

# Epidemiological Facies of Human Rabies Deaths in Côte d'Ivoire from 2016 to 2022

Tiembré Issaka<sup>1,2\*</sup>, Tetchi Sopi Malthide<sup>1,2</sup>, Coulibaly Adama<sup>3</sup>, Christiane Djoman<sup>1,2</sup>, Dagnan N'cho Simplicie<sup>1,2</sup>, Dosso Mireille<sup>4</sup>

<sup>1</sup>Félix Houphouët Boigny University, Abidjan, Côte d'Ivoire

<sup>2</sup>National Institute of Public Hygiene, Abidjan, Côte d'Ivoire

<sup>3</sup>National Institute of Public Hygiene, Adzopé, Côte d'Ivoire

<sup>4</sup>Pasteur Institute of Côte d'Ivoire Laboratory, Abidjan, Côte d'Ivoire

Email: \*itiembre@yahoo.fr

**How to cite this paper:** Issaka, T., Malthide, T.S., Adama, C., Djoman, C., Simplicie, D.N. and Mireille, D. (2023) Epidemiological Facies of Human Rabies Deaths in Côte d'Ivoire from 2016 to 2022. *Open Journal of Epidemiology*, **13**, 372-384. <https://doi.org/10.4236/ojepi.2023.134027>

**Received:** August 31, 2023

**Accepted:** November 20, 2023

**Published:** November 23, 2023

Copyright © 2023 by author(s) and Scientific Research Publishing Inc. This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

## Abstract

**Introduction:** Rabies is a highly fatal viral disease outside the post-exposure prophylaxis (PEP). Data from previous studies and reports from the rabies center show that cases of death from human rabies are regularly reported, despite training measures for health workers, awareness-raising and communities, and the availability of vaccines. **Objectives:** The aim of this study was to analyse the determinants of human rabies deaths in Côte d'Ivoire from 2016 to 2022. **Method:** A retrospective cross-sectional qualitative study was carried out from January to August 2023 on all the records of patients who died of human rabies at the Treichville Rabies Center from 2016 to 2022. An analysis of the rabies center's annual activity reports from 2016 to 2022 was also carried out in order to complete the information gathered from the files. **Results:** The socio-demographic characteristics showed that out of 148 deaths, children accounted for 47.97% (71) and 66.22% (98) of rabies deaths were male, with an M/F sex ratio of 1.96. In terms of clinical characteristics, in 97.30% (144) of cases, the deceased had presented with furious rabies, and analysis by the Pasteur Institute of Côte d'Ivoire laboratory confirmed 101 cases (92.66%) of human rabies. Geographical distribution showed that cases of human rabies were recorded in 56 health district, and 64% (94) of the deceased lived in rural areas. The main causes of the occurrence of rabies were essentially non-use of post-exposure prophylaxis (PEP) and missed vaccination due to ignorance. **Conclusion:** In view of these results, control strategies and interventions need to be adapted to the epidemiological characteristics of the disease, using a community-based approach with a view to eliminating dog-transmitted rabies by 2030.

## Keywords

Epidemiological Facies, Post-Exposure Prophylaxis, Rabies, Deaths, Côte d'Ivoire

## 1. Introduction

Rabies is a viral disease that is highly fatal unless post-exposure prophylaxis (PEP) is used. It is mainly transmitted to humans by the bite of a rabid animal. The rabies virus is present in the saliva of the infected animal, usually the dog in more than 99% of cases [1].

Rabies is one of the neglected tropical diseases affecting mainly poor and vulnerable populations living in isolated rural areas. Although effective vaccines and immunoglobulins exist for humans, they are not readily available or accessible to those who need them.

Worldwide, rabies deaths are under-reported and children aged 5 - 14 are the frequent victims [1]. According to the same source, rabies is rife on every continent, but more than 95 percent of deaths occur in Africa and Asia, while deaths are virtually non-existent in developed countries.

