

# Rift Valley Fever

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- Dr Linda Logan, “Rift Valley Fever” CSU Foreign Animal Disease Training Course, College of Veterinary Medicine and Biomedical Sciences, August 1-5, 2005.
- Professor JAW Coetzer, Department of Veterinary Tropical Diseases, Faculty of Veterinary Science, University of Pretoria, “Rift Valley Fever” presented at the FEAD course in Knoxville, Tenn. 2005.





# Rift Valley Fever

*In this presentation the authors especially drew from the first hand experience of their colleagues in South Africa. Personal interviews as well as standard research sources provide the insights we bring you for the recognition of this exotic disease.*

**JAW Coetzer**  
**Jeffrey Musser**  
**Suzanne Burnham**



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# Rift Valley Fever

- Rift Valley Fever (RVF) is an arthropod-borne, acute, fever-causing viral disease of sheep, goats, cattle and people.





Rift Valley fever in Africa causes abortions in sheep, cattle and goats high mortalities in lambs and kids and generalized disease in man.



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# Rift Valley Fever



- RVF is reportable to the OIE.
- It is also on the USDA and Department of Health and Human Services *High Consequence lists*.



# Rift Valley Fever

- Generally found in eastern and southern Africa where sheep and cattle are raised
- Most countries of sub-Saharan Africa
- Madagascar
- September 2000 RVF outbreak in Saudi Arabia and Yemen – first outbreak outside of the African continent



# Rift Valley Fever

RVF was first observed when European stocks of domestic animals were introduced to Africa. These species are more severely affected than native African stock.



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# Rift Valley Fever

Rift Valley Fever was first reported at Lake Naivasha in Kenya.

There were many sheep abortions and young lambs were found sick or dead.





# The Rift Valley



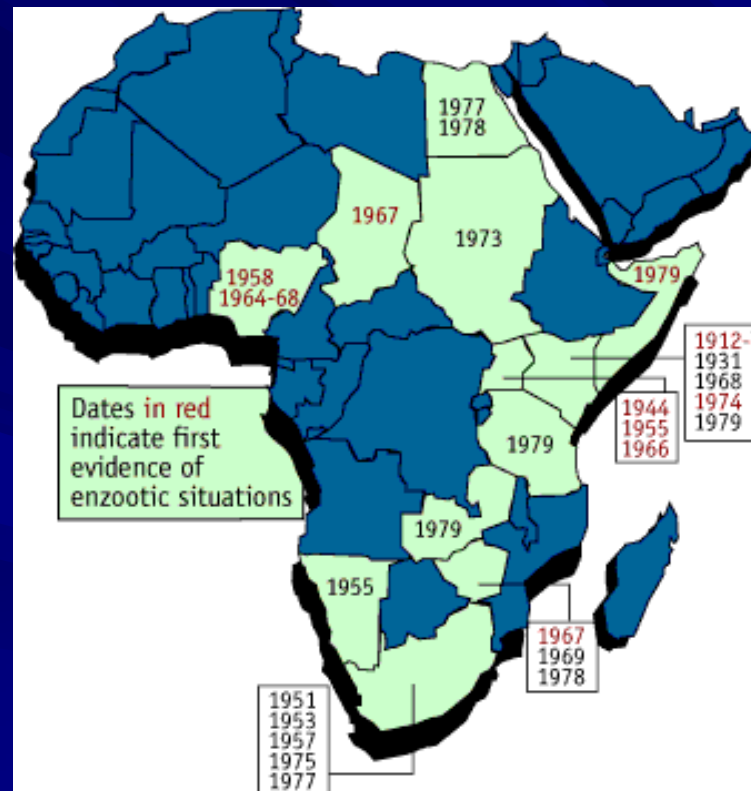
**Lake Naivasha**

# Major Outbreaks

- 1950-1951
  - In Kenya
  - 100,000 mortality in sheep
  - 500,000 abortions
- 1977, 1983
  - In Egypt in the Nile Delta
  - 18,000 human cases, 596 case fatality 1977
- 1987
  - Senegal River Basin/  
Mauritania
- 1997-1998
  - Kenya and Tanzania
  - 89,000 human cases
  - Cattle and sheep
- 2000
  - Saudi Arabia and Yemen
  - Saudi: 11,000 cases with 40 deaths reported
- 2002
  - Gambia, in 8 locations
- 2003, 2004
  - Mauritania, Senegal, Egypt, Yemen, Saudi Arabia



# Major Outbreaks



Dates of reported outbreaks in Africa

Bres, P. (1981). Prevention of the spread of Rift Valley fever from the African continent. Contributions to Epidemiology Biostatistic, 3, 178-190.



