



सत्यमेव जयते

Ministry of Health & Family Welfare
Government of India

A Comprehensive Learning Guide

Kyasanur Forest Disease (KFD)



**NATIONAL CENTRE FOR DISEASE CONTROL
DIRECTORATE GENERAL OF HEALTH SERVICES**
Ministry of Health & Family Welfare, Government of India



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National Centre for Disease Control
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Government of India

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स्वास्थ्य सेवा महानिदेशक

DIRECTOR GENERAL OF HEALTH SERVICES



सत्यमेव जयते

भारत सरकार
स्वास्थ्य एवं परिवार कल्याण मंत्रालय
स्वास्थ्य सेवा महानिदेशालय

Government of India
Ministry of Health & Family Welfare
Directorate General of Health Services



Message

Zoonotic diseases pose a significant and ongoing threat to biodiversity, human and public health and economic stability. Given India's diverse ecosystem, high population density and increasing human-animal action, the country remains particularly susceptible to zoonotic outbreaks. Past occurrences of plague, Nipah virus, avian influenza, leptospirosis, and Kyasanur Forest Disease emphasizes a critical need for robust surveillance, early detection, and a coordinated, intersectoral response.

Recognizing the importance of addressing zoonotic diseases as a public health priority, the Centre for One Health, under the National Centre for Disease Control (NCDC), is committed for strengthening surveillance, prevention, and response mechanisms through an integrated One Health approach. As part of this effort, the Centre for One Health has developed comprehensive learning guides on Priority Zoonotic Diseases. These modules provide scientifically validated, evidence-based guidance on the epidemiology, diagnosis, treatment, and prevention of key zoonotic diseases.

Strengthening disease surveillance, ensuring early diagnosis, and implementing timely interventions through a coordinated and multi-sectoral approach are critical to mitigating the risks associated with zoonotic diseases.

I am pleased to release these learning guides as a significant step in our ongoing efforts to combat zoonotic diseases. I urge all healthcare professionals, veterinary experts, and community leaders to actively utilize these resources to enhance their clinical index of suspicion for zoonosis and eventually contribute towards strengthening our health care system for responding timely and more efficiently to future outbreaks.

(Atul Goel)



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MESSAGE

It is my pleasure to know that the Centre for One Health at NCDC has prepared **Comprehensive Learning Guides** on 10 priority zoonotic diseases, which is now being shared with all concerned.

These resources become relevant in considering; India has encountered multiple zoonotic disease outbreaks in recent years, highlighting their persistent and evolving threat to public health. The re-emergence of **Nipah virus** in Kerala, **Kyasanur Forest Disease (KFD)** in Karnataka, and **avian influenza** across several states underscores the complex interconnections between human, animal, and environmental health. The rising cases of **leptospirosis** and **scrub typhus**, driven by climatic changes and ecological disruptions, further illustrate the unpredictable nature of zoonotic spillovers. With the additional challenges posed by **emerging coronaviruses** and **antimicrobial resistance (AMR)**, there is an urgent need for a **cohesive, evidence-based approach** to mitigate these risks effectively.

In recognition of this pressing need, the **National Centre for Disease Control (NCDC)** has intensified its efforts to fortify **zoonotic disease surveillance, outbreak preparedness, and intersectoral coordination**. As part of this initiative, the **Centre for One Health, NCDC**, has meticulously curated **Comprehensive Learning Guides** on priority zoonotic diseases. These guides, underpinned by the latest scientific insights and global best practices, serve as indispensable resources for **healthcare professionals, veterinarians, and epidemiologists**, equipping them with the knowledge to anticipate, detect, and mitigate zoonotic threats with precision.

To effectively curtail the impact of zoonotic diseases, a **harmonized One Health approach** is paramount—one that transcends disciplinary boundaries and fosters synergies across the human, animal, and environmental health sectors. I urge all stakeholders to **leverage these scholarly resources, enhance disease intelligence networks, and champion research-driven interventions**. By embracing a proactive and interdisciplinary ethos, we can **bolster pandemic preparedness, fortify national health security, and avert future spillover events**.

I sincerely **appreciate** my colleagues at the Centre for One Health, NCDC for their dedication to strengthening zoonotic disease control. Their efforts in enhancing surveillance, preparedness, and public health response are crucial in preventing and managing emerging health threats.

I am glad to see their commitment translating into evidence-based interventions and capacity-building initiatives that enhance zoonotic disease surveillance, outbreak preparedness, and overall health system resilience.

Through continuous innovation, collaboration, and unwavering dedication, we can fortify our health systems and safeguard our nation against zoonotic threats.

Wishing you all happy learning and skill enhancement wherever possible.

रंजन दास 19/3/25
Prof. (Dr.) Ranjan Das



Antibiotic resistance Containment Stewardship: Our Role, Our Responsibility
Judicious Use of Antibiotic: Key to Contain Antibiotic Resistance





भारत सरकार

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Message

Zoonotic diseases of public health importance continue to pose significant challenges to public health. These diseases, often driven by intricate human-animal-environment interactions, present substantial health risks, particularly to vulnerable populations, and demand a coordinated and robust response from the health sector.

In recognition of the pivotal role healthcare providers play in addressing these challenges, the **Centre for One Health** has developed a **Comprehensive Learning Guide for Priority Zoonotic Diseases**. This guide is designed to build capacity across the health sector, equipping professionals with the essential knowledge and skills needed to identify, manage, and prevent these diseases effectively. By enhancing surveillance systems, fostering rapid and accurate diagnostics, and implementing targeted prevention and control measures, healthcare providers can play a transformative role in mitigating the impact of zoonotic diseases.

The guide emphasizes the importance of building a resilient health workforce capable of responding to outbreaks, engaging communities, and collaborating across disciplines. Through these efforts, we aim to reduce the burden of zoonotic diseases, improve health outcomes, and contribute to the creation of a safer and healthier future.

I encourage all healthcare professionals to utilize this guide as a resource for improving their understanding and response to zoonotic diseases. Together, let us strengthen our health systems and work towards a future free from the threats posed by zoonotic diseases.

Dr. Simmi Tiwari
Joint Director and Head
Centre for One Health



Antibiotic Resistance Containment Stewardship: Our Role, Our Responsibility
Judicious Use of Antibiotic: Key to Contain Antibiotic Resistance



Acknowledgement

The **Comprehensive Learning Guide** for Kyasanur forest disease (KFD) has been developed to address the significant public health challenges posed by zoonotic diseases, which have serious health, economic, and social implications, particularly for vulnerable populations. The priority zoonotic diseases necessitate robust surveillance, timely diagnosis, and effective prevention and control measures. This guide aims to strengthen the capacity of healthcare professionals by equipping them with the requisite knowledge and skills to mitigate these public health threats and improve health outcomes.

We acknowledge with deep appreciation the valuable contributions of the **subject matter experts** from leading medical institutions and research organizations, whose guidance and technical expertise has been critical in shaping this **Comprehensive Learning Guide**.

The Centre for One Health, NCDC, expresses its sincere gratitude to Ms. Punya Salila Srivastava, Secretary, Health and Family Welfare, Government of India; Ms. L.S. Changsan, Additional Secretary, Ministry of Health and Family Welfare, Government of India; Prof. (Dr.) Atul Goel, Director General of Health Services (DGHS), Government of India; Ms. Latha Ganapathy, Joint Secretary, Department of Health & Family Welfare, Government of India for their leadership, guidance, and support.

Lastly, we acknowledge the USAID-funded RISE project team, implemented by Jhpiego, for their technical support in drafting and finalizing this guide. Their collaboration has been pivotal in ensuring the quality and relevance of this resource.

Dr. Simmi Tiwari
Joint Director and Head
Centre for One Health
National Centre for Disease Control
Directorate General of Health Services
Ministry of Health and Family Welfare
Government of India

Preface

Kyasanur forest disease (KFD) is a rare but potentially deadly viral disease found primarily in rural areas of India. Kyasanur Forest disease (KFD) is caused by Kyasanur Forest Disease Virus (KFDV), a member of the virus family Flaviviridae. KFD is a febrile disease associated with hemorrhages caused by an arbovirus, flavivirus and transmitted to man by bite of infective TICKS.

KFDV was identified in 1957 when it was isolated from a sick monkey from the Kyasanur forest in Karnataka (formerly Mysore) State, India. Since then, between 400-500 human cases per year have been reported. Hard ticks (*Hemaphysalis spinigera*) are the reservoir of 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.

Humans are adventitious hosts and become infected when they come into contact with infected ticks, which are usually found on cattle or other domestic animals. The virus has also been isolated from domestic animals such as goats, sheep and dogs, suggesting that these may act as reservoirs of infection.

This scientific module aims to equip learners with the knowledge and tools necessary to educate and train individuals involved in various aspects of KFD management. It provides a comprehensive overview of the disease, covering its epidemiology, clinical presentation, laboratory diagnosis, treatment options, and preventive measures.

The module is structured in a user-friendly manner, allowing learners to effectively communicate complex scientific concepts to their audience. It contains detailed explanations to enhance understanding and engagement. The content is supported by the latest scientific research and public health guidelines, ensuring the information presented is accurate and up to date.

It is our sincere hope that this module will serve as a valuable resource for learners and educators, enabling them to grasp essential knowledge and skills. By equipping professionals and individuals at risk with the necessary information, we can enhance our collective ability to detect, prevent, and respond to KFD, thereby safeguarding public health.

It is our sincere hope that this module will serve as a valuable resource for learners and educators, enabling them to grasp essential knowledge and skills. By equipping professionals and individuals at risk with the necessary information, we can enhance our collective ability to detect, prevent, and respond to KFD, thereby safeguarding public health.

We hope you find this module informative, engaging, and ultimately, empowering. Together, let us work towards building a safer and healthier future by combating KFD through knowledge and preparedness.

Abbreviations

AFI	Acute Febrile Illness
ALT	Alanine Aminotransferase
AST	Aspartate Aminotransferase
BHK-21	Baby Hamster Kidney-21 (cell line)
BP	Blood Pressure
BSL	Biosafety Level
CF	Complement Fixation
CO₂	Carbon Dioxide
CRP	C-Reactive Protein
DDT	Dichlorodiphenyltrichloroethane
DNA	Deoxyribonucleic Acid
ELISA	Enzyme-Linked Immunosorbent Assay
ESR	Erythrocyte Sedimentation Rate
GI	Gastrointestinal
IDSP	Integrated Disease Surveillance Program
IEC	Information, Education, and Communication
IgG	Immunoglobulin G
IgM	Immunoglobulin M
IV	Intravenous
KFD	Kyasanur Forest Disease
KFDV	Kyasanur Forest Disease Virus
NCDC	National Centre for Disease Control
NSAID	Non-Steroidal Anti-Inflammatory Drug
NST	Non-Structural Protein
NT	Neutralization Test
OG	Oral Glucose
PPE	Personal Protective Equipment
PRBC	Packed Red Blood Cells
PCR	Polymerase Chain Reaction
prE	Precursor Envelope Protein
prM	Precursor Membrane Protein
RBC	Red Blood Cell
RNA	Ribonucleic Acid
RT-PCR	Reverse Transcription Polymerase Chain Reaction
UK	United Kingdom
USA	United States of America
VDL	Virus Diagnostic Laboratory
WHO	World Health Organization

Table of Contents

Contents	Page no.
Acknowledgement	11
Preface	13
Abbreviations	14
Introduction to Learning Guide for Kyasanur Forest Disease (KFD)	17
Course Description	19
Course Design	19
Evaluation Approach	19
• <i>Pre-Training Quiz</i>	19
• <i>Post-Training Quiz</i>	19
Course Syllabus	20
Course Goals	20
• <i>Participant's Learning Objectives</i>	20
• <i>Participant Selection Criteria</i>	20
• <i>Using the Resource Guide</i>	21
• <i>Composition of participants</i>	21
Course Schedule	21
Course Outline	22
Agenda	23
Session 1: Introduction to KFD	24
Introduction	25
Virus, Vector and Hosts	25
Session 2: Epidemiology of KFD	31
Geographical Distribution of KFD	32
Environmental factors	35
Session 3: KFD in Humans	38
KFD in Humans	39
• <i>Disease Progression</i>	39
• <i>Clinical Features</i>	40
• <i>Case definition</i>	41
• <i>Differential Diagnosis</i>	41
Session 4: KFD in Animals	48
KFD in Animals	49
Session 5: Diagnosis	50
Laboratory techniques for KFD diagnosis	51
• <i>Sample collection and transportation</i>	51
• <i>Sample Storage</i>	51
• <i>Transportation of the sample to the reference laboratory</i>	51
Designated laboratory for KFDV diagnosis	51
Laboratory Diagnosis	52

• <i>Molecular diagnostics</i>	53
• <i>Serological diagnosis</i>	53
• <i>Virus isolation</i>	53
Sampling window	53
Biosafety	54
Session 6: Treatment, Prevention & Control	59
Treatment	60
Prevention and Control measures	61
• <i>Tick Vector Control</i>	61
• <i>Physical control</i>	61
• <i>Chemical Control</i>	61
• <i>Biological control</i>	62
• <i>Targeted application</i>	62
• <i>Area spraying</i>	62
• <i>Personal protection</i>	62
• <i>Avoidance of tick habitats</i>	62
• <i>Protective clothing</i>	63
• <i>Tick Removal</i>	63
• <i>Repellents</i>	63
Stakeholders in KFD Prevention and Treatment	64
Session 7: KFD Surveillance	68
Surveillance	69
• <i>Human Surveillance</i>	69
• <i>Monkey Monitoring</i>	69
• <i>Tick surveillance</i>	69
Active tick surveillance	69
• <i>Dragging and flagging methods</i>	70
• <i>Dry ice baited method</i>	70
• <i>Collection of tick parasitizing live host</i>	71
• <i>Leaf litter sampling method</i>	72
Passive Surveillance	72
Information, education, and communication (IEC)	72
• <i>Do's</i>	72
• <i>Don'ts</i>	73
References	76
Note to Facilitators	77
Pre/Post Training Quiz	81
Answer Key	83

Introduction to Learning Guide for Kyasanur Forest Disease (KFD)

Historically, zoonotic diseases have had a significant impact on human evolution, particularly on cultures and societies that domesticated and raised animals for food and clothing. Zoonoses pose a frequent and feared risk to humanity, transcending natural boundaries and occurring worldwide. Their profound effect on the global economy and health is well recognized, ranging from the international movement of animals and the importation of diseases to bans on animal product imports and restrictions on other international trade practices. Thus, zoonoses are no longer confined to national borders, and global surveillance is necessary for effective control.

Controlling zoonoses remains a priority for international agencies, addressing the specific health and economic challenges of each region. Despite being poorly documented, zoonotic diseases pose a significant public health problem in India. They equally impact animal, human, and environmental sectors, causing substantial damage to the nation's economy. To protect all sectors, it is essential for India to rapidly identify, diagnose, and manage these diseases. The One Health approach plays a crucial role in this endeavor, as we have learned valuable lessons from the COVID-19 pandemic regarding the need for strong surveillance and diagnostic preparedness to handle future pandemic situations.

To provide comprehensive training, the Center for One Health, NCDC has developed learning guide. These guides serve as both trainers' guides and self-directed learning resources. The training focuses on zoonoses and zoonotic diseases of public health importance in India (ZPHI) and emphasizes the One Health approach to responding to zoonotic diseases. By the end of the training, participants should have a solid understanding of the core principles of KFD, its outbreak potential, health emergencies, risk communication, diagnostic procedures, laboratory safety, surveillance, data reporting, and their applications.

The guide is based on national and international guidelines and serve as a comprehensive training resource for individuals involved in zoonotic disease diagnosis and surveillance activities. They provide a deeper insight into the understanding of KFD. The curriculum is designed to enable facilitators and learners to undergo step-by-step learning within a specified time frame, ensuring a thorough understanding of each module.

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The guide consists of a Facilitators' Guide (FG). which provides instructional processes and supports educators in facilitating and assessing learning. Each module follows a standardized structure, including a session outline, detailed session plans, slide decks, and a wide range of references and resources for further reading. These resources offer comprehensive information on the respective topics.

The learning guide aims to provide a comprehensive education for medical professionals including doctors, veterinarians, paramedical staff, and laboratory personnel. It helps them understand, identify, and differentiate between zoonotic diseases and equips them with the necessary knowledge and orientation for diagnostics procedures and surveillance systems.

