

Factors Associated with Delayed Rabies Post-Exposure Prophylaxis among Dog Bite Victims in Nyagatare District, Rwanda, 2017 to 2019

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Abstract

Background

Rabies is an incurable zoonotic disease of public health concern. After exposure the only effective intervention is Post-Exposure Prophylaxis (PEP). Surveillance data in Rwanda shows that a high number of dog bites do not get PEP in time.

Objectives

Determine factors associated with delays in post-exposure prophylaxis among victims of dog bites.

Methods

The retrospective cross-sectional study was conducted in Nyagatare District. It targeted people bitten by dogs and who attended Nyagatare district from January 2017 to December 2019. Review of registers and interview with victims were used to collect data using excel and analyze them using STATA version 15. Odds ratio (OR) and confidence interval (CI) were reported.

Results

Among 412 dog bite victims, 161 (39%) delayed getting PEP. The more likely to delay in getting PEP, were people living in rural areas, AOR = 3.54, 95%CI [2.12, 5.90], and those without medical insurance, AOR = 4.40, 95%CI [1.82-10.62].

Conclusion

Seeking PEP among dog bites victims is subject to delay in Nyagatare district. Local leaders should establish initiatives to support people to get medical insurance while public health officers need to prioritize sensitization for PEP for people living in rural areas.

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Keywords: Rabies, post-exposure prophylaxis, risk factors

Background

Rabies is a zoonotic disease caused by lyssavirus transmitted throughout mucosal exposure to infected vertebrate.[1] The domestic dog is the main reservoir and almost all cases in human is caused by dog bites.[2] Globally, rabies remain a public health concern as each year over 15 million of people experience dog bites, and 60000 victims die from rabies.[3]

The World Health Organization (WHO), the Food and Agriculture Organization of the United Nations (FAO), the World Organization for Animal Health (OIE) and the Global Alliance for Rabies Control (GARC) have inaugurated “United Against Rabies” as a joint program running for the eradication of human rabies by 2030.[2]

The manner that rabies is almost always lethal once the clinical signs occur makes primary prevention a compulsory strategy to fight against the disease especially by holding back any dog bites.[4]

In Africa, the disease is ranked at seventh killer as 10% of all deaths are attributed to rabies infection,[2]while annually around 200000 people acquire anti-rabies PEP following the animal bites for preventing the evolution of rabies.[5] In Sub-Saharan Africa countries, lack of prioritization is a big challenge contributed to unsustainability of prevention measures.[6]

In Rwanda, the Rwanda Biomedical Center (RBC) and the Rwanda Agriculture and Animal Resources Development Board are responsible to coordinate needful activities. However, the weak collaboration between veterinary services and public health officers negatively influences the surveillance and public awareness on rabies prevention and control.[7] Rwanda is described among the countries with no information in 2017,[8] indicating that the data on the disease are less captured. Timely Post-Exposure Prophylaxis is the milestone to combat the infection of rabies for people victims of dog bite. Post exposure prophylaxis is made of the combination of a dose of human rabies immunoglobulin (HRIG) on day1 and four dose of rabies vaccine given on day1, day3, day7 and day14.[9] The immune compromised people acquire fifth dose of rabies vaccine on day 28.[10] In Rwanda for strengthening security measures, a total of five doses of rabies vaccine are recommended for all.

Thus, in Rwanda, 413 dog bites victims and 1 death from rabies were reported in eight months from January to August 2016 nationwide.[11]Nyagatare District Hospital recorded 421 cases of dog bites from January 2017 to December 2019. Analysis of factors associated with the delay of PEP is important as PEP is the final step to close or open for death after a dog bite. Although, some studies were conducted on dog bites and PEP but there is no evidence

linking dog bites with both public health and veterinary services concepts.

One study conducted in Rwanda focused on knowledge and practices of rabies control among dog owners.[12]Study aimed specifically responding to the following questions:

What are socio demographic characteristics of dog bite victims in Nyagatare district from 2017 to 2019?What are factors associated with the delay of dog bite post-exposure prophylaxis in Nyagatare district from 2017 to 2019?