# Kenya, Africa 1950-1951

- Largest outbreak reported in sheep was in 1950-1951



100,000 mortality in sheep

500,000 abortions in sheep



# Kenya, Africa 1997-1998

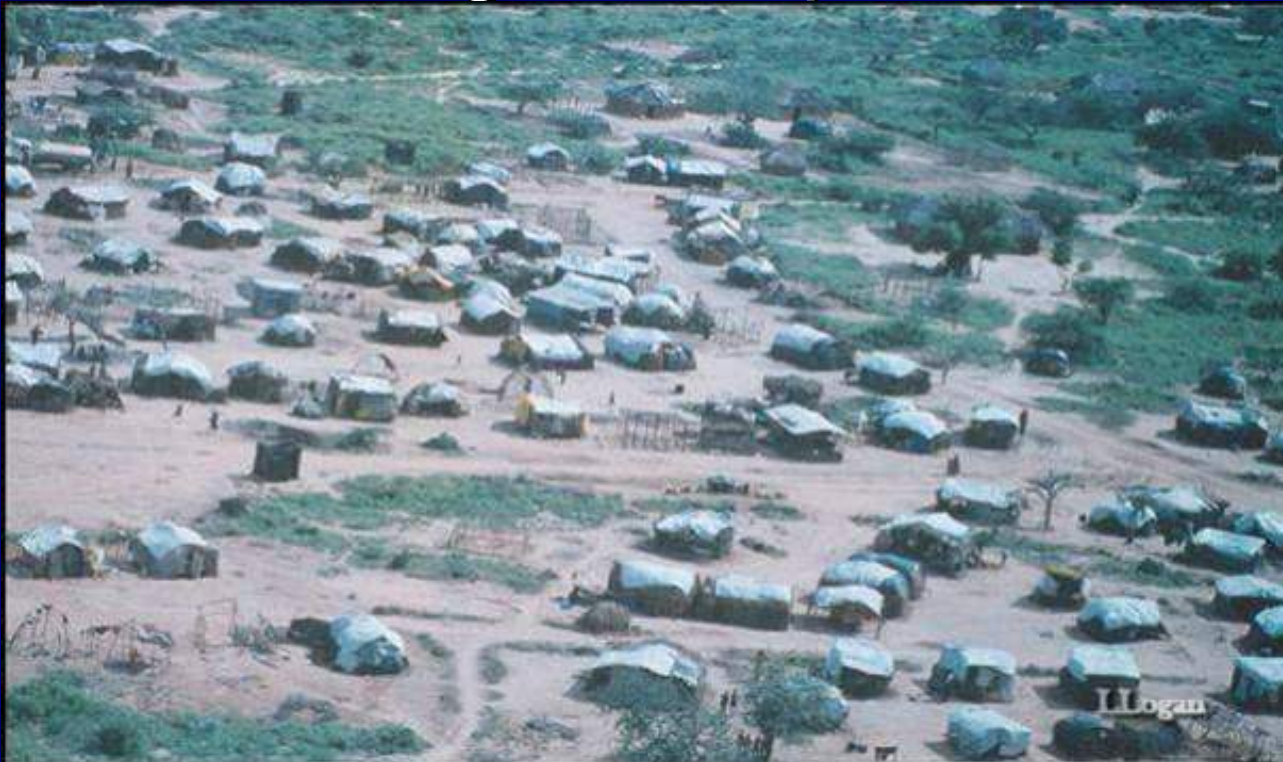
- Largest outbreak recorded for human cases: 89,000 cases - 478 deaths.

- Flooding near Garissa, Kenya



# Rift Valley Fever Outbreak 1997-98

## ■ Nomadic Refugee Camp at Garissa, 1997





# Rift Valley Fever Outbreak



Disease in 89,000 farm workers,  
animal handlers, veterinarians



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# Cyclic epidemics

- Periodic pandemics may originate near “Dambos” or Playa lakes and spread widely
- “Dambos” are depressions that accumulate water
- Epidemics occur in 5-15 year cycles usually following heavy rainfall
- Flooded Dambos allow the *Aedes* mosquitoes infected with RVF to emerge