COURSE DESCRIPTION

Course Design

This comprehensive KFD training resource guide is tailored for medical professionals including doctors, veterinarians, paramedical staff and laboratory personnel. The course is designed to enhance their understanding and expertise in dealing with KFD cases, spanning various aspects of prevention, diagnosis, and treatment. The training approach emphasizes practical application, aiming to equip participants with hands-on skills and competencies that can be directly applied in their professional roles.

Evaluation Approach

The evaluation approach for the KFD preparedness and response training guide includes a comprehensive pre and post-training quiz questionnaire designed to assess participants' knowledge and learning progression. The questionnaire utilizes multiple-choice questions (MCQs) to gauge participants' understanding of KFD-related concepts before and after the training. This approach allows for a clear measurement of knowledge enhancement and provides valuable insights into the effectiveness of the training program.

- ***Pre-Training Quiz:***

Before the training begins, participants will be administered a pre-training questionnaire. This questionnaire serves as a baseline assessment of participants' existing knowledge and awareness of KFD. The pre-training quiz will consist of MCQs that cover various aspects of KFD, including its etiology, modes of transmission, clinical manifestations, prevention measures, and response strategies. The purpose of the pre-training quiz is to establish a starting point and identify areas where participants may require more focused training.

- ***Post-Training Quiz:***

Upon completion of the KFD preparedness and response training guide, participants will be given a post-training quiz questionnaire. This questionnaire will contain a similar set of MCQs as the pre-training quiz, covering the same topics related to KFD. The aim of the post-training quiz is to evaluate participants' knowledge advancement and to measure the effectiveness of the training in enhancing their understanding of KFD-related concepts and procedures.

COURSE SYLLABUS

Course Goals

Foster an in-depth comprehension of KFD and its diverse forms.

- Equip participants with skills for KFD diagnosis, management, and prevention.
- Emphasize the importance of the One Health approach in addressing zoonotic diseases.
- Develop proficiency in risk communication, laboratory safety, and surveillance strategies.

Participant's Learning Objectives

By the course's conclusion, participants will be able to:

- Identify various KFD forms and their clinical characteristics.
- Apply diagnostic and treatment protocols for KFD management.
- Implement preventive strategies and outbreak management tactics.

Participant Selection Criteria

Participants for this KFD response and preparedness training should be professionals from various fields involved in emergency response and public health:

- Emergency Responders: Including public health experts, medical personnel, and first responders.
- Laboratory and Biosafety Staff: Those experienced in handling biohazards.
- Government and Decision-Makers: Officials with authority in emergency coordination.
- Community Leaders and Experts: Community influencers, researchers, and mental health specialists.

Using the Resource Guide

All training activities in this course will be conducted in an interactive, participatory manner using the training guide appropriately as suggested in the course outline in the facilitators' guide. To accomplish this, the trainer will have to change roles throughout the course. For example, the trainer is a facilitator when conducting small group discussions and finally, when objectively assessing performance, the trainer serves as an evaluator.

Composition of participants

The training is intended for 15-20 participants hailing from various state and healthcare fraternities. There can be a single facilitator as an expert of the disease.

COURSE SCHEDULE

Morning Session

Introduce and welcome participants.

- Discuss participant expectations and prior knowledge.
- Outline the objectives of the course and learning outcomes.

Review the course schedule and its components.

- Provide an overview of the training guide materials.
- Conduct a pre-course knowledge assessment to gauge participants' baseline understanding.
- Distribute course materials, including handouts and resources.

Interactive presentations

- Take Sessions 1-4 and discuss in detail about basics of KFD, its epidemiology, bioweapon potential, clinical disease and its significant features in humans and animals.
- Interactive discussion and Q&A session after the lecture

Afternoon Session

Interactive presentations

- Take Sessions 5-10 and discuss in detail about frequently asked questions, diagnosis of KFD, its treatment, prevention & control, outbreak management and surveillance.

Debriefing and group discussions on simulation outcomes

- Interactive discussion and Q&A session after the lecture.

Review, Assessment, and Closing

- Comprehensive review of key concepts covered during the training.
- Interactive quiz to reinforce learning.
- Final assessment to measure participants' understanding of course material.
- Reflection session: Participants share insights and takeaways from the course.
- Closing remarks, thanking participants for their engagement.

COURSE OUTLINE

The course outline presented here follows a model structure for the training curriculum. It delineates the enabling objectives necessary to achieve the participant learning goals outlined in the course syllabus. The outline offers recommendations for suitable learning activities and essential resources and materials for each enabling objective. Depending on specific participant requirements, the trainer has the option to introduce supplementary practice activities, devise case studies, role-play scenarios, or tailor learning situations accordingly.

The course outline comprises four columns:

- **Duration:** This column specifies the estimated time allocated for each learning activity. This allocation ensures an equitable distribution of time across the diverse training components.
- **Learning Objectives:** This column lays out the enabling objectives and their alignment with corresponding learning activities. The objectives are sequenced to provide guidance on the training structure. The interplay of objectives and activities—ranging from icebreakers and interactive group tasks to practical exercises and breaks—constitutes the overall training progression.
- **Pre-requisite Knowledge/Skill:** This column addresses the foundational knowledge or skills that participants should possess prior to the session. It underscores the importance of existing competencies for effective engagement in the training.
- **Competencies to be Achieved:** The fourth column enumerates the competencies participants are expected to acquire by the conclusion of the session. It underscores the practical outcomes that participants will attain through engagement in the training.

AGENDA

S. No	Topic	Duration
1.	Welcome & Introduction of the training setting ground rules	15 mins
2.	Ice Breaker: Talk about yourself. - Contribution to the management & control of Zoonoses - Expectations from the training	30 mins
3.	Training objectives	15 mins
4.	Pre-Test Quiz	15 mins
5.	Session 1: Introduction to KFD	15 mins
6.	Session 2: Epidemiology of KFD	30 mins
7.	Session 3: KFD in Humans	20 mins
8.	Session 4: KFD in Animals	10 mins
9.	Session 5: Diagnosis	20 mins
10.	Session 6: Treatment, Prevention & Control	20 mins
11.	Session 7: Surveillance	20 mins
14.	Post - Test Quiz	15 mins
15.	Q/A session, review, and discussion	15 mins
16.	Closing remarks	05 mins

Session-1

Introduction to KFD

Course No. 001	Session 1: Introduction to KFD
Duration	15 minutes
Learning Objective	• Describe disease overview • Understand causative agent and its characteristics • Vector and hosts
Pre-requisite knowledge/skill	• Basic understanding of viral hemorrhagic fevers and zoonotic diseases • Familiarity with the characteristics of Kyasanur Forest Disease Virus (KFDV), a flavivirus • Knowledge of tick-borne transmission and the role of monkeys and rodents as hosts
Competencies to be achieved	• Learners would gain knowledge of the basic characteristics and features of KFD • Understanding of the characteristics and classification of causative agent

INTRODUCTION

Kyasanur Forest Disease (KFD) is a re-emerging zoonotic disease associated with sudden onset of high-grade fever, prostration, nausea, vomiting, diarrhoea and occasionally neurological & haemorrhagic manifestations. The KFD virus is a member of the genus flavivirus and family Flaviviridae. It is transmitted to humans by bite of infected ticks. This disease was first discovered in 1957 from Kyasanur forest area, Shimoga district of Karnataka derives its name from the forest range where the virus was first isolated.

KFD is also known as **Monkey fever** because of its close association with monkey deaths. **Omsk hemorrhagic fever virus** (Siberia), **Alkhurma hemorrhagic fever virus** (Saudi Arabia) and **Nanjanyin virus** (China) are close relatives of KFD virus.

The zoonotic aspect of KFD emphasizes the importance of One Health approaches, recognizing the interconnections between human, animal, and environmental health. It also underscores the significance of effective surveillance and preventive measures to mitigate outbreaks.

VIRUS, VECTOR AND HOSTS

The **KFD virus** is a typical flavivirus measuring about 40-60 nm in diameter. The genome of KFDV consists of 10,774 nucleotides of single-stranded, positive-sense RNA encoding a single polyprotein that is cleaved post-translationally into three structural (C, prM/M and E) and seven non-structural (NS1, NS2a, NS2b, NS3, NS4a, NS4b and NS5) proteins. The genome of KFDV is very similar (>92% homologous) to that of *Alkhurma Hemorrhagic Fever Virus* which is primarily found in Saudi Arabia. These two species both belong to the family Flaviviridae and diverged over 700 years ago and have thus remained geographically separated.

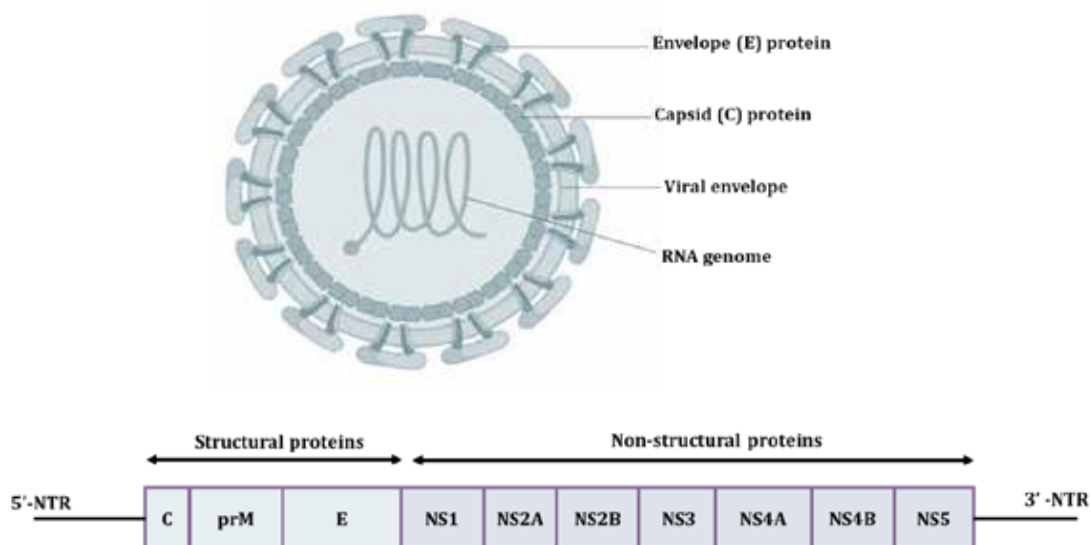


Fig 1: Genome of KFDV

(Image source: Mandary et al; Int. J. Mol. Sci. 2019)

KFDV is primarily transmitted by an **infected tick-bite within primates** (*Presbytis entellus* and *Macaca radiata*) and **other wild reservoirs and accidentally to humans**. Ticks of various genera within Ixodid families such as *Haemaphysalis* spp., *Dermacentor* spp., *Ixodes* spp., and *Rhipicephalus* spp. are widely identified with KDV infections. While *Haemaphysalis spinigera* is the primary vector, apart from that many other species of *Haemaphysalis* spp. were recorded with KFDV in India, which includes *H. turturis*, *H. pauana kinneari*, *H. minuta*, *H. cuspidata*, *H. bispinosa*, *H. kysanurensis*, *H. wellingtoni* and *H. aculeate*. Additionally, some ticks of Argasidae (*Ornithodoros* spp. and *Argas* spp.) have demonstrated successful KFDV acquisition under laboratory conditions.

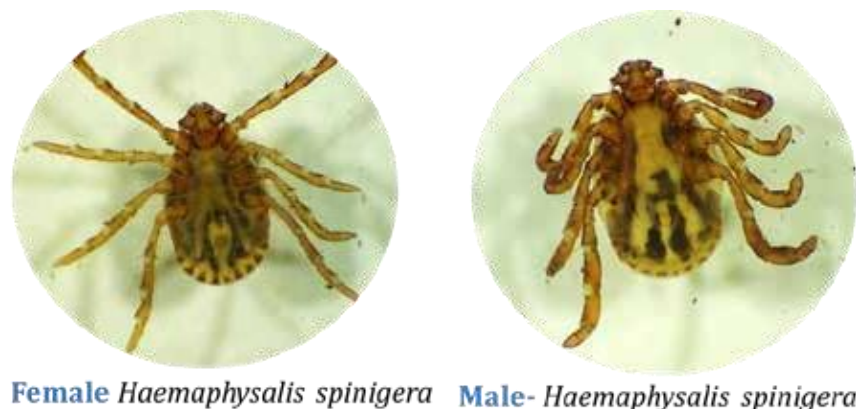


Fig 2: Microscopic picture of female and male *Haemaphysalis spinigera*

(Image source: Kysanur Forest Disease: A compendium of Scientific Literature Prepared by NCDC, New Delhi)

Haemaphysalis species are the ticks of the temperate region, and they act as ectoparasites for more than one animal during their life-cycle. A *Haemaphysalis* tick life cycle involves three life stages (Larvae, Nymph and Adult) and feeds on three different vertebrate hosts, as they require blood-source to either molt into next life-stage or for nourishing their eggs. Ticks usually inject its saliva into the host at the site of bite and virus enters the host along with saliva. Tick bite and attachment while feeding on the host is generally painless and extend for a longer duration (several hours to sometimes days) enhancing their vector potential. *Haemaphysalis* ticks can be infectious only after they acquire an infection during their immature life stage (usually larval stage) and can be infectious through the rest of their life via transstadial transmission. An Ixodid can act as a natural reservoir for KFD due to its longer life span. Nymphs are the more infective life stage of KFD for both primates and humans as their host preferences are poorest during this stage. Compared to adult ticks, the immature are non-specific in host selection and end up frequently feeding on all immediately available living-hosts including humans. Otherwise, humans have no role in the maintenance of virus apart from being an accidental and dead-end host. Usually, a hard-tick detaches from its dead host in search of others to complete feeding the feeding procedure. Therefore, entering the zone closer to infected dead monkey were suspected to be high risk to infected tick bites and KFD infection.

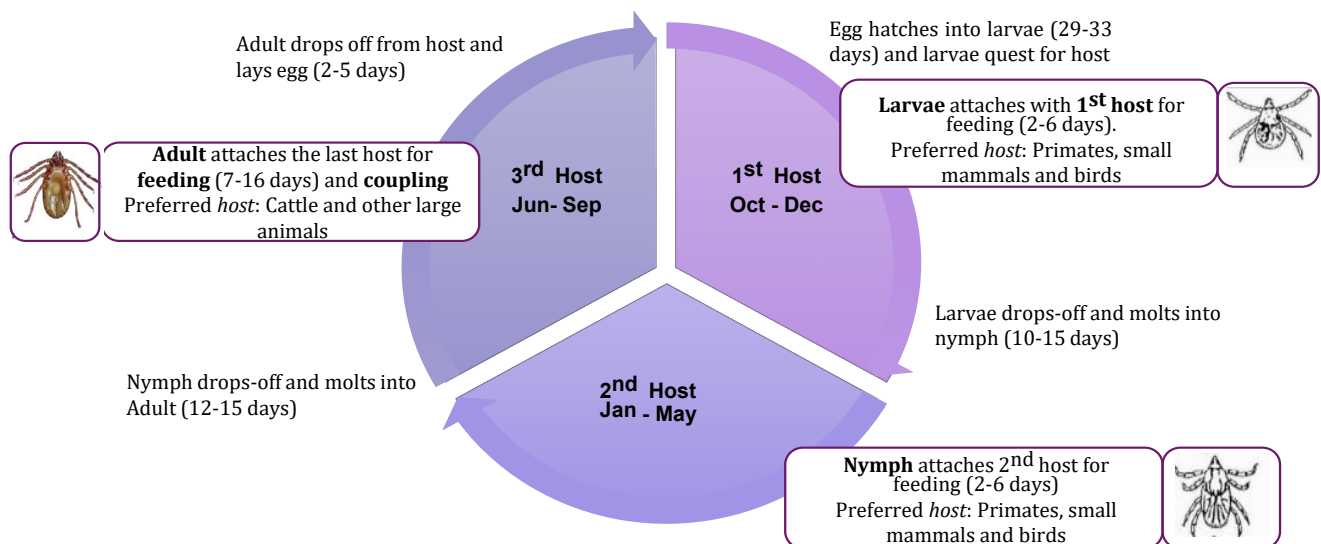


Fig 3: The Life cycle of tick (*Haemaphysalis spinigera*) responsible for the transmission of KFDV to humans

(Image source: Kyasanur Forest Disease: A compendium of Scientific Literature Prepared by NCDC, New Delhi)

Overview

Humans

Agent: KFD virus, SS RNA Flavivirus (Arbovirus)

Vector: Hard Ticks (*Haemaphysalis spinigera*)

Transmission: Bite of infected hard ticks, contact with an infected animal

Symptoms: High fever with frontal headaches, chills, severe muscle pain, vomiting, bleeding, and diarrhea

Diagnostic procedures: Culture, RT-PCR, ELISA (Blood sample)

Treatment & Prevention: Only supportive therapy and clinical management. Prevention by application of repelling agents

Animals

Agent: SS RNA KFD virus (Arbovirus)

Vector: Hard Ticks (*Haemaphysalis spinigera*)

Transmission: Viremic birds, carrying ticks infected with virus spread infection to distant areas.