Methodology

Study design, study population and sample size

A cross sectional study was conducted in Nyagatare district, and it targeted all people bitten by the dog who were admitted at District Hospital for rabies post-exposure prophylaxis from 2017 to 2019. The consecutive sampling method was used, whereby data of dog bite cases were extracted from outpatient department (OPD) registers and packaged into excel spreadsheet. The person who took PEP but not having been bitten in Nyagatare district was not included. Nyagatare District is one of seven districts composing the Eastern Province of Rwanda. It is made of 14 Sectors lying on 1,919sqkm where the great part is occupied by Akagera National Park. The District is neighbored by Tanzania and Uganda respectively in East and North respectively. In the South and West, it borders Gatsibo and Gicumbi districts respectively. The population is estimated at 465,855 citizens representing 17.9% of national population. The people are predominantly living in rural areas at 89.8% and 27.5% in urban.[13]

The indoor owned dogs are estimated at 849 while the total number including roaming dogs is approximated to 4,080.[14] The number of roaming dogs is estimated at 3,231 and the number of stray dogs is not well known. Nyagatare is a District with a high number of cattle living in farms estimated at 7,159.

As social norms and behavior, livestock guardians created companionship with dogs and thus, abandoned dogs and stray dogs once come into farms they get adopted and stay there with cows at the level of more than four dogs in one farm for the security purpose. However, the dogs are neither recorded nor controlled leading to unplanned reproduction and thus, the number of roaming dogs in the District results in uncountable dog bites.[15]

Data collection procedures

The data were collected using established excel sheet composed of elements on socio-demographic items, type of wound, part of the body injured, the duration between each dog bite and any recent rabies awareness campaign conducted by veterinary services. To get the needed information, both review of registers and interview with dog bite victims were used. The indications of post exposure behavior were selected from CDC guidelines,[16] while dog bites pre-exposure measure, were captured from OIE guidelines for rabies eradication.[4] To assess the practices done by the government for premier prevention related to both rabies awareness and prevention of rabies in dogs, the interviews with sector and district animal health officers were also conducted to get the information on the time of recent awareness campaign against rabies. Some questions like “Which date did you conduct rabies vaccination?” and “How is the population of dogs in Nyagatare?” were asked in order to measure the period between the dog bite and previous recommended practice for rabies prevention. During dataset cleaning we observed nine of the records that had incomplete information, and were not known by community health workers, and therefore the final sample was composed of 412 people.

Study variables

Dependent variable

The dependent variable was “PEP timeliness” with two expected responses from the reviewers or interviewer: Timely PEP or Delay PEP.

PEP Timeliness is defined as the interval of hours from the time of dog bites to the time of injection of the first dose of rabies vaccine. It is categorized into two elements: “Timely PEP” which consists of acquiring of first dose of rabies vaccine in the first 24 hours following the exposure, while “Delay PEP” consists of the injection of the first dose of rabies vaccine after 24 hours following the dog bite.

Independent variables

Socio-demographic and clinical characteristics of participants are dichotomized and independently analyzed as risk factors. Veterinary activities were focused to seek if consistent and regular rabies awareness campaigns normally organized by veterinary activities might influence the mindset of the community leading to timeliness of PEP. Age meant chronological age of the study participants in years; collected under five categories (10 years and below, 11-17years, 18-45 years, 46-60 years and 61years and above). Sex was gender of participants grouped into male and female. Residence consisted of living places of participants classified into rural and urban. The district master plan locates urban places to Nyagatare and Rwimiyaga Sectors .

Educational level refers to the years of formal instruction acquired and completed successfully. It is grouped “into incomplete primary education” for the participants who did not stand on to complete primary school, and “upper education” for any person who successfully completed primary school and above, for children under 12 years, the education level of caregiver is considered. The interval from recent rabies awareness campaign organized by veterinary services to the time of dog bites is classified into “above a year” and “less a year”. Owning the medical insurance was classified into “yes” for someone who had medication insurance on the date of dog bite and “no” for someone who did not have any insurance for medication.

Type of wound was classified into “superficial” and “deep”. Injured part of the body was presented into “Buttock”, “lower limb”, “trunk”, and “upper limb”. Awareness campaign is a veterinary activity which include mass vaccination campaign in dogs recording of dog owners and awareness of rabies on its reservoir, transmission mode, prevention and control measures. The awareness should be organized normally at least once a year by veterinary services.

Data analysis

Data were cleaned for completeness and consistency. The dog bite cases were counted and their distribution is described in months of the different years. Descriptive analysis was plotted with frequencies and percentages for all the study participants. Bivariate analysis was computed with Odd Ratio (ORs) and CI between each covariate and the outcome variable. Later on, all significant variables within the bivariate model were put into the full model to compute the adjusted ORs and CI to determine factors statistically associated with delay in PEP uptake among victims of dog bites in Nyagatare district. The timeliness of PEP is analyzed using STATA statistical software (version 15). The significance of association was assessed with the confidence interval level of 95% and p-value less or equal to 0.05.

