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A Retrospective Study on Dog Bite Associated Rabies in Human and the Use of Post-exposure Prophylaxis in Nepal during 2008 to 2017

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ABSTRACT

A 10-year (2008-2017) retrospective canine-mediated human rabies epidemiology was studied to assess the burden of rabies in Nepal. To this end, the number of dog bites, the use of post-exposure prophylaxis (PEP), and human death records from 2008 to 2017 were retrieved from Sukraraj Tropical Hospital, Kathmandu, Nepal. The findings revealed that the number of human rabies occurrences was consistent with minor fluctuations throughout the study period. There were 252,297 dog bite cases in humans recorded between 2008 and 2017. Every month, 2,102 people were bitten by mostly stray dogs. There was a gradual increase in PEP use throughout 10 years. On average, 36,995 PEP dosages were used per year for stray dog bites. The PEP consumption and the number of human deaths were negatively correlated. A total of 482 human rabies deaths were recorded in Nepal during the study period. On average, 49 people died of canine-mediated rabies each year. Although there was an increase in the use of PEP, the number of human deaths and street dog bites recorded were still high. The high mortality due to rabies could then be attributed to the flawed surveillance system and stray dog population management, and not merely the lack of PEP services. Hence, it is recommended that the government agencies and other concerned stakeholders should organize mass vaccination and population management program for stray dogs in order to reduce the country's rabies burden.

Keywords: Dog bite, Epidemiology, Prophylaxis, Rabies

INTRODUCTION

Rabies has been viewed as an extreme and dismissed general medical issue worldwide, with an estimated 55,000 human deaths each year (WHO, 2013). The majority of death occurs in developing countries like Asia and Africa ones (Knobel et al., 2005). About 21,000-24,000 people died in Southeast Asia due to rabies infection (Gongal and Wright, 2011) and this infection counts for 45% of human deaths around the world (Masiira et al., 2018). Nonetheless, due to all rabies cases not being reported, the actual case numbers are unknown. Although the disease is undoubtedly lethal once clinical signs are developed in the patient, it can be prevented with timely pre-exposure and post-exposure prophylactic vaccination (Overall and Love, 2001). The exposure regimen of human diploid vaccines is 0, 7, and 21 or 28 days and need to be renewed after a year in risky populations whereas post-exposure prophylaxis regimen is 0, 3, 5, 14 to 28 days with the primary aids, i.e. thorough washing and flushing of wounds (WHO, 1997; WHO, 2010). As per the World Health Organization (WHO), more than 15 million people annually receive PEP for rabies worldwide mostly in India and China (WHO, 2010). Children are at the greatest risk of rabies exposure and approximately 40% of PEP is given to children aged between 5 and14 years old (WHO, 2007).

Nepal is a small and landlocked country situated between India and China. There is a free and open border with India from which restriction-free trade and movement of humans and animals occur, facilitating the transmission of infectious diseases (Yadav et al., 2020). Nepal and India share similar socio-financial circumstances, given that India carries the burden of the biggest rabies cases worldwide (Knobel et al., 2005). Nepal has been considered endemic in rabies for a long time with an average mortality of 100 people every year (Annual Report of the Department of Health Services, Nepal, 2013). In order to control rabies, the government of Nepal established a national coordinating committee for dog rabies expulsion in Nepal in 1979 (Joshi, 1991). However, it took the measures in 1983 by initiating the rabies control program, supported by the Department of Livestock Development and Animal Health (DLDAH), the Department of Health, and representatives of local government (Bögel and Joshi, 1990). The program involved the organization of mass vaccination in stray dogs for the first few years, but it terminated after few years because of the political changes and other internal reformation process happened in the country during the 1990s (Joshi, 1991).