Symptoms: Diarrhea, Bradycardia & Hypotension, death in **monkeys**. Encephalitis and interstitial pneumonitis, vascular necrosis in **mice**

Diagnostic procedures: Culture, RT-PCR, ELISA (Visceral sample)

Treatment: No specific anti-viral drug therapy for KFD. Only supportive therapy and clinical management.



Source for this Module: NCDC, MoHFW

KYASANUR FOREST DISEASE (KFD)

Introduction



- **Kyasanur forest disease (KFD)**, a tick-borne viral monkey fever.
- First discovered in **1957 in Kyasanur forest area, Shimoga district, Karnataka**, India.
- Both the virus and the disease get their names from "**Kyasanur forest**"
- Also referred to as **monkey fever** due to its association with dead monkeys
- KFD is common in the dry months from **November to May**, with peaks in **February and March**.
- The fatality rate ranges between **3-10%**

Source for this Module: NCDC, MoHFW

KYASANUR FOREST DISEASE (KFD)

Introduction

- Ever since its isolation from dead monkey, monkey deaths were regarded as the initial indication of human infection.
- The first KFD outbreak was mistaken for yellow fever spread by *Aedes Aegypti* mosquito, later corrected by epidemiological research.
- Virus infects man, monkeys, other animals like deer, rats, mice, squirrels, shrews and bats which are infected by ticks.
- During the period 1957-2004, a total of **24721 human cases** and **6475 monkey deaths** were recorded.
- Since 1957, epidemics of KFD occurred every year.
- KFDV can cause epizootics with high fatality in primates.

Source for this Module: NCDC, MoHFW

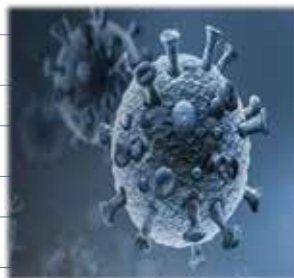
KYASANUR FOREST DISEASE (KFD)

VIRUS, VECTOR & HOST

Member of group B togaviruses, family flaviridae.

Antigenically related to other tick-borne flavivirus

KFD virus has prolonged viraemia in human. (≥ 10 days)

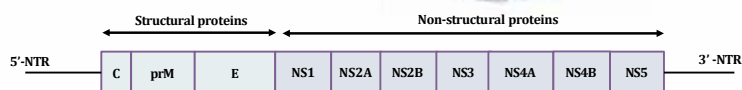
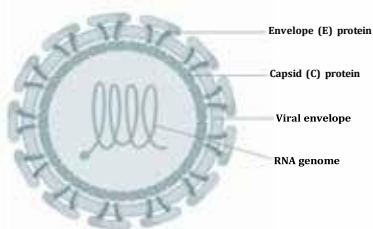


Source for this Module: NCDC, MoHFW

KYASANUR FOREST DISEASE (KFD)

Notes

- The genome of KFDV consists of 10,774 nucleotides of single-stranded, positive-sense RNA encoding:
 - **3 Structural proteins:** Capsid protein (C), Envelope Glycoprotein (pM), Envelope Glycoprotein (E) and
 - **7 non-structural proteins:** NS1, NS2A, NS2B, NS3, NS4A, NS4B, and NS5.
- This RNA virus measures 40-60nm in diameter
- The KFD virus (KFDV) has high sequence similarity with *Alkhurma Hemorrhagic Fever Virus* (AHFV)



Mondrus et al. Int. J. Mol. Sci. 2016,

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KYASANUR FOREST DISEASE (KFD)

- Ticks of various genera belonging to family **Ixodidae** like ***Haemaphysalis spp.***, ***Dermacentor spp.***, ***Ixodes spp.***, and ***Rhipicephalus spp.*** are widely identified with KDV infections.
- ***Haemaphysalis spinigera*** is the primary vector for KfV transmission, apart from many other species of *Haemaphysalis spp* (*H. turturis*, *H. pauana kinnerari*, *H. minuta*, *H. cuspidata*, *H. hispinosa*, *H. kysanurensis*, *H. wellingtoni* and *H. aculeate*)
- In addition, some ticks of family **Argasidae** (*Ornithodoros spp.* and *Argas spp.*) have also been identified as carrier KFDV infection under laboratory conditions.



Female *Haemaphysalis spinigera*



Male- *Haemaphysalis spinigera*

Kusumkar Forest Disease: A cornucopia of Scientific Literature Presented by NCDC, New Delhi

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KYASANUR FOREST DISEASE (KFD)

1st Host
Oct - Dec

Egg hatches into larvae (29-33 days) and larvae quest for host

Larvae attaches with **1st host** for feeding (2-6 days).
Preferred host: Primates, small mammals and birds

Larvae drops-off and molts into nymph (10-15 days)

2nd Host
Jan - May

Nymph attaches 2nd host for feeding (2-6 days)
Preferred host: Primates, small mammals and birds

Nymph drops-off and molts into adult (12-15 days)

3rd Host
Jun- Sep

Adult attaches the last host for feeding (7-16 days) and **coupling**
Preferred host: Cattle and other large animals.

Adult drops off from host and lays egg (2-5 days)

Khasanur Forest Disease A compendium of Scientific Literature Prepared by NCDG, New Delhi

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KYASANUR FOREST DISEASE (KFD)

Natural/Reservoir hosts
Porcupines, rats, squirrels, mice, shrews, sheep, cattle



Amplifying hosts

Red-faced Bonnet (*Macaca radiata*),
Black-faced Hanuman langur (*Semnopithecus entellus*).

Red-faced parrot mol
 3/10/2000 10:00 AM

Black faced Hanuman langoor
(Presbytis entellus)

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KYASANUR FOREST DISEASE (KFD)

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Modes of transmission

- Infected monkeys suffer severe febrile illness.
- **Dead monkeys** become hotspots as ticks drop from them bodies, leading to further spread.

• **Tick-to-Human Transmission:** Humans are infected by the **bite of infected ticks**.

- **Animal-to-Human Transmission:**
- Humans can also acquire the disease by **contact** with an infected animal, such as a **sick or recently dead monkey**.

- **Human-to-Human Transmission:**
- No evidence of transmission between humans in natural settings. Laboratory-acquired infections have occurred in the past during work on the virus.

Source: *for this module, NCDC, MoHFW*

KYASANUR FOREST DISEASE (KFD)

Notes

Session-2

Epidemiology of KFD

Course No. 002	Session 2: Epidemiology of KFD
Duration	30 minutes
Learning Objective	• Understand history and epidemic potential of KFD • Understand geographical distribution of KFD in India
Pre-requisite knowledge/skill	• Basic knowledge of emerging and re-emerging viral infections in India • Familiarity with the epidemiological history of KFD outbreaks • Understanding of endemic zones and ecological factors influencing disease spread
Competencies to be achieved	• Epidemic potential assessment of KFD • Analysis of seasonality and understanding its implications • Assessment of geographical distribution and prevalence of KFD disease

GEOGRAPHICAL DISTRIBUTION OF KFD

Global

KFD cases have not been recorded from any country nation other than India since its discovery in 1957.

India

After the discovery of KFD, it was mainly confined to three taluks (Sagar, Shikaripur and Sorab) of the Shimoga district of Karnataka, until 1972. Thereafter, foci were reported from four additional areas, namely Chikmagalur, Dakshina Kannada, Udipi and Uttar Kanada districts of Karnataka state. For a long time, KFD was thought to be endemic in Shivamogga district. However, serological evidence obtained in the past during different studies, suggests that KFD virus or related viruses are present in other areas of India, which include parts of the Saurashtra region in Gujarat state, forested regions west of Kolkata, West Bengal state, and the Andaman Islands.

Since 1957, the estimated incidence of KFD in India has been 400–500 cases per year. The epidemic period begins in November or December and peaks from January to April, then declines by May and June. Between 2003 and March 2012, there were 3263 reported human cases and, of these, 823 were laboratory confirmed. Large numbers of human infections were reported in 2003–2004, but a significant decline occurred in 2007 and again in 2010–2011. The frequency of cases can be correlated with the number of confirmed KFD-infected nonhuman primates. As far as spread in new areas is concerned, an outbreak of KFD was reported for the first time in December 2012 in Chamarajanagar district of Karnataka. In 2013, KFDV was detected in autopsy of dead monkeys in Nilgiris District, Tamil Nadu and in a human case from Wayanad district, Kerala. In 2014, an outbreak of KFD was confirmed by screening human samples, monkey necropsy samples and tick pools from the Kannangi and Konandur areas in Thirthahalli taluk. Sindhudurg district in Maharashtra has become a public health concern for this tick-borne disease.

Haemaphysalis ticks are the most prevalent host-seeking tick of Western-Ghats region in India and especially highly abundant in the KFD reported areas. Hence there is a high chance of domestic or other local animals to transport the tick to human settlements, which again could elevate the extent of the disease spread. The presence and prevalence of *Haemaphysalis* ticks depend on factors such as climatic and microclimatic conditions, vegetation, and host availability/mobility. The activity of *Haemaphysalis* nymphs is reported highest during the post-monsoon season (November to May), and so most of the human and primate infections occur during this period of a year. Most of the wild vertebrates get ectoparasite infestation as a cluster, which usually composes of different species and stages of ticks or mites. Even if the vertebrate host is uninfected, ticks can acquire an infection during this mass feeding process directly from mouthpart of an infected tick to an uninfected one and the phenomenon is widely known as co-feeding transmission.

The co-feeding transmission is demonstrated in many of the tick-borne viral, bacterial and rickettsial diseases including CCHF.



Fig 4: Map indicating states (colored in orange) in India and the regions (labeled in red) where Kyasanur Forest Disease has been reported.

(Image source: Shah, Syed Z. et al. "Epidemiology, Pathogenesis, and Control of a Tick-Borne Disease- Kyasanur Forest Disease: Current Status and Future Directions.")

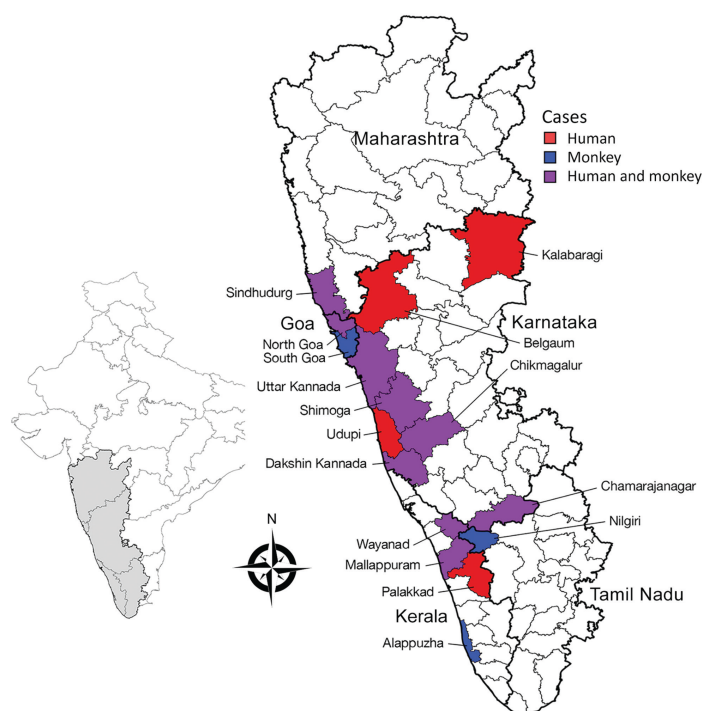


Fig 5: Hotspot areas for human cases and monkey deaths attributable to Kyasanur Forest disease, India, 1957-2020. Inset map shows the region in context of the Indian subcontinent.

(Image source: https://www.researchgate.net/publication/352410085_Retrospective_Study_of_Kyasanur_Forest_Disease_and_Deaths_Among_Nonhuman_Primates_India_1957-2020)

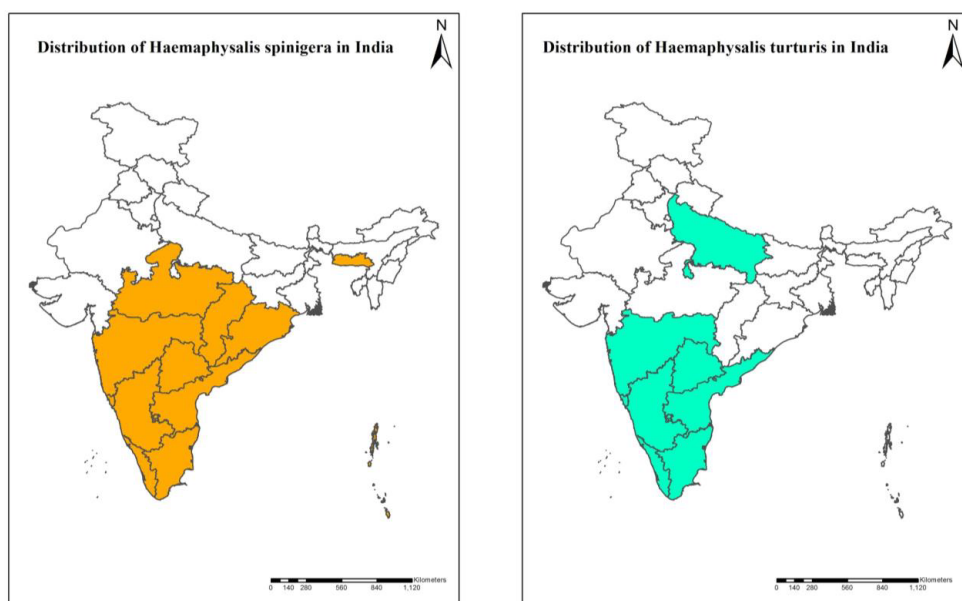


Fig 6: Distribution of *Haemaphysalis spinigera* and *Haemaphysalis turturis* in India

(Image source: Kyasanur Forest Disease: A compendium of Scientific Literature Prepared by NCDC, New Delhi)

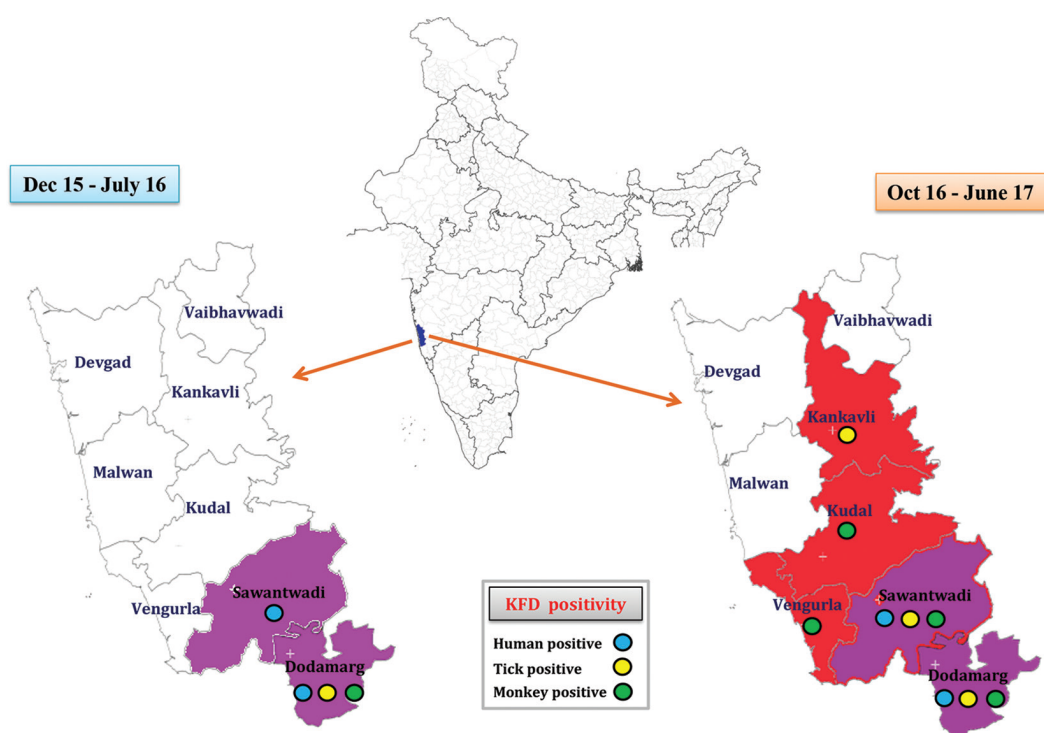


Fig 7: KFDV activity – Sindhudurg, Maharashtra (2015-16 & 2017)

