



Rift Valley Fever in Kenya

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Rift Valley Fever Disease Definition

- RVF is an arthropod-borne acute viral disease of cattle, sheep, goats, camels, wildlife and man caused by an RNA arbovirus of the Genus *Phlebovirus* and Family *Bunyaviridae*.
- Acute disease in ruminants is characterised by high mortality in young animals and abortions.
- Infection in man presents as an influenza like syndrome.
- Individual cases of RVF are difficult to detect due to the non-specific nature of clinical signs.

Clinical signs in livestock

- Sudden onset of high fever, acute prostration, collapse & death (young animals);
- Anorexia, dysgalactia, nasal and lachrymal discharges, salivation, 'vomiting', lymphadenitis, colic, jaundice, haemorrhagic enteritis.

Clinical signs in livestock

- Abortions, dystocia, teratology, hydrops amnii;



Morbidity/mortality in livestock

- Sheep most susceptible followed by cattle and goats;
- Camels susceptible and in pastoral districts the indicator (abortion only);
- Clinical disease especially in exotic breeds;
- Indigenous animals generally less susceptible – except in arid zones;
- 20-90% morbidity;
- 40-60% mortality in young, 2-5% in adults;

Field recognition of RVF outbreaks

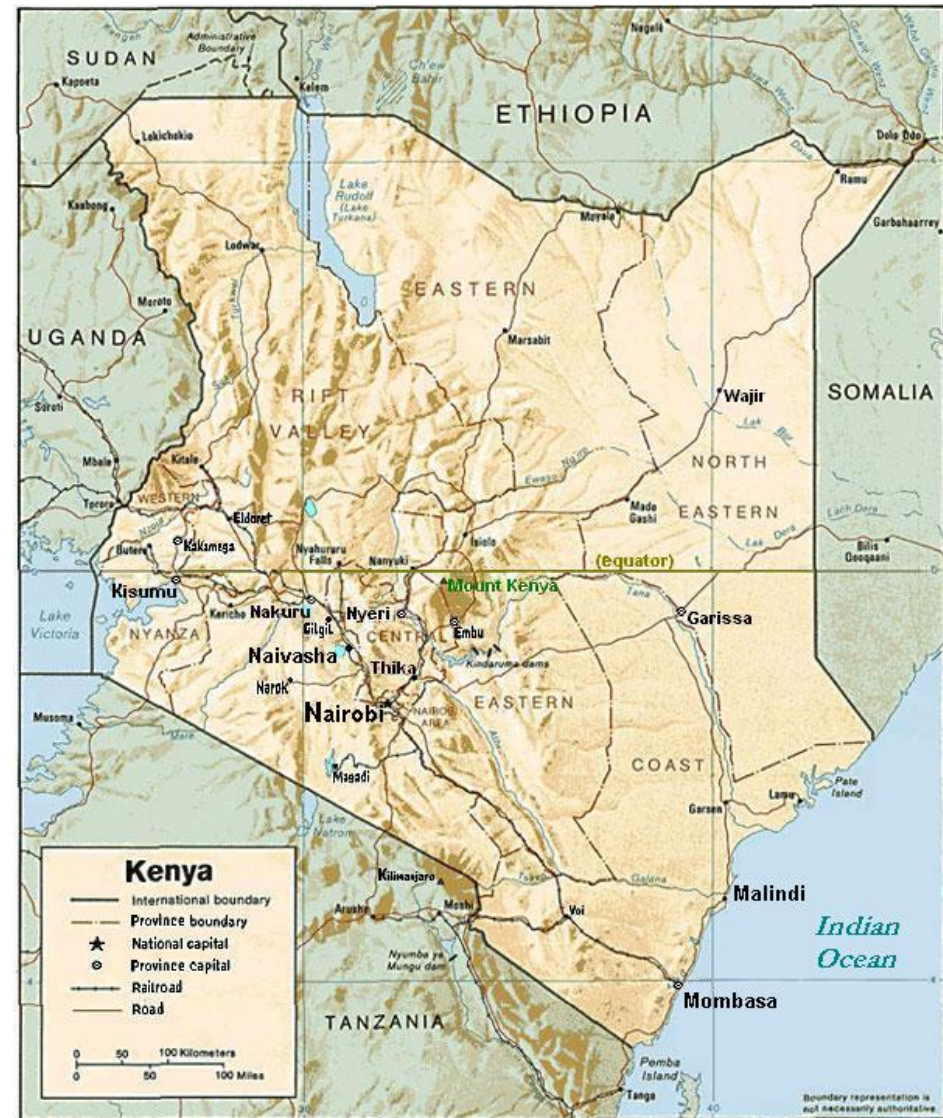
- Sudden outbreak of disease involving deaths of young ruminants (especially lambs & calves) and abortion in pregnant adults following the occurrence of heavy rains,
- Accompanying reports of febrile disease in man.
- Nose bleeding in sheep, goats and cattle in RVF hot spots should always arouse suspicion and may be the only sign

History of RVF in Kenya

- A disease fitting RVF was first described in Kenya in 1910 by Montgomery.
- RVF probably also occurred in 1913 because an outbreak fitting the description and associated with heavy mortalities of sheep was described in the Rift Valley (Bres, 1981).