A “Dambo”  
or  
Playa Lake



Cattle near a  
“Dambo” in Kenya





## Playa or “Dambo” near a village



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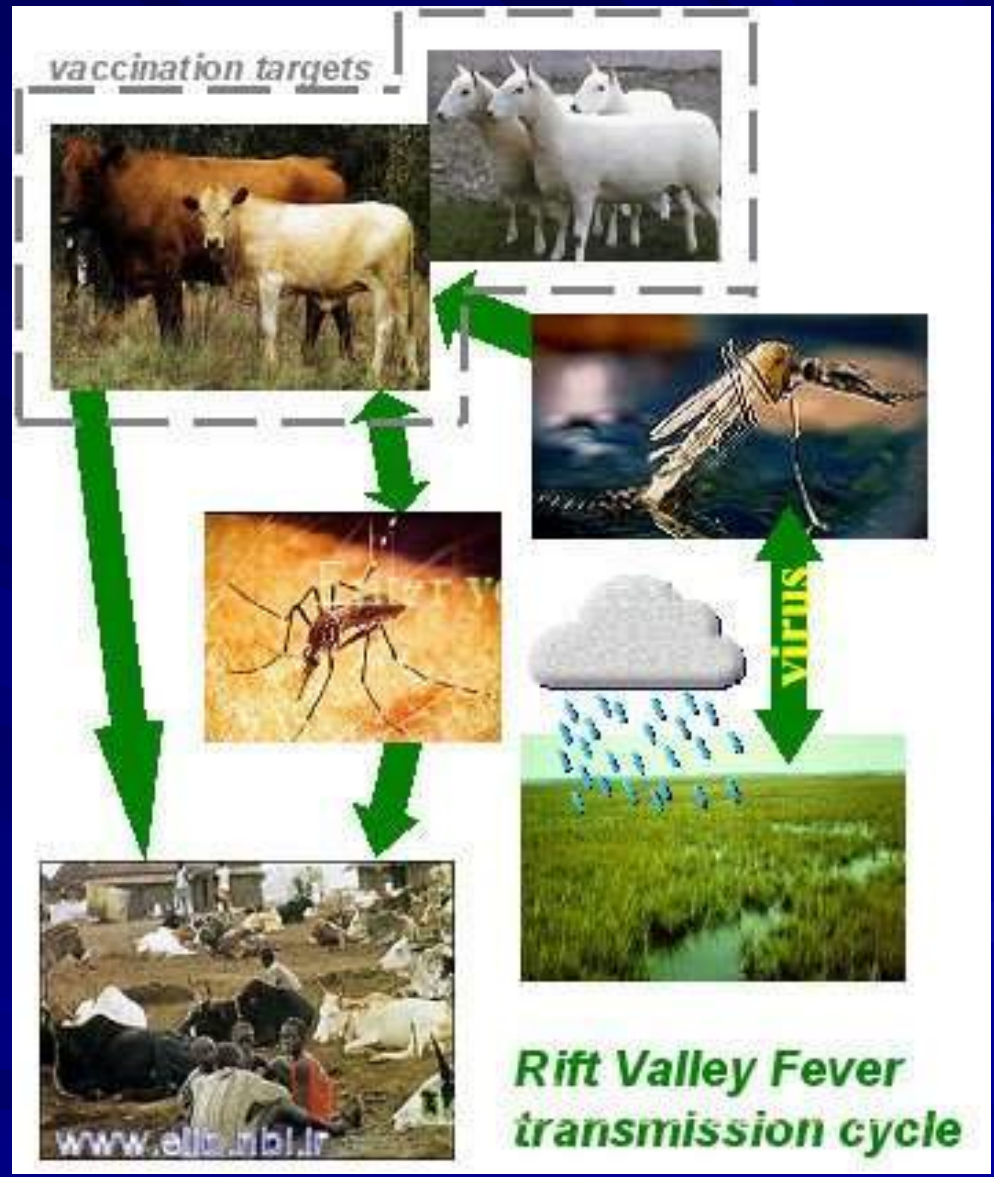


## Wetlands harbor mosquito populations



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[http://www.elib.hbi.ir/persian/EMERGING\\_EBOOK/20\\_RIFT\\_VALLEY\\_FEVER\\_files/image005.jpg](http://www.elib.hbi.ir/persian/EMERGING_EBOOK/20_RIFT_VALLEY_FEVER_files/image005.jpg)

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# Enigma of Epidemiology

- How is the virus maintained between epidemics?
- Is there an unknown reservoir in a vertebrate population? Possibly, or
- Is the virus maintained by transovarial transmission in the aedes mosquito?



# Transovarial Transmission in mosquitoes

- Mosquito eggs dormant in soil for long period of time; survive long dry spells.
- Hatch with heavy rainfall





# Economic Impact

## Livestock losses

- High mortality in newborns
- Abortions associated with high fever stage
- Up to 50% abortions in small ruminants



# Economic Impact

Countries of the Arabian peninsula may ban trade of livestock from Africa



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# Rift Valley Fever

in the World in 2004, OIE



-  Disease reported present
-  Disease reported absent
-  Data unavailable or incomplete

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# Rift Valley Fever

- Etiology
- Host range
- Incubation
- Clinical signs
- Transmission
- Diagnosis
- Differential Diagnosis

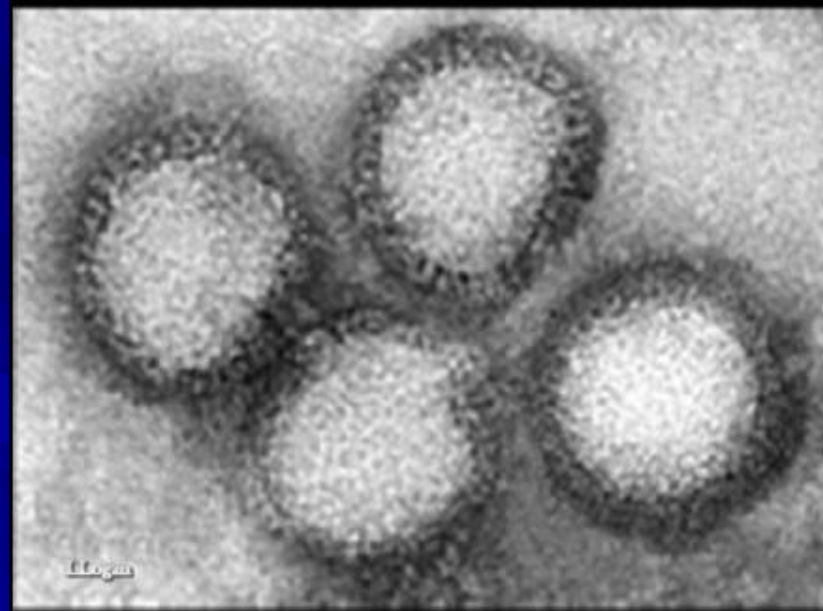


# Etiology

RVF virus is a fairly stable virus of the

■ Family:  
Bunyaviridae

■ Genus:  
Phlebovirus



# Etiology

- RVF virus is serologically related to other phleboviruses, but can be differentiated by serum neutralization tests.
- Enveloped RNA virus
- There is only one serotype of RVF virus
- However, there is different pathogenicity among strains of RVF virus