Ethical review

There was a signed consent from the respondent before the interview was to be conducted. All study participants were explained on the why of the study, asked for volunteer participation and guarantee for the secret across the whole process of the study. After signing the consent, there was an interview and no participants name was used to keep all information confidential.

Results

Socio-demographic characteristics of dog bite victims

The study included 412 participants who attended Nyagatare District for PEP from 2017 to 2019.

Specifically, their age ranged from 1 to 75 years, 55.83% of dog bites victims were under 18 years old, the median of their ages was 15 years (Q1=9, Q3=31.5) with the standard deviation of 17.40. Females represented 42.48% while males were 57.52%. Regarding education level, people with upper education represented 98.06% (n=404) and participants who did not complete primary education were 1.94% (n = 8).

Dog bite cases were high in Nyagatare Sector 22.09%, while there was no case in Mimuri Sector 0% (n=0) (Figure 1). There was a preponderance of dog bites in rural areas at 67.72% (n=279), than in urban areas at 32.28% (n=133). The majority 92.23% (n=380) of participants had medical insurance, while those who did not have medical insurance were 7.77% (n= 32). The cases with deep wound were 42.96% (n=177) and superficial wound were 57.04% (n=235). Concerning bitten part of the body, the dog bites attacked lower limb at 83.25% (n=343), upper limb at 10.44% (n=43), buttock at 5.58%, (n=23) and trunk 0.73% (n=3). When no rabies awareness campaign for more than one year, the dog bite notification increased to 62.86% (n=259) while it is 37.14% (n=153) if the campaign on dog bite was conducted at least once year.

Among 412 dog bites victims, only 39.08% received the first injection of PEP after 24 hours following the exposure. The PEP intake varied from Day 0 to the Day 10 while the mean duration of the interval from exposure to PEP intake was 15 hours and 38 minutes with the standard deviation of 29 hours and 55 minutes. The median number of hours from dog bite to the time of getting PEP is 15 hours, the first quartile=6 hours, and the third quartile=30 hours), with the mean of 23.9 hours and the standard deviation of 29.64 hours. Among the Sectors composing Nyagatare District, the incidence of delaying to receive PEP was highest in Mukama sector 75% (7) and less in Katabagemu Sector 20%(2).

Considering the bitten part of the body, the delay to PEP appeared bigger for people bitten on the trunk at 100% (3), on the upper limb at 53.49% (23), on buttock at 39.13 (9) while the low proportion of delayed victims was lower for people bitten on the lower limb 36.73% (126).

About 39.57%(93) of the superficially wounded people delayed to get PEP, while a lower delay rate, 38.42%(68) was found among people with deep wound. On the other hand, incidence of delaying to PEP was at 75%(24) for the people without medical insurance and much lower at 36% (137) for the people who had medical insurance.

Distribution of dog bite cases per sector of origin

Table1. Sector of origin for dog bites victims

Sectors	Total number of dog bites victims by Sector	Dog bites victims delayed for PEP	Dog bites victims timely attended PEP
	n (%)	n (%)	n (%)
Gatunda	13 (3.16)	8 (61.5)	5 (38.5)
karama	14 (3.4)	5 (35.7)	9 (64.3)
Karangazi	80 (19.42)	41(51.2)	39 (48.8)
Katabagemu	10 (2.43)	2 (20%)	8 (80)
Kiyombe	8 (1.94)	3 (37.50)	5 (62.50)
Matimba	15 (3.64)	5 (33.33)	10 (66.67)
Mukama	4 (0.97)	3 (75)	1 (25)
Musheli	17 (4.13)	8 (47.06)	9 (52.94)
Nyagatare	91 (22.09)	30 (32.97)	61(67.03)
Rukomo	36 (8.74)	14 (38.89)	22 (61.11)
Rwempasha	40 (9.71)	15 (37.50)	25 (62.50)
Tabagwe	43 (10.44)	18 (41.86)	25 (58.14)
Rwimiyaga	42 (10.19)	18 (42.86)	24 (57.14)
Mimuli	0 (0%)	-	-
Grand total	413	170	243

