

## The Effect of Oral Cholera Vaccine in Response to an Outbreak of Cholera in a Complex Emergency, Borno State, Northeast Nigeria

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### ABSTRACT

**Background:** Cholera Outbreak remains a global health threat amongst Internally Displaced Persons (IDPs) and areas facing complex emergencies. The insurgency in Northeast Nigeria disrupted social services and displaced thousands into IDPs camps which are overcrowded with sub-optimal water, sanitation, and hygiene. We confirmed, characterized the outbreak and instituted control measures which include the first-ever use of Oral Cholera Vaccine (OCV) in Nigeria.

**Methods:** We defined a suspected cholera case-patient as any person above two ( $\geq 2$ ) years of age presenting with Acute Watery Diarrhea (AWD) and severe dehydration or dying from AWD, with or without vomiting between 14<sup>th</sup> August to 21<sup>st</sup> December 2017. We conducted a descriptive and analytic study. Using the Polio vaccination structure, we launched an OCV campaign in two phases (rounds) targeting all people above one ( $\geq 1$ ) year of age in the affected communities and IDP camps.

**Results:** We identified 6,430 case-patients with 61 deaths in seven (7) Local Government Areas (LGAs) of Borno State which include 3,512 (54.62%) in Jere, 1,870 (29.08%) Monguno, 845 (13.14%) Dikwa, 115 (1.79%) Guzamala, 63 (0.98%) Maiduguri, 23 (0.36%) Mafa and 2 (0.03%) in Gubio. Most of the case-patients 6,109 (95%) were IDPs living in camps. The median age was nine (9) years (Range: 2-80). Females 2,780 (43%) were most affected than males. We targeted a total of 855,492 individuals above one year of age in the affected LGAs for an OCV. We vaccinated 896,919 individuals using 914,565 doses of OCV, giving a coverage rate of 105%. The wastage rate was 0.4%. We did not report any Adverse Events Following Immunization (AEFI). On OCV day four, 122 was the highest number of daily reported case-patients after which the daily case count began to decline until the end of the outbreak. The overall case fatality rate (CFR:0.95%) was 0.95%.

**Conclusion:** The protracted cholera outbreak increased in magnitude and strength, and affected mostly children living in IDPs camps. The cholera outbreak was rapidly detected, and the response was timely, which might have been a possible reason for the low CFR. The reactive OCV might have influenced the ending of the outbreak. Despite the complex and challenging context, we were able to contain the outbreak within four months with a low CFR.

**Keywords:** Oral Cholera; Vaccine; Nigeria

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**Abbreviation:** AWD: Acute Watery Diarrhoea; CFR: Case Fatality Rate; EOC: Emergency Operation Centre; EWARS: Early Warning Alert and Response System; GAVI: Global Alliance for Vaccines and Immunization; IDPs: Internally Displaced Persons; IDSR: Integrated Disease Surveillance and Response System; IMS: Incident Management Structure; LGA: Local Government Area; MSF: Médecins Sans Frontières; NCDC: Nigeria Centre for Disease Control; NRL: National Reference Laboratory; OCV: Oral Cholera Vaccine; QGIS: Geographic Information System application; RDT: Rapid Diagnostic Test Kit; RRT: Rapid Response Team; SMOH: State Ministry of Health; SWOT: Strength Weakness Opportunity and Threat; UMTH: University of Maiduguri Teaching Hospital; UNICEF: United Nations Children's Fund; WASH: Water Sanitation; WHO: World Health Organisation

## INTRODUCTION

Cholera is an acute diarrheal disease that remains a threat to public health and an indicator of inequity and lacks social development globally [1]. Cholera is extremely virulent, affects both children and adults and causes severe acute watery diarrhea [2]. Transmission is mainly through ingestion of contaminated water or food by the bacterium *Vibrio cholera* which has a relatively short incubation period between two hours to five days [3]. Cholera disease can lead to death without adequate and prompt treatment. Most individuals (75%) infected with the bacteria do not develop symptoms. A few (20%) develop mild to moderate dehydration, very few (5%) develop acute watery diarrhea with severe dehydration [4]. The primary treatment is oral rehydration therapy. Severe cases require intravenous fluids such as Ringer's lactate. Antibiotics and Oral Cholera Vaccine (OCV) are beneficial to patient treatment [5]. Vaccine shortage limits the use of OCV which is known to be useful in the prevention and control of outbreaks and can provide reasonable protection for about six months [6].

