International Journal of
Medical and Health Sciences
ISSN: 3143-701X | https://www.ioro.org/ijmhs

# Emerging technologies against Kyasanur Forest Disease Virus: A new Era of Detection, Therapy, and Prevention.

**Kondru Hemalatha[1], Pilla Jyotshna [2] ,Sabbisetti Suryakala[3], [*]Praveen Kumar Uppala[4] , Maddi Ramaiah[5]**

[1]B.Pharmacy, Maharajah's College of Pharmacy, vizianagaram, Andhra Pradesh, India, kondruhemalatha3006@gmail.com

[2]B.Pharmacy, Maharajah's College of Pharmacy, vizianagaram, Andhra Pradesh, India, pillajyotshna@gmail.com

[3]B.Pharmacy, Maharajah's College of Pharmacy, vizianagaram, Andhra Pradesh, India, suryakalasabbisetti@gmail.com

[4]Assistant professor, Dept.of Pharmacology, Maharajah's College of Pharmacy, Vizianagaram, Andhra Pradesh, India, praveen.chintu32@gmail.com

[5]Professor and Principal, Maharajah's College of Pharmacy, Vizianagaram, Andhra Pradesh, India, rampharma83@gmail.com

**Abstract:**

Kyasanur Forest Disease (KFD), better known as monkey fever, is a tick-borne virus that causes a zoonotic disease endemic to the Western Ghats of India. The disease is caused by Kyasanur Forest Disease virus (KFDV) belonging to the genus Flavivirus. Humans are often infected by the bite of infected Haemaphysalis ticks during work or travel in forested environments. The disease was first reported from Karnataka in the year 1957 and has slowly spread to a few neighboring states. The disease is an important public health problem.

KFD is naturally transmitted between ticks, wild animals and humans. Monkeys, particularly bonnet macaques and gray langurs, are very susceptible to infection and often die during outbreaks, serving as early indicators of viral activity. Human cases are most frequently reported January through June when tick populations are highest. The distribution of infected ticks and the persistence of the disease are influenced by environmental factors, such as forest vegetation, climate and wildlife movement.

Patients with KFD usually present with sudden onset of fever, severe headache, myalgia and gastrointestinal symptoms, although a minority may develop bleeding or neurological complications. Illness and deaths can be reduced by early detection, supportive medical care and preventive measures. Efective control depends on continuous disease surveillance, vaccination of high-risk groups, public awareness, protection against tick bites, and coordinated vector control. Continued research and improved public health programs are still needed to control KFD spread in endemic areas.

**Keywords:** Kyasanur Forest Disease, tick-borne virus, Haemaphysalis, monkey fever, bonnet macaques, gray langurs

## 1. Introduction:

Kyasanur Forest Disease (KFD), also known as monkey fever, is a tick-borne zoonotic viral disease caused by Kyasanur Forest Disease virus (KFDV), a member of the genus Flavivirus. The disease was first identified in 1957 in the Kyasanur Forest of Karnataka, India and has since spread to neighboring states Goa, Kerala, Tamil Nadu and Maharashtra. The expanding geographical distribution of KFD has made it a major public health problem in the region of Western Ghats. The virus is mainly transmitted by the bite of infected Haemaphysalis ticks, but the natural transmission cycle involves wildlife, especially monkeys and small mammals. Bonnet



*© 2026 The Author(s). Published by IORO Publications. This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY 4.0) (https://creativecommons.org/licenses/by/4.0/), which permits use, distribution, and reproduction in any medium, provided the original author and source are credited, a link to the license is provided, and any changes are indicated.*

macaques and gray langurs are highly susceptible to infection and are often the first sentinels of viral activity. Farmers, cattle grazers and forest workers living or working near forests are more prone to get infected as they are often exposed to tick infested environments and infected animals. The incubation period is generally 2 to 8 days. Patients develop a sudden high fever, severe headache, muscle aches, weakness and gastrointestinal symptoms. Most cases recover with supportive care but some develop bleeding manifestations or progress to a second phase with neurological complications including tremor, muscle weakness, numbness and in severe cases, encephalitis (1). Laboratory findings are often marked by decreased white blood cell and platelet counts and elevated liver enzymes.



