

Spatial Spread of Diphtheria and Public Health Engagement in Nigeria: A Review

Olusola Olufemi, PhD ; and Oluwasayo Olatunde, MD CFP

¹Associate Professor of Urban and Regional Planning, Independent Consultant, Ontario, Canada; Associate, Society for Good Health, Ibadan, Oyo State, Nigeria. ²Department of Family Medicine, Dalhousie University, Halifax, Nova Scotia, Canada; Department of Family Medicine, University of British Columbia, Vancouver, British Columbia, Canada.

Corresponding author: solaoluf@yahoo.com

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Abstract

Diphtheria is a potentially fatal and highly contagious vaccine-preventable disease that spreads between people mainly by direct contact or through the air via respiratory droplets. The disease can affect all age groups, however, unimmunized children are particularly at risk. This article examines the spatial spread of diphtheria in Nigeria. The paper examines community awareness and public health actions taken by various actors and stakeholders to alleviate the diphtheria outbreak. The risks of spreading diphtheria and the vulnerability of children due to poor immunisation are frightening. Consistency in data collection and good quality (quantitative) data provides a basis for timely intervention and future response to the treatment of diphtheria. Curtailing crowding, reducing multidimensional poverty and social inequalities, and enhancing hygienic practices (WASH) are practical measures to reduce spread, infection, and death arising from the diphtheria outbreak in Nigeria and other countries.

Keywords: Diphtheria, Public Engagement, Spatial Spread, Vaccination Education.

Introduction

Diphtheria is a life-threatening disease that requires early detection, rapid treatment, and intensive care interventions in very severe cases, and it is a potentially fatal infection caused mainly by toxigenic strains of *Corynebacterium diphtheriae* and occasionally by toxigenic strains of *C. ulcerans* and *C. pseudotuberculosis* (Sharma et al., 2019). The re-emergence of diphtheria and its rapid spread in the Nigerian community continues to be a cause of concern among health care workers and the society at large. The vulnerability of children and people with zero doses to the diphtheria epidemic is also a major concern. The main concern of the diphtheria outbreak is the result of low immunisation and poor uptake of routine immunisation is one of the main causes of the disease (IFRC, 2023). With the present globalisation and the poor immunisation indices in Nigeria, Nigeria is more vulnerable to this disease (Sadoh and Oladokun, 2012). The outbreak serves as a reminder of the importance of herd immunity and the impact of vaccination coverage on controlling the spread of infectious diseases (Adegboye et al. 2023). This article examines the spatial spread of diphtheria in Nigerian communities by exploring the social aspects of the

propagation of the disease, community awareness, and public health actions taken by various actors to alleviate the outbreak of diphtheria. This is to sensitize the Nigerian community to the risks and vulnerability of zero-dose immunisation and to improve knowledge and awareness of the hazard of diphtheria outbreak.

Objectives

The objectives of this paper are the following.

1. Examine the causes of the spatial spread of diphtheria in Nigeria
2. Sensitize Nigerian communities to the risks and vulnerabilities of zero-dose immunisation.
3. Improve knowledge and awareness of the hazard of diphtheria outbreak.

Statement of the Problem

The vulnerability of children and persons with zero vaccination constitutes a major challenge in the fight against the diphtheria outbreak in Nigeria. With increasing multidimensional poverty, vaccine hesitancy and vulnerability to infectious diseases, many Nigerians continue to be susceptible to epidemic outbreaks of Cholera, Lassa fever, and Diphtheria among others. Residents of densely crowded places and unsanitary areas are also at risk of contracting the disease. Healthcare professionals, hospital front-line workers, and anyone who has encountered suspected or confirmed diphtheria cases are also at risk (IFRC, 2023). Therefore, it becomes imperative to understand community involvement in the process of obtaining access to vaccination promptly. Other problems include limited training of public health personnel and fragmented policies. Accessing funds in a timely manner is also crucial to the intervention of diphtheria.

Methodology

This article uses secondary data and a review of the literature through a systematic search of approximately 30 studies on diphtheria. A search was carried out in the following journals on Google Scholar, PubMed, ScienceDirect, and Elsevier, using the search terms 'Diphtheria', 'Social aspects of Diphtheria', and 'Diphtheria in Nigeria'.

Theoretical/Conceptual Framework

The 2030 Agenda for Sustainable Development of the United Nations presents a global guide to address the present needs of people without depriving future generations of the resources they need to live dignified, healthy and meaningful lives (SDG, 2017 & 2018). This article adopts the concept of community engagement and participation in health promotion using the social ecological model of the health approach.

Concept of Community

Community can be conceived from four perspectives (NIH, 2011:5):

1. Systems perspective: a community like a living creature comprising different parts, functions, and activities.
2. Social perspective: describes the social and political networks that link the community together.
3. Virtual perspective: virtual communities that utilise computer-mediated communication, for example texting, X, Facebook, and YouTube, etc.
4. Individual perspective: Individual sense of community and belonging.

NIH (2011: xvi) notes that 'community' sometimes refers to those affected by the health issues being addressed and 'community' can be used in a more general way to refer to stakeholders such as academics, public health professionals, and policy makers as communities'. In the case of the diphtheria outbreak in Nigeria, the community in this document refers to both (the community and the stakeholders).

Community Engagement

Community Engagement is 'a process of developing relationships that allow stakeholders to work together to address health-related issues and promote well-being to achieve positive health impact and results' (WHO, 2017a:4). Health promotion employs community participation, defined as "the process of working collaboratively with and through groups of people affiliated by geographic proximity, special interest, or similar situations to address issues affecting the well-being of those people" (CDC, 1997:9). The goals of community engagement are to build trust, enlist new resources and allies, create better communication, and improve overall health outcomes and lasting collaborations (CDC, 1997; Shore, 2006; Wallerstein, 2002). Community engagement is grounded in the principles of community organisation: fairness, justice, empowerment, participation, and self-determination (Alinsky, 1962; Chávez et al., 2007; Freire, 1970; Wallerstein and Duran, 2006).

NIH (2011:7) asserts "community engagement can take many forms, and partners can include organized groups, agencies, institutions, or individuals. Community engagement can also be seen as a continuum of community involvement" (Figure 1).



Figure 1: Community Engagement Continuum

Source: NIH (2011:8).

Community engagement has been described as both 'art and science' to develop relationships and direct collective actions towards the common good' (cited in WHO, 2020:7). Although four levels of community engagement are community-orientated (Information and community mobilisation), community-based (consultation and involvement), community-managed (collaboration), and community-owned (ownership and empowerment) (WHO, 2020), there must always be continuous engagement with the community and stakeholders, as indicated in Figure 2.