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The production of reactogenic nerve-tissue vaccines started in Nepal in 2006 as an attempt to control rabies, but it was soon replaced by tissue culture vaccines. However, the production of reactogenic nerve-tissue vaccine phased out in the middle of 2006. Thereafter, recent rabies tissue-culture vaccines, such as human diploid cell vaccine (HDCV), purified Vero cell rabies vaccine (PVRV), purified chick embryo cell vaccine (PCECV), and purified duck embryo vaccine (PDEV) have come into practice. These vaccines were mainly imported from India. The cost of the whole course of the vaccine is equivalent to 12,000 Nepalese rupees (WHO, 2005). The Department of Livestock Service, Government of Nepal had developed a 10-year rabies control program in 2010 to produce 50,000 cell culture rabies vaccine for animal use, and the production of rabies vaccine for human use is in progress (Acharya et al., 2019). According to this plan, a rabies vaccine bank was supposed to be established at least at five regional veterinary laboratories in Nepal. However, it is not yet established due to financial constraints.

Stray dog bites have been considered as the major source of the rabies in human population in Nepal, but most of the cases go unreported because of poor surveillance, lack of awareness, and improper reporting system (Devleesschauwer et al., 2016). The stray dog population in Nepal has been increasing and humane efforts to control the uncontrolled dog population are very limited (Kakati, 2010). Children aged below 15 and old aged people are at the most risk of dog bites (Pantha et al., 2020). The first humane approach to control the stray dog population was established in 2004 by the Kathmandu Animal Treatment Centre (KAT), a non-governmental organization with limited resources. The local government in the capital of Nepal joined KAT's mission to control the stray dog population in 2017.

An effective strategy for control of rabies takes into account the epidemiology of animal bites; and rabies and factors influencing post-exposure treatment which is absent in Nepal (Gongal and Wright, 2011). Rabies is certainly not a notifiable illness in Nepal, and there is no coordinated monitoring program between medical veterinary divisions (Acharya et al., 2019). The genuine number of death due to rabies might be a lot higher than the reported cases (Sharma, 2005). There are very few and incomplete epidemiological reports on rabies and the available reports have discrepancies over the rabies statistics. Therefore, the purpose of this study was to explain the rabies epidemiology in terms of PEP consumption, dog bite injuries, and human death from 2008-2017 in Nepal. As Nepal has shown solidarity with the global approach to eradicate rabies by 2030, the finding of this study would assist the government authorities and other stakeholders in improving the current rabies surveillance and monitoring system leading to building up a systematic and effective surveillance system.

MATERIALS AND METHODS

Ethical approval

The present study did not involve either humans or animals as an experimental setup. Required permission in verbal forms to conduct the research and to use the data has been received from relevant authorities involving in this study.

Data source and data management

The study was a retrospective review of epidemiological surveillance data in humans on animal bite injuries, rabies deaths, and the use of PEP reported to the national database from 2008 to 2017. The raw data were collected from the Sukraraj Tropical Hospital, Teku, Kathmandu, Nepal, which is the only Central Referral Medical Center for infectious diseases that deals with rabies issues. In addition, human rabies occurrence data were collected from other hospitals and medical centers located in different parts of the country.

Data analysis

The raw data were categorized yearly and analyzed using descriptive statistics. Likewise, the occurrence of dog bites, human deaths due to rabies, and PEP use in the last 10 years were graphically plotted to examine the respective trends. Bivariate analysis was performed and a Pearson's correlation coefficient was used to describe the strength and direction of relationship among years, number of dog bites, number of anti-rabies vaccine for PEP, number of human deaths.

RESULTS

During the past 10 years, the burden of human rabies in Nepal appeared consistently with minor variations. There were 252,297 dog bite cases recorded and 2,219,701 PEP vials were used to counter those dog bites. In the same way, 482 people died of rabies during the same period. Likewise, 25,164 bites from other species of animals, including cats, monkeys, and rats were also documented by the Department of Health Services, Nepal (Annual Report of the Department of Health Services, Nepal, 2014).

There was a trend of a gradual increase of dog bites from 2008 to 2012 with a little drop in 2009 reaching the highest bites in 2013, and an abrupt drop was recorded in 2014. For the rest of the period, it remained stable (Figure 1).