History of RVF in Kenya

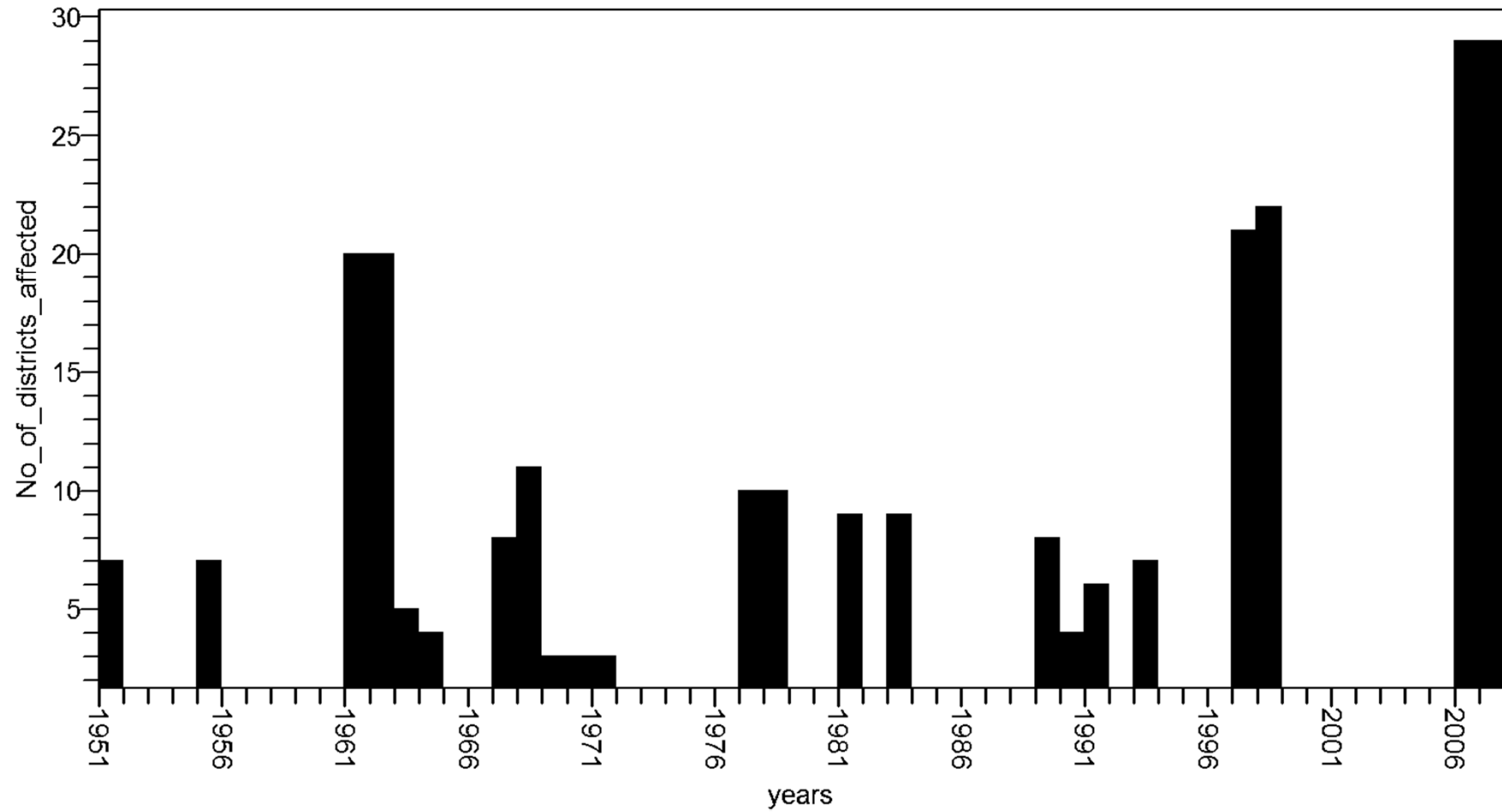
- RVF virus first isolated and characterised in 1931 close to Lake Naivasha in the Kenyan Rift Valley where about 4,700 ewes were infected (Daubney, Hudson and Garnham, 1931).



