Evaluation of animal rabies surveillance system, Sunyani West District- Ghana, 2019

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ABSTRACT

Introduction: Rabies is an important global public health concern causing 70,000 human deaths annually. In Ghana rabies is endemic and costs more than 16 million dollars annually. Ghana has both human and animal rabies surveillance systems to monitor the incidence and inform prevention and control measures. We evaluated the animal rabies surveillance system in Sunyani West District (SWD) to assess its attributes, usefulness and system performance in meeting its objectives. **Methods:** The CDC updated guidelines for evaluating public health surveillance systems was adapted in this evaluation. We extracted and reviewed rabies data for 2014-2018 from veterinary and human records in SWD. We interviewed key stakeholders on the operations and attributes of the system. We performed summary descriptive statistics on quantitative data and direct content analysis on qualitative data. **Results:** SWD recorded 14 dog-bites/suspected rabies cases at the veterinary office for the period with one confirmed outbreak. All veterinary staff at SWD (4/4) involved in rabies surveillance knew the case definition and could complete the case investigation forms within 10 minutes. However, most 92.9% (13/14) case investigation forms were incompletely filled. Health workers interviewed said they referred all dog bites cases to veterinarians. However, referrals were done verbally through the victim. No community assessment for unreported animal bites was done. **Conclusion:** The animal rabies surveillance system is meeting its objectives by detecting an outbreak. It is useful, simple, and sensitive but has poor data quality and not acceptable. Strengthening the One-Health approach will be required to improve the overall performance of the system.

Introduction

Rabies is present on all continents and endemic in most African and Asian countries [1]. It is a zoonosis with 100% case fatality, it is 100 % preventable yet a neglected tropical disease and one of the most important public health concerns worldwide. Globally, it is estimated to cause up to 70,000 human deaths every year [2-3]. It has an important economic impact due to the losses in livestock and the cost of the implementation of preventive and control measures in both animals and humans. In Africa and Asia, these deaths and losses are responsible for 1.74 million disability-adjusted life years (DALYs) lost each year [2].

In Ghana, rabies is endemic in all the regions [4] and costs more than 16 million dollars annually [5]. According to data from the District Health Information Management System-2 (DHIS-2) nationwide, 265 clinically diagnosed human rabies were recorded between 2014 and 2018 and of which 28.7% (76/265) people died. Between 2009 and 2012, 54 laboratory-confirmed canine rabies was reported in Techiman Municipality in the Brong-Ahafo region of which five human deaths occurred [6]. In the Eastern region, between 2013 and 2015, 4821 dog-bites cases with 15 clinically diagnosed human rabies were reported [4]. During the same period, Kumasi Metropolitan in the Ashanti region recorded 21 suspected human rabies cases [7]. In 2018, eight (8) persons suffered from dog bites in the Volta region from the same animal [8] and laboratory diagnosis confirmed the dog to be rabid. Rabies is one of the scheduled diseases under surveillance in Ghana [9]. Dog bite cases are captured by the parallel surveillance system of Ghana Health Services (GHS) and the Veterinary Services Directorate (VSD). Animal rabies is captured by the VSD surveillance system. Periodic evaluations of these systems are important to assess the data quality generated and determine weaknesses for improvement.

The animal rabies surveillance began as far back as the 1970s [10] and its objectives include early detection of animal rabies outbreaks in endemic areas, monitoring the spread and progress of outbreaks, determining high-risk areas for intervention and evaluating the effectiveness of intervention at the level of the animal reservoir. These objectives are essential to inform the impact of rabies on public health.

We evaluated the rabies surveillance system in Sunyani West District (SWD) to assess whether it is meeting its objectives, assess its usefulness and system attributes.