Worldwide, an estimate of about 1.3 to 4.0 million cases and 21,000 to 143,000 deaths due to cholera occur each year [7]. Globally, in 2016, 38 countries reported a total of 132,121 cases with 2,420 deaths (CFR=1.8%). Although this represents a 23% decrease in the number of cases reported compared to the year 2015 (172,454 cases, CFR=0.8%). This decline is, nonetheless, accompanied by a more than doubling of the CFR [8].

In the mid-1980s, there has been a resurgence of cholera in Africa which constitutes about 55% of the global cholera burden. Since then, cholera remains a grave public health problem, characterized by substantial disease burden, frequent outbreaks, persistent endemicity, and high CFRs [9].

The first case of cholera in Nigeria occurred in a village near Lagos on 26th December 1970, leading to an epidemic of 22,931 cases with 2,945 deaths (CFR 12.8%). In Nigeria, cholera is endemic and seasonal, occurring annually during rainy seasons and more often in areas that have poor sanitation and is often associated with a high Case Fatality Rate (CFR) [10]. Since late 1970, Nigeria had an unfair share of cholera epidemic reporting over 100 cholera deaths per year [11]. In 1991 an outbreak occurred involving 59,478 cases with 7,654 deaths (CFR 12.9%) which remains the highest rate reported in the country to date [12]. In 2010, Nigeria reported 41,787 cases with 1,716 deaths (CFR 5.1%) from 222 LGAs in 18 States of the country, including Borno State [13]. In 2011, the CFR was

3.2%, 2015 CFR was 3.87%, 2012 CFR was 2.6% and in 2013 CFR was 3.4% [14,15].

The on-going Boko Haram insurgency in Borno State led to the displacement of an estimated 7.7 million people who now live in the Internally Displaced (IDP) camps and virtually depend on humanitarian assistance for survival [16]. The consequences of the humanitarian crises worthy of not include; the disruption of health services, resettlement in overcrowded temporary locations (IDP camps), scarcity of safe drinking water, poor sanitation and waste management. These risk factors placed populations affected by a humanitarian emergency at risk of high morbidity and mortality from infectious diseases, such as Cholera [17]. Borno State has a high burden of cholera and has never had a history of cholera vaccination. In 2014, there were 4,536 cases of cholera, including 70 deaths [18]. In 2015 the outbreak involved 1,039 case-patients with 28 deaths (CFR 1.8%). The goal standard of every outbreak response is to achieve a CFR below 1% [19].

### Objectives

1. To confirm the existence of an outbreak
2. To describe the characteristics of the case-patients in time, place and person
3. To institute control measure with the first-ever use of OCV in Nigeria

## MATERIALS AND METHODS

### Study design

We conducted descriptive epidemiology of the cholera outbreak case-based line list between 14th August to 21st December 2017. We calculated frequencies, proportions, attack rates, and age-specific attack rates.

### Study setting

Borno State was the study area located in Northeast Nigeria, which lies within the latitude 100°30'N and 140°00'N and Longitude 110°03'E and 140°45'E. The state has a landmass of about 69436 sq km with a population density of approximately 60 inhabitants per sq km. In 2016, the National Population Commission estimated a total population of 4151193 people, which is projected to 5878089 for 2019 based on the 3.2% annual growth rate [20]. Borno State has 27 LGAs with 311

political wards, shares an international boundary with Niger, Chad and Cameroon and shares an interstate border with Yobe to the West, Adamawa to the South and Gombe to the Southwest. In the Lake Chad Basin region, the insurgency since 2009 has steadily become the single most significant cause of displacement with more than 2.3 million people becoming refugees, Internally Displaced People (IDPs) or returnees as a result. About 78% of the displaced population in Borno State are within Maiduguri, the state capital living in official and unofficial IDP camps [16,17,21]. The IDP camps in Borno state is categorized into both formal and informal, which was set up by the Government with partner collaboration mainly to ensure the safety of the displaced persons.

