

Passive Surveillance of Rabies Post Exposure Incidents in Goshta and Mohmand Dara Districts

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ABSTRACT

Background: Rabies is a perilous viral disease that is lethal, affecting primarily warm-blooded creatures, including humans. Once clinical signs manifest, the illness becomes fatal. The World Health Organization (WHO) approximates that approximately 59,000 individuals perish annually worldwide due to rabies.

Materials and Methods: This disease poses a significant challenge to health and public welfare in Afghanistan, where there is close contact between stray dogs, animals, and humans. Our research was conducted in the Goshta and Mohmand Dara districts of Nangarhar province, employing the principles of passive surveillance and retrospective review. We focused on registered potential cases of exposure to dog bites in both humans and animals. The data collected encompassed patient attributes, such as age, gender, residency (village), place of exposure, time of exposure, animal classification (wild, stray or domestic), anatomical location of the bite, depth of injury, and administered vaccination doses.

Findings: A total of 17 human cases were recorded where out of the mentioned cases 12 belonged to Mohmand Dara district and five cases to Goshta district. In the studied human population except for two cases which were bitten/scratched by other animals (donkey and cat) all remaining were bitten/scratched by dogs. Only four dogs showed clinical symptoms of rabies. All victims received complete doses (5 doses) of anti-rabies vaccination (ARV) after exposure and were observed until the end of the research study, all cured. This study showed that case occurrence is different according to area and occurs more in males (82.352%) compared to females (17.647%). Also, people with an age of less than 20 years are more susceptible to dog bites. This study also showed that understudy populations are more bitten by dogs. A higher percentage of people are bitten in lower limbs. No predator animals have shown symptoms. The dog bites were significantly ($P < 0.05$) increased during May-July compared to Aug-Sep, it means the exposure was effected by season. A total of four animal (cattle) cases of different ages were recorded in veterinary health centers, all bitten by dogs, none showed symptoms. Two of the mentioned animals were slaughtered before onset of symptoms and two remaining were observed no one showed symptoms.

Conclusion: The study shows that dog bite is the main cause of transmission in humans and animals, especially among the male sex including children and young adults. Amended surveillance and prevention of dog bite-related wounds, predominantly among children, are needed.

Keywords: Rabies, Passive surveillance, Dog bite, humans, Mohmand Dara and Goshta

INTRODUCTION

As a global burden, 59000 human-related rabies deaths are estimated annually around the world (Hampson et al., 2015) and more than 95% are due to transmission of causative infection through dog bites (WHO, 2016). Rabies is a pervasive disease that afflicts all continents except for Antarctica. It primarily affects bats and carnivorous animals but can also be transmitted to humans (Hagan and Bruner, 1988). Astonishingly, approximately 95% of human deaths caused by rabies occur in Asia and Africa (WHO, 2010). This viral disease, which is highly lethal and impacts the central nervous system (CNS), affects not only humans but all warm-blooded animals. The incubation period can range from two weeks to six months, with some exceptional cases even exceeding this timeframe. Methods such as heating the rabies virus to 56 degrees Celsius for 30 minutes or using chemical agents like formalin (1%) can effectively inactivate the virus (Dwight et al., 2004).

Clinical manifestations of rabies in dogs include excessive salivation, frothing at the mouth, difficulty in swallowing and drinking, convulsions, and muscular incoordination. Interestingly, certain affected dogs may only experience a paralytic or "dumb" stage, completely bypassing the furious stage. This form of rabies is

characterized by paralysis of the muscles in the pharynx and lower jaw, as well as incoordination that ultimately leads to coma and death (Pedroso et al., 2009). It is important to note that dog bites and the associated risk of rabies are underreported in emerging countries, indicating a poor understanding of the disease burden (Ziadi et al., 2013).

