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A brief history of rabies in Haiti until the adoption of the One Health approach for its epidemiological surveillance and control

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Abstract

Rabies was first identified in dogs and humans by a French veterinarian, Jean Lompagieu Lapole, in 1788 in the colony of Saint-Domingue, which later became Haiti. Rabies has continued to persist in the country despite some intermittent successes in combating this disease over the past 20 years. We are trying to understand why rabies, which has officially existed in the country for around 250 years, is still classified as a neglected disease and continues to result in cases of human mortality. For a significant period, until the implementation of the Haiti Animal Rabies Surveillance Program (HARSP) in 2011, there was no robust initiative to fight against rabies based on regular vaccination campaigns and an effective epidemiological surveillance system despite certain efforts made by the Ministry of Agriculture and Pan American Health Organization Project of Strengthening Public Agricultural Services (RESEPAG): Projet de Renforcement des Services publics Agricoles (PAHO) to increase dog vaccinations. The HARSP program was established with technical assistance from the Center for Disease Prevention and Control of Infectious Diseases (CDC) to control and eliminate rabies in the short term, according to the One Health approach. It was a passive surveillance system based on strengthening the rabies diagnostic capacity of the Veterinary Laboratory, training veterinary and public health technicians, and supporting rabies vaccination campaigns. This approach has resulted in effective cooperation between the Ministry of Agriculture and the Ministry of Public Health based on the "One Health" enabling the Ministry of Public Health to report daily on bite to

the Ministry of Agriculture for further investigations. HARSP marked a pivotal moment in the Rabies Control and Elimination Program. Between January 2013 and December 2017, there were 9,342 reported human exposures to animals suspected of carrying rabies in Haiti. The number of Human exposures to rabies suspected animals in Haiti from January 2013 to December 2017 was 9,342 heads. Among these cases, 2.4% were confirmed, 4.9% probable, 17.8% suspected, and 74.6% discarded. The One Health rabies program has demonstrated the potential for achieving control of both animal and human rabies in Haiti if the ministries of Agriculture and Health commit unequivocally to continue their collaborative development efforts and adhere to HARSP methodology, including vaccinating over 70% of the dog population.

Keywords: History of rabies, Haiti, One Health approach, epidemiological surveillance, control

INTRODUCTION

Rabies is a central nervous system disease that affects all mammals including humans. It is primarily transmitted through bites from animals infected with the rabies virus. The main sources of virulent material are saliva, nerve tissue, and lacrimal secretions. Rabies is caused by a virus belonging to the genus Lyssavirus and the family Rhabdoviridae[1]. Rabies virus (RABV) is the only species of Lyssavirus found in the Americas, where it mainly circulates in bats and mesocarnivores[2]. It typically causes behavioral disturbances, hyperexcitability, anxiety, paralysis, dysphagia, hydrophobia, and other neurological abnormalities. The evolution of the disease is always fatal once its clinical signs begin to appear[1,3,4]. In dogs, it often causes a change in the timbre of the voice, a tendency to run away, hallucinations, excessive salivation, and paralysis of the lower jaw which becomes drooping[3].

Rabies is estimated to be responsible for more than 59,000 human deaths each year[5,6]. Although all mammals are susceptible to infection by the rabies virus, the domestic dog is responsible for approximately 99% of human rabies deaths, particularly in regions where rabies is endemic, such as Africa and Asia[6].

Canine rabies has been eliminated in most developed countries, primarily due to successful rabies vaccination programs and responsible dog population management[4]. Haiti is one of the higher-risk areas for human rabies transmitted by dogs, necessitating increased collaboration and financial support[7]. The most recent large-scale reduction in the prevalence of canine rabies has been observed in the Western Hemisphere, where human deaths from rabies transmitted by dogs reached historic lows starting in 2014[8]. The Republic of Haiti, a Caribbean nation with a population of 11.65 million, has been identified as one of the few countries in the Western Hemisphere where progress in controlling canine rabies is not evident. Dogs are the only known reservoir for the rabies virus in Haiti, but neighboring countries Cuba and the Dominican Republic have identified endemic transmission cycles in mongooses and bats[2]. Both of these species are endemic to Haiti and may represent cryptic reservoir species[2,9].

THEORETICAL FRAME

Rabies in the American continent, especially in Saint Domingue

Despite the existence of rabies in bats and skunks for millennia, and the fact that dog populations entered the Americas with humans long before the arrival of Europeans, overlapping in the same geographic areas and at the same time, with RABLV variants circulating in bats and skunks, America remained free of canine rabies long after the first Europeans arrived[10,11].This situation seems to have lasted for more than two centuries, without being able to explain with the greatest certainty why the Americas (North, South, Central, and Caribbean) remained free from enzootic rabies maintained by dogs for such a long period. Mexico was the first country in 1709 to record the first dog-borne epizootic of rabies in the New World. It would have occurred in the Greater Antilles during the period 1776-1778[12].

