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In-depth investigation of suspected cases of diphtheria in Bassikounou district, Hodh Chargui region, Mauritania - August 2024

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Abstract

Introduction

Diphtheria is a serious infectious disease caused by the bacterium Corynebacterium diphtheriae. Despite vaccination efforts, diphtheria epidemics continue to occur, particularly in the Hodh El Chargui region. This study aims to investigate suspected cases of diphtheria in the district of Bassikounou.

Methods

We conducted a descriptive cross-sectional study. An investigation was carried out following the notification of suspected cases of diphtheria in the district of Bassikounou, reporting two suspected cases of diphtheria on 31 July 2024. Data were collected through interviews with patients, families and health professionals, as well as through the review of medical records and vaccination registries. Biological samples were collected for laboratory confirmation.

Results

The investigation revealed a total of 32 suspected cases of diphtheria, including six clinically compatible cases of diphtheria, for the outcome, two died of asphyxia, one recovered, three still ill. Most cases were unvaccinated children aged 2 to 20 years. During our investigation, some factors identified include low vaccination coverage, limited access to health services and precarious living conditions. Control measures put in place included mass vaccination, community outreach, and contact tracing.

Conclusion

Active search for suspected cases of diphtheria and unvaccinated children in the district of Bassikounou has led to the detection of a cluster of cases among Malian refugees. Despite the lack of biological confirmation, the results of the investigation underscore the importance of continuous surveillance and vaccination to prevent future outbreaks.

Keywords: Diphtheria, Epidemiological investigation, Suspected cases, Bassikounou District, Mauritania.

Introduction

Diphtheria is a bacterial disease whose clinical symptoms are related to the production of an extracellular protein (exotoxin) by Corynebacterium diphtheriae, a curved bacillus[1]. People of any age can be affected, except for newborns who are protected by maternal antibodies up to 6-12 months[2]. In countries where vaccination coverage remains low, diphtheria mainly affects children. On a global scale, however, the age distribution is changing, with a majority of cases currently occurring in adolescents and adults, as a result of increased vaccination coverage among children[3]. Historically, diphtheria has been one of the most feared childhood diseases, characterized by devastating outbreaks. Although most infections are asymptomatic or show a relatively mild clinical course, many patients succumbed to toxic myocarditis or airway obstruction caused by laryngeal involvement[4].

According to WHO, diphtheria is not a common disease in the African Region. Of the 97 438 cases reported worldwide between 2013 and 2022, 29 163 (29.9%) were in the African Region. Sporadic cases often escape surveillance systems due to a lack of early detection measures and/or a lack of diagnostic capacity in specialized laboratories in some countries[5].

The high regional coverage of DTP3 vaccination is largely responsible for the previously low incidence of the disease in the Region. According to WHO/UNICEF estimates of national immunization coverage for the period 2013–2022, coverage with the first dose of diphtheria-tetanus-pertussis vaccine (DTP1) and DTP3 averaged 80.5% and 73%, respectively. From 2019 to 2022, an estimated 29 million children in Africa did not receive their first dose of DTP. From 1 January to 20 December 2022, a total of 910 cases of diphtheria were reported to the WHO Regional Office for Africa through the International Health Regulations (IHR) system or directly to AFRO's vaccine-preventable disease program. These cases were notified in descending order by Niger (736), Madagascar (92), Burkina Faso (34), Democratic Republic of the Congo (44) and Algeria (4). DTP3 coverage is low in most African countries. Since the beginning of July 2023 (epidemiological week 26), at least five countries in the African Region (Guinea, Mauritania, Niger, Nigeria and South Africa) have recorded an unusual increase in the number of diphtheria cases and are facing active outbreaks[5].

In Mauritania, suspected cases of diphtheria have been reported since October 2023 in the region of the Hodh-Ech Charghi and precisely in the district of Bassiknou. As of 19 October 2023, there are 16 clinically compatible cases of which 4 fatality rates of 25%. All cases were reported in the locality of Fassala, district from Bassiknou, Hodh EchChargui [6]. Following an alert on 05/08/2024 by the Minis-

try of Health (MOH), following the notification by the district from Bassiknou, two suspected cases of diphtheria, including one death at the Mberra, a joint mission (MS and CNOUSP) was dispatched to conduct an in-depth investigation at Bassiknou and Mberra from 17 August to 26 August 2024. The district is on the border with Mali and are home to refugee camps. Diphtheria is a public health emergency requiring close coordination, adequate resources, and the implementation of prevention and management measures. The objective of this study is to investigate suspected cases of diphtheria in the district of Bassikounou and to strengthen local capacities to contain the epidemic and protect vulnerable populations.