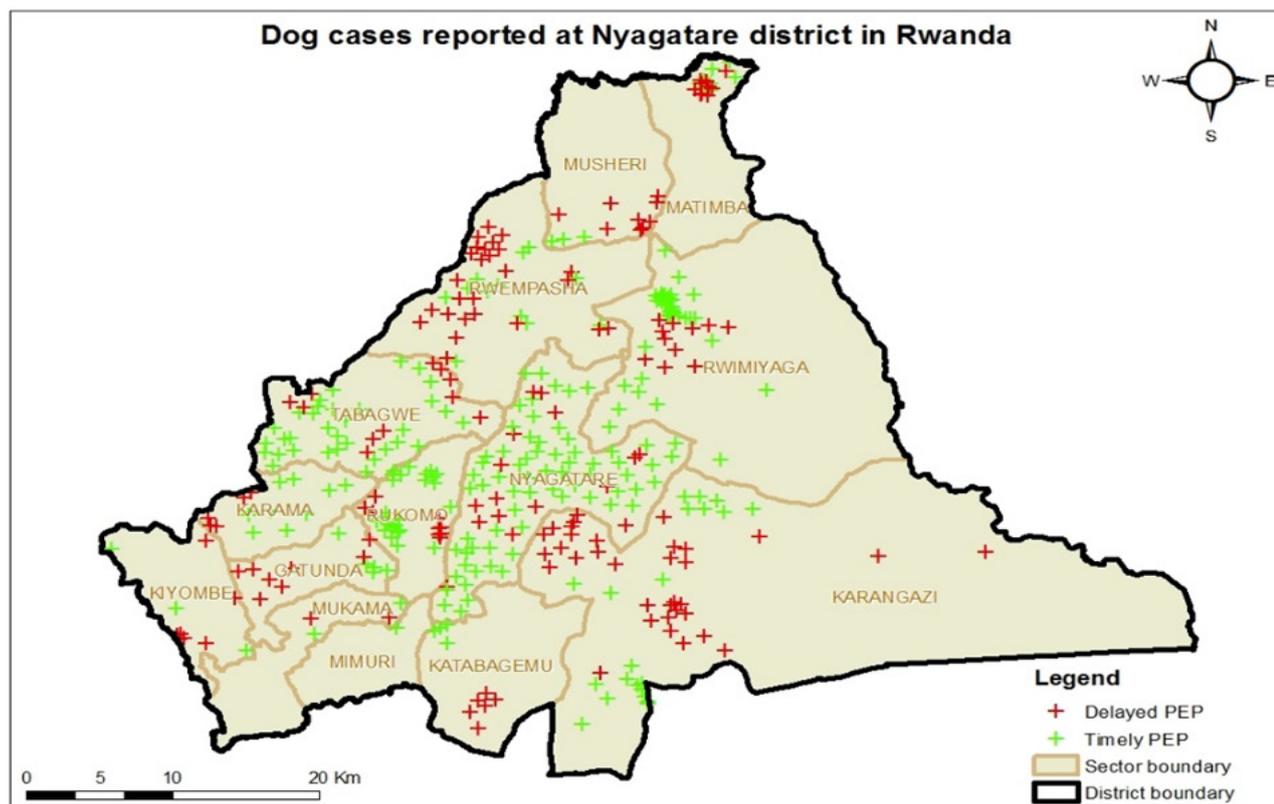


Figure 1. Dog bite cases reported at Nyagatare District, Rwanda (data analysis)

Distribution of dog bites over three years

During the three years, the number of dog bite cases increased with time as 2017 had 37 (8.98%) cases, 2018 with 149 (36.16%) cases, while 2019 presented 226 (54.85%) cases. Over the three years, the largest total number of monthly cases appeared in October with 47 (11.41%) cases and November with 58 (14.08%) (Figure 2).