In his book entitled "Observations Relating to the Health of Animals in Saint Domingue or Essay on their diseases" published in 1788, the French veterinarian Jean Lompargieu Lapole mentions a set of conditions present in animals and humans in the colony, namely strangles, glanders, lymphatic and non-anthrax tumors, anthrax, wormy bronchitis, rabies, *etc*.[13]. For his part, the historian Jacques Cauna mentioned that among the diseases that plagued the colony, cases of hydrophobia in dogs, according to him, corresponded to rabies[14]. Dr. Lapole was somewhat reluctant since there were not many dogs in the colony at the time. But he admitted to having observed the case of a dog suspected of rabies that had escaped from its cage and the next day had bitten a black slave on the hand as the slave passed in the street. The same dog had entered a stable to devour the upper lip of a horse. Two months later, the unfortunate slave showed signs of excitement and stiffness and succumbed to the most painful and horrific seizures eight days later. The discovery of this case of canine rabies followed by a human death led the municipal agents of the time to take the problem of rabies in the colony very seriously, starting by initiating control activities or, more simply, by killing stray dogs because people already knew that rabies had a fatal outcome[13].

Rabies in Haiti after its independence in 1804

In the aftermath of Haiti's independence in 1804, the new leaders of the state had far more pressing concerns than rabies, such as defending the territory. Even though, throughout the 19th century, a few cases of furious canine rabies were observed in Haiti. There was practically no technical service dealing with the control of this disease and even less with organizing its monitoring in the country. It was only during the American occupation (1915-1934) that we began to organize the Veterinary Services in Haiti and implemented activities to control canine rabies effectively. During this period, a veterinary department was established under the direction of the American veterinary doctor I.B. Boughton, in the Department of Agriculture and Vocational Education of Haiti. This department initiated the anti-rabies vaccination of dogs and cats in 1928 and reported cases of rabies in dogs and humans across the country. These activities were relatively insignificant because of the limited technical staff and inadequate financial resources devoted to the fight against rabies. There are limited data on human and animal rabies cases from the 18th through 20th centuries in Haiti[15].

After 1934, a National Program for the vaccination of dogs and cats against rabies was established, but without a strong focus on achieving sufficient vaccination coverage to break the cycle of rabies virus infection. The epidemiological surveillance of the disease was poorly organized due to the lack of veterinary professionals and a budget for rabies. However, a foundation for animal health was established through the collaboration of foreign veterinary experts from the FAO and the French Mission for Cooperation and Cultural Action. It was not until 1968 that the government created a Higher School of Veterinary Nurses with a two-year training program to produce a certain number of veterinary technicians for the country[16].

To understand how the National Rabies Control Program works, let us consider the vaccination activities carried out by this program from 1995 to 2010. There has been a noticeable increase in vaccination coverage in Haiti from year to year since 1995. The highest number of dogs vaccinated was 429,254 in 2009. However, this coverage still fell short of the 70% of the canine population required for effective national anti-rabies vaccination campaigns for dogs[17]. Haiti recorded 998 rabies cases among dogs and cats (an average of 59 per year), and in 2013-2014, 101 rabid animals (50 per year) were recorded[18].

The roles of the Ministries of Agriculture and Public Health in rabies control become clearer. The Ministry of Agriculture was responsible for vaccinating dogs and cats against rabies, while the Ministry of Public Health was responsible for caring for people in both pre-exposure and post-exposure, as well as for addressing the issue of stray dogs.

The true incidence of human and canine rabies in Haiti is currently unknown. However, limited surveillance activity from 2009-2012 detected an average of four canine and seven human rabies cases annually[8,9]. To get a clear situation of the rabies vaccination coverage, it is worthwhile to refer to Figure 1 titled "Canine vaccination coverage from 2005 to 2015" [Figure 1].

In several Latin American countries, through primary intervention methods applied in the 1970s, deaths caused by human rabies transmitted by dogs decreased from 350 per year to less than 10 between 1980 and 2010. Unfortunately, these positive results were not observed in Haiti, as between 1980 and 1986, 18 human deaths from human rabies were reported (an average of 2.6 per year). Reported human deaths from human rabies appear to have only increased over time, as a passive human rabies surveillance system in Haiti currently detects approximately 7 to 17 human deaths from human rabies each year[8,9,18].

The system of notification of animal and human rabies cases

However, despite the efforts made, the system for notifying cases of animal and human rabies was not yet well-established due to a lack of competent human resources and a lack of motivation among the managers for epidemiological surveillance. Deficiencies in animal rabies surveillance systems resulted in the underreporting of the number of biting animals potentially at risk for rabies and the underreporting of cases of human bites by suspect animals, the impossibility of on-site experimental diagnosis of rabies at certain times due to various reasons such as the malfunction of laboratory equipment and the non-availability of reagents and antigens.

