

Investigation of a suspected measles outbreak in a security crisis and border zone, Cinkansé, Burkina Faso, November 2022

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ABSTRACT

Introduction: From September 12, 2022, to October 23, 2022, the border CSPS (Health and Social Promotion Center) in Cinkansé reported a total of 22 suspected cases of measles. In response to this unusual number of suspected cases, we investigated to confirm the outbreak and guide the response. Methods: We conducted a cross-sectional study. The investigation took place over two days, from October 31 to November 1, 2022. A suspected case of measles was defined as any person residing in Cinkansé and presenting between August 29 and November 1, 2022, with fever, maculopapular rash, cough, cold or conjunctivitis. A confirmed case was any suspected case with positive measles virus IgM. We abstracted data from the consultation registers and complimented this with primary data collected through clinical observation and individual interviews. A vaccination coverage survey was carried out in the community. The collection tools used included an interview guide and a documentary analysis framework. Data analysis was carried out with Epi info and we calculated proportions. Results: We found 44 suspected cases of measles, including 2 during an active community search. Of these, 77.3% (34/44) lived in Cinkansé_Burkina and 22.7% (10/44) in Cinkassé_Togo. The average age of cases is 2.2 years. Extreme ages are represented by cases aged 3 months and 34 years. Not all cases received their second dose of measles-rubella vaccine (RR2). Blood samples were taken from 33/44 cases, but only 11 samples were analyzed by the laboratory due to a lack of reagent availability. Of the 11 samples analyzed, 9 were positive for measles IgM. For the other cases, we had 10 epidemiologically confirmed cases and 23 clinically compatible cases. The measles epidemic was confirmed on November 16, 2022. The vaccine coverage survey showed that 61.90% (13/21) of children had received their second dose of measles-rubella vaccine (RR2). We conducted a joint reactive vaccination campaign with Togo from December 5 to 11, 2022. The target was subjects aged 6 months to 14 years. A total of 47,592 children in this age group benefited from this vaccination, i.e. coverage of 115.20%. Vaccination led to a gradual decline in the number of cases, followed by the declaration of the end of the epidemic on March 5, 2023 Conclusion: A measles epidemic was confirmed. Reinforced epidemiological surveillance at all levels and cross-border collaboration could prevent futures epidemics.

KEYWORDS: Investigation, measles, border, Cinkansé, Burkina Faso

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RECEIVED 29/11/2023

ACCEPTED 18/09/2024

PUBLISHED 25/09/2024

LINK

www.afenet-journal.net/content/article/7/44/full

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CITATION

Morou Nikiema et al . Investigation of a suspected measles outbreak in a security crisis and border zone, Cinkansé, Burkina Faso, November 2022. J Interval Epidemiol Public Health. 2024 Sep 25; 7(3): 18. DOI:

https://www.doi.org/10.37432/jieph.2024.7.3.13 5

AFENE



Introduction

Measles is a febrile eruptive disease caused by a virus of the *paramyxoviridae* family (morbillivirus). It is transmitted by air from person to person via airborne respiratory microdroplets [1]. The incubation period for measles is 7 to 14 days. It is an immunisable disease. Prior to the introduction of vaccination in 1963, major measles epidemics occurred every 2-3 years, causing up to 2.6 million deaths a year [2-4]. The implementation of the Expanded Program on Immunization and the establishment of regional measles elimination plans have dramatically reduced the burden of the disease and its mortality, particularly in Africa[5].

Notwithstanding this progress, measles remains one of the major causes of death in young children. In the world, an estimated 89,780 people, the majority of them children under the age of 5, died from measles in 2016 [2]. The vast majority of measles deaths occur in countries with low per capita income and fragile health infrastructure [2].

In recent years, there has been a resurgence of measles cases around the world. For some authors, this situation is linked to the under-vaccination of children against measles [3]. Others believe that countries hit hardest by natural disasters or conflict, with deterioration of health infrastructures, interruption of systematic vaccination and overcrowding of camps are responsible for this upsurge of cases [2].

