

## Rabies Prevalence, Prevention and Clinical Features in Case of Developing Countries: Article Review

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### Abstract

Rabies is a viral disease that affects the central nervous system (CNS) of mammals and has an extremely high case fatality rate. It is widely distributed across the world, with only a few countries (mainly islands and peninsulas) that are free of the disease. It is a neglected disease of poor and vulnerable communities. Underreporting and not recording of cases made it unable to control. Africa and especially South East Asia and are the most common regions to be highly victims of dog bite rabies each year. Mostly young aged and rurals were commonly affected. All mammals are vulnerable to rabies, but only a limited number of species also act as reservoir hosts. They include members of the families *Canidae* (dogs, jackals, coyotes, wolves, foxes and raccoon dogs), *Mustelidae* (e.g., skunks), *Viverridae* (e.g., mongooses), and *Procyonidae* (raccoons), and the order *Chiroptera* (bats). Once clinical signs develop, there are very few survivors. Vaccines can protect pets, as well as people exposed to these animals, but the maintenance of rabies viruses in wildlife complicates control. In humans, illness can be prevented by administering anti-rabies antibodies and a series of vaccinations before the symptoms appear. However, people in impoverished countries do not always have access to effective post-exposure prophylaxis. In general, Domestic dogs serve as a major reservoir of rabies virus in many developing countries and are capable of maintaining virus transmission in a well-defined maintenance cycle. Cats are not known to act as maintenance reservoirs for unique rabies virus variants. They are important as incidental hosts affected by spillover and can serve as important in a chain of transmission of rabies virus to humans and other domestic animals. The only means to prevent rabies is ant rabies vaccination.

**Keywords:** Domestic animals, Dogs, Developing Countries, Epidemiology, Human rabies, Vaccine Prevention and Control

### 1. Introduction

The acute disease produced by rabies virus infection is characterized by such characteristic symptoms that a presumptive diagnosis can be made from the writings of Democritus (500BC) and Aristotle (400 BC)[1], [2]. But circumstantial evidence suggests that the rabies virus originated in Africa, although records of rabies in Africa do not occur until the 20<sup>th</sup> century [3]. Rabies victims live in developing countries in Latin America, Africa and Asia, and are exposed to the rabies virus through dog bites[4]. Every case of rabies prevented is a life saved, so century there is an urgent need to implement rabies prevention diligently and globally. It is a major public health hazard in many developing countries, where the dog population forms the reservoir of the disease and approximately 40 percent of the victims are children[5]. There are several negative costs attributed to rabies. This puts great burden especially on under developed countries. For instance, human death, monetary costs and wildlife loss are widely problems associated with enzootic or epizootic rabies[6].=

### 2. Epidemiology of Rabies in the developing countries

Rabies remains endemic throughout the world except for certain Western European countries and a number of islands, but more than 99% of all human rabies deaths occur in the poorest developing countries. But most rabies cases occur in countries with inadequate diagnostic facilities and surveillance systems for rabies[7]. Recorded deaths in developing countries probably provide a gross underestimate of the true situation as these areas generally have notoriously poor notification systems[8]. The major reason why it persists today is that rabies is a disease which often affects people whose deaths are not heard about or recorded [5].

It is caused by the rabies virus, a neurotropic virus in the genus *Lyssavirus*, family *Rhabdoviridae*[9]. There are many variants (strains) of this virus, each maintained in a particular reservoir host[10].

The major rabies reservoir mammal species were Domestic dog (Widespread dominant reservoir), Jackal, mongoose, Frugivorous and insectivorous bats (Duvenhage virusa) in *Africa* whereas in *Asia* Domestic dog, Wolf and Chinese ferret badger. But Over 90% of human deaths from rabies worldwide are caused by dog bites[2,3, 5,8–12].