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Likewise, deaths caused by rabies in the human population showed a constant and consistent pattern from 2008 to 2012. The occurrence gradually decreased from 2013 towards 2016, though there was an abrupt increase in the number of human deaths in 2017 (Figure 2).

The descriptive analysis showed the gradual increase of PEP use from 2008 to 2011, which was slightly decreased during 2012 and 2013. However, the use of PEP increased again between 2014 and 2015. Once again, the cases were decreased in 2016 and further increased again in 2018. The PEP vaccine use ranged from 145,978 to 320,139 vials (Figure 3). On average, 221,970 vials per year were used for dog bite cases.

Table 1 presents the results of bivariate correlation analysis. The statistical results revealed that there was a very weak relationship between dog bites and deaths and a negative correlation found between dog bites and PEP consumption. The number of deaths was negatively correlated with the number of anti-rabies vaccines for PEP. In addition, the number of deaths declined from 2008 to 2017.

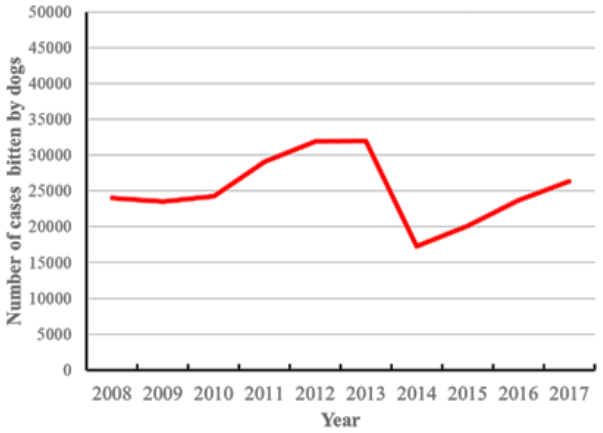

Figure 1. Dog bites cases reported to Sukraraj Tropical Hospital, Nepal from 2008 to 2017. Source: Department of Health Services, Government of Nepal.

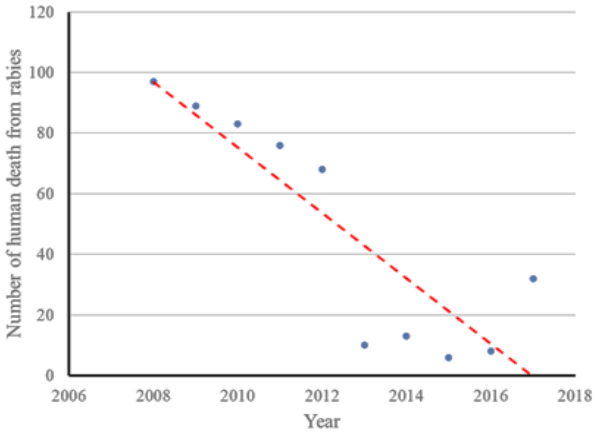

Figure 2. Human deaths due to canine-mediated rabies in Nepal from 2008 to 2017. Source: Department of Health Services, Government of Nepal.

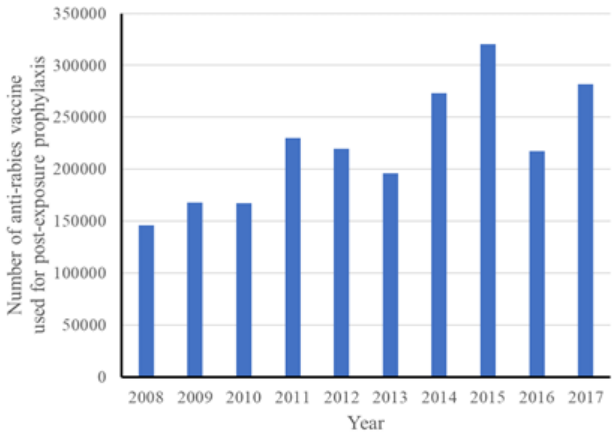

Figure 3. Number of post-exposure prophylaxis vials administered to dog bite patients in Nepal from 2008 to 2017. Source: Department of Health Services, Government of Nepal

Table 1. Correlation among year, number of cases bitten by dogs, number of anti-rabies vaccine for post-exposure prophylaxis (PEP), and number of deaths.