Methods

Study setting

The evaluation was conducted in Sunyani West District (SWD) located in Brong-Ahafo region (currently Bono, Bono East and Ahafo regions). Based on the 2010 population and with the 2.5% population growth rate, SWD has a population of 103,896 as of 2018. Most often, the VSD partners with GHS to have their polio canvassers do the dog & cat census while going for their door-to-door polio vaccination. Based on the last animal census figures of 2008 by the GHS, and using the ten-average growth rate of 4.5% for dogs and 2.5% for cats, the estimated dog/cats population for the Brong-Ahafo region is 287,083 as of 2018. SWD has three (3) agricultural zones which represent the sub-districts according to the Ghana VSD. Of these three zones, only Zone 1 has a physical structure which houses the veterinary office and collates information from the other two (2) zones. There are no private veterinary clinics in the district.

Case definition, operation and resources of surveillance system

The animal rabies surveillance system in SWD is passive and targets all warm-blooded animals. The case definition of rabies used is determined at three levels; suspected case, probable case and confirmed case [10].

Suspected rabies case is established on the presence of the following symptoms: indiscriminate or unprovoked biting animal plus one of these; behaviour disorder, excessive salivation, progressive paralysis.

Probable rabies case is defined as a sudden change in behaviour, excessive salivation, and progressive paralysis present in an animal with an epidemiological link to a confirmed case or which had a bite from a confirmed case.

Confirmed rabies case is defined as any animal with a positive laboratory result for rabies virus from the brain tissue or saliva.

Figure 1 illustrates the information flow in the animal surveillance system where data originates from the community to the district, region, national and international levels.

On a monthly basis, all cases detected and investigated (positive and negative) at the district level are captured on an integrated surveillance form; the Veterinary Form 1 (VF-1) and submitted to the next levels. An outbreak of rabies is defined as one laboratory-confirmed case of rabies in an animal. Basic descriptive analysis is done at the district level. At the regional level, all data are collated, some analyses are performed, and reports are forwarded to the national level. Sometimes, reports from the district level go directly to the national level, when samples are sent directly to the national laboratory. At the national level, the information is then shared with the GHS, international partners in the animal sector; the World Organization of Animal Health (WOAH)/African Union Inter-African Bureau for Animal Resources (AU-IBAR)/Food and Agriculture Organization (FAO) which subsequently share with the human counterpart in the World Health Organization (WHO).

Data collection tools and methods

We adapted the Centers for Disease Control and Prevention (CDC) updated guidelines [11] for evaluating public health systems in this evaluation process. We developed an interview guide, a checklist to satisfy the objectives of the evaluation and describes the system´s operations. We interviewed all veterinary staff involved in

the operation of the surveillance system from district (4), regional (2) and national (1) levels using the interview guide. From the human health side, we conducted an unstructured interview of disease control officers (2), medical doctors (2) and public health nurses (3) at four health facilities: one private and three public. Health facilities were selected purposively. We extracted and reviewed data from veterinary and health records for a five-year period; 2014 to 2018. The sources of data were the Veterinary Form 1, veterinary monthly reports and laboratory registers, and DHIMS-2.

Surveillance system´s performance (assessing whether the rabies surveillance system is meeting its objectives)
We assessed the system´s objectives to verify its fulfilment through veterinary surveillance data review and interviews of key informants of the animal surveillance system. Its objectives are to; rapidly detect, monitor the spread and progress of outbreaks, determine high risk areas for intervention, and evaluate the effectiveness of intervention at the level of animal reservoir.

Assessing the usefulness of the rabies Surveillance system
We reviewed data on; the system´s contribution to rapidly detecting an outbreak/outbreaks and initiation of prevention and control at the level of animal reservoir. In addition, we interviewed key informants on the use of surveillance data for action and decision making.

