site of replication to critical organs such as the spleen, liver and brain which are either damaged by the pathogenic effects of the virus or immunopathological mechanisms, else there is recovery mediated by nonspecific and specific host response. The virus is conveyed from the inoculation site by lymphatic drainages to regulate lymph nodes where there is replication and spin over into the circulation which leads to viremia and systemic infections (Ikegami *et al.,* 2011).

2.4. Clinical manifestations of Rift Valley Fever

In animals

The incubation period of the virus varies from 1 to 6 days. The incubation period is 12-72 hours for newborn lambs, 24-72 hours in adult sheep, goats and cattle and 3-6 days in humans (Mandell and Flick, 2011). RVF is characterized by high abortion rates and high mortality in neonates usually occurring after periods of heavy rainfall. In Cattle**,** Calves experience fever (40-41°C), in appetence, weakness, depression, diarrhea and jaundice. Adults often experience unapparent infection but fever lasting 24-96 hours, dull coat, lacrimation, nasal discharge, excessive salivation, anorexia, weakness, bloody diarrhea, low milk yield and high abortion rates in pregnant cows are common (Hartley *et al.,* 2011).

In Sheep and Goats**,** newborn lambs and kids (less than 2 weeks of age) experience biphasic fever (40-41°C), anorexia, weakness, abdominal pain, rapid respiration and death within 24-36 hours. Lambs (over 2 weeks of age), adult sheep and goats experience fever lasting 24- 96 hours, anorexia, weakness, depression, increased respiratory rate, vomiting, bloody diarrhea, mucopurulent nasal discharge, jaundice and abortion rates approaching 100% (Hartley *et al.,* 2011).

In humans

In humans, RVF presents as influenza-like syndrome characterized by fever (37.8-40°C), headache, myalgia, weakness, nausea and light sensitivity. In addition, retinopathy, blindness, meningoencephalitis, hemorrhagic syndrome with jaundice, petechiae and death can arise with different Complications (Archer *et al.,* 2011). The illness may occur as mild or sever. In Mild case**,** the incubation period (interval from infection to onset of symptoms) for RVF varies from two to six days. Clinically, it presents as a fever with flu-like symptoms, neck stiffness, sensitivity to light (photophobia), loss of appetite and vomiting. Symptoms of RVF usually last from four to seven days, after which the immune response becomes detectable with the appearance of antibodies and the virus gradually disappears from the blood (Archer *et al.,* 2011).

A small percentage of patients develop severe form of the disease, which can manifest as one or more of ocular disease (retinitis), meningoencephalitis, hepatitis and renal failure (Archer *et al.,* 2011).

2.5. Pathologic lesions

Hepatic necrosis is the primary lesion observed in RVF. In aborted fetuses and neonatal animals, particularly the lambs and calves, the liver is soft, enlarged, friable and yellowish brown to dark in color. In addition, the edema and hemorrhages in the wall of gall bladder, hemorrhagic enteritis, enlarged edematous peripheral and visceral lymph nodes, widespread cutaneous hemorrhages, accumulation of blood stained fluids in the body cavities and extensive subcutaneous and serosal hemorrhages are also observed. The rapid decaying of the carcass may be a consequence of the severe liver damage. In addition, there is also a focal to diffuse coagulative necrosis of hepatocytes in the affected liver and intramuscular inclusion bodies are seen in lambs (Davies and Martin, 2006).

2.6. Diagnosis of rift valley fever

Table 2: Descriptions of Clinical and laboratory methods of RVF diagnosis

S/No	Types	Descriptions	Years and authors
1	Clinical diagnosis	Based on observed clinical signs. Eg. fever (40-42°C), anorexia, depression, weakness, mucopurulent nasal discharge, vomiting, jaundice and hemorrhagic diarrhea	Swanepoel and Coetzer, 2004
2	Laboratory diagnosis	Methods by which RVF virus can be diagnosed using clinical laboratories	
2.1	Direct methods	Based on detection of viral particles, viral antigens or nucleic acid and detection of characteristic changes in tissues at site of infections.	Radostits *et al.*, 2007
2.2	Isolation and identification of causative agent	Isolation of infecting virus in cell culture from Organs (clinical specimens). Several types of cell cultures employed for the isolation of virus. Some examples are Baby Hamster Kidney (BHK), African green monkey kidney (Vero) and Chicken Embryo Reticulum (CER)	Pal *et al.,* 2012; Melkamu,2018
2.3	Serologic diagnosis	The detection of specific viral antibody at various stages of the disease (demonstration of antibodies against the virus) using ELISA, Agar Gel Immune Diffusion (AGID), Hem agglutination (HI) and virus neutralization methods	Stear, 2005; LaBeaud *et al.,* 2011
2.4	Molecular diagnosis	Detected by Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) & PCR. It is a very specific and sensitive molecular tool for the diagnosis of RVF in the early phase of disease	Archer *et al.,* 2011
2.5	Field diagnosis	RVF should be suspected when abnormally heavy rains fall is followed by higher abortion rate, high mortality among new born animals, influenza like disease in humans	Stear,2005; Pal *et al.,* 2012;