According to Ministry of Public Health (MoPH) Afghanistan reports 12,000 dog bite wounds were recorded in 2013 with 148 deaths, and 6,000 dog bite wounds were recorded in 2014 with 104 deaths (MoPH, 2015). Based on the given description rabies counts as an important problem and requires to be studied for finding useful paths for its threat and eradication. It was necessary to conduct studies on passive surveillance of rabies post-exposure incidents aimed to study the passive surveillance of possible rabies post-exposure cases in Nangarhar province Gosheta and Mohmand Dara districts.

Literature review

1. *Passive surveillance*

Based on the report of the Ministry of Public Health (MoPH) of Afghanistan, 12,000 dog bite wounds were recorded in 2013 with 148 deaths and also, 6,000 dog bite wounds were recorded in 2014 with 104 deaths (MoPH, 2015). A passive surveillance revision was conducted in Uganda, based on a random sample of health centers provided with rabies vaccine, to determine the characteristics of patients with bite injuries. The study examined factors such as age, sex, site of bite, severity of injuries, management techniques, and details of the vaccination course administered. The results indicated that the majority of patients were bitten by dogs, with a significant proportion being young children who are at a higher risk of developing rabies if left untreated due to the location of the bites. It is suggested that active animal bite surveillance studies are necessary to improve mortality estimates and understand the true extent of the rabies problem in the country's population (Fevre et al., 2005).

From 2009 through 2010, a hospital-based survey was conducted among victims of dog bites in three hospitals in Bhutan to assess the administration of anti-rabies vaccine injections. A total of 374 dog bite victims were interviewed, revealing that males (62%) were at a higher risk compared to females ($P < 0.001$). Children between the ages of 5 and 9 years were more frequently bitten than individuals in other age groups. The majority of victims (71%) were bitten by stray dogs (Tenzin et al., 2011).

A prospective data collection was implemented to utilize mobile phones for dog bite and rabies surveillance across nine emergency rooms in Pakistan. The results showed a total of 6212 dog-bite cases over two years starting in February 2009, with the highest number of cases reported in Karachi (59.7%), followed by Peshawar (13.1%) and Hyderabad (11.4%). The severity of the dog bites was measured using the WHO categorization, with 40% of patients having Type I (least severe) bites, 28.1% having Type II bites, and 31.9% had Type III (most severe) bites (Ziadi et al., 2013).

The results of a retrospective cross-sectional review on patients referred to the Sina Hospital Rabies Disease Control and Prevention Center located in Tabriz, Iran the total 1084 patients included in the study, 918 were men and 166 were women, with 777 residing in urban areas and 307 in rural areas. The median age of the patients ranged from 20 to 30 years. The highest number of accidents occurred in January and May. Dogs accounted for 72.4% of the attacks, followed by cats (20.6%), rats (4.1%), and other animals (3%). The majority of attacks (45.8%) took place at home, while 41.8% occurred outdoors and 12.4% at work. Of the attacks, 80.4% involved pet animals, 15.6% involved wild animals, and 4.1% involved animals encountered outdoors. In terms of outcome, 80.4% of the animals were under surveillance, 17.5% ran away, and 2.1% were killed. Superficial bites accounted for 78.7% of all bites, while 21.3% were deep bites. The bites were primarily located on the upper limbs (50.6%), lower limbs (43.5%), head (2.4%), neck (0.6%), chest (1.8%), abdomen (0.7%), and genital area (0.3%). In terms of location, 54.3% of all bite exposures occurred in covered areas, while 45.7% occurred in exposed areas. Surprisingly, 98.6% of the animals, mostly pets, had no history of vaccination (Vahdati et al., 2013).

The findings of a study conducted by Feizhaddad in Iran demonstrate that the average prevalence of animal bites over five years was 1.3 per 1000 individuals in the population. A total of 1300 cases of animal bites were documented, with males accounting for 74.7% and females accounting for 25.3%. Furthermore, the majority of animal bites (31.9%) occurred in the age group of 10-20. In terms of the location of the bites, the most prevalent site was the feet, accounting for 907 cases (69.7%), followed by the hands with 236 cases

(18.2%). Only one bite was confirmed to have occurred on the neck. Overall, 95.8% of the bites were attributed to dogs, while cats were responsible for only 3.3% of the bites (Feizhaddad et al., 2014).

