

# Rift Valley Fever

*Infectious enzootic hepatitis of sheep and cattle*

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**Institute for International  
Cooperation in Animal Biologics**  
*An OIE Collaborating Center*  
Iowa State University  
College of Veterinary Medicine



IOWA STATE UNIVERSITY®

**Center for Food  
Security and Public Health**  
College of Veterinary Medicine  
Iowa State University  
Ames, Iowa 50011  
Phone: (515) 294-7189  
FAX: (515) 294-8259  
E-mail: [cfsph@iastate.edu](mailto:cfsph@iastate.edu)  
Web: <http://www.cfsph.iastate.edu>

## Etiology

Rift Valley fever results from infection by the Rift Valley fever virus, an RNA virus in the genus *Phlebovirus* (family Bunyaviridae).

## Geographic Distribution

Rift Valley fever is found throughout most of Africa. Outbreaks occur at irregular intervals in southern and eastern Africa, as well as in Egypt, Saudi Arabia and Yemen.

## Transmission

Rift Valley fever is transmitted by mosquitoes and is usually amplified in ruminant hosts. The virus appears to survive in the dried eggs of *Aedes* mosquitoes; when these mosquitoes hatch during wet years, epidemics can occur. *Aedes* and other species of mosquitoes can transmit infections from the amplifying hosts. Ticks and biting midges may also be able to spread the virus. Humans do not seem to be infected by contact with live hosts, but can be infected by aerosols or direct contact with tissues during parturition, necropsy, slaughter, laboratory procedures or meat preparation for cooking. The Rift Valley fever virus can be found in raw milk. It is also likely to be present in semen; therefore, sexual transmission may be possible.

Under optimal conditions, the Rift Valley fever virus remains viable in aerosols for more than an hour at 25° C. In a neutral or alkaline pH, mixed with serum or other proteins, the virus can survive for as long as 4 months at 4° C and 8 years below 0° C. It is quickly destroyed in decomposing carcasses by pH changes.

## Disinfection

The Rift Valley fever virus is susceptible to low pH, lipid solvents and detergents, ether, chloroform and solutions of sodium or calcium hypochlorite with a residual chlorine content greater than 5000 ppm.

## Infections in Humans

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### Incubation Period

In humans, the incubation period is 2 to 6 days.

### Clinical Signs

Infection with the Rift Valley fever virus usually results in an asymptomatic infection or a relatively mild illness with fever and liver abnormalities. The symptoms of uncomplicated infections may include fever, headache, generalized weakness, dizziness, weight loss, myalgia and back pain. Some patients also have stiffness of the neck, photophobia and vomiting. Most people recover spontaneously within 2 days to a week.

Complications - hemorrhagic fever, meningoencephalitis or ocular disease - occur in a small percentage of patients. Hemorrhagic fever usually develops 2 to 4 days after the initial symptoms. The symptoms may include jaundice, hematemesis, melena, a purpuric rash, petechiae and bleeding from the gums. Hemorrhagic fever may progress to frank hemorrhages, shock and death.

Ocular disease and meningoencephalitis are usually seen one to three weeks after the initial symptoms. The ocular form is characterized by retinal lesions and may result in some degree of permanent visual impairment. Death is rare in cases of ocular disease or meningoencephalitis.

### Communicability

Virus titers in infected humans are high enough to infect mosquitoes and introduce Rift Valley fever into new areas. Virus can be found in the blood and tissues.

## Diagnostic Tests

The Rift Valley fever virus can be isolated from the blood, brain, liver or other tissues; in living hosts, viremia is usually seen only during the first three days of fever. The virus can be grown in numerous cell lines including baby hamster kidney cells, monkey kidney (Vero) cells, chicken embryo reticulum, and primary cultures from cattle or sheep. Hamsters, adult or suckling mice, embryonated chicken eggs or 2-day-old lambs can also be used.

Virus antigens can be detected in blood and tissue samples by various tests including reverse transcription polymerase chain reaction (RT-PCR) testing. Enzyme-linked immunoassay (ELISA) and other serologic assays can detect specific IgM or rising titers.

## Treatment and Vaccination

No specific treatment, other than supportive care, is available; however, ribavirin has been promising in animal studies. Interferon, immune modulators and convalescent-phase plasma may also prove to be helpful. Most cases of Rift Valley fever are relatively brief and mild illnesses and may not require treatment.

A human vaccine has been developed and other vaccines are in earlier stages of investigation. None of these vaccines are sold commercially, but one may be available from government sources for people who are occupationally exposed.

## Morbidity and Mortality

Humans are highly susceptible to Rift Valley fever. Most cases develop in veterinarians, abattoir workers and others who work closely with blood and tissue samples of animals. During outbreaks in animals, mosquitoes may spread the virus to humans and cause epidemics. In Egypt, approximately 200,000 human cases and 598 deaths occurred during a 1977 epidemic.

Most people with Rift Valley fever recover spontaneously within a week. Ocular disease is seen in approximately 0.5 to 2% and meningoencephalitis and hemorrhagic fever in less than 1%. The case fatality rate for hemorrhagic fever is about 50%. Deaths rarely occur in cases of eye disease or meningoencephalitis but 1 to 10% of patients with ocular disease have some permanent visual impairment. The overall case fatality rate for all patients with Rift Valley fever is less than 1%.

## Infections in Animals

### Species Affected

Rift Valley fever can affect many species, including sheep, cattle, goats, buffalo, camels, monkeys, gray squirrels and other rodents. The primary amplifying hosts are sheep and cattle. Viremia without severe disease may be seen in

adult cats, dogs, horses and some monkeys, but severe disease can occur in newborn puppies and kittens. Rabbits, pigs, guinea pigs, chickens and hedgehogs do not become viremic.

