Incidence of Meningococcal Meningitis Serogroup C in Two North-Western States of Nigeria

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Abstract:- **The aim of this study is to report the incidence of NmC outbreak caused by Neisseria meningitidis serogroup C (NmC) in Sokoto and Zamfara between December 2016 and June 2017.From week 51 2016 to week 19, 2017, data on CSM cases and deaths were recorded on standardized line-lists from case management sites. Cerebrospinal fluid (CSF) samples collected from suspected cases during the outbreak were tested using rapid Pastorex® latex agglutination to determine causative serogroup. A total of 5,372 cases of MNC were reported in Zamfara and Sokoto states. CSF was collected from 281 (5.2%) suspected cases (190 from Sokoto and 91 from Zamfara), there were 277 deaths in Sokoto and 81 in Zamfara, making a total of 358 deaths, 5,188 probable cases and 184 confirmed cases from both states. Out of 5,372 cases of NMC seen, 57.2% were males and 42.8% were females (M:F = 1.3:1). The most affected age group in both states was 6-15 years with 49.3% from Sokoto and 53.9% from Zamfara. The peak of meningitis cases was observed at week 7, 2017 in Zamfara and week 15 in Sokoto. Marudun local government recorded the highest incidence (146) in Zamfara while Sokoto North and South accounted for the highest incidence in Sokoto state (1016; 21.2%). Reactive vaccination in the affected areas may have helped curtail the epidemic. A vaccination campaign against NmC with a long-lasting conjugate vaccine should be considered in the northern parts of Nigeria.**

Keywords: **Meningitis belt, outbreak, cerebrospinal fluid, reactive vaccination, epidemiology**

I. INTRODUCTION

Meningococcal disease is a life-threatening and endemic bacterial infection, caused by *Neisseria meningitidis*,with a case fatality ratio of 10–15%; 11–19% of survivors experience long-term sequelae[1], [2]. Meningococcal disease has been reported in various parts of the world. The outbreaks are sporadic in different settings of some countries, for example meningococcal serogroup B (NmB) outbreaks on university campuses and meningococcal serogroup C (NmC) outbreaks among the general population and among men who have sex with men (MSM) in United States[3], [4].

II. REVIEW OF LITERATURE

Large meningococcal outbreaks and epidemics have also been reported in some countries of the world, including Nigeria [5], [6], [7], [8]. Globally, invasive meningococcal disease (IMD) has been reported to be highest in Africa with high endemic rates and periodic epidemics[9].Incidence rates of meningococcal disease are highly variable from year to year andbetween countries, which makes precise estimates of the overallburden in Africa challenging[9]. In most parts of the world, meningococcal disease incidence rates are below 5 cases per 100,000 persons. The case of Africa is different as nearly all African countries have high endemic ratesof over 10 cases per 100,000 and/or experience epidemics[5].

Since 2013, *Neisseria meningitidis*C has been themain cause of meningococcal disease in Nigeria and Niger andhas the potential for further spread in the region[8], [10].Nigeria is within meningitis belt with a long history of high incidence meningitisoutbreaks since the early 1900s and in 1921 when an outbreak in northern Nigeria caused as high as 46,000 deaths[11].

For vaccine prevention efforts, it is important to closely monitorthese highly dynamic epidemiologic changes[9]. This study therefore reports the epidemiology ofmeningococcal serogroup C disease in Sokoto and Zamfara states of Northern Nigeria.

III. MATERIALS AND METHODS

A. Case Definition

The case definition for cerebrospinal meningitis (CSM) as designed by Médecins Sans Frontières (2008), UNICEF and WHOwas used throughout theoutbreak.Suspected case of acute meningitis was sudden onset of fever and either of neck stiffness or petechial rash. For infants under 1 year of age, the case definition was sudden onset of fever and either of bulging fontanelle or petechial rash. In Northern Nigeria, petechial rash is difficult to distinguish due to hyper-pigmentation of the skin (dark skin). Confirmed case of acute meningitis was any case with positive CSF antigen detection via positive latex agglutination test or positive culture.