Under these conditions, the data on the epidemiological situation of human rabies were quite alarming. In 2006, out of 29 cases of human rabies reported on the American continent, 11 originated from Haiti. Furthermore, in 2011, the situation got even worse as public health services officially reported 13 cases[8]. Despite the fact that the number of rabies cases per year was relatively high compared to other Latin American countries, modeled estimates suggest that this number may exceed 130 human rabies deaths annually[18].

In 1993, while ten (10) cases of people exposed to rabies were reported for the entire Center Department, less than a year later, in 1994, 11 were reported at the level of 3 municipalities of this Department. This evolution in the data was undoubtedly due to the establishment of an initial organizational structure for the notification of cases of bites on people by rabid animals[18]. From 2004, alerts for rabies cases in animals, although still limited, became more frequent. Agriculture and Public Health Ministries have worked together more and more.

Rabies has always been considered one of the so-called neglected diseases by the Ministry of Public Health and Population (MSPP). But during the years 2006 and 2007, Pan American Health Organization (PAHO)/ WHO and Project of Strengthening Public Agricultural Services (RESEPAG): provided significant collaboration in vaccines for veterinary use to the Ministry of Agriculture and in vaccines for human use to the Ministry of Public Health and Population thanks to assistance from Brazil. PAHO promoted the elaboration of the first National Rabies Eradication.

This Plan included an epidemiological surveillance component for animal and human rabies. However, it did not create genuine coordination of the Rabies activities among different public and private institutions to establish a functional partnership model integrating a One Health approach. During this period, there was some improvement in rabies vaccination campaigns, but the epidemiological surveillance of rabies remained slow[18-20].

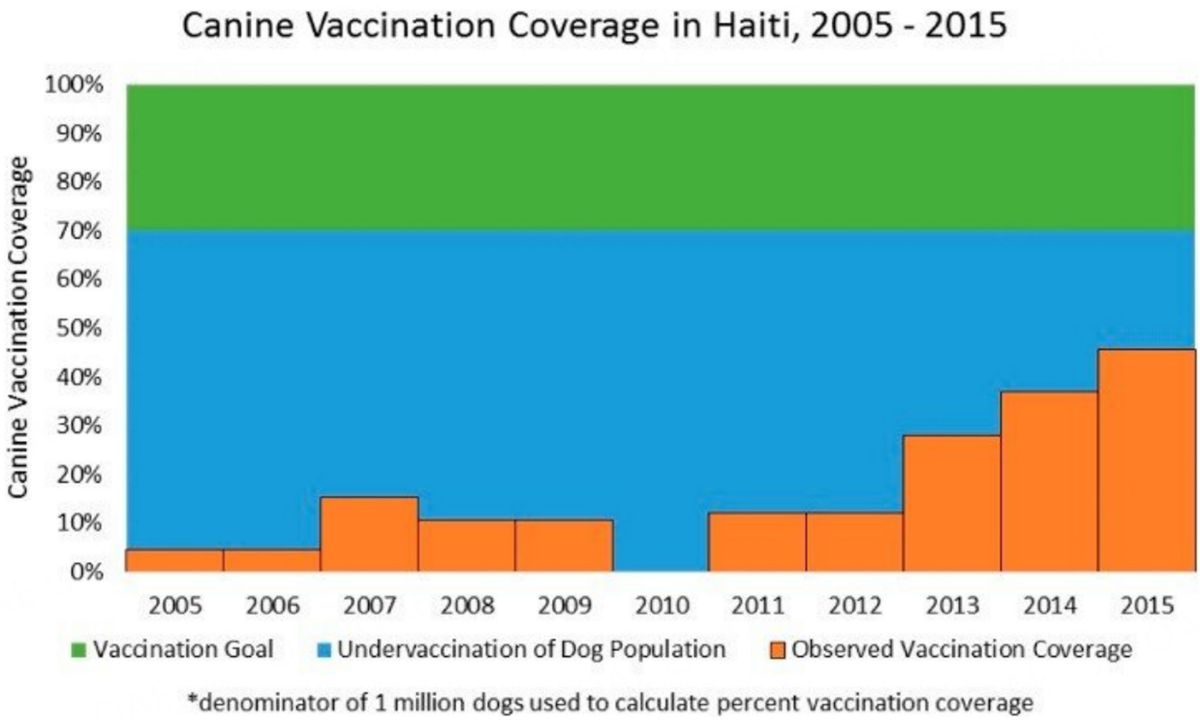

Figure 1. Canine vaccination coverage in Haiti from 2005-2015[18].

This National Rabies Plan focused on the cooperation between the Agriculture and Public Health Ministries as well as other public institutions like the Ministry of National Education and NGOs such as Christian Veterinary Mission (CVM)[21].