Canine rabies predominates in most of the developing world where the greater burden of human rabies also falls. It is estimated that approximately 50 000 people (90% CI: 24,500-90,800) with 56% of deaths to occur in Asia and Africa. The majority (84%) of deaths occur in rural settings[12, 16]. Beyond this psychological

burden of rabies accounts 32,385 and 139,893 Daily Adjusted Life Years in Africa and Asia respectively[16].

Consequently, a further 15 million receive post exposure treatment to prevent the disease. They are the most affected regions, where rabies is most common in children. Though it is preventable zoonosis but it is not effectively controlled throughout much of the developing world[1,3, 5,9,12,13].

Regarding the age distribution of persons bitten was skewed towards the younger ages (median age 9 years, range <1–84 years) a common pattern seen across developing country settings; 60% of cases occurred in the 0- to 12-year age range, 10% in the 13- to 19-year range, and 30% in the >20 age range[1].

According to the World Survey of Rabies (19), annual human deaths due to rabies in Asia and Africa was 33075 and 204 respectively[18] [Table 1].

Table 1 dog bites and number of cases in some of developing countries extracted from different literatures[1,2,4, 6, 18]

Countries	Dog bites and cases per year
South Africa	257/10000
India	30000/100000*
Mexico	15/100,000*
Hong Kong	421
Tanzania	426
Kenya	3245
Indonesia	141
Ethiopia	322
Bangladesh	2000
Philippines	362
Sudan	29
Egypt	23
Uganda	12
Vietnam	230

\*-Estimated incidence rate of rabies but others are deaths due to dog bite rabies.

### 3. CLINICAL FEATURES OF RABIES

Consequently, Early recognition depends on eliciting a history of a bite or other contact with a possibly infected mammal, most commonly in dog rabies endemic areas of Asia, Africa or South America[18]. Initial symptoms of clinical rabies are often vague and non-descript[19]. As the disease progresses, rabid animals exhibit certain clinical signs that are typical of rabies, with variations peculiar to carnivores, ruminants, and bats. It is extremely rare to observe all signs in a single infected animal[13].

But signs and symptoms are different in different animals as stated as follows

#### Dogs

Virus excretion can begin 4 days before onset of illness. The dog may exhibit a subtle change in temperament with a slight rise in temperature, dilation of pupils, and a sluggish corneal reflex, attacking and biting anything (often injuring mouth and breaking teeth), exaggerated responses to sound and light, restlessness, nervousness, snapping at imaginary flying insects, disorientation, wandering aimlessly, a fixed stare, drooling saliva, hoarse howling, choking sounds, *progressive paralysis* (become apparent with a change in bark (due to paralysis of laryngeal muscles) and difficulty in swallowing (due to spasms and eventual paralysis of pharyngeal muscles), leading to drooling of saliva[9,11,13,14].

#### Cats

Similarly with dogs Virus excretion can begin 4 days before onset of illness. Symptoms are being aggressive, uncoordinated, frothing, increased accumulation of saliva, slight incoordination or muscular tremors, often accompanied by nervousness, aggressiveness, and irritability[15]. At this time the cat may be particularly dangerous, often attempting to bite and scratch anything encountered. unusually affectionate and purr, or extend and retract their claws[1,19,20]. The cat develops ascending and generalized paralysis; coma and death soon follow[13].

#### Cattle

Clinical manifestations among cattle were a typical hoarse bellow, aggressive particularly on provocation, brutal attacks on lifeless objects, striking other cattle, attacking humans, wind-sucking, separate themselves from rest of herd, anorexia, knuckling of fetlocks especially hind limbs, swaying gait, tail and posterior limb paralysis, jaw and tongue paralysis, profuse salivation, dragging hooves, pseudo-oestrous, hypersexual behaviour, decreased milk production, dilated pupils, fixed stare, grinding teeth, pica, tenesmus with diarrhoea, frequent urination, loss of condition, and emphysema[8].