B. Data Collection

Morbidity, mortality, and demographic data for CSM casestreated by MSF were recorded daily on a standardized line-list from each MSF supported casemanagement site in Zamfara and Sokoto states. Only patients presenting for medical care casemanagement sites during the outbreak period were included on the line list.There are 14 and 23 local government areas in Zamfara and Sokoto states and within each LGA there are approximately 10-15 wards, with variable population (estimatedrange 2,500-140,000); population estimates were estimated using annualprojections based on the most recent national census (2006). The aggregated data analysed in this paper were collected as part of the routine activities from MSF and WHOwith supports from Nigeria Centre for Disease Control and Ministries of Health.

C. Laboratory Methods

Samples of CSF were collected from suspected CSM casesduring the outbreak as well asfrom suspected cases. All samples were tested using the rapid Pastorex® (Bio-rad Laboratories USA) latex agglutination kit to determine thecausative agent. Test kits were stored and transported at 2-8°C. Quality control testsconducted on the kits were before usage. Gram stainingand standard biochemical reactions were briefly done in order to identify bacteria, followed by sero-grouping of N.meningitidis strains using Remel, GA, USA commercial antisera. Antimicrobial susceptibility wasdetermined using minimal inhibitory concentrations (MIC) and classified using the European Committee on Antimicrobial Susceptibility Testing (EUCAST). Multilocus sequence typing (MLST) tests were conducted on each strain identified and compared to the MLST website. PCR analysis wasperformed on culture-negative samples using QiAmp DNA mini kit (Qiagen) and analysed by real-time PCR for speciation followed by genogrouping. Nested porA-PCR was used to determine PorA variant by DNA sequencing of the porAgene [7].As part of routine practice, the rapid Paracheck-Pf® diagnostic test was also conducted on all cases whopresented at anMSF-supported treatment sites.

D. Data Analysis

The Data used for this study were gotten from MOHs and NCDC. However, before the data is shared, quality checks on these figures were done constantly by EOC **emergency operations center team.**SPSS version 25.0 and Microsoft Excel 2016 were used for descriptive analysis including frequencies and summaries.

E. Reactive Vaccination

MSF-OCA acted in a supportive role to the State MOH, and worked in close collaboration with other partners (WHO, CDC, UNICEF) to organise the implementation of a mass meningitis vaccination campaign among age's 1-20years in Zamfara and Sokoto states. The vaccination campaign was executed on between January and May 2017. Each individual was to receive 0.5mls of NeisVac-C vaccine single dose to offer protection against meningitis for 3-5yrs. All the team members were trained for two days prior to the launching of vaccination campaign. Teams were selected from the MSF Pools of Supervisors and few new other Qualified Medics were added.

The vaccination campaign was done for Seven days (5 days for Vaccination and 2 days for aggressive mop-up) in each state after sensitization and mobilization of the community had been done 2 days prior to the vaccination campaign and throughout the exercise by the State mobilization committee in collaboration with UNICEF. The LGA Health Educators and village heads were also involved in community mobilization and sensitization. MOH teams consisting of 6 members (2 vaccinators, 2 recorders/Tally Persons, 1 crowd controller, and a town announcer) were used to cover all the affected local governments.

IV. RESULTS AND DISCUSSION

A. Result

Between December 2016 to June 2017, 5,372 cases of MNC were reported in Zamfara and Sokoto states. There were 277 deaths in Sokoto and 81in Zamfara, making a total for 5,188 probable cases, 184 confirmed and 358 deaths from both states (Table 1). Out of 5,372 cases of NMC seen, 3,074 (57.2%) were males and 2,298 (42.8%) were females with male to female ratio of 1.3:1 while in Sokoto and Zamfara, male to female ratios were 1.4:1 and 1.2:1 respectively. The most affected by NMC in both states was 6-15 years with 49.3% for Sokoto, 53.9% for Zamfara and overall 49.8%. Cerebrospinal fluid (CSFc was collected from 281 (5.2%) suspected cases (190 from Sokoto and 91 from Zamfara), (Table 2).

Table 1: Number, deaths, rates of confirmed and probable CSM cases treated Sokoto and Zamfara States between December 2016 and June 2017

State	Population affected	Number of Probable Cases	No. of Confirmed cases	Total Number of Cases	Number of Deaths
Sokoto	296,922	4,675	124	4,799	277
Zamfara	3,226,789	513	60	573	81
Total	3,523,711	5,188	184	5,372	358

Table 2: Demographic of all cases of NMC seen in Sokoto and Zamfara between December 2016 and June, 2017.