**Fig 1 Gray langurs** **Bonnet macaques**

There is no specific antiviral therapy for KFD at present and prevention is the key to control of the disease. Vaccination is the main preventive measure in endemic areas. The currently available formalin inactivated vaccine requires two doses with booster doses to maintain immunity. Studies have shown that vaccine protection is significantly improved after booster vaccination contributing to reduction in disease severity and mortality in vaccinated populations.

KFD continues to be a challenge despite the availability of vaccine, due to its expanding distribution, complex wildlife–tick transmission cycle and incomplete vaccine coverage. Some communities have been reluctant to get vaccinated, in part due to mild local reactions following vaccination (2). Controlling diseases and preventing future outbreaks relies on strengthening surveillance, raising public awareness, improving vaccination rates, and adopting a One Health approach that integrates the health of humans, animals and the environment.

## Epidemiology:

Kyasanur Forest disease also known as monkey fever is a severe viral disease transmitted by tick and affects both human being and animals. The infection is caused by Kyasanur forest disease virus (KFDV) belonging to Flaviviridae family. The disease was first reported in 1957 in the Kyasanur forest of Shivamogga district, Karnataka, and remains endemic to some forested areas of India.It has become a public health problem of increasing importance as it has been slowly spreading into previously unaffected areas over the years, and continuous surveillance, effective prevention and timely control measures are required (3).

## Geographic distribution:

Kyasanur Forest Disease (KFD) is largely confined to the forested areas of the Western Ghats, which is favorable for the survival and transmission of the Virus. Initially confined to Karnataka, the disease has now spread to several Districts in the State and to neighboring regions of Kerala, Tamil Nadu, Goa and Maharashtra. This expanding distribution indicates that KFD is not limited to its historical endemic area and continues to emerge in new forest ecosystems.

## Reservoirs and vectors:

Kyasanur Forest Disease (KFD) is maintained by a natural cycle involving Haemaphysalis ticks and a variety of Wild animals. Monkeys, rodents and small mammals maintain the virus, which can also circulate in Birds and bats. Monkeys are among these hosts Act as sentinel animals, because their sudden deaths are often Indicators of ongoing viral activity in surrounding forested areas.
**Mode of Transmission:** Humans acquire Kyasanur Forest disease (KFD) mainly by bites of infected nymphal ticks in forested areas during work. It can also be acquired by handling infected monkey corpses, but there is no of human-to-human transmission. Farmers, livestock grazers, plantation workers and those collecting forest products face the highest risk of infection because their work requires regular contact with forests.

**Population at risk**: Individuals living near forests or working in occupations that require frequent contact with forest environments are at the greatest risk of Kyasanur Forest Disease (KFD) High risk groups are forest workers, farmers, tribal communities, cattle grazers, hunters and plantation laborers (4). The risk of infection increases greatly when you have regular contact with tick-infested vegetation.

**Occurrence through the seasons**: Kyasanur Forest Disease (KFD) exhibits a clear seasonal trend with the majority of cases occurring during the period of peak tick activity and maximal human contact, December to May. Monkey deaths are frequently an early warning of virus transmission in active areas, occurring before human infections.

**Outbreak characteristics**: Kyasanur Forest Disease (KFD) usually appears in sporadic outbreaks in villages near forest areas, not as continuous widespread transmission. These outbreaks are closely linked to increased tick activity and monkey deaths and illustrate the strong ecological association of the virus with wildlife hosts and the forest environment.

## Epidemiological trends:

KFD has been confined to Karnataka for several years but has been steadily spreading to neighboring states since 2011. The Expansion of the geographical range has been associated with environmental changes like

deforestation, disruption of habitats, climate variability and increased human activity in forest ecosystems, pointing to KFD as an emerging public health threat (5)

## Disease burden:

Kyasanur Forest Disease **(**KFD**)** is endemic in parts of India**,** with several hundred confirmed cases occurring annually. Most infections are mild or asymptomatic, but the estimated case fatality rate is 3-10%. Serious cases can result in bleeding, neurological complications and a long recovery period.