According to the World Health Organization (WHO), in 2018, some 9,769,600 cases of measles were reported worldwide, with 142,200 deaths [6]. Between January 2008 and May 2012, more than 22,000 cases of measles were reported in France, the majority among children under one year of age[7].

According to a study carried out in Mali, between 2009 and 2018, around 6,461 cases of measles were reported [8]. In Burkina Faso, clusters of suspected measles epidemics have become increasingly frequent in recent years. According to the 2021 Burkina Faso statistical yearbook, 3,866 suspects cases of measles were reported nationwide. According to the same source, the Centre-Est region recorded just 34 cases, or 0.88% of cases. However, in 2022, with the continuing deterioration of the security situation in the Centre

Est region, according to the Weekly Official Letter Telegram (TLOH), 449 suspected cases of measles were reported, including 46.77% in the health area of the Cinkansé health and social promotion center (CSPS). In view of the unusually high number of suspected measles cases in the Cinkansé area, we initiated an investigation to confirm the outbreak and guide response actions. Cinkansé's geographical location on the border and the unfavorable security context in its area made this investigation particularly important.

Methods

Study setting

Our study took place in the health area of the Cinkansé's Centre de Santé et de Promotion Sociale (CSPS or health center in English), Ouargaye health district, Centre Est region, Burkina Faso [9]. The Ouargaye health district shares a 141 km border with the Republic of Togo and has eight (08) border CSPSs.

The village of Cinkansé is home to the Cinkansé entry point, along with several crossing points. The village is subdivided into two parts: Cinkansé_Burkina and Cinkassé_Togo. It is a commercial zone with two markets, one on each side of the border. Both markets are frequented by people from Burkina Faso and Togo. This situation makes it very difficult to control the population of Cinkansé, which is always underestimated during public health interventions. The village of Cinkansé is also a promiscuous shantytown. The administrative measles-rubella vaccine coverage (RR2) of the CSPS of Cinkansé-Burkina is above 133%, 125% and 181% for 2020, 2021 and 2022 respectively. Population movements on either side of the border influence coverage rates, which are often not real. On the security front, the district has been preyed to attacks by armed men since 2018. This situation has forced many people to move to safer towns like Cinkansé.

Study design and period

This was a cross-sectional study from August 29, 2022, to March 5, 2023. The study period can be subdivided into four parts:

- August 29, 2022, to October 30, 2022: preinvestigation period, which was used to conduct documents review in the health centers.

- October 31 to November 1: investigation of cases in health centers.

- November 2, 2022, to March 4, 2023: monitoring of suspected measles cases in health centers.

- March 5, 2023: declaration of the end of the epidemic.

Study Population and Sampling

Our study population was drawn from border villages in both Burkina Faso and Togo. All suspected measles cases were notified to the TLOH or found in the community or registers during the investigation, and all children aged 0 to 14 years living in one of the villages in the health area of the 10 border CSPSs were included in the study. The sample for this study includes anyone who showed signs suggestive of measles during the study period. It is an exhaustive sample.

Data collection

Data collection source and tool

We used patients and their parents or guardians, consultation registers, Expanded Program on Immunization (EPI) registers and copies of investigation forms as sources of information to collect data. The collection tools used included an questionnaire and a documentary analysis framework. the questionnaire was used to collect information for the household survey on vaccination coverage.

Data collection technique

Interviews, document reviews and observation were the main techniques used. Discussions were held with the people in charge of surveillance at Cinkassé-Togo.

Investigation team

The Cinkansé-Burkina investigation team comprised a doctor, an epidemiologist, a nurse, a

community volunteer, a biologist, a hygienist, and a driver.