# Host Range

- Mainly a disease of sheep



# Host Range

- In Sheep  
Mortality in lambs  
under 2 weeks of  
age approaches  
100%

Mortality in older sheep  
reaches 30%  
with abortions  
approaching 100%





# Host range

- Cattle are less susceptible than sheep, some are subclinical; mortality averages 5% with some abortions



# Host Range

- Goats
- Buffalo



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# Host Range

- Domestic dogs and cats – susceptible but usually only have asymptomatic viremia
- Swine - resistant
- Birds - refractory, no virus isolation



# Host Range

- Horses – have viremia but are resistant



# Host range - wildlife

- Springbok
- African Buffalo
- Camels (in Egypt)
- Water buffalo in Egypt



# Host range - wildlife



Water buffalo - up to 50% abortion rate



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# Host range - wildlife



Camels (in Egypt) - inapparent disease except abortions



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## Rift Valley fever host range and disease severity

Mortality ~ 100%	Severe Illness Abortion, Low Mortality	Severe Illness Viremia Abortion	Infection Viremia	Refractive to infection
Lambs Calves Kids Puppies Kittens White mice Hamster Field mice Door mice Field voles	Sheep Cattle Goats Water buffalo  Humans	Monkeys Camels Rats Gray squirrels	Horses Cats Dogs Monkeys	Guinea pigs Rabbits Pigs Hedgehogs Tortoises Frogs Chickens Canaries Pigeons Parakeets





# Incubation period

- 1-6 days
- 12-36 hours in lambs; will be dead before they can acquire passive immunity



# Clinical signs

## Sheep and Goats

- Incubation period less than 3 days
- High rate of abortion at any stage of gestation
- Some show no symptoms





In pregnant ewes, abortion may approach 100%  
Aborted fetus is usually autolyzed.



# Clinical signs Sheep and Goats

- Abortion rate in sheep from 40 – 100%
- Ewe may also retain the placenta
- Endometritis is another complication after aborting the fetus



USDA



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# Clinical signs

## Sheep and Goats

### Early signs

- Fever 40-41°C
- Loss of appetite
- Jaundice
- Weakness



# Clinical signs Sheep and Goats

- Encrustation around the muzzle from bloody nasal discharge



# Clinical signs Sheep and Goats



- Some develop diarrhea



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# Clinical signs

## Sheep and Goats

- Acute death may occur in 20-30% of adults



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# Clinical signs Sheep and Goats



Heavy sheep losses  
occur  
during epidemic



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# Clinical Signs in lambs and kids

■ Newborn Lambs, Kids: Most severe in young lambs under 2wks old (mortality has high as 90%)

- fever (40-42°C),
- anorexia,
- weakness,



# Clinical Signs in lambs and kids



Lambs seem reluctant to move;  
they have signs of abdominal pain,  
rapid respiration and listlessness.



# Clinical Signs in lambs and kids

Death may occur within 24 to 36 hours after the first signs appear. Death is due to severe liver necrosis and vascular collapse.



# Clinical signs in cattle



- Anorexia

- Weakness

- Fetid diarrhea

- Often only sign is a drop in calving rates



# Clinical signs in cattle

- Calves: fever (40-41°C), depression. Mortality rate: 10-70% Death occurs about 2-8 days after the first signs appear.
- Adults: fever (40-41°C), excessive salivation, anorexia, weakness, fetid diarrhea, fall in milk yield. Abortion may reach 85% in the herd. Mortality rate is usually less than 10%



# Clinical signs in cattle



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# Clinical signs in cattle

- Disease most severe signs are seen in young animals
- Symptoms may be prolonged and will include jaundice in some calves
- Aborted calves are moderately autolyzed.





# Clinical signs

- Dogs: Abortions may occur in adult dogs; severe disease and death usually only in puppies
- Cats: Death in kittens



# Relative susceptibility

Newborn ruminants	++++
Pregnant ruminants	++++
Sheep and young cattle	+++
Adult cattle, goats, sheep	++
Humans	++
Dogs, cats and camels	+
Pigs	-



# Possible modes of spread

- Infected vector insects: mosquitoes
- Movement of viremic animals
- Windborne movement of vectors
- Contaminated viscera and tissues



# Transmission

- RVF is primarily transmitted from animal to animal by a mosquito



- *Aedes, Culex, Anopheles, Erehmapodites, Monsosmia*



# Transmission

- Vertical transmission in mosquitoes is probably important in maintaining RVF in endemic areas
- Trans-ovarial transmission is important in causing epidemics and maintaining the virus in endemic areas



# Transmission

- Other arthropods (Stomoxys, midges and tabanids) are able to transmit RVF by mechanical means



# Aerosol Transmission to Humans

- RVF virus levels very high in body fluids during viremia
- Virus aerosolized during butchering or necropsy of infected animals
- Surgery, autopsy (humans)
- Laboratory workers, Livestock handlers and butchers have the highest risk



# Transmission to humans

- Direct contact is also significant for humans
- Humans get RVF from handling tissues, blood, secretions and excretions of infected animals.





