

Analysis of Epidemiological Investigations and Responses to Human Rabies Deaths in Côte d'Ivoire, 2021

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Abstract

Rabies is an infectious disease that almost always leads to death as soon as the first signs appear, and is still endemic in several regions, including Côte d'Ivoire. Epidemiological investigations are carried out and response measures implemented in the event of any death from human rabies. However, the quality of these investigations does not always allow the adoption of response measures. The aim of this work was to evaluate the reports of epidemiological investigations and response actions carried out during the occurrence of human rabies deaths from 2016 to 2018. This was a cross-sectional study that took place from April to September 2021 at the National Institute of Public Hygiene and focused on human rabies deaths notified from 2016 to 2018. Of sixty-one (61) human rabies deaths recorded, sixty (60) were investigated, among which fifty-nine (59) deaths had been subject to response. Most deaths occurred in rural areas (75%), and the main vector was the dog (98%). Several shortcomings were noted: response actions were not carried out promptly; joint interventions bringing together human and animal health professionals were rare, there was little communication about rabies to communities (36%), and very little vaccination of the vector, the source of the disease (12%); an almost total absence of capacity-building for local players (7%); the health districts of Abobo-Ouest, Bondoukou, Divo and Fresco, which had regularly recorded human rabies deaths, had not benefited from dog vaccination, which is supposed to break the circulation of the virus. The persistence of rabies deaths in the health districts could probably be linked to these shortcomings. Faced with these realities, it is essential to strengthen the epidemiological investigation capacities of the players involved, in order to improve the quality of investigations and ensure an effective response.

Keywords

Epidemiological Investigations, Response, Human Rabies, Côte d'Ivoire

1. Introduction

Rabies is an infectious disease that almost always leads to death as soon as the first signs appear. According to the WHO, this zoonosis affects more than 150 countries worldwide and is estimated to cause more than 59,000 deaths annually [1] [2] and more than 3.7 million disability-adjusted life years (DALYs) lost each year [3]. It could be responsible for more than one million deaths in the 67 rabies-endemic countries from 2020 to 2035 if nothing is done [4]. Several factors, including lack of vaccination of exposed persons, ignorance of rabies risk in communities, lack of vaccination of dogs and a weak surveillance system, have been cited as contributing to the occurrence of rabies [5] [6]. Punctual interventions such as epidemiological investigations integrating response actions constitute opportunities for progressive improvement aimed at the control and prevention of an epidemic [7]. In this respect, epidemiological investigations followed by countermeasures were carried out to limit rabies deaths in localities in a number of at-risk countries, based on a series of actions including: 1) community awareness-raising; 2) a dog vaccination campaign; 3) capacity-building for human and veterinary health professionals; 4) vaccination of contacts [8] [9] [10]. These actions aim to act concomitantly on the main risk factors identified. They are based on multidisciplinary risk management involving public authorities, veterinary and medical services [1].

Every year, Côte d'Ivoire records at least 18 rabies deaths thanks to the surveillance system set up by the Institut National d'Hygiène Publique (INHP) since 2006, representing an average incidence of 6 to 8 deaths per 100,000 inhabitants. At least 80% of cases have been confirmed by the Institut Pasteur de Côte d'Ivoire (IPCI) laboratory, with over 50% of cases under the age of 15 [11] [12]. The dog population is poorly controlled, with only 10% of dogs vaccinated [13].

When rabies-related deaths occurred in humans, an epidemiological investigation was carried out, followed by a response.

These investigations were followed by an investigation report, prior to any response action. However, in most cases of death, the response is difficult to implement. In this context, we asked ourselves the following question. What is the quality of the investigations carried out? We hypothesise that the investigations are not of good quality and do not allow rapid implementation of response measures in the event of an outbreak of human rabies.

The aim of this work is to assess the quality of epidemiological investigations and responses carried out following human rabies deaths from 2016 to 2018 in Côte d'Ivoire, in order to remedy the shortcomings linked to these investigations.

The specific objectives are:

- To describe the epidemiological characteristics of human rabies cases.
- Determine the proportion of cases investigated.
- Analyse the characteristics of investigations (time taken to complete investigations, joint investigations).
- Analyse the activities carried out during response operations.