Study variables

The main study variables are grouped as follows: socio-demographic characteristics: age, gender, residence, nationality; clinical characteristics: clinical signs, case definition, vaccination coverage; Population knowledge of measles; biological characteristics: presence or absence of measles IgM in the blood; Public health initiatives undertaken, and Monitoring the evolution of cases.

Operating definitions

We used the case definition contained in the SIMR third edition guide of the Burkina Faso Ministry of Health [9]. According to this guide:

A suspected case of measles was:

Any person presenting with fever, generalized maculopapular rash with one of the following signs: cough, cold or conjunctivitis (red eyes) or Anyone in whom the practitioner suspects measles/rubella. The person should have stayed or resided in the villages of Cinkansé-Burkina and/or Cinkassé-Togo between August 29 and November 1, 2022.

Confirmed cases of measles

Any suspected case that is: Laboratory-confirmed (positive measles IgM serology) or epidemiologically linked to confirmed cases or Coming from an epidemic zone. Residing or having stayed in the villages of Cinkansé-Burkina and/or Cinkassé-Togo between August 29, 2022 and November 1, 2022.

Undetermined case of measles:

Samples with optical densities between 0.1 and 0.2 are considered indeterminate.

Suspected measles epidemic

The occurrence of a cluster of 5 suspected measles cases in the same month in the CSPS Cinkansé area between August 29, 2022, and November 1, 2022.

Confirmed measles epidemic

The occurrence of a cluster of 3 laboratoryconfirmed measles IgM cases in the CSPS de Cinkansé area between August 29, 2022, and November 1, 2022

End of the epidemic

A measles epidemic is said to be coming to an end if there has been no new suspected case of measles for more than 3 consecutive weeks.

Data analysis

A univariate analysis of the data was carried out using Epi-info software. Means and proportions were calculated.

Ethical consideration

Ethical and deontological aspects were taken into account in our study. Prior to data collection, we obtained the approval of the Ethics Committee. Respondents were interviewed with their free and informed consent. Individual data were processed and analyzed in complete anonymity. Confidentiality was respected at all stages of the study.

Results

Case description

Case description by time

The index case began presenting symptoms on September 12, 2022, and consulted the Cinkansé health center the same day (corresponding to epidemiological week 37). He is a male child born on June 22, 2019. He has not received any doses of measles-rubella (RR) vaccine. He lives in Cinkassé_Togo.

The outbreak began in epidemiological week 41 (week of October 10 to 16, 2022), with the highest number of cases observed from week 47 (November 21 to 27, 2022) (Figure 1). A total of 44 suspected cases were identified.

Breakdown of cases by country of residence

77.27% (34/44) of cases were in Cinkansé-Burkina and 22.73% (10/44) in Cinkassé-Togo.

Distribution of cases by notifying health center

The 44 cases were notified in the health area of two health centers. 93.2% (41/44) of cases were notified in the health area of the Cinkansé CSPS and 6.8% (3/44) in the health area of the Cinkansé-Sangha CSPS.

Breakdown of cases by person

Among the suspected cases 68.2% (30/44) were under five years of age (Table 1). the median age of cases is 1, with an interquartile range of 2-5. The sex ratio was 1, and no measles-related deaths were reported - 0% case fatality rate. Not all suspected cases benefited from RR2. A survey of vaccination coverage carried out in 20 households in the Burkinabe part of the country revealed RR2 coverage of 61.90% (13/21). During the literature review, we found that the annual administrative vaccination coverage for the second dose of the measles-rubella vaccine at the Cinkansé-Burkina CSPS was above 100% in 2020, 2021 and 2022.

Distribution of cases by clinical signs

All (100%) of the cases showed the main signs of measles: fever, rash and cough. In addition to these signs, 28% had a cold and 46% conjunctivitis.

Distribution by case type

Biological confirmation: A total of 34 blood samples were sent to the national reference laboratory. Of these, only 11 could be analyzed for lack of reagents, with nine (81.8%) testing positive for measles IgM and two (18.2%) undetermined cases.

