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Review Article

Review on Economic Importance's of Rabies in Developing Countries and Its Controls

Abstract

Rabies is a zoonotic viral disease of mammals most often transmitted through the bite of a rabid animal. Warm blooded animals are susceptible to infection with rabies virus and are therefore possible reservoirs. Dogs are the main reservoir of rabies virus in developing countries and are responsible for 99% of human infections. Even though developed countries have been able to contain recent outbreaks of zoonotic diseases, many resource-limited and transitioning countries have not been able to react adequately. Rabies remains a global zoonosis of major public health, agricultural and economic significance. It cause many economic loses in many developing country. Rabies transmitted by dogs is responsible for the loss of over 1.8 million DALYs (disability adjusted life years) every year, with direct and indirect economic costs (PEP, animal tests, dog vaccination, and livestock losses) totaling $5.5 billion per year. In addition to that its effects also included the costs associated with the risk of human mortality, resulted in a global cost for canine rabies of $120 billion. These virus disease result in about 24,000 to 60,000 deaths worldwide per year. More than 95% of human deaths caused by rabies occur in Africa and Asia. For instance thousands of people are infected with rabies in Ethiopia, and an estimated 2,700 people die each year—one of the highest rates in the world. Even though total number of animal burden is unknown, but healthcare workers and scientists confirmed thousands of cases of rabies in dogs in Addis Ababa (the country's capital) region alone. Rabies is present in more than 150 countries and on all continents but Antarctica. To mitigate those economic loss due to rabies, it is important to prevent through use of vaccine and environmental management.

Introduction

Tb, Mastitis, lameness, metabolic abnormalities and other diseases affect many developing countries' animals are many times more prevalent than rabies. However, rabies is all but 100% fatal in humans and animals; it can be transmitted from animals to humans, making it a very important disease to recognize [1]. Rabies is a rapidly progressive and uniformly fatal viral cause's encephalitis caused by the bullet-shaped viral particles of the rabies group of Rhabdoviridae, genus Lyssavirus whose nucleus is RNA [2]. It causes inflammation of the brain in humans and other mammals. Early symptoms can include fever, tingling at the site of exposure, anorexia and change in behavior [3].

These symptoms are followed by one or more of the following symptoms: violent movements, uncontrolled excitement, fear of water, an inability to move parts of the body, confusion, and loss of consciousness [3].Once symptoms appear, the result is nearly always death [3]. It transmissible disease among animals and animals to human. It causes economic loses directly or indirectly on local and national economy.

Etiology and epidemiology

Rabies is caused by lyssaviruses in the Rhabdovirus family. Lyssaviruses are usually confined to one major reservoir species in a given geographic area, although spillover to other species is common. Identification of different virus variants by laboratory procedures such as monoclonal antibody analysis or genetic sequencing has greatly enhanced understanding of rabies epidemiology. Generally, each virus variant is responsible for virus transmission between members of the same species in a given geographic area. To date, >15 different lyssaviruses have been described. Globally, rabies virus is the most important member of the genus.

From an epidemiologic perspective, the name of the mammalian species acting as the reservoir and vector is used as an adjective to describe involvement in the infection process. For example, rabies maintained by dog-to-dog transmission is termed canine rabies, whereas rabies in a dog as a result of

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infection with a variant from a different reservoir mammal, eg, skunk (or raccoon or fox), would be referred to as skunk (or raccoon or fox, etc) rabies in a dog [4]. The rabies virus is present on all continents except Antarctica. Some countries have implemented vigilant control measures and succeeded in eradicating the disease to meet the OIE requirements for rabies free status. However, in some countries, the disease remains endemic with rabies present mainly in wild animal hosts Although the infection of domestic livestock could have economic consequences in some countries, it is the occurrence of rabies in domestic dogs posing a threat to humans that is of major concern in several developing and in-transition countries ([PDF]Rabies – OIE).