2.7. Differential diagnosis

In animals, RVF should be differentiated from the following diseases: Wessel bore disease, blue tongue, heart water disease, Nairobi sheep disease, ephemeral fever, brucellosis, pest des petites ruminitis, foot and mouth disease. However, Nairobi sheep disease has no hepatitis and does not occur in new born lambs. In case of bluetongue no hepatitis and lesions on mouth and foot (coronitis) are common. Serous fluid in body cavities and neurological signs are common in heart water disease. In ephemeral fever, there is recumbence (muscle weakness), rapid recovery and is not commonly occur in sheep and goats, while brucellosis does not occur in relation with heavy rain fall. Wessel borne disease is rare viral disease and less severe than RVF. Pest des petites ruminitis has high mortality in lambs while foot and mouth disease has neonatal mortality and abortions in small ruminants (Gerdes, 2004). However, RVF manifests itself in a dramatic way with the following fashions; a sudden onset of many abortions at all stages of pregnancy, an acute febrile disease with high fatality rates in young animals, liver lesions are present in all cases, associated with high mosquito population and / or flooding of grass lands, associated with influenza-like disease in humans (Davies and Martin, 2003).

2.8. Control and Prevention of RVF

In animals

Several control options are available in animals, such as vaccines, larvicides in vector breeding sites and/or insecticide spraying (vector control), animal trade control and the provision of information to exposed human populations (Breiman *et al.,* 2010). In endemic areas, animal vaccination is probably the best way to protect human health.

Both modified live attenuated virus and inactivated virus vaccines have been developed for veterinary use. Only 1 dose of the live vaccine is required to provide long-term immunity but this vaccine may result in spontaneous abortion if given to pregnant animals. The inactivated virus vaccine does not have this side effect, but multiple doses are required in order to provide protection which may prove problematic in endemic areas (Zeller *et al.,* 2013).

Animal immunization must be implemented prior to an outbreak if an epizootic is to be prevented. Once an outbreak has occurred animal vaccination should not be implemented because there is a high risk of intensifying the outbreak. During mass animal vaccination campaigns, animal health workers may inadvertently transmit the virus through the use of multi-dose vials and the re-use of needles and syringes. If some of the animals in the herd are already infected and viraemic (although not yet displaying obvious signs of illness), the virus will be transmitted among the herd and the outbreak will be amplified (Escadafal *et al.,* 2013; Zeller *et al*., 2013).

In humans

Control measures to prevent the spread of the virus to humans include sanitary restrictions relating to products of animal origin, such as meat and milk, use of insect repellents and netting, information delivering for those targeting at risk (e.g. farmers), and appropriate disposal of dead animals. Standard precautions in healthcare settings are effective at preventing transmission (Ogoma *et al.,* 2010). Because the initial epidemiological cycle involves domestic ruminants and humans mostly become infected after contact with viraemic animals, vaccination of ruminants is the favored method of preventing human disease (Zeller *et al.,* 2013).

Since there is no commercially available vaccine for humans, a person's chances of becoming infected can be reduced by taking measures to decrease contact with blood, body fluids, or tissues of infected animals and protecting themselves against mosquitoes and other bloodsucking insects. Use of mosquito repellents and bednets are two effective methods. For persons working with animals in RVF-endemic areas, wearing protective equipment to avoid any exposure to blood or tissues of animals that may potentially be infected is an important protective measure (Chevalier *et al.,* 2010).

2.9. Treatment

There is no specific treatment for Rift valley fever in both animals and human. Most human cases of RVF are mild and self-limiting. Therefore, serious cases are generally limited to supportive care (Nyakarahuka *et al.,* 2018).

3. Status Of RVF In Ethiopia

Rift valley fever occurs mostly in Africa, causing human deaths and important economic losses in the livestock sector. The Horn of Africa has been historically affected by RVF (Nanyingi *et al.,* 2015). However, the occurrence of RVF has never been reported in Ethiopia, which shares borders with infected countries, like Kenya (Hightower *et al.,* 2012), northern Somalia (Soumare *et al.,* 2007) and Sudan (Aradaib *et al.,* 2013). Historically, Ethiopia remained free from outbreaks, but the geographical locations as well as the livestock exchanges with their neighbors make this country highly vulnerable to the disease. This may be related to the lack of information on the suitability of Ethiopian ecosystems for the transmission of the RVF (Hightower *et al.,* 2012).