Assessing the attributes of the system
We assessed the attributes of the system as indicated in Table 1

Data analysis
Data was analyzed both qualitatively and quantitatively. Direct content analysis was performed on qualitative data. All sections of the questionnaire that highlighted the main areas as stated by the guidelines; case definitions, purpose and objectives of the system, operation of the system, components of the system and the nine (9) system attributes were selected as themes for analysis.
Descriptive analysis was done for quantitative data. Mean year in service was summarized using mean and standard deviation. The age of workers was summarized using median and interquartile range. Data was entered in Statistical Package for the Social Sciences (SPSS) version 22.0 and all statistical analyses were performed using Stata version 15.0 (StataCorp, College Station, TX, USA). Microsoft Excel 2016 was used in constructing the graphs. Statistical analyses were expressed as frequencies, percentages, ranges, means and graphs.

Ethical consideration
The Ghana Field Epidemiology and Laboratory Training Program (GFELTP); run by both the Ghana Health Service and the School of Public Health - University of Ghana granted approval. The Director of the Diseases Surveillance Department of the Ghana Health Service also granted approval for the access and use of the data for this review. Permission was sought from the office of the Director of the Veterinary Services Directorate (VSD) to access official documents on rabies at district, regional and national levels. Informed consent was obtained from participants without any form of coercion.

Results

A total of seven (7) veterinary staff were interviewed from the sub-district, regional to the national level. Majority 85.7% (6/7) were males and most 57.14% (4/7) were veterinary technicians who worked at the district level. The remaining three (3) worked at regional and national level. The median age of staff was 53 years (IQR:38 - 56). The mean year in service was 22.7 ± 12.2 years.
All veterinary staff at SWD (4/4) were involved in rabies surveillance and knew the case definition for the animal rabies surveillance system. However, they did not have the case definition posters/charts pasted in the office. They all said to use knowledge from school to classify suspected/confirmed rabies cases. Four (57.1%) of the respondents were conversant with rabies surveillance information flow. No data analysis was done at the district level. Trainings are received on ad hoc basis and are usually available to those at the national level.
At the health facility level, workers interviewed had knowledge on the human case definition and had them pasted on their walls. All said they referred dog bites cases to the veterinarians. However, only the private health facility used a referral form, the rest did referral verbally through the victim.
For the period evaluated the system recorded 14 suspected cases at the district veterinary office of which one outbreak. At the regional level, a total of 417 suspected rabies was detected out of which 76.7% (320/417) samples reached the regional veterinary laboratory for testing in good condition. About 12.8% (41/320) of samples tested positive. All samples were sent immediately upon collection to the laboratory. The laboratory results are obtained within 48 hours and feedback is given to the reporting facility or next level in real-time. However, key informants indicated that most of the outbreaks detected are not investigated due to lack of resources. District-level staff did not perform any analysis of the data collected to monitor the spread of outbreaks.
Though the system detected suspected cases and outbreaks, the interviews revealed that majority of the samples for the region came from only districts close to the regional laboratory. In the case of SWD, all suspected cases and the only outbreak detected were reported from only one agricultural zone out of the three (3).
The highest vaccination coverages were 5.5% (2014), 8.5% (2014) and 7.1% (2015) at national, regional and district levels respectively below the 70% target (Figure 2).

Usefulness of the system
Results from the data reviewed indicated that the brains of highly suspected rabid animals (i.e an animal with more than one sign of rabies) are submitted immediately to the laboratory for testing. Suspected animals at the origin of human exposure that cannot be killed are kept under 10 - 14 days´ observation. Exchange of information within the

surveillance system from one level to the next was real-time. Four of the seven (57.1%) respondents (the regional and national levels) indicated the data collected on rabies was used for planning and procurement of vaccines.

Attributes of the system

Simplicity: all staff knew the case definition. Case investigation forms were easy to complete; requiring less than 10 minutes. Only two follow-ups at one-week interval were required to update case status. Seller´s Staining Test (SST) is used in diagnosing rabies in this evaluation. It yields results under one-hour, inexpensive laboratory equipment needed to perform the test.

Stability: there is no budgetary allocation specifically for rabies surveillance. Resources allocated come irregularly and very minimal. Human resources was inadequate (one staff per sub-district). However, the system did not experience power outrages for the period the system was evaluated.