## Public health importance:

Kyasanur Forest Disease (KFD) remains a major public health concern in endemic regions. Effective control relies on early detection, continuous surveillance, tick control, public awareness, personal protective measures, and vaccination of high-risk populations. Strengthening vaccine coverage and implementing a One Health approach that integrates human, animal, and environmental health are essential to reduce disease transmission and prevent further spread.

**Table 1 Chronology of Kyasanur Forest Disease (KFD) Outbreaks, 2000–2024**

| Period/Year | State | District/Region | Reported Outbreak/Development |
|---|---|---|---|
| 2000–2003 | Karnataka | Shivamogga and Uttara Kannada | Sporadic KFD outbreaks continued in the established endemic districts. |
| 2004–2008 | Karnataka | Predominantly endemic districts | Seasonal outbreaks occurred annually, mainly from January to May, with several hundred cases reported. |
| 2009 | Karnataka | Chikkamagaluru | KFD was reported in Chikkamagaluru, indicating spread beyond the traditional endemic areas. |
| 2011 | Karnataka | Chamarajanagar (Bandipur region) | KFD was detected in the Bandipur region, suggesting further geographic expansion. |
| 2012–2013 | Karnataka | Additional affected areas | Outbreaks continued, with KFD reported from additional areas within the state. |
| 2014 | Kerala | Wayanad | The first confirmed outbreak in Kerala was reported, marking the spread of KFD beyond Karnataka. |
| 2015 | Goa | — | The first confirmed human cases of KFD were identified in Goa. |
| 2015–2016 | Tamil Nadu | Nilgiris | KFD was reported for the first time in Tamil Nadu. |
| 2016–2018 | Karnataka, Kerala, Goa and Maharashtra | Forested and endemic areas | Recurrent outbreaks were reported, demonstrating the wider geographic distribution of KFD across the Western Ghats. |
| 2019 | Karnataka, Kerala, Goa and Maharashtra | Endemic and affected areas | Seasonal outbreaks continued, accompanied by ongoing surveillance and vaccination activities. |
| 2020–2024 | Karnataka, Kerala, Goa, Maharashtra and Tamil Nadu | Endemic and newly affected districts | Annual outbreaks continued in endemic and newly affected districts, indicating the continued geographic spread of KFD. |

Abbreviation: KFD – Kyasanur Forest Disease.

**Virology of Kyasanur Forest Disease Virus (KFDV):** Kyasanur Forest Disease Virus [KFDV] is the etiological agent of Kyasanur Forest Disease [KFD] a tick-borne viral infection afecting humans and several animal

species. It is part of the Flavivirus genus of Flaviviridae Family, including dengue, zika and Japanese encephalitis viruses. KFDV was first isolated in 1957 in Karnataka,India and has become an important. Zoonotic pathogen as it spreads increasingly to new endemic areas.FDV is a single-stranded, positive-sense RNA virus that is enveloped and has A genome encodingstructural and non-structural proteins required for viral Entry, replication, and survival within the host (6). The transmission In nature, the virus is maintained in a transmission cycle involving wild animals and Haemaphysalis ticks. Small mammals and birds are reservoir hosts and monkeys are important amplifying hosts and early markers of virus circulation. Humans are infected mainly through the bite of infected ticks, and there is no evidence of person-to-person transmission.

Once in the body, KFDV infects immune cells and then spreads through the bloodstream to organs such as the liver, spleen, kidneys and brain. It can cause inflammation, bleeding, low platelets counts and in severe cases, neurological complications.The virus is genetically similar to other tick-borne flaviviruses but has unique properties. Continued research into its biology and evolution is essential for improving diagnosis, vaccine development, disease surveillance and future control strategies.

**CLINICAL SIGN OF KYASANUR FOREST DISEASE VIRUS (KFDV)**: Kyasanur Forest Disease (KFD) is an acute tick-borne viral disease with 3-8 days incubation period after the bite of an infected tick. The disease has a sudden onset and varies from mild febrile illness to severe haemorrhagic and neurological complications.