### Study approach

The Borno State Ministry of Health (SMOH) officially declared cholera outbreak on the 14<sup>th</sup> of August 2017 following the detection of three case-patients (two laboratories confirmed and

01 probable) with three deaths (CFR=100%) in Muna Garage IDP camp in Jere LGA. The outbreak investigation team paid advocacy visits to the state commissioner and other state-level stakeholders. A meeting of stakeholders and partners was held with the SMOH to organise the response and develop a framework for coordination in the Emergency Operation Centre (EOC) based on the standards set by the Nigerian Centre for Disease Control (NCDC) [22]. We conducted a risk assessment, active case search, contact tracing and visited the cholera treatment centres to conduct on-site supportive supervision to improve the accurate recording of case-patient data. We reviewed the line list of case-patients and analyzed surveillance and OCV data in time, place and person using Microsoft Excel 2016, Epi-info 7.2 and QGIS 2.8.1 we generated frequencies and proportions. The team also ensured the transmission of daily call-in morbidity and mortality data for situation reports during EOC meetings. We conducted a SWOT analysis, identified gaps and instituted corrective feedbacks (Table 1).

Table 1: SWOT analysis of 2017 cholera outbreak response in Borno State.

Strength Weakness and Threat (SWOT) analysis			
Strengths	Weaknesses	Opportunities	Threats
The Borno SMOH and partners demonstrated a commitment to the success of the intervention.	Non-use of vaccination cards for the first round of OCV campaign.	Intense National and International support and presence on the field	The OCV implementation was not at the same time in all the participating LGAs due to security issues.
The response plan and availability of funds by the relevant stakeholders were timely.	Inappropriate classification of the age ranges for data collection during the first round.	The quick response of the state to tackle the anti-immunization rumors	External supervisors were not able to access some LGAs due to security concern
The standard case definition and treatment protocol, as well as strict adherence to standard infection prevention and control policy, was adhered.	The health personnel working in the treatment centres had no formal training on cholera case management before the outbreak.	Leverage from existing polio structure	
Community awareness, health education and sensitization campaign conducted in all the affected LGAs.	The OCV used in this campaign (Shanchol) being single-dose placed much stress on the cold chain storage system.	Full participation of the State Polio EOC in the planning and monitoring of the OCV campaigns	
On the job training and close, supportive supervision to improve on the capacities of the cholera case management personnel.	Suboptimal compliance by adults noted in the initial days of the first round.	Involvement of the Supplemental Immunization Activity (SIA) Unit in the conduct of the post OCV2 In-house coverage survey.	
The well-coordinated response between surveillance and case management team in treatment centres to harmonise efforts as regards treatment, reporting and line listing of patients.	Daily call-in data were not always complete due to network challenges in some LGAs.		
	There was no correctly structured IMS at the initial stage of the outbreak		
WASH interventions conducted include well disinfection, water source based water treatment, household water treatment, chlorine-based products, community-driven sanitation, hygiene promotion, hygiene kit distribution and environmental hygiene.	There were no clear definition of the thematic functions of epidemiology and surveillance during the response.		
	The state government did not actively coordinate partner's activities during the response.		

<p>The OCV campaign implemented in the six affected LGAs.</p> <p>There was high demand for the vaccine probably because of the scale in cholera morbidity and mortality during the outbreak.</p> <p>The State line list is updated daily.</p> <p>Daily analysis of case-patients (time, place and person) for evidence-based decision making at the EOC</p>	<p>The social mobilisation team input was highly demanding because the vaccine is new to the state and the country.</p> <p>Vaccination coverage update was not timely as at the time of reporting in the EOC.</p> <p>Some communities associated the OCV campaign with food items distribution, thereby purposefully rejecting with the sole aim of attracting food supply.</p> <p>Broken down Incinerators in the state necessitated transportation of generated wastes to neighbouring Gombe State for incineration.</p>
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## Cholera surveillance in Borno state

Cholera surveillance in Borno State is mainly through the Integrated Disease Surveillance and Response System (IDSR) platform and the Early Warning Alert and Response System (EWARS). On the IDSR, Information flows from the health facilities, through the ward focal persons to the LGA's DSNOs and then to the State's DSNOs. The feedback is in the opposite direction [23]. In August 2016, the EWARS was established in Borno State to complement the IDSR tool. IDSR tools were operational in all the health facilities, EWARS is not. The objectives of EWARS are to promote the early detection of disease outbreaks and to develop stronger links to public health actions through the initiation of timely and effective response efforts [24].

## IDSR cholera case definitions

The following case definitions of cholera were used during the outbreak to identify and line list case-patients appropriately based on NCDC guidelines [22].