Parameter	Sokoto (n = 4799)	Zamfara (n = 573)	Total (n = 5372)
Gender			
Male	2767 (57.7%)	307 (53.6%)	3074 (57.2%)
Female	2032 (42.3%)	266 (46.4%)	2298 (42.8%)
Age group			
0-5	717 (14.9%)	131 (22.9%)	848 (15.8%)
6-15	2367 (49.3%)	309 (53.9%)	2676 (49.8%)
16-20	733 (15.3%)	60 (10.5%)	793 (14.8%)
Above 20	971 (20.2%	73 (12.7%)	1044 (19.4%)
Not stated	11 (0.2%)	0	11 (0.2%)
CSF	190 (4.0%)	91 (15.9%)	281 (5.2%)

Figure Ishows the weekly number of suspected meningitis cases in Zamfara and Sokoto between December 2016 and June, 2017. The outbreak was seen from week 51, 2016 to week 10, 2017 in Zamfara and lasted from week 2 to week 19, 2017 in Sokoto state. The peak of meningitis cases was observed at week 7, 2017 with 120 suspected cases and minimum at week 10 with while meningitis peak was observed in Sokoto at week 15 with 799 cases.

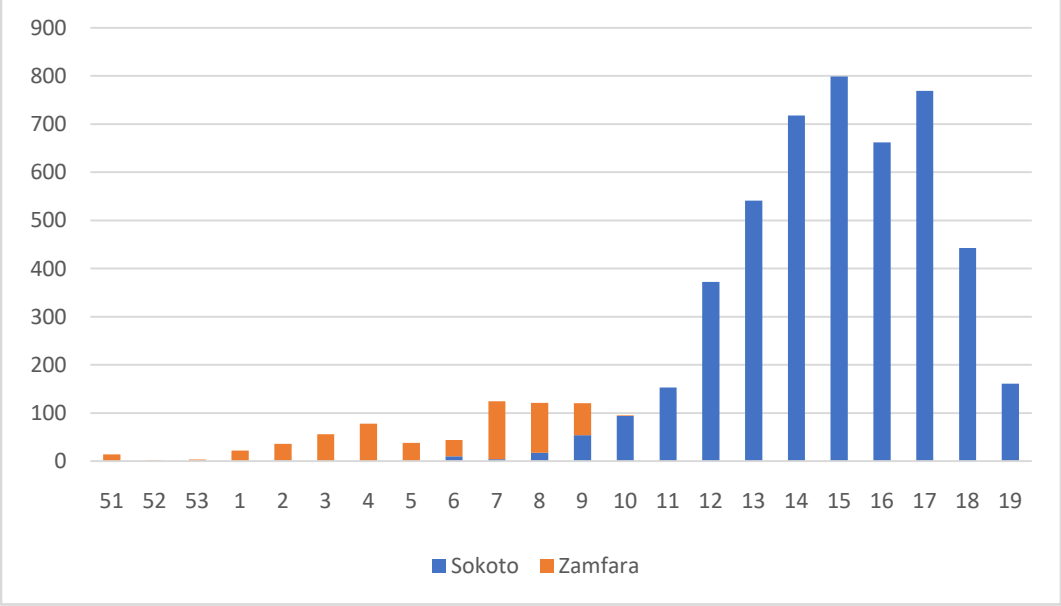

Figure I: Weekly number of suspected meningitis cases in Sokoto and Zamfara states from December 2016 to June 2017.

Figures II and III show the distribution of suspected meningitis cases across all local government areas in both Zamfara and Sokoto states. Marudun local government of recorded the highest incidence (146) in Zamfara followed by BirninMagaji (139) while only 1 case each was seen in Gummi and Maru local governments. In Sokoto state, Sokoto North and South accounted for the highest incidence(1016; 21.2%) followed by Dungeshuni with 600 suspected cases while Gudu local government had the least number (6) of suspected cases.In Zamfara state, the highest number of death

(20) was recorded at week 4 followed by 17 deaths recorded at week 7 before reducing to zero at week 10.