The initial symptoms are usually high fever, chills, headache and muscle pain, weakness, loss of appetite, nausea, vomiting and abdominal pain. When the “infection progresses, some patients will develop symptoms of bleeding, such as Bleeding gums, nosebleeds, gastrointestinal bleeding and petechiae.Thrombocytopenia and leukopenia are often present on laboratory findings may predispose to bleeding. Some patients develop a biphasic illness. Fever can come back after temporary improvement recurs with neurological complications such as severe headache, stiff neck, tremors, confusion, altered consciousness and in severe cases, meningitis or encephalitis These Complications should be quickly assessed and received supportive care.

**Transmission of Kyasanur Forest Disease Virus (KFDV):**

Kyasanur Forest Disease Virus (KFDV) is an arthropod-borne zoonotic virus mainly transmitted by the bites of Haemaphysalis spinigera ticks (7).



*Figure 2: Microscopic picture of female and male Haemaphysalis spinigera*

Activate Wi
Go to Settings t

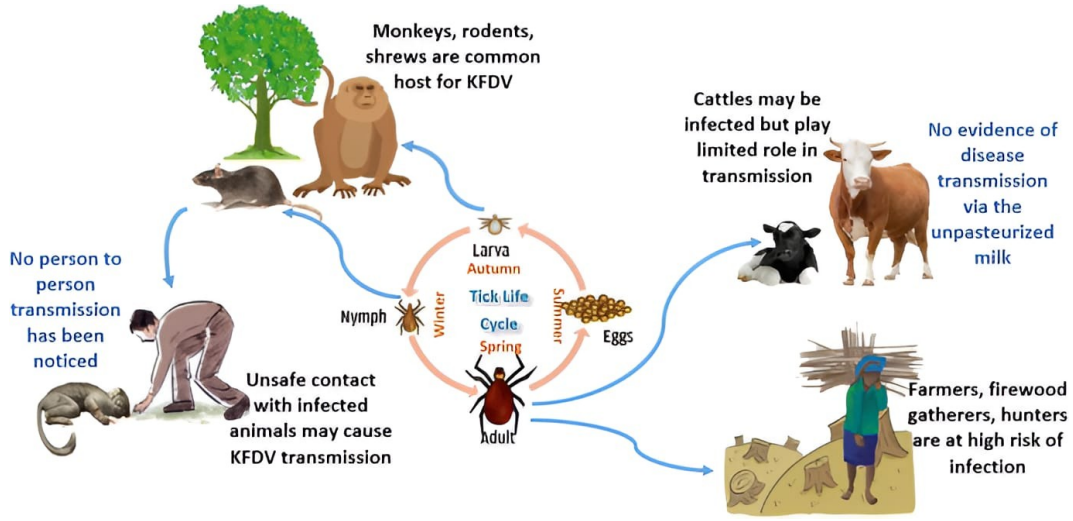
In nature, the virus is maintained in a transmission cycle between ticks, small mammals and non-human primates. Other monkeys, such as bonnet macaques and gray langur, also get heavily infected with the virus

and often die out during outbreaks, making them important sentinel animals indicating active viral circulation.

Cattle, goats and sheep are domestic animals that do not act as major transmitters of the virus to humans. However, they provide blood meals to ticks, thus maintaining tick populations and indirectly supporting the persistence of the virus in endemic forest ecosystems.Humans are mostly infected by bites from infected ticks when working or visiting forested areas. Sometimes infection can occur through contact with infected animal tissues, especially dead monkeys. Because there have been no reports of human-to- human transmission, infected people are considered dead-end hosts and do not pass the virus on to others.

People at the highest risk include farmers, forest workers, hunters, tribal communities, and others who frequently enter forests. Environmental changes such as deforestation, habitat disturbance, low vaccination coverage, and inadequate personal protection increase contact between humans and infected ticks, contributing to the spread of the disease

There are several mechanisms maintaining the virus in tick populations. The virus survives the transition from the larval to the nymphal and adult stages in the tick (transstadial transmission), can be transmitted between ticks feeding on the same host (co-feeding transmission), and may be transmitted from infected female ticks to offspring via the eggs (transovarial transmission). These mechanisms enable the maintenance of KFDV in nature and the recurrence of outbreak




## Diagnosis:

The onset of Kyasanur Forest Disease (KFD) is non-specific with symptoms like sudden high fever, severe headache, muscle pain, backache, vomiting and diarrhea, thus making early clinical diagnosis difficult. Severe cases may develop hemorrhagic features including bleeding, low blood pressure and shock and some patients develop neurological complications including tremors, confusion and decreased consciousness (8). These features resemble other tropical infections and laboratory confirmation is necessary for accurate diagnosis.