Variable	Year	Number of cases bitten by dogs	Number of anti-rabies vaccine for PEP	Number of Death
Year	1			
Number of cases bitten by dogs	-0.130	1		
Number of anti-rabies vaccine for PEP	0.799**	-0.316	1	
Number of deaths	-0.869**	0.221	-0.704*	1

* Correlation is significant at the $p < 0.05$. **Correlation is significant at the $p < 0.01$

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DISCUSSION

No reports of a large-scale survey have been available for appraisal of dog bites, use of PEP, and human rabies mortality. Hence, this study attempted to use available data to determine the rabies burden in Nepal. Prior to this work, small-scale-epidemiological reports based on a brief time frame had been documented (Joshi, 1991; Karki and Thakuri, 2010; Pantha et al., 2020). These previous studies are therefore used in the present study to make some relevant comparisons.

The present study showed that humans bitten by dogs occurred during 2008-2017 with an average of 25,229 dog bites per annum, and this figure accounts the 0.084% of the total population of Nepal. The dog bite injury in Nepal was 25% in 100,000 populations. On a monthly basis, 2,102 people got bitten by the dogs. Most of these bites were reported from urban areas, where the stray dog population is higher than the rural areas. Kathmandu Animal Treatment Centre reported that more than 22,500 stray dogs were roaming in Kathmandu City, the capital city, alone in 2012 (Kakati, 2010). Without precise information on patterns of human rabies and difficulties in rabies diagnosis in developing countries, the utilization of surveillance data on animal bites gives valuable data to rabies observation and improves the distribution of clinical and veterinary assets (Martin et al., 1969). It was also comparable to the dog bite occurrence rates with immediate neighboring countries, such as India and China, which recorded more than 15 million dog bites per year (WHO, 2013). It might be due to the higher population of stray dogs in those countries. At the regional level, Bhutan, another country similar in topography and cultural settings reported around 6,416 dog bites in 2018, which was significantly lower than Nepal. Another country in Asia, the Philippines reported 32,859 dog bite occurrences per annum, which were much higher than Nepal (Gongal and Wright, 2011). A study in Central India reported that 95.8% of victims were bitten by stray dogs (Marathe and Kumar, 2016), which is very much in alignment with our findings. Similar findings were also reported from Uganda, the study stated that 25,420 patients reported roaming dog bite injuries (Wangoda et al., 2019). The dog bite occurrence revealed a peak in 2103 and a sharp declined in 2014. The increasing occurrence of animal bites was suggesting that the potential exposure to rabies infection remains important to public health and so vice versa. The results were similar to the study performed in Uganda (Dodet and African Rabies Bureau, 2009).

This study also showed PEP consumption and human rabies exposure for 10 years (2008-2017) in Nepal. Results revealed that there was a gradual increase throughout the 10 years in PEP use with a small drop in 2013, which was still higher than the first three years. It was observed that the PEP use and dog bites were negatively correlated. However, dog bites and PEP consumption have both increased for the last 10 years. However, in comparison to dog bite cases, the PEP use was higher. This is in agreement with other findings (Helmick, 1983; Khkhar et al., 2003; Sriaroon et al., 2005), which might be due to the increased awareness level of people residing in urban areas. Moreover, hospital authorities informed us that they recommended patients for PEP even for minor scratching and licking because of several reasons, such as poor diagnostic facilities in the hospitals, a large number of free-roaming and stray dogs, and no quarantine facility for biting animals (WHO, 2019). This finding is also in agreement with the study performed in Illinois, USA (Helmick, 1983). Despite the increased use of PEP, there were still enormous deaths which might be due to poor access to PEP facilities for the genuine cases. The shortage and immature availability of PEP in rabies clinics had been reported from India (Hanumanthaiah and Haradanhalli, 2019). In appropriate distribution and availability of PEP was an issue in China (Qi et al., 2018).