- Any person above two ( $\geq 2$ ) years of age in Borno State presenting with AWD and severe dehydration or died as a result (with or without vomiting), between 14 August to 21 December 2017
- Suspected case-patient with an epidemiological link to the confirmed case
- Isolation of from any patient presenting with diarrhea with or without vomiting

## Laboratory investigation to confirm the existence of an outbreak

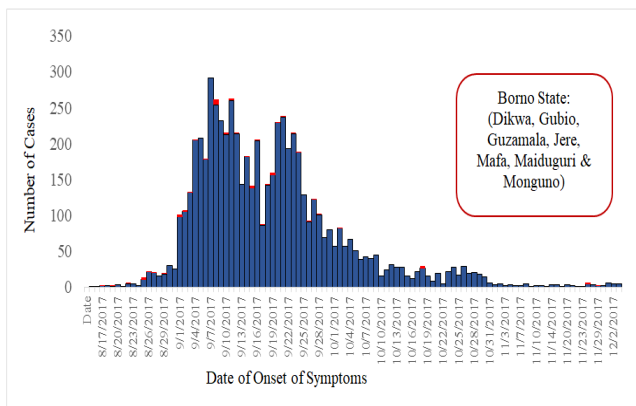
On the 14th August 2017, the EWARS picked an increase in the number of AWD in a health facility in Muna IDP camp of Jere LGA, and immediately the state Rapid Response Team (RRT) investigated. Laboratory diagnosis was made using cholera Rapid Diagnostic Test (RDT) kits in the field and stool culture at the University of Maiduguri Teaching Hospital (UMTH). We shipped all stool samples cultured positive for *Vibrio Cholerae* to the National Reference Laboratory (NRL) in Gaduwa, Abuja for a two-step confirmation. Stool and water samples were also cultured positive and sent to Senegal for further re-confirmation. Samples from the confirmed cases were also taken to the WHO laboratory in Lagos for serotyping. The result revealed the presence of cholera organisms Ogawa 01. We initiated Community-based active surveillance to enhance case detection by intensive community sensitization through the house to house mobilization, radio and television jingles announcing the availability of free treatment at all cholera treatment centres and oral rehydration points.

## Ethical consideration

We sought for the approval to use the cholera case-based line list from the Public Health Department of the Borno State Ministry of Health. We did not identify patients' personal information during extraction and data analysis to protect patient confidentiality.

## RESULTS

We identified 6430 case-patients with 61 deaths (CFR: 0.95%) between 16th August to 21st December 2017 in Borno State (Figure 1).



**Figure 1:** Distribution of 2017 cholera cases and deaths by date of onset.

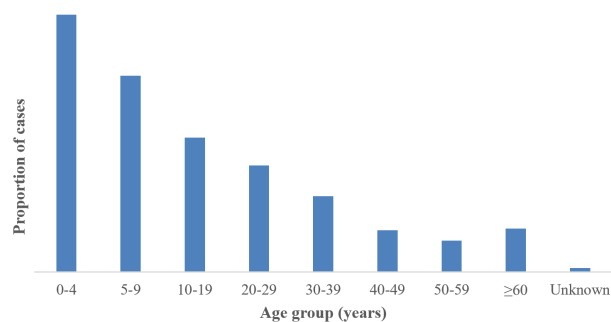
There were more 3392 (52.75%) female case-patients than male 3038 (47.25%) case-patients (Table 2).

**Table 2:** Age and sex-specific CFR, 2017 cholera outbreak in Borno State.

Variables		Cases	Deaths	CFR (%)
Age group (years)	0-4	1858	18	0.97
	5-9	1417	15	1.06
	10-19	970	2	0.21
	20-29	770	6	0.78
	30-39	547	9	1.64
	40-49	302	1	0.33
	50-59	225	3	1.33
	≥ 60	314	7	2.23
Sex	Male	3038	19	0.63
	Female	3392	42	1.24
Overall		6430	61	0.95

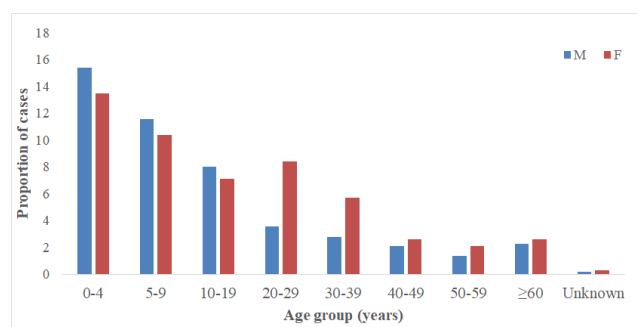
The median age for the case-patients was nine (9) years, with an age range of 2-80 years.