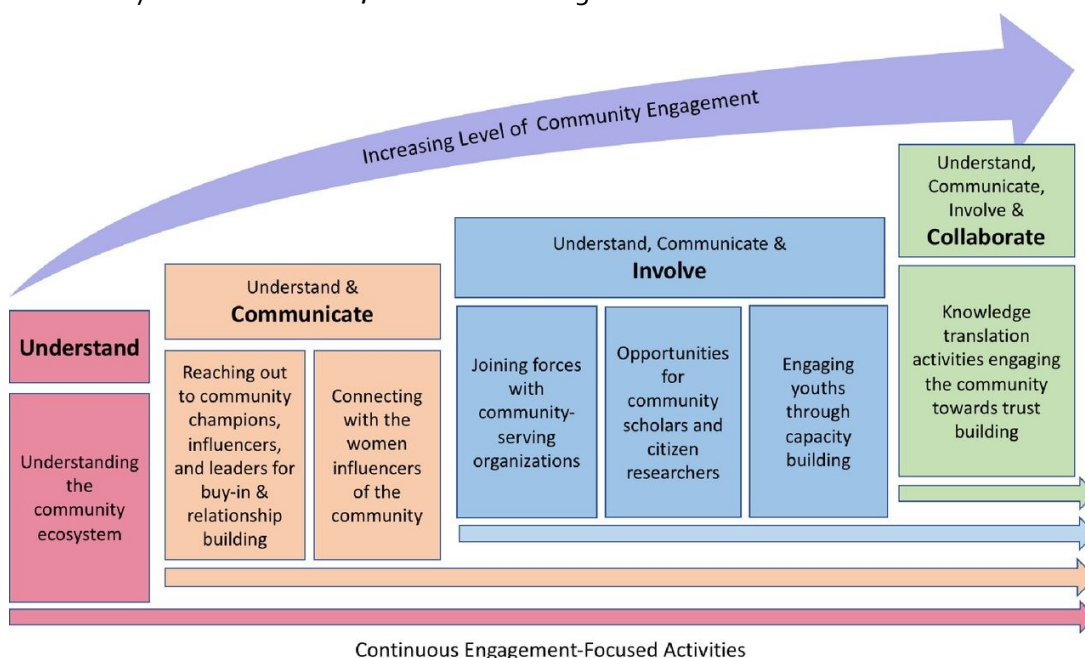


Figure 2: Continuous engagement-focused activities to achieve different levels of engagement.

Source: IAP2. IPA2 spectrum of public participation, 2018; Turin et al. 2021:2. The levels of engagement were adapted from the participation spectrum described by the International Association of Participation Professionals (IAP2).

On the other hand, five different levels are often referred to as the levels of participation – inform, consult, involve, collaborate, and empower. Empowerment is considered a level with the highest degree of participation, and refers to 'a process by which people gain greater control over decisions and actions that affect their lives; Community empowerment specifically involves people acting collectively to gain greater control over their community, including their health and quality of life' (WHO, 2018a; WHO, 2020: 7). For health promotion, community engagement, organising, and collaboration tie into the social ecological model approach, which focusses on the multiple factors that impact individual, community health from social, environmental, political, economic, and cultural.

The Social-Ecological Model of Health

The social ecological model conceptualises health broadly and focusses on multiple factors that could affect health. The social ecological model understands health to be affected by the interaction between the individual, the group/community, and the physical, social, and political environments (Israel et al., 2003; Sallis, Owen, and Fisher, 2008; Wallerstein and Duran, 2003). "The social ecological model understands health to be affected by the interaction between the individual, the group/community, and the physical, social, and political environments" (NIH, 2011:20).

Stokols (1996) proposed four core principles that underlie the ways the social ecological model can contribute to efforts to engage communities:

- Health status, emotional well-being, and social cohesion are influenced by the physical, social, and cultural dimensions of the environment of the individual or community and personal attributes (e.g., behaviour patterns, psychology, genetics).
- The same environment can have different effects on an individual's health depending on a variety of factors, including perceptions of the ability to control the environment and financial resources.
- Individuals and groups operate in multiple environments (e.g., workplace, neighbourhood, larger geographic communities) that "spill over" and influence each other.
- There are 'personal and environmental leverage points', such as the physical environment, available resources, and social norms, that exert vital influences on health and well-being.

The CDC created a four-level model of the factors affecting health grounded in social ecological theory (2007; Figure 3) to inform health promotion programmes.

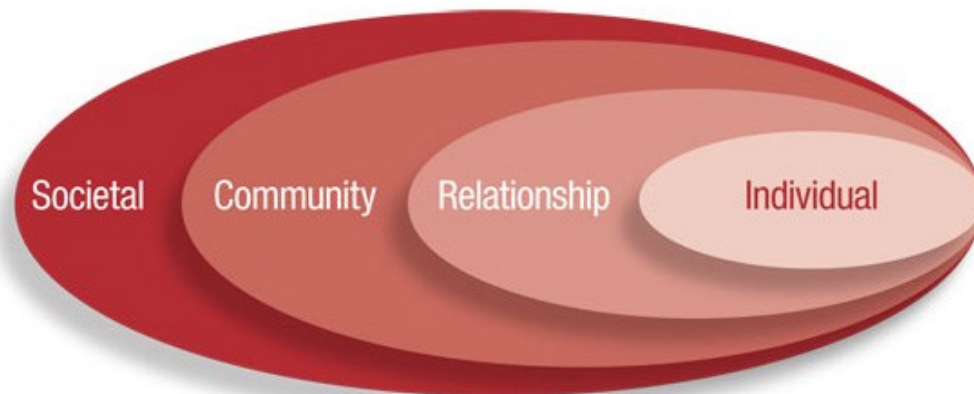


Figure 3: The Social-Ecological Model: A Framework for Prevention Societal Community Relationship Individual

Source: CDC, 2007

Figure 3 (NIH, 2011: 22) indicates:

1. The first level of the model (at the extreme right) includes individual biology and other personal characteristics, such as age, education, income, and health history.
2. The second level, the relationship, includes the closest social circle of a person, such as friends, partners, and family members, all of whom influence a person's behaviour and contribute to his or her experiences.
3. The third level, community, explores the settings in which people have social relationships, such as schools, workplaces, and neighbourhoods, and seeks to identify the characteristics of these settings that affect health.
4. The fourth level looks at the broad societal factors that favour or impair health".

Both the community engagement approach and the social ecological model recognise the complex role played by context in the development of health problems, the role of stakeholders and the different levels of the individual, the interpersonal level, the community, society to disease prevention and health promotion (NIH, 2011).

Literature Review

Worldwide, thousands of cases of diphtheria are still reported annually from several countries in Asia and Africa, usually with a lack of specificity due to underreported cases along with many outbreaks and changes in the epidemiology of diphtheria (Adegoke and Adebayo, 2017; Sharma et al., 2019). In 2017, a total of 8,819 cases of diphtheria were reported worldwide, the highest since 2004 (Clarke et al., 2019). During 2016–2019, diphtheria outbreaks were reported in multiple countries, including Bangladesh, Yemen, and Venezuela, and several outbreaks were among vulnerable populations or in areas of social disruption and conflict.