Materials and Methods

Scope of the study

Mauritania is a country in West Africa with an area of 1,036,000 km2. It borders Algeria to the northeast, Western Sahara to the northwest, Mali to the east and southeast, Senegal to the southwest and the Atlantic Ocean to the west. The national territory is divided into 15 regions, each of which is subdivided into districts (Department, 63 in total). The districts are subdivided into communes (216 communes in total). Our study takes place in the district of Bassikounou (a commune in southeastern Mauritania, located in the region of Hodh El Chargui, on the border with Mali) (Figure 1) which has an area of about 183,000 km2, the population is 430,668 (2013), this desert region has a particularly harsh climate. A significant proportion of the region's population is still nomadic or semi-nomadic. Seasonal transhumance takes place from north to south in search of pasture to the interior of neighboring Malian regions in search of pasture. The populations of the two countries also meet at the many weekly markets that are held in the border areas. Insecurity in Mali has led to an influx of more than 55,480 refugees from that country who have been partly hosted in the Mberra camp.

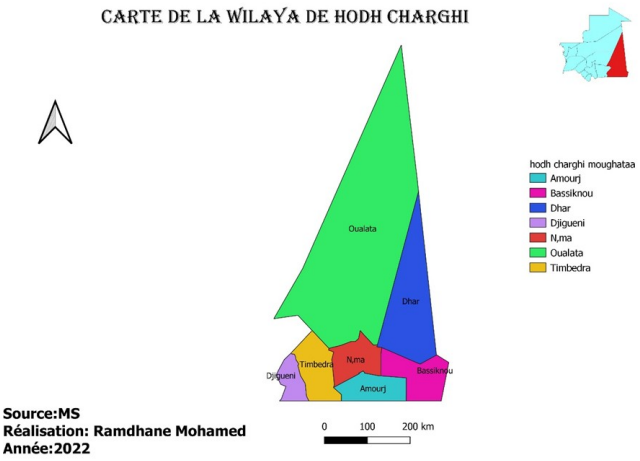

Figure 1: Health map of the Hodh Charghi region

Type and period of study

A descriptive cross-sectional study was conducted in the district of Bassikounou from August 17 to August 26, 2024.

Study population and sampling

The investigation focused on the entire population of Bassikounou. Data were collected through an exhaustive sampling of suspected cases, considering all diphtheria cases detected from 17 to 26 August 2024. Cases were searched in health facilities from consultation records and in the community through interviews, based on the clinical signs defined in the case definition.

Definition and final classification of diphtheria cases[5]

Cas suspect

Anyone with pharyngitis, nasopharyngitis, tonsillitis or laryngitis AND adherent pseudomembrane of the throat or nose. The person must have stayed or resided in the district of Bassikounou between July 31 and August 26, 2024.

Laboratory-confirmed case

A laboratory-confirmed case is a person with C. diphtheriae isolated by culture who has tested positive for toxin production, regardless of symptoms. Toxigenicity should be confirmed by the Elek phenotypic assay in all cases. Gene amplification (PCR) may complement surveillance and may be considered laboratory confirmation after examination of the epidemiology and clinical manifestations of the case. Laboratory-confirmed cases can be classified into three subcategories depending on the type of surveillance existing in the country.

- Laboratory-confirmed classic cases of respiratory diphtheria meet the definition of suspected cases and are laboratory-confirmed as indicated above.
- Laboratory-confirmed cases of mild/ asymptomatic respiratory diphtheria have some respiratory symptoms such as pharyngitis and tonsillitis, but no pseudomembrane, or no symptoms (usually identified by contact tracing).
- Laboratory-confirmed non-respiratory diphtheria cases have a skin lesion or non-respiratory mucosal infection (e.g., eyes, ears, or genitals) from which *C. Diphtheriae* is isolated by culture and tested positive for toxin production.

Epidemiologically linked case (confirmed)

One epidemiologically linked case meets the definition of a suspected case and is epidemiologically associated with a laboratory-confirmed case. In this situation, a person has had intimate respiratory or physical contact with a laboratory-confirmed case in the 14 days prior to the onset of a sore throat.