#### Sheep/Goats

Similar with cattle symptoms but hypersexual behaviour, sexual excitement, incessant bleating, aggression,

aimless running, pawing and paddling, and grinding of teeth are prominent[7].

**Horses**

Muzzle tremors are the most frequently observed and most common initial signs. Unexplained aggressiveness, kicking, biting, colic, sudden onset of lameness, Pharyngeal paralysis, anorexia, depression, colic and ataxia and inability to swallow[3].

**Pigs**

Hiding in corners of pen, hypersexual behaviour, aggression, biting, and may kill offspring[4,6,9,15,18].

**Wild animals:** Often lose fear of humans.

**Raccoons**

Most of the time raccoon's is aggressiveness. Other clinical abnormalities noted in rabid raccoons include incoordination leading to an inability to walk or unusual behavior such as wandering aimlessly in daylight, and showing no fear of dogs or humans[8]

**Fox, jackals and wild cats**

They exhibit confusion as a predominant sign bites people and other animals only when approached by them. Yellow mongooses generally demonstrate tame behaviour, but some are very aggressive. Jackals are usually aggressive, and lose fear of humans.[2,6,9,12,16].



Figure 1 Salivation, Bellowing and loss of condition[8]



Figure 2 Cow salivation, bellowing and lameness[8]



Figure 3 In horse, muzzle tremors colic and ataxia[8].



Figure 4 Aggressive behavior in unusual circumstances is well documented in domestic and wild animals infected with Rabies[8]

**Diagnosing Rabies in Humans:** -Because rabies is often not considered during the evaluation of patients with acute encephalitis. But human rabies cases are usually identified after death. Ante mortem diagnosis is possible, however, by analyzing the saliva, cerebrospinal fluid, skin (from the posterior neck), and serum of a symptomatic patient. Brain biopsy material can also be examined for rabies[8] .



Figure 5 The collection of a corneal scraping to assist in the ante mortem diagnosis of rabies[8]

#### 4. PREVENTION OF RABIES

There is no specific treatment for rabies, which is a fatal disease[9] that implies incurable but preventable. But immunizing all dogs owned by an individual or by the community and reduce the size of the ownerless dog population by reproduction control, reduction of the carrying capacity of the environment and law enforcement when needed[1,6,19, 21]. Nonetheless, identified four common reasons for the lack of effective canine rabies control in developing countries including Africa were:

1. A low priority given to disease control as a result of the lack of awareness of the rabies burden
2. Epidemiological constraints, such as uncertainties about the required levels of vaccination coverage and

- the possibility of sustained infection cycles in wildlife
3. Operational handicaps, including the accessibility of dogs for vaccination and insufficient knowledge of dog population sizes when planning the vaccination campaigns
  4. Limited resources for the implementation of rabies surveillance and control[3,4, 8,17, 21].

Consequently, to reduce the risk of rabies, it is important that thorough cleaning of the bite wound is initiated as soon as possible. Rabies vaccine is usually given after exposure to a possibly rabid mammal, but it is more effective if used beforehand. The combination of pre-exposure immunization followed by post exposure boosting has proved 100% effective[3, 6, 8, 10,19,20,22]. But in developing countries, where resources for animal disease control are limited or not present, diseases can readily become established as endemic, which frequently results in death, and threats to food security and local economies[5].

**Vaccination:** - vaccinating dogs have multiple advantages rather than culling them [6]. For instance,

- 1) **It's a barrier** Dogs are the main reservoir host for human and canine rabies. Vaccinating at least 70%of dogs in an area creates 'herd immunity'. The vaccinated dogs form a barrier, slowing the spread of rabies until it dies out. By eradicating this main source of infection, rabies cases in dogs and other animal populations can be eliminated and human rabies deaths vastly reduced[6,15,21].
- 2) **Its humane** Millions of dogs are saved from needless inhumane culling that is driven by a fear of rabies; millions of cases of rabies in dogs are also prevented; vaccination promotes a more responsible and less fearful attitude towards dogs within communities[21].
- 3) **It's cost-effective** Vaccinating dogs is not only more effective than culling dogs for controlling rabies, but it is also very cost-effective. As more dogs are vaccinated, fewer people are bitten by rabid dogs and this can greatly reduce the demand for costly human vaccines given for post-exposure treatment. Consequently all dogs and cats regardless of their age, weight or pregnancy status should safely be vaccinated[15,21].