Since 2015, a global initiative to eliminate dog-transmitted human rabies mortality by 2030 has been in place [2]. Côte d'Ivoire has joined this initiative, and many activities to combat the disease are being carried out under the "One Health" concept.

Data from previous studies and reports from the rabies center show that there are regular reports of deaths from human rabies, despite measures to train health workers, raise awareness among the population and communities, and ensure the availability of vaccines [3]-[8]. In this context, we asked ourselves the following research question: what are the determinants of human rabies deaths in Côte d'Ivoire? Our hypothesis was that people's ignorance about rabies is the main cause of human rabies deaths.

The objectives were as follows.

### 1.1. General Objective

To analyse the determinants of human rabies deaths in Côte d'Ivoire from 2016 to 2022.

### 1.2. Specific Objectives

- 1) Determine the socio-demographic and clinical characteristics of patients who died of human rabies from 2016 to 2022.
- 2) To determine the geographical distribution of human rabies cases in Côte d'Ivoire in the general population and in the population of people at risk.
- 3) To describe the use and compliance of post exposure prophylaxis in human rabies deaths in Côte d'Ivoire from 2016 to 2022.

## 2. Materials and Methods

### 2.1. Setting of the Study

The study took place at the Rabies Centre of the National Institute of Public Hygiene (NIPH) located in the Treichville Health District (Abidjan). This Centre is the reference service for the fight against human rabies in Côte d'Ivoire. It is re-

sponsible for the systematic care of people exposed to rabies, for behavior change communication about rabies and for coordinating epidemiological surveillance of human rabies throughout the country. These activities are carried out in collaboration with the health districts via the National Institute of Public Hygiene branches. In addition, the rabies center collects and analyses data from all the rabies centers (INHP branches) for dissemination at the central level.

## 2.2. Type and Period of Study

We carried out a retrospective cross-sectional qualitative study from January to August 2023 on all the records of patients who died of human rabies at the Treichville Rabies Centre from 2016 to 2022. An analysis of the rabies center's annual activity reports from 2016 to 2022 was also carried out in order to complete the information gathered from the files.

## 2.3. File Selection Criteria and Process

We carried out an exhaustive study, all records of patients who died of human rabies from January 2016 to December 2022 at the National Institute of Public Health's rabies center were selected for our study.

## 2.4. Data Collection

Data were collected from patient files and activity reports from health centers, branches of the National Institute of Public Health and the rabies center. The following variables were selected:

- Patient's socio-demographic data: age, sex, level of education, occupation, marital status, place of residence, vaccination status;
- Animal bites: species, breed, vaccination status, owner identified or not;
- Circumstances of the bite: location, time of day, the fate of the animal responsible for transmitting the disease;
- Post-exposure care: care-seeking circuit, time between bite and request for care.

## 2.5. Data Analysis

We carried out a descriptive analysis of deaths due to human rabies. Data analysis was performed with Epi info software version 3.5.1.

The data were analyzed in terms of

- Patient profile (child/adult, male/female, rural/urban, seeking care/no seeking care after the bite);
- The profile of the biting animal and the bite: per year and from one year to the next.

The incidence of the disease in the general population was calculated using the following formula: number of cases/average general population  $\times$  100,000. The average incidence was calculated using the following formula: Average annual number of rabies deaths over the 7 years/average annual number of cases of ex-

posure  $\times 100,000$ .

The results presented are summarized in tables and figures.

## 2.6. Ethical Aspects

Authorization was obtained from the National Institute of Public Hygiene management to access the medical records of patients who died at the anti-rabies center. The confidentiality of the data processed was respected, as was the non-disclosure of any information enabling the patients and their relatives to be identified.

## 3. Results

### 3.1. Sociodemographic Characteristics of Patients Who Died of Human Rabies from 2016 to 2022 in Côte d'Ivoire

The socio-demographic characteristics of patients who died of human rabies from 2016 to 2022 in Côte d'Ivoire are shown in the following table.