Sensitivity: For the five (5) years period the system was able to detect one rabies outbreak. Predictive value positive: PVP of 12.8% (41/320) was recorded at regional level (**Table 2**).

Timeliness: Reporting of suspected cases to the next level was real-time and sample submission to the laboratory was within 24 hours. However, monthly reports submissions to the regional and national offices were behind schedule by two weeks.

Flexibility: the system has also been used to detect other diseases; e.g African swine fever in November 2018 with little resources required. The data collection form for animal rabies could easily be modified to collect data on other events.

Completeness/data quality: of the 14 cases reviewed, 92.9% (13/14) had investigation report form. None of the available forms was completely filled out especially the Geographical Position System (GPS) coordinates. Data in reports was inconsistent at the district, regional and national levels and there was no back-up system for the all data collected.

Representativeness: records review showed that all cases came from one sub-district. There was no record representing cases from the other sub-districts.

Acceptability: the district veterinary office suspected only 14 rabies cases as against 254 suspected cases recorded at health facilities in the district (**Figure 3**). None of the 14 case investigation forms was completely filled. The system did not respond to the outbreak detected at the district.

Discussion

This study evaluated the animal rabies surveillance system in SWD in the Brong-Ahafo region Ghana for the period 2014 to 2018. Key informants had high knowledge on the system´s operation which could be attributed to the high mean years in service. Yet high knowledge did not reflect reporting rates. In this evaluation, reporting rates was lower at the district veterinary office compared to the health facility which could be attributed to a gap in referrals between the sectors. The gap in referrals in turn could be due to the lack of the implementation of integrated animal bite management. This is comparable to findings from a study conducted in Tanzania where it was found that prior to the implementation of integrated animal-bite management cases were unreported and uninvestigated [12]. The findings suggest a weak One-health approach to rabies surveillance. A study in Ghana which reported inadequacy in the number of dog-bite cases, outbreak cases and sources of infection [13] also attributed it to a weak One-Health approach to rabies surveillance [13]. The implication of the non-implementation of integrated animal bite management and weak One-Health approach to rabies surveillance is that rabid animals are not found and removed from the community, and monitoring the spread and progress of the disease will not be achieved.

Another reason for low reporting rates at the district veterinary office is the absence of physical structure in all its sub-districts. Though, it is indicated that the agricultural zone with the physical structure collates all the reports emanating from the other zones, human health workers indicated they did not know where to report in these zones.

Timeliness in samples submitted to the laboratory, obtaining laboratory results and feedback to the reporting facility or next level was found to be good. Good timeliness allows rapid/early detection of outbreaks and prevention and control activities to be initiated early. The capacity for data management and analysis at the district level was deficient; participants working on the surveillance only collected data and transferred to the next level. The mere collection of data without transforming it into usable form for action undermines the purpose of disease surveillance on monitoring the spread of the disease. The district is likely to miss the identification of high-risk areas due to inefficient use of data collected. The target vaccination coverage for rabies according to the World Organization Animal Health (WOAH) is 70%. However, in this evaluation, we found that all the levels of the system have covered their respective areas with coverages below 10%. With regards to decision making vaccine procurement was based on the use of surveillance data. The poor vaccination coverage coupled with the lack of identifying a high-risk area for interventions makes the rabies surveillance system in SWD partially effective The low detection of the outbreaks could be attributed to the inefficient referral system between the human health centres and district veterinary office and poor vaccination coverages could be attributed to limited logistics resources; budgetary and human.

Despite the human, and financial resources constraints, and low number of outbreaks detected or low reporting rates, the SWD rabies surveillance system was found to be sensitive, useful but partially meeting its objectives.

