

Investigation of Yellow Fever Cases in the Manankoro Area, Bougouni Health District, Sikasso Region, December 2019

Dr Soungalo Diakite^{a*}, Dr Dramane Traore^b, Dr Djibril Barry^c, Dr Bénéôit Traore^d, Dr Daouda Niare^e, Mr. Demba Koita^f, Dr Chaka Sanogo^g, Dr Yacouba Kone^h, Mr Ousséni Bagayokoⁱ, Dr Yiriba Diarra^j, Dr Moussa Camara^k, Dr Mala Sylla^l, Dr Djemoutery Justin Sanou^m, Dr Kalifa Diarraⁿ, Dr Aimé Christophe Dembele^o, Dr Hanine Keita^p, Dr Bouyagui Traore^q, Mr Souleymane Coulibaly^r,
Dr Cheick Abou Coulibaly^s

^{a,b,d,l,j,k}Regional Health Directorate of Sikasso, ^cPublic Health Emergency Operations Department, ^eEntomologist Faculty of Medicine and Odonto-Stomatology, ^{f,g,h}General Directorate of Health and Public Hygiene, ^{i,m,n}Reference Health Center of Bougouni, ^oCommunity Health Center of Manankoro, ^{p,q}Training Program in First Line Field Epidemiology/Mali, ^rNational Institute of Public Health/Mali, ^sAssistant Professor of Public Health/Mali

^ahead of epidemiological surveillance at the Regional Health Directorate. Address: Hamdallaye rue 446, porte 133, Sikasso BP 19, Mali.

^bRegional Health Director. Address: Wayerma, Sikasso BP19, Mali

^aEmail: soungalodiakite2013@gmail.com, ^bEmail: dramanegss@gmail.com

Abstract

Introduction : Following the confirmation of two (2) cases in the health district of Bougouni on 03/12/2019. We conducted an investigation whose objective was to describe the cases of yellow fever in the Manankoro health area in time, place and people and to put in place control and prevention measures against the epidemic.

Methodology : We conducted a cross-sectional descriptive study in December 2019, a case of yellow fever was any person who stayed in Manankoro or surrounding village between October 20 to December 05, 2019 and who presented during this period the following signs : Fever or notion of fever in the previous days and jaundice in the 2 weeks following the onset of the signs . We conducted a search for other unreported cases based on data collected using a questionnaire. The data was analyzed in time, place and person.

Received: 3/20/2023

Accepted: 4/10/2023

Published: 5/7/2023

* Corresponding author.

Results : Case confirmed by the laboratory , this is a 25-year-old adult , farmer , male gender , residence Kémingouara / Republic of Côte d'Ivoire, came on November 06, 2019 for consultation at the Lafia cabinet in Manankoro in a table of coma and referred to the CSRéf of Bougouni for better care where Hey died 11 hours after his blood sample on 08/11/2019. **Conclusion** : The investigation made it possible to identify 12 additional cases among which 3 cases of death , the age group of 30 to 34 years was the most represented , that is to say 33%. The male sex was predominant with 10 boxes. Fever, jaundice and vomiting were the most frequent symptoms . The *Aedes* species responsible for yellow fever was not found during this investigation.

Keywords: Investigation; yellow fever; Manankoro; Sikasso; 2019.

1. Introduction

Yellow fever is a notifiable acute haemorrhagic disease of viral origin caused by a Flavivirus with human-to-human transmission, via domestic mosquitoes belonging to the *Aedes* species (urban epidemics) or transmitted to humans from the reservoir constituted by primates, through mosquitoes belonging to sylvatic species (sylvatic cycle) [1].

In the second half of the 20th century, the yellow fever virus was mainly transmitted in several forms: the sylvatic form, where the animal reservoir (non-human primates living in the forest or the jungle) infects arboreal mosquitoes of the genus *Haemogogus* (in the Americas) and *Aedes spp* (in Africa), which in turn bite humans who enter the forest to hunt or work; the intermediate form, where many sub-species of *Aedes* go there between the forest and areas where human populations live who thus play a host role in the transmission cycle [2].

This cycle can take place in rural villages, within what is called the "emergence zone" in Africa, but large outbreaks may have occurred elsewhere, after infected people have traveled to an urban center.

The urban form, does not require a return to the wild reservoir to transmit the virus between two human beings directly. Urban outbreaks are particularly deadly and cause severe disruption. These are also the most likely to spread to other countries [2].