# Transmission to humans



Village butchers are at risk

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# Transmission to humans



Veterinarians and Livestock handlers are at risk



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# Transmission to humans



Milk contains virus: not known how important this is to transmission



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# Disease in humans

- Incubation 2-6 days
- Many are Inapparent, or have mild flu-like symptoms
- Others may have fever, headache, myalgia, nausea and painful eyes
- Recovery 4-7 days
- Retinopathy, loss of visual acuity
- Mortality ~1%



# Clinical Signs in humans

**RVF in humans can be a severe influenza-like disease.**

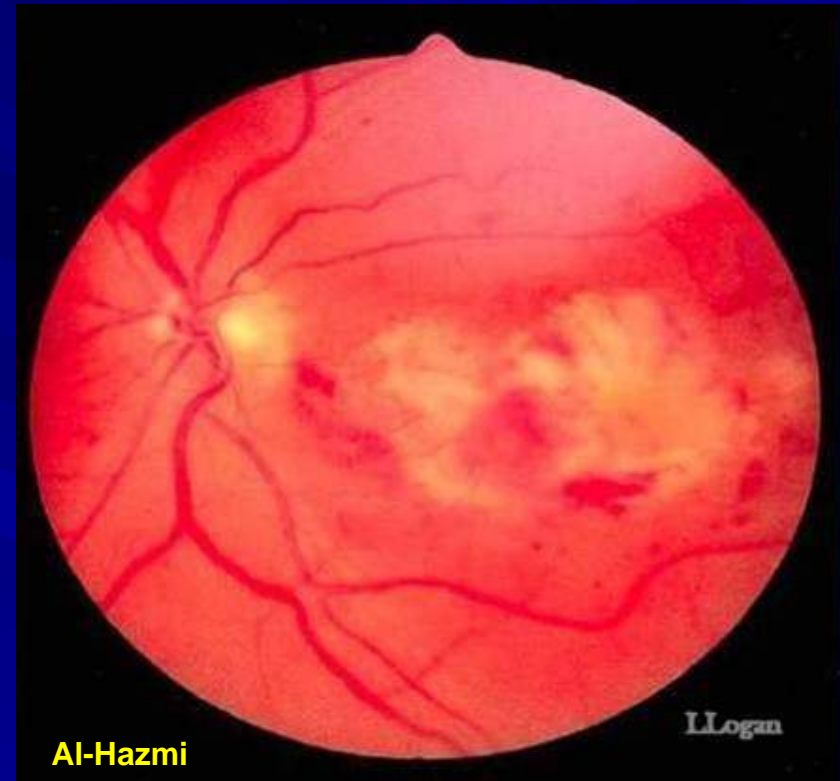
- Damage to retina (can lead to blindness)
- High fever (100-104 °F, 37.8-40°C),
- Muscular pain
- Nausea
- Epigastric discomfort
- Photophobia
- Hemorrhagic fever symptoms
- Encephalitis in rare instances



# Retinopathy

Occurs in 1-10% of  
affected humans

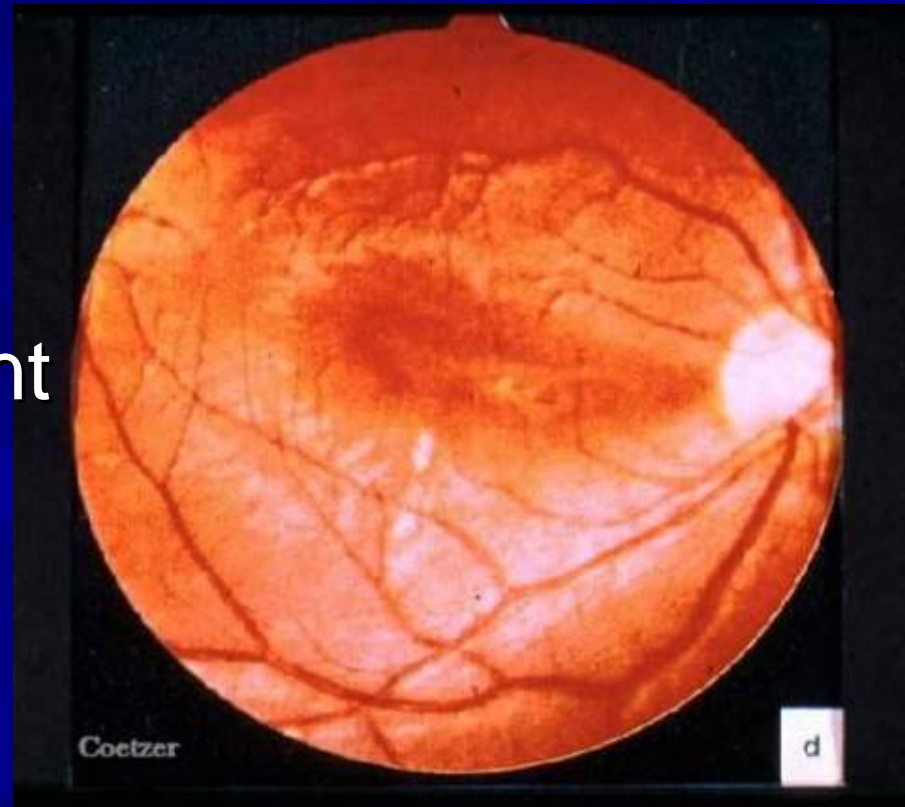
Conjunctivitis



# Retinopathy

Photophobia

Can lead to permanent vision loss



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# Diagnosis in Animals

Tentative diagnosis- Field Diagnosis:  
epidemiological, clinical and pathological features