Clinical description

Rabies is an acute encephalomyelitis that almost always progresses to coma or death within 10 days after the first symptom. 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. There is a wide range of non-specific prodromal symptoms, so rabies patients have presented to rheumatologists, neurologists, psychiatrists, cardiologists, respiratory and acute medicine physicians, ear, nose and throat specialists, general and transplant surgeons and GPs [5]. It includes, Paresis or paralysis, delirium, convulsions. Without medical attention, death in about 6 days, usually caused by respiratory paralysis.

Diagnosis of rabies: Laboratory tests of secretions and biological fluids such as saliva, spinal fluid, tears, and tissues may be used to diagnose rabies [6]. Laboratory techniques are preferably conducted on central nervous system (CNS) tissue removed from the cranium. The most widely used test for rabies diagnosis is the FAT, which is recommended by both WHO and OIE. This test may be used directly on a smear, and can also be used to confirm the presence of rabies antigen in cell culture or in brain tissue of mice that have been inoculated for diagnosis (Shankar, B. P, 2009).

Detection by FAT on skin biopsy (ante mortem). FAT positive after inoculation of brain tissue, saliva or CSF in cell culture, or after intracerebral inoculation in mice or in suckling mice. Detectable rabies-neutralizing antibody titer in the serum or the CSF of an unvaccinated person. Detection of viral nucleic acids by PCR on tissue collected post mortem or intra vitam in a clinical specimen (brain tissue or skin, cornea, urine or saliva) (www. who. Int). RABV was isolated through intracerebral inoculation of suckling mice or by addition of suspensions of brain or saliva specimens to cultured mouse neuroblastoma cells, as described previously (Noah, 1998).

Dimention to economic impacts of rabies

Like all zoonotic diseases, rabies is maintained in an animal reservoir. In developed countries, where canine rabies has been eliminated, the virus may continue to circulate in wildlife, whereas in most developing countries the principal reservoir is domestic dogs. Human and livestock exposure is based on a multitude of risk factors (Zinsstag et al., 2007) [7]. Dog vaccination status is of paramount importance and while it represents a cost (indicated by the shaded box), it minimizes or eliminates further economic impact. In contrast, unvaccinated dogs, or dogs whose vaccination status is unknown, represent a pathway to further economic impacts. If the vaccination status of a dog can be readily determined, the initial cost of vaccination negates any further downstream impacts, but when humans and livestock are exposed to a dog that might have rabies, or whose vaccination status is unknown, further costs may be in curred. Livestock vaccination also represents an up-front cost, without further impacts, while unvaccinated, exposed animals will either not become infected, or will die from rabies. Similarly, there are two pathways following human exposure: the individual either seeks medical treatment and is given PEP, incurring direct and indirect costs [8], or he does not receive PEP, and either remains well or dies from rabies, leading to further costs. In Ethiopia, *Rabies* incidence rates of 21% and 11% at herd level were calculated for the mixed crop-livestock and pastoral production systems, respectively [9].

Counting the costs of rabies

On livestock and working animals: In countries where rabies is present, livestock and other working animals can become infected with the rabies virus. Livestock is an important source of food and income globally and working animals contribute to livelihoods particularly of livestock dependent poor in many parts of the world. Working animals are not limited to cattle, buffaloes, horses, donkeys and camels for plowing the fields and transportation of people and goods as dogs are used for hunting, herding livestock, assisting military and police forces and guarding property. Moreover in some cultures, the consumption of dogs is a common practice. Deficient surveillance and the lack of reliable data on the number of rabies cases is a major constraint to assessing the economic impact of rabies on the local economies when livestock and working animals die due to rabies or infect humans. In addition, the need to pay for transport and expensive post-exposure prophylaxis for rabies exposed family or community members can lead to the unplanned sale of production animals and livelihoods assets, further impacting food and economic security.

The epidemiology of rabies in livestock and working animals varies geographically. Changing land use and reforestation has led to the expansion of areas where livestock have increased contact with rabies infected bats and wildlife. Vampire bat rabies especially impacts livestock production in Latin America while in Eastern Europe and Asia, livestock and working animals are more readily infected by other wildlife such as foxes, jackals and wolves. In Africa, dogs appear to play an important role in the transmission of the disease to transport animals especially in urban and peri-urban areas. Improved surveillance and a clear picture of the economic and public health impacts of rabies on the national and local economies would contribute to more appropriate allocation of resources and the urgently needed political will. In Ethiopia, there is 412.83 cases per 100,000 in dogs, 19.89 cases per 100,000 in

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cattle, 67.68 cases per 100,000 in equines, and 14.45 cases per 100,000 in goats (Table 1) [10,11].

