

Rabies Prevention through Veterinary Public Health and One Health

Muhammad Awais Nadeem^{1*}, Huzaila Mudassar², Fakhar Abbas¹, Muhammad Huzaifa Ahmad¹, Ali Naqi Hassan³ and Ahmad Raza¹

1. Faculty of Veterinary Sciences, University of Agriculture Faisalabad, Pakistan
2. Department of RCVets, Riphah International University, Lahore, Pakistan
3. Faculty of Veterinary Sciences, Pmas Arid Agriculture University Rawalpindi, Pakistan

*Corresponding Author: muhammadawaisnadeem533@gmail.com

ABSTRACT

Rabies is an ancient, fatal zoonotic disease with worldwide distribution caused by the rabies virus of the genus *Lyssavirus* and the family *Rhabdoviridae*. Humans and livestock animals are at major risk of getting rabies infection from rabid dogs, that result in thousands of deaths annually. Transmission of the virus occurs when the saliva of infected dogs enters the body through a bite. Diagnosis of the disease is done through history, clinical signs, and laboratory-based surveillance. Surveillance should not be limited to domestic animals; it must involve all the animals that have a chance of getting rabies. Rabies can be prevented by vaccinating dogs and humans before or after exposure. One Health strengthens public health by promoting vaccination, raising community awareness, responsible pet ownership, and controlling rabies through shared action among people, animals, and the environment. This article describes the etiology, role of veterinarians in disease surveillance, laboratory-based surveillance, mass dog vaccination programs, challenges in rabies control, and community awareness about rabies.

Keywords: Rabies Infection, Public Health, Control, Prevention, Challenges

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Introduction

Rabies is a highly fatal zoonotic disease that is included in Neglected Tropical Diseases (NTD). The mortality rate of this disease is 100% in both humans and animals if symptoms appear. Most rabies cases reported in humans are from dogs that are already infected with this virus [1]. Rabies is a main public health problem worldwide in more than 150 territories, including India and Pakistan. Rabies virus is a bullet-shaped *Lyssavirus* with a single-stranded enveloped RNA genome. The virus belongs to the *Rhabdoviridae* family that has negative-sense RNA genomes. According to recent research, there are seven genotypes of *Lyssavirus*, of which the rabies virus belongs to genotype 1 [2]. The rabies virus possesses a high degree of neurotropism, invading the central nervous system and causing progressive encephalitis [3].

Unvaccinated dogs are the major source of disease in different geographical locations. Rabies infection occurs when infected saliva penetrates the wound after bites from infected animals. Some other non-bite exposures include transmission through aerosols, organ transplantation, and gastrointestinal tract transmission after ingestion of infected tissues [4,5]. The virus present in the saliva of a rabid dog enters the body by abrasion or direct mucosal membrane contact. The virus starts replication in the bitten muscular tissues and binds with nicotinic acetylcholine receptors at the neuromuscular junction. Afterwards, the virus enters the central nervous system and spreads infection to the skin, salivary glands, heart, and a variety of other organs [2].

Veterinary Public Health in Rabies Prevention:

Role of the veterinarian in disease surveillance:

Identify animals showing signs consistent with rabies. Clinical signs of rabies include hypersalivation, paralysis, lethargy, unprovoked abnormal aggression, difficulty in swallowing, and abnormal vocalization [6]. A proper investigation of the case should be conducted. History of animal bites, vaccination status, wildlife exposure, and movement of affected animals are collected by veterinarians [7]. A suspected rabid animal that has had a known exposure (i.e., bite, scratch, or contact with saliva) to a suspected, probable, or confirmed rabid animal, and that is not known to be alive within ten days of the observed clinical signs, or a suspected rabid animal that dies, is killed, or disappears within ten days of the observed clinical signs.

Laboratory-based rabies surveillance:

Rabies surveillance through laboratory and variant typing is a key component of the control and prevention of rabies. Surveillance should not be limited to domestic animals. It must involve all the animals that have a chance of being affected by rabies. Animals that have undergone rabies testing should be recorded and reported to the Centers for Disease Control (CDC) and prevention for the evaluation of surveillance trends [8]. Information like species, point location, vaccination status, rabies virus variant (if rabid) and human or domestic animal exposures should be

submitted for rabies testing. Electronic laboratory reporting and notification systems should be implemented by public health authorities [9].

Mass dog vaccination program:

As we know, all livestock animals, cats, dogs, humans, and even wildlife are susceptible to this infection [10]. Once clinical signs develop, it is an almost fatal condition with no treatment available [11]; so, to save the exposed patients, prevention is the main approach. It is impossible to eliminate canine rabies from the world due to wildlife. It is impossible to vaccinate all the wildlife. But to attain "herd immunity" in endemic areas, the World Health Organization (WHO) recommends vaccination of 70% of the dogs per year in endemic areas [12].