Young fever is present throughout the territory or in certain regions of the 47 countries of Africa (34) and Latin America (13). Modeling on African data sources has estimated the burden of disease attributable to this disease in 2013 that there are 84,000 to 170,000 serious cases and 29,000 to 60,000 deaths. There is currently no specific antiviral medication for fever [2].

In 2018, WHO listed Yellow Fever as one of the top 10 global health threats [2].

The first major epidemic of yellow fever was observed in 1648 in the Gulf of Mexico and its first appearance in America dates from 1668, while in Africa the first epidemic was observed in 1530 in the Gulf of Benin and then in 1778 in Saint-Louis of Senegal [3].

In Mali, efforts have been made in the fight against yellow fever through the organization of mass vaccination

campaigns since 2006. Although Mali benefited from the CVPM (massive preventive vaccination campaign) in 2006, the Routine yellow fever vaccination coverage was less than 70% [4].

The last yellow fever epidemic in the Sikasso Region dates back to 2015 with seven (7) positive Ig M cases including four (04) in Kolondièba, two (02) in Koutiala and one (01) in Nièna. (3)

The Bougouni health district had never had a yellow fever epidemic, even though it borders Guinea and Côte d'Ivoire, which are two places that are not free of the disease.

In 2019 from S1 to S48 of the epidemiological week, the Sikasso Region notified 63 suspected cases including 9 positive cases with 2 death cases for the Bougouni Health District.

Following the confirmation of two (2) cases in the health district of Bougouni on 03/12/2019, a joint team from the national, regional and district levels went to the health area of Manankoro to investigate the yellow fever epidemic december 2019.

2. Objectives

2.1 General objective

- Investigate yellow fever cases in the Manankoro health area, Bougouni health district, December 2019

2.2 Specific objectives

- Actively search for additional unreported cases;
- Describe the clinical and biological socio-demographic characteristics of the cases in time, place and people;
- Determine the VAA vaccination coverage from 2015 to 2019 in the Manankoro health area and the Bougouni health district;
- Assess the risk of yellow fever virus transmission in certain health areas around the outbreak.

3. Methodology

3.1. Framework of the investigation

a. Presentation of the District :

The health district of Bougouni covers an area of 20,028 km² with an estimated population of 637,744 inhabitants in 2019. Located south of the 3rd administrative region of Mali (Sikasso) and shares its borders with the circle of Sikasso to the east. ; the Cercles of Kolondièba, Yanfolila and the Republic of Côte d'Ivoire in the South; the circle of Kati in the West and the circle of Dioila in the North.

a- Presentation of the Manankoro health area :

The Manankoro health area is located 150 km from the district capital on the Ivorian border. It is made up of 7 villages and has an estimated population of 13,731 inhabitants in 2019. The population is predominantly peasant (herder, farmer).

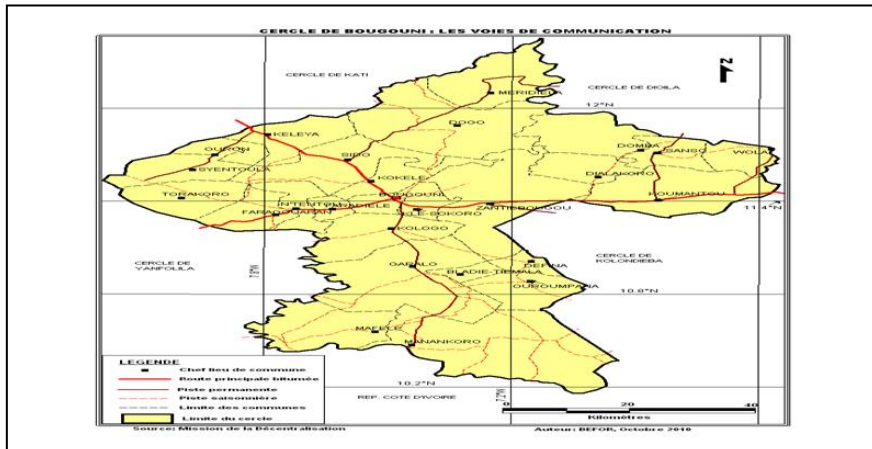


Figure 1: Bougouni district health map

Source: Circle Council

vs. Socio-sanitary situation :

The health district has 45 functional health areas, including 9 medical ones, 149 CHW sites, 193 rural maternities and 1,000 community relays.