The majority 1858 (28.89%) of the case-patients were within the age group 0-4 years, followed by the age group 5-9 years 1417 (22.04%). The age group with the least reported morbidity 225 (3.5%) was 50-59 years (Figure 2).



**Figure 2:** Proportion of 2017 cholera case-patients by age group.

The age group 5-9 years 1417 (22.04%) and 10-19 years 970 (15.09%) had the highest proportion of both males and females (Figure 3).



**Figure 3:** Age distribution by sex of 2017 cholera cases in Borno State.

The age-specific CFR was highest (2.23%) among those above 60 years of age. The CFR among females (1.24%) is double that of males (0.63%) (Table 1).

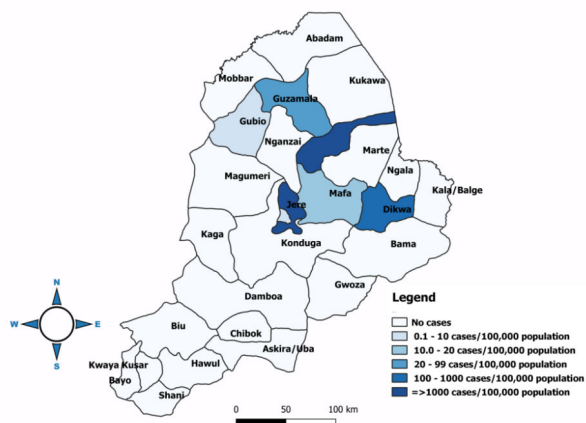
The cholera outbreak affected seven LGAs include; Jere 3512 (54.62%), Monguno 1870 (29.08%), Dikwa 854 (13.28%), Guzamala 115 (1.78%), Maiduguri 63 (0.98%), Mafa 23 (0.35%) and Gubio 2 (0.03%) LGAs (Figure 4).



**Figure 4:** Map of Borno State highlighting LGAs affected by cholera.

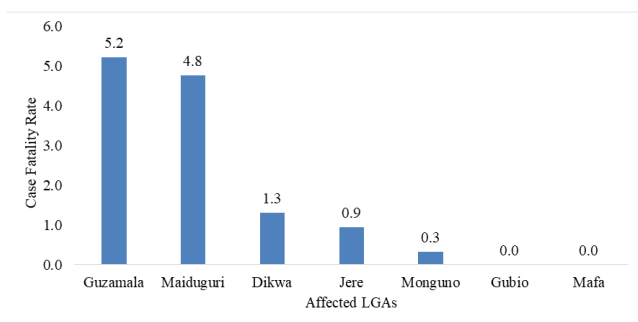
Most of the case-patients 6109 (95%) were from IDPs camp. Jere and Monguno had the highest attack rates, while Gubio and Maiduguri had the lowest (Figure 5).





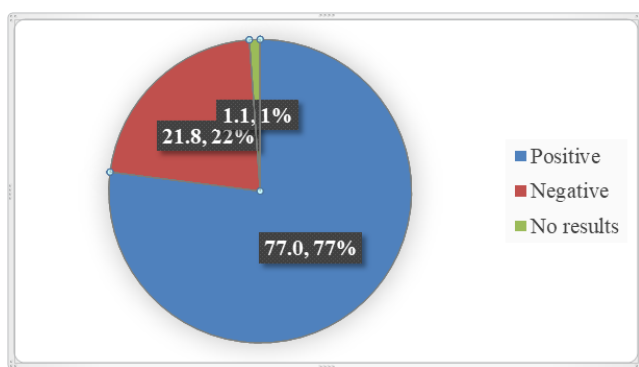
**Figure 5:** Attack rates/100,000 population in 2017 Cholera Affected LGAs.

Guzamala (5.2%) and Maiduguri (4.8%) had the highest specific CFRs, while Gubio and Mafa recorded no fatality (Figure 6).



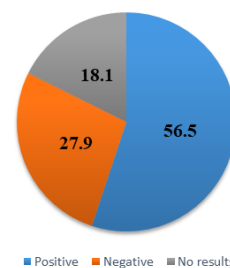
**Figure 6:** CFRs in 2017 cholera outbreak affected lgas of Borno State.