(Image source: Mourya et al, 2018)

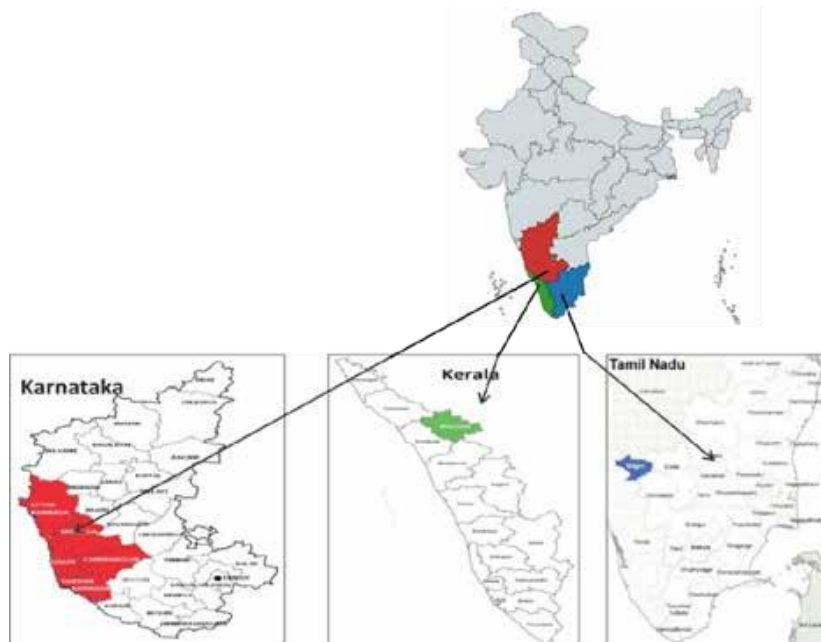


Fig 8: KFD Distribution in Karnataka, Kerala and Tamil Nadu

(Image source: Mourya et al, 2018)

ENVIRONMENTAL FACTORS

KFD shows seasonality, the epidemic period usually begins in November and peaks from January to April, then declines by May and June. The epidemic/outbreaks relate to the activity of nymphs, which is very high during November to May (monsoon rains generally start in May in the region). Adult fed female ticks lay eggs, which hatch to larvae under the leaves. They further infest small mammals and monkeys, as well as accidentally infect humans, and feed on their hosts. Subsequently, they mature to nymphs, and the cycle is repeated. Nymphs and adults also transmit the disease to rodents and rabbits by bite, and this rodent–tick cycle continues for more than one lifecycle.

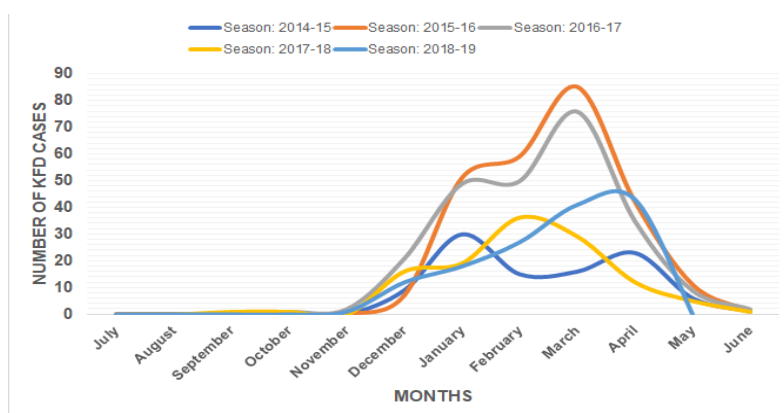


Fig 9: Seasonality of KFD with laboratory confirmed cases detected through AFI Surveillance (2014-19)

(Image source: Kyasanur Forest Disease: A compendium of Scientific Literature Prepared by NCDC, New Delhi)

KFD reported only from India.

Initially, KFD virus was suspected as a **Russian spring-summer (RSS) complex** of viruses.

The viruses which are closely related to KFD are **Omsk hemorrhagic fever virus** in Siberia, **Alkhurma virus** in Saudi Arabia, **Nanjanyin virus** in China, **Powassan virus** in the United States and Russia.



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KYASANIUR FOREST DISEASE (KFD)

- KFDV was first isolated from a sick monkey from the Kyasanur forest in Karnataka State, India in 1957
- **400-500** human cases reported each year since its first identification.
- Expansion of KFD virus to newer and neighboring states (*Tamil Nadu, Kerala, Maharashtra, Gujarat, Goa*) is a major cause for concern.

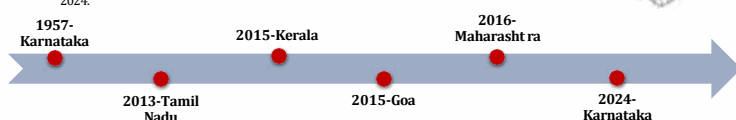


Source: Shah, Soud Z. et al. "Epidemiology, Pathogenesis, and Control of a Tick-Borne Disease, Kyasanur Forest Disease: Current Status and Future Directions."

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KYASANUR FOREST DISEASE (KFD)

- Till 2012, only 5 Karnataka districts (*Shimoga, Chikkamagaluru, Uttara Kannada, Dakshina Kannada, and Udupi*) reported KFD cases.
- Detected in dead monkeys in *Nilgiri district* of Tamil Nadu, 2013.
- Human cases also reported from *Wayanad and Malappuram* districts of Kerala, *Pali village* of Goa and in *Sindhudurg* district of Maharashtra.
- Two fatalities and 49 positive cases reported across Uttara *Kannada, Chikkamagaluru and Shivamogga* Karnataka as of February 9th, 2024.



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KYASANUR FOREST DISEASE (KFD)

Viktoriya Egorovna Dnepova, *A commodification of Scientific Literature*

Contact for the Journal: 301-223-2400; 301-223-2470

KYASANIUR FOREST DISEASE (KFD)

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KFDV activity – Sindhudurg, Maharashtra (2015-16 & 2017)

The map illustrates the distribution of KFDV activity in Sindhudurg, Maharashtra, across two periods. The left side shows the period from Dec 15 to July 16, and the right side shows the period from Oct 16 to June 17. The map includes districts such as Raigad, Talasari, Karandev, Malabar, and Raichur. A legend indicates KFDV positive status for different forest types: Shrubland positive (blue dot), Tidal positive (yellow dot), and Shrubland positive (green dot).

KFDV Distribution Karnataka, Kerala and Tamil Nadu

The figure consists of a main map of India and three inset maps. The main map shows the distribution of KFDV in three states: Karnataka (red), Kerala (green), and Tamil Nadu (blue). Three arrows point from these states to their respective inset maps. The Karnataka inset map shows the state's districts, with KFDV distribution concentrated in the southern districts. The Kerala inset map shows the state's districts, with KFDV distribution concentrated in the southern districts. The Tamil Nadu inset map shows the state's districts, with KFDV distribution concentrated in the southern districts.

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KYASANI/R FOREST DISEASE (KFD)

Seasonality of KFD (2014-19)

Legend: Season: 2014-15 (Blue), Season: 2015-16 (Orange), Season: 2016-17 (Grey), Season: 2017-18 (Yellow), Season: 2018-19 (Dark Blue)

Month	Season: 2014-15	Season: 2015-16	Season: 2016-17	Season: 2017-18	Season: 2018-19
July	0	0	0	0	0
August	0	0	0	0	0
September	0	0	0	0	0
October	0	0	0	0	0
November	0	0	0	0	0
December	5	10	10	10	10
January	15	55	50	25	20
February	25	65	55	35	30
March	35	85	75	40	45
April	25	65	55	20	25
May	5	10	10	5	5
June	0	0	0	0	0

Source for this study: NCDC, Mumbai

KYASANUR FOREST DISEASE (KFD)

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Session-3

KFD in Human

Course No. 003	Session 3: KFD in Human
Duration	20 minutes
Learning Objective	• Describing symptoms, and transmission • Disease Progression • Identification of risk individuals • Case definitions
Pre-requisite knowledge/skill	• Basic understanding of clinical features of viral hemorrhagic fevers. • Familiarity with transmission dynamics of tick-borne diseases. • Knowledge of risk groups and criteria used for defining suspected, probable, and confirmed cases.
Competencies to be achieved	• Enumerate types of KFD disease in humans • Understanding and identifying symptoms • Explaining high risk/zoonotic individuals and the transmission route • Classifying case in humans

KFD IN HUMANS

KFDV is transmitted by an infected tick, especially nymphal stage ticks. The wild monkeys *Semnopithecus entellus* and *Macaca radiata*, gets the disease through the bites of infected ticks. Infection causes severe febrile illness in most monkeys. When infected monkeys die, the ticks drop from their body, thereby generating “**hot spots**” of infectious ticks that further spread the disease. Humans can get the disease from an infected tick bite or by contact with an infected animal such as sick or recently dead monkey. Available epidemiological data does not suggest any human-to-human transmission. However, human cases have been reported in the past while working on this virus in the laboratory.

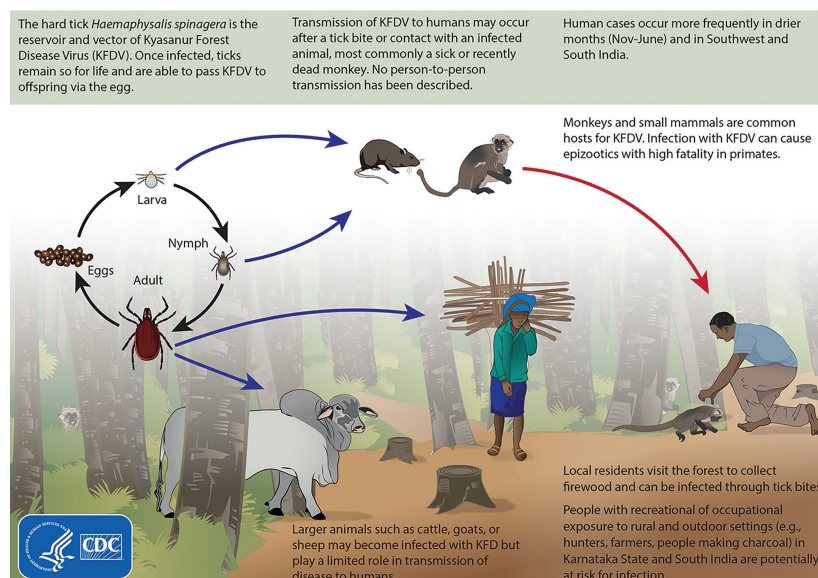


Fig 10: Transmission of Kyasanur Forest Disease Virus (KFDV)

Disease Progression

Disease progression in the early stages of the disease is associated with gastrointestinal symptoms such as vomiting, abdominal pain, and diarrhea. Occasional epistaxis with blood in vomit and feces have also been noted. Dehydration can result in severe dehydration. Decreased cardiac output heart rate (Bradycardia) and a drop-in blood pressure are observed. Lymphadenopathy and hepatomegaly are also observed. Ocular symptoms include photophobia, conjunctivitis, keratitis, iritis, retinal and vitreous hemorrhages, lens opacification haemorrhages on the soft and hard palate, bleeding from the gums and nose. Pulmonary involvement is also sometimes seen with persistent cough and bloody sputum. A small proportion of patients develop coma or bronchopneumonia before death.

By the end of the second week, most patients recover without complications. However, nearly a tenth of patients develop a second phase disease with neurological manifestations such as severe headache, drowsiness, transient disorientation, confusion, rarely convulsions, and loss of consciousness lasting an additional two weeks. The patient is unable to straighten the thighs and ankles. In the convalescence period, survivors experience occasional tremors and physical weakness for up to a month. The mortality rate is approximately 3–5%.

The hypotension in KFD may be of myocardial origin, whereas encephalopathy may be due to a metabolic cause, probably of hepatic origin, and pulmonary symptoms due to interalveolar hemorrhage and secondary infections.

Clinical Features

KFD usually presents with sudden onset of high-grade fever with chills, intense frontal headache, severe myalgia and body aches. Muscle tenderness, photophobia, nausea, vomiting, and diarrhea are usually seen. Respiratory symptoms like persistent cough, may be present in some cases. Temperature may be as high as 104° F/40°C, and last for 5-12 days and there is intense prostration. In few cases hemorrhagic symptoms may occur in early stage in the form of bleeding from the nose, gums and intestines as evidenced by hematemesis or fresh blood in the stools. Some patients have persistent cough, with blood-tinged sputum and occasionally substantial hemoptysis but generally resolve soon. There may be cervical, axillary and epitrochlear lymphadenopathy. A papilo-vesicular lesion in the soft palate is observed as a constant finding in most cases.

In severe cases neurological symptoms like neck stiffness, mental disturbance, coarse tremors, giddiness, and abnormality of reflexes are noted. Un-treated cases rapidly progress to convulsions, coma and death. Few cases show a biphasic picture of illness. The second phase of the illness occurs after the febrile phase, on an average, from day 8 onwards. This phase is initiated by headache, severe prostration progressing to signs and symptoms of central nervous system involvement in very few cases presenting as meningo-encephalitis. Hemorrhagic manifestations can occur in both phases, and severe bleeding from various sites can lead to shock and death. Case fatality is 2-10%. Fatality is higher in the elderly and in patients with co-morbid conditions like - liver diseases (alcoholic) etc. Differential diagnosis: Dengue/DHF, typhoid, malaria, rickettsial infections, leptospirosis and other viral haemorrhagic fevers.

(Ref-<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6206778/#:~:text=The%20clinical%20presentation%20of%20KFD%20is%20usually%20described%20as%20biphasic,and%20lower%20back%20and%20extremities.>)

Case definition

Presumptive case:

A patient of any age presenting with acute onset of high-grade fever with any of the following:

Headache/ Myalgia/ Prostration/ Extreme weakness/ Nausea/ Vomiting/ Diarrhea/ Occasionally neurological/ haemorrhagic manifestations.

Confirmed case:

A presumptive case, which is laboratory-confirmed by any one of the following assays:

- Detection of KFDV-specific viral RNA by reverse transcription polymerase chain reaction (RT-PCR) or real time RT-PCR from blood or tissues.
- Isolation of KFDV in cell culture or in a mouse model, from blood or tissues.
- Positive for immunoglobulin M (IgM) enzyme-linked immunosorbent assay (ELISA) for KFD. (Considered Lab Confirmed for Operational Purposes)

CASE STUDY

A 35 year old forest guard from Shimoga district in Karnataka attends the outpatient department with following complaints.

- Complaints – Fever high grade with chills----- 3 days
- Abdominal Pain -----3 days
- Vomiting 4-5 times -----1 day

Q. Which of the following history will make you suspect KFD?

- A. Patient is staying in a KFD endemic area**
- B. He ate some herbs in the forest
- C. He is having type 1 diabetes mellitus
- D. There was a monkey death in the forest 15 days ago**

Answer – A & D

Explanation:

KFD is a viral infection which is transmitted by tick bite (bite by *Haemaphysalis spinigera*). Travel or stay in endemic area exposes the patient to high risk of developing KFD. Death of a monkey is a sentinel event leading to outbreak of KFD

Q. Which of the following statements regarding transmission of KFD are true

- A. Humans can transmit the disease to other humans
- B. Infected ticks can transmit the virus to both humans and monkeys by bite in nymphal stage**

C. Transmission occurs via consumption of unpasteurized animal milk

D. Seasonality of KFD is due to transstadial transmission

Answer – B & D

Explanation:

Ref: Transmission of KFD by tick bite

Q. The patient is given symptomatic treatment and sent home without any investigations. 3 days later he comes to emergency room with hematemesis, dehydration and shock. What investigations will you send now?