According to Völzke et al. (2006), the prevalence of susceptibility to diphtheria was 32.4% in North-East Germany and multivariate analysis revealed 45% increased odds of women being susceptible to diphtheria. Women who had not received diphtheria toxoid vaccination during the previous 10 years had four times greater odds of being susceptible to diphtheria toxin compared to unvaccinated men. None of the social factors investigated was associated with susceptibility status. It was concluded that a high proportion of middle-aged adults was susceptible to diphtheria. Women lacked seroprotection more often than men, which might be explained, in part, by gender-specific immune responses after vaccination.

"Diphtheria is a severe bacterial infection that can affect the nose, throat, and occasionally the skin of a person. It is caused by the *Corynebacterium* species. The people at the highest risk of contracting diphtheria are children and people who have not received any or only a single dose of the vaccine (a diphtheria toxoid-containing vaccine). Sharma et al. (2019) observes that diphtheria is generally an acute respiratory infection, characterised by the formation of a pseudo membrane in the throat, but cutaneous infections are possible. Systemic effects, such as myocarditis and neuropathy, which are associated with increased risk of death, are due to diphtheria toxin, an exotoxin produced by the pathogen that inhibits protein synthesis and causes cell death.

Causes of Diphtheria

Diphtheria is a serious bacterial infection that affects the nose, throat, and sometimes the skin of an individual. It is caused by the bacterium *Corynebacterium* species, mainly by toxin-producing *Corynebacterium diphtheriae* and rarely by toxin-producing strains of *C. ulcerans* and *C. pseudotuberculosis* (Sharma et al., 2019). WHO (2017b) states that diphtheria is an infection caused by the *Corynebacterium diphtheriae* bacteria and signs and symptoms usually begin 2 to 5 days after exposure and range from mild to severe. Symptoms often progress gradually, beginning with a sore throat and fever. In severe cases, the bacteria produce a poison (toxin) that causes a thick grey or white patch on the back of the throat. This can block the airways, making it difficult to breathe or swallow and creating a snoring cough. The neck may swell in part due to enlarged lymph nodes. The poison may also enter the bloodstream, causing complications that can include inflammation and damage to the heart muscle, nerve inflammation, kidney problems, and bleeding problems due to low blood platelets. Damaged heart muscles can result in an abnormal heart rate and inflammation of the nerves can result in paralysis. Diphtheria spreads easily between people by direct contact or through the air through respiratory droplets, such as coughing or sneezing. It may also be spread by contaminated clothing and objects.

The NBS and UNICEF (2022:366) report indicates that "access to safe drinking water, sanitation, and hygiene (WASH) is essential for good health, welfare, and productivity and is widely recognised as a human right. Inadequate WASH is primarily responsible for the transmission of diseases such as cholera, diarrhoea, dysentery, hepatitis A, typhoid, and

polio.' Immunisation is a proven tool for controlling and eliminating life-threatening infectious diseases and is estimated to prevent between 2 and 3 million deaths each year (WHO, 2016). It is one of the most cost-effective health investments, with proven strategies that make it accessible to even the most hard-to-reach and vulnerable populations. The WHO recommended routine immunisations for children endorses that all children be vaccinated against tuberculosis, diphtheria, tetanus, pertussis, polio, measles, hepatitis B, haemophilus influenzae type b, pneumococcal bacteria / disease, rotavirus and rubella (WHO, 2018b).

Results and Discussion

Spatial Spread of Diphtheria in Nigeria

With headlines like 'Diphtheria: Nigeria confirms 80 deaths' (Premium Times; "Nigeria records 216 confirmed diphtheria cases – NCDC" (Vanguard Nigeria Online), the outbreak and spread of diphtheria in Nigeria becomes disconcerting. For a country of 226.7 million people with **53.9 %** of the population **urban**, and an average life expectancy of 53.87 years (UN, 2023), the reemergence of diphtheria is a cause for concern. Nigeria is divided into six geopolitical zones (Figure 4) that are South West (Ekiti, Lagos, Ogun, Ondo, Osun, Oyo), South East (Abia, Anambra, Ebonyi, Enugu, Imo), South-South (Akwa Ibom, Bayelsa, Cross River, Delta, Edo, Rivers), North West (Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto, Zamfara), North East (Adamawa, Bauchi, Borno, Gombe, Taraba, Yobe), North Central (Benue, Kogi, Kwara, Nasarawa, Niger, Plateau, Federal Capital Territory).



Figure 4: Six Geopolitical Zones in Nigeria

Source: <https://mavink.com/explore/Map-of-Nigeria-Showing-Regions>

The most significant reported diphtheria outbreak in Nigeria occurred in 2011 that affected rural areas of Borno State (northeast region). There were 98 cases and 21 deaths in the northeastern region, 21% of these cases resulting in subsequent mortality (WHO, 2018c). According to Besa et al. (2014), a diphtheria outbreak occurred from February to November 2011 in the village of Kimba and its surrounding settlements, in Borno state, northeastern Nigeria. A retrospective outbreak investigation was conducted in the village of Kimba and surrounding settlements to better describe the extent and clinical characteristics of this outbreak. Of the 98 confirmed cases, 63 (64.3%) of whom were children under 10 years of age. 98% of the cases had never been immunised against diphtheria and none of the 98 cases received diphtheria antitoxin, penicillin, or erythromycin during their illness (Besa et al., 2014).

The World Health Organisation reporting system indicates that there has been a constant dwindle of outlined diphtheria occurrences from 5039 in 1989 to 2468 in 2001 and 312 in 2006 (Aborode et al., 2023). A total of 1870 cases were reported in Nigeria in 2018 (Shariff et al., 2023). However, there was a reemergence of diphtheria in 2022. The Nigeria Centre for Disease Control and Prevention (NCDC) was first notified of suspected diphtheria cases on 1 December 2022. On 20 January 2023, the NCDC officially declared the situation as an outbreak in Lagos and Kano States. These two states have a combined population of more than 30 million (Adegboyega et al., 2023). By July 2023 Kano, Yobe, Kaduna, Katsina, Federal Capital Territory (FCT), Lagos and Osun States reported severe cases (Figure 5). However, Kano has consistently remained the epicentre of the diphtheria outbreak (Figure 6).

