

## **Canine Vaccination, Human Post-Exposure and Pre-Exposure Prophylaxis, and Human Rabies Infection in Regions VI, VII, and VIII Philippines as Model Regions for Rabies Control**

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### **ABSTRACT**

*Canine bite cases in the Philippines increased by 462% from 2009 to 2018 which also increased the risk of human rabies infection. The Department of Health declared some municipalities in Region II, IV-B, V, VII, and X, as rabies-free areas in 2017. However, there are still positive cases of rabies infection to these areas and municipalities. This study seeks to provide the epidemiology of rabies cases in Visayas Region and assess their successful canine vaccination implementation. The study utilized the method of Manual Electronic Database Searching, which showed that only full articles that came from the Visayas Region were consistent in data and rabies prevention program in the years 2015-2018. In result to this, the researcher gave an analysis on rabies epidemiology in the Philippines and provided a Recommended Assessment Guide for rabies epidemiology and rabies control based on the consistent updates and reports of the Model Region for rabies prevention and control which is the Visayas Region.*

**Keywords:** *Rabies epidemiology, human post- and pre-exposure prophylaxis*

### **INTRODUCTION**

In the Philippines, canine rabies infection remains to be a major public health problem due to its annual human infection cases of 200-300 from the years 2001-2011. As canine rabies remains endemic to the islands of the Philippines, endemic rabies canine cases shows that 95% of rabies deaths are contributed by Africa and Asia in which the Philippines is located. According to the World Health Organization (WHO), the presence of poverty, crowding, and poor sanitation are factors which affect the number of canine rabies infections. As the Department of Health (DOH) together with global organizations formulated an effective canine rabies prevention and elimination program, sustainable and comprehensive approach are in need to achieve (1) affordable human vaccine and antibodies against canine rabies (2) urgent treatment for bite cases of rabies infected canine or human post-exposure prophylaxis; and (3) mass canine vaccination.

Despite the rabies control prevention and extermination program in the Philippines, the DOH stated that the fatality rate is almost 100%. Moreover, assessing the rabies cases infection starts by determining the number of bite cases thus, providing preliminary data for assessment. The number of canine bite cases reported in the Philippines increased by a total of 462% from the years 2009 to 2018 which is a significant percentage of increase. In 2009, a total of 206, 253 bite cases were reported and in 2018, a total of 1, 159, 711 bite cases were reported. In terms of human rabies cases per region in the Philippines, it is shown that Regions III, IV-A, V, and XII are reported to have the greatest number of confirmed cases from the years 2008-2018.

Conversely, within 6 years of the implementation of rabies elimination program, Regions VI, VII, and VIII had two provinces, five island municipalities, and five more islands declared by the WHO as rabies free sectors. Therefore, assessment and epidemiology of the rabies free regions in Visayas may aid as Model Regions for prevention and elimination of rabies in the Philippines.

## **Review of Literature**

### *Canine rabies, geographic distribution, and mortality rate*

Belonging members within the Lyssavirus genus of the family Rhabdoviridae canine rabies causes fatal encephalitis in infected humans (Gigante et al., 2020). Commonly known as the rabies virus, Rabies lyssavirus causes the majority of human rabies deaths due to bite cases of rabid dogs which results in 99% of human infection and have major clades that are endemic in the Philippines (Saito et al., 2013). In addition, in financially struggling countries the rabies virus remains endemic to it which results in an estimated value of 59, 000 – 60, 000 people die each year due to the rabies virus (Collinsonid et al., 2020). According to the WHO, rabies virus remains endemic to countries which possess the following factors: crowding, poor sanitation, and poverty or financial incapability. Countries which fall under these factors are Asia and Africa thus contributing to 95% of the world's human death cases (Department of Health Philippines, 2012). Moreover, the Philippines which belongs to Asia, tallies annual human rabies cases ranging from 200-300 according to the National Notifiable Diseases Surveillance System in the years 2001-2011 (Saito et al., 2013).