**Table 1.** Socio-demographic characteristics of patients who died of rabies from 2016 to 2022

Distribution of subjects surveyed according to:					
Age (years)			Level of education		
Brackets	Workforce	%	Level	Workforce	%
0 - 4	11	7.43	Primary	65	43.92
5 - 14	60	40.54	None	56	37.84
15 and more	77	52.03	Secondary	22	14.86
			Preschool	3	2.03
<b>Total</b>	<b>148</b>	<b>100</b>	Higher	2	1.35
			<b>Total</b>	<b>148</b>	<b>100</b>

Distribution of subjects surveyed according to:					
Type			Occupation		
Sex	Workforce	%	Profession	Workforce	%
M	98	66.22	No profession	50	33.78
F	50	33.78	Student	49	33.11
<b>Total</b>	<b>148</b>	<b>100</b>	Farmer	29	19.60
			Liberal profession	8	5.41
			Security guard	4	2.70
			Shopkeeper	4	2.70
			Student	2	1.35
			Other	2	1.35
			<b>Total</b>	<b>148</b>	<b>100</b>

Children accounted for 47.97% (71) of rabies deaths and 66.22% (98) of rabies deaths were male, with a M/F sex ratio of 1.96. Of the people who died of rabies, 50 had no occupation (33.78%), 49 were students (33.11%) and 29 were farmers (19.60%). 65 people (43.92%) who died of rabies had primary education and 56 (37.84%) had secondary education (Table 1).

### 3.2. Clinical Characteristics of Patients Who Died of Human Rabies from 2016 to 2022 in Côte d'Ivoire

97.97% (145) of exposure lesions were bitten, 47.98% (71) of which were on the upper limbs and 37.16% (55) on the lower limbs. In 97.30% (144) of cases, the deceased had presented with furious rabies (Table 2).

### 3.3. Confirmed Cases of Rabies

109 rabies cases out of 148, or 73.65%, had been sampled. The results of these samples are shown in the figure below.

Analysis by the Pasteur Institute of Côte d'Ivoire laboratory confirmed 101 cases (92.66%) of human rabies, while 8 inadequate samples (7.34%) could not be analyzed (Figure 1).

### 3.4. Type of Biting Animals Involved

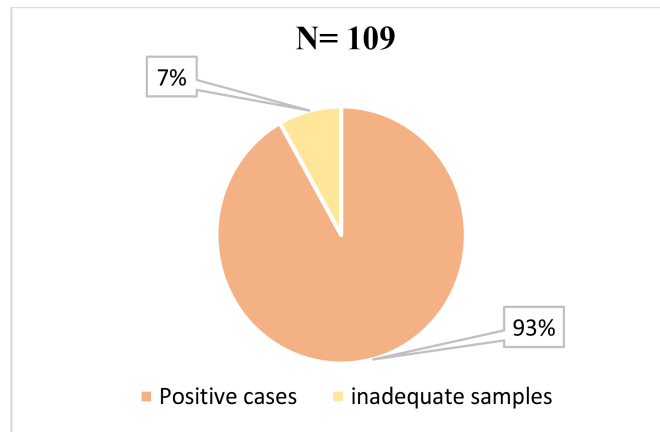
Dogs accounted for 98.65% (146) of the animals that transmitted rabies to the deceased. 89.19% (132) of the biting animals were unvaccinated and 10.81% (16) had unknown vaccination status (Table 3).

### 3.5. Precise Geographical Distribution of Human Rabies Cases in Côte d'Ivoire in the General Population and in the Population of Exposed Individuals

Cases of human rabies were recorded in 56 health districts during the study

**Table 2.** Distribution of patients who died of rabies from 2016 to 2022 in Côte d'Ivoire according to socio-economic characteristics.