A total of 482 human rabies deaths were recorded in Nepal from 2008 to 2017. The number of human rabies cases gradually decreased from 2013 to 2016 and a slight increase was recorded in 2017. This phenomenon may be due to rabies control being emphasized and strengthened by the central government in Nepal after 2007. However, the human rabies cases remained stable from 2007 to 2012 indicating that human rabies constitutes a real public health threat in Nepal. On average, human mortality was 49 in the last 10 years. This finding was contradictory to the study performed by Pant in 2012 (Pant, 2013). He demonstrated that rabies mortality in humans ranges between 100 and 150 deaths per year in Nepal. Similar figures were also reported by WHO in 2013 (WHO, 2013). These higher estimates might be based on projected statistics from PEP use and under-reporting scenario. Another study carried out by WHO in 2007 stated that the rabies mortality was 0.21 per 100 000 human population while our study showed 0.0048, which was lower than the studies carried out in Tanzania (Cleaveland et al., 2002). This study did not include the data before 2008, so there might be a higher number of cases during or before 2007. In the Asian regions, Nepal lies in between in terms of the human rabies burden. India has the highest human death records 3 in 100,000 and Thailand (0.012/100,000) being the lowest (Acharya et al., 2019). However, the recent study from India indicated 2 deaths per 100,000 population due to rabies (Sudarshan et al., 2007).

CONCLUSION

Based on the findings, it can be concluded that the death rate in humans inflicted by canine-mediated rabies was considered unstable during the study period. However, the dog bite cases and PEP consumption increased, which

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indicates rabies is a public health challenge affecting Nepal. Eliminating rabies by the year 2030 would be possible if the strengthening of rabies prevention and control strategies are applied in a coordinated approach at all levels of the health and veterinary areas. These sectors should adopt the "One Health" approach with a strategic focus on strengthening rabies surveillance, controlling rabies in dogs, controlling the stray dog population, and ensuring the availability of post-exposure prophylaxis at rural health offices.

DECLARATIONS

Authors' contribution

P. Pal and T. Rukkwamsuk conceive the idea, designed the project, and write the manuscript. H. Shimoda and A. Yawongsa helped with the analysis of the data. R. Bashyal helped in data collection. T. Rukkwamsuk supervises the project throughout the study and write-up process. All authors had full access to all data in the study and took responsibility for the integrity of the data and the accuracy of the data analysis. All authors approved the final draft of the manuscript and the statistical analysis of data for publication.

Competing interests

The authors certify that there is no conflict of interest.

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Ethical considerations

Ethical issues (including plagiarism, consent to publish, misconduct data and/or falsification, double publication and/or submission, and redundancy) have been checked.

REFERENCES

Acharya KP, Adhikari N, and Tariq M (2019). Fight against rabies in Nepal: Immediate need for government intervention. One Health, 9: Article number 100114. DOI: https://www.doi.org/10.1016/j.onehlt.2019.100114

Annual Report of the Department of Health Services, Nepal (2013). Available at: http://ghdx.healthdata.org/record/nepal-department-health-services-annual-report-2012-2013.

Annual Report of the Department of Health Services, Nepal (2014). Avialable at: http://edcd.gov.np/resources/dohs-annual-report-fy-2071-72.

Bögel K, and Joshi DD (1990). Accessibility of dog populations for rabies control in Kathmandu Valley, Nepal. Bulletin of the World Health Organization, 68: 611-617. Available at: https://apps.who.int/iris/bitstream/handle/10665/53422/bulletin_1990_68%285%29_611-617.pdf?sequence=1&isAllowed=y

Cleaveland S, Fevre EM, Kaare M, and Coleman PG (2002). Estimating human rabies mortality in the United Republic of Tanzania from dog bite injuries. Bulletin of the World Health Organization, 80: 304-310. Available at: https://pubmed.ncbi.nlm.nih.gov/12075367/.