The most important tool to control rabies is vaccination. There are two types of vaccination exposures i.e Pre Exposure vaccination and post-exposure vaccination. In Asian countries, post-exposure vaccination is valid, but it is not advisable in the United States [13]. Pre-exposure vaccination is recommended for people who are in contact with animals, such as laboratory staff, animal handlers, veterinarians, wildlife officers, children living in areas at risk, and individuals living in or moving to the areas of risk. The intramuscular (IM) route is considered the standard route of vaccine administration [14].

Pre-exposure prophylaxis (PrEP) consists of two doses of rabies vaccine administered on days 0 and 7 through either the intradermal (at 2-site, 0.1 mL per site) or intramuscular (at 1-site, 0.5mL or 1.0mL depending on the product) route [15]. Immunocompromised individuals may require an additional third dose on days 21–28. Prophylaxis after post-exposure is based on the type of exposure and includes prompt washing of wounds, rabies vaccination, and Rabies immunoglobulin (RIG) for Category III exposures [16]. Individuals who are already vaccinated require only two doses on days 0 and 3 to boost the immune system in case of re-exposure, and RIG is not required.

Currently, Oral vaccines are used to eliminate rabies infection among red foxes in several countries of Europe [17,18] and to prevent raccoon rabies from expanding in the eastern United States and Canada [19]. Fox rabies has been successfully eradicated from much of Europe through the implementation of oral rabies vaccination (ORV) programs. Immunological and vaccine delivery challenges are the main hindrance to the effectiveness of ORV in free-roaming dogs. For effective immunization, dogs must chew the vaccine-containing sachet or blister pack, allowing the vaccine to be released and deposited into the oral mucosa [20].

Challenges in Rabies Control and Elimination:

It is difficult to control rabies because of the following five major challenges to be overcome [21]

- The population of stray dogs is so high that it cannot be vaccinated.
- Lack of information about dog ecology and dog population size.
- Rabies is considered a low priority for public health and One Health.
- Lack of resources to vaccinate the entire dog population.

- Wild animal species are also a source of infection. We cannot vaccinate these species.

Wide host range and worldwide distribution are also important challenges of rabies. Translocation of raccoons and other mesocarnivores, which is done accidentally or intentionally, is a major threat to the control of rabies [22, 23]. Lack of awareness and knowledge among the public about the severity of this disease is also a considerable challenge in rabies control. Some cultures use dog saliva for wound treatment [24]. Similarly, it is found that aggressiveness and uncharacteristic behavior of people or animals with symptoms of rabies are linked with sorcery or demon possession [25]. Third-world countries lack the resources to control stray dogs that spread urban rabies. Studies have found that stray dogs and the absence of rabies control programs are two factors responsible for millions of cases in Latin America and Asia [26]. In these countries, people lack the resources to buy the vaccines because they are expensive. Nerve tissue vaccines are still used in these countries, and they have serious neurologic complications because of autoimmune disease [27].

Community Awareness and Responsible Pet Ownership:

The deficiency of community awareness about the disease is a major hurdle in fighting rabies [28]. Governments of different countries have initiated different awareness programs for the prevention and control of this lethal disease. The government of Bangladesh has implemented four strategies for rabies control: advocacy, communication, social mobilization (ACSM), modern treatment for dog bite, mass dog vaccination (MDV), and dog population management (DPM). These strategies will help to reduce rabies cases if people follow them. Community knowledge, attitudes, and practices play a key role in controlling rabies in both animals and humans [29]. Awareness should be created among people by discussing the fatality and danger level of the disease. Current perceptions of the public about rabies should be changed by arranging media talks, fundraising, and education programs [30]. It is the responsibility of pet owners to vaccinate their pets on time and follow the protocols of vaccination [31].

Conclusion:

Rabies is among the entirely preventable zoonotic diseases, making its control a shared responsibility of the veterinary and public health sectors. Timely disease surveillance, early diagnosis, and mass vaccination of dogs are the most beneficial approaches to interrupt transmission and protect both animals and humans. Timely administration of pre-exposure and post-exposure prophylaxis can prevent humans from having severe consequences of rabies. Increasing community awareness, boosting responsible pet ownership, and improving access to low-cost vaccines are equally important for successful rabies prevention. Following a coordinated One Health approach that integrates human healthcare, veterinary services, and community participation is essential to obtain the global objective of excluding human rabies from dogs and safeguarding public health. A coordinated One Health approach remains the keystone for achieving the world's goal of zero human deaths from dog-mediated rabies.

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