2. Materials and Methods

2.1. Study Setting

Our study took place at the Centre Antirabique of the Institut National d'Hygiène Publique in Abidjan Treichville. The Centre Antirabique is the reference center for human rabies control in Côte d'Ivoire (case management guidelines, epidemiological surveillance, human rabies investigation and response). In addition to the Reference Center, 30 rabies centers throughout the country provide case management and epidemiological surveillance. In addition, some fifteen rabies vaccination units are located in the health districts. All these centers are responsible for case management and epidemiological surveillance, in collaboration with the veterinary services. As part of surveillance activities, human rabies case notification forms, investigation reports and analysis results of samples taken from suspected rabies cases are made available to the Treichville RAC for information and decision-making support.

2.2. Methods

This is an analytical cross-sectional study of the epidemiological investigations of rabies deaths that occurred between 2016 and 2018. Human rabies cases are detected based on the case definition:

Suspected case: Acute neurological syndrome (encephalitis) dominated by forms of hyperactivity (furious rabies) or paralytic signs (paralytic rabies) evolving towards coma and death within seven to ten days after the appearance of the first signs with notion of contact with an animal.

Confirmed case: This is a suspected case in which saliva and/or skin samples returned positive to the laboratory of the Institut Pasteur de Côte d'Ivoire.

Study population

We included in our study all cases of suspected and/or confirmed human rabies notified to the rabies centre between 2016 and 2018.

In Côte d'Ivoire, all suspected cases of human rabies are reported to the Institut Pasteur, where samples are taken for diagnosis, and investigated. The information is passed on to the Anti-Rabies Centre, and the response is organised following the response from the Anti-Rabies Centre.

The material consisted of epidemiological investigation reports and responses to human rabies deaths recorded during the study period. We carried out a review of the rabies death notification forms available in the archives of CAR Treichville.

- human rabies case notification forms;

- epidemiological investigation reports;
- results of analysis of samples taken from suspected rabies cases.

Additional useful information not found in these documents was obtained by telephone calls to INHP branch managers who had participated in the collection of investigation and response data.

The location of rabies deaths according to health districts was determined using Health Mapper mapping software.

The variables selected related to:

- the composition of the investigation teams (multi-sector team including a veterinarian and/or a professional from the environment or the Ministry of the Interior) the time taken to carry out investigations (investigation carried out within 72 hours);
- investigation report drafting and transmission deadlines (report drafted and transmitted within 48 hours of investigation).
- the components of the investigation report (descriptive phase with time description of the person, determination of the therapeutic course, identification of contact subjects, recommendations for response) and an analytical phase clearly describing the determinants or factors that contributed to the death).
- timeframe for completion of the response;
- activities carried out during the response (community awareness-raising, vaccination of contacts, rabies vaccination of dogs and capacity-building for human and animal health professionals).

A data entry mask was designed using Epi info software version 3.5.4. for recording, compiling and analyzing data.

The promptness of activities was assessed in accordance with the principles of any investigation and response during an epidemic [14].

Shortcomings in epidemiological investigation and response were identified through activities carried out in accordance with those commonly recommended in the event of a human rabies fatality.

Ethical aspects: This study was carried out as part of the surveillance, investigation and response to cases of rabies in Côte d'Ivoire by the Institut National d'Hygiène Publique. The study was carried out as part of a Master's thesis in public health. It was therefore not necessary to present the protocol to the ethics committee. The use of the database of cases and investigation and response reports required information from the management of the National Institute of Public Hygiene. The database and the investigation and response data were made anonymous. Names were removed.

Interviews with INHP branch managers required their informed consent, and the anonymity and confidentiality of the data were ensured.

3. Results

During our study period, 61 human rabies deaths were recorded. The deaths came from 36 health districts in Côte d'Ivoire, with a high concentration in the southwest.

In 2016, 18 human rabies deaths were reported by 17 health districts. In 2017, there were also 18 human rabies deaths from 16 health districts. In 2018, 25 human rabies deaths had been recorded by 18 health districts (**Figure 1**).

The health districts of Abobo-Ouest, Bondoukou, Fresco and Divo recorded at least one human rabies death each year during the study period. Fresco and Bondoukou had 3 deaths each, while Abobo-Ouest and Divo had four deaths each (**Table 1**).

Of the human rabies deaths recorded, 46 (75%) came from rural areas, and the animal responsible for rabies transmission was the dog in 98% (60) of cases.

Epidemiological investigations were organized around 60 human rabies deaths (98%). All health districts that had recorded at least one death from human rabies each year during this period were investigated for all rabies-related deaths. These investigations generally took place within the first three days (97%) following notification of the rabies case. Eight investigations (13%) were carried out by joint teams from the animal and human health sectors. The human health team intervened alone in the majority of investigations (85%).