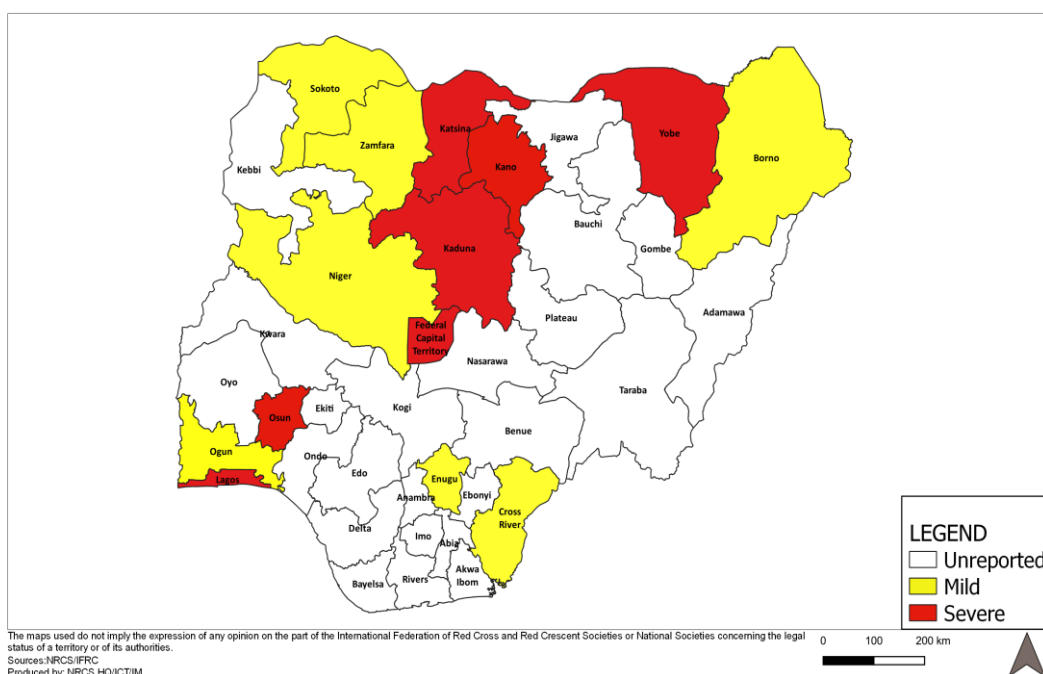


Figure 5: States Spread of Diphtheria Outbreak in Nigeria, July 2023

Source: Nigerian Red Cross Society, IFRC, 2023

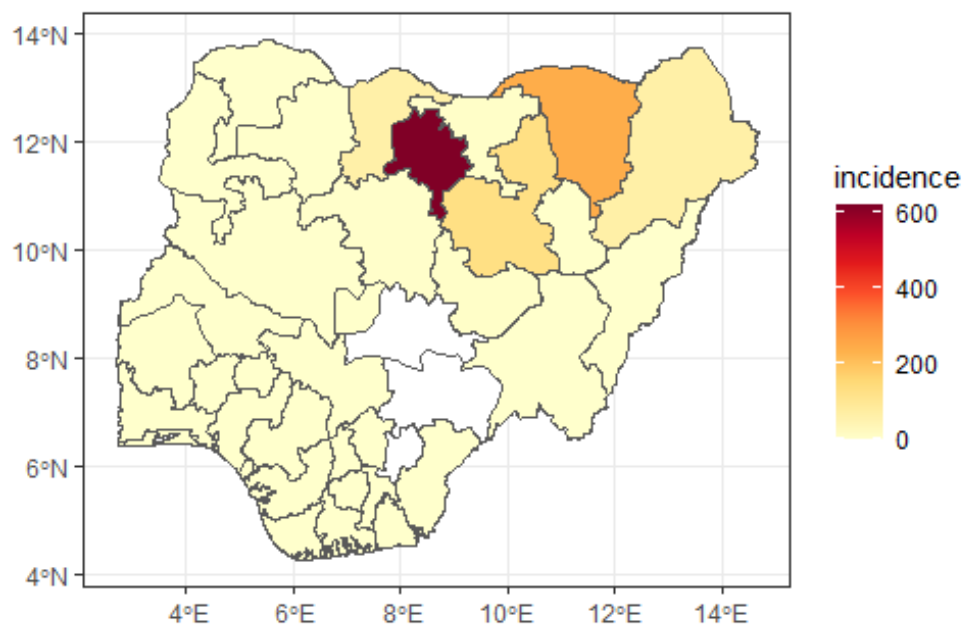


Figure 6: Incidence (per million population) of confirmed diphtheria cases in Nigeria by State, May 2022 -December 24, 2023

Source: NCDC, 2023a [A Publication of the National Diphtheria Emergency Operations Centre (EOC)].

Cumulatively, from May 2022 to December 2023 a total of 22,293 suspected cases were reported in 36 states across 297 local government areas, while 13,387 (60.1%) cases were confirmed and distributed across 21 states and 158 local government areas. According to NCDC (2023a), Kano, Yobe, Katsina, Bauchi, Borno, Kaduna and Jigawa accounted for 96.2% of suspected cases and Kano, Bauchi, Yobe, Katsina, Borno, Jigawa, Plateau and Kaduna accounted for 99.4% of confirmed cases (Table 1). The suspected and confirmed cases are lost in the northern parts of Nigeria where multidimensional poverty, the Boko Haram insurgency, farmer-herdsmen incursions and conflicts, and internal displacement continue to hinder residents from accessing health care. NCDC (2023a) notes that the majority of confirmed cases were among children aged 1-14 years and only 3,376 (25.2%) out of the confirmed cases of 13,387 were fully vaccinated with a diphtheria toxoid-containing vaccine. A total of 598 deaths have been recorded among the confirmed cases. Kano reported 382 deaths (63.9%) and Yobe reported 73 deaths 12.2%).

Table 1: Distribution of diphtheria cases and deaths in Nigeria, May 2022-December 2023

States	Number of Suspected Cases	Number of Confirmed Cases	% of Confirmed cases	Number of Deaths among Confirmed cases	CFR among Confirmed Cases (%)
Kano	14,126	10,085	71	382	4
Yobe	2238	1009	45	73	7
Katsina	1734	599	35	48	8
Bauchi	1376	1059	77	23	2
Borno	1148	483	42	30	6
Kaduna	573	28	5	8	29
Jigawa	256	45	18	5	11
Zamfara	152	7	5	0	0
Gombe	136	6	4	1	17
FCT	127	13	10	5	38
Taraba	90	2	2	0	0
Plateau	66	31	47	15	48
Kebbi	46	1	2	0	0
Sokoto	41	4	10	0	0
Lagos	37	6	16	5	83
Kogi	36	0	0	0	-
Osun	16	3	19	1	33
Bayelsa	15	0	0	0	-
Oyo	14	0	0	0	-
Enugu	12	1	8	0	0
Niger	11	2	18	0	0
Ekiti	10	1	10	1	100
Imo	9	0	0	0	-
Nasarawa	7	1	14	1	100
Abia	3	0	0	0	-
Delta	2	0	0	0	-
Edo	2	0	0	0	-
Ondo	2	0	0	0	-
Rivers	2	0	0	0	-
Adamawa	1	0	0	0	-
Akwa Ibom	1	0	0	0	-
Anambra	1	0	0	0	-
Cross River	1	1	100	0	0
Kwara	1	0	0	0	-
Ogun	1	0	0	0	-
Total	22,293	13,387	-	598	-

Source: NCDC, 2023a [A Publication of the National Diphtheria Emergency Operations Centre (EOC) December 2023].

From Table 1 the top seven states with the highest number of confirmed cases and deaths are in the north. Although Nigeria has a high level of poverty and inequality, the spatial divide relating to the outbreak of diphtheria could not be more evident, especially in the northern states. Multidimensional poverty and deprivation are intensified in the northern states due to conflict (Boko Haram insurgency), climate crisis (flooding, drought, desertification, heat), and internally displaced persons, among others.