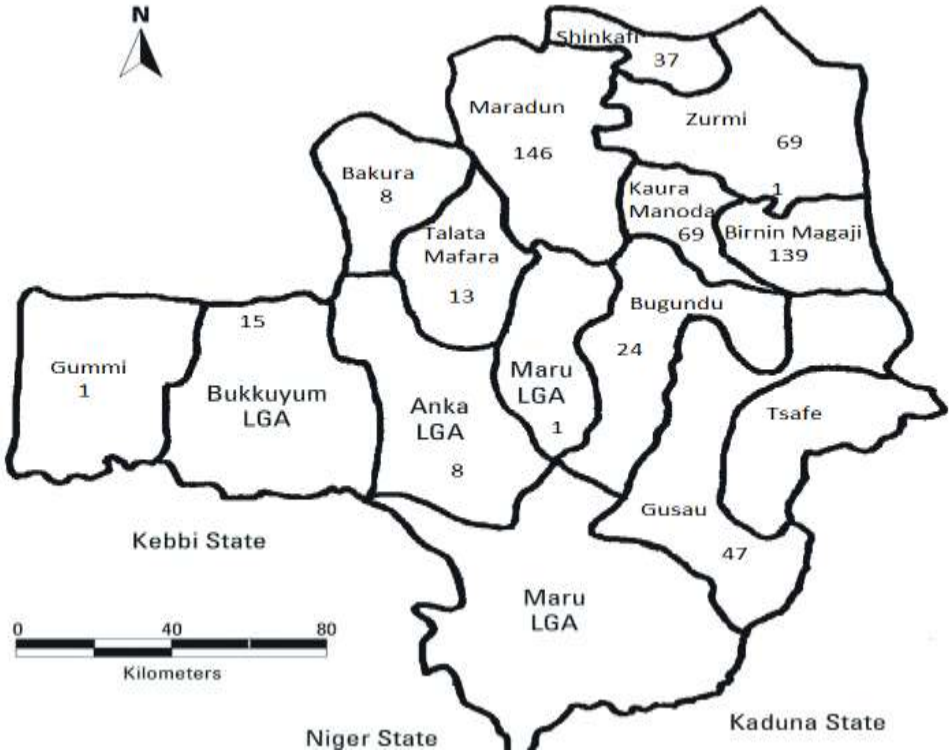

Figure II: Distribution of suspected meningitis cases across all 14 local governments in Zamfara state from December 2016 to March, 2017.

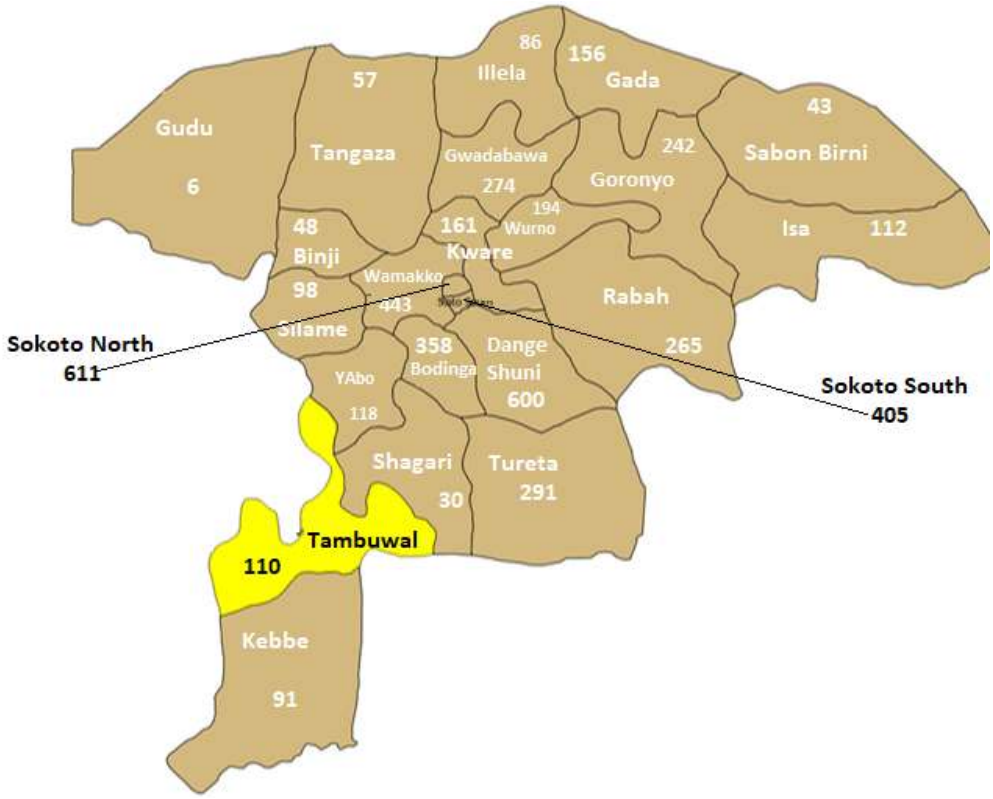

Figure III: Distribution of suspected meningitis cases across all 23 local governments in Sokoto state from February – June, 2017