The health district is made up of 26 municipalities, one (1) of which is urban, 9 districts and 500 villages.

3.2. Type of study

This is a cross-sectional descriptive study.

3.3. Study population

Our study concerned the entire population of the Manankoro health area during the period of our investigation.

3.4. Study period

Our investigation took place from December 4 to 8, 2019 and concerned data from October 20 to December 05 .

3.5. Yellow fever case definition

- **Suspected case** : anyone who stayed in Manankoro or the surrounding village between October 20 and December 05, 2019 and who presented the following signs during this period: Fever or notion of fever in the previous days and or jaundice within 2 weeks following the start of the signs.

- **Probable case:** Presumed case + epidemiological link with a confirmed case or an epidemic outbreak.
- **Confirmed case** = a suspected case confirmed by the laboratory in the absence of recent vaccination (2 years) documented by a card.

Wanted active cases:

We searched for previously reported cases and additional cases by going door to door in the community, and reviewing consultation registers in public and private health facilities.

3.6. Collection techniques and tools

Data collection:

Data were collected using a questionnaire containing the variables of interest. The collection methods were as follows:

- Observation of the premises and people living in the households,
- Documentary review through consultation registers, notification forms, the list of diseases with epidemic potential,
- Interview people using an individual yellow fever investigation form given to family members.

3.7. Data analysis

The data collected was analyzed using Epiinfo 7.2.5 and Excel 2016 software in time, place and person.

4. Ethics

We obtained authorization from the Regional Health Director of Sikasso, the head doctor of the Bougouni health district and the prefect of Manankoro to carry out the investigation.

The anonymity of the patients was respected and the information obtained is kept on a hard disk in a secure place.

5. Results

- **Laboratory confirmed cases**

Index case: This is a 25-year-old adult, farmer, male, residence Kémingouara / Republic of Côte d'Ivoire, came on November 06, 2019 for consultation at the Lafia de Manankoro office in a coma and referred to the CSRéf of Bougouni for better care where he died 11 hours after his blood sample on 08/11/2019 and the test was positive

- **Active case finding**

It made it possible to find 12 additional suspected cases in the village of Manankoro from which they were sampled and notified. The samples were sent to the laboratory for confirmation, only one case was positive and the others negative.

- **Cases found by epidemiological link**

No cases were found by epidemiological link.

- **Sociodemographic characteristics**

Overall a total of 14 cases were identified including 3 positive cases and 11 negative cases, the range was from 1 year 4 months to 34 years with the median age of 15 years. Lethality was 21% (3/14)

- **Epidemic curve of yellow fever cases**

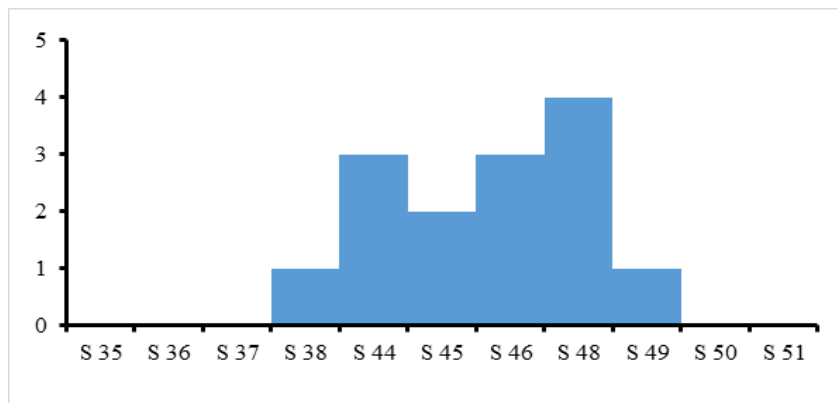


Figure 1: Distribution of suspected cases of fever from S35 to S49 epidemiological, Manankoro 2019

Cases were observed from week 38 to week 49 and the highest number was reported at week 48 with 4 suspected cases.

