

ONE HEALTH IN ACTION: ELIMINATING RABIES FROM HUMAN AND ANIMAL HEALTH

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ABSTRACT

Rabies, an infectious disease which is very fatal. It has a major public health concern worldwide. Mostly transmitted to human through dog bites. Bat bite is also a cause of transmission. It is caused by Lyssavirus of Rhabdoviridae family. It is present in around 150 countries worldwide. India contributes around 35% of human rabies death and 60 % of Asia cases. It has 2 form i.e. paralytic and furious form. Treatment is only symptomatic once clinical signs appears. Prevention and control are very important for rabies. Rabies is 100% preventable through proper vaccination. Prophylaxis pre and post both are very important for rabies. Pre-exposure prophylaxis is important for high-risk group. Post-exposure prophylaxis depends on World Health Organization's category of exposure. Rabies control is not possible through isolated actions. Since rabies occurs at the intersection of human, animal, and environmental health, a One Health approach is essential for its elimination.

INTRODUCTION

Rabies is acute fatal disease of central nervous system. It is zoonotic in nature. It affects all warm-blooded animals including mammals. It is a major life threat for both human and animals. It is also known as hydrophobia.

Some important facts about rabies,

- 99 % of human rabies cases are due to bites from infected dogs,
- More than 95% of rabies deaths occur in Africa and Asia,
- More than 80% of rabies cases occur in rural areas,
- 4 out of 10 rabies deaths are in children,
- Near 100 % fatality rate once clinical symptoms manifest and
- Rabies causing about 59,000 deaths annually, of which 59.6 % occur in Asia and 36.4 % in Africa.

The World Health Organization (WHO) classified rabies as a neglected tropical disease (NTD).

ETIOLOGY

Rabies virus belongs to the genus Lyssavirus, family *Rhabdoviridae* and the order Mononegavirales. It is a bullet shaped virus, containing a single-stranded RNA genome. Lyssavirus is non-segmented and enveloped virus. Genome of virus encodes five proteins namely Nucleoprotein (N), Phosphoprotein (P), Matrix protein (M), Glycoprotein (G) and large protein (L). The arrangement and positioning of these protein and RNA genomes determine the structure of the rabies virus.

Rabies virus can be inactivated by various means. It is prone to ultraviolet radiation. Virus is rapidly inactivated by heat and sunlight. Lipid coat of virus is disrupted by 1% soap solution. Chemicals like sodium hypochlorite, ethanol, iodine preparations, quaternary ammonium compounds, formaldehyde, phenol, ether etc can be used for disruption of virus.

EPIDEMIOLOGY

Rabies is found in more than 150 countries on all continents except Antarctica.

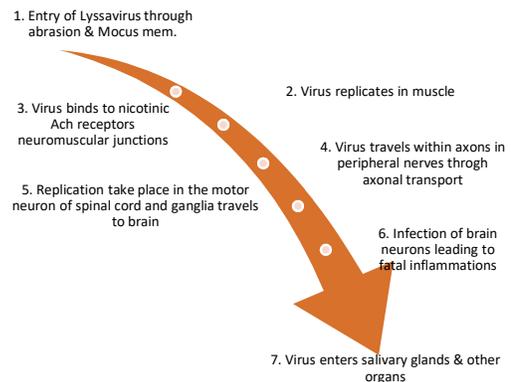
Stray dogs are the main carriers of the virus and are the leading cause of human rabies cases, especially in parts of Asia and Africa. Some countries are considered rabies-free, including Australia, Belgium, Fiji, England, Ireland, Ireland, Japan, New Zealand, Northern Ireland, Scotland, Sweden, Singapore and Vatican City. Some countries are classified as rabies-controlled like Chile, Canada, Hong Kong, Kuwait, Hungary, Qatar, Taiwan, United Arab Emirates and United States (World Population Review, 2025). The greatest risk of rabies persists in countries like India, China, Bangladesh, Pakistan, Nepal, Indonesia, Philippines, Thailand, Vietnam, Nigeria, Uganda, Tanzania, Kenya, South Sudan, Mexico, Brazil (Annual Report CDC, 2024).

NATIONAL PERSPECTIVE ON RABIES IN INDIA

- In India, dog-mediated human rabies presents as dog bite accounts 95% for rabies cases. According to country data 2022 of WHO, there are 305 reported number of human rabies death. India contributes to nearly 35% of global human rabies deaths and around 60% of the cases reported in Asia.
- Dog bite cases reported at IDSP (from 2022-25) are around 21 lacs in 2022, 30 lacs in 2023, 37 lacs in 2024 and 4 lacs in January 2025. Among states, maximum dog bite reported from Maharashtra.
- Human rabies death reported 21 in 2022, 50 in 2023, 54 in 2024 and 1 in January 2025 (IDSP/IHIP data).
- Between 2012 to 2022, the National Rabies Control Program recorded 6,644 suspected cases and fatalities in humans. Kerala has shown a particularly high number of rabies-related deaths in recent years.
- All this increase in reported cases highlights a major public health concern in India.