Distribution of subjects surveyed according to:								
Nature of the exhibition			Location of lesions			Developed form of rage		
Nature	Workforce	%	Member	Workforce	%	Form of rage	Workforce	%
Bite	145	97.97	Senior	71	47.98	Furious	144	97.30
Scratch	3	2.03	Lower	55	37.16	Paralytic	4	2.70
<b>Total</b>	<b>148</b>	<b>100</b>	Head and neck	10	6.76	<b>Total</b>	<b>148</b>	<b>100</b>
			Trunk	7	4.73			
			Multiple	5	3.38			
			<b>Total</b>	<b>148</b>	<b>100</b>			



**Figure 1.** Breakdown of rabies deaths by laboratory confirmation.

**Table 3.** Breakdown of subjects surveyed by biting animal and vaccination status.

Distribution of subjects surveyed according to:					
Animal biter			Status Animal biter		
Type	Workforce	%	Vaccination status	Workforce	%
Dog	146	98.65	Not vaccinated	132	89.19
Cat	2	1.35	Unknown	16	10.81
<b>Total</b>	<b>148</b>	<b>100</b>	<b>Total</b>	<b>148</b>	<b>100</b>

period (2016-2022).

- The Health Districts of Bouaké-West in the center of the country and Divo and Daloa in the south-west recorded at least 7 cases, *i.e.* one case a year;
- The Health Districts that have recorded at least 5 cases of human rabies are: Vavoua, San Pedro, Abobo West, Lakota and Duékoué.

94% or 63.51% of people who died of rabies lived in rural areas (**Table 4**).

### 3.6. Incidence of Human Rabies in Côte d'Ivoire from 2016 to 2022

In our study, the incidence of human rabies is estimated at 0.0714, or 0.07 cases of high-grade rabies per 100,000 inhabitants. The incidence of human rabies is fluctuating. It rises to reach a peak in 2019, then falls to reach its lowest level in 2021 before rising again in 2022 (**Figure 2**).

### 3.7. Use of Post-Exposure Rabies Prophylaxis

#### 3.7.1. Inadequate Use of Post-Exposure Prophylaxis

118 or 79.73% of people who died of rabies did not use post-exposure prophylaxis. 16 (10.81%) of rabies decedents abandoned the post-exposure prophylaxis and 14 (9.46%) used it late.

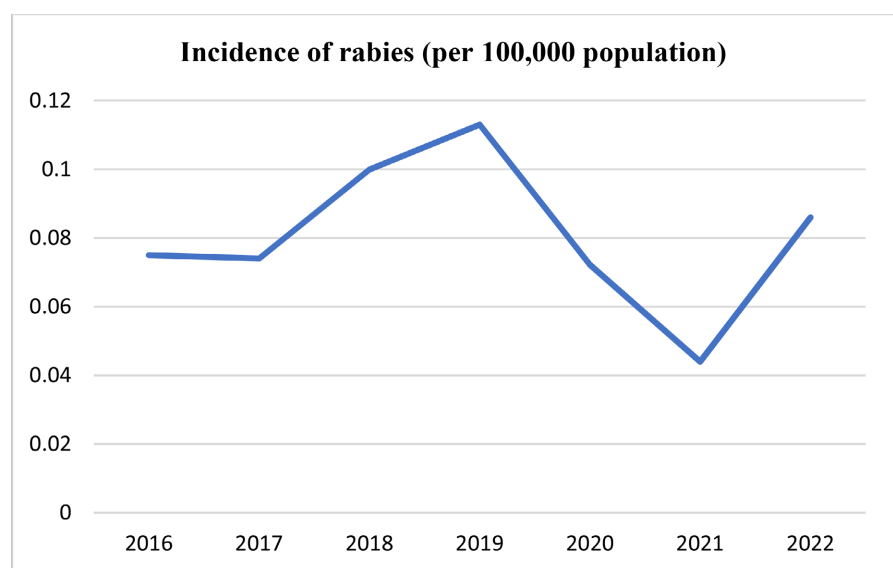
Of the 16 people who died after abandoning post-exposure prophylaxis, 2 (12.5%) did so after one dose, 13 (81.25%) after 2 doses and one (6.25%) after