Initiation of a real One Health rabies surveillance program

Until the year 2010, despite progress made in vaccination and some improvement in the system for reporting suspected cases, the rabies situation remained quite complicated due to the weak capacity of the rabies veterinary Laboratory. For about five years, the diagnosis of rabies was only based on the identification of Negri bodies by Sellers staining. A new era began after the earthquake in 2011 for the revival of the National Rabies Control Program with the financial and technical assistance of the Center for Prevention and Control of Infectious Diseases (CDC) of Atlanta (USA). The CDC technical team has helped Haiti to strengthen the cooperation between Public Health and Agriculture Ministries in the field of rabies. This team, during their visit, organized a training session on the experimental diagnosis of rabies. This marked the beginning of the CDC/HAITI cooperation, leading to the implementation of the Animal Rabies Surveillance Program in Haiti (HARSP)[9,18,19].

This One Health Program was originally designed in 2011 under the leadership of the Ministry of Agriculture, Natural Resources and Rural Development (MARNDR) and CDC, but with the collaboration of the National Representation of PAHO/WHO, MSPP and the NGO Christian Veterinary Mission (CVM). Other institutions have been invited to join this Program, such as the Ministry of National Education, the Ministry of Communication, peasant associations such as the Animal Health Groups (GSB), INTERVET, private veterinary clinics, NGOs such as Humane Society International (HSI), and local NGOs such as VETERIMED[9,18,21]. The central and departmental structures of the Ministries of Agriculture and Public Health have all been mobilized for the deployment of HARSP activities. Figure 2 illustrates a comparison of rabid animals detected before and after the development of an animal rabies program, 2009-2012 and 2013-2015 [Figure 2].

For a quick understanding of the study, we made a video on this topic of less than five min[22].

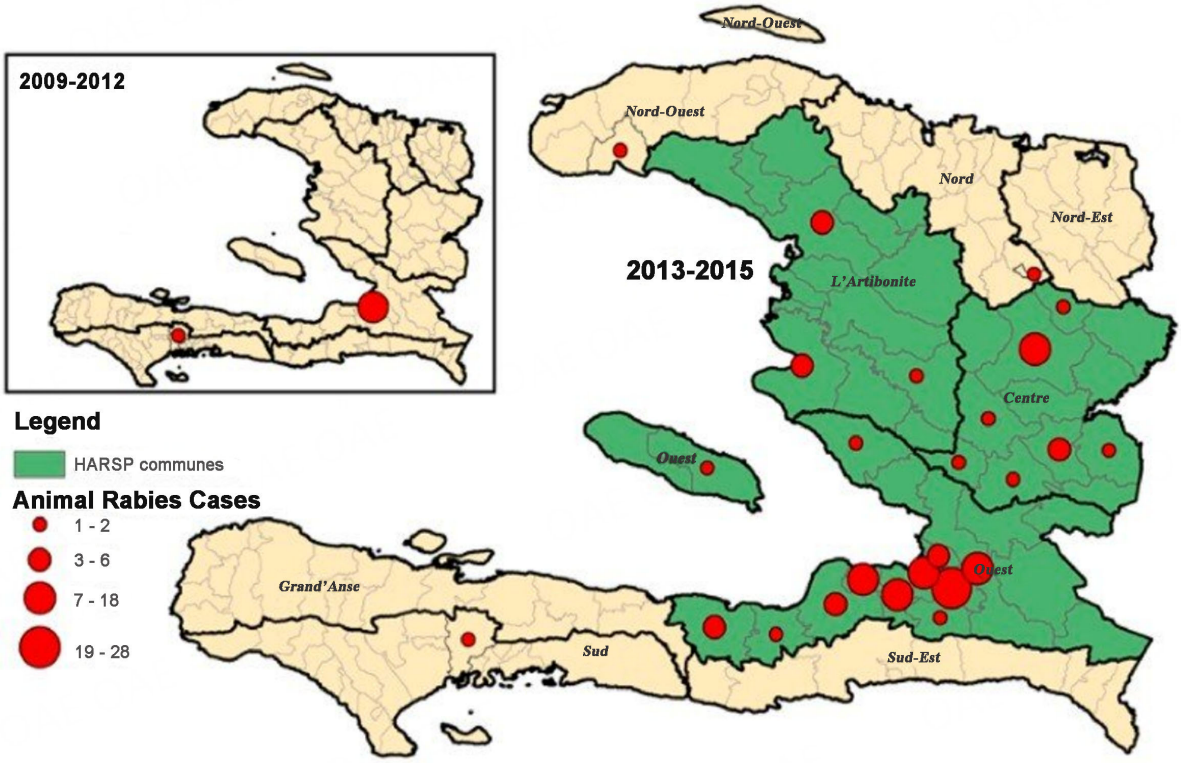

Figure 2. Rabid animals detected before and after the development of an animal rabies program, 2009-2012 and 2013-2015[18].