## Incubation Period

The incubation period can be as long as 3 days in sheep, cattle, goats and dogs. In newborn lambs, it is 12 to 36 hours. Experimental infections usually become evident after 12 hours in newborn lambs, calves, kids and puppies.

## Clinical Signs

The clinical signs vary with the age, species and breed of the animal. In endemic regions, epidemics of Rift Valley fever can be recognized by the high mortality in newborn animals and abortions in adults.

Rift Valley fever is usually most severe in young animals. In young lambs, a biphasic fever, anorexia and lymphadenopathy may be followed by weakness and death within 36 hours; hemorrhagic diarrhea or abdominal pain can also occur. The mortality rate may reach 90 to 100% in neonates. Disease is similar in young calves: fever, anorexia and depression are typical, with mortality rates of 10 to 70%.

The symptoms in adult sheep may include fever, a mucopurulent nasal discharge (sometimes bloodstained), hemorrhagic or foul-smelling diarrhea, vomiting, jaundice, abortion and an unsteady gait. In adult cattle, fever, anorexia, weakness, excessive salivation, fetid diarrhea, abortion and decreased milk production may be seen. In some cases, abortion can be the only sign of infection in these two species. Similar but milder infections occur in goats. Adult camels do not develop symptoms other than abortion but young animals may have more severe disease.

## Communicability

Infections are typically transmitted by mosquitoes and not by direct contact; however, during parturition, necropsy or slaughter, viruses in the tissues can be spread by aerosols and enter the skin through abrasions. The Rift Valley fever virus has also been found in raw milk and may be present in semen.

## Diagnostic Tests

Rift Valley fever can be diagnosed by virus isolation. The virus can be isolated from the blood of febrile animals. It can also be recovered from the tissues from dead animals and aborted fetuses; the liver, spleen and brain are generally used. Virus can be grown in numerous cell lines including baby hamster kidney cells, monkey kidney (Vero) cells, chicken embryo reticulum and primary cultures from cattle or sheep. Hamsters, adult or suckling mice, embryonated chicken eggs or 2-day-old lambs can also be used.

Virus titers in tissues are often high; a rapid diagnosis can sometimes be made with complement fixation, neutral-

ization and agar gel diffusion tests on tissue suspensions. Rapid tests may need to be confirmed by virus isolation. Virus antigens can also be detected by immunofluorescent staining of the liver, spleen or brain. Enzyme immunoassays and immunodiffusion tests can identify virus in the blood.

Serologic tests are helpful in epidemiologic studies but may be of limited use in diagnosis. Available tests include virus neutralization, enzyme-linked immunosorbent assay (ELISA), hemagglutination inhibition, immunofluorescence, complement fixation and immunodiffusion assays. Cross-reactions may occur with other phleboviruses.

## Treatment and Vaccination

The only treatment is supportive care. Vaccines are available in some countries.

## Morbidity and Mortality

Epidemics of Rift Valley fever tend to occur at intervals, when heavy rainfalls cause infected mosquitoes to hatch and a susceptible animal population has developed. Outbreaks are characterized by large numbers of abortions and high mortality in neonates. Indigenous cattle may have asymptomatic infections, while more severe disease is seen in exotic species.

The mortality rate can be very high in young animals, with fatalities decreasing in older age groups. Deaths are common in neonatal lambs, calves, kids, puppies and kittens. The mortality rate is 90 to 100% in newborn lambs, 40 to 60% in weaners and 15 to 30% in adult sheep. Ewes that abort are more likely to have a fatal infection. In calves, mortality rates range from 10 to 70%. Fewer than 10% of infections in adult cattle are fatal. Abortion rates range from 5 to almost 100% in ewes but are usually less than 10% in cattle.

## Post-Mortem Lesions

The most consistent lesion is hepatic necrosis; the necrosis is more extensive and severe in younger animals. In aborted fetuses and newborn lambs, the liver may be very large, yellowish-brown to dark reddish-brown, soft and friable, with patchy congestion (2406). Multiple gray to white necrotic foci are usually present, but may only be visible microscopically. The liver lesions are usually less severe in adult animals and may consist of numerous pinpoint necrotic foci.

Additional lesions may include jaundice, widespread cutaneous hemorrhages and fluid in the body cavities (2417, 2415). The peripheral lymph nodes and spleen may be enlarged and edematous and often contain petechiae. The walls of the gallbladder are often edematous, with visible hemorrhages. A variable degree of inflammation or hemorrhagic enteritis can sometimes be found in the intestines (2401). In lambs, many small hemorrhages are usually seen in the abomasal mucosa and the small intestine and aboma-

sum may contain dark chocolate-brown contents, with partially digested blood. In addition, petechial and ecchymotic hemorrhages may be seen on the surface of other internal organs.

## Internet Resources

Animal Health Australia.

The National Animal Health Information System (NAHIS)

<http://www.brs.gov.au/usr-bin/aphb/ahsq?dislist=alpha>

CDC Rift Valley fever page

<http://www.cdc.gov/ncidod/dvrd/spb/mnpages/dispages/rvf.htm>

Manual for the Recognition of Exotic Diseases of Livestock

<http://panis.spc.int/>

*Medical Microbiology*

<http://www.gsbs.utmb.edu/microbook>

Office International des Epizooties (OIE)

*Manual of Standards for Diagnostic Tests and Vaccines*

[http://www.oie.int/eng/normes/mmanual/a\\_summry.htm](http://www.oie.int/eng/normes/mmanual/a_summry.htm)

*The Merck Veterinary Manual*

<http://www.merckvetmanual.com/mvm/index.jsp>

WHO Fact Sheet on Rift Valley fever

<http://www.who.int/inf-fs/en/fact207.html>

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