- **Distribution of cases by sex**

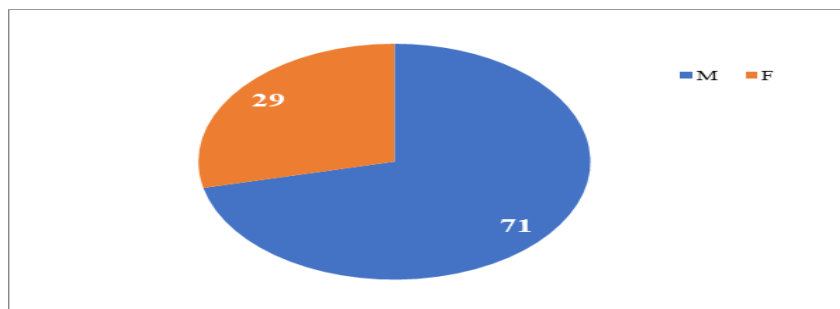


Figure 2: Percentage distribution of suspected yellow fever cases by sex from epidemiological S35 to S49, Manankoro 2019

The male sex was predominant with 71% of notified cases.

- **Distribution of cases by age group**

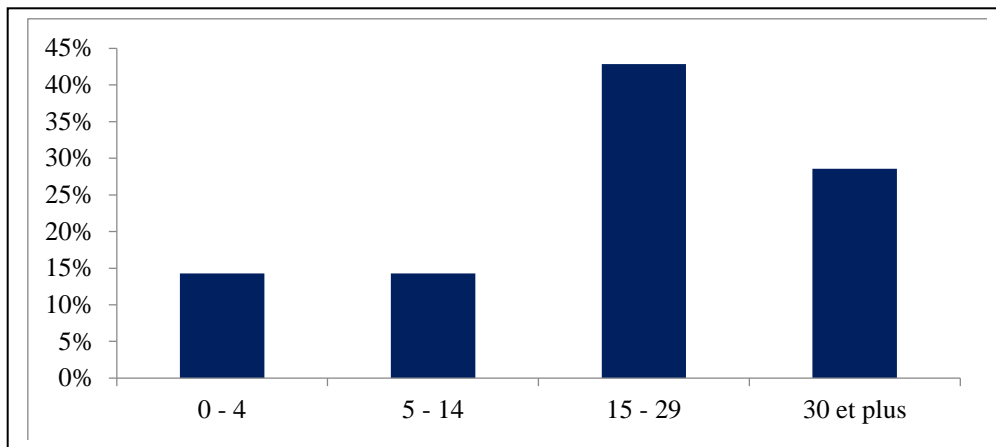


Figure 3: Distribution of yellow fever cases by age group from S35 to S49 epidemiological Manankoro 2019

The age group from 15 to 29 was the most represented with 45% of all cases.

- **Distribution of cases by symptom**

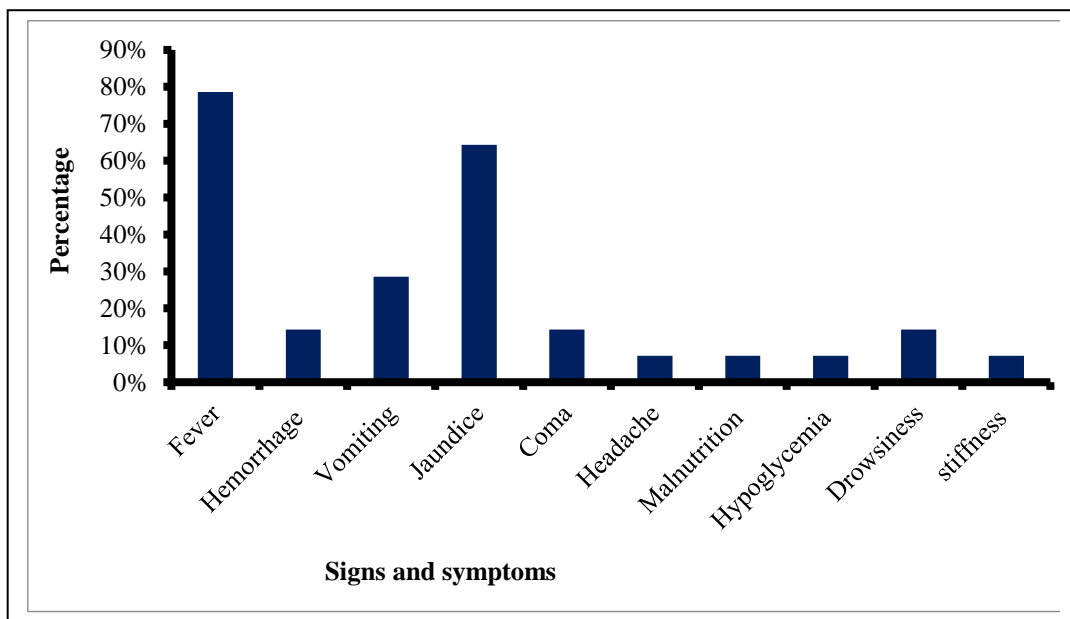


Figure 4: Distribution of the percentage of symptoms of yellow fever cases from S35 to S49 epidemiological Manankoro 2019