A total of 435 samples (6.8% of case-patients) were collected and tested using RDT kits. 335 (77%) were RDT positive, while 95 (21.8%) were negative (Figure 7).



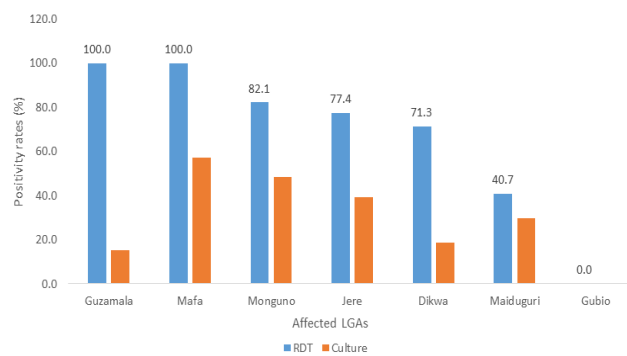
**Figure 7:** Proportion of laboratory results using RDT Aug-Dec, 2017.

Only 262 (60.2%) of the total (435) stool samples collected were cultured. 148 (56.5%) of the cultured samples tested positive, while 73 (27.9%) were culture-negative (Figure 8).



**Figure 8:** Proportion of stool culture laboratory results of 2017 cholera outbreak in Borno State.

Guzamala (100%) and Mafa (100%) LGAs had the highest positive rate of the total samples tested RDT positive (Figure 9).



**Figure 9:** Positivity rate by RDT and culture in affected LGAs.

### Public health action

The outbreak escalated within a short period and spread within the IDP camp and host communities to affect seven (7) LGAs of the state. We activated the cholera EOC to coordinate the response led by the Borno State Ministry of Health in collaboration with WHO and other partners. We initiated multiple approaches which include the provision of WASH services, health promotion messaging, early case detection and management. Alongside other interventions, the International Coordinating Group (ICG) through the National Primary Health Care Development Agency (NPHCDA) licensed the use of Schancol as the first-ever use of OCV in Nigeria. Global Alliance for Vaccines and Immunisation (GAVI) covered the operational cost for the 914565 doses of OCV used during the vaccination campaign ((0.38 USD) cents per dose). Using the Polio vaccination structure, we conducted a two-dose OCV campaign at the peak of the outbreak to prevent the occurrence, limit the spread and reduce mortality, conduct active surveillance for cholera cases in all the affected communities and achieve vaccination coverage of at least 95% of all targeted population in affected communities. We targeted all individuals above one year of age in the affected communities and IDP camps, accounting for 96% of its total population (Table 3).

**Table 3:** Summary of the target population, vaccination coverage, and wastage.

S/No.	LGAs	Population				Vaccinated		AEFI		Coverage.		Wastage
		Total	Target (>1 yr)	1-6 Yrs	>6 Yrs	Total	1-6 Yrs	>6 Yrs	Total			
1	Jere	131264	126013	40706	88745	129451	0	141%	91%	103%	0.9%	
2	Maiduguri	352954	338836	122463	215645	338108	0	158%	83%	100%	0.6%	
3	Monguno	111938	107460	59282	70224	129506	0	241%	85%	121%	0.2%	
4	Dikwa	197020	189139	40363	163045	203408	0	93%	112%	108%	0.0%	
5	Konduga	45347	43533	13546	30286	43832	0	136%	90%	101%	0.2%	
6	Mafa	52614	50509	13680	38934	52614	0	118%	100%	104%	0.0%	
Total		891137	855492	290040	606879	896919	0	148%	92%	105%	0.4%	

**Training:** We identified and conducted training for all the relevant actors involved in the leadership and implementation of polio vaccination campaigns from the state to the community level for the OCV campaign using standard training guidelines. We prepared training materials on critical components of the OCV campaign to ensure the quality and consistency of the training curriculum and shared with the trainers and supervisors selected from State during the training of trainers.