A. Complete blood count to see for leucopenia and thrombocytopenia

B. Liver function tests

C. Coagulation studies

D. IgM and IgG for KFDV by Elisa

E. All of the above

Answer - E

Q. The patient is hospitalized, and reports confirm KFDV with thrombocytopenia. He is hospitalized and treated symptomatically. He recovers and is discharged. He comes again after a week with 10 days with severe headache and convulsions. Which of the following management approaches are correct?

A. A CT scan should be performed for intracranial bleed

B. Repeat testing should be done for KFDV

C. Testing should be done for other viral infections

D. He should be given anticonvulsants for seizure control and observed

Answer – A & D

Explanation:

KFD occurs in 3 phases: First phase patient has fever, diarrhoea and vomiting and severe prostration. Second phase – Fever subsides but patient can develop haemorrhagic and neurological complications. Third Phase – Convalescent phase can occur after few months and patient may develop tremors and generalized weakness

Answer

3 days – KFDV real time RT- PCR

15 days – KFDV real time RT- PCR and Anti KFDV IgM ELISA

30 days – Anti KFDV IgM ELISA and Anti KFDV IgG ELISA

4 months - Anti KFDV IgG ELISA

Explanation:

Ref: KFD testing Algorithm

Differential Diagnosis

In the KFD-endemic area of Karnataka state, India, the differential diagnosis should include consideration of Dengue hemorrhagic, other viral hemorrhagic fever, leptospirosis, influenza, typhoid and rickettsial group of fevers, for example, Q fever and mite-borne typhus in mild cases, and malaria and leptospirosis in moderate to severe cases.

Disease	Key Clinical Differences	Epidemiological Clue	Sample	Tests and Expected Results	Biochemical Tests (Elevations)
KFD (Kyasanur Forest Disease)	Biphasic illness: fever, headache, malaise followed by haemorrhagic fever	Exposure to forested areas or tick bites	Blood serum	RT-PCR: Positive for KFD virus RNA; Serology: Elevated IgM/IgG antibodies	Elevated liver enzymes (ALT, AST), elevated CRP, ESR
Q Fever/Mite-Borne Typhus	Mild systemic symptoms: fever, headache, malaise	Exposure to livestock or tick bites	Blood	Serology: Elevated IgM/IgG antibodies for <i>Coxiella burnetii</i>	Elevated CRP, possible mild elevation in liver enzymes (ALT/AST)
Influenza	Respiratory symptoms: fever, cough, sore throat	Seasonal outbreaks; close contact	Nasopharyngeal swab	RT-PCR: Positive for Influenza RNA; Rapid antigen: Positive	Mildly elevated CRP; no significant liver or kidney abnormalities
Leptospirosis	Muscle pain with conjunctival suffusion	Exposure to contaminated water/animals	Blood, urine	Serology: Positive IgM for <i>Leptospira</i> . PCR: Positive DNA	Elevated liver enzymes (ALT, AST), elevated bilirubin, elevated CRP, creatinine (if renal involvement)
Malaria	Cyclical fever with chills and sweating	Travel to endemic areas; mosquito bites	Blood	Blood smear: Parasites in RBCs; Rapid diagnostic test	Elevated CRP, ESR, liver enzymes (ALT, AST), mild anemia
Typhoid	Gastrointestinal symptoms: sustained fever, abdominal pain	History of contaminated food/water	Blood, stool	Blood culture: <i>Salmonella</i> Typhi; Widal test: Positive	Blood culture: <i>Salmonella</i> Typhi; Widal test: Positive

Transmission

Infected tick (*Haemaphysalis spinigera*) bite in nymphal stage transmits the virus to humans and monkeys

Nymphs are anthropophilic (preferring human beings than other animals)

Humans can also get the disease by contact with an infected animal.

No transmission from human to other hosts

Rare chances of transmission from other animals such as goats, cows, and sheep

Transmission via the consumption of unpasteurized animal milk is also very

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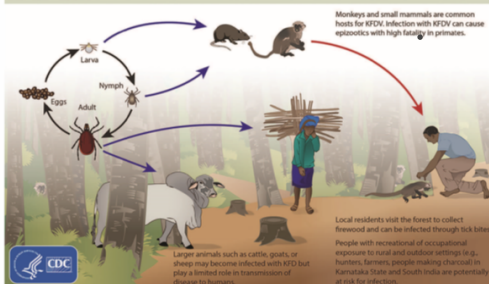
KYASANUR FOREST DISEASE (KFD)

Transmission (Vector - host)

The hard tick *Haemaphysalis spinigera* is the vector and vector of Kyasanur Forest Disease Virus (KFDV). Once infected, ticks remain so for life and are able to pass KFDV to offspring via the eggs.

Transmission of KFDV to humans may occur after a tick bite or contact with an infected animal, most commonly a sick or recently dead monkey. No person-to-person transmission has been described.

Human cases occur more frequently in drier months (Nov-June) and in Southwest and South India.



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KYASANUR FOREST DISEASE (KFD)

Symptoms



High fever with frontal headaches



Chills



Vomiting



Severe muscle pain



Gastrointestinal symptoms



Bleeding

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KYASANUR FOREST DISEASE (KFD)

Disease Progression



First Phase
7-12 days post incubation period

Sudden onset of continuous high-grade fever, diarrhea, vomiting, severe prostration, myalgia, and headache.



Second Phase (Occurs in a subset of 10 to 20% of the cases)
2-12 days after an afebrile period of 1-2 weeks

Severe headache, drowsiness, transient disorientation, confusion, Meningeal signs, altered sensorium, seizures, bleeding manifestations



Convalescent period
Few months after 2nd phase

occasional tremors, body weakness

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KYASANUR FOREST DISEASE (KFD)

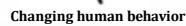
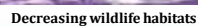
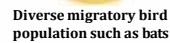
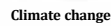
Notes

The spill-over of this zoonotic disease happens at the crossroads of the animal-human interaction, especially in villages adjoining forest areas and inter-state borders



KYASANUR FOREST DISEASE (KFD)

Population densities



Grants for the Month: \$220,000

KYASANUR FOREST DISEASE (KFD)

Grades for this Month: 100% (100%)

KYASANUR FOREST DISEASE (KFD)

Explanation:
KFD is a viral infection which is transmitted by tick bite (bite by *Haemaphysalis Spinigera*). Travel or stay in endemic area exposes the patient to high risk of developing KFD. Death of a monkey is a sentinel event leading to outbreak of KFD

Center for Drug Modeling, NCI/NCI, Bethesda

KYASANIUR FOREST DISEASE (KFD)

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Which of the following statements regarding transmission of KFD are true?

- A. Humans can transmit the disease to other humans
- B. Infected ticks can transmit the virus to both humans and monkeys by bite in nymphal stage
- C. Transmission occurs via consumption of unpasteurized animal milk
- D. Seasonality of KFD is due to transstadial transmission

Answer – B & D

Explanation:

- Ref: Transmission of KFD by tick bite

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KYASANUR FOREST DISEASE (KFD)

The patient is given symptomatic treatment and sent home without any investigations. 3 days later he comes to emergency room with hematemesis, dehydration and shock.

What investigations will you send now?

- A) Complete blood count to see for leucopenia and thrombocytopenia
- B) Liver function tests
- C) Coagulation studies
- D) IgM and IgG for KFDV by Elisa
- E) **All of the above**



Answer - E

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KYASANUR FOREST DISEASE (KFD)

The patient is hospitalized, and reports confirm KFDV with thrombocytopenia. He is hospitalized and treated symptomatically. He recovers and is discharged. He comes again after a week with 10 days with severe headache and convulsions.

Which of the following management approaches are correct?

- A. A CT scan should be performed for intracranial bleed
- B. Repeat testing should be done for KFDV
- C. Testing should be done for other viral infections
- D. He should be given anticonvulsants for seizure control and observed

Answer – A & D

Explanation:

KFD occurs in 3 phases:

1. **First phase** - patient has fever, diarrhoea and vomiting and severe prostration.
2. **Second phase** - Fever subsides but patient can develop haemorrhagic and neurological complications.
3. **Third Phase** - Convalescent phase can occur after few months and patient may develop tremors and generalized weakness

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KYASANUR FOREST DISEASE (KFD)

What tests will you do for KFDV in patients who present with symptom duration of 3 days, 15 days, 30 days and 4 months after recovery?

Answer

- A. 3 days – KFDV real time RT- PCR
- B. 15 days – KFDV real time RT- PCR and Anti KFDV IgM ELISA
- C. 30 days – Anti KFDV IgM ELISA and Anti KFDV IgG ELISA
- D. 4 months - Anti KFDV IgG ELISA

Explanation:

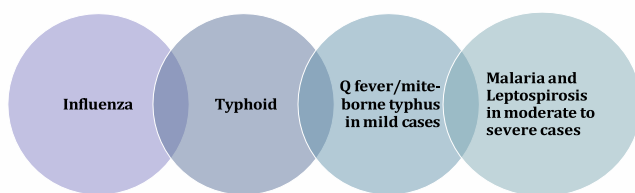
Ref: KFD testing Algorithm



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KYASANUR FOREST DISEASE (KFD)

Differential diagnosis



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KYASANUR FOREST DISEASE (KFD)

Notes

Differential Diagnosis

Disease	Key Clinical Differences	Epidemiological Clue	Sample	Tests and Expected Results	Biochemical Tests (Elevations)
KFD	Biphasic illness: fever, headache, malaise followed by hemorrhagic fever	Exposure to forested areas or tick bites	Blood serum	RT-PCR: Positive for KFD virus RNA; Serology: Elevated IgM/IgG antibodies	Elevated liver enzymes (ALT, AST), elevated CRP, ESR
Q Fever/Mite-Borne Typhus	Mild systemic symptoms: fever, headache, malaise	Exposure to livestock or tick bites	Blood	Serology: Elevated IgM/IgG antibodies for Coxiella burnetii	Elevated CRP, possible mild elevation in liver enzymes (ALT/AST)
Influenza	Respiratory symptoms: fever, cough, sore throat	Seasonal outbreaks; close contact	Nasopharyngeal swab	RT-PCR: Positive for Influenza RNA; Rapid antigen: Positive	Mildly elevated CRP; no significant liver or kidney abnormalities
Leptospirosis	Muscle pain with conjunctival suffusion	Exposure to contaminated water/animals	Blood, urine	Serology: Positive IgM for Leptospira; PCR: Positive DNA	Elevated liver enzymes (ALT, AST), elevated bilirubin, elevated CRP, creatinine (if renal involvement)
Malaria	Cyclical fever with chills and sweating	Travel to endemic areas; mosquito bites	Blood	Blood smear: Parasites in RBCs; Rapid diagnostic test	Elevated CRP, ESR, liver enzymes (ALT, AST), mild anemia
Typhoid	Gastrointestinal symptoms: sustained fever, abdominal pain	History of contaminated food/water	Blood, stool	Blood culture: Salmonella Typhi; Widal test: Positive	Elevated liver enzymes (ALT, AST), elevated CRP, bilirubin, possible mild anemia

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KYASANUR FOREST DISEASE (KFD)

Comparing KFD virus infection with other diseases prevalent in India:

Category	Q Fever	Influenza	Leptospirosis	Malaria	Typhoid
Vector	Coxiella burnetii bacteria (spread by ticks)	Influenza virus (spread through droplets)	Leptospira bacteria (spread through contaminated water or soil)	Anopheles mosquitoes	Salmonella Typhi bacteria (spread through contaminated food or water)
Symptoms	Fever, chills, headache, muscle aches, pneumonia	Fever, cough, sore throat, aches, fatigue	Fever, headache, muscle aches, vomiting, diarrhea, jaundice	Fever, chills, sweating, headache	Fever, headache, abdominal pain, constipation or diarrhea
Pregnancy	Possible miscarriage, neonatal death	Increased risk of complications for pregnant women	Possible miscarriage, premature birth	Increased risk of complications for pregnant women	Possible miscarriage, premature birth
Geographic	Worldwide, including India	Worldwide, including India	Worldwide, including India	Widespread in India, particularly rural areas	Worldwide, including India
Diagnosis	Blood test for antibodies	Nasal swab, rapid influenza diagnostic test	Urine test, blood test	Blood smear	Blood test, stool culture
Prevention	Tick bite prevention, pasteurization of milk	Vaccination, hand hygiene	Avoiding contact with contaminated water, wearing protective gear	Mosquito nets, prophylactic medication	Vaccination, proper food and water hygiene
Treatment	Antibiotics	Antiviral medications for severe cases	Antibiotics	Antimalarial medications	Antibiotics

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KYASANUR FOREST DISEASE (KFD)

Session-4

KFD in Animals

Course No. 004	Session 4: KFD in Animals
Duration	10 minutes
Learning Objective	• Describe clinical signs and symptoms • Understand disease transmission in animals
Pre-requisite knowledge/skill	• Basic knowledge of zoonotic viral infections affecting wildlife and livestock • Familiarity with clinical manifestations of tick-borne illnesses in animals • Understanding of transmission cycles involving animals, ticks, and humans
Competencies to be achieved	• Capability to explain the signs and symptoms in different animals

KFD IN ANIMALS

Clinically monkey reported to develop anemia, hypotension, thrombocytopenia, diarrhea, leukopenia and encephalitis. Hematological changes include abnormally low lymphocytes level and anemia. Histopathological changes are noticed in GI tract and lymphoid organs. Alterations in the fatty deposition in the liver, resulting in depletion of lymphocytes along with occasional necrosis of lymphoid organs, as well as the loss of GI tract architecture without any evidence of neurologic involvement. Among various KFDV-infected macaques, peripheral and visceral lymph nodes, spleens, and all mucosal lymphoid tissues showed moderate to severe follicular involution in addition to a variable degree of depletion of lymphocytes within the T-cell- dependent zones. A mucosal erosion leading to a reduced surface area of the luminal epithelium in the stomach and large intestine in addition to villus blunting and ultimately fusion in the small intestine.

In case of mice, no gross lesions seen in major organs. Encephalitis and interstitial pneumonitis are significant changes in mice pathogenicity. Histopathological finding in the brain showed vascular necrosis with lymphocyte infiltration in vessel walls. Spongiform lesions in vessel walls and vascular lesions progressed along with sickness with the onset of paralysis. Necrosis of neurons followed by the complete disappearance of neuron cells. Hemorrhages seen in lungs alveoli. The liver of mice does not show any inclusion such as observed in monkeys.

Recently, studies have reported that severe dehydration resulting in polydipsia has been observed among sick monkeys which make them move towards the nearby water source.

Cattle play a significant role in maintaining the tick population.

Clinical Manifestations

 Monkeys	➤ Anemia, hypotension, thrombocytopenia, diarrhea, leukopenia and encephalitis. ➤ Depletion of lymphocytes, necrosis of lymphoid organs, severe dehydration resulting in polydipsia
 Macaques	➤ Moderate to severe follicular involution in peripheral and visceral lymph nodes, spleens, and all mucosal lymphoid tissues. ➤ Depletion of lymphocytes, Mucosal erosion
 Mice	➤ Encephalitis and interstitial pneumonitis, vascular necrosis with lymphocyte infiltration in vessel walls. ➤ Spongiform lesions in vessel walls and vascular lesions, Necrosis of neurons. ➤ Hemorrhages in lungs alveoli

Cattle have a significant role in maintaining the tick population

Centre for One Health, NCDC, MoHFW

KYASANUR FOREST DISEASE (KFD)

Notes

Session-5

Diagnosis

Course No. 005	Session 5: Diagnosis
Duration	20 minutes
Learning Objectives	• Describe sampling, transport and storage of specimens • Knowledge about referral laboratories in India • Laboratory • Techniques to identify the pathogen • Biosafety
Pre-requisite knowledge/skill	• Basic understanding of specimen collection, storage, and transport procedures • Familiarity with diagnostic techniques such as RT-PCR and ELISA for viral detection • Knowledge of biosafety practices and referral laboratory networks in India
Competencies to be achieved	• Understanding materials to be needed for sampling • Describe PPE kit and triple packaging system • Explain various presumptive and confirmatory tests • Capability to describe referral laboratories in India

LABORATORY TECHNIQUES FOR KFD DIAGNOSIS

Sample collection and transportation

Collection of serum from suspected patients: Collect 4-5 ml blood in a plain vial. Separate the serum following standard biosafety precautions. Paired sera sample can be used for serological examination.