Fever, jaundice and vomiting were the most notable with 79%, 64% and 29% respectively,

- **Distribution of cases according to vaccination status**

Table 1: Distribution of yellow fever cases according to their vaccination status from epidemiological S35 to S49 Manankoro 2019

Status	Number	Percentage(%)
Vaccinated (verbal)	4	29
Not vaccinated	10	71
Total	14	100

The unvaccinated were 71% of reported cases.

- **Breakdown of cases by occupation**

Table 2: Distribution of yellow fever cases by profession from S35 to S49 epidemiological Manankoro 2019

Occupation	Number of cases	Percentage(%)
Shepherd	1	7
Farmer	6	43
Koranic student	1	7
Preschool*	3	21
Household	3	21
TOTAL	14	100

* = children under 5 years old

The 43% of cases were farmers followed by preschoolers and housewives with 21% each.

- **Distribution of cases by reporting site**

Table 3: Distribution of yellow fever cases by reporting site from S35 to S49 epidemiological Manankoro 2019

Locality of consultation	Number of cases	Percentage(%)
Lafia Clinic / Manankoro	5	36
CSCom Manankoro	6	43
Garrison Infirmary	1	7
Wogona Maternity	2	14
TOTAL	14	100

The Manankoro community health center reported the highest number of cases with 43% (6/14).

- **Evolution of VAA vaccination coverage in Bougouni district, 2015-2019**

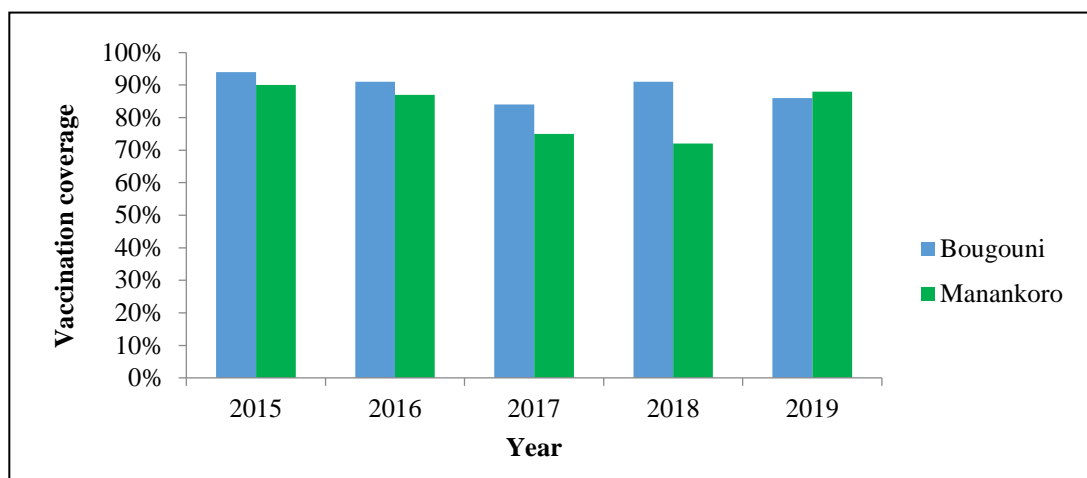


Figure 5: Evolution of VAA coverage of Bougouni and Manankoro according to the DVD-MT, 2015-2019*

Source : DVD-MT, 2015-2019*

VAA vaccination coverage in the district and health area did not reach the set target of 95%. An average of 82.4% coverage of Manankoro is below the set target.

- **The Public Health actions undertaken are as follows**

Holding information meetings with the administrative, customary and political authorities in the health district (Prefecture, Sub-prefecture, Municipal Council and the ECD).

Table 4: Organization of response activities.

Health area	Target	Number vaccinated					Coverage	Number of doses used	loss rate
		9 -59 months	5-14 years old	15 years and over	Total vaccinated				
Manankoro	13320	1907	2965	2977	7849	59%	7850	1%	
Total		1907	2965	2977	7849	59%	7850	1%	

- **Biological data**

The 6 identified suspected cases were the subject of dry tube samples, including 3 cases of icteric serum and one case with an insufficient quantity of serum.