**Table 4.** Distribution of human rabies cases notified in Côte d'Ivoire from 2016 to 2022 by health district.

Health district	Frequency	Percentage
Abengourou	1	0.68
Abobo est	3	2.03
Abobo ouest	6	4.05
Aboisso	1	0.68
Adzopé	2	1.35
Agboville	3	2.03
Akoupé	1	0.68
Anyama	2	1.35
Adjamé plateau Attécoubé	1	0.68
Bangolo	3	2.03
Béoumi	3	2.03
Biankouman	2	1.35
Bondoukou	2	1.35
Bouaflé	1	0.68
Bouaké ouest	8	5.41
Bouaké sud	1	0.68
Bouna	2	1.35
Boundiali	2	1.35
Cocody Bingerville	3	2.03
Dabakala	4	2,70
Dabou	1	0.68
Daloa	8	5.41
Danané	1	0.68
Daoukro	4	2.70
Dimbokro	1	0.68
Divo	9	6.08
Duékoué	6	4.05
Fresco	3	2.03
Gagnoa	3	2.03
Grand-Lahou	1	0.68
Guiglo	3	2.03
Guitry	1	0.68
Issia	1	0.68
Korhogo	2	1.35
Lakota	5	3.38

## Continued

Man	1	0.68
Mankono	1	0.68
Méagui	2	1.35
Minignan	1	0.68
Nassian	1	0.68
Odienné	2	1.35
Oumé	4	2.70
Sakassou	1	0.68
San pédro	5	3.38
Sassandra	2	1.35
Seguéla	4	2.70
Sinfra	1	0.68
Soubré	4	2.70
Tabou	2	1.35
Taï	2	1.35
Tiassalé	3	2.03
Touba	1	0.68
Vavoua	5	3.38
Yamoussoukro	1	0.68
Yopougon ouest	1	0.68
Zuénoula	4	2.70
<b>Total</b>	<b>148</b>	<b>100.00</b>



**Figure 2.** Incidence of human rabies in Côte d'Ivoire from 2016 to 2022



three doses (Table 4).

### 3.7.2. Factors Linked to Missed Vaccination

Reason for not-vaccinating with missed vaccination are shown in the figure below:

103 (69.59%) people who died of rabies missed vaccination because of ignorance, 34 (22.98%) people who died of rabies missed vaccination because of financial difficulties and 8 (5.41%) because of negligence missed vaccination and lost their lives (Figure 3).

## 4. Discussion

### 4.1. Socio-Demographic Characteristics of Patients Who Died of Rabies from 2016 to 2022 in Côte d'Ivoire

The essential characteristics of human rabies cases over the period 2016-2022 are as follows:

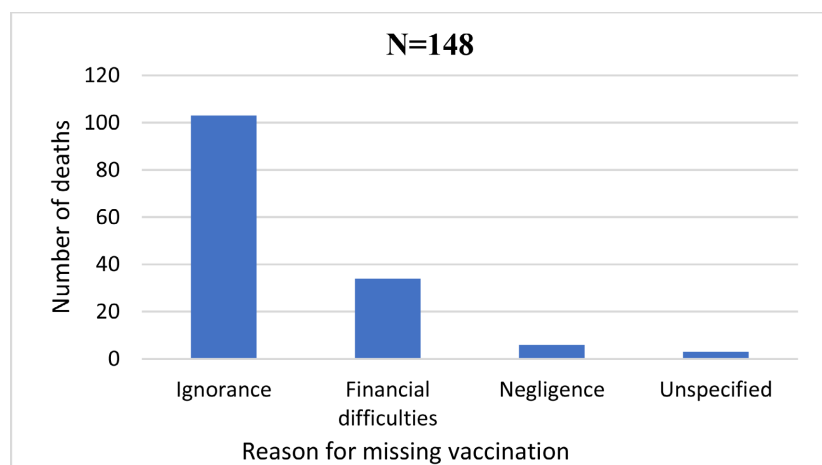
47.97% (71) of people who died of rabies were children and 66.21% (98) were male, with a M/F sex ratio of 1.96.