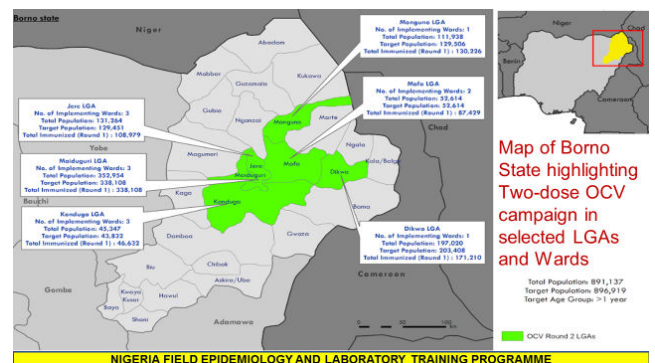
**Advocacy/social mobilization:** The OCV social mobilization working group, constituted at the state level, developed a strategy that helped to create awareness on OCV campaign and generate demand for the vaccine. One of the strategies employed by the social mobilization group was concerted effort to engage the community through mass media messages, the involvement of community leaders as well as messages through town announcers. The social mobilization efforts were effective in tackling the anti-immunization rumors. In general, there was a high degree of acceptance of the vaccine.

**Vaccine logistics and cold chain:** The vaccine was freighted to Maiduguri from Abuja in batches to minimize the risk of a shortage of space at the state cold-room (Figure 10).

**Figure 10:** Offloading cholera vaccines into the state cold room for storage.

Similarly, the challenge of storing huge vaccine volume at the LGAs was addressed by dispatching their supplies every other day from the state cold-room, given the OCV used (Schanchol) being a single dose vial vaccine. Provision of additional two vaccine carriers per team minimizes the issue of vaccine volume and the need for restocking in the middle of the campaign.

We implemented the first round of the OCV campaign between 17th-21st September 2017 in six affected LGAs, namely: MMC, Jere, Monguno, Konduga, Dikwa and Mafa (Figure 11).

**Figure 11:** Map of Borno State highlighting OCV implementing LGAs.

We targeted 855492 but vaccinated 896919 individuals who gave a coverage rate of 105%. The average wastage rate was 0.4% with the lowest (0%) in Mafa and the highest (0.9%) in Jere. We implemented the second round of the OCV campaign between 8th-18th December 2017 to increase OCV life-saving protection against cholera and increase herd immunity. The target population includes adults and children over the age of 1 year, who received the first dose of OCV (Table 4). We targeted 896919 (total vaccinated during OCV1) though we did not

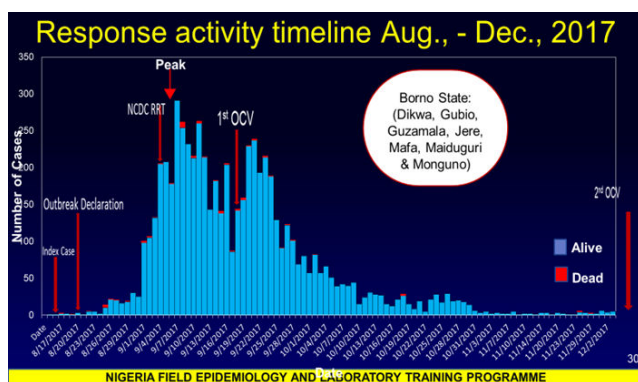
record any Adverse Events Following Immunization (AEFI). The highest number of daily recorded case-patients (306) ever during

the outbreak was on 8th September 2017. Since then, the number began to decline until the end of the outbreak (Figure 12).

**Table 4:** Target population for OCV 1 and 2 per LGA.

LGA	Population	OCV1 Target Population (>1 Years)	OCV2 Target Population (OCV1 vaccinated)	Wards
Jere	131264	126013	129451	3
Konduga	45347	43533	43832	1
Maiduguri	352954	338836	338,108	3
Monguno	111938	107460	129,506	1
Mafa	52614	50509	52614	2
Dikwa	197020	189139	203,408	1
Total	891137	855492	896,919	13

Rates by LGA during 2017 OCV 1 in Borno State



**Figure 12:** Trend of cholera cases during the OCV campaign.

## DISCUSSION

The cholera outbreak response was successful through a coordinated mechanism articulated from the EOC in Maiduguri as well as in all the affected LGAs. The Borno SMOH supported by WHO, UNICEF, MSF, FHI360, donors and other partners. The response pillars were surveillance, case management, water sanitation and hygiene, OCV vaccination and social mobilization. Critical interventions consisted of timely management of case-patients with the set-up of cholera treatment centres alongside targeted daily WASH and health promotion activities in households of case-patients. This OCV campaign was the first-ever use of OCV in Nigeria. Despite the on-going efforts to control the outbreak through improved water and sanitary services, health promotion messaging and early case detection and management, the outbreak increased in magnitude and strength. Also, an increasing number of suspected cholera cases noted new hot spots during the outbreak. The total number of cases and deaths as of 8<sup>th</sup> September 2017 was 1165 and 30 respectively making the case