On tourism, recreation and wild life conservation: Rabies threatens many species with disease epidemics drastically reducing population's numbers. Ethiopian wolves, *Canissimensis*, are limited to a decreasing, fragmented range of mountainous habitat. Numbers of the Ethiopian wolf have fallen to an estimated 210 adult individuals in. The recent decreases in the population are mainly the result of consecutive epizootics of Rabies and another viral disease, canine distemper (IUCN red list).The African Wild dog, *Lycaonpictus,* is facing extinction due to rabies as well. The Kudu, *Tragelaphus*, is also threatened in some regions Extinction of some species could have detrimental effects on biodiversity [12].

There is no doubt that canine rabies control has the potential for enormous public health benefits, not only reducing the number of human rabies deaths, but also the demand for costly post-exposure prophylaxis. However, control of animal rabies also has broader societal impacts, with benefits for both human and animal populations affected by the disease. Rabies is a disease that elicits great fear and distress, both as a result of uncertainties faced by those requiring post-exposure prophylaxis in impoverished and remote rural communities, and as a result of the psychological trauma involved in managing human rabies cases. More recently, rabies has become a concern for the tourism industry with travel advisories issued in countries experiencing a reintroduction of rabies or on-going endemic disease. Imported cases of human rabies, although rare, highlight a continuing lack of awareness among travelers of the disease risk in canine rabies-endemic countries. Additional impacts of animal rabies control include benefits for animal welfare, with improved attitudes and treatment of dogs, and benefits for wildlife conservation, with mass dog vaccination recommended as part of conservation strategies for wild carnivore populations threatened by canine rabies. Awareness of the multiple benefits of animal rabies control not only provides added justification for rabies control initiatives, but also broadens the constituency for support, offering the potential for developing integrated control measures that involve veterinary public health, tourism, wildlife conservation and animal welfare agencies.

Human and animal cost of global rabies: Rabies remains a low priority for the global public health community, despite the feasibility of control and potential for elimination. A lack of accurate data on the burden of rabies contributes to this neglect. In an effort to redress this balance, we have launched a global survey amongst stakeholders in rabies control and prevention and are reviewing published literature with the aim of re-assessing the global burden of canine rabies. This research highlights knowledge gaps in key parameters (exposure incidence, probability of bite victims receiving post-exposure prophylaxis, and prevalence of rabies in animal populations) and geographical regions (North and Central Africa, China, Central and South Asia) where data is sparse or cannot be reliably validated. Nonetheless, we identify significant correlations between key epidemiological parameters and socioeconomic attributes and use these to parameterize a probabilistic model to quantify the burden of rabies with country data or cluster averages. The model suggests that the death toll from rabies is greater than all other zoo noses and that the global burden of rabies in disability-adjusted life-years exceeds that of schistosomiasis, trypanosomiasis, onchocerciasis and dengue. The study generates a number of location-specific predictions that could be tested with active surveillance studies, and provides guidance for future research and prioritization of strengthening control efforts. Critically, the model draws attention to the relationship between investments in rabies control in the animal sector and concomitant reductions in human rabies and expenditure by the public health sector. Overall these findings demonstrate the magnitude of the burden of rabies and the substantial reductions in human suffering and economic savings possible through multisector and political. Ethiopia has been considered among the most rabies affected country in the world with an estimated annual occurrence of 10, 000 cases of human rabies which is equivalent to 18.6 cases per100, 000 people. In the 1980's Bogel and Motschwillor (Bögel K, Motschwiller E, 1986) had also reported 12 cases per million people which made Ethiopia the second worse affected by rabies next to India [13] .

Table 1: Estimated impact of rabies in livestock.