- **Entomological data**

Thirteen (13) different breeding sites have been identified in Manankoro (7), Wogona (6). The breeding sites were rich in other species. No *Aedes* have been identified.

6. Limits of the investigation

The accessibility of the residence of the index case for the investigators because he lived on the border between Côte d'Ivoire and Mali. The non-availability of the vaccination records of suspected persons for verification. The growing insecurity in the area, which has restricted our movement on the ground. The case was already deceased which hampers the search for further information on the case. Delay in initiating case investigation to better assess disease transmission status.

7. Discussion

A total of 14 suspected cases were notified with a sample, of which 2 cases came back positive for the yellow fever virus and 3 cases died. The third deceased was confirmed during the investigation. The border zone is nested by shepherds who transit with animals from Mali to Côte d'Ivoire vice versa. It is a place likely to create *aedes* mosquitoes due to the sylvatic environment. It was the first time that the health area of Manankoro declared an epidemic of yellow fever, no less for the health district of Bougouni. The positive patients were received at the reference health center in critical condition and they died a few hours later after their blood was drawn and sent to the laboratory for confirmation. They were not vaccinated, seeing that they lived in the forest zone, no reliable information could be obtained by the accompanying persons. During the epidemic we found that in all the cases, the male sex represented 71.% which is similar to the authors [5 ' 6] . The large number of cases was reported at week 48 which was different from the reports made in the first 12 weeks by the author [6] . The age group (15 to 29) years was the most represented with 36% (5/14) of the cases, which is contrary to the authors [1,5] who found the age group (0 to 5) years old with 71% and 56% respectively and also the age group (0 to 17) years old which was found with 56% according to the author [7] . Fever 79%, jaundice 64% and vomiting 29% were the most observed symptoms during this epidemic, which was similar to the majority symptoms to the author [5] . which found 94% for fever and 100% for jaundice. The 71% of cases were unvaccinated and this is similar to the authors [8] , who found that 100% of cases were unvaccinated. A shepherd and two farmers died, representing 7% and 46% of the notified cases respectively according to their profession with a lethality of 21% which is similar to 17% and 32% respectively according to the authors [9 , 10]] which explains that their way of life may be a factor exposing them to the disease, especially the place from which the cases came, it is the border area of Côte d'Ivoire and Mali which is sylvatic, hence the transmission of the disease is high according to the author [11] . The breeding sites were rich in other species but no *Aedes* were identified this was similar to the author (12) which was contrary to the authors [13 , 14 , 15] which showed that *Aedes aegypti* roosts existed. Since the introduction of the yellow fever vaccine in Mali in 1987 in the strategy

to fight against diseases with epidemic potential, it has allowed the reduction of outbreaks in the Sikasso region, especially in the districts. More generally the episodes appear sporadically in urban and rural areas.

8. Conclusion

The investigation made it possible to identify 12 additional cases including 3 deaths, the age group of 30 to 34 years was the most represented, that is to say 33%. The male sex was predominant with 10 cases. Fever, jaundice and vomiting were the most frequent symptoms in our study. Entomological investigation led to the conclusion that *Culex* and *Anopheles gambiae sl* are the majority species in the Manankoro area. The *Aedes* species responsible for yellow fever was not found during this investigation. The ecological conditions, habits and behaviors of the border populations between Mali and Côte d'Ivoire, in addition to the presence of a non-immune population, are favorable factors for the outbreak of a yellow fever epidemic in the region.

Conflicts of interest : The authors declare no conflicts of interest for this work.

9. Recommendations

- **Directorate General for Health and Public Hygiene:**

Create a framework for exchange with the Ivorian authorities to jointly conduct cross-border investigations.

- **At the Regional Health Department :**

Support the implementation of the vaccination response in the Manankoro, Mafèlè, Banzana and Bamba health areas.

Evaluate the epidemiological surveillance system for vaccine-preventable diseases in Bougouni district.

- **In the health district:**

Organize a vaccination response campaign against yellow fever in the areas of Manankoro, Mafèlè, Banzana and Bamba.

Provide the CSCoM of Manankoro with rolling logistics

Strengthen local supervision of epidemiological surveillance and PEV in border health areas

Train agents of private structures on epidemiological surveillance.