Completion of case investigation forms and follow-up to update a case were simple for the staff and they knew the case definition. Also, laboratory diagnosis of a case was simple and inexpensive. However, the technique (SST) used has comparatively low sensitivity which could amount to many false positives diagnoses.
The lack of data backup systems, inconsistent data at all levels, and missing forms and variables in the investigation forms suggest poor data validation and quality. Meanwhile, accurate data is crucial for decision-making. For instance, the GPS coordinates in the surveillance of rabies is one of the most important components in filling out the forms. It helps to map out the cases and to enhance planning, analysis and monitoring capabilities. This also will help to assess the effectiveness of interventions at the animal reservoir level.
The system´s flexibility in its ability to report other diseases or events using minimal modification of case investigation forms reduces cost, and delays and shows integration with other systems. In this evaluation, rabies case investigation and reporting tools were utilized in the case of African Swine Fever. In addition, the system is simple, thus, making it flexible.
With regard to stability, the system was found to be not stable. Availability and regular funds are prerequisites for materials and resources for the successful operation of the system. As it stands now, funding for rabies surveillance is incorporated in the limited funds for all diseases under surveillance. Hence, the VSD, must institute strategies to allocate specific funding for rabies, especially for the investigations and vaccination campaigns.
Representativeness and acceptability of the system were threatened as they did not capture as many suspected cases as their human counterpart due to referral issues. Thus, there must be a proper referral channel for rabies between the two sectors. Also, of the three sub-districts within the district, only one has a physical veterinary structure which means many cases could be missed due to the fact that the community and human health workers will not know where to report cases. The VSD should therefore ensure the establishment of physical structures in the remaining sub-districts.
This evaluation had a few limitations. No community/village health team assessment for unreported animal bites was done. Also, we did not assess the knowledge, attitude and practices of the community on rabies. As such, more assessment at the community level is required to be done to ascertain some of the facts and add more value to the study.

Conclusion

The rabies surveillance system in SWD is useful. It meets one of its objectives; early detection of outbreaks. It is simple, timely and sensitive but has poor data quality, not acceptable and not stable. The system faces challenges financially, human resource and inadequate collaboration with the human health sector. Refresher training on data reporting and strengthening the One-Health approach to rabies surveillance will be required to improve the overall performance of the system. As part of public health action, an on-site staff training on filling the case investigation forms was done. Additionally, findings were presented to the district, rabies awareness education on local radio station and 3 days' free vaccination of pets in the district.

What is known about this topic

- Rabies is 100% preventable
- In Ghana, rabies remains endemic
- Rabies data are captured by the parallel surveillance systems of the GHS and VSD

What this study adds

- The animal rabies surveillance system in Sunyani West District is unstable
- There is a lack of implementation of integrated animal bite management between the animal and human health sector
- Not every outbreak of rabies detected is investigated as required

Competing interests

Authors declare no competing interests.

Authors' contributions

Conceptualization: BZ, HA, CL, BBK. Data collection: BZ, HA, SD, GK. Data analysis and report writing: BZ, HA, SD, GK, DB, BBK, CLN. Drafting of manuscript: BZ, HA, SD, GK, DB, BBK, EA, EK, CLN. Finalization of manuscript: BZ, HA, SD, GK, DB, BBK, EA, EK, CLN. All authors read and approved and the final version of the manuscript.

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Table 1: Assessment of attributes of the animal rabies surveillance system		
Attributes	**Data collection**	**Indicator(s) evaluated**
Simplicity	Interviews	Knowledge on case definition, ease and time in completing an investigation form, time to obtain laboratory results, number of follow-ups to update a case
Stability	Interviews	Budgetary allocation specific for the system, human resources, frequency of funds received for surveillance
Sensitivity	Records review	the ability of the system to detect outbreak(s)
PVP	Records review	Proportion of confirmed cases from the suspected rabies cases
Timeliness	Record review & interviews	Reporting of suspected cases to the next level, sample submission to the laboratory, submission of monthly report
Flexibility	Records review & interview	Ability to detect other outbreaks, integration with other systems
Data quality	Records review	Proportion of investigative form available, proportion of completed investigative forms, storage facility and back-ups, data validation
Representativeness	Records review	Sources of cases reported
Acceptability	Records review & interviews	Reporting rate of dog-bite between health/community and veterinarian, completeness of investigation forms