### *Dog vaccination and bite case*

In the Philippines, canine remains the main cause of rabies cases whereas in the total 3000 biting animals, 2.2% are rabies-positive (Quiambao et al., 2020). Ninety-nine percent of global human rabies cases and deaths are a result of exposure and bite of rabies infected canines (Lapiz et al., 2012). Among the species affected by rabies, canines are responsible for rabies infection by around 74.9%, feline at 20.4%, and other species at 9% (Lagayan, 2018). In relation to the canine bite cases, the location of the bite is significantly associated with the severity of the Rabies lyssavirus to human exposure (Evangelio et al., 2020).

A recommendation from the World Health Organization says that in order to prevent and eliminate rabies cases, at least 70% of the whole dog population must be vaccinated (Amano, 2017). This recommendation from the WHO also applies to countries with endemic cases of rabies which states that the 70% vaccination of the dog population must be done yearly which is essential in order to prevent and interrupt the rabies transmission. In addition, most rabies vaccines intended for dogs are licensed and only compatible for dogs older than 12 weeks which includes a revaccination of a booster one year after the first vaccination (Nelwan, 2018). In response to the Philippines having high cases of canine rabies infection on humans, the DOH procured a proposal to the WHO which aims to implement a rabies prevention and elimination campaign particularly in the Visayas region which is composed of regions VI, VII, VIII. The mass dog vaccination started in 2010 satisfying the recommended 70% of the whole dog population in the areas of Western Visayas and half of Central Visayas for Phase I and as for Phase II the second half of Central Visayas and Eastern Visayas (Ferguson et al., 2015).

### *Human post-exposure and pre-exposure prophylaxis and cost*

In the post-exposure prophylaxis, there are three categories; category I which includes licking of undamaged skin with secretions and excretions of rabid animals, touching, and feeding animals; category II includes bites, scrabs, and scratches without the result of any bleeding; and category III which includes simple and multiple transdermal bites with simple to severe bleeding (Nelwan, 2018). Patients who fall under category II without any vaccination need to receive rabies immune globulins (RIG) and cell culture and embryonated egg-based rabies vaccines (CCEV) immediately (Reece, 2008). Moreover, the treatment for category III patients requires also

immediate administration of both RIG and CCEV according to the WHO since category III is more severe than category II (Peters, 2018). For the RIG, there are two clinically available treatments namely: HRIG or the human rabies immunoglobulins and ERIG which is the equine rabies immunoglobulins (World Health Organization, 2013).

For the local treatment of wounds, washing and flushing for at least 15 minutes with soap and water on the bite wounds or scratches is required to be done immediately upon exposure (Beyene et al., 2018). As for the pre-exposure prophylaxis, the vaccine is given in order to prepare the human immune system to have protection against the Rabies lyssavirus which can be caused by rabies infected canine exposure through bites and scratches. In addition, the Department of Health (DOH) conducted a mass pre-exposure prophylaxis on children in January to February 2012. The children were given doses of purified Verocell rabies vaccine which followed the procedure, standard, and protocols of the World Health Organization (WHO) (Deray et al., 2018). This also reflects community awareness regarding post and pre-exposure prophylaxis and general rabies epidemiology (Barroga et al., 2018). Moreover, the cost for rabies post-exposure prophylaxis remains to be high which leads to financial incapability (Rysava et al., 2019). In the developing countries, rabies vaccines remain costly and the supply for vaccination is inadequate (Amparo et al., 2018).

### **Objectives of the Study**

Generally, the study seeks to provide the epidemiology of rabies cases in the Visayas Region of the Philippines. Specifically, the study aims to assess how Regions VI, VII, and VIII are successful in the implementation of canine vaccination and human post-exposure prophylaxis in order to provide a scientific claim in considering this rabies free regions as a Model Regions for the prevention and elimination of rabies in the Philippines.

### **METHODOLOGY**

The researcher used a descriptive quantitative style of study. Data that are used were collected through a bibliographic method. Specifically, manual electronic database searching from Google Scholar and PubMed which covers MEDLINE and EBM (Evidence Based Medicine) reviews (Soares, 2013) and includes references from the World Health Organization, Philippines' Department of Health, and Local Government Units from Regions VI, VII, and VIII.