Livestock losses [11]	Africa estimate	Asia estimate
Total no. cattle	230 000 000	423 000 000
Rabies incidence rate/100 000 cattle	5	5
Annual no. of cattle deaths from rabies	1100	350

Indirect costs of Rabies Exposure: Indirect costs were incurred by patient andnonpatient (government) entities. Patient IC referred to any lost wages, travel costs, alternative medicine costs, or other outlays related to the patient volunteer receiving PEP, such as babysitter fees, day-care charges, longdistancetelephone costs, and psychological. Fees for counseling or anxiety treatment. Nonpatient IC included public health and animal control costs borne by county governments to contain the public health risk of the disease. The average salary of public health and animal control workers plus average transportation and investigational costs (e.g.,diagnostic laboratory test to identify the rabies virus in animals) was used to value activities based upon the mean hours worked/traveled per case (Stephanie A. , Ray T., et.al., 2007). In addition to that, diagnostic testing and observation and dog vaccination constitute the two main indirect costs of canine rabies. Additionally, dog population control is used in some regions and is relevant cost. Following possible human exposure to rabid dog, an animal control agency will attempt to obtain the dog and determine its rabies status. Such testing and observation plays an important role in disease surveillance.

Regional status

An estimated 31,000 human deaths due to rabies occur annually in Asia, (WHO) with the majority – approximately 20,000 – concentrated in India. (Harris, Gardiner (6 August 2012) Worldwide, India has the highest rate of human rabies

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in the world primarily due to stray dogs. The burden of canine rabies falls most heavily on Asia (e.g. China and India), which experiences over half of human and cattle deaths, and performs more than 90%of PEP administrations and just under half of dog vaccinations Total human and livestock deaths in Latin America are much lower than in Africa and Asia, probably as a direct result of coordinated efforts by many countries in the region to eliminate canine rabies [14], which also explains the high annual number of dog vaccinations. Expenditures to fight rabies in Africa are much lower than in Latin America and Asia, but many deaths could be prevented through better access to PEP and expanded dog vaccination efforts.

The most dramatic difference between Asia, Africa and Latin America is seen in access to PEP. For each fatal case of human rabies, Latin America performs over 41,000 PEPs, while Asia and Africa give around 200 and 8, respectively. Greater access to PEP in Latin America clearly decreases the number of human lives lost. The three regions show a similar disparity in dog vaccination rates. In Latin America, over 2.8 million dogs were vaccinated per human life lost, while only some 1000 were vaccinated in Asia and 200 in Africa. The large number of dog vaccination sin Latin America has had an obvious impact on the number of humans who die from rabies in the region. Cattle losses show a similar trend: for each cow lost to rabies in Latin America, over 1.7 million dogs were vaccinated, while in Asia and Africa the numbers were approximately 1900 and 600, respectively.

Macroeconomic impacts

The rabies burden is made up of different components. Societal costs include mortality and lost productivity from premature death, and morbidity from adverse events (AE) of vaccination using nerve tissue vaccines (NTVs) and psychological effects of exposure to this fatal disease, expressed as disability-adjusted life years (DALYs). Direct costs of PEP (depending on the use of rabies immunoglobulin (RIG), and the type of vaccine and regimen, for example intramuscular (IM) versus intradermal (ID) administration) and indirect costs of seeking PEP (travel and accommodation for multiple clinic visits and lost income) fall upon the medical sector and affected communities, whilst the veterinary sector typically incurs costs related to dog vaccination. Veterinary and medical sectors both have responsibility for surveillance costs. Livestock losses depend on the size of at-risk livestock populations and preventative measures taken, and impact both national economies and households [15].

Human and livestock deaths from rabies and the cost of PEP produce regional macroeconomic impacts, including changes in income and employment, which arise from multiple sources. First, human death and loss of income while seeking PEP reduce consumer spending throughout the economy. Canine rabies also causes significant livestock losses, which reduce producers' incomes, resulting in a fall in spending in other sectors of the local and regional economy. These macroeconomic impacts illustrate how rabies affects persons who are not at direct risk of the disease. In this regard, Regional Economic Analysis (REA) allows for the estimation of disease impacts in terms such as income and employment, which are important to the general public. Although models such as IMPLAN (Impact Analysis for Planning, Minnesota IMPLAN ''Group) and REMI (Regional Economic Modeling Inc.)Are commonly used in REA, a lack of data often prevents their application in developing countries (MIG Inc.2012).