- **To health areas:**

Strengthen epidemiological surveillance;

Strengthen collaboration with private structures and traditional healers,

Record and report all suspected cases meeting the case definition,

Organize the response according to the recommendations of the investigation,

Strengthen routine EPI activities, especially in advanced strategies

Set up the registers/linear notebook of MADO.

References

- [1]. Konate I, Bane S, Traoré M, Guindo I, Koné O, Katilé D, et al. Management of the Yellow Fever Epidemic that Occurred in the Health Districts of Koutiala and Kolondieba in 2015 in Mali. *Health Science Dis* [Internet]. 2019 Apr 30 [cited 2022 Mar 7];20(3). Available at: <http://www.hsd-fmsb.org/index.php/hsd/article/view/1378>
- [2]. Key facts about yellow fever [Internet]. [cited 2022 Jul 15]. Available at: <https://www.who.int/en/news-room/fact-sheets/detail/yellow-fever>
- [3]. Traore M. Evaluation of the management of the yellow fever epidemic that occurred in the health districts of Koutiala and Kolondieba in 2015 in Mali. 2018;
- [4]. WER9633-377-392-eng-fre.pdf [Internet]. [cited 2023 Mar 6]. Available at: <https://apps.who.int/iris/bitstream/handle/10665/344323/WER9633-377-392-eng-fre.pdf?sequence=1>
- [5]. Maïga A. Epidemiology of yellow fever in the Kayes region. *Th Med*. 2006;(334).
- [6]. Casali FT, Minucci GS, Meira ALP, Souza LPS e, Casali FT, Minucci GS, et al. Analysis das characteristics epidemiological of February amarella em um Estado da Regiao Sudeste do Brasil. *Locked up News Costa Rica*. 2019 Dec ;(37):50-65.
- [7]. CISSE MBM. THE ROLE OF THE NATIONAL REFERENCE LABORATORY IN YELLOW FEVER SURVEILLANCE IN MALI FROM 2002 TO 2006. 2008;
- [8]. Diagne MM, Ndione MHD, Gaye A, Barry MA, Diallo D, Diallo A, et al. Yellow Fever Outbreak in Eastern Senegal , 2020-2021. *Viruses* . 2021 Jul 28;13(8):1475.
- [9]. Attoh-Touré H, Dagnan NS, Tagliante-Saracino J. Resurgence of yellow fever epidemics in Ivory Coast. *Bull Society Pathol Exot* . 2010;103(5):323-6.
- [10]. Calado A, Paz F. Profile analysis epidemiological and incidence of February amarela no Brasil. *Res Soc Dev*. 1 Jan 2020;9:09932271.
- [11]. Djarma OM, Elisee D, Bolti MA, Sougoudi DA, Diop AB, Hagggar FA, et al. [Resurgence of yellow fever in Chad: case report of the last confirmed case in the health district of Lai-Chad]. *Pan Afr Med J*. 2021;38:248.
- [12]. Lhuillier M, Sarthou JL, Cordellier R, Monteny N, Gershy-Damet GM, Bouchite B. Endemic emergence of yellow fever in Côte d'Ivoire: role of yellow fever IgM detection in the surveillance strategy. *Bull World Health Organ* . 1986;64(3):415.
- [13]. Danet L. Study of the determinants of dissemination of the yellow fever virus in its vector *Aedes*

aegypti [PhD Thesis]. Sorbonne Paris City University; 2019.

[14]. Fernandes NCC de A, Guerra JM, Cunha MS, Beraldo KRF, Ressio RA, Cirqueira CDS, et al. Yellow fever surveillance challenge: Investigation of a marmoset non- autochthonous case. Act Too. Dec 2020;212:105702.

[15]. Bonnel PH, Deutschman Z. Yellow fever in Africa in recent years. Bull World Health Organ . 1954;11(3):325.

Appendices

Some pictures :



Figure 6

Wogona Maternity Work session at the rural Wogona Maternity



Figure 7

Sensitization visit to the village chief of Wogona Active research and sensitization to the Imam of Wogona



Figure 8

Captured vector image



Figure 9

Figure 1 Briefing between Regional and National Team Orientation visit to municipal authorities



Figure 10

Visit to the village chief of Manakoro /District of Bougouni active research



Figure 11

Microclimat Wogona Recherche active de cas chez les malades mise en observation

Image de cas suspects prélevés au cours de l'investigation