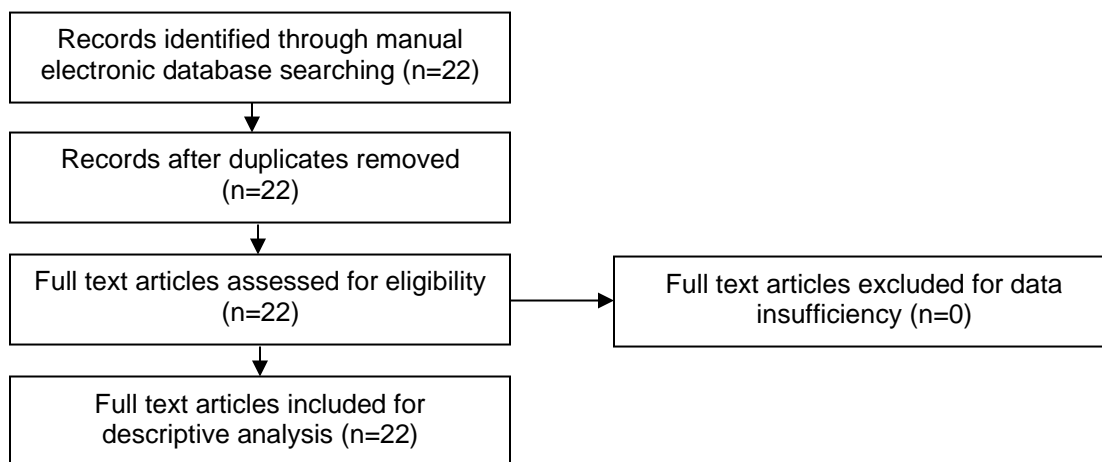


Figure 1. Number of Full Text Articles Gathered from Manual Electronic Database Searching

## RESULTS AND DISCUSSIONS

A total of 276 human rabies cases was recorded in the year 2018 (Department of Health Philippines, 2020). According to the Philippines Statistics Authority, in 2018, the population of Filipinos is estimated at 107,587,132 which gives an average of 2 people per million of population is susceptible to death due to the Rabies lyssavirus.

Moreover, having this high incidence rate of human rabies cases in the Philippines, Region 3 or the Central Luzon had the highest number of human rabies cases (Lagayan, 2018). This is followed by Region 4A CALABARZON. Despite the Department of Health declaring in 2017 that Regions II, IV-B, V, VII, and X are rabies free areas, the data submitted by each municipality in each region to the Department of Health shows that these rabies free areas and municipalities still have positive cases of human rabies.

Table 1. Human rabies cases in the Philippines per region in 2018

Region	No. of Human Rabies Cases
3	58
4A	30
7	25
12	21
1	20
6	16
2	16
11	16
NCR	15
9	12
10	11
5	11
4B	10
CARAGA	6
8	5
CAR	4
ARMM	0
Total	276

*Data source: Disease Prevention and Control Bureau, Infectious Disease Office, DOH Philippines*

As shown in Table 2, a total of 10,757 are cases of Category I exposure which includes licking of undamaged skin with secretions and excretions of rabid animals, touching, and feeding animals. As treatment for Category I, washing and flushing for at least 15 minutes with soap and water on the bite wounds or scratches is required to be done immediately upon exposure (Beyene et al., 2018). In addition, there are a total of reported 836,616 cases of Category II exposure which includes bites, scratches, and scratches without the result of any bleeding. Category II exposure patients with or without prior vaccination need to receive RIG and CCEV immediately or not beyond 72 hours of the bite (Reece, 2008). Lastly, there is a total of 309,004 cases of Category III which includes simple and multiple transdermal bites with simple to severe bleeding (Nelwan, 2018). Treatment for category III patients requires immediate administration of both RIG and CCEV according to the WHO since category III is more severe than category II (Peters, 2018). For the RIG, there are two clinically available treatments namely: HRIG or the human rabies immunoglobulins and ERIG which is the equine rabies immunoglobulins.