A study was conducted between 1999 and 2001 to describe cases of animal bites suspected to be related to rabies and the practice of post-exposure prophylaxis (PEP) in the Narlidere district of Turkey. A total of 1569 cases of animal bites suspected to be related to rabies were identified based on the district's rabies surveillance forms. Males accounted for 66.7% of the cases and 43.5% of the total cases involved individuals under the age of 20. In 74% of the cases, the animals responsible for the bites were dogs. Only 70% of the animals had an owner, and a mere 17% of the animals had a rabies vaccination certificate. In terms of treatment, 68% of the human cases received PEP, and 21% of the cases required an additional sixth vaccination dose. This poses a significant problem for the healthcare system, with an annual cost of half a million US dollars. Additionally, the currently recommended strategy for controlling the dog population and vaccinating domesticated animals should be supplemented by comprehensive bite prevention training for both adults and children to reduce the incidence of animal bites, particularly dog bites (Kilic et al., 2005).

A survey conducted by Davis et al. in the Palakkad district of Kerala, India aimed to assess the level of public risk posed by stray dog bites. For 10 months, approximately 3800 humans and 549 domestic animals were reported to have been bitten by stray dogs. Among humans, males accounted for 60% of the bite cases, while females accounted for 40%. In comparison to humans, the number of reported bite cases in animals was significantly underestimated, primarily due to inadequate surveillance systems for recording animal casualties. Most of the reported animal cases were in domestic goats, with a smaller number occurring in domestic cows and dogs. Furthermore, two human deaths and eight animal losses, which were presumed to be a result of rabies virus infection, had a history of stray dog bites. The animal losses included five goats, two cows, and one domestic dog (Davis et al., 2016).

A retrospective investigation was undertaken by Rezaeinasab to determine the prevalence of domestic and wild animal bites, as well as the incidence of rabies in humans, within the Kerman province of southeastern Iran. The findings of this study reveal that between 1994 and 2003, there were a total of 10 fatalities in humans, comprising 8 males and 2 females. Half of these individuals were bitten by dogs, while the other half was bitten by foxes. When considering the specific locations of the bites, it was observed that 47% of the victims were wounded on their feet, 41% on their hands, 7% on their trunks, 3% on their faces, and 2% on their head and neck regions. The age group most significantly affected by animal bites was individuals between 10 and 19 years old, while the least affected were children under the age of 4. Males were found to be affected more frequently than females, with a gender distribution of 73.48% and 26.52% respectively ($P < 0.01$) (Rezaeinasab et al., 2006).

Rabies is limited to developing countries and for covering the overall goal for control of rabies it is required to find out the weak points for the control in Asia. The weak surveillance system limited access to modern vaccines, general awareness, and insufficient political commitment are assumed to be the weaknesses for rabies control in Asia (WHO, 2001). Even though the trend toward a seasonal distribution was non-significant, the frequency of dog bite wounds, with the peak rates being observed throughout the summertime months (Harold et al., 1998).

2. *Control methods and strategies*

More than 99% of fatalities caused by rabies in humans can be attributed to dog bites. Therefore, efforts to prevent this disease should primarily focus on addressing the issue of dogs. A comprehensive approach, known as the "One Health" strategy, should be employed to achieve canine rabies elimination. This strategy aims to establish immunity in dogs through the implementation of proven vaccination methods at the local level. In addition, public education and supervision of the human population should accompany these measures. The success of such strategies has been observed in both developed and developing countries, and they can be adapted to suit specific local contexts. Numerous instances in Africa, Asia, and Latin America have demonstrated the effectiveness of community-based vaccination and training programs. These initiatives, guided by a cooperative vision and long-term commitment, have the potential to eliminate canine rabies (Richard et al., 2013).