According to our case definition, this was the midst of a measles epidemic in the Cinkansé CSPS health area. Measles epidemic was confirmed on November 16, 2022 with: 20,45% (9/44) biologically confirmed cases, 4,54% (2/44) undetermined, 22,72% (10/44) epidemiologically confirmed cases and 52,27% (23/44) clinically compatible cases.

Cross-border cooperation in investigations

The following actions were carried out jointly with the Togo team:

Before the response

Information sharing

In view of the geographical distribution of cases, according to preliminary information received from the head nurse of the CSPS in Cinkansé, we proceeded to share epidemiological information with those in charge of surveillance on the Togo side. To facilitate exchanges, a WhatsApp group was set up, bringing together players from both sides of the border. The investigation period was decided jointly.

Carrying out the investigation

A joint investigation team had initially been proposed, but given the security situation in the area, the idea was abandoned. Each team had to investigate on its own followed by an exchange meeting at the border.

The exchange meeting between the two teams

The joint exchange meeting took place on October 31, 2022, from 4pm to 5pm in the meeting room of the Juxtaposed Control Post (PCJ). It provided an opportunity to review the background to the investigation, and the results of the investigation, particularly in terms of where the cases came from. It was also decided to hold a joint reactive vaccination campaign.

Management of the response

The main response to the epidemic was a joint reactive vaccination campaign from December 5 to 11, 2022.

In Cinkansé_Burkina, reactive vaccination took place in the two health centers that reported cases (Cinkansé and Cinkansé-Sangha), as well as in nine others contiguous CSPSs (Figure 2). The target population for the vaccination campaign was people aged between 6 months and 14 years, corresponding to 93.2% (41/44) of cases according to our analysis. This target comprised 47,592 people, comprising: 1001 children aged 6 to 8 months, 974 children aged 9 to 11 months, 15,344 Children aged 12 to 59 months, 30,273 children aged 5 to 14 years.

The main activities implemented during the campaign are: a preparatory meeting with vaccination managers from the eleven health centers, an advocacy meeting with the leaders of all the villages to solicit their support for social mobilization, mobilization of logistics (vaccines and other inputs),conduct vaccination campaigns in all health centers and strategic locations (entry points, markets, places of worship, schools, etc.), supervision of vaccination teams, a review meeting at the end of the campaign.

By the end of the campaign, 47,592 children aged 6 months to 14 years had been vaccinated, representing a coverage rate of 115.20%.

In Togo, the reactive vaccination campaign coincided with a national measles and rubella vaccination campaign targeting children aged 9 to 59 months. Coverage was 105%. Cross-border vaccination teams were stationed at the various crossing points.

After the response

The evolution of the number of cases was monitored jointly by the two teams through an epidemiological curve of cases, updated regularly and shared with all players in the WhatsApp group. Exchanges of health information continued after the investigation: when Burkina health workers received a suspected case of measles originating in Togo, the full identity of the patient and his or her parents, as well as their precise place of residence, were shared with Togo surveillance players, and vice versa. The number of measles cases gradually declined, ending on February 14, 2023. It should be noted that during the course of surveillance, a slight resurgence of cases was observed between epidemiological weeks S1 and S6 of 2023. In-depth case analysis revealed that all cases came from Togo, with a median age not taken into account in the target for reactive vaccination on the Togolese side.

In Burkina Faso, the number of cases continued to fall steadily and on March 5, 2023, we declared the end of the epidemic.

Discussion

Description of cases

The index case is said to be a national of Cinkassé Togo. No evidence of travel was found. It is important to note that clusters of measles epidemics exist in Togo, especially in the Mango area, some 75km from the index case's place of residence. As the index case's parents frequented the large market in Cinkassé_Togo, we believe that our index case was contaminated by a trader who probably came from Mango. We did not find any favourable factors in the index case, apart from an out-of-date vaccination status. In view of the high concentration of settlements and friction between populations in Cinkansé, this case could have been at the origin of the outbreak.