Table 2. Human rabies category of exposure in the Philippines per region in 2018

Region	Category of Exposure			Total
	Category I	Category II	Category III	
1	524	62960	11845	75329
2	291	74652	17936	92879
3	596	102746	25363	128705
4A	1635	69894	20945	92474
4B	982	24465	8341	33788
5	868	32830	9403	43101
6	131	50905	42476	93512
7	1651	65578	34936	102165
8	29	15861	11551	27441
9	1107	49928	24336	75371
10	0	47218	11166	58384
11	96	37896	6678	44670
12	572	34840	12589	48001
CARAGA	309	17549	4722	22580
CAR	656	20360	7814	28830
NCR	1154	128125	58443	187722
ARMM	156	809	460	1425
Total	10 757	836 616	309 004	1 156 377

*Data source: Disease Prevention and Control Bureau, Infectious Disease Office, DOH Philippines*

In connection to this, the coverage of Post-Exposure Prophylaxis (PEP) and Equine Rabies Immunoglobulin (ERIG) is seen on Table 3. A total of 1,073,904 Tissue Culture Rabies Vaccine (TCV) is recorded with a coverage of 93.7% from Region I to ARMM. This significant increase of coverage from 2007 to 2018 shows improvement on Post-Exposure Prophylaxis coverage in the Philippines. As for the Equine Rabies Immunoglobulin (ERIG), there is a total of 162,824 with a coverage of 52.6% from Region I to ARMM.

Table 3. Coverage of Post-Exposure Prophylaxis (PEP) and Equine Rabies Immunoglobulin (ERIG)

Region	TCV	%TCV	ERIG	%ERIG
1	68168	91.1	6420	54.2
2	85910	92.7	12788	71.2
3	126522	98.7	14467	57
4A	85019	93.5	9212	43.9
4B	31046	94.6	4493	53.8
5	47767	113.1	4792	50.9
6	75753	81.1	12732	30
7	98286	96.2	20415	58.4
8	26735	97.5	5835	50.7
9	64730	87.1	11361	46.6
10	58507	100	6505	58.5
11	44601	99.8	3527	52.9
12	48508	102.2	8505	67.5
CARAGA	18413	82.6	2592	54.8
CAR	26018	92.3	4837	61.9
NCR	167286	89.6	34235	58.5

ARMM	635	50	108	23.4
Total	1 073 904	93.7	162 824	52.6

*Data source: Disease Prevention and Control Bureau, Infectious Disease Office, DOH Philippines*

### *Visayas Region as Model Region for Rabies Control*

As a response of the Philippine Government and Local Government Units, together with the World Health Organization, an effective canine rabies prevention and elimination program was formulated. This included a sustainable and comprehensive approach that needed to achieve (1) affordable human vaccine and antibodies against canine rabies (2) urgent treatment for bite cases of rabies infected canine or human post-exposure prophylaxis; and (3) mass canine vaccination. Upon this initiative, the DOH procured a proposal that is approved by the WHO which aims to implement a rabies prevention and elimination program particularly in the Visayas Region which is composed of regions VI, VII, VIII (Cobonpue, 2020). The program includes mass dog vaccination that started in 2010 satisfying the recommended 70% of the whole dog population in the areas of Western Visayas and half of Central Visayas for Phase I and as for Phase II the second half of Central Visayas and Eastern Visayas (Ferguson et al., 2015).

**Table 4. Dog vaccination coverage in Regions VI, VII, and VIII (2015-2018)**

Region	2015	2016	2017	2018
VI	48.43 %	61.62 %	67.78 %	69.46 %
VII	76.27 %	70.32 %	52.27 %	74.09 %
VIII	55.56 %	59.10 %	60.86 %	57.30 %

*Data source: Disease Prevention and Control Bureau, Infectious Disease Office, DOH Philippines*