METHODOLOGY FOR HARSP

The present study is a review research. The One Health epidemiological surveillance was developed in the following stages:

Capacity of the Veterinary Laboratory

This first step consisted of the development of the diagnostic capacity of the Veterinary Laboratory that was carried out by the CDC over a period of two years (2011-2012). This provided the Laboratory with certain materials and equipment for the experimental diagnosis of animal rabies, such as a fluorescence microscope, incubator, freezer, fume hood, and supplies necessary for the treatment and diagnosis of the samples.

CDC specialists trained Haitian staff of veterinary Laboratory in various diagnostic tests: direct immunofluorescence test method (DFA), direct rapid immunohistochemistry test (dRIT), and LN-34 real-time polymerase chain reaction (RT-PCR) assay[9,18]

Quality control of testing was ensured through confirmatory testing of samples tested on-site at the veterinary laboratory by the CDC laboratory, the participation of the Haiti Laboratory in the diagnostic proficiency testing program of Latin America, and lastly, the twice-yearly on-site training of technicians from the Veterinary Laboratory by the CDC.

Training of the field veterinary technicians

New staff recruitments have been made by HARSH to carry out veterinary and epidemiological surveillance activities. To this end, from December 2012 to June 2013, training was organized on public health education and rabies prevention. The training included both theoretical courses in the classroom and practical activities in the field. A total of 18 participants made up of veterinary agents (9 weeks para-professional training plus experience), and veterinary technicians (2 or 3 diploma) were selected by the MARNDR to undergo training that enabled them to engage in rabies surveillance work[9,18-20].

The step for the strengthening of the rabies diagnostic capacity and the training of the field veterinary professionals has been extended from 2011 to 2013.

Strengthening of the field veterinary agents and technicians (2013-2017) team for better notification

In October 2013, HARSP recruited three additional veterinary officers to expand the program's coverage in the West Department, where there was only one technician. In October 2014, nine additional technicians were recruited to work in the communes of Center and Artibonite. Rabies vaccination activities for dogs were conducted in accordance with the vaccination procedures jointly defined by the Animal Health Department of the MARNDR and the CDC. This marked the first integration of smartphones and GPS technology to record the geographical coordinates of the vaccination posts, ensuring effective monitoring of vaccination programs. In October 2016, with funding from the World Bank under the RESEPAG Program, ten additional technicians were reassigned to work as HARSP professionals in the South and North departments[9,21].

The HARSP surveillance system relies on event reports from the medical, veterinary and community sectors, as indicated in Figure 3. These events consist of animal bites, particularly animals suspected of rabies, which will lead to an investigation by rabies technicians within the MARNDR. In Haiti, bites recorded in hospitals or health centers are events that must be notified to the Department of Epidemiology, Laboratory, and Research (DELR) of the MSPP. Therefore, HARSP really relies on inter-ministerial collaboration under the "One Health" approach to animal surveillance, which allows the MSPP to report bites on a daily basis to the MARNDR for investigation [Table 1].

Summary reports of rabies investigations are shared at weekly DELR meetings for case reporting, investigation, and diagnostic testing of animals suspected of rabies. All the results obtained at the level of the Veterinary Laboratory have been communicated to the Department of Epidemiology, Laboratory and Research of the MSPP[9,18].

HARSP investigations were conducted at two levels: (i) public health (investigation of bites at the community level) and (ii) Agriculture (investigation of animal rabies by the Veterinary Services). Suspected animals were placed in home quarantine for 14 days with instructions on proper care and prevention of rabies exposure. If the animals were in good health, then they were released from observation. If, on the contrary, they showed clinical signs of rabies during the investigation or the quarantine period, they were anesthetized and euthanized according to the standards of the American Veterinary Medical Association. Animals suspected of rabies that were euthanized or found dead were tested at the MARNDR National Veterinary Laboratory. The results of the investigations were communicated by telephone to the victim of the bite, the health center that had made the declaration to DELR, and all persons who were identified during the surveys as being exposed to bites in the community for evaluation of post-exposure prophylaxis (PEP) against rabies.

Table 1. Rabies case status by animal species and department, Haiti (January 2013 - December 2017)[9,23]