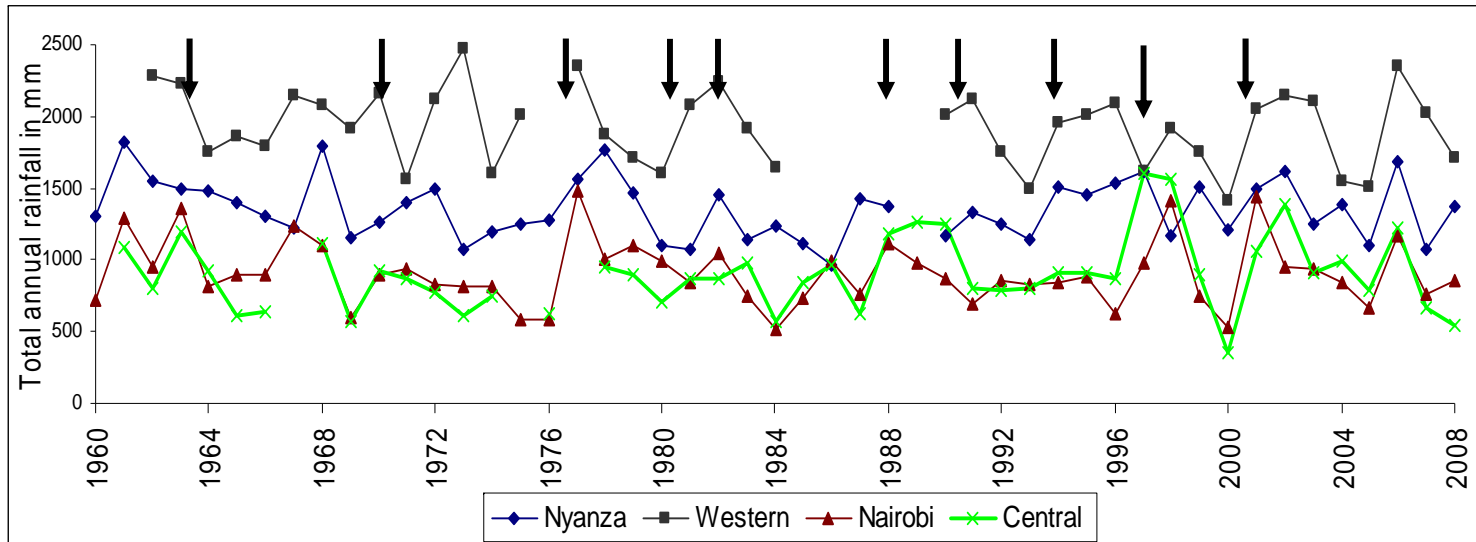
History of RVF in Kenya

- In an outbreak following the *El Niño* rains of 1997, some people contracted the disease in Garissa District (Wood, Peters, Spertzel and Patrick, 2002).
- The most recent RVF outbreak in Kenya first recognized in December 2006 and ended in March 2007