Collection of monkey viscera: Collect Brain, Lungs, Heart, Liver and Kidney specimens from the dead monkey following standard biosafety precautions. Involve veterinarians- for collection of samples and Carcass disposal by forest department.

Tick Pool Sample: In a study area of 5-km aerial radius (minimum 10 pools) or in hotspot (2-5 pool), ticks must be collected by adopting different collection methods. Refrigerate them. Segregate species wise and put in a sterile polypropylene vial (note: don't add any preservatives). Label the vial with date and time of collection, address of area where tick is collected. Seal the vial tightly using parafilm/ cellophane tape. Then follow the above guidelines for storage, packing and transportation. Tick pools are to be sent to laboratory along with 'Lab Request form.

Sample Storage

Keep serum of human cases and viscera of monkey's tick samples refrigerated (2-80C) if it is to be processed (or sent to a reference laboratory) within 8 hours. Keep frozen (-200C to - 100C), if it is to be processed after a week. The sample can be preserved for extended periods.

Transportation of the sample to the reference laboratory

Always use triple-layer packaging and should be shipped immediately or ship within 48 hours of collection under cold chain (dry ice or at least with cooling gels). The original samples should be packed, labelled, and marked. Always include the completely filled out clinical and epidemiological record.

DESIGNATED LABORATORY FOR KFDV DIAGNOSIS

The designated laboratory for diagnosis and isolation of KFDV in humans, monkey necropsy samples, and ticks' sample.

1. National Institute of Virology (NIV)
Microbial Containment Complex, 130/1 Sus Road. Pashan, India,
Pune-411021. Tel.No: 91-020-26006390

2. Virus Diagnostic Laboratory (VDL)
Opp. Scout Bhawan, B H Road, Shivamogga, Karnataka, India.
Tel: +91-0812-222050
Email ddvdlsmsg@gmail.com.

The samples for diagnosis of the disease in suspected human cases can be sent to the above-mentioned designated laboratories.

Proper PPE is essential to prevent exposure. Wear gloves, masks, gowns, and eye protection while handling potentially infected materials. Adhering to PPE donning and doffing guidelines ensures safety for both laboratory workers and the environment. Appropriate disposal of the used PPE is important.

LABORATORY DIAGNOSIS

Methods of laboratory diagnosis of KFDV currently include real-time RT-PCR assay, nested RT-PCR assay, anti-KFD IgM and anti-KFD IgG ELISA. Currently none of the diagnostic tests are commercially available.

Testing Algorithm

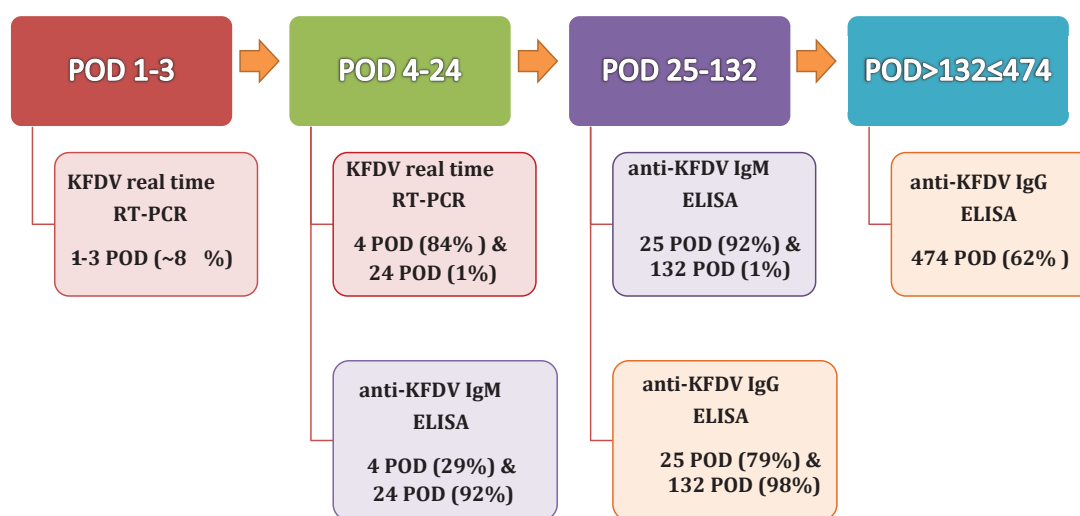


Fig 11: Algorithm for accurate KFD laboratory diagnosis

(Source: Indian J Med Res. 2019 Aug; 150(2): 186–193.)

The figure shows the recommend test accordance with the POD for KFD-affected patients. Rectangles depicts the POD range and numbers in the parenthesis indicate the probability of percentage positivity. KFDV, Kyasanur forest disease virus; POD, post-onset day; ELISA, enzyme-linked immunosorbent assay; RT-PCR, Reverse transcriptase polymerase chain reaction.

Molecular diagnostics

RTPCR and real-time PCR enable very rapid and accurate diagnosis and represent the first line of testing for the diagnosis of KFD. The RTPCR reactions are highly specific and sensitive compared to other conventional methods. Mourya et al. (2012) developed an embedded RTPCR, a real-time RTPCR for rapid detection of KFD during the acute phase of infection. The flavivirus-specific NS5 region was chosen for primer design. The present real-time test is very sensitive, almost as sensitive as detecting up to 10 copies of viral RNA.

Serological diagnosis

KFDV antibodies have been detected in humans and animals in many states of India, particularly in southwestern states such as Gujarat and Maharashtra, and also in West Bengal and in the Andaman and Nicobar Islands. KFD IgM, antibodies can be detected from the 5th day after the onset of symptoms up to 3 months. In-house KFDV IgM and IgG tests are currently available at the National Institute of Virology, Pune, and the Centre for Disease Control and Prevention, USA.

Virus isolation

Virus isolation of KFDV can be performed in BHK-21, Vero E6 cell lines, embryonated chicken cells or in mice. In BHK-21, KFDV produces a characteristic cytopathic effect. Intracerebral inoculation of the virus in 3-day-old mice results in death in all. Similar results were obtained after intraperitoneal inoculation in 50-day-old mice. Mice (3 days old) are strongly recommended for virus isolation. Virus isolation from KFDV positive specimens should be performed in the BSL-3 laboratory.

SAMPLING WINDOW

Time Frame	Sample	Diagnostic Tests
Day 1-3 (Acute Phase)	Blood, Serum, Plasma	RT-PCR (for KFD virus detection in blood or plasma)
Day 4-24 (Transition Phase)	Blood	RT-PCR and IgM ELISA (detects antibodies against KFD virus, indicating recent infection)
Day 25-132 (Recovery Phase)	Blood	IgM and IgG ELISA (for past infection or convalescence)
Day 132 <=474	Blood, Serum	IgG ELISA
Post Mortem (if needed)	Tissue samples (e.g., brain, liver)	RT-PCR (for detecting KFD virus in tissue samples), Histopathology (detects viral inclusions)

Biosafety

In the UK and US, KFD virus is a class 4 pathogen. However, for ELISA and sensitive one-step RT-PCR assay to detect KFD virus RNA, it can be readily used in any BSL-2 laboratory along with biosafety precautions for screening suspected KFD cases be used. In the absence of a Biosafety level 3 and Biosafety Level 4 facility in smaller laboratories, detection of KFD virus RNA can be performed after inactivation of the patient/monkey/tick sample with phenol or its variants such as Trizol. Virus isolation and traditional serological techniques such as neutralization testing and hemagglutination can generate aerosols and should therefore be performed in safer laboratories.

Appropriate PPE, waste disposal and disinfectants

Swabs, transport medium, suitable collection tools and containers

Marker pens or barcodes

Absorbent material, plastic bag, sturdy outer container, racks, cooler box, thermometer

Regular schedule and method to move the samples to the laboratory, personnel trained in sample handling

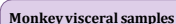
BSL 3 or 4 (Virus isolation), BSL 2 (RT-PCR)

Order for this Month: 10000, 100000

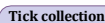
KYASANUR FOREST DISEASE (KFD)

Human Blood samples

1. Collect 4-5 ml blood in a plain vial.
2. Separate the serum following standard biosafety precautions.
3. Paired sera sample can be used for serological examination



Monkey visceral samples
Collect Brain, Lungs, Heart, Liver and Kidney specimens from the dead monkey following standard biosafety precautions



Collect nymph tick in a air-tight sterilized polypropylene container. Seal the containers in plastic bags to prevent spread/leakage of tick during transportation

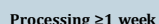
- Proper collection of specimen is the most important step in laboratory diagnosis of infectious diseases.
- Improper sample collection may lead to false negative test results.

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KYASANIIR FOREST DISEASE (KFD)

Immediate testing

Once collected, the samples should be immediately sent to the laboratory for testing.



Samples should be stored under frozen conditions (-20°C to 80 °C), if processing takes ≥ 1 weeks time

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KYASANIUR FOREST DISEASE (KFD)

1. Place absorbent material and the plastic vials holding the serum inside bag 1, and seal it

- 2.** Place the sealed plastic bag into the shipping canister. Place a biohazard label on the outer surface of the shipping container. Line a plastic screw-top canister (shipping canister) with absorbent sheets. In case of spill use enough absorbent material to absorb the entire contents of the plastic vials, should there be a leak or spill.



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KYASANUR FOREST DISEASE (KFD)

[illegible]

Packaging and Transportation

- Place dry ice into a polystyrene foam-lined box (the overpack). Place the shipping canister into the overpack
- Place an itemized list of contents inside a second sealable plastic bag (bag 2). Seal bag 2 and place it inside the overpack.



Polystyrene foam-lined box with dry ice



Bag 2



Overpack

- Label the package properly as "**Biohazardous material**" on the outside. Name, address & contact no. of person responsible for shipment should be clearly mentioned on the package. This person must be knowledgeable about the shipment and know how to remediate in case of spill or leakage.

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KYASANUR FOREST DISEASE (KFD)

Notes

Referral Laboratories

National Institute of Virology, Pune



Viral diagnostic lab, (VDL), Karnataka



Manipal Institute of Virology, Karnataka



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KYASANUR FOREST DISEASE (KFD)

Recommended PPE for specimen collection



Long-sleeved isolation gown that extends from neck to knees and entirely covers upper body



N95 respirator that is secured properly and fits your face



Head coverings, shoe covers or dedicated shoes



Eye protection (e.g. goggles or disposable full-face shield) that can be adjusted to fits face



Clean non-sterile disposable gloves that cover the wrist area of isolation gown

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KYASANUR FOREST DISEASE (KFD)

Laboratory Investigations

KFD is diagnosed using assays such as Real-time RT-PCR, nested RT-PCR, and ELISA.



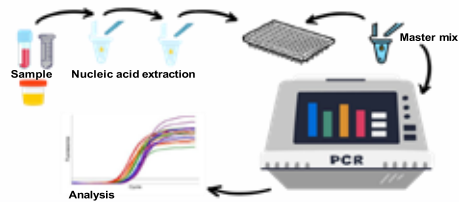
No commercial diagnostic tests available for KFD as of now

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KYASANUR FOREST DISEASE (KFD)

RT-PCR/Real Time-PCR

- RT-PCR/Real Time- PCR is rapid, accurate and the first line of diagnostic test method for KFD
- Molecular diagnostics provide rapid detection of KFD during acute phase of infection
- Flavivirus specific **NS-5** region is targeted for designing of primer
- The real-time PCR can detect as few as 10 copies of KFD viral RNA in a patient sample.
- Viremia levels peaks 3-6 days after the onset of illness and remains high up to 2 weeks

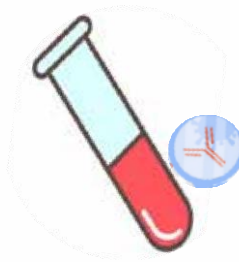


Order for the Month: 10/20/2019

KYASANUR FOREST DISEASE (KFD)

Serology

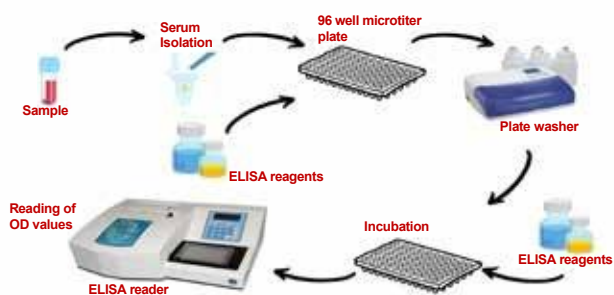
- KFD IgM and IgG antibodies are determined by enzyme-linked immunosorbent assay (ELISA).
- Antibody detection can be carried out from 5th day of onset of symptoms till 3 months.
- Currently in house KFDV IgM and IgG test is available with National institute of virology, Pune.
- Some other antibody based detection methods include:
 - hemagglutination inhibition (HI),
 - complement fixation (CF) and
 - neutralization test (NT)



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KYASANUR FOREST DISEASE (KFD)

Step wise procedure for ELISA



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KYASANUR FOREST DISEASE (KFD)

Virus isolation

- KFDV can be isolated from the blood of patients (in acute phase 2-5 days), positive tick pools, or from the blood/viscera of monkeys
- BHK 21, Vero E6 cell lines, embryonic chick cells can be used for virus isolation



Mourya et al. 2014

Center for One Health, NCI, NIH

KYASANUR FOREST DISEASE (KFD)

Notes

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Session-6

Treatment, Prevention & Control

Course No. 006	Session 6: Treatment, Prevention & Control
Duration	20 minutes
Learning Objectives	• Describe standard treatment options in humans • Understand guidelines for effective KFD control program • Describe preventive measures for personal protection • Describe disinfection procedures • Describe current vaccines available
Pre-requisite knowledge/skill	• Basic understanding of antiviral and supportive treatment approaches for viral infections. • Familiarity with public health guidelines for managing vector-borne diseases. • Knowledge of available vaccines, personal protective measures, and disinfection protocols.
Competencies to be achieved	• Thorough understanding of preventive measures to adopt for at-risk individuals • Ability to describe various disinfection options • Knowledge about available vaccines for humans

TREATMENT

There is no specific treatment for KFD, but early hospitalization and supportive care are important. Supportive therapy includes maintenance of fluid intake and usual precautions for patients with bleeding disorders. However, as patients clinical parameters change during the course of the illness, they require monitoring. Patients, whether hospitalized or not, are required to be monitored daily for vital signs and general conditions. Their complete blood picture should be repeated at least on alternate days to monitor for worsening thrombocytopenia, until it shows improving trend.

Symptomatic Treatment Recommended for KFD

Sr. No.	Symptoms	Treatment	Preferred medication/line of treatment
1.	Fever, headache, severe myalgia, malaise	Anti-pyretic and analgesics	T. Paracetamol (0.5 –1g every 4 –6 hourly, max 4g daily) till symptoms abate. Dosage adjusted as per weight and age. T. Tramadol 50 mg every 8 hourly.
2.	Nausea and vomiting	Anti-emetics	Metoclopramide (Perinorm) 5–10 mg IV, T. Domperidone 10 mg tid half an hour before meals, Inj. Ondansetron 8 mg IV bd.
		H2 receptor blockers/ Proton pump inhibitors	T. Ranitidine 150 mg bd or T. Pantoprazole 40 mg od (may be given IV).
		IV Fluids	IV fluids if patient has postural/dehydration and cannot take orally.
3.	Secondary infections	Antibiotics	Broad-spectrum antibiotics such as Inj. Ceftriaxone 1g IV bd / other antibiotic as per local antibiogram (if superadded bacterial infection is suspected).
4.	Haemorrhagic diathesis	Haemostatic agents	a. Vitamin-K, 10mg/day subcutaneously for 3 days. b. T. Tranexamic acid 500mg tid.
		PRBC transfusion*	If Hb< 8g/dl.
		Platelet transfusion*	If thrombocytopenia <20,000 cells/mm ³ or if platelet <50,000 cells/mm ³ + bleeding.
		Fresh frozen plasma	If abnormal coagulopathy with bleeding.
5.	Altered sensorium, irritability, coarse tremors, abnormal reflexes, neck stiffness	-	Mannitol 20% – 8 hourly for 3 days followed by oral Glycerol 30ml TDS for 3 days—if symptoms persist. Age-wise dosage as per body weight recommended.
6.	Electrolyte imbalance/ hyponatremia and acidosis	IV fluids	Sodium chloride / Soda bi-carb, depending on the degree of dehydration, metabolic acidosis, and general condition of the patient.
7.	Fluid refractory hypotension/ shock	Vasopressors	Norepinephrine – 0.2 to 1.5 µg/kg/min. If required, add vasopressin (up to 0.03 U/min) or epinephrine.

