



Trends and Geographical Distribution of Diphtheria in Nigeria: A Re-emerging Disease [†]

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† Presented at the 2nd International Electronic Conference on Microbiology, 1–15 December 2023; Available online: <https://ecm2023.sciforum.net>.

Abstract: Diphtheria is a highly contagious, deadly vaccine – preventable bacterial infection that affects a person's nose, throat, and occasionally the skin. Diphtheria is fatal in 5-10% of cases; however, the Case fatality Rate (CFR) can be as high as 20 - 40% among children and unvaccinated adults. Currently, the number of diphtheria cases reported globally has been increasing gradually. Nigeria ranks number 6 in the list of countries by population with about 42.54% of its population below 14 years of age. Despite the availability of the antitoxin vaccine in the country, only 41.7% of children under 15 years of age are fully vaccinated, making the country more vulnerable to the disease. The study, therefore, aimed to examine the spread and trend of diphtheria in Nigeria since the major outbreak of the disease in December 2022. Data for the study were sourced from secondary sources. From December 2022 to January 2023, Nigeria recorded a total of 111 (42.1%) confirmed cases and 22 deaths, with a case fatality rate for confirmed/probable cases of 19.8% in four States. Out of the 111 confirmed cases, only a small percentage (10.8%) were vaccinated with the diphtheria toxin-containing vaccine. Additionally, the majority (91.9%) of the confirmed cases occurred in children aged 2-14 years. Since then, there has been a constant number of reported cases. As of July 31st, 2023, the country recorded a total 1,534 confirmed cases in 11 states and 137 deaths, with a CFR of 8.9%. The majority (66.4%) of the confirmed cases occurred among children aged 1-14 years, with only 18.1% of the 1,534 confirmed cases previously vaccinated. In this era of globalization, if prompt action is not taken, diphtheria will become a major threat not only to Nigeria but also globally.

Keywords: Diphtheria; Nigeria; Confirmed cases; Vaccinated

Citation: Salim; S. M.; Hamza; F. M. Trends and Geographical Distribution of Diphtheria in Nigeria: A Re-emerging Disease. 2024, 3, x. <https://doi.org/10.3390/xxxxx>

Academic Editor(s): Nico Jehmlich

Published: date



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1. Introduction

Re-emerging diseases are diseases that reappear due to a breakdown in public health measures for diseases that were once under control or when new strains of known disease-causing organisms appear (Johns Hopkins Medicine, 2023). Diphtheria is one such disease caused by toxin-producing strains of the aerobic gram-positive bacteria, *Corynebacterium diphtheriae* (Bruce, 2022). Diphtheria is a highly contagious, vaccine-preventable deadly disease that can affect nose and throat, damage the kidneys, nervous system, heart, and even cause paralysis, respiratory failure, ulcerating skin lesions, and death (CDC, 2019). Diphtheria is fatal in 5-10% of cases; however, the Case Fatality Rate (CFR) can be as high as 20% - 40% among children and unvaccinated adults (World Health Organization, 2023). Infected patients can transmit *diphtheria* through respiratory droplets, nasopharyngeal secretions, and rarely fomites (Chen *et al.*, 1985; Dass and Deepika, 2008). *C. diphtheriae* was first described in the 5th century BC by Hippocrates, and epidemics were described in the 6th century AD by Aetius (Anna *et al.*, 2022; Bruce, 2022). The largest epidemic was that of 1990-1995, which emerged in the Russian Federation, where more than 157,000 cases and 5,000 deaths were recorded (Anna *et al.*, 2022). Currently,

diphtheria is extremely rare in developed countries due to improved vaccination rates, however, many countries with limited healthcare and vaccination options still experience high rates of diphtheria (Mayo Clinic, 2023). Nigeria has recorded minimal diphtheria outbreaks in the past, with the most significant outbreak reported in 2011, where 98 cases were reported, with 21% of those cases resulting in subsequent mortality (World Health Organization, 2018). Currently, Nigeria ranks number 6 on the list of countries by population, with about 42.54% of its population below 14 years of age (The World Fact Book, 2018; Akor *et al.*, 2022). Despite the availability of antitoxing vaccine in the country, only 41.7% of children under 15 years of age were fully vaccinated (Adetifa, 2023), making the country more vulnerable to the disease. The study, therefore, aimed to examine the spread and trend of diphtheria disease in Nigeria from the onset of the major outbreak of the disease in December 2022.