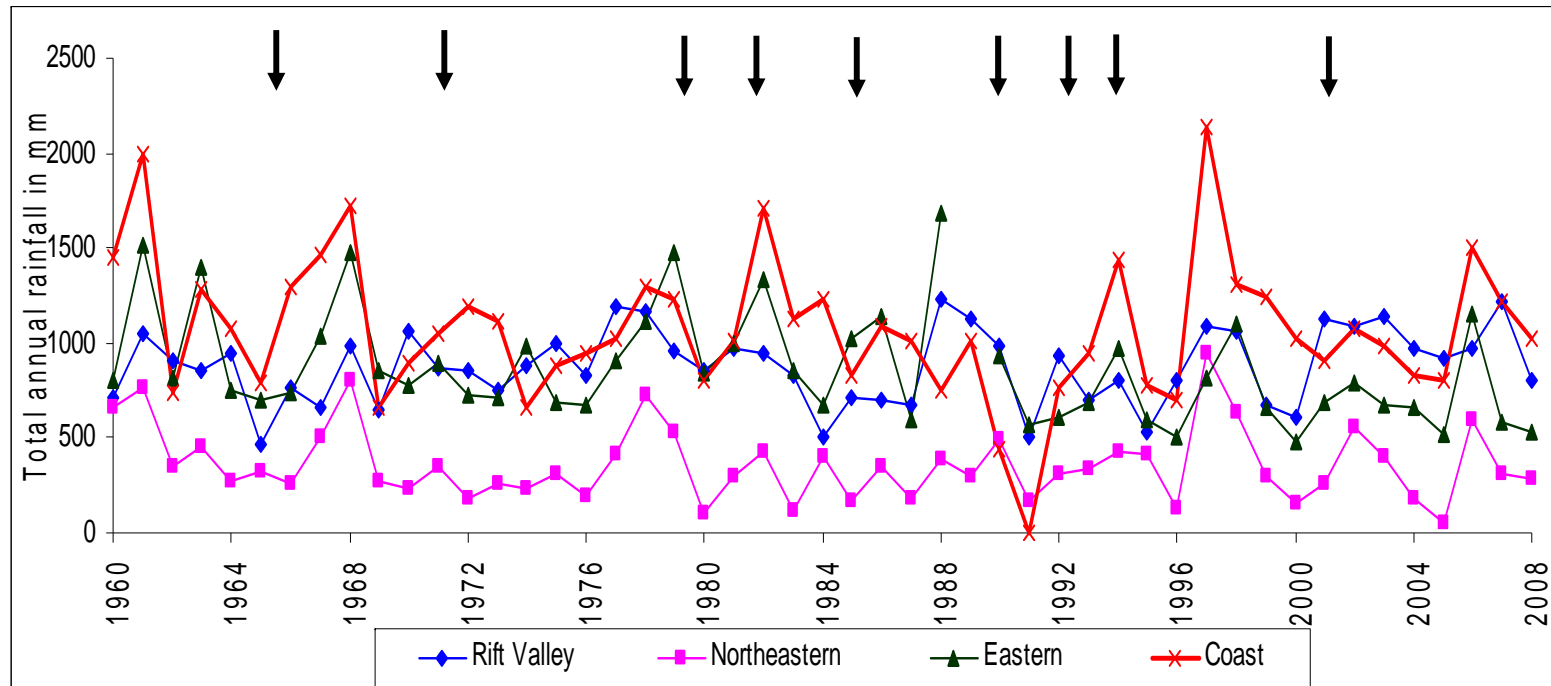
RVF Epizootics Kenya 1951-2007



Rainfall and RVF Epizootics



Rainfall and RVF Epizootics

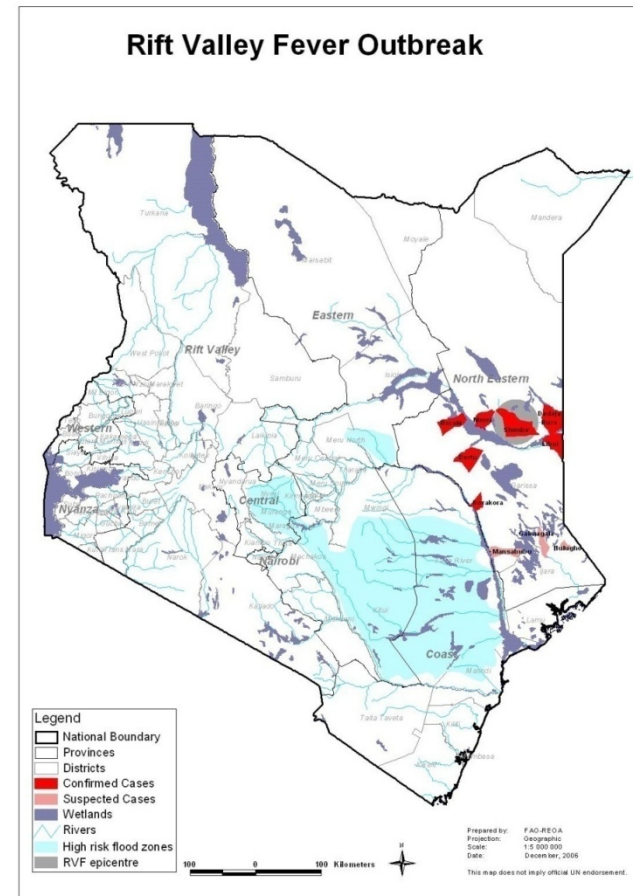


•Seven rainfall seasons when the average rainfall increased by at least 50% compared to the previous years except Western province: 1961-1962, 1967-1968, 1977-1978, 1981-1982, 1997-1998, 2001-2002 and 2006-2007

Arrows - there were national RVF epizootics in each of these high-rainfall seasons except in 2001–2002 when only a few cases were reported in Nakuru

2006/2007 RVF outbreak

- First case detected in human in Garissa District in early December 2006,
- RVF virus RNA or IgM antibodies were detected in blood or serum specimen from 10 human patients,
- This coincided with confirmations in livestock,

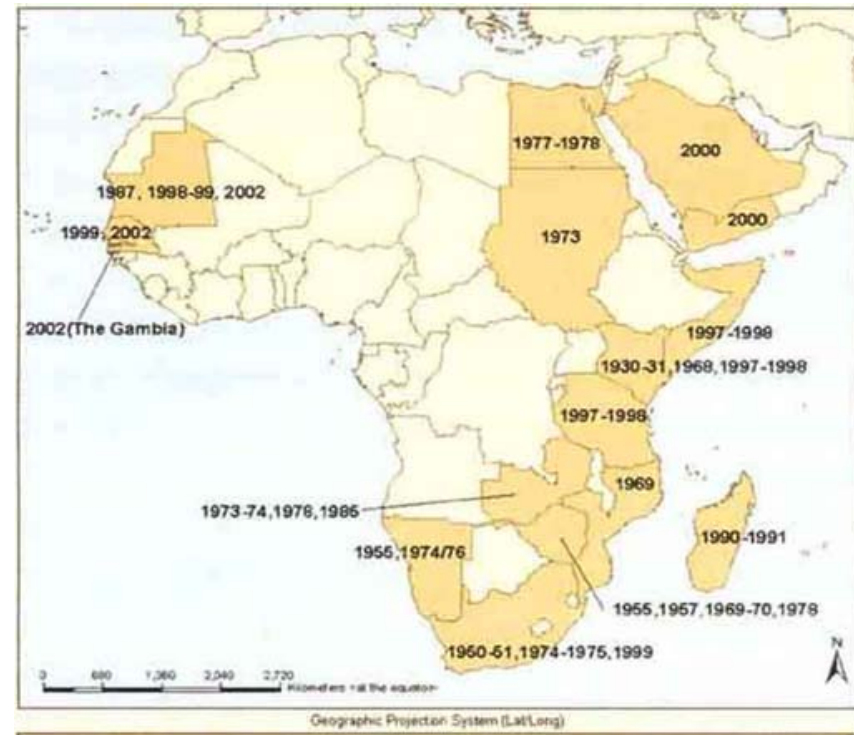


Inter-epidemic Period

- The IEP is defined as the number of years between the end of one national epizootic and the beginning of the next
- For the 1951–2007 period, 11 national epizootics spanning 22 years were reported, with an average IEP of 3.6 years (range 1–7 years)
- However, the IEP within individual districts was longer

Geographic Spread

- RVF has historically been confined to Africa until the September 2000 outbreak in Saudi Arabia and Yemen following rainfall and flooding in coastal areas.