fatality rate 2.6%, which was far above the acceptable level. As at the time of OCV implementation, more than 90% of the cases are in IDP camps which caused several deaths in the state. The highest case fatality rates recorded in this outbreak were 5.2% in Guzamala LGA (Figure 6). Interventions of the SMOH and NCDC assisted by different partners in setting up cholera treatment centres in all affected LGAs yielded useful results. To this end, the NPHCDA in collaboration with WHO quickly submitted a proposal to source for OCV through the ICG for vaccination campaigns to reach over 900000 people in the six (6) affected LGAs (Jere, MMC, Dikwa, Konduga, Monguno, and Mafa).

As a part of the cholera outbreak control measures, underlining the importance of focusing control measures in the overcrowded IDP camps, the first round of OCV campaign was implemented between 17<sup>th</sup>-21<sup>st</sup> September 2017 in six affected LGAs (namely Maiduguri Municipal Council, Jere, Monguno, Konduga, Dikwa, and Mafa). The general objectives of the first OCV campaign were to prevent the occurrence, limit the spread and reduce mortality due to cholera disease outbreak. The second round OCV campaign of the campaign was between the 8<sup>th</sup>-18<sup>th</sup> December 2017 and reached 896919 beneficiaries. Nine hundred fifteen thousand doses were approved, and 914565 doses were delivered to the country on the 15<sup>th</sup> September 2017 for onward shipment to Maiduguri, the Borno state capital on 16<sup>th</sup> September 2017. We conducted the campaign within five days each and between 18<sup>th</sup>-22<sup>nd</sup> September 2017 targeting population above one year in the five mentioned LGAs vaccinated. The vaccine used was (Schancol) an oral vaccine manufactured in India, which was the first-ever use of OCV in Nigeria, a two-dose campaign. At the end of the first-round exercise, the coverage was 105% of the target population, and there was a balance of vaccine not used. So, the committee carried out vaccination in Mafa a new area not covered in the initial planned five (5) LGAs.



## CONCLUSION

The insurgency in Northeastern Nigeria disrupted social services and displaced thousands into overcrowded IDP camps with sub-optimal Water, Sanitation and Hygiene (WASH). The continuation of the insecurity and its risk factors associated resulted in a cholera outbreak which started on the 16<sup>th</sup> August 2017 to spread to other camps and host communities with over 6340 cases with 61 deaths recorded by 21<sup>st</sup> December 2017. The government supported by partners mounted an unprecedented response to the cholera outbreak, and this included the first-ever use of OCV in Nigeria (over 1 million people vaccinated in the two rounds of the campaign). The team recommended the formation of the case management cluster and a cluster lead was identified to enhance coordination and communication. Preventive OCV Campaign. There is a need for more cold chain capacities at all levels to accommodate such a large volume of vaccines in subsequent campaigns. There is a need for more cold chain capacity, even additional vaccine carriers per team. State government and the relevant agencies to undertake exhaustive repairs of all the old incinerators. A modern designed study could give additional evidence on operational issues such as vaccine efficacy, the effect of OCV on the rapid diagnostic test. Despite the complex and challenging context, we contained the outbreak within four months with a case fatality of 1.1%. The cholera outbreak in Borno state was successfully curtailed on 21<sup>st</sup> December 2017, through the concerted effort of the SMOH, with support from WHO and partners. There number of reported cholera cases after the OCV campaign was seen to decline, though other cholera outbreak measures and the arrival of the dry season may have also contributed.

### What is known about this topic?

- Cholera outbreaks remains a global health threat amongst internally displaced
- Persons (IDPs) and areas facing complex emergencies

### What does this study add?

- A reactive OCV might have influenced the ending of the cholera outbreak
- Despite the complex and challenging context, we contained the cholera outbreak involving a large number of case-patients, within four months with a low CFR
- Public health officials may draw on this experience and conduct oral cholera vaccination campaigns more frequently

## CONFLICT OF INTEREST

The authors declare that they have no conflict of interests.

## AUTHORS' CONTRIBUTION

Dr. Kumshida Yakubu Balami: made the concept and study design, literature search, data review, and analysis as well as drafting the manuscript; Dr. Collins Owili: coordinated the entire cholera outbreak response; Dr. Uzoma Iheanyi Ugochukwu: coordinated the surveillance activities; Dr. Arhyel

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