Costs and cost-effectiveness of control measures

Attempts to build support for more widespread investment in rabies control require an appreciation of the current economic costs inflicted by rabies, the cost of control measures, and the potential benefits of those control measures [16]. The composition of the economic impacts of canine rabies in Latin America, Africa and Asia reveals something about the effectiveness of management strategies within each region. In Latin America, the distribution of costs reflectssignificantefforts to eliminate the disease, because human and livestock losses are low, but expenses for PEP and dog vaccination are relatively high. This may also reflect lag time between investing in canine rabies reduction and the return on that investment in terms of reduced PEP and fewer vaccinations. As noted above, even when the prevalence of canine rabies is reduced, it may take some time before individual ls perceive their risk to be lower, and become less likely to seek PEP inappropriately, after incidents unlikely to constitute rabies exposure.

In contrast to Latin America, Africa experiences the world's second highest total costs from human and livestock deaths from rabies, while relatively little overall effort is devoted to PEP, animal tests and dog vaccinations. This pattern of economic impacts indicates that Africa is the region furthest from eliminating canine rabies, but it also implies that large benefits could be derived by shifting costs towards prevention.

In Asia, even though significant investments have been made in PEP, dog vaccination, human deaths and livestock losses remain high, indicating that prevention efforts still fall significantly short of the levels needed to drive costs down. This suggests that prevention efforts are incomplete, because while PEP and dog vaccination are crucial for preventing rabies in humans and livestock, animal testing represents the surveillance portion of prevention efforts. Without adequate surveillance, it may be difficult to gauge the dis- ease status of dog populations, resulting in incorrect estimates of the level of vaccination needed.

Because the economic costs of canine rabies can be seen as benefits that would be realized if it were eliminated it is essential to understand the pathways to economic impacts of the disease. Importantly, the global burden of canine rabies is not distributed equally, and it disproportionately affects regions with limited resources, that are least capable of responding to the disease. America, Africa and Asia are at different stages of canine rabies elimination. Due to the nature of the reservoir and the close relationship between dogs and humans, dog vaccination is a crucial component in all regions. In Latin America vaccination campaigns are one of the primary factors that have reduced human death, while in Africa the lack of dog vaccination is one of the main factors behind

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the high human death rate. The benefits of eliminating the disease extend beyond persons directly exposed to rabid dogs, to everyone in the community. Understanding the economic impact of canine rabies and the benefits that can be achieved by its elimination is central to the effective cooperation of health sectors. Taking data for each country from the recent global burden reassessment, it is possible to compare the pattern of burdens and costs across the three main endemic regions for canine rabies (Table 2). Africa suffers the highest per capita rate of human deaths of the three continents. Death rates are lower in Asia, due to substantial investment in the provision of PEP, but overall deaths are higher. Finally, investment in dog vaccination in Africa and Asia is not high enough to create the level of coverage that has been shown to be effective at reducing rabies exposures in Latin America in recent years.

Rabies control and prevention

The mortality rate of rabies is extremely high. Due to no proven standard therapy, current

Management for rabies patients is mostly symptomatic and palliative (Wu, Hoa-Hsin., et.al, 2013), including adequate sedative agents, setting the patients in a private, quite area, and emotional support.

The use of wider measures to control the spread of rabies, even in cases where it seems unlikely that an animal has been in a position to infect others, is very likely to be instigated given the serious nature of even a small risk of rabies. Measures will be focused on containing and eradicating the disease as quickly to protect public and human health and to prevent the disease from becoming established in any animal population (Rabies Control Strategy June 2011).

Table 2: The impacts and economic burdens of canine rabies vary by continent [16].