Importance of Human Disease in Early Recognition of RVF

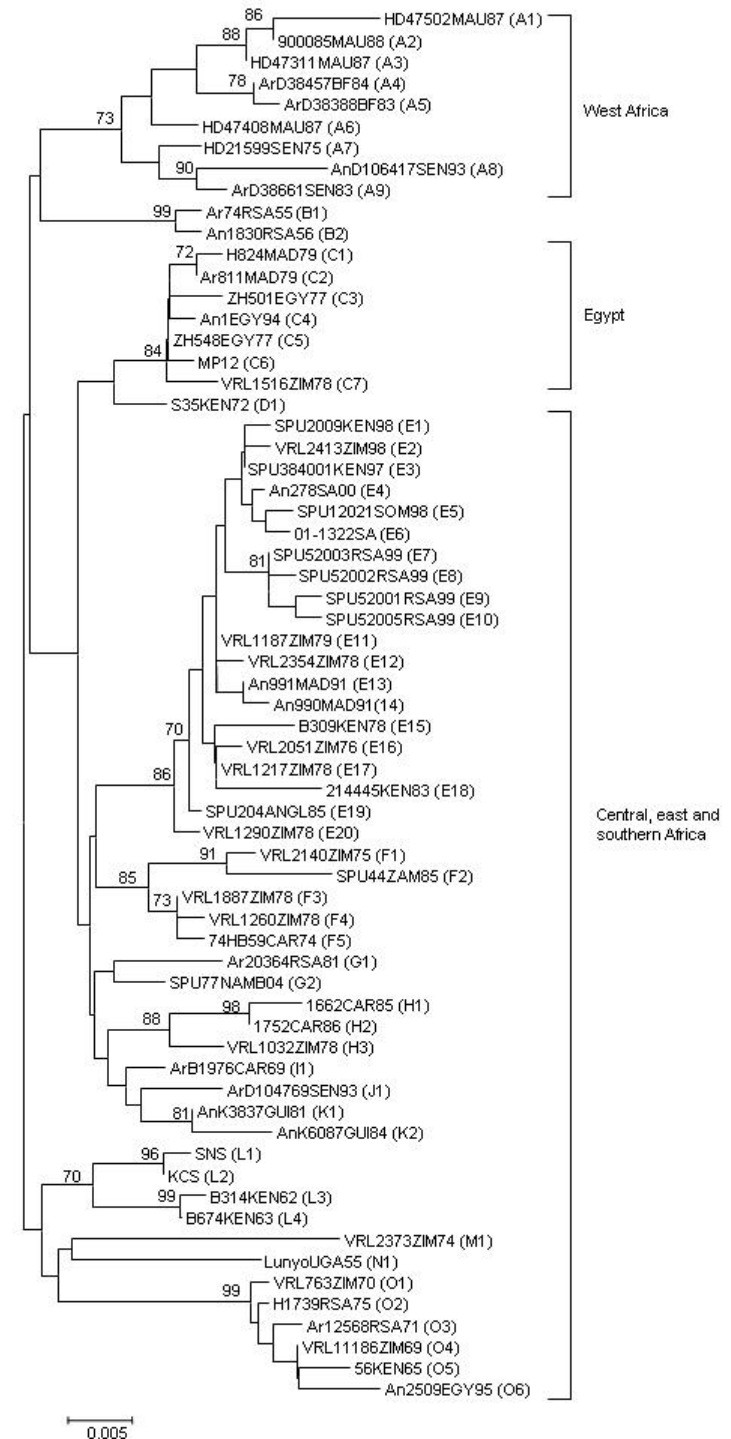
- Many affected areas have poor roads and services,
- The occurrence of human disease with fatalities is usually reported by medical services/NGO'S,
- Abortions in livestock at 5-15% level usually not reported.