The 44 cases were notified in the health area of two health centers. 93.2% of cases were notified in the health area of the Cinkansé CSPS and 6.8% in the health area of the Cinkansé-Sangha CSPS. These two health centers are neighbors, 7km apart. They are all located on the border with Togo. Apart from these two health centers, the documentary review and active case-finding in the community did not find any cases in the other border health centers. Nevertheless, they were included in the reactive vaccination campaign.

100% of cases showed the main signs of measles: fever, rash and cough.

In addition to these signs, 28% had a cold and 46% conjunctivitis. This could be explained by the difference in the onset of clinical signs.

Promiscuity, non-compliance with the vaccination schedule, the persistence of certain traditional habits such as hand-waving and poor hand hygiene and lack of f respect for barrier measures are the main risk factors that could explain this outbreak.

As for low vaccination coverage, this is attributable to the security situation. The Ouargaye district has been a security-challenged district since 2018. This situation has led to the closure of several health centers, with a considerable impact on vaccination programs. According to several studies, conflict has a strong negative impact on vaccination programs [10-12]. The decline in measles vaccination coverage has affected several countries since the covid 19 pandemic [13].

In our study, children under five years of age predominated (68.2%). The average age of suspected cases was 2.2 years. Ibrahima Seck (2009) et al in Senegal noted the same trend, with a predominance of under-5s estimated at 67.4% [14]. The extreme ages are also comparable between the two studies: 3 months to 34 years for our case; 4 months to 35 years for the study by Ibrahima Seck et al [8]. This similarity could be explained by the similarity of the vaccination schedules in Burkina Faso and Senegal. No measles-related deaths were reported in our case. Ibrahima Seck in Senegal reached the same result [8]. However, Ouattara S. in Mali reported 3 deaths out of 213 collected [1]. The larger scope of Ouattara's study and the higher number of cases could explain this discrepancy. In our case, only 11 samples out of 34 could be analyzed, including 9 positives for measles IgM and two undetermined cases. This situation is linked, on the one hand, to the shortage of reagents at national reference laboratories and, on the other, to the security situation, which did not facilitate the transport of samples. The presence of undetermined cases could be explained by samples taken very early before the appearance of antibodies, or by inadequate settings on the automated system. The administrative RR2 vaccination coverage of the CSPS Cinkansé-Burkina is above 100% in 2020, 2021 and 2022. We believe that these RR2 administrative vaccination coverage figures do not reflect reality. In fact, given the influx of internally displaced people into the area, and given Cinkansé's border location with its large market, attendance at the CSPS by people from outside the area would have helped to increase coverage.

Cross-border collaboration

The measles epidemic in Cinkansé strengthened cross-border collaboration between Burkinabe and Togolese health teams.

The synergy of action between the different teams enabled the investigation to be carried out

effectively and ensured an efficient response. However, the creation of a joint rapid intervention team (EIR) with a single intervention protocol would have produced better results.

The safety challenge

The security challenge facing the Ouargaye health district did not facilitate the investigation and implementation of response activities. The investigation had to be postponed by one day for security reasons. Also, some border CSPSs with high security challenges were supervised thanks to new information and communication technologies. Notwithstanding these difficulties, local initiatives were developed. This made it possible to carry out the investigation and lead the response. These strategies include:

- Involvement of security forces during travel,
- Use of safer routes,
- Supporting traditional and religious leaders in responding to the epidemic,
- Involvement of community-based health workers,
- Directing some mothers of children to the safest localities for vaccination.

Conclusion

We confirmed a measles outbreak in Cinkansé, Burkina Faso. The resurgence of clusters of measles epidemics is attributed to non-compliance with the vaccination schedule due to the security challenge in the affected region which also happens to be a border zone. Good cross-border collaboration albeit a few shortcomings enabled us to successfully investigate and respond to the measles epidemic in Cinkansé which was declared over on March 5, 2023. Strengthening this cross-border collaboration on all these aspects will enable us to detect and respond to other potential epidemics in good time.