Devleesschauwer B, Aryal A, Sharma BK, Ale A, Declercq A, Depraz S, Gaire TN, Gongal G, Karki S, Pandey BD et al. (2016). Epidemiology, impact and control of rabies in Nepal: A systematic review. PloS Neglected Tropical Diseases, 10: e0004461. DOI: https://www.doi.org/10.1371/journal.pntd.0004461.

Dodet B, and African Rabies Bureau (AfroREB) (2009) The fight against rabies in Africa: From recognition to action. Vaccine, 27(37): 5027-5032. DOI: https://www.doi.org/10.1016/j.vaccine.2009.06.030.

Gongal G, and Wright AE (2011). Human rabies in the WHO Southeast Asia region: Forward steps for elimination. Advances in Preventive Medicine, Article ID: 383870. DOI: https://www.doi.org/10.4061/2011/383870

Hanumanthaiah AND, and Haradanhalli RS (2019). Assessment of procurement, distribution, availability, and utilization of rabies biologicals for postpexposure prophylaxis in seven state of India. Indian Journal of Public Health, 63: 31-36. DOI: http://www.doi.org/10.4103/ijph.IJPH_365_19.

Helmick CG (1983). The epidemiology of human rabies postexposure prophylaxis, 1980-81. Journal of the American Medical Association, 250: 1990-1996. DOI: https://www.doi.org/10.1001/jama.1983.03340150032022.

Joshi DD (1991). Organization of veterinary public health in the South Asia region. Revue Scientifique et Technique, 10: 1101-1129. DOI: https://www.doi.org/10.20506/rst.10.4.587.

Kakati K (2010). Street dog population survey, Kathmandu 2010. Final Report to the World Society for the Protection of Animals, pp. 1-20. Available at: https://www.studylib.net/doc/7636360/street-dog-population-survey-kathmandu.

Karki S, and Thakuri KC (2010). Epidemiological situation of animal rabies and its control strategy in Nepal. The proceedings of the 9th conference of Kathmandu, Nepal: Veterinary Association, pp. 105-110. Available at: http://nva.org.np/downloadsdetail.php?id=2

Khkhar A, Meena GS, and Mehara M (2003). Profile of dog bites cases attending M.C.D. dispensary at Atipur, Delhi. Indian Journal of Community Medicine, 28: 157-160. Available at:

https://www.indmedica.com/journals.php?journalid=7&issueid=37&articleid=477&action=article.

Knobel DL, Cleaveland S, Coleman PG, Fèvre EM, Meltzer MI, Miranda MEG, Shaw A, Zinsstag J, and Meslin FX (2005). Re-evaluating the burden of rabies in Africa and Asia. Bulletin of the World Health Organization, 83: 360-368. Avialable at: https://www.pubmed.ncbi.nlm.nih.gov/15976877/

Marathe N, and Kumar S (2016). Epidemiological study of animal bite victims in Central India: a cross sectional institutional study. International Journal of Community Medicine and Public Health, 3(1): 78-82. DOI: https://www.dx.doi.org/10.18203/2394-6040.ijcmph20151220.

Martin RJ, Schnurrenberger PR, and Rose NJ (1969). Epidemiology of rabies vaccinations of persons in Illinois 1967-68. Public Health Report, 84: 1069-1077.DOI: https://www.doi.org/10.2307/4593757.

Masiira B, Makumbi I, Matovu JKB, Ario AR, Nabukenya I, Kihembo C, Kaharuza F, Musenero M, and Mbonye A (2018). Long term trends and spatial distribution of animal bite injuries and deaths due to human rabies infection in Uganda, 2001-2015. PLoS One, 13: e0198568. DOI: https://www.doi.org/10.1371.journal.pone.0198568.

Overall KL, and Love M (2001). Dog bites to humans–demography, epidemiology, injury and risk. Journal of the American Veterinary Medical Association, 218: 1923-1934. DOI: https://www.doi.org/10.2460/javma.2001.218.1923.

Pant GR (2013). Rabies control strategy in SAARC member countries. In: Proceedings of the Inception Meeting of the OIE/JTF Project for Controlling Zoonoses in Asia Under One Health Concept, Japan: World Organization for Animal Health. Available at: https://pdffox.com/rabies-control-strategy-in-saarc-pdffree-html.