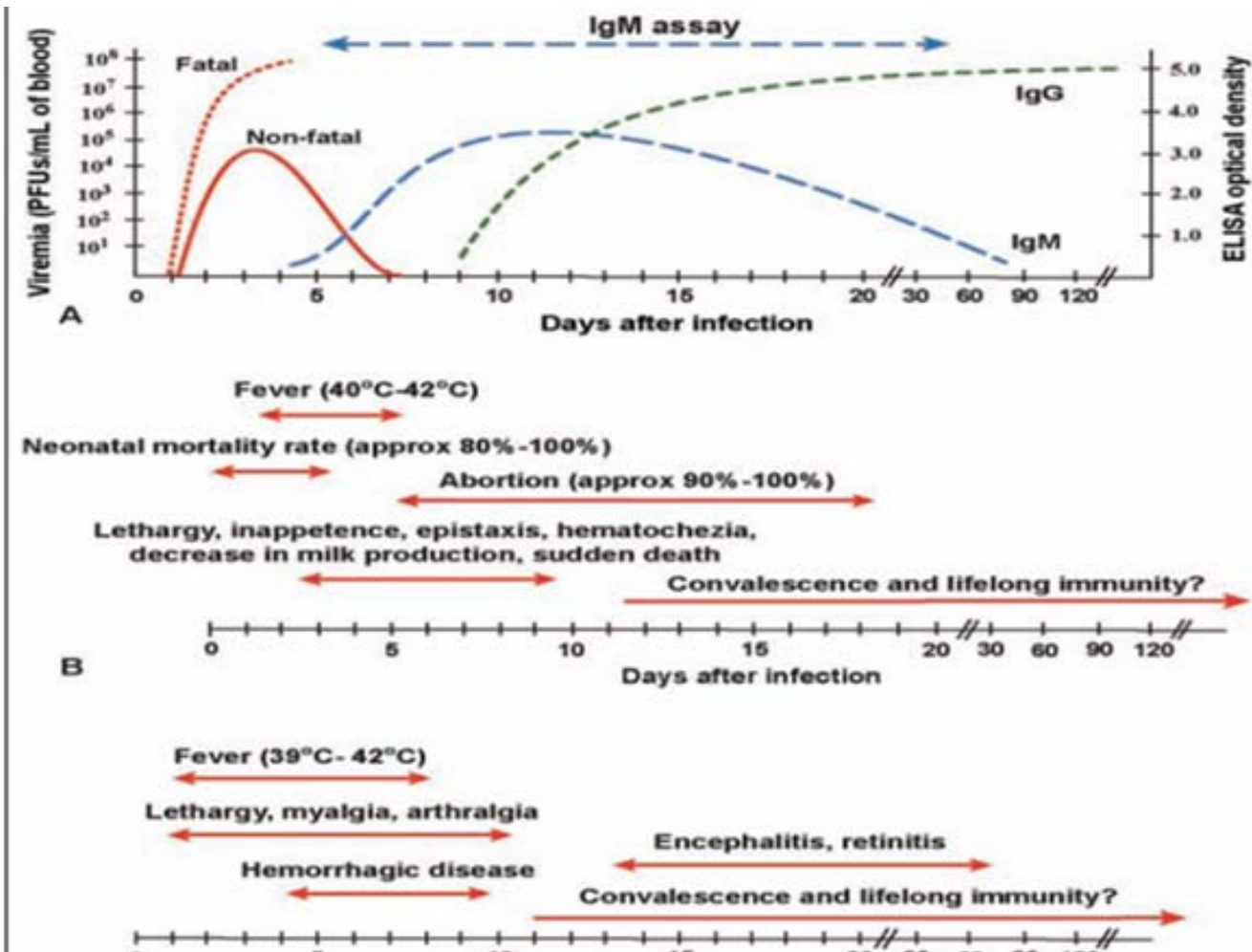
Virus phylogeny

- Causal virus remarkably stable genetically and antigenically

- Outbreaks associated either with a single genetic lineage of virus or with simultaneous emergence of multiple Lineages.

(Bird B.H., et al)





Generalized time course of viremia and antibody response against RVF

In panel A, the intervals during which diagnostic testing involving nucleic acid-based (RT-PCR assays) and serologic (RVF virus-specific IgM or IgG) assays are appropriate are indicated in relation to the period of viremia. The development of RVF in panel B and C among livestock and humans respectively

Classification

- RVF is a high risk public health disease
- It has recently been classified as a potential agent for bio-terrorism (deliberate use of pathogenic biological agents against animal populations that have both animal and public health dimensions).

Transmission

- RVFV is transmitted transovarially by *Aedes* spp mosquitoes (primary vectors)
- Other mosquitoes involved are *Culex*, *Anopheles* and *Mansonia*
- Transmitted mechanically by biting flies – *Culicoides*, *Stomoxys*, *tabanids* and *Glossina* spp.



Vectors of RVF

- Two types of vectors involved:
 1. Enzootic (endemic)
 - Floodwater breeding *Aedes* mosquitoes (not all *Aedes*)
 2. Epizootic(epidemic)
 - Culicine mosquitoes and biting flies