Table 2: Confirmed Animal Rabies Cases at Regional Veterinary Laboratory Level, Brong-Ahafo, 2014 - 2018				
Year	**Samples submitted**	**Number positive**	**Number negative**	**PVP (%)**
2014	79	18	54	22.9
2015	73	10	62	13.7
2016	69	3	66	4.3
2017	49	6	43	12.2
2018	50	4	46	8.0
Total	320	41	271	12.8

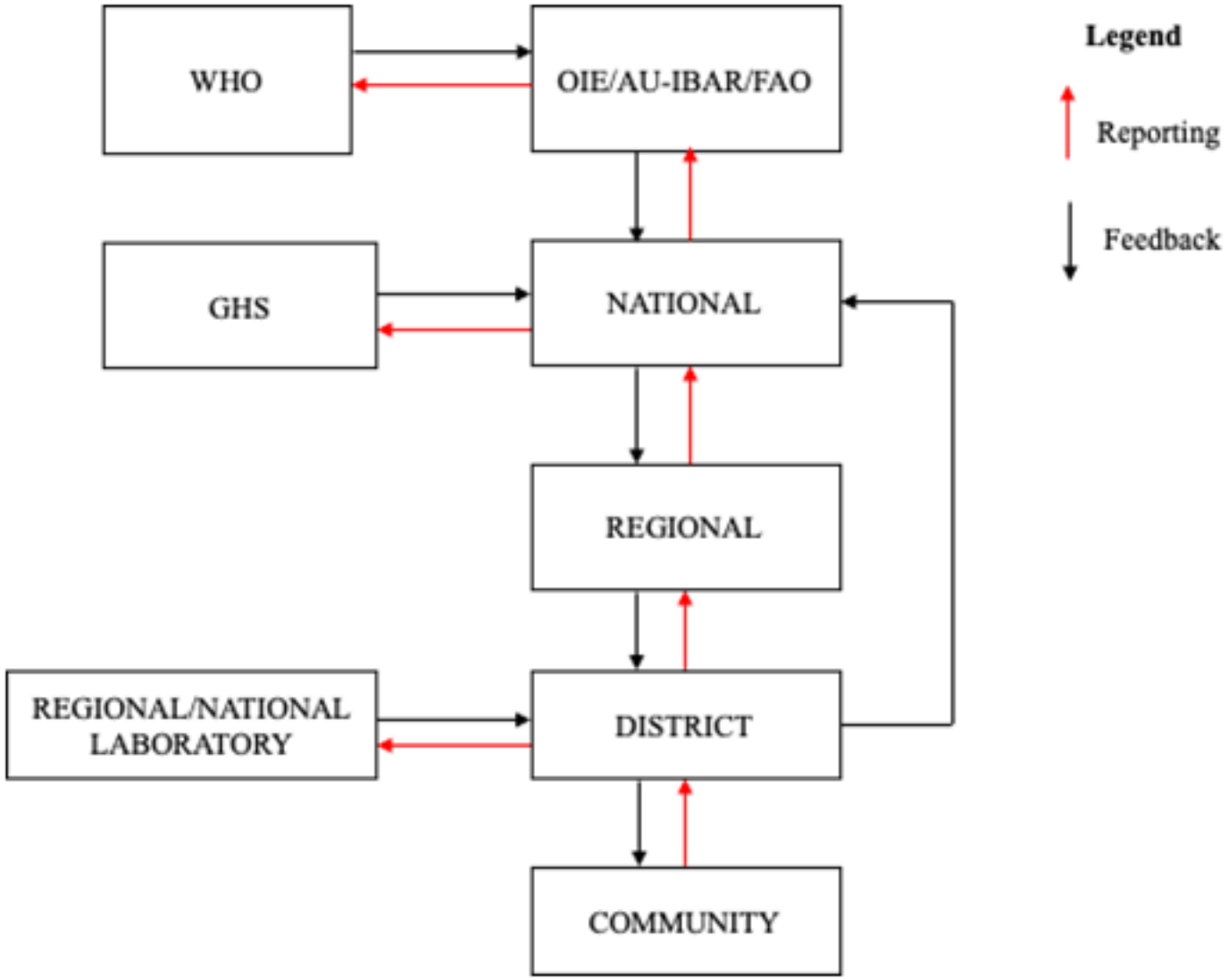

Figure 1: Information flow chart in rabies surveillance system

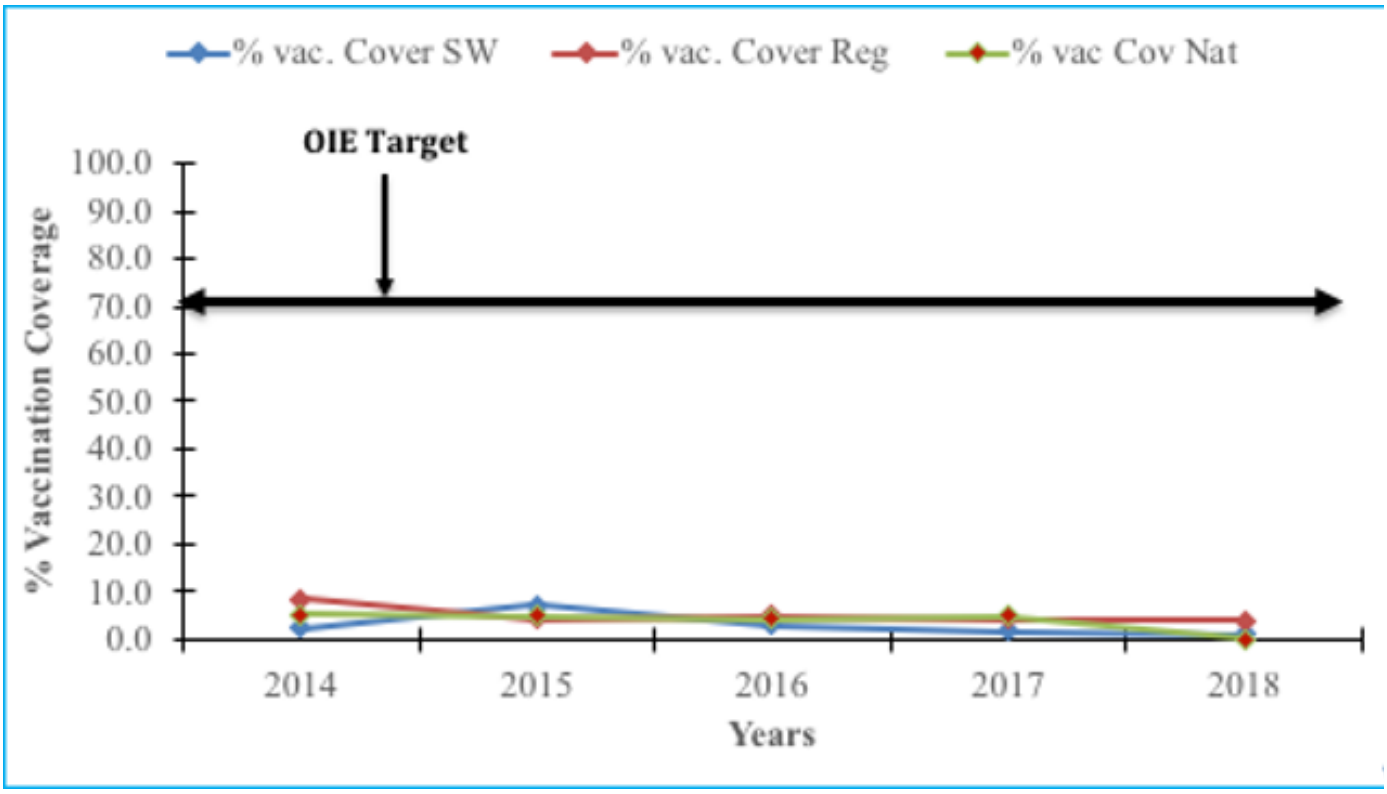

Figure 2: Rabies vaccination coverage from district, regional and national levels, 2014 - 2018