Diagnosis is mainly through serological and molecular tests. Reverse transcriptase polymerase early stage of infection, preferred method is chain reaction (RT-PCR), while IgM ELISA is used to detect recent infection and IgG antibodies indicate past or later stage infection. Supported by laboratory findings are thrombocytopenia, leukopenia and elevated liver enzymes. Virus isolation is done to provide definitive confirmation but it is only in specialized high-containment labs because of biosafety requirements.

**World Health Organization (WHO) Response:**

Kyasanur Forest Disease (KFD) is an important tick borne zoonotic disease. The World Health Organization (WHO) states that KFD helps India to strengthen disease surveillance, laboratory diagnosis and early outbreak detection. The WHO is urging immediate reporting of suspected cases and continued monitoring of human infections, ticks and animal hosts to help curb the spread of the illness.

WHO advocates a One Health approach that links human, animal and environmental health to enhance the control and prevention of KFD. The organization also supports public awareness, personal protective measures against tick bites, timely vaccination of high risk populations, increased laboratory capacity, and continued research to develop better diagnostic methods, vaccines and vector control strategies.

**Control Strategies:**

The control of Kyasanur Forest Disease (KFD) can be done effectively by a combination of tick prevention, vaccination, disease surveillance and community engagement. Reducing exposure to infected ticks by wearing protective clothing, applying repellents and carefully removing ticks after activities in forests is an important measure of prevention (9). Vaccination should be offered to high risk populations including forest workers, farmers and people living inPlays an important role in reducing Infection in endemic areas. Continued monitoring of human cases,monkey deaths and tick populations, early diagnosis and prompt medical care, helps Limit the spread of disease and its complications.

## Control and Prevention of KFD virus:

**1. Personal protective measures**: The most effective way to minimize the risk of Kyasanur Forest Disease is to prevent tick bites. People going into wooded areas should wear protective clothing, use approved tick repellents and carefully check their body and clothing for ticks after they leave the woods. Promptly and safely remove any attached ticks.

**2.Vaccination:** Vaccination is an important prevention for people living or regularly travel to KFD-affected areas. “High risk individuals should get the recommended vaccine”and booster doses to sustain protection from infection.

**3.Tick control:** Controlling tick populations can help reduce the spread of Kyasanur Forest Disease. Targeted use of tick-control measures in outbreak Areas and locations where infected monkeys are detected can lower the risk of human exposure, even though eliminating ticks from forests is not feasible.

**4. Disease surveillance**: Continuous surveillance plays a vital role in the early detection and control of Kyasanur Forest Disease. Monitoring human Infections, monkey deaths, and tick activity, along with prompt reporting of suspected cases, enables timely public health action to limit disease spread (10).

**5. Public awareness and health education:** Community awareness is Kyasanur Forest Disease. Teaching people on encourages disease transmission, early symptoms, and tick bite prevention Timely medical care and reduces the spread of infection.

**6.Early diagnosis and preventive care :**There is no specific antiviral treatment for Kyasanur Forest Disease, so early diagnosis and supportive medical care are paramount. Adequate hydration, control of symptoms and careful monitoring for complications can Improve the recovery of patients (11).

**7. Environmental and occupational safety:** People working in forests or nearby farms should Take protective measures to reduce the risk of tick bites. Wearing appropriate clothing, using tick Repellents, and following

safety guidelines are essential. Forest authorities should also provide Public awareness, issue health advisories, and display warning signs during periods of increased KFD activity can improve the recovery of patients.

**8.One health approach:** An integrated one health approach is required for the prevention and control of Kyasanur forest disease. Collaboration between human health, veterinary, wildlife and environmental sectors improves surveillance, early detection of outbreaks by monitoring monkey deaths and tick populations, and timely, coordinated response actions.