Clinically compatible case (confirmed)

This case type meets the definition of a suspected case and does not have a confirmatory laboratory test result or epidemiological link to a laboratory-confirmed case. Clinically confirmed cases of diphtheria may present with symptoms such as pharyngitis, nasopharyngitis, tonsillitis, laryngitis, greyish pseudomembrane, bull's neck appearance or non-healing ulcers in a person who has travelled to an endemic or diphtheria-affected country (ongoing outbreak).

Case ruled out (not a case of diphtheria, final diagnosis to be specified)

A ruled-out case is a suspected case that meets one of the following criteria:

- C. diphtheriae, but Elek test negative (C. Non-toxigenic diphtheriae) OR
- A negative PCR test for the diphtheria toxin (tox) gene.

Classification of asymptomatic or mild cases

Occasionally, during outbreak investigations involving household contacts, a person may be identified as a carrier of Corynebacterium and show evidence of toxigenicity but may not meet the definition of a suspected case because they are asymptomatic or have mild disease. However, these individuals should be reported as laboratory-confirmed cases, as their treatment and public health response are the same as for other laboratory-confirmed cases.

Study Variables

The main variables of the study are grouped as follows: sociodemographic characteristics: age, sex, residence, clinical characteristics: clinical signs, case definition, vaccination coverage, public health initiatives undertaken and monitoring of the evolution of cases.

Data collection

At the level of the district concerned, the investigation begins with a working and awareness-raising meeting with the Authorities (Wali, Hakeem, Mayor, DRS and MCM) to take stock of the epidemiological situation, before selecting the priority areas for supervision. At the level of each area, the investigation begins with the active search for cases through interviews, interviews with the medical team, verification of consultation records and interviews with inpatients, in addition to the verification and correction, if necessary, of the management protocol. The structures concerned are equipped, if necessary, with tools for sampling and reporting cases and appropriate medicines.

Data analysis

Data analysis was performed using Epi Info software version 7.2.5.0. Frequencies, proportions and rates were calculated for descriptive analysis.

Ethical considerations

Our study was carried out with the authorization of the health authorities of Mauritania for data acquisition and analysis. The names and surnames of the cases have been anonymized to guarantee confidentiality.

Results

Index Case Description

She is M.H.L., of Malian nationality, female, born on 23/12/2022 in ESSAKANE, north of Timbuktu (Mali) and never vaccinated, and having resided under the family roof in Mberra village 2 (outside the camp). The reason for non-vaccination is the lack of access to health services in an area of insecurity. His father is the paternal uncle of two suspected cases. The two families, like the rest of the clan, arrived in Mauritania in December 2023 and were seeing each other regularly.

Description of the two suspected cases

They are two children from a family of Malian refugee newcomers who have never been vaccinated. The reason for the non-vaccination is the lack of access to health services in an insecure area following the presence of armed groups. Arriving in Mauritania in December 2023, this family currently resides in Mberra camp. After investigations, these suspected cases were linked to an index case in the same extended family at Mberra village 2 (outside camp). Here is the chronology of events:

Cas suspect N°1

She is K. M.E.B., of Malian nationality, female, 5 years old. She is the older sister of the 2nd suspected case in a household of 7 people (2 adults and 5 children). According to her mother, she was vaccinated against measles on arrival during an advanced activity at the camp (No documented trace of this passage). 23/06/2024: She visited, with her family and the rest of the clan, her first cousin (index case) (the child of her paternal uncle) who had been ill (fever, sore throat) since 10/06/2024 with a notion of close contact with the latter.

26/06/2024: corresponds to the date of onset of symptoms (fever and sore throat) at the family home with a notion of self-medication at home (infusions).

30/06/2024: the worsening of the complaints with cough and breathing difficulty, motivated the parents to consult at the Mberra health center at 8:00 p.m. She was taken care of by the on-call team. The latter, having suspected diphtheria, placed her in isolation on oxygen with injectable treatment (Ampicillin and Perfalgan®).

01/07/2024: the clinical course was marked by respiratory distress followed by irreversible cardiorespiratory arrest at 09:00 am. After the death was confirmed, the remains were handed over to the family without any notion of a safe burial.

Cas suspect N°2

They are S.O.M., of Malian nationality, male, 19 months old, known contact of K.M.E.B (his brother) and residing under the family roof in the Mberra camp.