Following epidemiological investigations, 59% or 97% of human rabies deaths had been responded to. Fifty-three percent (53%) of these response actions had been organized eight to fifteen days after case notification.

Awareness-raising was organized in 21 (36%) communities where human rabies deaths had been reported. Free vaccination of contacts was possible around 54 (91%) deaths; a dog vaccination campaign was organized only for seven (12%) human rabies deaths. For four deaths (7%), capacity-building on rabies was provided for human and veterinary health professionals (**Table 2**).

Table 1. Annual distribution of human rabies deaths in health districts recording at least one death per year from 2016 to 2018 in Côte d'Ivoire.

Health districts	Number of human rabies deaths per year			
	2016	2017	2018	Total
Abobo-Ouest	2	1	1	4
Divo	1	1	2	4
Fresco	1	1	1	3
Bondoukou	1	1	1	3
Total	5	4	5	14

Table 2. Breakdown of activities carried out during the response around human rabies deaths from 2016 to 2018 in Côte d'Ivoire (N = 59).

Nature of activities carried out	Numbers	Percentage (%)
Raising awareness among family and friends	59	100
Vaccination of contacts	54	91
Community awareness	21	36
Dog vaccination campaign	7	12
Capacity building	4	7

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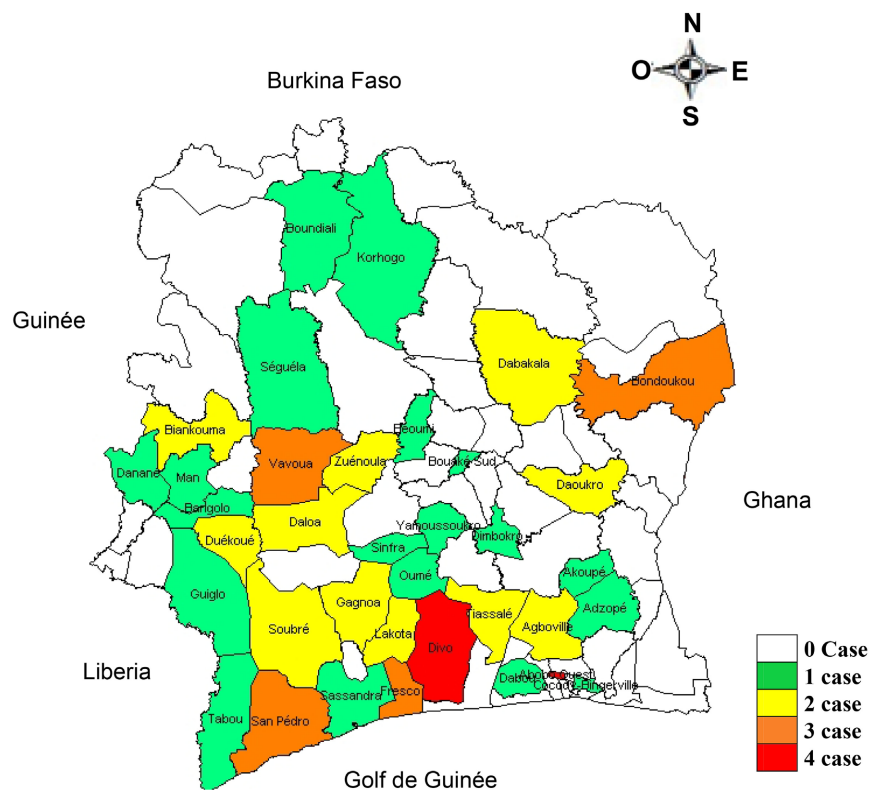


Figure 1. Répartition annuelle des décès de rage humaine dans les districts sanitaires ayant enregistré au moins un décès par an de 2016 à 2018 en Côte d'Ivoire.

The response to human rabies deaths was carried out by a joint team in 22% (13 cases) of a total of 59 organized responses. Vaccination of contacts and awareness-raising among family and friends were two activities regularly carried out in the event of a death during this period. Other activities, such as raising community awareness, vaccinating dogs and building the capacity of human and veterinary health professionals, were not carried out in all cases.

In Abobo-ouest, a community awareness campaign was organized following 2 deaths out of a total of four reported. No dog vaccination campaign or capacity-building for human and veterinary health professionals had been carried out. In the Divo and Fresco health districts, none of these three activities had been carried out for all the human rabies deaths reported. The situation was similar in the Bondoukou health district.