Proper registration of all dogs, including the issuance of certificates for immunized dogs, is essential. Active surveillance for rabies in animals must be maintained, and immediate action should be taken to observe any healthy dog or cat that has had contact with a suspected rabid animal for 10 days. Should an animal die

under suspicious circumstances, its complete head should be preserved in ice and submitted to a laboratory for examination. Non-immunized dogs or cats that have been bitten by an identified rabid animal should be euthanized without delay. Additionally, prompt treatment of bites and wounds, as well as the use of inactive immunity and vaccines, are crucial for controlling and eradicating this threat (Benenson, 1995).

In various regions of the world, including Asia, policies aimed at reducing the dog population have been met with significant opposition. Countries such as Indonesia, Malaysia, the Philippines, Sri Lanka, and Vietnam have implemented extensive dog control measures across their territories or in specific areas (WHO, 2001).

At the local level, particularly in areas affected by rabies, immediate attention should be given to patients with a history of animal contact, typically involving bites or scratches. These cases should be treated as emergencies, emphasizing the importance of timely medical intervention. Data on individual cases and aggregated statistics must be regularly transmitted from lower to intermediate and central levels. Suspected and confirmed cases should be promptly reported from peripheral levels, with both the diagnosing physician and laboratory involved in the process. Furthermore, there should be a rapid exchange of information with relevant authorities responsible for animal rabies surveillance and control (WHO, 1999).

Therefore, the priority is to have strong encouragement for global awareness of rabies. As part of the advocacy procedure, there is a need to raise rabies surveillance. Consequently, rabies must be a reportable disease and be included in the integrated communicable disease surveillance scheme. The surveillance data must contain both human and animal rabies cases plus records on rabies exposure and human post-exposure cure. There is a need for local and national laboratory networking and quality reassurance programs to settle the collection of more consistent data (WHO, 2001).

Rabies, a fatal disease in humans, can be entirely prevented through prompt and appropriate medical treatment. However, a staggering number of individuals, exceeding 55,000, predominantly in Africa and Asia, succumb to rabies annually, equating to one person every ten minutes (CDC, 2015). Despite its fatality, rabies can be effectively evaded by employing currently available strategies. Vaccination is highly efficacious in providing pre-exposure prophylaxis (PrEP) against rabies in both humans and animals. Likewise, post-bite prophylaxis (PEP) utilizing vaccines and rabies immune globulin (RIG) can reliably avert disease in humans. Yet, the accessibility of these interventions and the knowledge regarding their correct utilization are frequently limited. In the absence of dependable diagnostic tools and accurate risk evaluation, the administration of vaccinations and RIG is often performed erroneously, resulting in chronic shortages of supplies and subsequently avoidable fatalities (Richard et al., 2013). The expenses associated with outbreaks of rabies can amount to hundreds of millions of dollars due to the necessity of public health investigations (USDA, 2011).

MATERIALS AND METHODS

Study area and duration

The study was conducted in Nangarhar Province Goshta and Mohmandara districts. Goshta District is located in the northeast of Nangarhar Province, edges with Durand Line between Afghanistan and Pakistan. Mohmandara is a district in the east of Nangarhar province, Afghanistan, Near to Durand line (Figure 1).

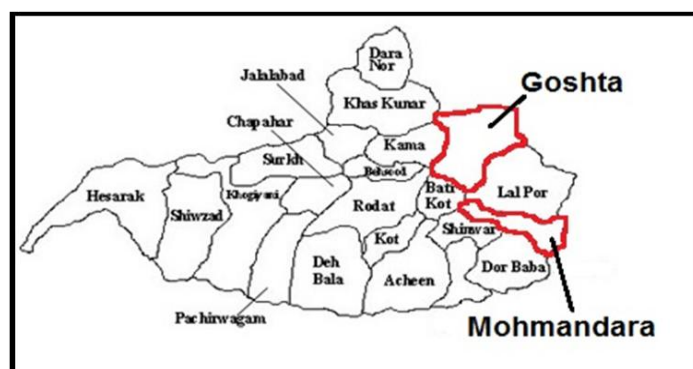


Figure 1: Shows Goshta and Mohmandara districts which are marked by red line in borders.