From 26 to 30/06/2024: he was in close contact with his older sister during his illness. 02/07/2024 is the date of the onset of his symptoms (sore throat, fever) 04/07/2024: around 8:30 a.m., his parents brought him to the CS in Mberra in a picture of tonsillitis, high fevers and convulsions. Given the epidemiological link with his sister who had died three days earlier, the team again suspected and reported a case of diphtheria. He was isolated, stabilized and then evacuated by ambulance to the Bassikounou hospital. 04/07/2024: During his hospitalization around 3:00 p.m., the initial physical examination was marked by the alteration of the general condition (painful face, physical asthenia, febrile on contact), lucid, collaborative consciousness, free and flexible ganglion areas, hyperemic tonsils without pseudomembrane. Placed in isolation, the child was treated as having ENT portal sepsis (erythematopultaceous angina). Treatment is made up of injectable antibiotic (Augmentin), antipyretic and maintenance infusion. The initial inflammatory profile was disrupted with a positive CRP (>6mg/L.) and neutrophilic predominant leukocytosis (WBC 26,000/mm3, N at 89.3%). He was not given diphtheria antitoxin (DAT) and no swabs were taken due to a lack of appropriate equipment.

On 06/07/22024, appearance of the whitish pseudomembrane at the tonsillar level On 08/07/2024 the control assessment shows normal kidney function, a WBC at 17000 From 09 to 10/07/2024: the patient presented with fever again, sometimes polypnea On the morning of 11/07/2024, the clinical course was marked by the persistence of the pseudomembrane, fever, rhinorrhea and dyspnea. The control report showed a WBC rate of 30,000/mm3 with N at 80.9%). Given the status quo, the family decided to leave the hospital against medical advice, around 5:00 p.m. to return to Mberra.

The date of onset of symptoms would date back to 10/06/2024 by fever, cough, sore throat, with self-medication at home. Faced with the worsening of the clinical course, the parents had consulted on 19/06/2024 at the CS of Mberra. She was diagnosed with angina and then referred to Bassikounou. On his admission to the Bassikounou Hospital on 19/06/2024, the initial assessment had revealed a WBC level of 14000/mm3, a positive CRP and a normal blood sugar level. The treatment initiated consisted of injectable ceftriaxone and dexamethasone. After a 4-day hospitalization, she was discharged on 23/06/2024 with a slight clinical improvement. Several children from the extended family attended to him when he was released from the hospital. They subsequently developed the same symptoms, including the 2 suspected cases reported. She died at home on 29/06/2024 in a respiratory distress picture.

Description of Additional Cases

In total, we included 32 suspected cases of diphtheria, including 6 clinically compatible cases and 26 contact cases, 59% of the cases are female, i.e., the sex ratio (F / M) = 1.3. The mean age was 14 years ± 6 years.

Chain of transmission

Figure 2 shows a total of six (06) cases with a clinic compatible with tonsillitis (including the 2 suspected cases reported). All cases are linked to MHL (index case). For the outcome, 02 died of asphyxiation, one recovered, three still sick. All cases were presented with similar initial symptoms (fever, sore throat, cough) after direct or indirect exposure to M.H.L. Only the 2nd suspected case (S.O.M.) reported had pseudomembranes in the course of the disease.

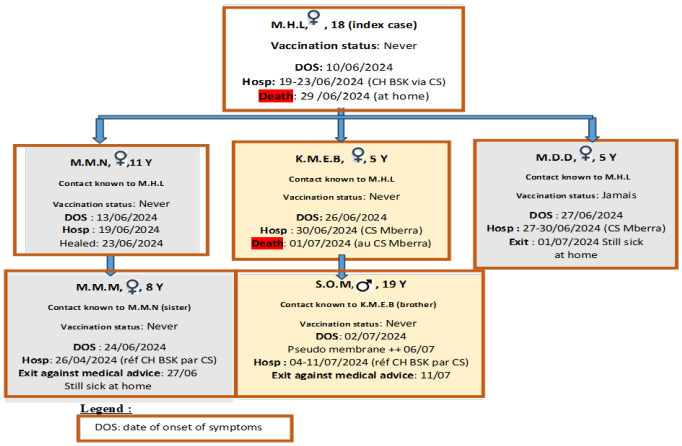

Figure 2: Transmission chain of diphtheria cases in Bassikounou district, August 2024