In terms of occupation, 50 had no occupation (33.78%) and 49 were students (33.11%).

In addition, 65 (43.92%) of the people who died of rabies had completed primary

**Table 5.** Breakdown of human rabies deaths according to use of post-exposure prophylaxis.

Recourse	Workforce	%
No use of the PPE	118	79.73
Late recourse	14	9.46
Withdrawal of PPE	16	10.81
<ul style="list-style-type: none"> <li>• discontinued of the PEP after 1 dose</li> <li>• discontinued of EPP after 2 doses</li> <li>• Discontinued PEP after 3 doses</li> </ul>	<ul style="list-style-type: none"> <li>2</li> <li>13</li> <li>1</li> </ul>	<ul style="list-style-type: none"> <li>12.5</li> <li>81.25</li> <li>6.25</li> </ul>



**Figure 3.** Breakdown of rabies deaths by reason for missed vaccination.

school and 56 (37.84%) secondary school. These data are found in most previous studies in Côte d'Ivoire [1] [9] [10] and in Africa [11]-[16].

Dogs accounted for 99% of the animals that transmitted rabies to the deceased. 89.19% (132) of the biting animals were unvaccinated and 10.81% had rabies status vaccine unknown. In Africa, as in Asia, the dog population is the main reservoir and vector of rabies [17].

This result confirms previous data and shows the need to implement a genuine mass immunisation plan for pets in Côte d'Ivoire, particularly dogs, in order to control the reservoir of the disease in the long term.

## 4.2. Geographical Distribution of Deaths

Although rabies is endemic in Côte d'Ivoire, cases have mainly been reported throughout the country, with a high concentration in the districts located in the western region of the country.

Cases of human rabies were recorded in 56 Health Districts, 23 (41.07%) of which were in the western part of the country during the study period.

In 2010, the geographical distribution of reported cases of human rabies showed that all cases were concentrated in the southern region of the country, where the epidemiological surveillance system was operational [4]. 63.5% of people who died of rabies lived in rural areas. These figures differ from those for Tiembré in 2010, which found that only 15.38% of human rabies cases originated in rural areas [4]. This situation may be due to improved surveillance and knowledge of the disease in rural areas.

## 4.3. Incidence of Human Rabies in Côte d'Ivoire

The incidence of human rabies in our study is estimated at 0.0714, or 0.07 cases of high-grade rabies per 100,000 inhabitants. As in most countries, this incidence is underestimated. According to Dacheux, global mortality from the disease, based on data communicated to the WHO by its member states via Rabnet, is underestimated [18]. In Nigeria, Otolorin highlighted this underreporting and attributed it to misreporting of cases, cultural beliefs, misdiagnosis of the disease and poor knowledge of how the disease is transmitted and prevented [19].

The under-reporting of cases means that the burden of rabies cannot be seen, which makes it impossible to lobby the health authorities for funding to combat the disease, perpetuating a vicious circle.

Indeed, in the absence of reliable epidemiological data, the health authorities are unable to perceive the importance of this disease in terms of public health. As a result, they pay little attention to it, and do not consider it worthwhile to allocate resources to monitoring the disease or treating the victims of bites. Many cases of rabies go unrecognised and unreported. In most cases, sufferers die at home without being diagnosed. Cases diagnosed in hospitals are rarely reported, or may be attributed to other diseases such as neuromalaria or meningitis. As a result, the number of deaths due to rabies is increasing without the

authorities being alerted, since cases are not reported (**Figure 1**), fuelling the vicious circle that has led to the current situation [19].

109 (73.65%) of the 148 recorded cases of rabies had been sampled, with analysis at the Pasteur Institute of Côte d'Ivoire laboratory confirming 101 cases (92.66%). However, 8 (7.34%) inadequate samples could not be analysed.