Even though it is preventable by vaccination developing countries face multiple challenge from implementation vaccination campaign. Many factors help to explain the relative lack of success of vaccination campaigns in developing countries, as compared to developed countries. For example, the campaigns are not always well managed; vaccination does not cover a sufficient number of animals, nor does it reach all communities; and the vaccines themselves are not always handled or applied correctly. The wide biodiversity present in many developing countries also complicates rabies control, because it increases the number of possible reservoirs of the rabies virus. This condition favors transmission of rabies from wild reservoirs to domestic animals, such as dogs the ('spillover') phenomenon [10,15,19-21].

**Administration of the vaccine** Peer-reviewed literature, epidemiological reviews and expert judgment were reviewed for evidence to support a reduced (four intramuscular doses at days 0, 3, 7 and 14) vaccine schedule in healthy patients during rabies post-exposure prophylaxis (PEP)[1,22,23]. Unless persons are immunosuppressed four doses is acceptable to prevent rabies. Otherwise five doses 0, 3, 7, 14 and 28 days is recommended for immunosuppressed individuals[2].

No increase in adverse events was identified or suspected following deletion of the final rabies vaccine dose (at day 28) of the "Essen" regimen for post-exposure prophylaxis. Various immunosuppressive agents, drugs and illnesses can interfere with active immunity after vaccination: seroconversion is may not be much important among immunosuppressed persons as a result they were easily attributable to infection[21].

Until additional evidence becomes available, prophylaxis in persons with broadly defined immunosuppression should be administered using five doses of vaccine.

Overall, previous studies indicate that PEP – combining wound treatment *plus* local infiltration of rabies immunoglobulin (RIG) *plus* vaccination – is uniformly effective when appropriately administered, regardless of whether a fifth dose of rabies vaccine is administered[3,9,19].

Table 2 WHO Approved Post Exposure rabies vaccination Regime [9]

Regimen	Summary	Day(number of sites)						
		0	3	7	14	21	28	90
<b>Essen (IM 1x5)</b>	One dose into deltoid muscle on each of five visits	(1)	(1)	(1)	(1)		(1)	
<b>Zagreb (IM 2-1-1)</b>	Double dose IM(1 dose at 2 sites) on day 0, followed by single doses on days 7 and 21	(2)		(1)		(1)		
<b>Thai Red Cross (ID 2-2-2-0-1-1)</b>	Double 0,1ml dose ID (1 dose at 2 sites) on days 0, 3, 7 followed by single doses on days 28 and 90	(2)	(2)	(2)			(1)	(1)
<b>Oxford (ID 8-0-4-0-1-1)</b>	Eight 0,1ml doses in separate sites on day 0, then four 0,1ml doses on day 7 (separate sites), then single doses at 28 and 90 days	(8)		(4)			(1)	(1)

## 5. CONCLUSION

Although rabies is widely distributed across the globe, it is great disease burden of poor and vulnerable communities. Rabies is often perceived as a rare or insignificant disease of humans in developing countries; this perception has been a major factor hampering the development of disease control initiatives among under developed countries. The vast majority of human rabies deaths can be prevented through sustained dog vaccination programmes. It was recognized as the most cost-effective intervention to interrupt the cycle of transmission and to avoid human deaths occurring due to dog rabies. Additional measures like dog population management, education, awareness and cooperation from all stakeholders improve the cost-effectiveness of the vaccination intervention.

**Competing Interests-** authors declare no competing interest.

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