The following should not be done:

Sr. No.	Don'ts
1.	Administering NSAIDS
2.	Administering steroids (Except in fluid refractory septic shock: Inj. Hydrocortisone 50 mg IV 6th hourly)
3.	Administering nephrotoxic drugs (like Diclofenac, Gentamicin)
4.	Administering nephrotoxic drugs (like Diclofenac, Gentamicin)

Administering nephrotoxic drugs (like Diclofenac, Gentamicin)

Sr. No.	Indicators
1.	Systolic BP < 90 mm Hg
2.	Heart rate > 100 beats/min or irregular pulse
3.	Respiratory rate > 24 breaths/min
4.	Altered sensorium
5.	Bleeding manifestations
6.	Decreased urine output
7.	Jaundice
8.	Severe dehydration

REFERENCE- Operational Manual Kyasanur Forest Disease Directorate of Health and Family Welfare Services Government of Karnataka 2020

PREVENTION AND CONTROL MEASURES

Tick Vector Control

Haemaphysalis ticks are naturally capable of parasitizing both wild and domestic animals. Acaricides application, biological control, reproductive host reduction or exclusion, host-targeted acaricides to tick reproductive or pathogen reservoir hosts, landscape and habitat modifications, and anti-tick vaccines help in controlling ticks. Ticks can be controlled chemically (use of acaricides) and by management of vegetation and host. Encouragingly personal protection method could be effectively used at large scale for tick-borne disease control.

Physical control

Controlled burning of the dry leaves and bushes in the forest boundaries, premises of human habitats.

Chemical Control

Acaricide can be used in multiple ways to control tick, and a suitable method should be adopted based on the conditions and requirements.

Biological control

Metarhizium abisopliae reduces tick fitness and growth and caused tick mortality leading to a 5-10 fold reduction in the tick population.

Note: Use *Karnataka Operational Guidelines for KFD. Section 6.4 and Section 6.4.2*

Targeted application

Insecticides can be applied upon a targeted habitat or animal host. Indoor, peri-domestic areas, animal shelters and areas around suspected dead-animals can be applied with insecticides such as DDT (5%), lindane (0.5%), propoxur (1%), bendiocarb (0.25–0.48%), pirimiphos methyl (1%), diazinon (0.5%), malathion (2%), carbaryl (5%), chlorpyrifos (0.5%). The residual sprays were usually applied on floors, walls, furniture and fences. Domestic animal which acts as vehicle for the tick to reach human from the wild condition. Those animals can be treated with insecticides such as; malathion (5%), dichlorvos (0.1%), carbaryl (1%), dioxathion (0.1%), naled (0.2%), coumaphos (1%) through Dipping, washing or spray-on procedures and carbaryl (5%), coumaphos (0.5%), malathion (3–5%), trichlorphon (1%) through Insecticidal powder dusting procedure. The back, neck, belly and the back of the head in animals are the common sites for tick attachment, which all need to be concentrated while insecticide application.

Area spraying

During outbreak conditions, outdoor area spraying is handy. Insecticides of organophosphorus, carbamate and pyrethroids insecticide compound groups can be used for the purpose. Large areas can be treated with ultra-low-volume spraying using aircraft, while a compression pump or mist blower could be useful for smaller areas.

Personal protection

These approaches are used to protect an individual or a group from tick-bite. It interrupts the contact between infected ticks with humans. These methods could sometime used by a large number of individuals in a community to make an impact on transmission control.

Avoidance of tick habitats

Usually, a host-seeking tick quest for wandering hosts by climbing the edges of plant leaves grass blades and leaf litters. Avoidance of entering wild conditions and bushy peri-domestic areas which are potential habitats for tick activities could be a simple personal protective measure against tick-bite. This method could be useful during outbreak/epidemic situations for the control of rapid disease spread. Activities such as trekking, leaves or firewood collection, camping, gardening, hunting, sleeping on the floor of affected forest areas need to be entirely avoided during outbreak conditions.

Protective clothing

In case of entering forested areas, proper clothing could protect from tick exposure. Gumboots, trousers tucked in boots, long -sleeved shirts tucked in trousers are the basic protective clothing recommended. Once after every visit to the forest, the clothing should be examined for ticks and should be removed if present (Light-colored cloths enables quick spotting of ticks). Addition clothing could be treated with pyrethroid insecticides such as 0.5% permethrin or cyfluthrin. The treatment can be made either by spraying or soaking, and they may remain effective for several weeks to months based on usage and washing frequency.

Tick Removal

Once returned from tick-infested areas, the whole body should be examined for tick attachment. Check especially under the arms, in and around the ears, inside the belly button, back of the knees, in and around the hair, between the legs, and around the waist. Tick attached with the skin should be removed using fine-pointed forceps or tick removal tool. The removing action should be slow and constant towards the upward direction and always remove the tick closer to the point of attachment (i.e., as close as possible from the mouth, to avoid squeezing of the abdomen). Care should be taken not to break off the embedded mouthparts, as they may cause irritation and secondary infection.

How to remove a tick

1. Use clean, fine-tipped tweezers to grasp the tick as close to the skin's surface as possible.
2. Pull upward with steady, even pressure. Don't twist or jerk the tick; this can cause the mouthparts to break off and remain in the skin. If this happens, remove the mouthparts with tweezers. If you cannot remove the mouth easily with tweezers, leave it alone and let the skin heal.
3. After removing the tick, thoroughly clean the bite area and your hands with rubbing alcohol or soap and water.
4. Never crush a tick with your fingers. Dispose of a live tick by putting it in alcohol, placing it in a sealed bag/container, wrapping it tightly in tape, or flushing it down the toilet.

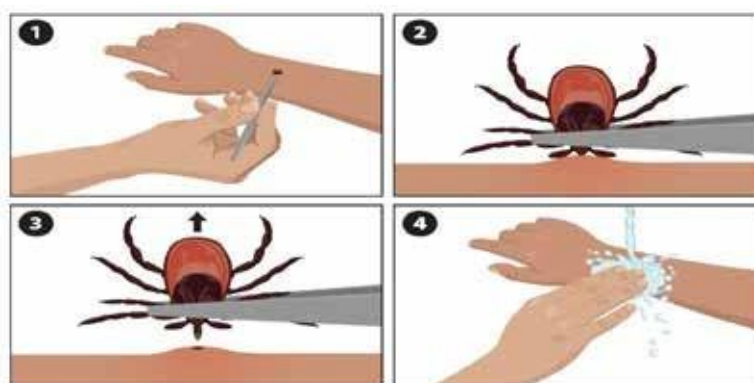


Fig 12: Procedure for Tick removal

(Image source: <https://www.cdc.gov/ticks/after-a-tick-bite/index.html>)

Repellents

Repellents such as DEET (N, N-Diethyl-meta-toluamide), DMP (dimethyl phthalate), benzyl benzoate, dimethyl carbamate, indalone, picaridin, PMD (para-menthane-diol), and 2-undecanone, could be used effectively against tick exposure. These repellents could be used either on skin or clothing. Repellents on clothing may be effective for a more extended period (even up to some days), than in skin (Usually between 15 min to 10 hours depending on the repellent used). In temperate condition, the effectiveness may reduce further due to constant perspiration, and it is recommended to repeat the application frequently. Repellents should be applied sparingly to all exposed skin, especially the neck, wrists and ankles. The surroundings of the eyes or mucous membranes (nose, mouth) should not be treated. Repellents should not be sprayed on the face directly but can be applied by spraying on to the hands. Some natural repellents of aromatic plants, leaves, flowers and tree bark oil or extracts were used against tick bites, but their effectiveness is yet to be verified.

Stakeholders in KFD Prevention and Treatment

KFD presents multidimensional risk factors for its transmission and maintenance. Looking at various aspects of KFD epidemiology, cross-sectoral coordination is crucial to effectively implement various prevention and control measures. The Department of Health, Public Health Veterinary Services, Forest and Wildlife Departments, Vector Control Department, Government, Tribal Welfare, Fire Protection Departments and many more are the key stakeholders in control. Each stakeholder needs to be clear about their roles and responsibilities. Careful division of labor between all these departments is essential for better coordinated work. The state and central government authorities should determine the responsibilities of the various departments.

Symptomatic Treatment Recommended for KFD

REFERENCE: Operational Manual Kyasanur Forest Disease Directorate of Health and Family Welfare Services Government of Karnataka 2020

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KYASANUR FOREST DISEASE (KFD)

Sr. No.	Symptoms	Treatment	Preferred medication/line of treatment
1	Fever, headache, severe myalgia, malaise	Anti-pyretic and analgesics	T. Paracetamol (0.5 – 1g every 4–6 hourly, max 4g daily) till symptoms abate. Dosage adjusted as per weight and age. T. Tramadol 50 mg every 8 hourly.
2	Nausea and vomiting	Anti-emetics	Metoclopramide (Pantocin) 5–10 mg IV, T. Domperidone 10 mg oral half an hour before meals, Inj. Ondansetron 8 mg IV bid.
		H2 receptor blockers, Proton pump inhibitors	T. Ranitidine 150 mg bid or T. Pantoprazole 40 mg od (must be given IV).
		IV fluids	IV fluids if patient has postural/dehydration and cannot take orally.
3	Secondary infections	Antibiotics	Broad-spectrum antibiotics such as Inj. Ceftriaxone 1g IV bid / other antibiotic as per local antibiogram (if suspected bacterial infection is suspected).
4	Haemorrhagic diathesis	Haemostatic agents	- Vitamin-K 10mg/day subcutaneously for 3 days. - T. Tranexamic acid 500mg tid.
		PRBC transfusion*	If Hb < 8g/dl.
		Platelet transfusion*	If thrombocytopenia < 20,000 cells/mm ³ or if platelet < 50,000 cells/mm ³ + bleeding.
		Fresh frozen plasma	If abnormal coagulopathy with bleeding.
5	Altered sensorium, irritability, convulsions, abnormal reflexes, neck stiffness	-	Mannitol 20% – 0.5 hourly for 3 days followed by oral Glycerol 30ml TDS for 3 days – if symptoms persist. Age-wise dosage as per body weight recommended.
6	Electrolyte imbalance/hypotension and acidosis	IV fluids	Sodium chloride / Soda bi-carb, depending on the degree of dehydration, metabolic acidosis, and general condition of the patient.
7	Fluid refractory hypotension / shock	Vasopressors	Norepinephrine – 0.2 to 1.5 µg/kg/min. If required, add vasopressin (up to 0.03 IU/min) or epinephrine.

Notes

The following should not be done:

Sr. No.	Don'ts
1	Administering NSAIDs
2	Administering steroids (Except in fluid refractory septic shock: Inj. Hydrocortisone 50 mg IV 6th hourly)
3	Administering nephrotoxic drugs (like Diclofenac, Gentamicin)
4	Administering intramuscular injection

Referral of cases to a higher center from PHC in case of the following

Sr. No.	Indicators
1	Systolic BP < 90 mm Hg
2	Heart rate > 100 beats/min or irregular pulse
3	Respiratory rate > 24 breaths/min
4	Altered sensorium
5	Bleeding manifestations
6	Decreased urine output
7	Jaundice
8	Severe dehydration

Treatment

- No specific treatment for KFD is available
- Supportive therapy including maintenance of hydration, hemodynamic stability
- Management of neurological symptoms to reduce morbidity and mortality.



Prevention



Vaccinating people against KFD in endemic areas



Disease awareness among people



Prohibition of access to infected forest areas during outbreak time



Integrated Pest/Vector Management (IPM) to control ticks

Centre for One Health, NCDC, MoHFW

KYASANUR FOREST DISEASE (KFD)

Vector control



- 

Controlled burning of the dry leaves and bushes in the forest boundaries, premises of human habitats.

Kynanur Forest Disease A comendium of Scientific Literature

Center for the Study of the History of Mathematics

KYASANUR FOREST DISEASE (KFD)

- For Indoor, peri-domestic areas, animal shelters and areas around suspected dead-animals:
 - *DDT* (5%),
 - *lindane* (0.5%),
 - *propoxur* (1%),
 - *bendiocarb* (0.25–0.48%),
 - *pirimiphos* methyl (1%),
 - *diazinon* (0.5%),
 - *malathion* (2%),
 - *carbaryl* (5%),
 - *chlorpyrifos* (0.5%)
- During outbreak conditions, insecticides of organophosphorus, carbamate and pyrethroids groups can be used



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KYASANUR FOREST DISEASE (KFD)

Avoidance of tick habitats



Protective clothing

Tick Removal

Tick Removal
Once returned from tick-infested areas, the whole body should be examined for tick attachment. Tick attached with the skin should be removed using fine-pointed forceps or tick removing tool.

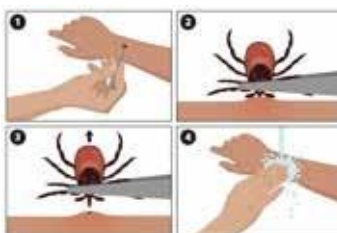
Repellents

Repellents such as *DEET* (N, N-Diethyl-metoluamide), *DMP* (dimethyl phthalate), *benzyl benzoate*, *dimethyl carbamate*, *indalone*, *picaridin*, *PMD* (para-menthenediol), and *2-undecanone*, could be used against tick exposure. Repellents could be applied on skin or clothing (more effective).

Control for the Models: WPC; Multiple

KYASANUR FOREST DISEASE (KFD)

- Use clean, fine-tipped tweezers to grasp the tick as close to the skin's surface as possible.
- Pull upward with steady, even pressure. Don't twist or jerk the tick; this can cause the mouth-parts to break off and remain in the skin. If this happens, remove the mouth-parts with tweezers. If you cannot remove the mouth easily with tweezers, leave it alone and let the skin heal.
- After removing the tick, thoroughly clean the bite area and your hands with rubbing alcohol or soap and water.
- Never crush a tick with your fingers. Dispose of a live tick by putting it in alcohol, placing it in a sealed bag/container, wrapping it tightly in tape, or flushing it down the toilet.



Center for the Study of Health, WISC: Madison

KYASANIUR FOREST DISEASE (KFD)

[illegible]

Role of a veterinarian

- The Veterinary Consultant is expected to:
 - Intimate health department when monkey falls are reported from an area.
 - work as link between human and animal health department to control the outbreak
- Properly disposing the monkey carcasses, preferably by incineration which eliminates pathogens and attached ticks and prevent further transmission from the source



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KYASANUR FOREST DISEASE (KFD)

Notes

Session-7

KFD Surveillance

Course No. 007	Session 7: KFD Surveillance
Duration	20 minutes
Learning Objectives	• Understand considerations of KFD surveillance in humans and Ticks • Describe risk communication and public awareness
Pre-requisite knowledge/skill	• Basic knowledge of surveillance systems for vector-borne and zoonotic diseases. • Familiarity with entomological surveillance methods, especially for ticks. • Understanding of principles and strategies for effective risk communication and public engagement.
Competencies to be achieved	• Comprehension of the various methods employed for surveillance and monitoring of cases. • Understanding the importance of collaboration between healthcare providers and public health authorities in addressing KFD cases

SURVEILLANCE

There are three forms of surveillance for Kyasanur Forest Disease as:

Human Surveillance

Early detection of patients, rapid laboratory diagnosis, and proper treatment of patients are vital. Passive routine surveillance, AFI surveillance and routine review of surveillance data as part of IDSP to detect impending KFD outbreaks. Event-based monitoring of unusual KFD suspects/fatalities as part of control and containment.

Monkey Monitoring

Monitoring of deaths of monkeys/monkeys in non-endemic as well as endemic areas of the KFD must be carried out regularly in real time in cooperation with the Forest and Veterinary Office. Cases in humans can be suspected in an unusual death of monkeys. Death of monkey is a sentinel event which forecast outbreak of KFD, hence, monkey surveillance is essential.

