

Module 8

Kyasanur Forest Disease (KFD) – Vectors

At the end of the module, the participant will be able to understand:

- Disease Transmission
- Vectors of KFD
- Biology
- Life Cycle
- Vector Surveillance
- Entomological Indicators
- Adult Vector Control
- Larval Vector Control

Kyasanur Forest Disease (KFD)

Kyasanur Forest disease (KFD) is caused by Kyasanur Forest disease virus (KFDV), a member of the virus family Flaviviridae. KFDV was identified in 1957 when it was isolated from a sick monkey in the Kyasanur Forest in Karnataka (formerly Mysore) State, India. Since then, 400-500 human cases per year have been reported and have a fatality rate of 3%–10%. Hard ticks (*Hemaphysalis spinigera*) are the reservoir of the KFD virus and once infected, remain so for life. Rodents, shrews, and monkeys are common hosts for KFDV after being bitten by an infected tick. KFDV can cause epizootics with high fatality in primates.

Transmission

Transmission to humans may occur after a tick bite or contact with an infected animal, most importantly a sick or recently dead monkey. No person-to-person transmission has been described. Large animals such as goats, cows, and sheep may become infected with KFD but play a limited role in the transmission of the disease. These animals provide the blood meals for ticks and it is possible for infected animals with viremia to infect other ticks, but transmission of KFDV to humans from these larger animals is extremely rare. Furthermore, there is no evidence of disease transmission via the unpasteurised milk of any of these animals.

Signs and Symptoms

After an incubation period of 3-8 days, the symptoms of KFD begin suddenly with chills, fever, and headache. Severe muscle pain with vomiting, gastrointestinal symptoms and bleeding problems may occur 3-4 days after initial symptom onset. Patients may experience abnormally low blood pressure, and low platelet, red blood cell, and white blood cell counts. After 1-2 weeks of symptoms, some patients recover without complication. However, the illness is biphasic for a subset of patients (10%–20%) who experience a second wave of symptoms at the beginning of the third week. These symptoms include fever and signs of neurological manifestations, such as severe headaches, mental disturbances, tremors, and vision deficits. The estimated case-fatality rate is from 3 to 5% for KFD.

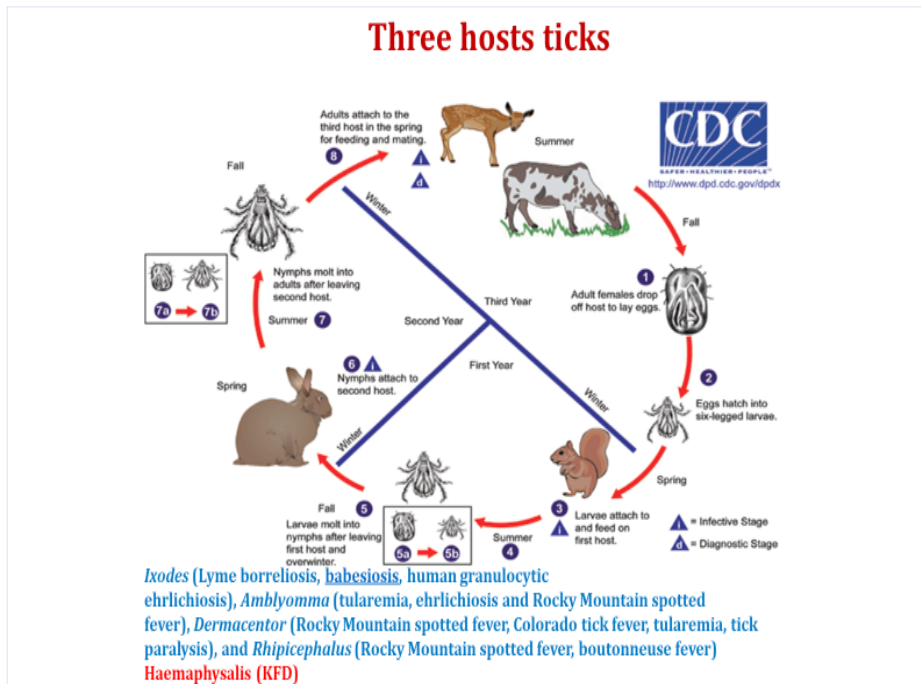


Figure 27. Life Cycle of KFD Vector (*Haemaphysalis spinigera*) – Source CDC

Risk of Exposure

KFD has historically been limited to the western and central districts of Karnataka State, India. However, in November 2012, samples from humans and monkeys tested positive for KFDV in the southernmost district of the State which neighbours Tamil Nadu State and Kerala State, indicating the possibility of wider distribution of KFDV. The disease has also shown its presence in the states of Maharashtra, Goa, and Gujarat.

People with recreational or occupational exposure to rural or outdoor settings (e.g., hunters, herders, forest workers, farmers) within Karnataka State are potentially at risk for infection by contact with infected ticks. Seasonality is another important risk factor as more cases are reported during the dry season, from November through June.