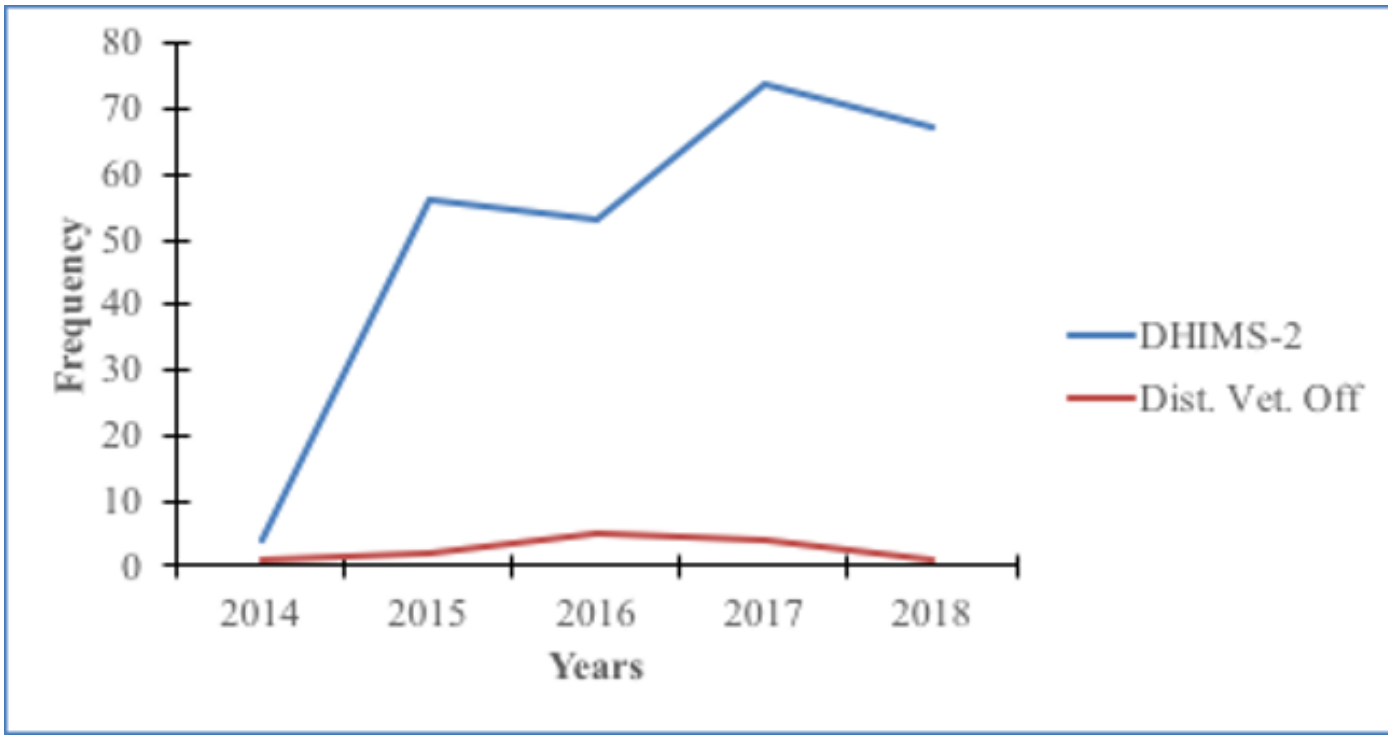

Figure 3: Dog bites records reported in the DHIMS-2 versus Veterinary Office, SWD, 2014 - 2018