Tick surveillance

Tick surveillance and tick mapping to identify hotspots and tick load studies in KFD-prone areas to monitor tick positivity so that KFD can be performed on a regular and regular basis. Tick surveillance usually conducted whenever there is a detection of human case or suspected death of monkey. This will aid in early identification of potential high-risk areas for a Human KFD case.

Together with human cases, surveillance and vector surveillance facilitate the Vector-borne disease control. Arthropods are typically collected, sent alive to an appropriate laboratory, or in ethanol (70%) preserved and examined for identification and infection. For surveillance purposes, ticks are captured, identified, sorted by life stage, sex and physiological type, counted and retained for later testing. Tick surveillance can be implemented in either the active or passive approach.

ACTIVE TICK SURVEILLANCE

Active tick surveillance involves the effective monitoring of the prevalence, distribution, and rate of infection among vector ticks in a given geographic area. Various methods have been successfully tested in tick surveillance, and the efficiency of each method may vary depending on the tick species, developmental stage, and host-searching behavior. Methods used in active tick surveillance approach are as follows:

- Dragging, flagging, and dry ice-baited traps are the few collection methods, which targets hosts seeking tick population.

- Collection of tick parasitizing live host.
- Leaf litter sampling method.

Dragging and flagging methods

In the drag and tag methods, a cloth is slid over the tick foraging areas, mimicking the host's exposure to tick bites in the natural environment. Tick dragging is performed using a rectangular white flannel cloth of standard dimensions (typically 1.5 x 1 m). Fastened with a solid pole (1.1m) along one side of the cloth and a 4m rope connecting both ends of the pole. Tick flags must also be performed with a rectangular white flannel cloth of standard dimensions (Normally 1m x 0.75 m) while a long, solid stick (usually 1.5 m) is attached to the cloth on one side. The towing method can be effective on plains, while flags are useful in vegetation of different heights. Shrubs, dry Leaves, meadows, animal paths, forest edges and areas with animal-human-tick interaction should be considered in the marking or dragging process. Tick frequency is expressed as the number of ticks collected per man-hour and tick density is expressed as the number of ticks collected per area covered (typically per 1000 m² area).



Fig 13: Dragging and flagging method.

(Image source: <https://www.thenewsminute.com/karnataka/find-monkey-fever-s-next-stop-karnataka-scientists-follow-ticks-carry-it-105439>)

Dry ice baited method

The dry ice-baited method of collecting ticks involves luring and capturing the host-seeking tick using slow-release CO₂ evaporation from dry ice. The CO₂ mimics the excretion of the host respiration, which is an olfactory cue for the ticks to seek a host for feeding. The ticks that approach the CO₂ bait can be collected with a white sheet, a drop trap or a sticky trap. The tick frequency is expressed as the average number of ticks per hour attracted to a bait (or day) per area covered (usually per 1000 m² area).



Fig 14: Dry ice bait collecting trap (a), which consists of a tarpaulin cylindrical trap and a cylindrical ice chest, installed at each environmental point and (b) a tick collection tube that prevents the escape of ticks.

(Image source: <https://www.researchgate.net/publication/353640010>.

Nationwide_Temporal_and_Geographical_Distribution_of_Tick_Populations_and_Phylogenetic_Analysis_of_Severe_Fever_with_Thrombocytopenia_Syndrome_Virus_in_Ticks_in_Korea_2020)

Collection of tick parasitizing live host

Collection of tick-parasitizing live hosts is commonly done from wild animal, rodent, and bird populations using the trapping and screening technique. If necessary, the method can also be carried out on pets. This method of tick monitoring provides us with basic information about host, pathogen and tick relationships. Fine-needle pliers or a special tick removal tool can be used to remove the tick from the host. The snout, head, pinna, neck, front leg, hind leg, breastbone, abdomen, tail and the rest of the body are the most common places to check for tick infestations. Sometimes the method of combing can be adjusted for effective tick collection on animals, especially rodents. Another option for a small animal may be that after being caged, the animals are placed over water. Ticks detached from the animals are collected from the water every morning and evening.



Fig 15: Tick collection

(Image source: *Kyasanur Forest Disease: Vector Surveillance and its Control. Journal of Communicable Diseases. Volume 51, Issue 2 - 2019, Pg. No. 38-44 DOI: <https://doi.org/10.24321/0019.5138.201915>*)

Leaf litter sampling method

In leaf litter sampling, leaf litter is collected in suspected tick habitats and then the leaf litter is examined for tick presence. Leaf litter is either visually inspected for ticks or placed in a Berlese-Tullgren funnel under an incandescent lamp. The arthropods move away from the heat and are trapped in a receiver containing 70% ethanol below the funnel.

PASSIVE SURVEILLANCE

Passive tick surveillance involves voluntarily submitting ticks found on humans or pets through participating medical and veterinary clinics, thus providing a signal for the presence of ticks in the environment. Ticks found on humans and ticks submitted by clinics also provide information on a direct measure of human exposure to ticks and the pathogens they transmit.

INFORMATION, EDUCATION, AND COMMUNICATION (IEC)

NCDC recommends routine IEC activities by field staff to educate people about the disease as well as convince them for KFD vaccination. IEC for KFD should be focused on regular annual sensitization program for veterinary department, forest department officials, ASHA, education department, and gram panchayat officials.

Do's

- Report monkey deaths to animal husbandry / forest officials and / health authority.
- Personal protective clothing (full sleeves etc.) is recommended for people visiting or working in tick-infested areas in the forest.
- Apply tick repellents like eucalyptus and neem oil, DEPA to the exposed parts before going into the forest.
- Wash the clothes and body with hot water and soap after returning from the forest.
- Report of incidence of the disease / deaths, which occurs as high fever with severe headache and body ache to nearest health facility.
- Educate the villagers to avoid the forests areas where monkeys have died.
- Bring to the notice of the Health Department or Department Hospitals or Private Hospitals, regarding any serious cases in the villages or from KFD affected areas, which require immediate symptomatic treatment.
- Ectoparasite (tick) control in cattle and domestic animals will help in reducing the density of tick's population.

Don'ts

- Don't bring the dry leaves of trees from KFD infected area to the village for cattle bedding material.
- Don't visit the area where recent monkey death has been reported, especially an area where case of KFD has been reported in the past.
- Don't handle the infected monkey carcass by bare hand without personal protective equipment.

Active surveillance

- Dragging, flagging, and dry ice-baited traps are the few collection methods, which targets hosts seeking tick population.
- Collection of tick parasitizing live host.
- Leaf litter sampling method.



Passive surveillance

- Provides a signal for the presence of ticks in the environment
- Provides information on the human exposure to ticks and the pathogens they transmit

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KYASANUR FOREST DISEASE (KFD)

Notes

Information Education and Communication (IEC) Activities

- Conduct regular annual sensitization program for veterinary department, forest department officials, ASHA, education department, and gram panchayat officials.
- IEC campaigns to be intensified involving all possible media



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KYASANUR FOREST DISEASE (KFD)

Safety Regulations

← DO's	&	Don'ts →
✓ Report monkey deaths to animal husbandry/forest officials and health authorities ✓ Personal clothing is recommended for people visiting or working in tick-infested areas in the forest. ✓ Apply tick repellents like DMP oil to the exposed parts before going into the forest ✓ Wash the clothes and body with hot water and soap after returning from the forest ✓ Report of incidence of the disease/death which occurs as high fever with severe headache and body ache to nearest health facility ✓ Educate the villagers to avoid the forest areas where monkeys have died. ✓ Notifying health departments (private and govt.) of any serious KFD cases in villages or affected areas, which require immediate symptomatic treatment. ✓ Tick control in cattle and domestic animals to help in reducing the density of tick population.	X X X	- Don't bring the leaves of trees from KFD-infected areas to the village for cattle bedding material - Don't visit the area where recent monkey death have been reported, especially an area where a case of KFD has been reported in the past - Don't handle the infected monkey carcass by bare hand without personal protective equipment

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KYASANUR FOREST DISEASE (KFD)

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NOTE TO FACILITATORS

This resource guide has been meticulously designed to enhance the understanding and expertise doctors, veterinarians, paramedical staff, and laboratory personnel in dealing with KFD cases. Your role is crucial in ensuring the success of this training, so please follow these instructions carefully:

Familiarize Yourself with the Content:

Thoroughly review all the materials provided in the KFD training resource guide. This includes presentations, handouts, and assessment tools.

Tailor the Training to Your Audience:

Understand the professional backgrounds of your participants (doctors, veterinarians, paramedics, and lab personnel). Tailor your examples and discussions to make the training relevant to their specific roles.

Set Clear Objectives:

Begin each session by clearly stating the objectives participants are expected to achieve by the end. This will give them a sense of direction and purpose throughout the training.

Create an Interactive Learning Environment:

Encourage active participation and open discussions. Use real-world scenarios to prompt critical thinking and problem-solving.

Use Multimodal Techniques:

Utilize a mix of teaching methods, such as presentations, group discussions and case-based learning. This will cater to different learning styles and keep participants engaged.

Encourage Questions:

Welcome questions and create a safe environment for participants to seek clarifications. This fosters deeper understanding and engagement.

Provide Regular Feedback:

Throughout the training, provide constructive feedback on participants' performance. This will help them identify areas for improvement and enhance their skills.

Summarize and Review:

At the end of each module, summarize key points and takeaways. Conduct a brief review to reinforce learning before moving on to the next topic.

Assessment

and

Certification:

Develop an assessment mechanism, such as quizzes, practical assessments, or case presentations. Issue certificates of completion to participants who meet the training requirements.

Adapt to Participants' Pace:

Gauge the participants' pace of learning. Adjust the training speed, accordingly, ensuring that everyone can follow and grasp the content.

Facilitate Networking:

Create opportunities for participants to interact and network with each other. This can lead to valuable knowledge exchange and collaboration.

Remember, your role as a trainer or facilitator is to guide participants through this comprehensive KFD training with expertise, enthusiasm, and a dedication to enhancing their professional skills. Your efforts will contribute to building a more capable and knowledgeable medical workforce prepared to manage KFD cases effectively.

Course Outline

It is imperative to underscore that the course outline harmonizes with the course schedule. Consequently, any modifications or adaptations made to the course schedule should be duly reflected in this course outline. This synergy between the schedule and the outline ensures consistency and alignment between training plans and their actual implementation.

NOTE: Make copies of the schedule, one for each participant and include in the training material bag.

TIME	TOPICS/ACTIVITIES	TRAINING/LEARNING METHODS	RESOURCES/MATERIALS
20 min	Welcome participants Facilitate introductions of participants Explore participants' expectations for the course	Open course with a word of welcome by organizers, lead trainers, etc. Facilitate the introductions of all participants and trainers. Explore participants' expectations for the course. Allow participants to freely explore their expectations. In the next session on review of the course objectives, address which expectations can be met, and which cannot be met.	Prepare welcome sign, Name. badges
20 min	Review course objectives and schedule Review components of the training guide	Review the course goals and objectives; the course design and expected outcomes; Review the course schedule, including starting and ending times and times for breaks and lunch; Review the materials to be used in the course and ensure that participants understand the use of course materials.	Copies of course schedule, one for each participant from Facilitators' Guide (FG). Full set of the training guide: Facilitators' Guide (FG) Questionnaire
20 min	Assess participants' pre-course knowledge	Distribute the Pre-course Knowledge Assessment sheet to each participant. Ask them to answer each question. Allow 15 minutes for assessment. Immediately review the correct responses—Have participants grade the papers while the trainer reviews the correct answers with them and collect the papers after reviewing all the answers.	Pre-Training Quiz Sheet for each participant

TIME	TOPICS/ACTIVITIES	TRAINING/LEARNING METHODS	RESOURCES/MATERIALS
4-5 hours	Presentation/ Discussion	Use the PowerPoint slides to present information	Power Point slides on the sessions planned as per agenda
20 min	Assess participants' post training knowledge	Distribute the Post Training Knowledge Assessment sheet to each participant. Ask them to answer each question. Allow 15 minutes for the Post Training Knowledge Assessment.	Copies of Post Training Knowledge Assessment Sheets (one for each participant)
15 min	Course Evaluation	Ask questions of the participants and engage them in the presentation of the information.	
15 min	Closing	Closing remarks by training organizers. Distribute certificates to participants.	Certificate for each participant

PRE/POST TRAINING QUIZ

Trainee Name:

Date:

Designation:

Test taken before the training (yes/no):

Test taken after the training (yes/no):

Instructions for the trainee:

- The test quiz carries 14 questions.
- Attempt all the questions.
- Put a tick mark on the correct option or fill the blanks with True/ False

Please check whether all questions are answered before submitting.

1. INCORRECT statement about the host in KFD is.

- a. Natural hosts are necessary for maintenance of the virus in the wild
- b. Natural hosts develop disease 3-8 days after the bite of the infected tick.
- c. Porcupines, squirrels, rats and mice are examples of natural hosts.
- d. Goats, sheep, cattle can become infected but don't amplify the virus.

2. *H.spinigera*, the predominant vector of KFD, is a

- a. One host tick
- b. Two host tick
- c. Three host tick
- d. Four host tick

3. INCORRECT statement regarding the temperature at which the blood sample taken for KFD confirmation should be stored at is.

- a. 2-4 degree Celsius if the sample will be transported within 48 hours.
- b. -20 degree Celsius if the sample will be transported within 48 hours – 7 days.
- c. -60 degree Celsius if the sample will be transported in less than 7 days.
- d. -70 degree Celsius if the sample will be transported in more than 7 days.

4. The 'hotspot' management team involves which of the following personnel.

- a. Panchayath Development Officer
- b. Accredited Social Health Activist
- c. Forest department officers
- d. All of the above

5. The target percentage for “patient response rate” to ensure quality/speed of KFD surveillance is.
- 60
 - 70
 - 80
 - 90
6. In the event of an outbreak, vaccination should be planned in villages around _____ kilometer radius of the infected zone.
- 1
 - 3
 - 5
 - 7
7. When an infected monkey dies, ticks can detach and crawl up to _____ feet. This radius is known as the “hotspot.”
- 20
 - 30
 - 40
 - 50
8. **True or False**
Consumption of unpasteurized milk can transmit KFD in humans.
9. The peak epidemic season for KFD is.
- Jan - May
 - June – Sept
 - Oct – Dec
 - Dec – Feb
10. KFD was first discovered in which state of India?
- Kerala
 - Tamil Nadu
 - Karnataka
 - Andhra Pradesh

ANSWER KEY

1. **Incorrect statement about the host in KFD is.**
 - a. Natural hosts are necessary for maintenance of the virus in the wild
 - b. Natural hosts develop disease 3-8 days after the bite of the infected tick.**
 - c. Porcupines, squirrels, rats and mice are examples of natural hosts.
 - d. Goats, sheep, cattle can become infected but don't amplify the virus.
2. ***H.spinigera*, the predominant vector of KFD, is a**
 - a. One host tick
 - b. Two host tick
 - c. Three host tick**
 - d. Four host tick
3. **INCORRECT statement regarding the temperature at which the blood sample taken for KFD confirmation should be stored at is.**
 - a. 2-4 degree Celsius if the sample will be transported within 48 hours.
 - b. -20 degree Celsius if the sample will be transported within 48 hours – 7 days.
 - c. -60 degree Celsius if the sample will be transported in less than 7 days.**
 - d. -70 degree Celsius if the sample will be transported in more than 7 days.
4. **The 'hotspot' management team involves which of the following personnel.**
 - a. Panchayath Development Officer
 - b. Accredited Social Health Activist
 - c. Forest department officers
 - d. All of the above**
5. **The target percentage for "patient response rate" to ensure quality/speed of KFD surveillance is.**
 - a. 60
 - b. 70
 - c. 80**
 - d. 90

6. In the event of an outbreak, vaccination should be planned in villages around ____ kilometer radius of the infected zone.
- 1
 - 3
 - 5**
 - 7
7. When an infected monkey dies, ticks can detach and crawl up to ____ feet. This radius is known as the “hotspot.”
- 20
 - 30**
 - 40
 - 50
8. True or False
- False** (Consumption of unpasteurized milk can transmit KFD in humans)
9. The peak epidemic season for KFD is.
- Jan - May**
 - June – Sept
 - Oct – Dec
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10. KFD was first discovered in which state of India?
- Kerala
 - Tamil Nadu
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 - Andhra Pradesh

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