As a result of this, it is evident that from 2015 to 2018, the whole Visayas Region is consistently aiming to satisfy the World Health Organization's recommendation of 70% vaccination of the whole dog population. In 2018, Regions VI, VII, and VIII had 69.46%, 74.09%, and 57.30% dog vaccination coverage respectively. It is shown in the table above that the Visayas Region remains consistent in achieving WHO's recommendation and is declared by the WHO as a rabies free area (two provinces, five island municipalities, and five smaller islands) (WHO, 2015) thus, making the Visayas Region as the Model Region for this study. Moreover, based on the manual electronic database searching from Google Scholar and PubMed which covers MEDLINE and EBM (Evidence Based Medicine) reviews (Soares, 2013), the only available data for rabies prevention and elimination program submitted by the local government units to the Department of Health Philippines, came from the areas and municipalities under the Visayas Region (Eleazar, 2010).

One of the available data which focuses on rabies prevention and elimination programs is evident in the study done in Cebu City which belongs to Region VII. It is seen in Figure 1 that the dog vaccination coverage in Cebu City is relatively low. Unvaccinated dogs in rural areas are at 65% and in Urban areas at 48% which gives a total of 56.60% unvaccinated dogs in the whole Cebu City (Kartal, 2017). In response to this, the Bureau of Animal Industry (BAI) together with the Cebu City Local Government Units, have created a program and research study which prioritizes a rabies free and zero human rabies cases in 2020. Due to Cebu City's strategic location, it was chosen by the BAI to be the locus of the study *Report on Owned Dog Population Survey in Cebu City, Philippines* by Dr. Amit Chaudhari, Dr. Kazami Joanne Amano, and Tamara Kartal in 2017. The study was done in order to acquire the accurate data for owned dog population in Cebu City in order to establish a basis for understanding and formulation of an improved and complemented dog population management which includes rabies prevention and elimination program in Cebu City. Since the whole Cebu City did not satisfy the 70% of the dog population to



be vaccinated, the study formulated a recommendation and strategic vaccination program and education system which aims to give awareness to the human population as well. Cebu City satisfies consistent update of data and programs in order to achieve their goal of a rabies free area in the Philippines.

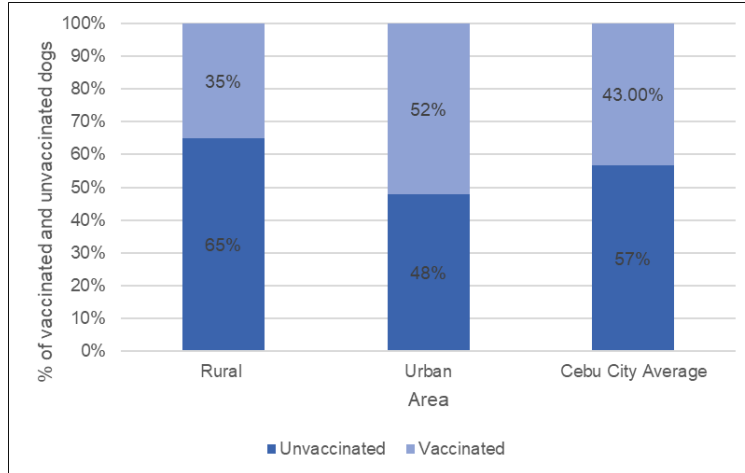


Figure 2. Dog Vaccine Coverage in Cebu City

Moreover, another part of the Visayas Region, Bohol City which is also under Region VII, also has data available in terms of improved strategic programs for post-exposure prophylaxis. The study “On the path to rabies elimination: The need for risk assessments to improve administration of post-exposure prophylaxis” by Rysava et al. in 2019, identified Bohol’s administration of post-exposure prophylaxis which includes the vaccines Rabies Immune Globulins (RIG) where there are two clinically available treatment namely: HRIG or the Human Rabies Immunoglobulins and ERIG which is the Equine Rabies Immunoglobulins and Cell Culture and Embryonated Egg-Based Rabies Vaccines (CCEV). In the study, it is evident that the location of animal bite treatment centers and animal bite clinics is strategically placed as seen in Figure 3. The location of animal bite treatment centers and animal bite clinics are placed in areas with human density of approximately 500 – 5000 (Rysava et al., 2019).