The World Bank's multidimensional poverty measures (MPM) is unique among in including information on both monetary and non-monetary poverty. Non-monetary deprivation includes water, sanitation, electricity, educational enrolment, and attainment. Almost half of Nigeria's population (47.3%) were multidimensionally poor in 2018/19 (World Bank, 2022). Poverty was exacerbated by the COVID-19 pandemic. Using the World Bank's MPM, a household is classified as multidimensionally poor if it is deprived of at least one third of the weighted multidimensional poverty indicators, namely monetary poverty, educational enrolment, educational attainment, water, sanitation and electricity. Multidimensional poverty was concentrated in northern Nigeria. The overall multidimensional poverty rate for the north (pooling the North Central, North East, and North West zones) was 67.3 percent in 2018/19, compared with 25.0 percent for the south (pooling the South East, South South, and South West zones" (World Bank, 2022, p.32). Northern Nigeria was more deprived than southern Nigeria in all six multidimensional poverty indicators. This disparity can also be observed in the outbreak and spread of diphtheria and vaccine gaps.

Vaccination Gaps and Diphtheria Treatment

Save the Children International indicated that Nigeria already has one of the lowest vaccination rates in the world, and only 42% of children under 15 years of age in Nigeria are fully vaccinated against diphtheria, and in the October 2023 outbreak, 80% of the confirmed cases are unvaccinated people (Ibrahim, 2023). Three in every four confirmed cases or 73.6% of all cases are of children under 14, with those aged between 5-14 years bearing the brunt of the disease (Dapam, 2023). Figure 7 indicates significant incidences among vaccinated and unvaccinated children. The number of deaths is higher among unvaccinated children between the ages of 1 and 14 years.

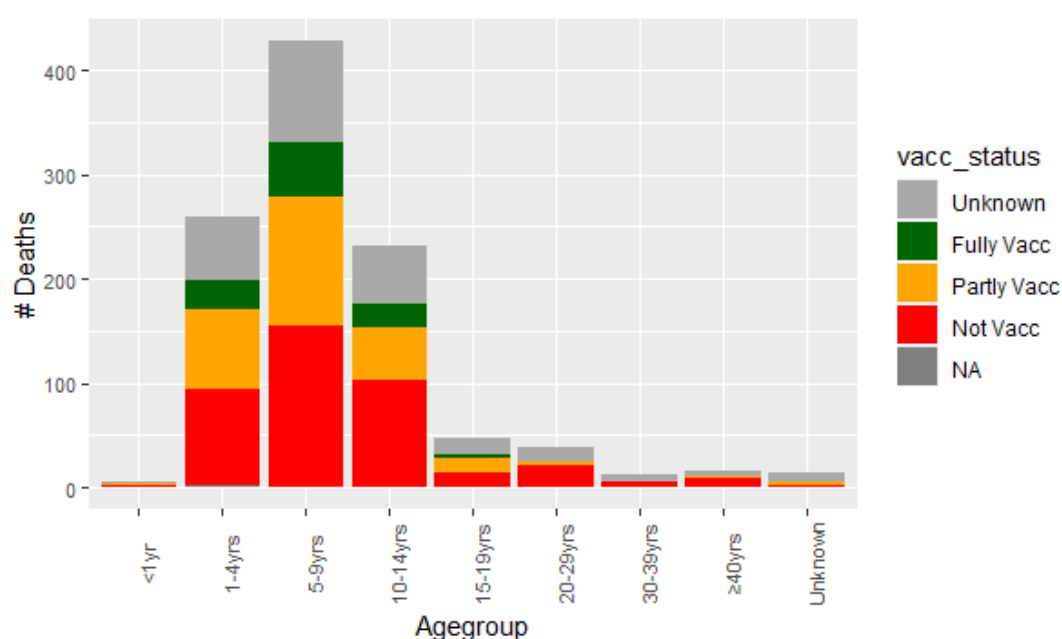


Figure 7: Age distribution and vaccination status of deaths among confirmed diphtheria cases in Nigeria, May 2022-December 2023

Source: NCDC, 2023b [A Publication of the National Diphtheria Emergency Operations Centre (EOC) December 2023]

Gender differences in confirmed cases of diphtheria outbreak are revealed in Figure 8. Apparently, between the ages of 2 and 4 years more men are affected, while more women are affected by the diphtheria outbreak from age 15 and older compared to men in the confirmed cases by gender in Nigeria. The proportion of fully and partially vaccinated is still very low compared to the number of unvaccinated. For example, in February 2023 out of the 216 confirmed cases, 184 (85.2%) were aged 2 to 14 years from both sexes, and 27 were fully vaccinated, 84 were unvaccinated, and 20 were partly vaccinated (Obinna, 2023).

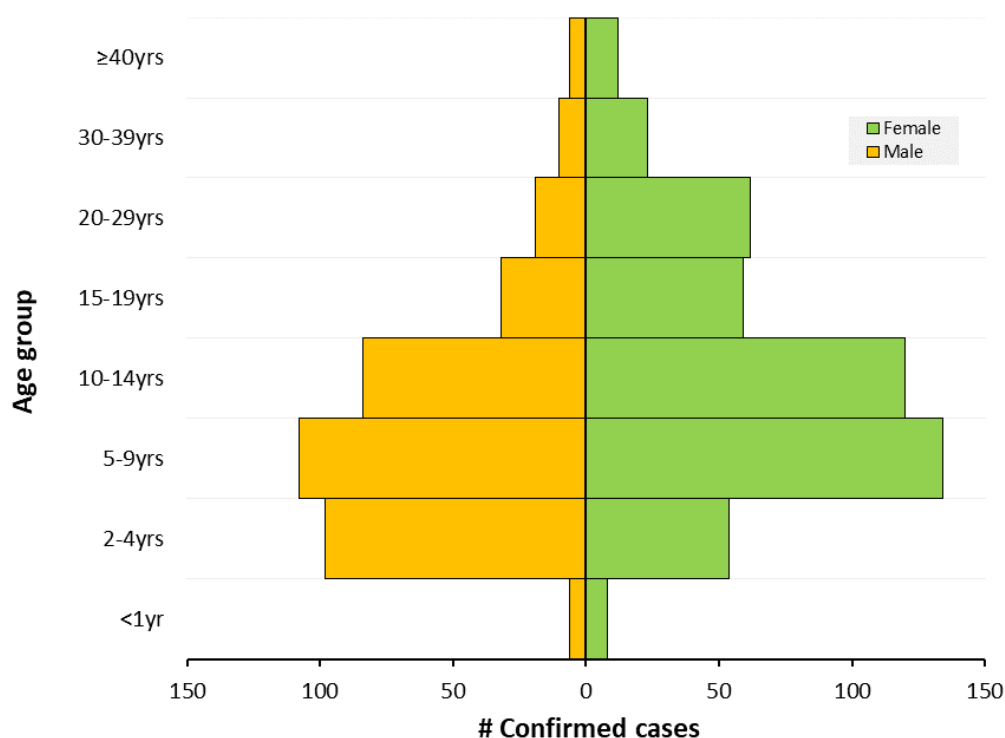


Figure 8: Age-sex distribution of confirmed diphtheria cases in Nigeria, May 2022 – June 2023