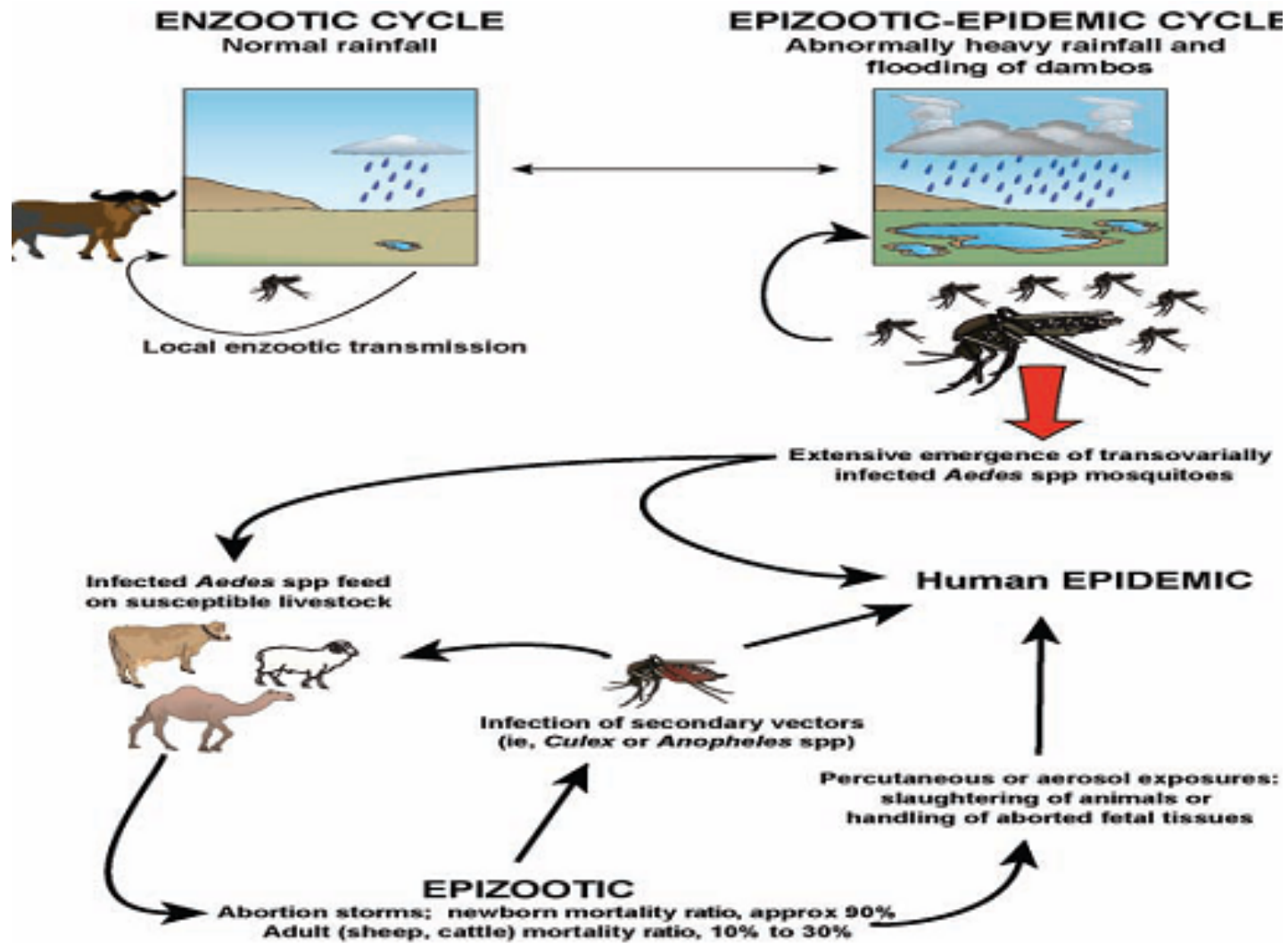


Figure 2.3: Schematic representation of RVF transmission

Source: (ian.umces.edu/symbols/), University of Maryland Centre for Environmental Science

Enzootic vectors of RVF

- Aedes mosquitoes breed in temporary floodwater pools and floodplains .
- Eggs are laid in mud at the edge of flooded dambos where they can survive for years.
- Infected eggs hatch and adult aedes emerge rapidly after flooding to transmit infection to animals.



Enzootic vectors of RVF

- The infected eggs represent a mechanism for survival (perpetuation) of the virus,
- Transovarial transmission of virus (passage of virus through the eggs) occurs in a low proportion of infected aedes mosquitoes,
- The Aedes life cycle is rapidly completed – approximately 20 days.

Epizootic vectors of RVF

- Following heavy flooding, culicine mosquitoes and biting flies, in large numbers, acquire virus by taking blood meals from infected (viraemic) livestock and then sustain the outbreak by transmitting infection.

RVF Geographic Predisposing Factors

- Factors associated with vulnerable ecological zones
 - Presence of water retaining soil types
 - Flat topology that supports flooding
 - Dense bush cover
 - High vector population
 - High susceptible livestock population

Critical Decision Points

- Decision-making in RVF outbreaks involves balancing lack of perfect information with the need to take action to avert probable losses..
- Difficult to gauge the ideal point where a decision should be taken.
- If the decision is taken too early, the likelihood of taking a wrong decision is increased and costs incurred from inappropriate or unnecessary activities.

Critical Decision Points

- If a decision is taken too late, the opportunity to intervene effectively may be lost, leading to unmitigated impacts.
- The decision-maker has to balance the risks of over-reacting against those of under-reacting

Timelines

International Livestock Research Institute,
Department of Veterinary Services-Kenya

Risk Factors		Cases		Response	
Rains	Vectors	Livestock	Human	Human	Vet
33.1 days	19.2 days	21 days	35.6 days	12.3 days	68.9 days

RVF Control Options

1. Sentinel Surveillance
2. Rainfall Remote Sensing and Survey Data Predictions
3. Vaccination
4. Vector Control
5. Public Education and Awareness