4. Discussion

The epidemiological investigation following the detection of a suspected case of human rabies makes it possible to assess the risk of exposure in the family, social and healthcare environments [7]. Deaths investigated during the period of our study were more concentrated in the south-western part of Côte d'Ivoire, with persistence over the years. This demonstrates once again the endemic nature of

rabies in Côte d'Ivoire. Indeed, previous studies [12] [13] revealed the same evolutionary trend for rabies in Côte d'Ivoire. This finding calls for an in-depth study in these areas in the future, with the aim of identifying the reasons for the implementation of specific control measures.

These epidemiological investigations were carried out promptly for the majority of deaths notified. These results are encouraging, as the promptness that governs any intervention in the context of an epidemic was taken into account [14].

The level of collaboration between the animal and human health sectors showed that investigation teams were rarely made up of professionals from both sectors involved in rabies. The quality of epidemiological investigations and the level of rabies prevention require teamwork between those involved in human and animal health [15] [16] [17]. This imbalance reflects a lack of collaboration between players, which is likely to have a negative impact on response actions.

Most of these epidemiological investigations were followed by response actions. More than half of the activities were organized within the second week following notification of the human rabies case. This period is well above the minimum incubation period required for signs of rabies to appear in the event of contamination [18]. This delay in taking action could have two consequences: it could result in rabies-related deaths among potential bite victims, and contaminated animals could continue to spread the rabies virus in the area, putting people's lives at risk. Promptness is needed in both the epidemiological investigation and response phases to limit the consequences of rabies [14]. This promptness in detection and response was found in the Philippines during the detection of a case of rabies, where investigation, community awareness and mass vaccination of dogs were implemented within 72 hours [10].

Overall analysis of the response shows that community awareness was only integrated into less than half of the response actions (36%). And yet, it is an essential activity for relaying information within the social strata. In the event of a reported death from human rabies, the population must necessarily be informed of the risk of contamination, so that they are aware of the danger and can avoid it in the future. The essential aim is to bring about a change in people's behavior, thereby encouraging their contribution to the fight against rabies [7] [16].

Most of the people identified as likely to have had risky contact with human rabies deaths had been vaccinated against rabies post-exposure. Although the risk of human-to-human transmission of rabies is exceptional, the obvious presence of the virus in several organs justifies administering the vaccine to these people [7]. Vaccination of contact subjects was the positive aspect of the response.

Vaccination of dogs, on the other hand, was poorly carried out, corresponding to a virtual absence of animal vaccination campaigns. However, among the various activities aimed at reducing the risk of rabies, animal vaccination is important insofar as it should enable the virus transmission chain to be broken in the various infected areas [1] [6] [19].

Capacity-building activities for human and animal health professionals on the disease remain insignificant in our study. Response interventions should provide opportunities to strengthen the local knowledge of those involved in rabies control. Procedures and regulatory standards to be applied in this field should be made available to them for better control of rabies surveillance in these high-risk health districts [8] [14].

In particular, the regularity of rabies-related deaths in the health districts of Abobo-Ouest, Divo, Fresco and Bondoukou raised concerns and deserved to be elucidated. An analysis focusing on the interventions carried out each year in these areas revealed the following aspects: 1) epidemiological investigations had been organized in all these health districts following the occurrence of any death from human rabies. On the whole, response activities were limited to vaccinating subjects who had been in risky contact with the rabies case. The so-called essential activities recommended in the context of rabies, in particular dog vaccination, were not implemented in these health districts during the response actions. Given the repeated occurrence of deaths in these areas, reflecting the continuing circulation of the virus in these areas, it is urgent to implement the package of activities recommended during the response.

5. Conclusion

Between 2016 and 2018, 60 cases of human rabies were investigated and 97% responded to. Analysis of the content of these interventions revealed a number of shortcomings, including a lack of promptness in implementing response actions, the rarity of joint interventions, weak communication on rabies vis-à-vis the community, very little vaccination of the vector, the source of the disease, and an almost total absence of capacity-building for local players. In the health districts of Abobo-Ouest, Divo, Fresco and Bondoukou, which regularly recorded deaths, dog vaccination had not been carried out. In order to overcome these shortcomings, it is essential to strengthen the capacities of local players in the fight against rabies in Côte d'Ivoire.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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