2. Methods

The study is a product of desktop research. Data for the study was sourced from secondary sources, namely, the Nigeria Centre for Disease Control (NCDC) website and the WHO Global Health Library Database (<https://ncdc.gov.ng/diseases/sitreps/?cat=18&name=An%20Update%20of%20Diphtheria%20Outbreak%20in%20Nigeria>; <https://www.who.int/emergencies/diseases-oubreak-news/item/2023-DON452>). Confirmed cases are defined as laboratory – confirmed or presumptive cases that are epidemiologically linked to laboratory – confirmed cases (NCDC, 2023). The data generated was collated and analyzed in Microsoft Excel spreadsheet using descriptive statistics.

3. Results and Discussion

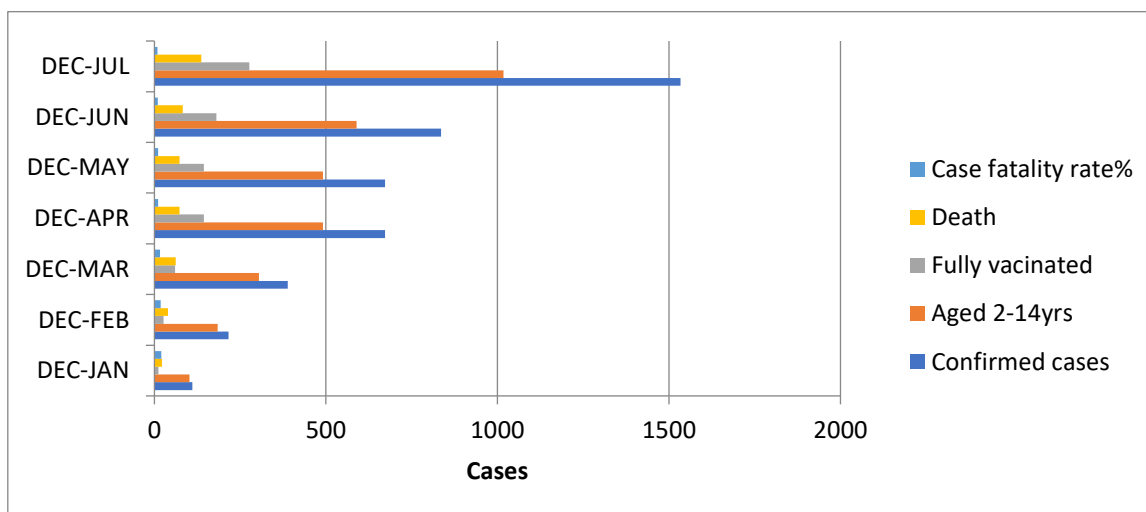


Figure 1. Monthly Trends of Diphtheria Cases in Nigeria from Dec-Jul, 2023.