Discussion

The results of this investigation of diphtheria in the Hodh El Chargui reveal several critical points that are comparable to other similar studies. The index case, a Malian child who was unvaccinated due to inaccessibility to health services in an insecure area, illustrates a recurring problem in conflict regions. This situation is comparable to that observed in a study conducted in Syria[7], where armed conflicts have also led to a significant drop in vaccination coverage and a resurgence of diphtheria. The two suspected cases, also unvaccinated for similar reasons, underscore the importance of accessibility to health services for the prevention of infectious diseases. A study carried out in Haiti[8] showed that inaccessibility to health care due to political instability and natural disasters led to similar diphtheria outbreaks. The chain of transmission identified in this study, with secondary cases linked to the index case by close contacts, is consistent with the modes of transmission of diphtheria described in the literature. A study in India[9] has also documented similar chains of transmission, where close household contacts have led to the spread of the disease. The results show that 59% of the cases were female, with an average age of 14 years. This demographic distribution is comparable to that observed in a study in Bangladesh[10], where the majority of diphtheria cases were also in children and adolescents, with a slight female predominance. Serious complications, such as respiratory distress and death by asphyxia, observed in some patients, are well-documented clinical manifestations of diphtheria. A study in Yemen[11] reported similar results, with high rates of respiratory complications and mortality in untreated or late-treated patients. We recognize some limitations to our study. Indeed, there has been no biological confirmation of diphtheria cases due to the lack of biological examination. All cases were clinically diagnosed. This could underestimate or overestimate the number of cases. The dates of onset of cases that occurred prior to our investigation may not be precise, which prevented the creation of an epidemic curve.

Conclusion

We have confirmed an outbreak of diphtheria in Bassikounou, Mauritania. In total we included 32 suspected cases of diphtheria, including 6 clinically compatible cases and 26 contact cases, for the outcome, two died of asphyxia, one recovered, three still sick. The resurgence of diphtheria outbreaks is attributed to the failure to adhere to the vaccination schedule, due to security challenges in the affected

region, which is also a border area. This investigation highlights the crucial importance of vaccination and access to health care to prevent diphtheria epidemics, especially in conflict regions. The results also highlight the need to strengthen surveillance and rapid response systems to detect and control outbreaks effectively.

Main activities:

Organization and Coordination

- Meeting with local administrative and health authorities
- Establishment of a local epidemic management committee
- Development of regular Sitreps and dissemination.

Epidemiological and Laboratory Surveillance

- Briefing and technical support to health workers on case detection and reporting (adaptation of case definitions, development of linear lists of suspected cases).
- Collect and send samples for confirmation to the INRSP.
- Strengthening of integrated surveillance tools (notification forms, EWARS platforms).
- Support epidemiological investigations to identify contacts, additional cases and other risk areas.
- Retrospectively collect angina cases in health facilities and in the community and trace the epidemic curve.

Case Management

- Distribution and management of diphtheria antitoxins (DATs) at the PEC site level.
- Briefing healthcare providers on standard case management protocols (administration of DAT/ Antibiotics).
- Strengthening of logistical capacities to ensure the distribution of the necessary medical inputs at the level of the health structures concerned (sampling kits, triple packaging, DAT, etc.).

Vaccination

- Identification of priority target groups (contacts of cases, at-risk populations).
- Planning and coordination of response immunization activities.
- Availability of vaccines and vaccination inputs.

Risk Communication and Community Engagement (CREC)

- Organization of awareness-raising sessions in the affected communities on the signs and prevention of diphtheria.
- Involvement of community and religious leaders to strengthen the support of the population.

What we know about this subject

- Diphtheria is a contagious infectious disease
- Biological confirmation is essential to confirm the epidemic
- Strategies for responding to a diphtheria outbreak include case management and reactive vaccination

What this study adds

- This investigation allowed the population to know the importance of vaccination.
- Unvaccinated children were vaccinated to prevent the spread of the disease.
- Managing diphtheria epidemics in a difficult security context requires the development of innovative initiatives to reach the target population.

Competing interests

The authors do not declare any conflict of interest.

Authors' contributions

MHM and AMM developed the investigation protocol, collected, analyzed and interpreted the data and wrote the manuscript. RBM, MES, NT, MMA contributed to the interpretation of the data and the revision of the manuscript. All authors have read and approved the latest version of the manuscript.

Thanks

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