Impact	Africa	Asia	Latin america
Death	21,502	37,266	182
Death/100,000 population	2,09	0.93	0.03
DALYs lost	1,345,643	2,354,159	11,951
Exposure(to rabies, not all dog bites)	847,326	14,633,844	122,701
PEP treatments	1,387,848	26,589,22	835,656
Dog vaccination coverage	~14%	~16%	~60
Cost of prevention (US$)	**15,948,303**	**42,115,175**	**63,287,263**
Dog vaccination	14,520,789	38,528,371	61,033,617
Dog popilation management	1,305,247	3,369,953	1,930,503
Surveillance	122,267	216,851	323,143
Preventable costs (US$)	**1,266,514,109**	**6,660,728,927**	**289,466,942**
Productivity losses	773,352,665	3,852,276,021	30,242,012
Direct PEP	156,110,495	1,363,634,648	129,331,962
Indirect PEP	57,504,777	1,225,773,035	117,705,839
Livestock losses	279,546,173	219,045,223	12,187,129
Total costs (us$)	**1,282,462412**	**6,702,844,102**	**352,754,205**
Cost of prevention/person	0.02	0.01	0.12
Preventable costs/person	1.23	1.67	0.54

Rabies, an invariably fatal disease, has been known and feared since antiquity and is usually caused by the bite of an infected animal. More than 98% of all human rabies deaths are caused by the bite(s) of rabid dogs. Rabies is distributed worldwide and can affect all mammals including humans. The virus responsible for rabies infects the central nervous system resulting in a neurological disorder characterized by horrific clinical signs and symptoms in both animals and humans.

The majority of human rabies deaths globally occur as a result of being bitten by dogs. However, reliable data indicating the actual incidence of human rabies exposure are scarce or non-existent in many countries, leading to the widespread belief that the global number of human deaths is significantly underreported. As a result, rabies impacts are often considered insignificant by policymakers, which ultimately results in inadequate political pressure to implement disease control measures. It is estimated that approximately 74,000 people die annually as a result of canine rabies, and most victims are children on the continents of Asia, Africa, and Latin America [15] .

Prevention of rabies in humans is complicated because those most commonly exposed to canine rabies (e.g., children, the poor) also lack the resources necessary to treat or prevent exposure. This means that governments, and other organizations are often the primary source of funding for the required post exposure prophylaxis (PEP).

Rabies transmitted by dogs is responsible for the loss of over 1.8 million DALYs (disability adjusted life years) every year, with direct and indirect economic costs (PEP, animal tests, dog vaccination, and livestock losses) totaling $5.5 billion per year. [15]. study another economic analysis, which also included the costs associated with the risk of human mortality, resulted in a global cost for canine rabies of $120 billion. [17]. Rabies also threatens the survival of endangered wildlife species. Controlling rabies is critically important to prevent human deaths and alleviate its burden in animal species and on local and national economies.

Preexposure vaccination and management: Adherence to a regular rabies vaccination schedule is critical to protect animals against recognized and unrecognized rabies exposures. Parenteral animal rabies vaccines should be administered only by or under the direct supervision of a licensed veterinarianon premises. Rabies vaccines may be administered under the supervision of a licensed veterinarian to animals held in animal shelters before release. The veterinarian signing a rabies vaccination certificate must ensure that the person who administered the vaccine is identified on the certificate and has been appropriately trained in vaccine storage, handling, and administration and in the management of adverse events. This ensures that a qualified and responsible person can be held accountable for properly vaccinating the animal [18].

Pre-exposure vaccination may be offered to high risk groups like laboratory staff handling the virus and infected material, clinicians and persons attending to human rabies cases, veterinarians, animal handlers and catchers, wildlife wardens, quarantine officers and travelers from rabies free areas to rabies endemic areas. Pre-exposure vaccination is

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administered as one full dose of vaccine intramuscularly or 0.1 ml intra-dermally on days 0, 7 and either day 21 or 28 (http://www.ncdc.gov.in/Rabies_Guidelines.pdf) (Table 3).

Domestic animal vaccination: Multiple vaccines are licensed for use in domestic animal species. Vaccines available include inactivated and modified-live virus vectored products, products for IM and SC administration, products with durations of immunity for periods of 1 to 3 years, and products with various minimum ages of vaccination. Rabies vaccines should be administered under the supervision of a licensed veterinarian to animals held in animal shelters before release. Within 28 days after initial vaccination, a peak rabies virus antibody titer is expected, and the animal can be considered immunized [19] Livestock, including species for which licensed vaccines are not available, that have frequent contact with humans (eg, in petting zoos, fairs, and other public exhibitions) should be vaccinated against rabies [20]. But vaccine for herbivores is not available in developing country.