Although all the health workers had been trained, 26.35% of cases were not sampled. The reasons for this could be linked to the death of patients whose families refused to take samples or buried them very quickly. We found that 8 of the samples taken were inadequate, hence the need to train and build the capacity of our staff in view of staff changes.

#### **4.4. Post Exposure Prophylaxis Use and Compliance**

Our study showed that 79.73% of people exposed to rabies had not sought medical care. Ignorance, financial hardship and negligence were also identified as key determinants of human rabies mortality among the deceased, with ignorance being the dominant factor.

According to Dodet (2009), victims of bites do not receive appropriate prophylactic care because patients do not know what to do for first aid, because health workers are not aware of the problem, because they do not have the necessary biological products, or because they do not have sufficient resources to cover the cost of preventive treatment.

In addition, the socio-economic environment of rural areas is conducive to the occurrence of cases of human rabies. This environment is characterised by low levels of education and cultural constraints, which also have a negative effect on people's relationship with dogs, the main vector of the disease in Côte d'Ivoire.

In addition to non-use of vaccination, non-compliance with the PEP was also noted. In fact, 14 people started vaccination late and 16 did not complete it. This is a worrying situation and could be the cause of rabies, especially in children.

Because of its retrospective nature and the under-reporting of human rabies cases, our study may have limitations due to selection bias. However, this bias does not significantly alter the epidemiological characteristics of human rabies deaths in Côte d'Ivoire. We are planning an analytical study to better analyze the factors associated with human rabies deaths in Côte d'Ivoire.

**Conclusion:** In view of these results, control strategies and interventions need to be adapted to the epidemiological characteristics of the disease. In addition, raising awareness and communicating about the disease with the full participation of the population would enable them to take ownership of the fight against rabies, which is essential if we are to eliminate dog-transmitted rabies by 2030. Finally, stepping up the vaccination of animals, especially dogs, will help to control the animal reservoir.

#### **Conflicts of Interest**

The authors declare no conflicts of interest regarding the publication of this pa-

per.

