

Zoonotic Risks Unleashed: Understanding Rabies Distribution and Engaging Communities with Bite Prevention, Wound Management, and Vaccination Strategies against Rabies in Pakistan

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ABSTRACT

Rabies is a major viral zoonotic disease in Pakistan, as it is in the rest of the world. The rising number of dog bites has led to an uptick in human rabies cases in Pakistan. In the province of Sindh, the district of Karachi has the highest incidence rate, with 25-30 cases reported daily. Increasing government efforts to eradicate it from Pakistan would require more research-based activity. The rabies virus, which can spread both through reservoir and non-reservoir transmission, mostly multiplies in the patient's neurological system. Although pre- and post-exposure vaccinations are available, the most effective means of preventing the spread of rabies are the avoidance of dog bites and initial management of the dog bite.

Background

While fascinating, rabies' roots are lost in time. According to Athenodorus, the phenomenon first manifested among humans during the time of the Asclepiadae. These people were descendants of Asclepius, the Greek god of medicine. History claims that the famous hunter Acteon was killed by his own rabid canines when he ambushed Diana and her servants at the bath [1]. Before Louis Pasteur's 19th-century research, dog tongues were thought to contain the disease's causative agent. Later, other researchers found that the virus would be detectable in infected animals' saliva two to three days before minor clinical signs appeared [2]. Rabies was named after the term rabha, which means "to do harm" in Sanskrit. Rabies is a zoonotic disease that has been around for ages, going all the way back around 4300 years [3]. Pakistan has around 50,000 dog bites with 6000 rabies deaths per year, inflicting significant economic losses [4]. Because of the disease's high fatality rate, rabies poses a significant threat to the public's health in developing countries like Pakistan with 7-9 annual casualties per million [5].

Etiology

Rabies is a viral disease caused by the Rabies virus belonging to the genus *Lyssavirus* in the family *Rhabdoviridae*. This is a negative-sense, single stranded, enveloped RNA virus [6].

Distribution and Transmission of Disease

Human rabies cases in Pakistan are almost entirely (97.5%) the result of exposure to the virus through the bites of stray dogs, while data on the role of foxes, bats, raccoons, and jackals in the transmission of the disease is scarce. Hospitals, private medical clinics, and veterinary strategies treat victims of animal bites by administering anti-rabies shots to their pets and providing victims with protective clothing [7]. The incidence and area of infected animals can both affect how rabies spreads. Although rabies is a worldwide problem, it is more common in certain areas than others. The incidence of rabies is maximum in regions with large numbers of non-vaccinated animals, notably in third world nations. Human cases of rabies are almost predominately transmitted by canines in these territories. The endemic disease of rabies has persisted in Pakistan for a long time despite government efforts to eradicate it. It is the oldest known viral zoonotic disease on the Indo-Pak region [8]. The population of dogs and the number of dog bites are both rising in Pakistan, but rabies is still mostly ignored there. It is estimated that every year in Pakistan, between two thousand and five thousand people suffer from rabies. The estimated rabies prevalence in Karachi stands at 9 per million people. Doctors at civil hospital Karachi, one of the largest public hospitals in the city, see approximately 25-30 new cases of dog bites every day. High-risk locations for rabies include parts of Punjab, Sindh, and Khyber Pakhtunkhwa, as well as a few districts in Baluchistan, including Naseerabad, Jafferabad, and Pishin [9]. Bites and scrapes from rabid animals can transmit the virus that induces infectious disease. The frequency of reported dog bite injuries to humans is disturbing, especially in the provinces of Sindh and Khyber Pakhtunkhwa

[10]. Baluchistan has the lowest documented cases of rabies and dog bite injuries in all of Pakistan since the province has the fewest stray dogs. On the other hand, Sindh has the highest rate of dog bite injuries and possible human rabies cases transmitted by dogs [8]. There are between fifty to seventy new cases of dog bite injuries treated each day in public hospitals. Human rabies is most prevalent in Karachi, Pakistan, where a hospital offering tertiary care handles hundreds of dog bite cases every day [10].