4. Economic And Public Health Significance Of RVF

4.1. Public health significance of Rift Valley Fever

Rift Valley Fever outbreak has a significant impact on both human and animal health with the loss of thousands of human and animal lives and high morbidity once occurred. The additional burdens for the affected countries are also counted in terms of the costs for the health sector and control measures. The increment in human morbidity and mortality linked with RVF outbreaks in the past two decades has exacerbated in both social and economic impacts in the area where the disease had been occurred. Although human RVF mortality was low during20th century, (CMR <1%), its rates raised to as high as 23%–47% during the East African outbreaks in 2006 and 2007. This was thought to be due to the genetic evolution of the virus (LaBeaud *et al*., 2008). Hospitalization due to arboviral diseases results in both monetary loss and loss of time with a significant impact of deaths on families, communities and countries in the region. Similarly, the psychological distress caused by RVF on the affected families is enormous and the loss of a productive member of the family in terms of labor, income and parental care results in serious consequences. Those who were seriously affected by the outbreak claimed that RVF represented a worse threat to health than the commonly dreaded human immunodeficiency virus/acquired immune deficiency syndrome (Sindato *et al.,* 2011).

4.2. Economic importance of Rift Valley Fever

Rift valley Fever is an economical concern beyond farm, region and country level once occurred as an outbreaks. The economic significance of a disease outbreak is beyond the direct cost of loss of livestock, because it also affects sectors within the livestock industry and most probably the farming populations in the affected regions. The adversely impacted groups includes the livestock producers, the livestock market chain dealers and consumers, the rural and national economy (Rich and Wanyoike, 2010; Peyre, 2015) and even the international livestock trade (Peyre, 2015). For instance, despite the important threat of RVF, few studies (17 studies identified for quantitative analysis on partial cost analysis with limited reference to mid‐ and long‐term impact, public health or risk mitigation measures) have been conducted to assess the socio‐economic impact of RVF outbreaks in Kenya, Tanzania, Somalia, Saudi Arabia and Yemen collectively led to a loss of up to 470 million US dollars (Peyre, 2015). The following figure **(Fig.2)** indicates some level of impacts and sector of impact by this devastating disease.

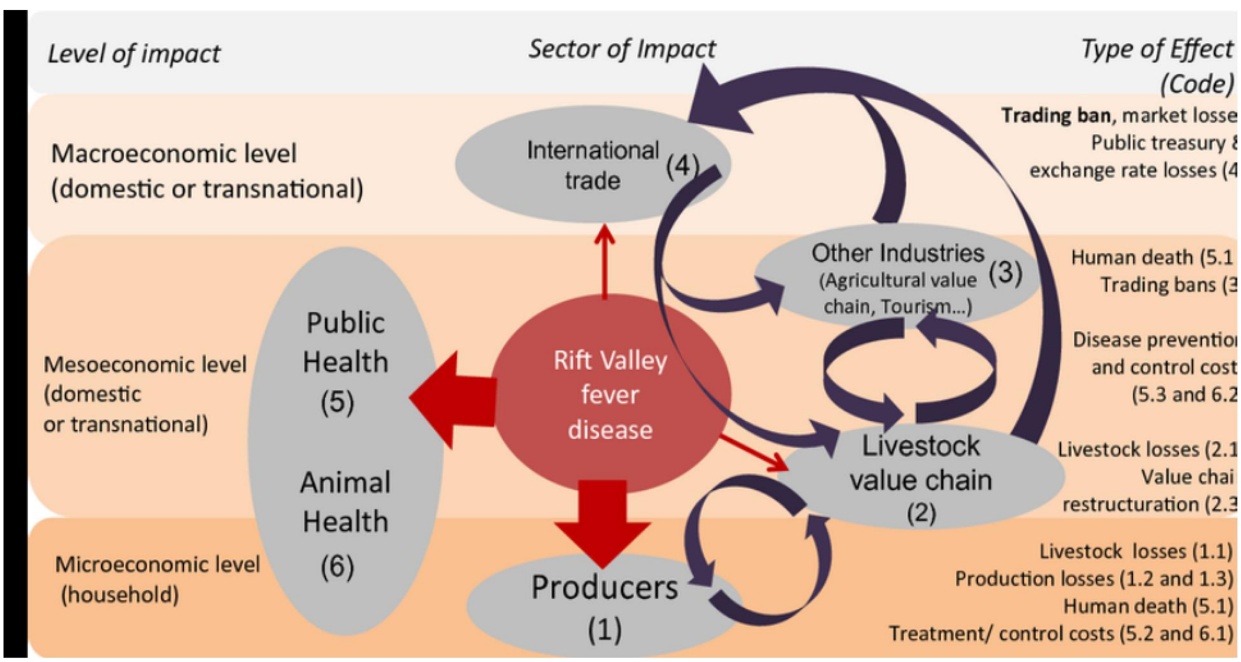


Fig.2. Level and type of socio-economic impacts of Rift Valley fever per sector (Peyre, 2015).