Departments	All rabies suspected animals					Dogs					Cats					Livestock					Other				
	Total	Probable		Confirmed		Total	Probable		Confirmed		Total	Probable		Confirmed		Total	Probable		Confirmed		Total	Probable		Confirmed	
	n	*n*	%	*n*	%	*n*	*n*	%	*n*	%	*n*	*n*	%	*n*	%	*n*	*n*	%	*n*	%	*n*	*n*	%	*n*	%
Artibonite	1,032	55	5.3%	9	0.9%	999	51	5.1%	9	0.9%	18	1	5.6%	0	0.0%	13	3	23.1%	0	0.0%	2	0	0.0%	0	0.0%
Centre	1,688	37	2.2%	18	1.1%	1,622	33	2.0%	18	1.1%	35	0	0.0%	0	0.0%	19	4	21.1%	0	0.0%	12	0	0.0%	0	0.0%
Grand'Anse	6	0	0.0%	0	0.0%	4	0	0.0%	0	0.0%	1	0	0.0%	0	0.0%	0	0	-	0	-	1	0	0.0%	0	0.0%
Nippes	23	1	4.3%	1	4.3%	23	1	4.3%	1	4.3%	0	0	-	0	-	0	0	-	0	-	0	0	-	0	-
Nord	612	15	2.5%	3	0.5%	580	10	1.7%	2	0.3%	13	1	7.7%	0	0.0%	17	4	23.5%	1	5.9%	2	0	0.0%	0	0.0%
Nord-est	3	0	0.0%	0	0.0%	2	0	0.0%	0	0.0%	1	0	0.0%	0	0.0%	0	0	-	0	-	0	0	-	0	-
Nord-ouest	36	2	5.6%	7	19.4%	36	2	5.6%	7	19.4%	0	0	-	0	-	0	0	-	0	-	0	0	-	0	-
Ouest	4,204	146	3.5%	118	2.8%	4,113	136	3.3%	110	2.7%	72	7	9.7%	5	6.9%	16	3	18.8%	3	18.8%	3	0	0.0%	0	0.0%
Sud	747	14	1.9%	1	0.1%	697	12	1.7%	1	0.1%	36	2	5.6	0	0.0%	14	0	0.0%	0	0.0%	0	0	-	0	-
Sud-est	9	0	0.0%	0	0.0%	8	0	0.0%	0	0,0%	0	0	-	0	-	1	0	0.0%	0	0.0%	0	0	-	0	-
Missing	13	1	7.7%	0	0.0%	11	1	9.1%	0	0.0%	0	0	-	0	-	0	0	-	0	-	0	0	0.0%	0	-
Total	8,373	271	3,2%	157	1.9%	8,095	246	3.0%	148	1.8%	176	11	6.3%	5	2.8%	80	14	17.5%	4	5.0%	20	0	0.0%	0	0.0%

Case definition

A case definition was developed based on the precise criteria to classify animals as confirmed rabies cases, probable rabies cases, suspected rabies cases, and discarded cases according to the status of the animals studied through the HARSP[9]. The criteria are generally those used in epidemiological studies of diseases requiring a case definition, but they have been adapted to the situation in Haiti.

Research and diagnostic data collected from January 2013 and December 2017 were managed by CDC in cooperation with the concerned Haitian Veterinary Services. The data were entered into a Microsoft Access database and exported to SAS software[9].

Evolution of the Rabies epidemiological surveillance after the successful period of HARSP (2017-2023)

The surveillance network for the main animal diseases was implemented by the Health Protection Unit, and began to break down due to a lack of viable sources of funding as all Haitian investigators were contract workers. Concurrently, CDC significantly reduced its technical assistance and the Haitian government did not allocate additional funds for these activities. However, PAHO continued to provide assistance to the Rabies Program.

During this phase, the same methodology was applied as before but with certain limitations, given the fact that field trips were becoming increasingly rare due to insecurity and that human and financial resources were becoming rarer for the operation of the national program for the control and elimination of animal and human rabies.