Confirmation of diagnosis:

1. Virus isolation  
liver, spleen and blood
2. Antigen capture ELISA
3. PCR
4. Serology
  - CF test
  - Virus neutralization
  - ELISA
  - other
5. Histopathology : Immunohistochemistry





# Diagnosis

Sample collection:

- Heparinized blood
- Spleen
- Liver
- Acute and convalescent serum samples



# Diagnosis

- Virus isolation in cell culture
- Virus neutralization
- Antigen detection by IF staining
- ELISA
- Polymerase Chain Reaction (PCR)



# Clinical Pathology

- Leucopenia
- Increased liver enzymes
- Prolonged clotting time, thrombocytopenia
- Disseminated intravascular coagulopathy



# Necropsy findings

- Massive hepatitis: hemorrhages, necrotic foci, marked enlargement, orange-brown, friable, edematous liver tissue

*(“If you open a newborn lamb, the liver jumps into your face” Coetzer)*

- Chocolate-brown digested blood in abomasum, hemorrhages in intestinal mucosa, free blood in lumen



# Pathology Summary

- Focal or generalized hepatic necrosis
- Congestion, enlargement, and discoloration of liver with subcapsular hemorrhages
- Brown-yellowish color of liver in aborted fetuses
- Hemorrhagic enteritis
- Icterus (low percentage)
- Widespread cutaneous hemorrhages, petechial to ecchymotic hemorrhages on parietal and visceral serosal membranes
- Enlargement, edema, hemorrhages and necrosis of lymph nodes
- Congestion and cortical hemorrhages of kidneys and gallbladder



# Necropsy : new-born lambs



Liver massively enlarged; hemorrhages; orange-brown color; small areas of necrosis. The liver is very friable.



# Necropsy : new-born lambs



Gall bladder hemorrhage; Abomasum diffuse hemorrhage,  
serosa has petechial hemorrhage



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# Necropsy : new-born lambs

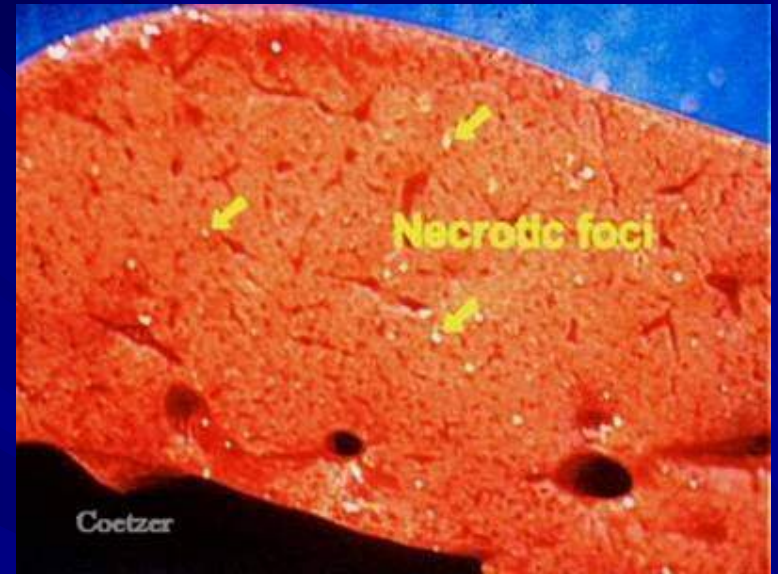
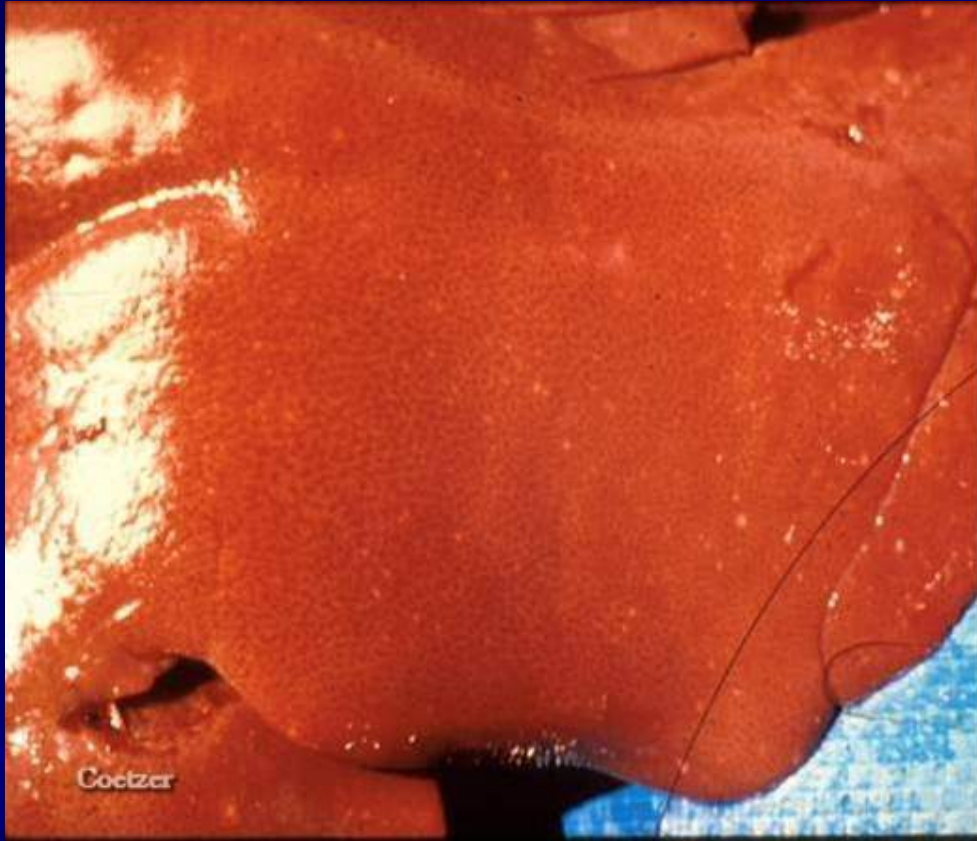