Source: NCDC, 2023c

Low rates of immunisation delayed clinical recognition of diphtheria and the lack of antitoxin treatment and appropriate antibiotics contributed to this epidemic and its severity (Besa et al., 2014). Nigeria has a low vaccination due to the low accessibility to access to diphtheria antitoxin (WHO, 2018b). Diphtheria outbreaks tend to reflect insufficient vaccination coverage, low vaccination coverage, and delays in diagnosis. The absence of antitoxin and antibiotics for treatment in health facilities was also a factor. WHO (2023a) notes that Nigeria's most recent immunisation data was published in 2022 and it showed stark coverage gaps. In August 2022, the National Bureau of Statistics (NBS) and other health partners released the 2021 Multiple Indicator Cluster Survey (Mics) and the Survey (Nics). The multiindicator survey provides, among other subjects, child mortality, health, education, sanitation, and hygiene, while the Nics assesses vaccination coverage. A total of 41,532 households were sampled nationally for the Mics, and 6,740 households for the immunisation survey. The immunisation survey showed that only 56.6% of children between ages 12 and 23 months had received the third dose of DTP at any time prior to the survey. This rose slightly to 57.9% in children aged 24 to 35 months. The Executive Director of the National Primary Health Care Development Agency noted that a total of 1,692,762 children, between 6 months and 4 years of age, have been diligently administered the pentavalent vaccine, a vital safeguard against this disease.

Diphtheria can be treated with timely administration of diphtheria antitoxin and antimicrobial therapy, and the prevalence of toxigenic *Corynebacterium* spp. highlights the need for appropriate clinical and epidemiological investigations to quickly identify and treat affected individuals, along with public health measures to prevent and contain the spread of this disease (Sharma et al., 2019). Although effective vaccines are available, this disease has the potential to re-emerge in countries where the recommended vaccination programmes are not sustained, and increasing proportions of adults are becoming susceptible to diphtheria. The disease can be treated by administering diphtheria antitoxin as well as antibiotics. Vaccination against diphtheria has dramatically reduced diphtheria mortality and morbidity. Diphtheria antitoxin is a medication made up of antibodies used in the treatment of diphtheria. Erythromycin IV (intravenous) refers to intravenous administration of the antibiotic medication erythromycin. Erythromycin is a macrolide antibiotic that is used to treat various bacterial infections. It works by inhibiting the growth of bacteria, helping the body's immune system fight infection. The therapy of diphtheria comprises antitoxin and penicillin or erythromycin; however, Nigeria currently does not routinely stock diphtheria antitoxin (DAT) (Sadoh and Oladokun, 2012). Therefore, children with diphtheria scarcely received DAT, which was reported to reduce mortality mainly if administered early in the course of the disease (Aborode, et. al, 2023).

Regarding drug sensitivity (Figure 9) Diphtheria appears to be highly resistant to Ciprofloxacin and Trimethoprim-Sulfamethaxole (TS) while the disease is highly indeterminate to Benzylpenicillin and Cefotaxime and highly sensitive to Erythromycin and tetracycline treatments.

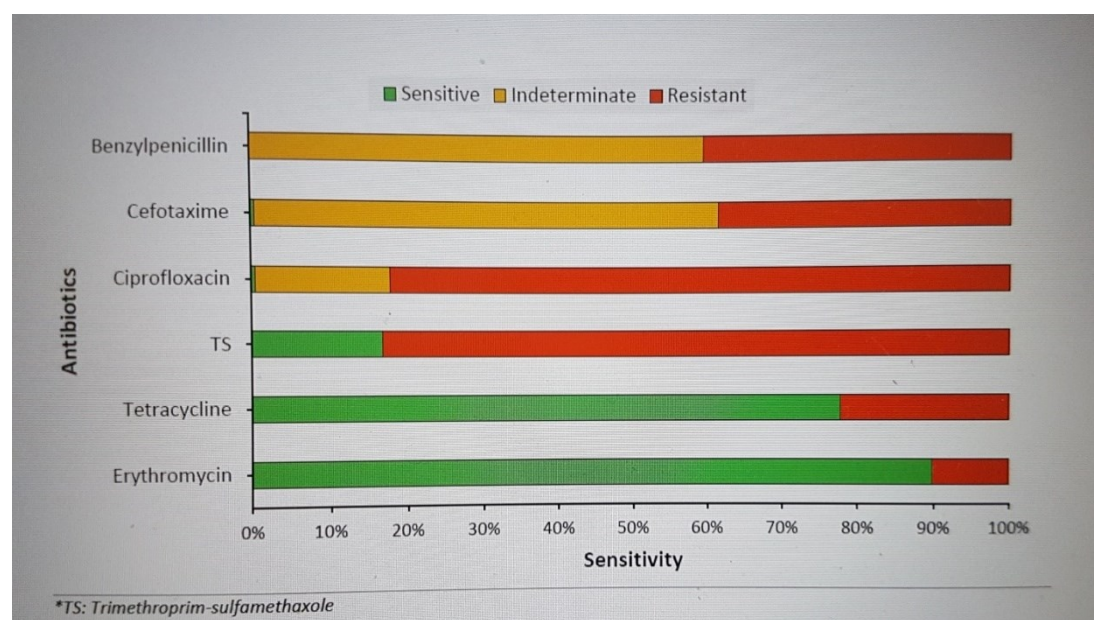


Figure 9: Drug sensitivity results of toxigenic *Corynebacterium diphtheriae* isolated in Nigeria, May 2022-December 2023

Source: NCDC, 2023a [A Publication of the National Diphtheria Emergency Operations Centre (EOC) December 2023].

Vaccine campaign outreaches were carried out in approximately 48 local government areas in the seven most impacted northern states (Table 2) in November 2023 by administering Penta vaccine to 1.9 million 6 weeks old children and about 3.4 million Td vaccine to children aged 4 to 14 years of age.

Table 2: Reactive vaccination campaign coverage for pentavalent and Td vaccine by states as of 25th November 2023

State #LGA)	Target Population for Penta (6weeks-<4years)	Total Vaccinated with Penta	Coverage for Penta	Target Population for Td (4-14 years)	Total vaccinated with Td	Coverage for Td
Kano (14)	511,406	555,134	109%	1,089,647	1,111,310	102%
Katsina (9)	448,369	396,843	89%	716,165	644,623	90%
Bauchi (5)	282,615	243399	86%	419,640	338,208	81%
Kaduna (5)	242,613	251,126	104%	516,531	502,657	97%
Yobe (8)	196,564	205,006	104%	417,843	438,431	105%
Jigawa (3)	183,161	180,287	98%	281,092	275,686	98%
Borno (4)	71,926	70,127	97%	153,132	156,809	102%
Total (48)	1,936,654	1,901,922	98%	3,594,050	3467724	96%

Source: NCDC, 2023a [A Publication of the National Diphtheria Emergency Operations Centre (EOC) December 2023].