## References

- [1] Organisation Mondiale de Santé (2018) Vaccins antirabiques: Note de synthèse de l'OMS. Relevé épidémiologique hebdomadaire, 201-219.
- [2] World Health Organization (2018) WHO Expert Consultation on Rabies: Third Report (Vol. 1012).
- [3] INHP (2022) Rapport d'activité, Abidjan, 173 p.
- [4] Tiembré, I., Dagnan, S., Douba, A., Adjogoua, E.V., Bourhy, H., Dacheux, L. and Odehouri-Koudou, P. (2010) Epidemiological Surveillance of Human Rabies in the Context of a Canine Rabies Endemic in Côte d'Ivoire. *Medicine and Infectious Diseases*, **40**, 398-403. <https://doi.org/10.1016/j.medmal.2010.01.008>
- [5] Tiembré, I., Dagnan, S., Benié, J., Tetchi, M. and Tagliante, S.J. (2012) Epidemiology of Human Rabies in Côte d'Ivoire from 2005 to 2011. *Santé Publique*, **23**, 279-286. <https://doi.org/10.3917/spub.114.0279>
- [6] Tiembre, I., Broban, A., Benie, J., Tetchi, M., Druelles, S. and L'Azou, M. (2018) Human Rabies in Côte d'Ivoire 2014-2016: Results Following Reinforcements to Rabies Surveillance. *PLOS Neglected Tropical Diseases*, **12**, 15 p. <https://doi.org/10.1371/journal.pntd.0006649>
- [7] Tetchi, M., Coulibaly, M., Kallo, V., Traoré, G., Tiembré, I., Benié, J., Lechenne, M., Zinsstag, J. and Bonfoh, B. (2020) The Thai Red Cross Protocol Experience in Côte d'Ivoire. *Acta Trocica*, **212**, Article 105710. <https://doi.org/10.1016/j.actatropica.2020.105710>
- [8] Zamina, B., Tiembre, I., Attoh-Toure, H., N'Guessan, K., Tetchi, M. And Benie, J. (2018) Factors Associated with the Abandonment of Post-Exposure Prophylaxis at the Abidjan Rabies Centre, Côte d'Ivoire. *Médecine et Santé Tropicales*, **28**, 212-218. <https://doi.org/10.1684/mst.2018.0796>
- [9] Effi, A., Kouassi, D.P., Yao, G.H.A., Soumahoro, S.I., Akani, B.C. and Kra, O. (2017) Determinants of the Abandonment of Rabies Post-Exposure Prophylaxis at the Rabies Centre of the Bouake Regional Public Health Antenna, Côte d'Ivoire, 2014-2015. *Revue Marocaine de Santé Publique*, **7**, 13-19.
- [10] Amalaman, D.M., N'dri, K.K.N. and Koné, I. (2019) Social Representations and Rabies Prevention among Primary School Pupils in Bouaké and San-Pedro, Côte d'Ivoire. *Revue Espace, Territoires, Sociétés et Santé*, **2**, 18-31.
- [11] Diop, S., Manga, N.M., Dia, N.M., Ndour, C.T., Seydi, M., Soumare, M., Diop, B.M. and Sow, P.S. (2007) Update on Human Rabies in Senegal from 1986 to 2005. *Médecine et Maladies Infectieuses*, **37**, 787-791. <https://doi.org/10.1016/j.medmal.2007.01.010>
- [12] Houessou, E. (2012) Etude épidémiologique rétrospective des cas cliniques de rages canine et humaine déclarées au Bénin: Cas Des Villes D'Abomey-Calavi, Cotonou Et Ouidah Au Cours De La Période 2012 À 2017.
- [13] Dao, S., Abdillahi, A.M., Bougoudogo, F., Toure, K. and Simbe, C. (2006) Epidemiological Aspects of Human and Animal Rabies in the Urban Environment of Bamako, Mali. *Bulletin de la Société de Pathologie Exotique*, **99**, 183-186.
- [14] Kampo, O., Traore, B., Sangho, O., Diakite, S. and Telly, N. (2019) Study of Dog Bite Cases from January 2017 to October 2019 in the Sikasso Health District, Mali. *Mali Santé Publique* 2019, 74-78. <https://doi.org/10.53318/msp.v9i01.1483>

- [15] Hampson, K., Coudeville, L., Lembo, T., Sambo, M., Kieffer, A., Attlan, M., *et al.* (2015) Estimating the Global Burden of Endemic Canine Rabies. *PLOS Neglected Tropical Diseases*, **9**, e0003709. <https://doi.org/10.1371/journal.pntd.0003709>
- [16] Hampson, K., Ventura, F., Steenson, R., Mancy, R., Trotter, C., Cooper, L. and Huong, N.T.T. (2018) The Potential Effect of Improved Provision of Rabies Post-Exposure Prophylaxis in Gavi-Eligible Countries: A Modelling Study. *The Lancet Infectious Diseases*, **19**, 102-111. [https://doi.org/10.1016/S1473-3099\(18\)30512-7](https://doi.org/10.1016/S1473-3099(18)30512-7)
- [17] Dodet, B. (2009) The Fight against Rabies in Africa: From Recognition to Action. *Vaccine*, **27**, 5027-5032. <https://doi.org/10.1016/j.vaccine.2009.06.030>
- [18] Dacheux, L., Reynes, J.M., Buchy, P., *et al.* (2008) A Reliable Diagnosis of Human Rabies Based on Analysis of Skin Biopsy Specimens. *Clinical Infectious Diseases*, **47**, 1410-1417. <https://doi.org/10.1086/592969>
- [19] Otolorin, G., Richard, O., Aiyedun, J., Paul, M.P.O., Ameh, V., Adamu, D.A., *et al.* (2015) Review on Human Deaths Associated with Rabies in Nigeria. *Journal of Vaccines & Vaccination*, **6**, 1-6.