Table 3: Number, deaths and weekly incidence rate of CSM cases in Zamfara and Sokoto states, December 2016 – June 2017

Epidemiology week	Zamfara			Sokoto		
	Probable cases	Positive cases	No of deaths	Probable cases	Positive cases	No of deaths
51	14	0	0	Na	Na	Na
52	1	0	0	Na	Na	Na
53	3	0	2	Na	Na	Na
1	22	0	4	Na	Na	Na
2	35	4	1	1	0	0
3	56	7	8	0	0	0
4	78	5	20	0	0	0
5	38	1	9	0	0	0
6	34	1	1	10	0	1
7	120	12	17	4	0	0
8	105	25	11	17	3	1
9	66	5	8	54	0	3
10	1	0	0	94	3	2
11	Na	Na	Na	153	3	8
12	Na	Na	Na	372	34	37
13	Na	Na	Na	541	27	21
14	Na	Na	Na	718	14	50
15	Na	Na	Na	799	5	49
16	Na	Na	Na	662	15	29
17	Na	Na	Na	769	10	55
18	Na	Na	Na	443	7	13
19	Na	Na	Na	161	3	8
Total	**573**	**60**	**81**	**4799**	**124**	**277**

Na = not applicable

B. Discussion

The largest outbreak of meningitis in Nigeria was reported between December 2016 and June 2019 mostly in the northern parts of Nigeria. We report meningitis outbreak to Sokoto and Zamfara which acounted for 37% (5372) of the 14,518 suspected meningitis cases reported across Nigeria during the period of the outbreak [12]. Almost 5000 cases of suspected meningitis were recorded in Sokoto during this period. The outbreaks reported in Kebbi and Sokoto in 2013 and 2014 were relatively small, with less than a thousand suspected cases and were particular to specific regions in the affected states [10]. However, large outbreak ofNmC was reported in Kebbi and Sokoto with 6,394 confirmed and probable cases in 2015 [7]. WHO also reported 8500 meningitis cases inneighbouring Republic of Nigerwith sporadic cases reported in Cote d'Ivore, Burkina Faso and Ghana [13].The outbreak of meningitis in Nigeria in 2017 wascaused by the same NmC strain as the 2013, 2014 and 2015 outbreaks but causedmore cases over a wider geographical area in Nigeria including Zamfara, Sokoto, Kebbi, Katsina, Yobe and other states [12]. After the identification of the unique strain of NmC in Nigeria in 2013,WHO expert group meeting concluded that due to this strain, there is a high risk of continuingexpansion of meningococcal meningitis in the meningitis belt[13], [14].No explanation exists yet for the epidemic pattern of meningitis in Africa belt despite much progress in surveillance and biological research, which is required tomathematically modelthe impact of vaccine strategies or to predict epidemics[15].Similar to the 2013, 2014, and 2015 outbreaks, the 2017 outbreak followed typicalmeningitis seasonal patterns in the African meningitis belt as it started during the dry season following the Harmattan winds and stopped at the beginning of raining season [7], [16], [17]. Age and sex distribution of cases seen in 2017 were also consistent with those seen earlier withmeningitis outbreaks, with the 6-15 followed by above 20years' age groups being the most affected andwith equal proportions of males and females [7], [10].

The 2017 outbreak season marked the second reactive vaccination campaign fowling the first reactive vaccination campaign against NmC innorthwest Nigeria in 2015 as a result of requests for vaccines against NmC made by the Kebbi StateMinistry of Health in 2014 which was approved in 2015 [7].

C. Limitations

The data used to describe and analyze the description of themeningitis cases and the outbreak was basedsolely on individuals who presented to various case management facility and weretreated. Additional suspected NmC cases are likely to have beenundetected and unreported because most Hausa married women are not allowed to come out of their compounds unless given permission by their husbands. This caused a low turn up of women in some villages.Also, some men did not want to be touched by women thus when they found ladies vaccinating they didn't get vaccinated.

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