Abomasum shows diffuse chocolate brown hemorrhages, serosa has petechial hemorrhages, necrotic foci, and D. I. C.





# Necropsy : adult sheep



May look like plant poisoning



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# Necropsy : adult sheep



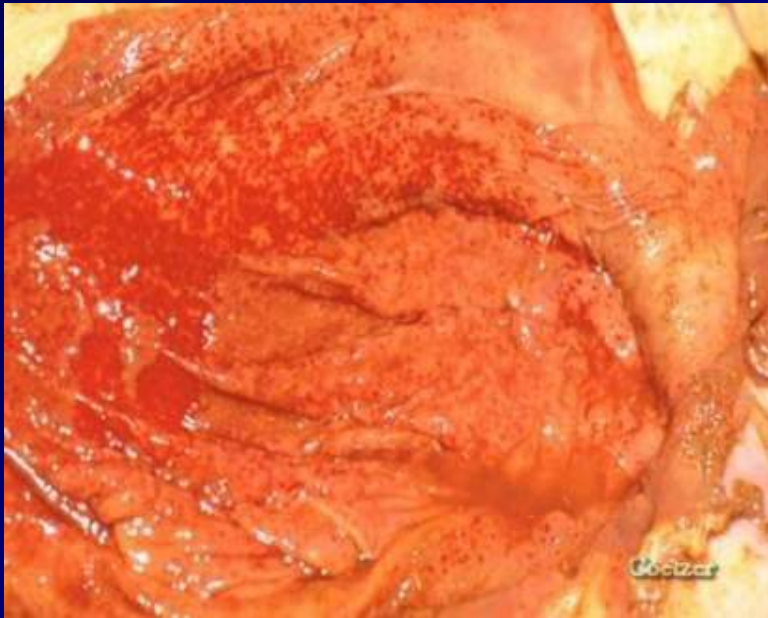
Gall bladder contains frank hemorrhage



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# Necropsy : sheep & cattle



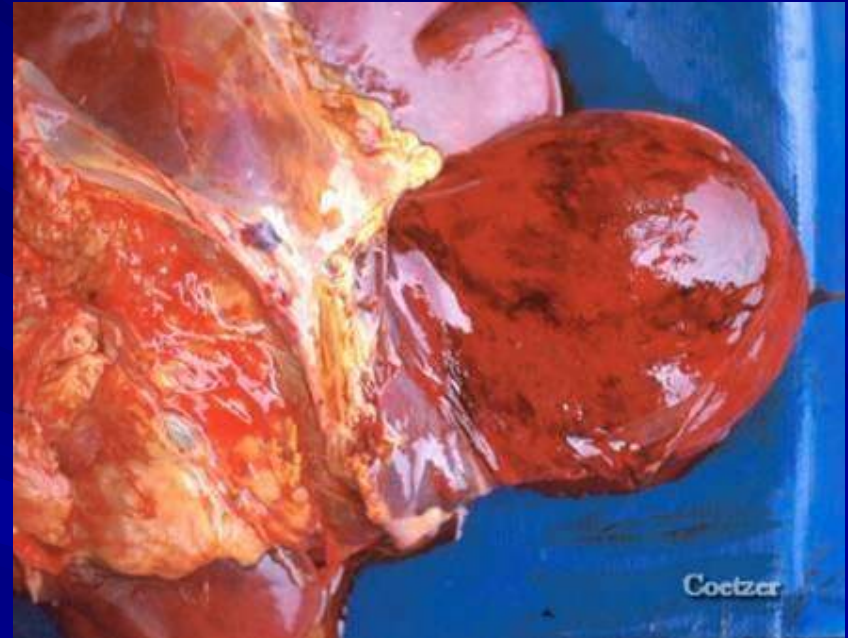
Abomasum is edematous similar to Heartwater