In addition to diphtheria treatment and vaccination gaps, there are also access challenges. According to WHO (2023b), the COVID-19 pandemic impacted vaccine uptake by creating barriers to accessing vaccination services and decreasing the demand and uptake of immunisation among caregivers. Movement restrictions and lockdowns also resulted in decreased delivery of general healthcare services, increased transportation costs, fewer engagements to promote vaccine uptake, and the discontinuation of mobile vaccination campaigns that targeted hard-to-reach communities.

Limitations to Vaccine Access

According to WHO (2023a) due to insecurity, especially in northeast Nigeria, vaccination coverage remains suboptimal, especially in areas controlled by nonstate armed groups. Therefore, the outbreak of diphtheria further complicates and strains the already

overstretched resources. The global supply of diphtheria antitoxin (DAT) is limited, and this may affect the availability of the required doses in a timely manner. The overall risk of diphtheria in Nigeria was assessed as high at the national level, low at the regional level, and low at the global level. The overall vaccination coverage of 56% in Nigeria remains suboptimal, with significant variations in the coverage of DPT₃ immunisation in Nigerian states (WHO, 2023b). Southern Nigeria has a higher vaccination rate than northern Nigeria (Truelove, Kegan, and Moss, 2019). The decline in the vaccination rate has put vulnerable people, such as children and unvaccinated individuals living in poor sanitary conditions, at a greater risk (Adegboye et al., 2023). Other reasons for poor access to vaccination include poverty and hunger, lack of knowledge, lack of education, insurgency, banditry & conflict, poor funding, poor infrastructure, poor storage, early child marriage, and data deficiency.

Engaging Community and Public Health Response to Diphtheria Outbreak

The Nigeria Centre for Disease Control and Prevention (NCDC) continues to take the lead and is at the forefront of the public health response to diphtheria in Nigeria through coordination, surveillance, laboratory investigation, risk communication, case management, and immunisation activities. NCDC efforts are supported by other actors and stakeholders, both international agencies and national and regional/local actors. Understanding the importance of community engagement in curbing the spread of the disease, the NCDC has prioritized risk communication. Public health advisories on diphtheria have been distributed, and social behavioural change materials have been distributed in collaboration with partners. Treatment centres and wards have been established in affected states, and the availability of diphtheria antitoxin (DAT) and IV erythromycin has significantly reduced the fatality rate. Despite these efforts, vaccine uptake remains a challenge. The National Primary Health Care Development Agency (NPHCDA) has administered the pentavalent vaccine to 1,692,762 children aged 6 months to 4 years and the TD vaccines to 3,166,419 children aged 4 to 14 years. However, a significant number of confirmed cases are either unvaccinated or partially vaccinated, indicating a gap that must be addressed.

As reiterated by IFRC (2023) and NCDC (2023; Ezigbo, 2023), the following agencies have intervened in the response to the diphtheria epidemic in Nigeria:

1. The NCDC has instituted the following:
 - a. An ongoing coordination, monitoring of diphtheria surveillance and response activities through the weekly diphtheria National Technical Working Group meetings.
 - b. Rapid Response Teams (RRTs) have been deployed to Katsina, Osun and Yobe States and re-deployed to Kano and Lagos States to support response activities. While sensitisation/training of clinical and surveillance officers has taken place in states where RRTs were deployed, on the presentation, prevention and surveillance of diphtheria.

- c. Cascaded trainings were conducted in their respective states by some of the laboratory scientists/physicians trained at the National Reference Laboratory (NRL) of the NCDC, Abuja.
 - d. Harmonisation of surveillance and laboratory data between states and laboratories is ongoing.
 - e. Procurement of reagents and sample collection and transportation materials/media processes has been initiated.
 - f. Drug sensitivity tests are ongoing at NCDC NRL on isolates sent from states.
 - g. Distribution of diphtheria antitoxin (DAT) to affected states has been ongoing since December 2022. The Centre has developed and disseminated Standard Operating Procedures for Diphtheria Antitoxin (DAT) use in health facilities and treatment centres.
 - h. Strengthening of routine immunisation activities across the country continues.
 - i. The National Emergency Operations Centre (EOC) was activated in January 2023, following an increase in- Diphtheria cases. The Emergency Operations Centre (EOC), which is hosted at NCDC, is being coordinated in collaboration with the Federal Ministries of Health, Environment and Water Resources, National Primary Health Care Development Agency (NPHCDA), World Health Organisation (WHO), IFRC, NRCS, and other implementing partners. The Multi-sectorial National EOC activated at level 02, coordinated by NCDC, has continued to work closely with all states, relevant stakeholders and partners, to provide the necessary support for the prevention and control of diphtheria in Nigeria.
 - j. NCDC is supporting states through deployment of rapid response teams, development, and dissemination of National Guidelines for Diphtheria, deployment of PCR kits, to five states. Katsina, Kano, Osun, Yobe, and Lagos with adequate laboratory testing of samples, case management, contract tracing, RCCE and partnering with stakeholders.
2. Nigerian Red Cross Society (NRCS):
 - a. Organising meetings, epidemic control for volunteers, community-based health and first aid (CBHFA), health action teams, and Mothers Clubs.
 - b. NRCS response plan and how to engage the state governments and deployed 500 community-based volunteers in 4 states.
 - c. Nigerian Red Cross and IFRC are currently part of the Risk Communication and Community Engagement (RCCE) pillar where they aim to support the social mobilisation of people to increase uptake of DAT vaccines during the intensification of routine vaccination (RI) in the affected states by the NPHCDA.
 3. The European Union through its European Civil Protection and Humanitarian Aid operators have provided 150,000 euros as a form of replenishment for the DREF to the NRCS.

4. British Red Cross are involved in the areas of WASH (Water, Sanitation and Hygiene) activities.
5. National Authorities:
 - a. Since September 2011, the Nigerian Ministry of Health, and Médecins Sans Frontières (MSF) offered case management.
 - b. The National Primary Health Care Development Agency (NPHCDA) intensification of routine immunisation to increase vaccine uptake and reduce the number of people not vaccinated or with zero dose vaccines such as the pentavalent vaccine. The comprehensive response plan of NPHCDA has been activated to detect early cases, contain spread, and prevent further transmission through a multiphased strategy.
6. WHO:
 - a. Access to routine immunisation was denied during COVID-19, causing low coverage, thus exacerbating the incidence, undernourishment, banditry, IDP (6.2 m children between 2019 and 2023 who lack access to routine immunisation, according to WHO).
 - b. WHO is currently providing Diphtheria Antitoxins (DAT) in the country as requested by NCDC. WHO is also providing laboratory testing kits such as PCR to the NCDC laboratory to support and facilitate the fast and efficient testing of Diphtheria samples to produce definite results.
 - c. Plans are underway to deliver 1800 vials of diphtheria antitoxin to Nigeria. The Nigeria Centre for Disease Control and Prevention requested WHO to purchase DAT and erythromycin IV for the management of cases of diphtheria.
7. UNICEF: UNICEF supports the NPHCDA in routine immunisation of children to reduce the number of unvaccinated children and zero-dose children in Nigeria. Nigeria is home to the second largest number of zero-dose children in the world. Zero-dose children remain vulnerable to vaccine-preventable diseases, along with under-immunised or “missed dose” children, which refers to those who do not complete their immunisation as stated in the National Immunisation Schedule (Adejoro, 2023).
8. MSF: Médecins sans Frontières (MSF) is bolstering the technical assistance of Risk Communication and Community Engagement (RCCE) to distribute crucial information on diphtheria in affected communities as part of its efforts to combat the current diphtheria outbreak. To ensure that the messages are distributed effectively and disseminated by the locally impacted areas, MSF is designing the guidelines and printing media materials and resources for the messages and critical data on diphtheria.
9. Indonesian Government: Approximately 1.5 million vaccines were made available in Nigeria by the Indonesian government and the Ministry of Health is processing