The above figure shows that, the links between the disease and different sectors and level impacted (health related costs) are represented by straight (red) arrows whereas the links between different sectors and level impacted (non-health-related costs) are represented by the bent (blue) arrows (Peyre, 2015).

In additions, RVF is known to cause abortions and prenatal mortality (>95%) in herds used for likelihood of the people like, meat, dairy production and income generation that leads to reduced food availability and income. These effects are more prone to poor dwellers that lack alternative sources of livelihood (Chengula *et al.,* 2014). In Tanzania, the loss of livestock during the 2006–2007 RVF outbreaks was estimated to be US $ 4, 243, 250 for cattle and US $ 2, 202, 467 for goats and sheep can be taken as good example (Anyangu *et al.,* 2010). The imposition of trade bans for three years on the exportation of live animals from the Horn of Africa exacerbated the impact of RVF-induced losses. During the 2006–2007 RVF outbreaks in Tanzania, the exports of cattle dropped by 54% while the domestic livestock market flow decreased by 37%. In Kenya, the loss was estimated at over US $32 million (Karl and Francis, 2010). The overall economic loss during the 2006–2007 RVF outbreaks in East Africa was estimated to exceed $60 million. Such severe losses due to this diseases are not only hazard for low-income people, but also has a huge impact at the country level as the governments of the affected countries are compelled to mobilize funds from different sources to combat the outbreak. Further more, the loss of earnings from the livestock trade results in a lack of finance for basic amenities such as education, health, food and shelter (Hotez and Kamath, 2009). In addition, movement bans on animals have caused animal traders to incur additional costs by keeping the animals they purchased before the bans were enforced (Sindato *et al.,* 2011). The associated loss of income for herd owners has damaged the pride, prestige, integrity and self-importance of livestock owners among their peers. Livestock traders were forced to rely on their past savings to such an extent that they lacked the financial capital to resume trading activities, even when the outbreak was contained (Sindato *et al.,* 2011). However, the political, psychological and economic implications of RVF may have contributed to an intentional underreporting of the disease, thus confounding the estimates of the size and impact of outbreaks.

5. Conclusions And Recommendations

Rift Valley fever (RVF) is an acute vector-borne emerging viral zoonotic disease, affecting both domestic animals and humans adversely and caused by the genus *Phlebovirus* and the family *Bunyaviridae*. It was first reported in Rift valley of Kenya with an experienced outbreak of abortion and death in exotic wool sheep and illness in humans in 1930-31. Since then, it has expanded to different geographical regions both in side and outside Africa. Rift Valley Fevr epidemiology in East Africa is closely associated with the ecological factors prevalent in the Great Rift Valley suitable for the breeding and survival of mosquito vectors, Climatic factor that determines the geographic and temporal distribution and the life cycles of arthropod vectors and human behavioral factors which are strongly associated with the emergence and re-emergence of arboviral disease. The disease has a variety of host ranges affects different species of animals including humans. It is considered as an occupational disease of livestock handlers, abattoir workers, dairy farmers and veterinarians. Rift Valley fever is economically an important disease due to its significant effect on import and export restriction particularly in those countries which livestock contributes great share in their economy. The disease posed a great threat not only to the livestock keepers but also to the Government due to its social and economic implications through costs incurred due to measures taken at different levels in order to prevent or control infection and disease outbreak in both humans and animals. As rift valley fever needs insects and mosquito for its life cycle and transmission, its epidemics has cyclical occurrence. Therefore, based on the above conclusion, the following recommendations are forwarded;

- ❖ Control of mosquito egg laying sites such as ponds, old tires, tarps, tree holes, bird baths and water holding area.
- ❖ Using RVF resistant breed (Most indigenous livestock species in Africa demonstrate a high level of resistance to the disease).
- ❖ Since the disease is a multi-disciplinary, one heath approach is needed in order to control it during the outbreaks.
- ❖ Proper vaccination should be recommended in endemic countries.
- ❖ RVFV endemic countries and their trade partners should collaborate and consider cost effectiveness analysis for planning and monitoring of rift valley fever to benefit the most out of the livestock industry.
- ❖ Using bed Net during sleeping in case of humans
- ❖ Avoiding contact with aborted fetus, contaminated fomites with veriemic, animal product contaminated with RVFV.
- ❖ Occupational workers like livestock handlers, abattoir workers, dairy farmers and veterinarians should be care of when they are working.

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