## Treatment for KFD virus:

**Specific Treatment:** As of right now, Kyasanur Forest Disease cannot be particularly treated with an antiviral drug. As a result, the key goals of patient care are symptom relief, preserving essential bodily functioning, and avoiding complications through supportive care.

**Supportive Therapy:**

In order to improve patient outcomes, supportive care is essential. It include staying well hydrated with oral or intravenous fluids, managing fever and pain with the right drugs, keeping an eye on vital signs like blood pressure, and administering oxygen treatment as needed. Patients with bleeding complications may need blood transfusions, and secondary bacterial infections should be treated with appropriate antibiotics (12). Those who develop severe illness (hemorrhage, neurological involvement, dehydration, shock, seizures, or altered consciousness) should be hospitalized for close observation and intensive care.

**Prognosis:**

With early diagnosis and appropriate supportive treatment most patients recover completely. However, severe cases can lead to serious complications, and the reported case fatality rate ranges from 3%-10%.Vaccines In addition, vaccination remains the best preventive measure for people living in or traveling to KFD-endemic areas. The vaccine currently available is a formalin-inactivated vaccine prepared from the Kyasanur Forest Disease virus grown in chick embryo tissue culture (13).

**Vaccine Schedule**

The recommended immunization schedule is two primary doses given one month apart, followed by a booster dose after 6-9 months. Booster doses should be continued for those continuing to live or work in areas of high risk to maintain immunity.

**Effectiveness of Vaccine**

The vaccine that is available offers moderate protection against KFD. Two doses provide partial immunity and booster doses significantly enhance protection (14). Research has shown that nearly 70% of vaccinated people develop 12 protective antibodies, with vaccine effectiveness rising to approximately 62% after two doses to around 83% after booster vaccination.

**Development of New Vaccines**

The Indian Council of Medical Research (ICMR) is working on the development of new indigenous KFD vaccine with better safety and efficacy for improved long-term protection and overall vaccine performance.

## Preventive and control measures

**How to prevent tick bite:**• KFDV is predominantly tick-borne. The following precautions may help to reduce the risk of infection:• Avoid visiting tick-infested forested areas, especially during outbreaks (15).

• Stay on clear trails and avoid contact with bushes, shrubs, and tall grass, where ticks may be present.

• Wear protective clothing such as full-length trousers and closed footwear, and long-sleeved shirts.

• Tuck trousers into socks to prevent ticks from entering clothing (16).

•Use insect repellents containing DEET or other recommended tick repellents on exposed skin. Educational and public health measures:

•Early detection and diagnosis help prevent further spread of infection.

•Tick control programs should be implemented in affected areas.

•Quarantine and surveillance measures should be followed during outbreaks (17).

•Direct contact with sick or dead monkeys should be avoided, as they may indicate active KFD Transmission.

•Entry into affected forest regions should be restricted during outbreak Periods.

•Individuals handling infected materials should use protective equipment, Including gloves, Protective clothing, and boots.

## Future challenges and research needs:

### Enhancing the Efficacy of Vaccines

The present KFD vaccine offers only moderate protection and requires multiple doses with booster vaccinations. A more effective vaccine that provides long-lasting immunity remains a key research priority (18).

### Increasing Endemic Areas

Environmental change, Deforestation, climate variability and increased human activity in forested areas are extending KFD beyond its traditional endemic zones continued monitoring is necessary to identify and track new affected areas.

### No Specific Antiviral Treatment:

KFD has no approved antiviral therapy to date, and thus it is managed with supportive measures. Research on efficient antiviral drugs and new therapeutic approaches is crucial.

### Problems in early diagnosis

Early symptoms are similar to other febrile illnesses and laboratory facilities are limited in rural areas, making timely diagnosis difficult. An important goal is the development of rapid, accurate and affordable diagnostic tests (19).

### Improving Surveillance and Public Education

Timely reporting, enhanced disease surveillance and increased public awareness are essential for early detection of outbreaks, for effective control measures and to contain the spread of KFD.

## Research requirements:

•**Improved Vaccines:** Research should be aimed at developing vaccines that provide stronger and longer-lasting immunity, require fewer doses and protect against different strains of the KFD virus (20).

• **Discovery of Antiviral Drugs:** Identifying safe and effective antiviral Medications remains a major priority to improve treatment beyond Supportive care.