RVF Sentinel Surveillance

- 9 RVF Sentinel Herd Sites in Kenya

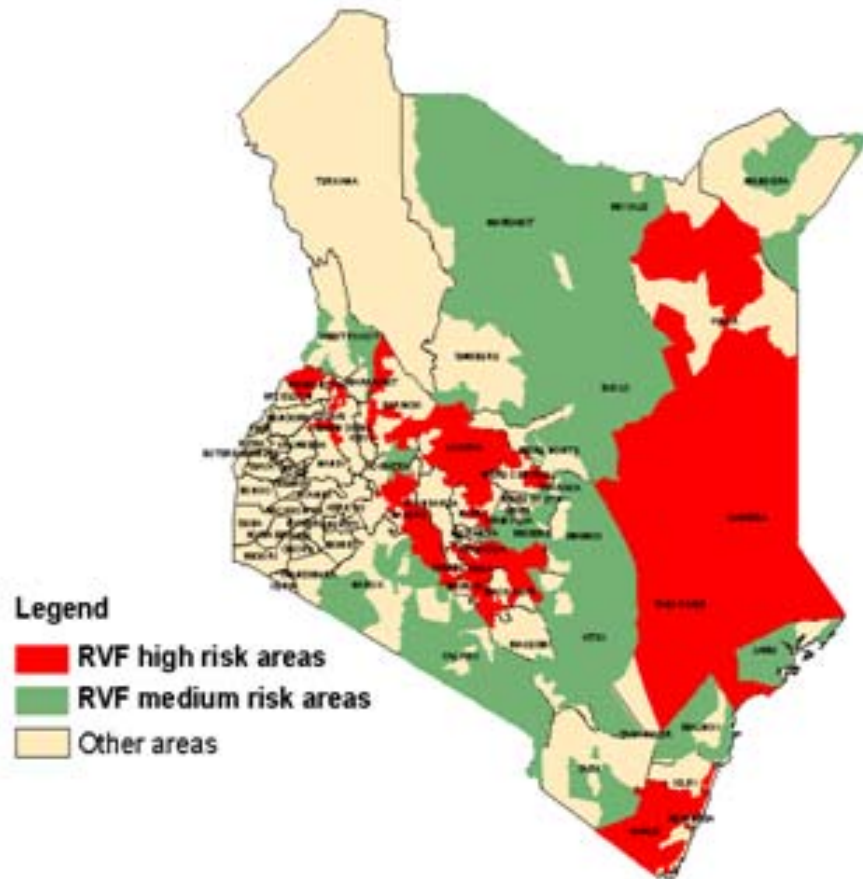


Surveillance in RVF Vectors

- The Veterinary Department Zoology Unit conducts risk based search of RVFV and other arboviruses (West Nile Fever virus) from the vector mosquitoes.
- Mosquito samples and other blood sucking insects collected from recent field surveillance are currently undergoing analysis at ILRI laboratories to establish presence of infection and if any, then Minimum Infection Rates.

RVF Vaccination

- A cost-effective vaccination strategy triggered by:
 - Increased risk of outbreak from Remote Sensing and Survey Data and other predictors,
 - Pre outbreak vaccination in high risk areas (hot spots),
 - Post outbreak vaccination extended to lower risk areas.



RVF Vaccine

Smithburn virus live attenuated vaccine;

- Developed in 1946 by Smithburn;
- Worldwide, only produced by KEVEVAPI and OBPI;
- Highly immunogenic- a single dose confers good immunity;

RVF Vaccine

- Can cause abortions and teratogenicity to foetus (Routine Vaccination of Weaners?).
- There is a risk of needle propagation of infection from incubating animals.
- The Smithburn live attenuated vaccine is not recommended in countries or zones that are free of RVF.

RVF Vaccination

- Vaccination has been proven to be useful in limiting outbreaks in Kenya.
- Prospects of new vaccines – clone 13?



RVF Outbreak Response

- Define infected areas/target populations
- Institute clinical/serological surveillance
- Survey flood zones – analyse RSSD – estimate potential for spread
- Vector control – adult insecticides, larvicides, repellants, nets
- Vaccination not usually an option

Vector control



- Reduction of vector population using insecticides
Synthetic Pyrethroid
Pour-On preps on livestock and spray wash (*Cypermethrin*, *Flumethrin 1%*).



RVF Outbreak Response

- Stop slaughter (sick animals allowed to die or recover), movement of animals
- Public education
- Caution against unprotected handling of diseased animals/tissues



RVF Sero-survey Results

- A seroprevalence survey involving 571 camel sera conducted after the 1979 RVF outbreak in the northern and coastal areas of Kenya
- Only 22 (3.9%) seroreactors from Galana in the coast were detected (Davies *et al*; 1984).
- (Scott *et al*;1963) had earlier reported the presence of neutralizing antibodies to RVF in camels from Garissa and Marsabit districts of Northern Kenya.

RVF Sero-survey Results

- In the 2006-2007 RVF outbreak that occurred in the drier semi desert parts of Kenya, serological tests showed that camels, sheep, goats and cattle were sub clinically infected (ILRI DVS, 2007).

Role of primates in spread of RVF

- To find the natural reservoir to RVF has been the subject of several studies
- Smithburnet *al.*, (1948) failed to detect antibodies in sera from 72 wild monkeys trapped in Uganda in an area where RVFV was isolated in mosquitoes
- Pellisier&Rousselet(1954) reported the presence of antibodies in 12 out of 122 monkeys kept in captivity in Brazzaville

RVF virus antibody studies in wildlife

- Study carried out in 2007 on 896 sera collected from 16 Kenyan wildlife species (Evans *et al.*, 2007)



RVF antibody to virus studies in wildlife

- Specimens from 7 species had detectable neutralizing antibodies against RVFV i.e. African buffalo, black rhino, lesser kudu, impala, African elephant, Kongoni and waterbuck.
- 249 sera samples collected and tested during the 2006/2007 RVF outbreak.
- 84% of the ruminant specimen had RVFV neutralizing titres of $\geq 1:80$.

RVF antibody to virus studies in birds

- Carried out in 1979 using 171 bird sera (Davies, 1979)
- Study was to check if RVF produced viraemia or neutralizing antibodies in birds
- Only 3 of *Ploceus* weavers tested contained specific antibodies to RVF



RVF Inter-epidemic Studies

- Survey studies carried out in different species to establish the existence of inter-epidemic host reservoirs of RVF virus.
- Studies conducted in birds, primates and wildlife.
- However, there is no proof that the virus is maintained in transmission cycles in birds, monkeys, baboons or other wild vertebrates.

Challenges in RVF Control

- Long (10-15 year) inter-epidemic cycles leading to:
- Loss of disease recognition institutional memory
- Vaccine shelf life of 4 years and difficulty in maintaining strategic vaccine stocks and writing it off following expiry (audit queries)
- Low commercial incentive to produce by vaccine institutes and sufficient volumes may not be available on time when required.



Thank You

16/09/2011