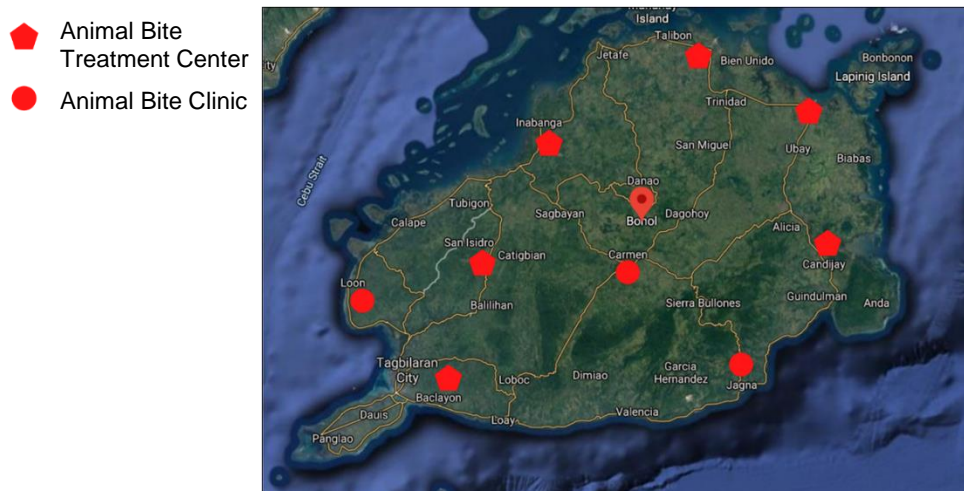


Figure 3. Treatment Centers and Bite Clinics Map in Bohol

Upon gathering data from the consistent updates on rabies prevention and elimination programs and research studies from the Local Government Units and researchers from the Visayas Region, a recommended assessment guide and strategic plan for rabies epidemiology is presented at Figure 4. The model is inspired by the Operational Plan for Rabies Elimination in Dogs in the Philippines (Animal Rabies Medium Term Plan for 2017-2022) presented by Maria Glofezita Opuencia Lagayan of Alternate Rabies Focal Person, Animal Health and Welfare Division, Bureau of Animal Industry, and Department of Agriculture for the 1st Asian Rabies Control Network (ARACON) Meeting in 2018. The model presented at ARACON mainly identifies the category of risk levels based on the regions' data and programs implemented within their sectors. As for the recommended assessment guide for rabies epidemiology in Figure 5, it provides recommended actions based on the regions' rabies program and control status.