PATHOGENESIS

Rabies virus first multiplies at the site of the bite within the muscle tissue and then progresses toward the central nervous system. Virions are passed in carrying vesicles and move to the CNS completely via rapid retrograde transport beside motor axons, by means of no uptake through sensory or sympathetic endings. Once the virus enters and spreads within the brain tissue, it results in fatal outcomes.



CLINICAL FEATURES

Incubation period

In human, it varies from weeks, months to years depends on extent of exposure. Usually, it is 4-8 weeks but may varies from 5 days to 7 years. Bite of rabies affected animal near to CNS have shorter incubation period.

In rabid dogs varies from a week to many months. In dogs and cats, the incubation period is 10 days to 6 months. Most dogs and cats may develop the disease within 1–2 months after exposure.

Prodromal Stage

In human, after incubation period, beginning of clinical symptoms starts. In prodromal stage which may last for 2-3 days, have symptoms like behavioural modification, anorexia, headaches, fever, pharyngitis, nausea, vomiting, diarrhoea, anxiety, depression etc can be seen.

In case of dog, clinical symptoms start with changes in the behavioural pattern. This phase lasts 2–3 days in dog. The aggressive

dogs may become friendlier or shy dogs may become more aggressive. Other symptoms like fever, dilatation of the pupil, covering of eyes with a nictitating membrane and hyper-salivation can be observed.

Excitement (Furious) Phase

It is also known as encephalitic phase.

In case of human, symptoms like mental excitement, restlessness, hyperesthesia and hydrophobia etc can be seen. In hydrophobia, sudden spasm of muscles of the mouth, pharynx, larynx, respiratory musculature etc present. Typical spasmodic jerks with violent contraction of diaphragm and other inspiratory muscles can be observed by offering water and water is ejected from the mouth. Aerophobia may also trigger spasms. Ultimately, death generally follows within a week after symptoms onset.

In case of animals, this phase can be described by polypnea, drooling, attacks upon other animals and objects, mental excitement, restlessness, hyperesthesia, and hydrophobia. Cattle show strange attentiveness. Nocturnal animal can be seen in daytime.

Paralytic (Dumb) Phase

In human, this phase is generally seen in bat-transmitted rabies and sometimes partially vaccinated person. It is characterised by progressive flaccid paralysis. This phase has more survivor rate than furious.

In dogs, paralysis of facial muscles, larynx, gullet and masseter muscle can occur. Symptoms like difficulty in swallowing, hypersalivation, dropping of lower jaw, change in voice i.e. atypical barking in dogs.

Atypical bellowing in cattle also observed. Later on, paralysis progress in hindlimb and leads to death.

DIAGNOSIS

Diagnosis of rabies in human

Virus Culture- It is positive in the 1st week from saliva, throat swab, eye swab and cerebrospinal fluid (CSF).

Identification of antigen- Direct Fluorescent Antibody Test (FAT) can be used for identification for antigen. For FAT, skin biopsy samples or hair follicles from rabies affected person can be taken. FAT of corneal impressions is rarely reliable as it may results false-positive.

Antibody Detection- Measured by virus neutralization test like rapid fluorescent focus inhibition test (RFFIT) and fluorescent antibody virus neutralization (FAVN) test. Sensitivity of these tests is low as antibodies appear 7-8 days after clinical symptoms first appear.

Serological tests are difficult to use in ante-mortem diagnosis of rabies in humans as rabies specific antibodies may be present in CSF.

Reverse Transcription Polymerase Chain Reaction (RT-PCR)-

This is recent advancement in the ante-mortem diagnosis of rabies. It is regarded as one of the most reliable laboratory techniques for confirming rabies, as it allows detection of rabies virus RNA in samples such as saliva.

Diagnosis of Rabies in Animals

DIAGNOSTIC TEST		DISCRIPTION
Detection	Immunochemical identification of rabies virus antigen	Include Direct Fluorescent Antibody (DFA) test- most widely used, recommended by both WHO and WOA. This test is used directly on a brain impression smear.
	Virus isolation	Include Rabies tissue culture infection test (RTCIT) and Mouse inoculation test (MIT)

and Identification of the agent	Rapid immunochromatographic tests (lateral flow devices)	Commercial Lateral Flow Devices (LFDs), for viral antigen detection are available. Field studies showed high sensitivity and specificity.
	Reverse-transcription polymerase chain reaction (RT-PCR)	Sensitive tools for the detection of lyssavirus-derived ribonucleic acid (RNA) within suspect specimens with the advantage that they do not require the presence of live virus.
Serological tests	Virus Neutralisation Test in cell culture: Fluorescent Antibody Virus Neutralisation Test (FAVN) and Rapid Fluorescent Focus Inhibition Test (RFFIT)	Both test's measures rabies virus-neutralizing antibodies.
	Enzyme-linked immunosorbent assay (ELISA)	Rapid serological test that avoids the requirement to handle live rabies antigen. Useful tool for monitoring rabies vaccination campaigns in wildlife species.