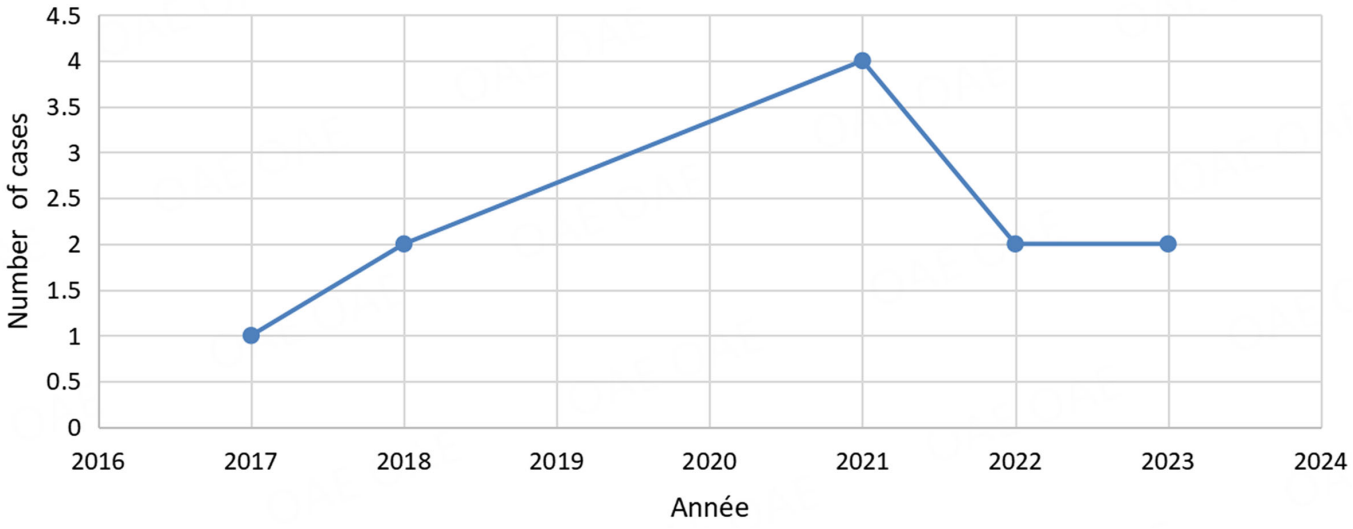

Figure 3. Evolution of cases of aggression by animals suspected of rabies by department from 2017 to the 7th week of the year 2023[24].

MONITORING RESULTS

According to the case definition, the results of the Rabies case status by animal species and department Haiti (January 2013 - December 2017).

Showed that:
• 222 animals (2.4%) were classified as confirmed rabies cases;
• 455 (4.9%) as probable rabies cases;
• 1,666 (17.8%) as suspected rabies cases;
• 6,969 (74.6%) as discarded cases[9].

Of the confirmed rabid animals, 217 (97.7%) were dogs, 5 (2.2%) were cats and 3 (1.3%) were farm animals.

Animals considered probable included 412 dogs (90.5%), 27 cats (5.9%), and 16 farm animals (3.7%). The majority of animal investigations during the five years were conducted in the West department (n = 4,204), followed by the Center department (n = 1,688), the Artibonite department (n = 1,032), the South department (n = 747) and the North department. (n = 612). The other five departments (South-East, Nippes, Grand'Anse, North-East, and Nord-West) accounted for a total of 77 (0.9%) animal rabies investigations because they did not have any veterinarians assigned to the HARSP responsible for the task of rabies epidemiological surveillance of animal rabies[9]. Under such conditions, it proved difficult to calculate correct rabies prevalence and incidence rates at the national level.

The animal rabies investigations were 8,373 heads reported from different sources, as indicated in Table 1[9].

The number of Human exposures to rabies-suspected animals by case status and species in Haiti from January 2013 to December 2017 is 9,342, as indicated in Table 2[9,24].

From 2017 to 2023, according to the reports from the Veterinary Services, animal notification activities were quite intense for the year 2018, with 4,013 notified cases. They were relatively lower compared to the year

Table 2. Human exposures to rabies suspect animals by case status and species, Haiti January 2013 - December 2017[9,23]

Case status	Total human exposures		Human exposures to dogs		Human exposures to cats		Human exposures to livestock		Human exposures to other animals	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Confirmed	222	2.4	217	2.4	2	1.0	3	3.9	-	0.0
Probable	455	4.9	412	4.6	27	13.0	16	21.1	-	0.0
Suspect	1,666	17.8	1,626	18	30	14.4	4	5.3	6	24.0
Non-case	6,969	74.6	6,748	74.7	149	71.6	53	69.7	19	76.0
Not classified	30	0.3	30	0.3	-	0.0	-	0.0	-	0.0
Total	9,342	100	9,033	100	208	100	76	100	25	100.0

2017 during which 4,342 cases were reported[23]. For the other years, the field veterinary activities have decreased, but important efforts have been made by both Ministries of Agriculture and Public Health with the cooperation of PAHO to maintain the One Health approach to control rabies [Figure 3][23].

More than 26,232 cases of aggression have been notified in Haiti from 2017 until the 7th week of the year 2023. On average, the MSPP can estimates about 4,300 cases of aggression by animals suspected of rabies in Haiti per year [Figure 3][24].

In 2017, there was one human case of rabies from a dog. In 2021, four cases and two in 2023 (7th week) [Figure 4][24].

DISCUSSION

HARSP has significantly improved the ability to detect rabies, leading to a substantial increase in reported animals each month compared to detection rates prior to the effective implementation of HARSP[9]. This large increase was the result of the continuous training that the investigating veterinary officers and technicians received. This increase is also dependent on the increased awareness of the community and health institutions in relation to the problem of rabies and the geographical extension of HARSP, which has increased from one to five departments.