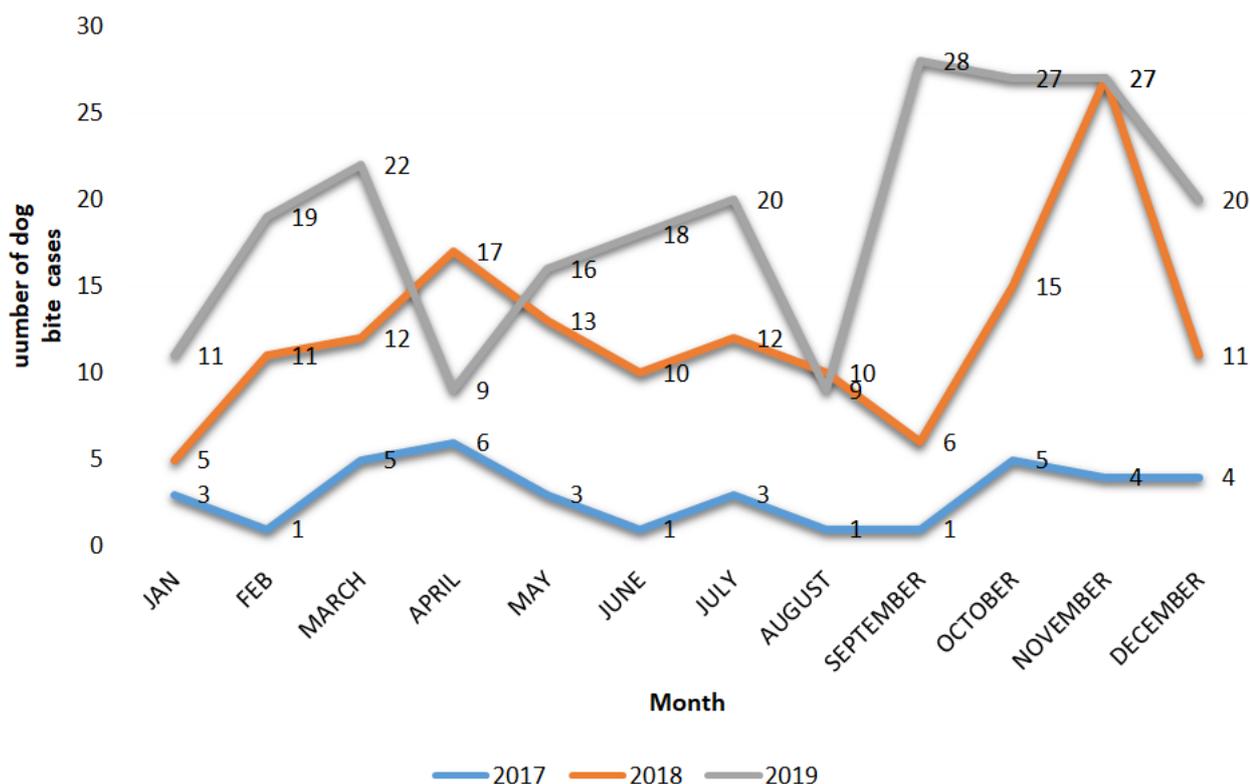


Figure 2. Monthly dog bites in 2017, 2018, and 2019

Factors associated with the delay of PEP

Some factors were seen to be associated with the delay in having PEP: being in rural area, lack of medical Insurance by the victim and lack of recent sensitization for the dog bite awareness(Table 2).

Table2. Factors associated to the delay of PEP

Variables	Total (%)	PEP timeliness		Unadjusted Analysis		Adjusted Analysis	
		Timely N(%)	Delayed N(%)	OR(95% CI)	P-value	OR (95% CI)	P-value
1.Socio-demographic factors							
Age							
1-10 years	143 (34.96)	85 (59.44)	58 (40.56)	1.25 (0.76, 2.06)	0.36	-	-
11-17 years	87 (21.12)	51 (58.62)	36 (41.38)	1.30(0.74, 2.27)	0.35	-	-
18-45 years	128 (31.7)	83 (64.84)	45 (35.16)	Reference	1	-	-
46-60 years	40 (9.71)	23 (57.50)	17 (42.50)	1.36 (0.66, 2.81)	0.4	-	-
61 years and above	14 (3.40)	9 (64.29)	5 (35.71)	1.02 (0.32, 3.24)	0.96	-	-
Residence							
Rural	279 (67.72)	143 (51.25)	136 (48.75)	4.1 (2.50,6.73)	0	3.54 (2.12, 5.9)	<0.001
Urban	133 (32.28)	108 (81.20)	25 (18.80)	Reference	1	Reference	-
Owning the medical Insurance							
No	32 (7.77)	8 (25)	24 (75)	5.3 (2.32, 2.16)	0	4.4 (1.82, 10.62)	<0.001
Yes	380 (92.23)	243 (63.97)	137 (36.05)	Reference	1	Reference	-
2.Clinical characteristics							
Type of wound							
Deep	177 (42.96)	68 (38.42)	109 (61.58)	Reference	1	-	-
Superficial	235 (57.04)	93 (39.57)	142 (60.43)	1.04 (0.70,1.56)	0.81	-	-
Injured part of body							
Buttock	23 (5.58)	9 (39.13)	14 (60.87)	1.10 (0.46-2.63)	0.23	0.72 (0.28,1.88)	<0.001
Lower limb	343 (83.25)	126 (36.73)	217 (63.27)	Reference	1	Reference	-
Trunk	3 (0.73)	3 (100)	0 (0)	1	-	1	-
Upper limb	43 (10.44)	20(46.51)	23 (53.49)	1.98 (1.04,3.74)	0.04	1.65 (0.83, 3.24)	<0.001
Recent rabies awareness campaign							
Above a year	259 (62.86)	142 (54.83)	117 (45.17)	2.04 (1.33,3.12)	0	1.72 (1.08,2.73)	<0.001
Less a year	153 (37.14)	109 (71.24)	44 (28.76)	Reference	1	Reference	-