Source - WOAH

TREATMENT

Generally, there is no specific treatment for rabies. Once symptoms develop, only supportive treatment is possible. Patient can be sedated to manage their fear and seizures. Airway and oxygenation should be maintained.

Wound treatment can be done for rabies post-exposure prophylaxis. It should be done immediately and can be started with washing and flushing of wound with soap and water for at least 15 minutes. Disinfection with detergent, ethanol, iodine etc can be done. In case of bleeding at wound site, either human or equine rabies immunoglobulin can be used in case of human.

PREVENTION AND CONTROL

Rabies is 100% preventable but it is also 100% fatal once clinical symptoms appear. Rabies is unique because preventive treatment can be started even after a person has been exposed. This is possible due to the

long incubation period of the disease, which provides enough time to implement protective measures.

Combination of proper wound care, passive immunization and vaccination is highly effective in prevention and control of rabies.

Pre-exposure prophylaxis

It is important for high-risk group like a veterinarian, laboratory staff, animal handlers, international travellers, children, wildlife staff etc.

Schedule for pre-exposure prophylaxis- One dose of vaccine is given on each of days 0, 7 and 21 or 28.

Vaccination in animals

- Dogs, cats, ferret must receive their initial rabies vaccination on or after 12 weeks (84 days)
- An animal (dog/cat/ferret) is considered immunized 28 days after their initial vaccination.

- Oral Rabies Vaccine (ORV) are live, recombinant vaccine administered orally. Mostly used for wildlife reservoirs like foxes, raccoons, jackals etc.

Post-exposure prophylaxis

Wound treatment should be done with water and soap solution immediately.

CATEGORY OF EXPOSURE	DESCRIPTION	POST-EXPOSURE PROPHYLAXIS (PEP)
Category-1	Touching or feeding of animals Licks on intact skin	No PEP required
Category-2	Nibbling of uncovered skin Minor scratches or abrasions without bleeding	Vaccine injected as soon as possible
Category-3	Single or multiple transdermal bites or scratches, licks on broken skin, contamination of mucus membrane with saliva (i.e. licks), exposures to bats	Administer rabies immunoglobulin and vaccine immediately. Stop treatment if animal remains healthy throughout observation period (10 days)

Source- WHO

Schedule for post-exposure prophylaxis- One dose of the vaccine should be administered on days 0, 3, 7, 14 and 28 (5 dose intramuscular regime).

Rabies Immunoglobulin (RIG)- 20 IU/kg for Human RIG (HRIG) or 40 IU/ kg of Equine RIG (ERIG) can be given.

ONE HEALTH APPROACH

Rabies control is not possible through isolated actions. One Health approach is essential as rabies lies at the interface of human health, animal health and the environment. One Health frame work emphasizes collaboration between human health sector (doctors, public health workers), animal health sector (veterinarians, para-vets, livestock officers) and environmental sector (wildlife managers, ecologists, community stakeholders).

Human health component can do early and accurate diagnosis of rabies exposure, post-exposure prophylaxis availability at all healthcare centres, community education on first aid after animal bites and strengthening surveillance and reporting of human rabies cases.

Animal health components can do mass dog vaccination campaigns, dog population management through sterilization and use of

oral rabies vaccines for wildlife in high-risk zones.

Environmental and community components can monitor rabies in wildlife reservoirs, awareness programs, safe management of solid waste etc.

For elimination of rabies in India, a One Health approach is started by government of India. This is National Action Plan for Dog-Mediated Rabies Elimination from India by 2030 (NAPRE). It is a government initiative to achieve zero human deaths from rabies by 2030. NAPRE is driven by the Ministry of Health & Family Welfare and Ministry of Fisheries, Animal Husbandry & Dairying. NAPRE was launched on 28 September, 2021. The strategy of NAPRE is built on three core principles:

- Prevention focuses on implementing affordable and effective public health measures to ensure accessibility and availability of post-exposure prophylaxis (PEP) for every individual in need.
- Promotion aims at spreading knowledge about rabies through awareness campaigns, advocacy, research and education.
- Partnership encourages collective action by bringing together

government bodies, civil society, private organisations and international stakeholders to strengthen the rabies elimination program.

emphasizes collaboration across human health, veterinary and environmental sectors, is essential to achieve sustainable rabies control and eventual elimination.

CONCLUSION

Rabies remains a preventable yet neglected zoonotic disease that continues to threaten both human and animal health worldwide. The one health approach, which

Many programs going on international, national and local level exemplifies how the one health framework can save lives, protect livelihoods and contribute to broader sustainable development objectives.

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