This study was conducted based on the principles of passive surveillance (Registered Possible cases of exposure to dog bite) in both human and animal where the main sources for data collection were: Regional Public Health Hospital, District hospital. Goshta: local CHC plus public health hospital, Mohmandara: local BHC clinics located in (Gerdi Ghaws) and a CHC clinic located in (Basawol), Zoonosis committee, Veterinary field units, Local veterinary clinics, Reports (based on retrospective investigations), Health education level and Private vaccination centers(Mohmandara: local private anti-rabies vaccination center, Ghani Khel: Mohmandara residents referred to the local private anti-rabies vaccination center in Ghani Khel district, Jalalabad city: Four anti-rabies vaccination centers located in Jalalabad city). The study was performed from November 2015 to November 2016.

Study population

Human referrals to the mentioned health centers related to rabies prevention and treatment were recorded in Goshta and Mohmandara districts according to age, sex, area, type (scratch or bite) and site of injury (lower limbs or upper limbs), date of injury, victim prognosis, predator animal type, clinical signs related to rabies and predator animal habitat (domestic or stray) and given vaccination doses.

Animals suspected of rabies or those that were bitten by dogs were recorded in Goshta and Mohmand Dara districts according to animal age, breed, sex, area, type (scratch or bite), and site of injury (fore limb or hind limb), date of injury, prognosis, predator animal type, clinical signs related to rabies and predator animal habitat (domestic or stray).

Study design

This was a retrospective review in the Mohmand Dara and Goshta districts of Nangarhar province, from 1 May 2015 to 30 Sep 2016. All the referrals to the health centers mentioned above were placed in these two districts and its residents referred to rabies control and prevention centers placed in Jalalabad city were the study population. Data included the patient identifications such as age, gender, residency (village), place of exposure, time of exposure, animal type (wild/stray or domestic), anatomic location of the bite, depth of injury and vaccination doses injected were studied.

Statistical Analysis

The data collected on the studied variables were analyzed using SPSS version 17. The independent sample t-test was employed to compare independent means. All variables were reported in terms of frequencies and percentages. A significance level of $P < 0.05$ was used as the threshold for statistical significance

RESULTS

The study was performed from November 2015 to November 2016 to study the rabies post-exposure incidents in the mentioned districts. A total of 17 humans and 4 animal suspected cases were recorded in both Mohmandara and Goshta districts. The research was based on passive surveillance in the studied human population except in two cases that were bitten/scratched by other animals (Donkey and cat) all remaining were bitten/ scratched by a dog. Only four dogs showed clinical symptoms of rabies. All victims received five doses (5 doses) of anti-rabies vaccination (ARV) after contact and were observed until the end of the research study, all cured.

Overall surveillance findings

1. Human: Out of 17 suspected cases 12 were recorded related to Mohmandara and 5 were from Goshta. Results of this study showed a higher percentage of suspected rabies cases in Mohmandara district compared to Goshta district. There was a statistically significant ($P > 0.05$) difference between the two districts (Table 1). The percentage of suspected rabies cases based on gender (male and female) groups in the male population showed higher incidents compared to the female. There was a statistically significance ($P > 0.05$) difference between the two sex groups (Table 2).