• **Improved Diagnostic Tools:** Developing rapid, accurate, affordable, and Field-friendly diagnostic tests will enable early detection and timely Management of KFD.

• **Genomic and Molecular Research:** Continued studies on the genetic Diversity, Evolution, and transmission of KFD virus will support surveillance And help identify emerging viral variants (21).

• **Ecological and Climate Studies:** Investigating how climate change, environmental factors, and wildlife ecology affect the distribution of ticks and the transmission of viruses will enhance the prediction and prevention of outbreaks.

**Enhancing the One Health Approach:** Promoting interdisciplinary collaboration to promote an integrated approach to human, animal and environmental health will improve disease surveillance, response to outbreaks and long-term prevention strategies (22).

**Conclusion:** Kyasanur forest disease (KFD) is an important tick-borne viral zoonotic disease and continues to pose a major public health problem in the forested regions of India. The virus is maintained in a complex transmission cycle involving ticks, wildlife and human beings. Environmental changes, deforestation and increased human activity in forest ecosystems have led to the spread of diseases into previously unaffected areas. At present, there is no specific anti viral therapy for KFD and prevention of disease is the basis for disease control.

Vaccination, early diagnosis, prompt supportive care, efective tick control, Public awareness and use of personal protective measures are important in reducing disease transmission. Furthermore, robust surveillance systems are required to detect cases early and respond to outbreaks in a timely Manner.

Improvements in vaccination efficacy, timely diagnostic tools, and targeted antiviral treatments are essential for the future management of KFD. In order to better monitor and prevent diseases, researchers must keep digging and adopt a One Health perspective that takes into account the well-being of all living things. To lessen the impact of KFD and forestall its recurrence, public health officials, researchers, and community members must work together in the long run.

## References :

[1] Virological epidemiology of the 1958 epidemic of Kyasanur forest disease. Work TH,Roderiguez FR, Bhatt PN. Am J Public Health Nations Health. 1959;49:869–874. Doi: 10.2105/ajph.49.7.869. [DOI] [PMC free article] [PubMed] [Google Scholar]

[2] Human behaviors elevating exposure to Ixodes pacificus (Acari: Ixodidae) nymphs andTheir associated bacterial zoonotic agents in a hardwood forest. Lane RS, Steinlein DB,Mun J. J Med Entomol. 2004;41:239–248. Doi: 10.1603/0022-2585-41.2.239. [DOI] [PubMed] [Google Scholar]

[3] Does the rise in cases of Kyasanur forest disease call for the implementation of OneHealth in India? Pattnaik S, Agrawal R, Murmu J, Kanungo S, Pati S. IJID Reg. 2023;7:18–21. Doi: 10.1016/j.ijregi.2023.02.003. [DOI] [PMC free article] [PubMed] [GoogleScholar]

[4] Kyasanur forest disease: a state-of-the-art review. Gupta N, Wilson W, Neumayr A,Saravu K. QJM. 2022;115:351–358. Doi: 10.1093/qjmed/hcaa310. [DOI] [PubMed] [Google Scholar]

[5] The updated list of ticks (Acari: Ixodidae & Argasidae) occurring in Iran with a key toThe identification of species. Hosseini-chegeni A, Tavakoli M, Telmadarraiy Z. Syst ApplAcarol. 2019;24:2133–2166. [Google Scholar]

[6] Kyasanur forest disease. Holbrook MR. Antiviral Res. 2012;96:353–362. Doi: 10.1016/j.Antiviral.2012.10.005. [DOI] [PMC free article] [PubMed] [Google Scholar]

[7] Role of host cell factors in flavivirus infection: implications for pathogenesis and Development of antiviral drugs. Pastorino B, Nougairède A, Wurtz N, Gould E, deLamballerie X. Antiviral Res. 2010;87:281–294. Doi: 10.1016/j.antiviral.2010.04.014. [DOI] [PubMed] [Google Scholar]

[8] Historical expansion of Kyasanur forest disease in India from 1957 to 2017: a Retrospective analysis. Chakraborty S, Andrade FC, Ghosh S, Uelmen J, Ruiz MO. Geohealth. 2019;3:44–55. Doi: 10.1029/2018GH000164. [DOI] [PMC free article] [PubMed] [Google Scholar]