Pantha S, Subedi D, Poudel U, Subedi S, Kaphle K, and Dhakal S (2020). Review of rabies in Nepal. One Health, 10: 100155. DOI: https://www.doi.org/10.1016/j.onehlt.2020.100155.

Qi L, Su K, Shen T, Tang W, Xiao B, Long J, Zhao H, Chen X, Xia Y, Xiong Y et al. (2018). Epidemiological characteristics and post-exposure prophylaxis of human rabies in Chongqing, China, 2007-2016. BMC Infectious Diseases, 18: Article number 6. DOI: https://www.doi.org/10.1186/s12879-017-2830-x.

Sharma M (2005). Knowledge and attitude of dog owner's towards the dog anti-rabies vaccination. Journal of Nepal Health Research Council, 3: 11-16. DOI: https://www.doi.org/10.33314/jnhrc.v0i0.94.

Sriaroon C, Jaijaroensup W, Tantawichien T, Benjawongkunchai M, Supich C, and Wilde H (2005). Common dilemmas in managing rabies exposed subjects. Travel Medicine and Infectious Disease, 3: 1-7. DOI: https://www.doi.org/10.1016/j.tmaid.2004.05.003.

Sudarshan MK, Madhusudana SN, Mahendra BJ, Rao NSN, Narayana DHA, Rahman SA, Meslin FX, Lobo D, Ravikumar K, and Gangaboraiah (2007). Assessing the burden of human rabies in India: Results of a national multi-center epidemiological survey. International Journal of Infectious Diseases, 11: 29-35. DOI: https://www.doi.org/10.1016/j.ijid.2005.10.007.

Wangoda R, Nakibuuka J, Nyangoma E, Kizito S, and Angida T (2019). Animal bite injuries in the accident and emergency unit at Mulago Hospital in Kampala, Uganda. The Pan African Medical Journal, 33: Article number 112. DOI: https://www.doi.org/10.11604/pamj.2019.33.112.16624.

World Health Organization (WHO) (1997). WHO recommendations on rabies post-exposure treatment and the correct technique of intradermal immunization against rabies. Available at: https://www.apps.who.int/iris/handle/10665/63396

World Health Organization (WHO) (2005). World Health Organization Expert Consultation on rabies. WHO Technical Report Series 931 First Report. Available at: http://www.wpro.who.int/NR/rdonlyres/B1ED8443-0993-408C-BF09-D1D06A6E1B45/0/FINALTEXTWHOTechnicalReportSeries090605.pdf

World Health Organization (WHO) (2007). Recommendations for inactivated rabies vaccine for human use produced in cell substrates and embryonated eggs. WHO Technical Report Series No. 941, Annex 2. Available at: https://www.who.int/biologicals/publications/trs/areas/vaccines/rabies/Annex%202%20inactivated%20rabies%20vaccine.pdf?ua=1

World Health Organization(WHO) (2010). Rabies vaccines: WHO position paper. Weekly Epidemiological Record, 85: 309-320. Available at: https://www.who.int/wer/2010/wer8532.pdf?ua=1.

World Health Organization (WHO) (2013). WHO Methods and Data Sources for Global Burden of Disease Estimates, 2000–2011. Global Health Estimates Technical Paper WHO/HIS/HSI/GHE/2013.4. Department of Health Statistics and Information Systems, World Health Organization. Available at: http://www.who.int/healthinfo/statistics/GlobalDALYmethods_2000_2011.pdf.

World Health Organization (WHO) (2019). Rabies: epidemiology and burden of disease. Available at: https://www.who.int/rabies/epidemiology/en/.

Yadav MP, Singh RK, and Malik YS (2020). Emerging and transboundary animal vial diseases: perspectives and preparedness. Emerging and Transboundary Animal Viruses, pp. 1-25. DOI: https://www.doi.org/10.1007/978-981-15-0402-0_1.

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