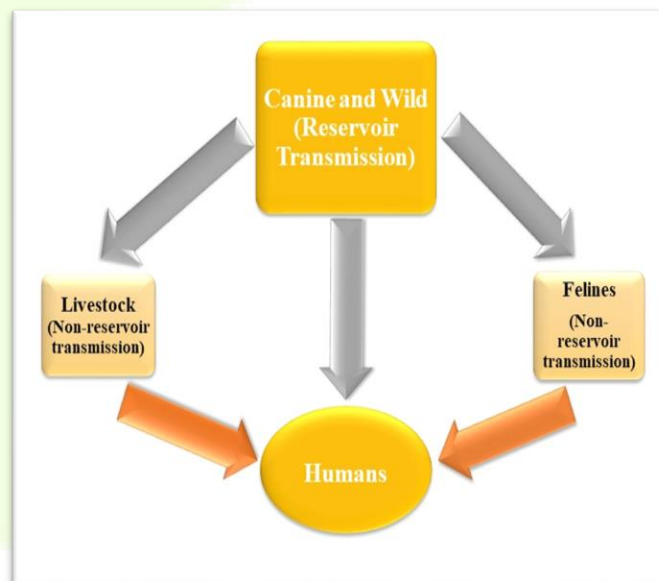


Figure 1. Transmission of the Rabies Virus

The rabies virus replication occurs in neurons and leads to the Central Nervous System, where it causes symptoms and spreads throughout the body [11,12]. There are two main ways through which the rabies virus spreads [Figure 1]:

- 1) Reservoir transmission
- 2) Non-reservoir transmission

Canine reservoirs (most commonly stray dogs) and wildlife reservoirs are the most common causes of reservoir transmission (foxes, bats, and raccoons). Cats, livestock, and humans are just some of the non-reservoir hosts that can spread the virus [13]. Scratches, open wounds, abrasions, and mucous membranes are all vulnerable to contamination from an infected animal's saliva or central nervous tissue, whether the animal is biting or not [14].

Pathogenesis

When an affected animal bites a person, the virus penetrates the body through the soft tissues and muscles, increases exponentially in the connective or striated tissue at the site of entry, and finally binds to receptors for nicotinic acetylcholine in the nerve fibers at the

neuromuscular junction. Viral replication occurs in the spinal cord [15]. At that point, it makes its way along the endoneurium of Schwann cells in motor and sensory axons to the grey matter of the brain. The virus spreads from the bite to the ganglion in the spinal cord and then, to the brain. After entering the brain, it propagates to the other parts of the body and is able to infect the salivary glands, likely to result in encephalitis [16]. The virus can be found in saliva after it has infected the salivary glands. Due to hypoxic conditions in these deeper tissues, viruses are able to multiply [17].

Prevention against Rabies

Managing the potential for dog bites is a reliable method for preventing rabies. This demands proper awareness and education among the people regarding different preventive and treatment protocols for rabies. Regarding these awareness campaigns, media particularly the social media can efficiently play its role in educating not only the pet owners or general public but can also provide latest information to the students and researchers in the higher education institutes [18,19,20]. Only by adhering to the following guidelines, you will get guaranteed protection from dog bites and a reduced risk of developing rabies:

- ✓ Never bring an unusual dog into the family.
- ✓ You shouldn't try to outrun or yell at a dog. Keep quiet like trees if that's the case.
- ✓ In the event of being knocked over by a dog, stay as still as a log.
- ✓ If you see a strange dog, don't look at it.
- ✓ Do not attempt to pet a wild or stray animal; instead, immediately report any aberrant behavior of a stray dog to the local wildlife department or another appropriate authority.
- ✓ Don't bother a dog while it's resting, eating, or caring for its puppies.
- ✓ Get your dogs vaccinated correctly by consulting a vet [21].
- ✓ Care for a Bites-Related Wound [Figure 2].



Figure 2. Initial Wound Management in Case of Dog Bite

Vaccination

There are two different schedules for administering rabies vaccines; Individuals who are likely to come into contact with rabies, such as veterinarians, animal handlers, and visitors to endemic regions, should get vaccinated before going there [Table 1]. Depending on the vaccine, two doses of vaccine are administered before exposure on days 0 and 7. Particular groups, such as those who work with animals, are encouraged to get a booster shot every two to three years [22].

Individuals who have been exposed to rabies—through, for example, a bite or a scratch from a rabid animal—should get vaccinated after their exposure. Depending on the circumstances, rabies immunoglobulin (RIG) may also be administered in addition to the four doses of vaccine

administered on days 0, 3, 7, and 14. Every 2–5 years, a booster dose may be necessary [19].

Table 1. Pre-exposure and post-exposure vaccination against rabies in humans

Vaccination Protocol	Pre-exposure	Post Exposure
Vaccination Schedule	Vaccine doses are administered at 0, and 7 days	Day 0; Day 3; Day 7; and Day 14
Booster Doses	Every 2-3 years	Every 2-5 years
Route of administration	Intramuscular	Intramuscular or Intradermal

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