The climate of violence over the past three years in Haiti has considerably limited the movement of veterinary and health professionals in the country. This bad situation did not prevent the two ministries (Agriculture and Public Health) from continuing to develop a certain number of activities according to the One Health approach with the support of PAHO. During the period 2017-2023), it is important to show (i) the number of cases of aggression by animals suspected of rabies by department in Haiti [Figure 3]; (ii) the trends of human rabies in the country [Figure 4]; and (iii) the celebration of World Rabies Day in September 2022 by MSPP with the participation of MARNDR [Supplementary Materials]. Several departments had very limited reports of animal notification, such as the departments of North-East, South-East, and Grand-Anse, which in 2017 still reported less than 10 rabies surveys. In 2023, that is the same situation with these departments because of a lack of human resources. These departments still have not carried out very extensive surveillance to form hypotheses regarding the level of endemicity of rabies, but it must be assumed that they are also affected. Almost all of the confirmed and probable rabies cases were dogs, which is consistent with the assertion that dogs are the reservoir of rabies in Haiti. The HARSP is designed to study animals involved in a human exposure event, both to remove rabid animals from communities and to provide exposed individuals with evidence-based post-exposure treatment recommendations[9,18].

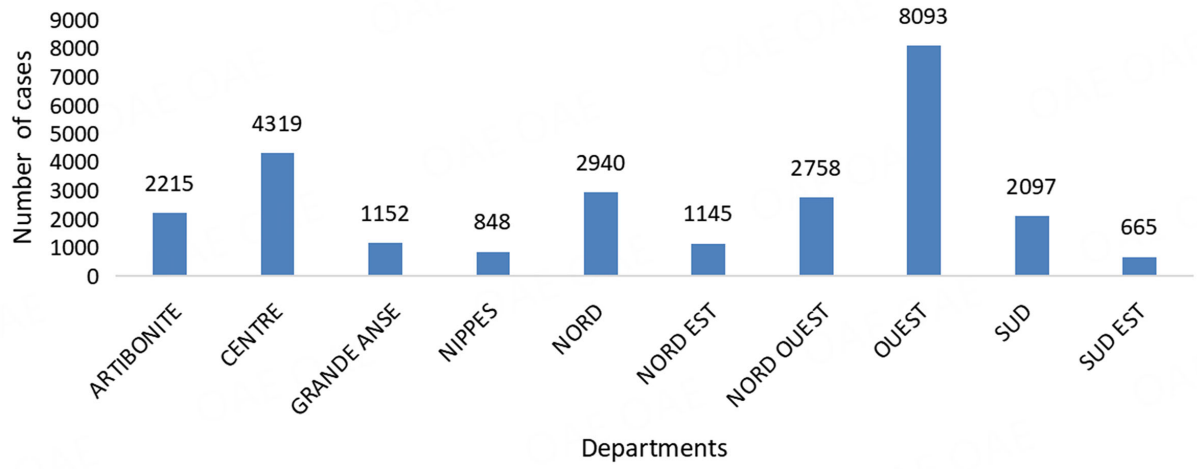

Figure 4. Trend of rabies in Haiti from 2017 to the 7th of the year 2023[24].

Observations and research have shown that purely basic vaccination and surveillance interventions can successfully stop transmission[18-20]. Passive surveillance programs, in addition to providing valuable information for targeted interventions, can also help stop enzootic transmission at the community level through the rapid elimination of rabid animals and reduction of dog-to-dog contact.

However, the vaccination campaigns during this period did not have, for different reasons, the expected results, namely achieving the vaccination coverage rate of 70% of dogs. On the contrary, they were below those obtained during the year 2015. When the security conditions of the country allow it, the Ministry of Agriculture has no other choice but to relaunch a strong anti-rabies vaccination program for dogs with the involvement of different sectors of the country concerned by the issue. In addition to that, it is important to maintain a participatory rabies epidemiological surveillance program according to the One Health approach initiated in 2011 by the Ministries of Agriculture and Public Health with the technical assistance of CDC and PAHO.

CONCLUSION

For a long time, the Republic of Haiti has made extensive efforts to modernize its national program for the fight against canine and human rabies, but this program only really took off with the CDC/MARNDR/MSPP tripartite cooperation. The implementation of HARSP is, indeed, a real turning point in the application of the One Health approach to the rabies control and eradication program. This One Health program has successfully created a robust system that connects the animal surveillance network with human rabies surveillance. It has demonstrated the feasibility of implementing an effective rabies control and elimination program incorporating a strong vaccination program to reach 70% of the dog population and epidemiological surveillance according to HARSP type. It is now crucial for the country to maintain the commitment to the continuity of the HARSP methodology, which will be the only way to stop considering rabies as a neglected infectious disease so that we are truly able to make it a disease of the past.

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Authors' contributions

Contributed to the collection of data on canine and human rabies in Haiti and provided photos illustrating the celebration of National Rabies Day in Hinche in the Center department: Suprême F

Provided administrative, technical and material support and a process for correcting and formatting the text: Duclair HR

Contributed to the collection of data on canine and human rabies in Haiti and to the proofreading of the article: Augustin PD

Redaction and correction of the article: Duclair HR, Millien MF

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Conflicts of interest

All authors declared that there are no conflicts of interest.

Ethical approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

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