Discussion

The study aimed to determine the factors associated with the promptness of PEP following the dog bite. The study findings highlighted delay of PEP among the people living in the rural areas than urban residents; the significant difference was determined as people living in rural areas were 3.5 (95%CI,2.1-5.9) times more likely to delay to rabies PEP compared to those living in urban places, this could be due to

the accessibility and the cost of transport from the place of exposure to the District hospital. This finding is different to the finding of Khazaei in the study conducted in Iran where the delay of PEP was quite the same in rural 7% and urban 5.7%.[17] On other hand, our finding corroborates with what found in the study conducted in Kenya.[18]

Considering the possession of medical insurance, dog bites victims who did not own a medical insurance were 5.3(95% CI, 2.3-12.1) times higher to delay for rabies PEP, this could be attributed to the fear of the cost of PEP. The previous studies pointed to affordability of PEP,[19,20] the health professionals estimated the cost of the full PEP at 60\$ excluding the additional cost to the Hospital. Fortunately, In Rwanda the possession of medical insurance is the norm and cover almost health needs including PEP rabies vaccines.[21]

The interval from the previous awareness campaign organized by veterinary services and the time of a dog bite is significantly associated the timeliness of PEP. Passing the time above a year without organizing any awareness campaign was 1.7 (95% CI, 1.08-2.73) times riskier to the delay of PEP. This might due to the lack of information on rabies transmission route, the incubation period and the virulence of a disease. The other study pointed on the lack of knowledge on rabies.[12] The regular awareness campaign to the disease could not only increase the number of vaccinated dogs but also the awareness of a disease and its prevention to human health. The study didn't found any association of delay in PEP with sex, bitten part of the body, type of wound and education to the timeliness of PEP intake, this contrast the study conducted in Iran and that of China which found the association from the above variables.[3,22]

The study planned to analyze both timeliness and completeness; fortunately all the patients who started the PEP have succeeded to complete the PEP, though there are no findings on factors that could be associated to incompleteness of PEP. Prior the data collection, ubudehe category should be analyzed, however dog bites victims who have attended Nyagatare District Hospital during the study period are in ubudehe category I or ubudehe category II which was characterized as poor people, although causal effect of financial status cannot be showed.

Furthermore, the used data are whom came for PEP either on time or late; those who didn't come were not reported and therefore should be missed during this study.

Study limitations

There was a poor recording especially in animal surveillance which interfered with data collection. In addition, some victims were missed for the interview while eligible for the study.

Conclusion

In all, dog bites need intensive attention in Nyagatare District and this requires the regular awareness to rabies especially on its epidemiology, prevention measures, route of infection and recommended post exposure behaviors. The management of zoonotic diseases such as rabies engages interdisciplinary teamwork. Therefore, one health professionals including veterinarians, environment experts and public health professionals should work together with the common benefit by increasing the awareness of rabies epidemiology, virulence and prevention. The regular awareness on rabies should be encouraged and conducted in rural area as people in rural were more likely to delay for PEP if compared to those from urban area. Public health officers have to avail PEP especially in rural areas for quick intervention and the sensitization for dog bite awareness have to be continuously done. This must go with the sensitization on owning health insurance so that the dog bite victim is ready to early consult after the event. In the awareness campaign, people have to be informed on how to behave when bitten . This requires the involvement of local leaders in motivating people to pay the medical insurance on time so that they can smoothly access health services accordingly.

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Authors' contribution

DM, and JN conceptualized the study and designed the methods. JN supervised the study and provided substantial contributions to the interpretation of data and took part in revising the paper critically for important intellectual contents. AN and FH contributed to the data analysis and drafted the manuscript. DM collected data and analyzed the data.

Conflict of interests

The authors declare that the research was conducted in the absence of any type of relationship that could potentially trigger any conflict of interest. All authors agreed to submit to the current journal, accountable for all aspects of the work, and provided final approval of the version to be published.

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