What is known about this topic

- Measles is a contagious viral disease
- Biological confirmation is essential to confirm the epidemic

• Response strategies to a measles epidemic include case management and reactive vaccination

What this study adds

- Timely joint investigation and response actions by both countries successfully ended a localized measles epidemic in border area experiencing a security crisis
- The management of measles epidemics in a security-challenged context requires the development of innovative initiatives to reach the target population

Competing interests

The authors declare no competing interests.

Authors' contributions

MN and AL developed the investigation protocol, collected, analyzed and interpreted the data and drafted the manuscript. DY, BK, MSB, IG, AS, SK, YK contributed to the interpretation of the data and revision of the manuscript. All authors read and approved the latest version of the manuscript.

Acknowledgments

We would like to thank the following structures: The FETP coordination in Burkina Faso and its partners, including AFENET and CDC Atlanta, who provided us with training in basic field epidemiology, which facilitated field investigation. CORUS, through the incident manager of the security challenge zones, for their sound advice. The Direction of Prevention and Vaccinations (DPV) of Burkina Faso for logistical and input support for the reactive vaccination campaign. UNICEF for financial support in implementing the reactive vaccination campaign.

Tables and figures

Table 1: Distribution of suspected measles casesnotified between S37 and S43 2022 in the CSPS deCinkansé_Burkina health area, by age group

Figure 1: Epidemiological curve of suspected measles cases notified to the Cinkansé CSPS in 2022 and 2023

Figure 2: Map of CSPSs on the Burkina Faso border that have implemented the reactive measles vaccination campaign

References

- Ouattara S. [Evolutionary trends of measles in Commune VI of the District of Bamako from 2014 to 2018]. Mali Sante Publique [Internet]. 2021 Apr 20 [cited 2024 Sep 16];10(2):23-8. French. https://doi.org/10.53318/msp.v1 0i02.1792 Download ojsadmin-revuemsp-2020-02-23-28.pdf. Google Scholar
- Moss WJ. <u>Measles</u>. The Lancet [Internet]. 2017 Jun 30 [cited 2024 Sep 16];390(10111):2490-50
 <u>https://doi.org/10.1016/S0140-</u> <u>6736(17)31463-0</u> Purchase or subscription required to view full text.
- Plemper RK. <u>Measles resurgence and drug</u> <u>development</u>. Current Opinion in Virology [Internet]. 2020 Apr 1 [cited 2024 Sep 16];41:8-17. <u>https://doi.org/10.1016/j.coviro.202</u> <u>0.02.007 PubMed</u> | <u>Google Scholar</u>
- WHO. <u>Measles</u> [Internet]. Geneva (Switzerland): WHO; 2024 Jul 12 [cited 2024 Sep 13]. Spanish, Russian, Arabic.
- Floret D. [The (unsurprising) return of measles]. La Presse Médicale Formation [Internet]. 2021 Mar 5 [Version of record 2021 Jun 8; cited 2024 Sep 16];2(2):135-42. French<u>https://doi.org/10.1016/j.lpmfor.</u> 2021.02.002 Purchase or subscription required to view full text. <u>Google Scholar</u>