Vectors: Ticks

Ticks are found throughout the world, in tropical and temperate zones. They are divided into two groups: the soft ticks of the family Argasidae (100 species) and the hard ticks of the family Ixodidae (700 species). Hard ticks are capable of transmitting such diseases as tularemia, Rocky Mountain spotted fever, Lyme disease, Q fever, and tick-borne encephalitis. They can cause a direct injury resulting in a condition known as tick paralysis. The soft tick may transmit spirochetes that cause tick-borne relapsing fever. The tick gets spirochetes when ingesting the blood of an infected animal. The spirochetes then multiply within the body of the tick, invading the tissues and the body cavity of the tick. Spirochetes are transmitted to the tick's eggs by transovarian transmission, even to the third generation.

Hard Ticks (Family Ixodidae)

The mouthparts can be seen from above; therefore the hard tick has a shield on the back (see figure). The life cycle of the hard tick is a type of gradual metamorphosis, consisting of four stages: egg, larva (not worm-like), nymph, and adult. The completion of this life cycle may take from 6 weeks to 2 years. All stages past the egg feed on the blood of vertebrates, mostly mammals. The female becomes greatly distended while feeding, a period of usually 5 to 10 days. Copulation takes place on the host while the female is feeding. After copulation, the female takes more blood, drops to the ground, finds a sheltered place, and in a few days deposits a gelatinous mass of eggs that may number into the thousands. This oviposition may take several days, after which the female dies. Under favorable conditions, the eggs hatch in about a month; but during cold weather, they may not hatch for several months. Some days after hatching, the six-legged larvae (also called "seed ticks") climb weeds, stems, or twigs or walk over the ground to find a suitable host

such as a small mammal. They engorge on the blood of the host, drop to the ground, and moult into the nymphal stage. The nymph then awaits an animal, feeds, drops to the ground, and moults into the adult which then repeats the cycle.

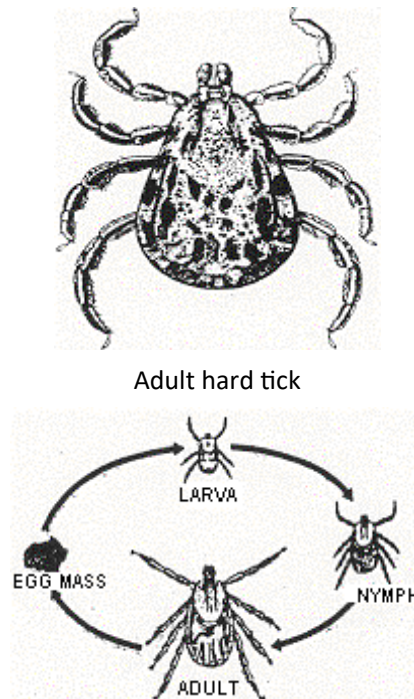


Figure 28. Life Cycle of the Tick (Note: The larval stage has six legs.)

Soft Ticks (Family Argasidae)

The soft ticks are round or oval and lack a shield on the back; their skin is leathery, wrinkled, and tough. In adults, the mouthparts are not visible from above (see Figure 29). Their development is similar to hard ticks but they may have two to several larval and nymphal stages. Soft ticks are secretive in their habits, feeding at night and concealing themselves during the day in crevices or cracks near the nest or roost of the host. The female feeds and lays eggs alternately over a relatively long period. Thus, a single soft tick may feed, on several different hosts during one lifetime, which sharply increases its disease-carrying potential. Many soft ticks feed on birds and reptiles, although others prefer mammals as a host.

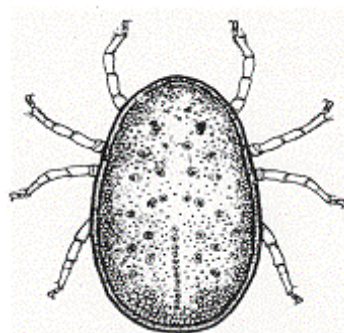


Figure 29. Soft Tick

Diseases Transmitted

Bovine piroplasmosis (caused by the protozoan, *Babesia* species. **Horse tick fever** is caused by 2 species of *Babesia*. **Theileriosis** is a disease of goats and sheep caused by the protozoan, *Theileria parva*. **Anaplasmosis** is a protozoan

disease caused by *Anaplasma marginale*. **The Indian tick typhus** is a rickettsial disease caused by *Rickettsia conorii* and transmitted by ixodid ticks. **Lyme disease** is also transmitted by ticks. **KFD (Kyzasanur Forest Disease)** is a viral disease transmitted by ticks.



Figure 30. Ixodid Tick

The clinical symptoms comprised of fever, headache and malaise lasting for 12–14 days and mortality is low. A maculopapular rash occurs on the second to fifth day of fever.

Ticks have four stages to their lifecycle, namely egg, larva, nymph, and adult. Ixodid ticks have three hosts, taking at least a year to complete their lifecycle. Argasid ticks have up to seven nymphal stages (instars), each one requiring a blood meal. Because of their habit of ingesting blood, ticks are vectors of at least twelve diseases that affect humans and other animals.

The following ixodid ticks have been reported to vectors of tick typhus.

1. *Rhipicephalus sanguineus*
2. *Ixodes Ricinus*
3. *Haemaphysalis indica*
4. *H. kinneari*
5. *H. turturis*
6. *H. spinigera*

Rodents and dogs harbour the potential tick vectors and maintain the reservoir of the disease in nature. Among the potential vector species *R. sanguineus* is the most common tick distributed in India.