the shipment of vaccines to affected states which will be administered directly to people at risk of diphtheria, such as children under 5 years of age.

10. Media:
 - a. In addition to the coverage of the print media, talk shows such as 'Your View' carried a discussion on diphtheria on 22 August 2023, bringing experts to discuss diphtheria and spread information and raise community awareness.
 - b. Regular media involvement such as this helps to proactively inform the public on raising awareness and addressing misconceptions about the diphtheria outbreak.
 - c. The diphtheria jingles and PSA are aired on the national network news 7 a.m. and 4 p.m. on Radio Nigeria.
 - d. NCDC continues to conduct social listening on social media channels to address misinformation and disinformation about diphtheria.
11. Sensitisation and community engagement to win those who are hesitant to get vaccinated for their children. Outreach programmes in markets, churches to curb the spread.
12. Support of the World Bank, Breakthrough Action Nigeria and other partners to design, validate and distribute diphtheria social behavioural change (SBC) materials to all states.
13. Engaging with state officials on the adaptation of diphtheria SBC materials (e-posters, flyers, and jingles) to their local languages.
14. Engaging school heads or Principals on diphtheria prevention and control measures in communities have been engaged in Kano state. Through state governments, primary and secondary school authorities, community and religious leaders in high-burden states have been involved in prevention and control measures of diphtheria.

However, IFRC (2023) confirms that about 1,585,080 people have been affected by the diphtheria outbreak, while the crisis category is yellow, and has been classified as an epidemic. CDC (2023) has placed Nigeria at level 2 (practice enhanced precautions), according to the outbreak, and recommends vaccination as essential to protect against diphtheria, avoid contact with people with symptoms, avoid touching wounds of others, practice hygiene-hand washing, covering nose and mouth when you cough or sneeze, and seek medical care when feeling sick.

Recommendations

A health promotion framework for the diphtheria intervention (Figure 10) must include the following:

- Health educators who have direct communication with families, households, and communities, especially in rural areas, and who have a hard time reaching communities to educate on:
- Diphtheria epidemiology (in simple language for understanding)
- Benefits and costs of vaccination
- Complications of zero vaccination

- Service improvements in number of public health immunization officers in the rural areas
- Case management of diphtheria patients and their families
- Minimising obstacles to vaccine uptake, distribution, and costs.
- Advocacy: Enhancing community engagement and empowerment based on mutual trusting relationships between the community and stakeholders.

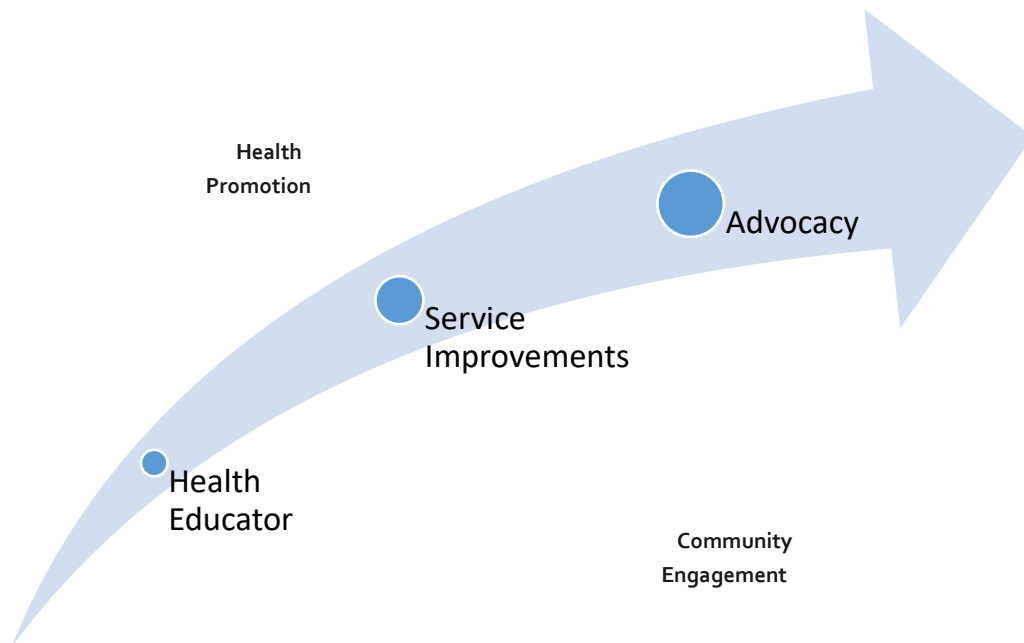


Figure 10: Community Engagement and Health promotion framework for Diphtheria Intervention

Source: Authors, 2024

Community engagement is key and a glue to achieving health promotion and meaningful health outcomes when it comes to diphtheria vaccination. Community engagement and mobilisation tailored to the actual needs of the targeted population can be very successful when there are community educators, parent-to-child education, and cultural aspects of the community are taken into account. The community and stakeholders should develop structures and tools to promote community empowerment and health improvement, community organising, community participation, capacity, and coalition building.

Conclusions

The public health response and community engagement efforts to address the diphtheria outbreak are laudable. More needs to be done in the areas of bridging immunisation gaps, education (especially maternal education) and providing basic infrastructure to reduce transmission of diphtheria. Educating mothers and allowing them to grasp the importance of vaccination and getting their children immunised on time is essential to reducing infections. For hard-to-reach communities, the use of donkeys, motorcycles, bicycles, and

other rudimentary forms of transportation is critical to get vaccines and information out and reduce the fatality rate in cases. Consistency in data collection and good quality (quantitative) data provides a basis for timely intervention and future response to the treatment of diphtheria. Community mobilisation efforts and sensitisation of men, men in the home, community leaders, and faith-based leaders should be intensified to break the myths of vaccination and improve social behaviour change. Curtailing crowding, reducing multidimensional poverty and social inequalities, and enhancing hygiene practices (WASH) are practical measures to reduce spread, infection, and death arising from the diphtheria outbreak.

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