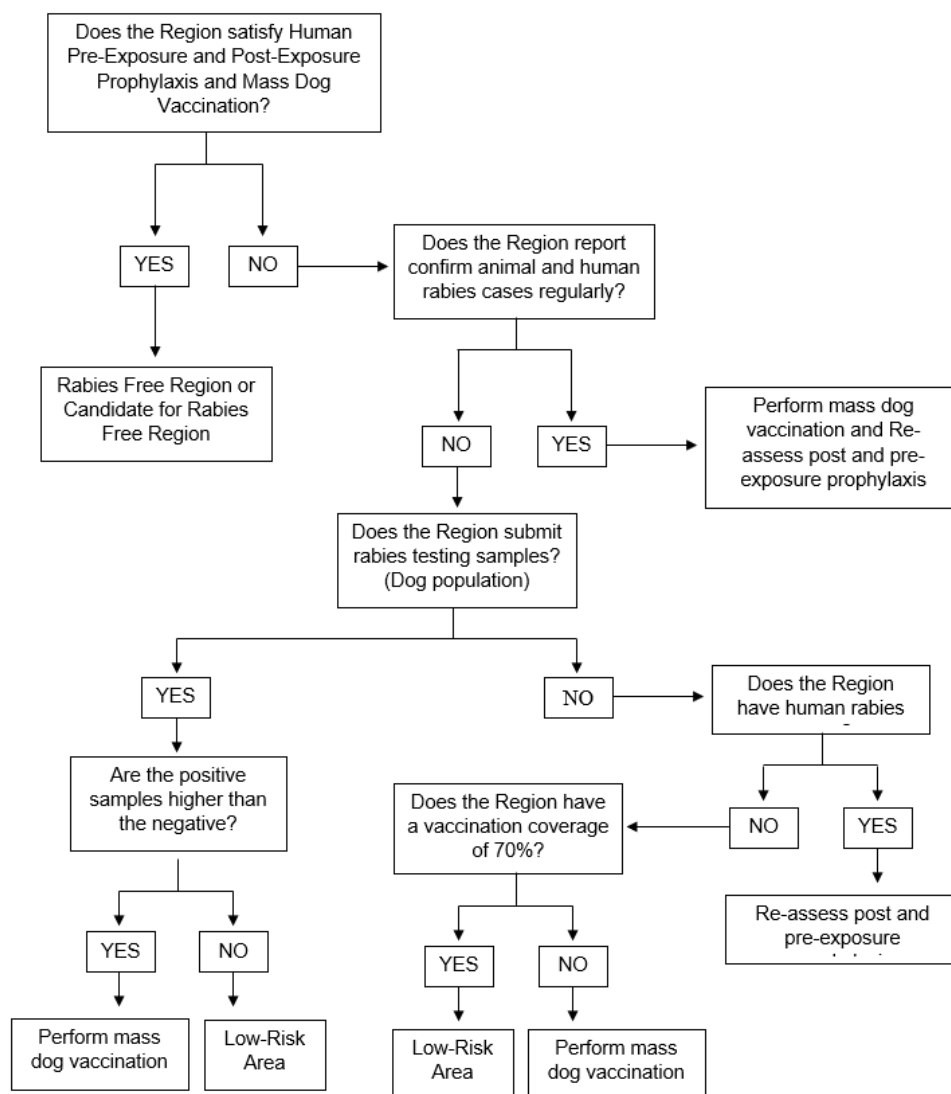


Figure 4. Recommended Assessment Guide for Rabies Epidemiology

### CONCLUSIONS

The study showed that rabies cases in the Philippines are still significantly increasing which states that the number of canine bite cases increased by a total of 462% from the years



2009 to 2018 which also increases the risk of human rabies infection. This is due to the fact that 99% of global human rabies cases and deaths are a result of exposure and bite of rabies infected canines. In relation to this, despite the Department of Health declaring rabies free areas in the Philippines such as municipalities in 2017 namely in, Region X, Region VII, Region II, Region IV-B, and Region V, the data provided by both the World Health Organization and Department of Health shows that rabies free areas and municipalities still have positive cases of human rabies. In addition, the study also determined that the total human rabies exposure is at 1,156,377. It is also revealed that most of the human rabies exposure in the Philippines fall under Category II which is at 836,616. Category II exposure can be treated by vaccination of (RIG) and (CCEV) immediately or not beyond 72 hours. In relation to this, the study also showed that the coverage of post-exposure prophylaxis (PEP) in form of tissue culture vaccine (TCV) and equine rabies immunoglobulin (ERIG) increased by a total of 93.7% and 52.6% respectively from the years 2007 to 2018.

Moreover, analysis of data regarding rabies epidemiology and preventive programs from consistent reports and updates from the Visayas Region, the Model Region for rabies control in this study, a recommended model for rabies control is procured. The recommended model is inspired by the Operational Plan for Rabies Elimination in Dogs in the Philippines presented by Maria Glofiezita Oplencia Lagayan. Furthermore, the recommended model provides an assessment guide for rabies epidemiology. By having a strategic assessment on rabies epidemiology, the model also shows recommended actions based on the regions' number of infected canines, human rabies cases, and rabies program and control status.

For future researchers, they provide an extension of this study by determining the population of stray and owned canines in a certain region or even barangay. By doing so, they can create more specific and attainable strategic actions to improve the current recommended assessment guide for rabies epidemiology and rabies control model. This will further provide a general guideline for small organizations in a certain place and even households so that they may be aware on how to handle post-human rabies exposure and prevention of rabies cases in their vicinity.

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