Awareness and education: Essential components of rabies prevention and control include ongoing public education, responsible pet ownership, routine veterinary care and vaccination, and professional continuing education. Most animal and human exposures to rabies can be prevented by raising awareness concerning rabies transmission routes, the importance of avoiding contact with wildlife, and the need for appropriate veterinary care. Prompt recognition and reporting of possible exposures to medical and veterinary professionals and local public health authorities are critical [21].

Conclusion

For many years rabies is considered as less economic significant disease. But the fact that it has more economic significance through way. It has effect on local and national economy directly or indirectly. So that it needs prevention and control of it. To achieve this one all community should be participants002E.

Table3 : Rabies Preexposure Prophylaxis Guide.

Risk category	Nature of risk	Typical populations	Pre-exposure recommendations
Continuous	Virus present continuously, often in high concentrations. Specific exposures likely to go unrecognized. Bite, nonbite, or aerosol exposure.	Rabies research laboratory workers; rabies biologics production workers.	Primary course. Serologic testing every 6 months; booster vaccination if antibody titer is below acceptable level.*
Frequent	Exposure usually episodic with source recognized, but exposure also might be unrecognized. Bite, nonbite, or aerosol exposure.	Rabies diagnostic laboratory workers, cavers, veterinarians and staff, and animal-control and wildlife workers in areas where rabies is enzootic. All persons who frequently handle bats.	Primary course. Serologic testing every 2 years; booster vaccination if antibody titer is below acceptable level.*
Infrequent (greater than population at large)	Exposure nearly always episodic with source recognized. Bite or nonbite exposure.	Veterinarians and animal-control staff working with terrestrial animals in areas where rabies is uncommon to rare. Veterinary students. Travelers visiting areas where rabies is enzootic and immediate access to appropriate medical care including biologics is limited.	Primary course. No serologic testing or booster vaccination.
Rare (population at large)	Exposure always episodic with source recognized. Bite or nonbite exposure.	U.S. population at large, including persons in areas where rabies is epizootic.	No vaccination necessary.

*Minimum acceptable antibody level is complete virus neutralization at a 1:5 serum dilution by the Rapid Fluorescent Focus Inhibition Test. A booster dose should be administered if the titer falls below this level.

References

1. Kopcha M (1987) Nutritional and metabolic diseases involving the nervous system. Vet Clin North Am Food Anim Pract 119- 135: Link: https://goo.gl/TrMNWb.
2. Frederick MA, Gibbs EJ, Horzinek MC, Studdert MJ (1999) Veterinary virology. Academic press. Link: https://goo.gl/GikL54
3. World Health Organization (2013). WHO Expert Consultation on Rabies: second report. No. 982. World Health Organization. Link: https://goo.gl/k8Q9GP
4. Belotto A, Leanes LF, Schneider MC, Tamayo H, Correa E (2005) Overview of rabies in the Americas. Virus research 111: 5-12. Link: https://goo.gl/liLjXG
5. Warrell MJ, Warrell DA (2015) Rabies: the clinical features, management and prevention of the classic zoonosis. Clin Med (Lond) 15: 78-81. Link: https://goo.gl/wpVV7o
6. Venom J (2007) Anim Toxins incl. Trop. Dis no.1 Botucatu
7. Narrod C, Zinsstag J, Tiongco M (2012) "A one health framework for estimating the economic costs of zoonotic diseases on society." EcoHealth 9: 150-162. Link: https://goo.gl/0SREO6
8. Shwiff S, Hampson K, Anderson A (2013) "Potential economic benefits of eliminating canine rabies." Antiviral res 98: 352-356. Link: https://goo.gl/h6Ud6y
9. Tariku J, Monique CM, Mouritsa, Hogeveen H (2016) 130: 67–76
10. Temesgen JW, Wassie M, Gizat A, Sefinew A (2013) "Incidence of rabies in humans and domestic animals and people's awareness in North Gondar Zone, Ethiopia." PLoSNegl Trop Dis 7, no. 5: e2216. Link: https://goo.gl/78yrXe
11. Knobel DL, Cleaveland S, Coleman PG, Fevre EM, Meltzer MI, et al. (2005) Re-evaluating the burden of rabies in Africa and Asia. Bull. World Health Organ. 83: 360–368. Link: https://goo.gl/yOdYNy
12. www.rabiescontrol.net
13. Fekadu M (1997) Human rabies surveillance and control in Ethiopia. In: proceeding of the southern and eastern African rabies group meeting 4-6; Nairobi, Kenya. Link: https://goo.gl/2MgWg7