[9] Coverage and effectiveness of Kyasanur forest disease (KFD) vaccine in Karnataka, South India, 2005-10. Kasabi GS, Murhekar MV, Sandhya VK, Raghunandan R, Kiran SK, Channabasappa GH, Mehendale SM. PLoS Negl Trop Dis. 2013;7:0. Doi: 10.1371/journal.Pntd.0002025. [DOI] [PMC free article] [PubMed] [Google Scholar]

[10] Kyasanur forest disease virus breaking the endemic barrier: an investigation into Ecological effects on disease emergence and future outlook. Ajesh K, Nagaraja BK,Sreejith K. Zoonoses Public Health. 2017;64:0–80. Doi: 10.1111/zph.12349. [DOI] [PubMed] [Google Scholar]

[11] Epidemiology, pathogenesis, and control of a tick-borne disease- Kyasanur forest Disease: current status and future directions. Shah SZ, Jabbar B, Ahmed N, et al. Front Cell Infect Microbiol. 2018;8:149. Doi: 10.3389/fcimb.2018.00149. [DOI] [PMC free Article] [PubMed] [Google Scholar]

[12] Experiences of Indian Council of Medical Research with tick-borne zoonotic Infections: Kyasanur forest disease & Crimean-Congo haemorrhagic fever in India with One Health focus. Mourya DT, Yadav PD, Patil DY, Sahay RR, Rahi M. Indian J Med Res.2021;153:339–347. Doi: 10.4103/ijmr.IJMR_532_21. [DOI] [PMC free article] [PubMed] [Google Scholar]

[13] Phylogeography of Kyasanur forest disease virus in India (1957-2017) reveals Evolution and spread in the Western Ghats region. Yadav PD, Patil S, Jadhav SM, et al. Sci Rep. 2020;10:1966. Doi: 10.1038/s41598-020-58242-w. [DOI] [PMC free article] [PubMed] [Google Scholar]

[14] Ancient ancestry of KFDV and AHFV revealed by complete genome analyses of Viruses isolated from ticks and mammalian hosts. Dodd KA, Bird BH, Khristova ML, et al.PLoS Negl Trop Dis. 2011;5:0. Doi: 10.1371/journal.pntd.0001352. [DOI] [PMC free Article] [PubMed] [Google Scholar]

[15] The reaction of cattle to Kyasanur forest disease virus. Anderson CR, Singh KR. https://pubmed.ncbi.nlm.nih.gov/5579235/ Indian J Med Res. 1971;59:195–198. [PubMed] [Google Scholar]

[16] Kyasanur forest disease: an epidemiological view in India. Pattnaik P. Rev Med Virol. 2006;16:151–165. Doi: 10.1002/rmv.495. [DOI] [PubMed]

[17] . History and Introduction. Operational Guidelines. Kyasanur Forest disease. Government of Karnataka . Directorate of Health and Family Welfare Services, Karnataka, India; 2020. 1–5.

[18] .EA Gould; T Solomon (February 9, 2008). “Pathogenic flaviviruses”. The Lancet. 371 (961):500–509. Doi:10.1016/S0140-6736(08)60238-X. ISSN 0140-6736. PMID 18262042. S2CID 205949828.

[19] The Lancet Infectious Diseases. Kyasanur Forest disease: an emerging arboviral threat. Lancet Infect Dis. 2026;26(5):e228-e239. Doi:10.1016/S1473-3099(25)00589-4.

[20] Holbrook MR. Kyasanur forest disease. Antiviral Res. 2012;96(3):353-362. Doi:10.1016/j.antiviral.2012.10.005

[21] Pathogenicity and virulence of Kyasanur Forest disease: A comprehensive review of an expanding Zoonotic threat in southwestern India. Microb Pathog. 2025. Doi available via PubMed.

[22] Kyasanur Forest Disease in India: Epidemiology, Transmission Ecology, Clinical Spectrum, Diagnostics and One Health Control. Asian J Res Infect Dis. 2026;17(1):13–24. Doi:10.9734/AJRID/2026/v17i1518.