The outcome of this study also indicated that the percentage of suspected rabies cases was significantly higher in people who were 1-20 years of age compared to the population with age of above 20 (Table 3). The result of this study showed that the stray and household dogs haven't significantly ($P > 0.05$) affected the bitten population (Table 4). In the studied population victims were significantly ($P < 0.05$) bitten or scratched in lower limbs compared to upper limb injuries by predator animals (Table 5). In our study bite is the most significant ($P < 0.05$) wound type recorded compared to scratch by predator animals (Table 6). The result of a recent study indicated that most of the suspected rabies incidents were recorded in August-Sep compared to the period of May-July. There was a statistically significance ($P < 0.05$) difference between the two time periods (Table 7).

2. Animals: In the current study total population of 4 animal cases were recorded. One of four cases was in Goshta and three of four cases belonging to Mohmandara. All animals were cattle. A higher percentage of suspected rabies cases was observed in female and adult (>2 years old) animals compared to male and young (≤ 2 years old) animals. The dog was the predator animal for all recorded cases 3 out of 4 dogs habituated strays and only 1 was household. Due to a lack of animal vaccine, none of the bitten animals were vaccinated and two animals were slaughtered before onset of clinical signs. Two other bitten animals were observed until the end of the study period with no clinical signs of onset.

Table 1: Percentage of suspected rabies cases according to the area (Mohmandara and Goshta).

Place	mean \pm S.E.	percentage	P value
Goshta	4.000 \pm 0.000 ^a	29.411%	0.020
Mohmandara	1.666 \pm 0.333 ^b	70.588%	

Mean \pm S.E inside a column with different small letters (a, b) are significantly different (P<0.05).

Table 2: Rabies suspected cases recorded according to sex.

Sex	Mean \pm S.E.	Percentage	P value
Male	4.666 \pm 0.333 ^a	82.352	0.008
Female	1.000 \pm 0.000 ^b	17.647	

Mean \pm S.E inside a column with different small letters (a, b) are significantly different (P<0.05).

Table 3: Rabies suspected cases recorded according to different age groups:

Age groups	Mean \pm S.E.	Percentage (%)	P-value
1-20	3.666 \pm 0.333 ^a	64.705	0.038
>20	2.000 \pm 0.000 ^b	35.294	

Mean \pm S.E inside a column with different small letters (a, b) are significantly different (P<0.05).

Table 4: Rabies suspected cases recorded according to dog habitats:

Dog habitats	Mean \pm S.E.	Percentage (%)	P-value
Stray	2.666 \pm 0.333 ^a	47.058	0.423
Household	3.000 \pm 0.000 ^a	52.941	

Mean \pm S.E inside a column with a small letter (a) is not significantly different (P>0.05).

Table 5: Rabies suspected cases recorded according to anatomical location of bite:

Anatomical location of the bite	Mean \pm S.E.	Percentage (%)	P-value
Upper body	2.000 \pm 0.000 ^b	35.294	0.038
Lower body	3.666 \pm 0.333 ^a	64.705	

Mean \pm S.E inside a column with different small letters (a, b) are significantly different (P<0.05).

Table 6: Rabies suspected cases recorded according to wound type:

Wound type	Mean \pm S.E.	Percentage (%)	P-value
Scratch	1.666 \pm 0.333 ^b	29.411	0.020
Bite	4.000 \pm 0.000 ^a	70.588	

Mean \pm S.E inside a column with different small letters (a, b) are significantly different (P<0.05).

Table 7: Rabies suspected cases recorded according to cases' season of year:

Case season	Mean±S.E.	Percentage (%)	P-value
May-July	1.333±0.333 ^b	23.529	0.035
Aug-Sep	4.333±0.333 ^a	76.470	

Mean± S.E inside a column with different small letters (a, b) are significantly different (P<0.05).

DISCUSSION

This study showed that the occurrence percentage of suspected rabies cases are different according to district 70.588%, 29.441%, Goshta district, and Mohmandara district respectively. The result agrees with the report of Ziadi et al. (2013) which shows different dog-bites occurrences in Karachi (59.7%), followed by Peshawar (13.1%) and Hyderabad (11.4%).