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# Necropsy : adult cattle



Close up of gall bladders



# Necropsy : adult cattle



Petecciation



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# Necropsy : cattle



Spleen with many hemorrhages



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# Necropsy : other lesions

Enlarged  
lymph nodes



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# Differential Diagnosis

- Abortifacient agents
- Agents causing hepatitis
- Agents that cause hemorrhages





# Differential Diagnosis

- Bluetongue
- Wesselsbron disease
- Enterotoxemia of sheep
- Ephemeral fever
- Brucellosis
- Vibriosis
- Trichomonosis



# Differential Diagnosis

- Nairobi sheep disease
- Heartwater
- Ovine enzootic abortion
- Toxic plants
- Bacterial septicemias (Pasteurella, Salmonella, Anthrax)
- Rinderpest and Peste des petits ruminants



# Suspect Rift Valley Fever if:

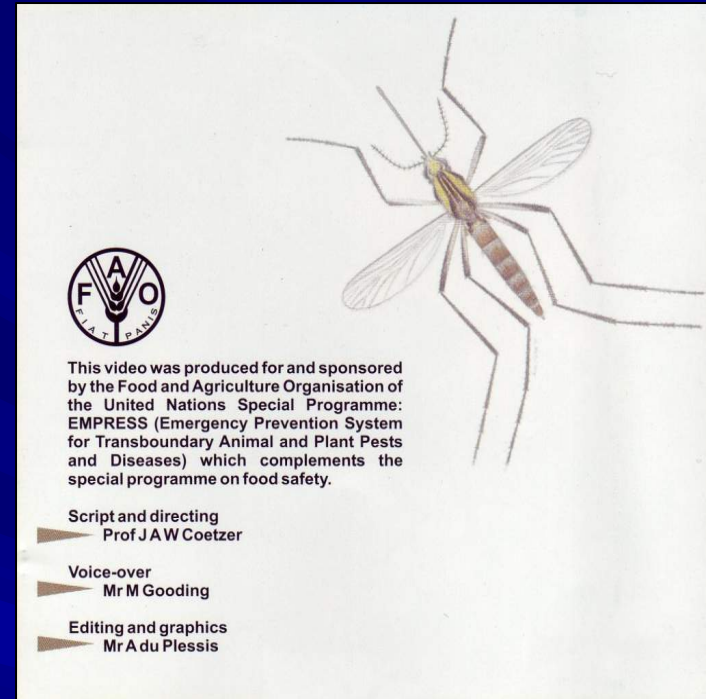
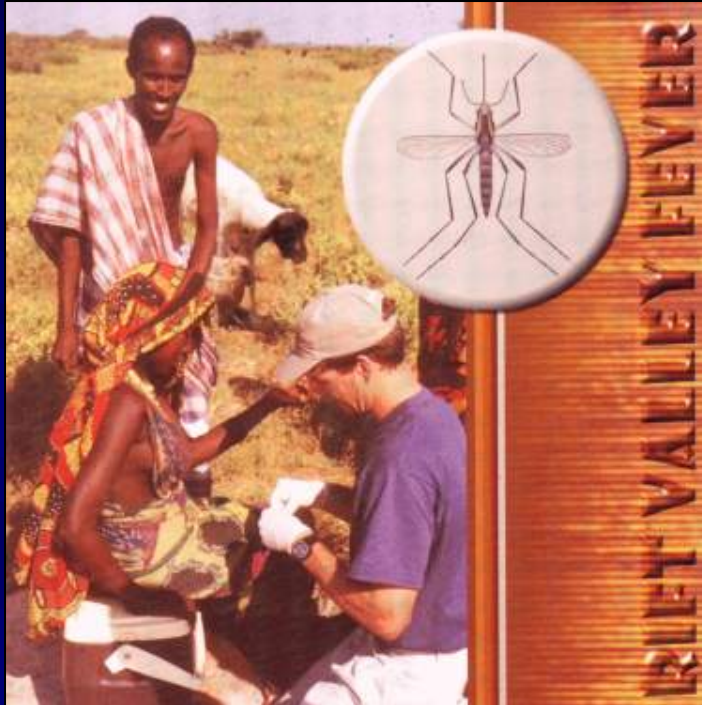
- High mortalities in lambs, kids and calves following increase in mosquito populations
- Disease is milder in adults than in newborns
- Abortions in sheep, goats and cattle
- Extensive necrotic liver changes
- Influenza symptoms in people working with sick animals or handling infected carcasses



# Rift Valley Fever - Bibliography

1. Linda L Logan, DVM PhD, USDA APHIS Attaché, North Africa, East Africa, Middle East, “Rift Valley Fever” CSU Foreign Animal Disease Training Course, Aug 1-5, 2005.
2. Professor J A W Coetzer, Department of Veterinary Tropical Diseases, Faculty of Veterinary Science, University of Pretoria, “Rift Valley Fever”
3. USAHA, Foreign Animal Diseases, 1992 Edition, p.311-317
4. W.A. Geering, A.J. Foreman and M.J. Nunn, Exotic Diseases of Animals, 1995 Australian Govt Publishing Service, Canberra; p.218- 224.





An excellent video about Rift Valley Fever is available from:  
[http://www.up.ac.za/academic/veterinary/depts\\_vtd\\_teach/index.htm](http://www.up.ac.za/academic/veterinary/depts_vtd_teach/index.htm)



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