- Office fédéral de la santé publique OFSP [Federal Office of Public Health FOPH] (SW). [Measles]. [Internet]. Bern (Switzerland): Office fédéral de la santé publique OFSP; [last modified 2024 Jul 23;cited 2024 Sep 13]. French, German, Italian, English.
- Antona D, Baudon C, Freymuth F, Lamy M, Maine C, Parent Du Chatelet I, Lévy-Bruhl D.[Measles in France]. Med Sci (Paris) [Internet]. 2012 Nov 12[cited 2024 Sep 16];28(11):1003-7. French. <u>https://doi.org/10.1051/medsci/</u> 20122811023 Google Scholar
- Amaguiré Sy EHI, Barry D, Traoré B, Boly A, Koné B, Dembélé A, Coulibaly OY, Tounkara A, Keita NM, Diourté G, Dara S, Sanogo I, Magazani A, Sawadogo B, Otshudiandjeka OJB, Diallo F, Laurent M, Keita H, Yanogo PK, Meda N. [Epidemiological profile of measles in Mali from 2009 to 2018] . JIEPH [Internet]. 2021 Sep 24 [cited 2023 Jan 17];4 (Suppl 3): 8. French <u>https://doi.org/10.37432/jieph.su</u> pp.2021.4.3.03.8 Google Scholar
- Ministère de la Santé (BF). [Technical Guide for Integrated Disease Surveillance and Response in Burkina Faso] [Internet]. Ouagadougou, Kadiogo (BF): Ministère de la Santé (BF); 2012 Jul [cited 2024 Sep 16]; 158 p. French. Download guide_simr_2012_section_9.pdf.
- 10. Tiembré I, Benié J, Coulibaly A, Dagnan S, Ekra D, Coulibaly S, Tagliante-Saracino J. [Impact of armed conflict on the health system of a health district in Ivory Coast]. Med Trop [Internet]. 2011 May 16 [cited 2024 Sep 13];71(3):249-52. French. Download 249-252 Impact du conflit armé sur le système de santé d'un district sanitaire en Côte d'Ivoire (Tiembré).pdf. PubMed | Google Scholar

- 11. Ngo NV, Pemunta NV, Muluh NE, Adedze M, Basil N, Agwale S. <u>Armed conflict, a neglected determinant of childhood vaccination: some children are left behind</u>. Human Vaccines & Immunotherapeutics [Internet]. 2019 Dec 6 [cited 2024 Sep 16];16(6):1454-63. <u>https://doi.org/10.1080/21645515.20 19.1688043 PubMed</u> | <u>Google Scholar</u>
- 12. Mangoua HG, Amani RY, Wilnique P, Otshudijenka JB, Tiembre I, Benie VJ. [313 - Evaluation of the measles epidemiological surveillance system, Indénié-Djuablin Health Region, Ivory Coast, January-September 2021]. Revue d'Épidémiologie et de Santé Publique [Internet]. 2022 Aug 1 [cited 2024 Sep 16];70(Suppl 3):S170. <u>https://doi.org/10.1016/j.respe.</u> 2022.06.114 French. Purchase or subscription required to view full text. <u>Google Scholar</u>
- Manus JM. [Return of measles, 40 million vulnerable children] . Revue Francophone des Laboratoires [Internet]. 2023 Jan 31 [cited 2024 Sep 16];2023(549):12. https://doi.org/10.1016 /S1773-035X(23)00011-4 French. Google Scholar
- 14. Seck I, Faye A, Mbacké Leye MM, Bathily A, Camara MD, Ndiaye P, Dia AT. [Measles epidemic and response in the region of Dakar (Senegal) in 2009]. Sante Publique [Internet]. 2012 Jun 12 [cited 2024 Sep 16];24(2):121-32. French. https://doi.org/10.3917/spub.12 2.0121

Table 1: Distribution of	suspected measles cases	s notified between	S37 and S43	2022 in the	Cinkansé
CSPS health area, by age	e group				

Age range (years)	Suspected measles cases	Proportion (%)
0-4	30	68,20
5-14	11	25,00
≥15	3	6,80
Total	44	100



Figure 1: Epidemiological curve of suspected measles cases notified to the Cinkansé CSPS in 2022 and 2023



Border health centers in Ouargaye district affected by measles epidemic and reactive vaccination campaign

Figure 2: Map of CSPSs on the Burkina Faso border that have implemented the reactive measles vaccination campaign