This present study showed that case occurrence is different according to the area and occurs more in males (82.352%) compared to females (17.647%). The study correlates with the findings of Feizhaddad et al. (2014) who explored males (74.7%) and females (25.3%) occurrence of bites respectively and Vahdaty et al. (2013) who reported that the occurrence of rabies incidents is higher in male compare to females. Also this study agrees with the finding of a retrospective study that was conducted by Rezaeinasab et al. (2006) and the findings agrees with the finding of study done by Philippe et al. (2012).

The present investigation demonstrated that the proportion of suspected cases of rabies in various age groups was greater in the demographic of individuals aged 1-20 years in comparison to the population aged above 20 years. The findings of this study align with the report by Rezaeinasab et al. (2006) and Feizhaddad et al. (2014). Furthermore, this study revealed a higher percentage (52.941) of dog bites being inflicted by domesticated dogs (those with an owner) as opposed to stray dogs (those without an owner). This outcome is consistent with the findings of another study conducted by Vahdati et al. (2013).

The recent investigation discovered that a majority of dog-bite incidents occurred in the lower body regions (waist, buttocks, and legs) with a percentage of 64.2, compared to the upper body regions (35.7%). This result concurs with the study conducted by Tenzin et al. (2011) and Feizhaddad et al. (2014), which indicates that the majority (90%) of dog bites were inflicted on the extremities, with 73% occurring on the legs and 18% on the hands/arms. Among all age groups, the lower extremities (leg/thigh) were the most common sites of bite. However, no incidents of dog bites were recorded on the neck, possibly due to the limited sample size.

In addition, our investigation also revealed a seasonal distribution of the disease, with a higher incidence observed during the summer months (76.4%) compared to the spring months (23.5%). This finding aligns with the study conducted by Harold et al. (1998), which describes a non-significant trend toward a seasonal distribution of dog bite injuries, with the highest rates occurring during the summer months.

The results of this study found that in almost all of the suspected cases, dogs were the predator animals. This correlates with the idea (Kahn, 2010) that reservoirs of rabies vary throughout the world. Canine rabies predominates in Africa, Asia, Latin America, and the Middle East. A WHO report reveals that over 95% of are due to infection through dog bites (WHO, 2016).

CONCLUSION

Based on the results and findings of the current study we conclude that incidents of rabies are present in Nangarhar province Goshta and Mohmand Dara districts in animal and human populations where the dog has the key role in transmission, and the disease affects males more than females. Kids and young adults are more vulnerable to dog bites. In the understudy area pet or household domestic and wild or stray dogs were responsible for dog cases. Among referrals to rabies, only two predator animals showed symptoms of clinical rabies. All victims were observed until the end of the study and none showed symptoms of clinical rabies. In centers all were given complete doses of vaccination and an extra TT (Tetanus Toxoid) vaccination dose was given to some of them. Dog bites among animals were also a major threat for animal stockholders. Animal owners' poor understanding of rabies routes of transmission also facilitates the transmission of rabies to both animals and humans.

The lack of an effective surveillance system also makes control of rabies difficult. Optimal conditions for surveillance of rabies in animal species are met in only a few countries. During this study, it was observed that no human ARV (Anti-rabies vaccine) is provided by the government and itself hardens surveillance and monitoring systems as a result of which there are no successful control systems operated. The lack of animal anti-rabies vaccination in the understudied area also makes it difficult for animal owners to prevent and control the disease and related risks successfully.

Registering dogs, eliminating stray dogs, immunizing against exposure risks, maintaining active surveillance and promoting animal welfare are key points for prevention and control. It's essential to develop diagnostic labs and secure government support for academic research, aided by cooperation between the Ministry of Higher Education, government bodies, and foreign sectors. By enabling research on zoonotic diseases and fostering collaboration among public health, veterinary medicine, and environmental sectors, efforts can be intensified in preventing these diseases effectively.

Conflict of Interest: All authors express no conflict of interest in any part of the research.

Funding: The research is funded by Relief International under one health program.

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