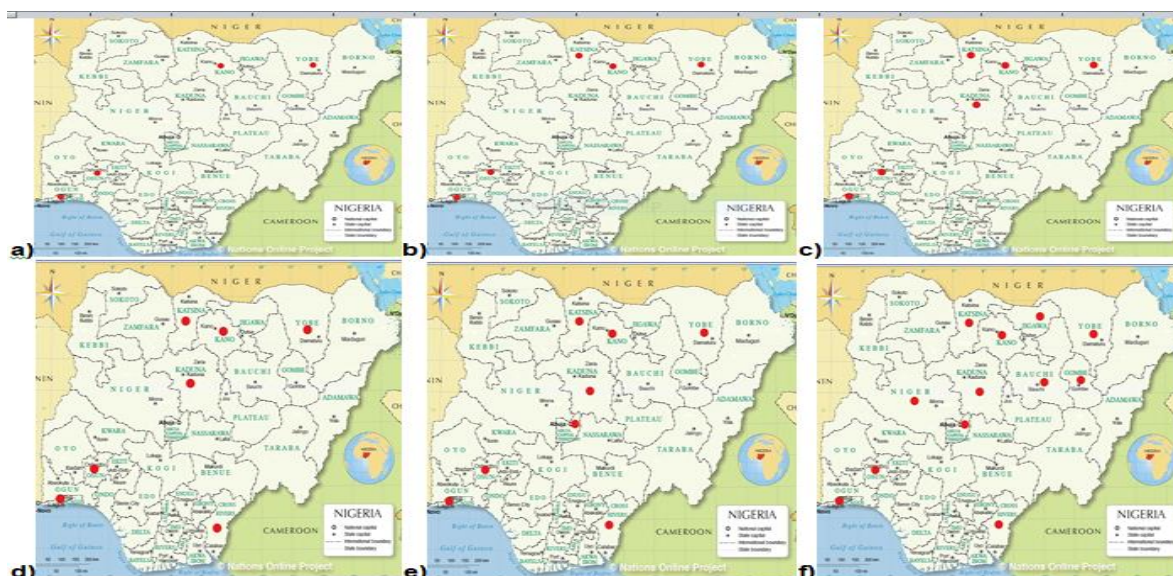


Figure 2. Distribution of Confirmed Diphtheria Cases by States from Dec-Jul, 2023 (a = DEC-JAN, b = FEB, c = MAR d = APR and MAY, e = JUN, f = JUL).

From December 1, 2022, to the third week of January 2023, a total of 111 confirmed cases of diphtheria and 22 deaths have been reported from four states in Nigeria, including Kano (107 cases), Yobe (2 cases), Lagos (1 case), and Osun (1 case). The Case Fatality Rate (CFR) for confirmed / probable cases was 19.8% with the majority (91.9%) of the confirmed cases occurring among children aged 2-14 years. Only a small portion (10.8%) of confirmed cases were fully vaccinated with the diphtheria toxin-containing vaccine. The number of cases gradually increased at an alarming rate up to the month of April of 2023. The number of cases increased from 111 cases across four states in January to 672 cases across seven states, with children aged 2-14 years being the most affected (491 cases). The increase may be due to low rates of immunization, low accessibility to healthcare facilities, low socioeconomic status, low educational levels, especially in rural areas, and delayed clinical recognition of diphtheria in the country. The NCDC reported that out of the 672 cases recorded in April, only 144 were fully vaccinated. These findings are in line with previous research conducted in Nigeria and Yemen (Morgalles *et al.*, 2021; WHO, 2023). Additionally, during this period, a total of 73 deaths with a CFR of 10.9% were recorded. Diphtheria is one of the diseases in which even with treatment, about 1 in 10 patients battling it die (National Center for Emerging and Zoonotic Infectious Diseases, 2023).

However, no new cases were recorded in May. Inadequate disease surveillance, due to a lack of resources, personnel, and cooperation between government agencies, may have caused a delay in obtaining the cumulative figures and impeded the effective detection of the disease. Though the NCDC has been working with stakeholders to increase awareness of the disease and improve the response to the outbreak, the cases slightly increased in June (836 cases) with more than half of the cases (589) being reported among children aged 2-14 years. As of July 31st, 2023, there was a rapid increase in the number of cases seen in the country, with 137 deaths. The number of confirmed diphtheria cases rose from 836 across eight states (Kano, Lagos, Yobe, Katsina, FCT Cross River, Kaduna, and Osun) to 1,534 cases across many states (Kano, Yobe, Katsina, Kaduna, Bauchi, FCT, Niger, Gombe, Jigawa, Cross River, Lagos, and Osun), with a CFR of 8.9%. Hence, the cases, geographical range, and death rate keep increasing, but with a decrease in CFR. The drop in CFR could be due to increased access to diphtheria antitoxin as well as antibiotics. The majority (1018) of the confirmed cases were found in children aged 2-14 years, and only 277 patients were fully vaccinated. This indicates that most of the patients affected with diphtheria in Nigeria were not fully vaccinated with the diphtheria toxin-containing vaccine. From the findings of the study, it can be seen that the figures recorded were much

higher than the previous figures reported during the last diphtheria outbreak, which occurred from February to November 2011 in the village of Kimba and its surrounding settlements in Borno State. In that outbreak, a total of 98 cases were found, and 64.3% of the affected cases were children under the age of 10, with an overall CFR of 21.4%. None of the patients received any prior vaccination against the disease (Besa *et al.*, 2014). The findings suggest that the present outbreak is the worst and can be labelled as one of the most severe outbreaks of diphtheria in Nigeria in recent years.

4. Conclusions

Since diphtheria is contagious and the outbreak has been clearly escalating, in this era of globalization, if prompt action is not taken, diphtheria will become a major threat not only to Nigeria but also globally. To address the situation, authorities should consider door-to-door vaccination of immunocompromised individuals, early identification of individuals with symptoms and, improved contact tracing.

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