Citation: Gemechu R (2017) Review on Economic Importance's of Rabies in Developing Countries and Its Controls. Arch Prev Med 2(1): 015-021.

14. Schneider CQ, Wagemann C (2010) Standards of good practice in qualitative comparative analysis (QCA) and fuzzy-sets. Comparative Sociology 9: 397-418. Link: https://goo.gl/MUxRPE

15. Hampson K, Coudeville L, Lembo T, Sambo M, Kieffer, et al. (2015) Estimating the global burden of endemic canine rabies. PLoSNegl Trop Dis, 9: e0003709. Link: https://goo.gl/xoRGuE

16. Taylor LH, Nel LH (2015) Global epidemiology of canine rabies: past, present, and future prospects. Vet Med Res Rep 6: 361-371. Link: https://goo.gl/MGZiJn

17. Anderson A, Shwiff S, Gebhardt K, Ramírez AJ, Shwiff S, et al. (2014) Economic evaluation of vampire bat (Desmodusrotundus) rabiesprevention in Mexico. Transbound. Emerg. Dis. 61:140-146. Link: https://goo.gl/PdWRnr

18. Brown CM, Slavinski S, Ettestad P, Sidwa TJ, Sorhage FE (2016) National Association of State Public Health Veterinarians.

19. Rupprecht CE, Gilbert J, Pitts R, Marshall KR, Koprowski H (1990). Evaluation of an inactivated rabies virus vaccine in domestic ferrets. J Am Vet Med Assoc 196: 1614-1616. Link: https://goo.gl/QZYFkN

20. Link: https://goo.gl/InxlNu

21. Compendium of Animal Rabies Prevention and Control (2016) Journal of the American Veterinary Medical Association 248: 505-517. Link: https://goo.gl/l8X2iN

22. Bellavance F, Dionne G, Lebeau M (2009) the value of a statistical life: a metaanalysis with a mixed effects regression model. J. Health Econ. 28: 444–464. Link: https://goo.gl/JpKV7T

23. Blanton JD, Palmer D, Rupprecht CE (2010) Rabies surveillance in the United States during 2009.J. Am. Vet. Med. Assoc. 237: 646–657. Link: https://goo.gl/a1Jg2K

24. Bowland BJ, Beghin JC (2001) Robust estimates of value of statistical life for developing economics. J. Policy Model. 23: 385–396. Link: https://goo.gl/qwM5TZ

25. Diao X, Alpuerto V, Nwafo M (2009) Economy wide impact of Avian Flu in Nigeria– a dynamic CGE model analysis. HPAI Research Brief No. 15. Link: https://goo.gl/8S8aj6

26. Doucouliagos C, Stanley TD, Giles M (2012) Are estimates of the value of a statistical life exaggerated? J. Health Econ. 31: 197–206. Link: https://goo.gl/368Cet

27. Global Alliance for Rabies Control, 2012. International Collaboration for Canine Rabies Elimination in Latin America. Link: https://goo.gl/qesZ7k

28. Hoffman S, Qin P, Krupnick A, Badrakh B, Batbaatar S, et al. (2012) The willingness to pay for mortality risk reductions in Mongolia. Resour. Energy Econ. 34: 493–513. Link: https://goo.gl/oCMtHi

29. Meslin FX, Briggs D (2013) Eliminating canine rabies, the principal source of human infection: what will it take? Antiviral Res.98: 291-296. Link: https://goo.gl/bpbsVI