

Cholera Outbreaks in Conflict-Hit Regions of Northern Nigeria: An Overview

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Cholera, an acute diarrheal disease, remains a major public health problem, causing substantial morbidity and mortality in many developing countries. Cholera infection occurs when food or water is tainted with the etiologic bacteria, *Vibrio cholerae*. Nigeria has seen sporadic outbreaks of epidemic cholera since it first appeared in 1972. Recently, cholera cases have significantly increased since June 2022 and have been negatively impacted by floods, with outbreaks mostly occurring in the northern states. Between January to September 2022, Nigeria reports more than 10,000 probable cholera cases. As of December 24, 2022, cholera outbreaks have been reported in the Northeastern States of Borno, Adamawa, and Yobe. A total of 7,700 cases, including 324 deaths, were reported across these three states, with Borno State accounting for 70.13% of these cases. The spread of cholera and

other waterborne diseases is likely to escalate due to factors such as flooding, limited access to hygiene services, and water contamination. Moreover, insurgency, which has devastated the Northeast and armed banditry in the Northwest, has displaced millions of people, limiting access to clean water and food. This situation has aggravated the outbreaks of cholera in the region leading to recurring outbreaks which are characterized by high mobility, increased hospitalization and deaths. However, the nature of the hostilities in the two regions makes it challenging to determine the precise burden of cholera due to reporting and access issues. Therefore, this article gives an overview of the cholera situation in the conflict-hit regions of Northern Nigeria in the hopes to create more awareness and facilitate the prevention strategies to contain the spread of cholera disease.

Cholera, caused by *Vibrio cholerae* continues to pose a threat to public health globally and is a major sign of a lack of social progress. Most developing nations in the tropics and subtropics are currently affected. It is widespread throughout Africa, the Middle East, some regions of Asia, and South and Central America [1,2]. Natural disasters like floods fuel the pandemic by upsetting the natural order, which causes numerous health issues, including those related to food and water [3,4]. In cholera-endemic regions, outbreaks typically occur when civil upheaval or war affects public sanitary services. Similarly, natural catastrophes, such as earthquakes, tsunamis, volcanic

eruptions, landslides, and floods, can disrupt the delicate balance of nature and consequently contribute to the occurrence of outbreaks [5]. Parasites and germs can contaminate food and water supplies, leading to several health issues, including cholera [5].

Since the first outbreak of epidemic cholera in Nigeria in 1972, the country has experienced cholera outbreaks on an annual basis, especially during the rainy season when the disease tends to spread more easily due to poor drainage systems, hygiene practices and limited access to clean tap water [3,5,6]. In 2010, a major epidemic notable for its high rate of confirmed cases (3,000) and

fatalities (781) began in the Northern region of Nigeria [5]. About a decade later, Nigeria recorded its highest number (100,000) of cholera-suspected cases in recent memory. Consequently, the Nigerian Center for Disease Control reported 3,604 fatalities and 111,062 cases of cholera in the country between From January to July 2021. These figures exceeded the numbers reported in 2020. More recently, outbreaks of cholera have been recorded across various regions of Nigeria [7].

Previous outbreaks of cholera in Nigeria have been discussed in the context of fragility brought on by either armed conflict or natural catastrophes such as floods [8]. Often, conflicts are accompanied by humanitarian crises leading to poor access to food, water and hygiene facilities, which drive the transmission of infectious diseases such as cholera. In addition, conflicts limit access to healthcare and humanitarian interventions. While the Northeastern States have been devastated by the Boko Haram military for more than one decade, the Northwestern States have witnessed several of the worst attacks by bandits for many years. Millions of people from the sixteen states in these regions were displaced, suffering from a severe lack of shelter, food, portable water and health care services [3–5].

Recurring outbreaks of cholera have been reported in these regions. For example, as of 24 December 2022, 7,700 cases of cholera, including 324 deaths, were reported across the three northern states of Borno, Adamawa and Yobe, with 5,400 of these cases in Borno state alone [9]. Adamawa State currently has 124 cholera cases and 5 fatalities across six local government areas (LGAs), including Yola. An estimated 1,300 people have been affected across 12 LGAs [9]. In addition, the nature of the conflicts in the two regions creates a situation where the exact burden of cholera will be challenging to establish due to underreporting and a lack of access. In addition, cholera's two most distinctive epidemiologic characteristics are its propensity to manifest in violent outbreaks and to cause pandemics that may gradually afflict several nations. Therefore, this paper distils available literature to get an understanding of the cholera situation in the region. Moreover, challenges faced by government and non-governmental eradication efforts and offered suggestions to help develop targeted infection

control and prevention initiatives as also discussed.

Boko Haram attacks in the Northeast and banditry in the Northwest

Boko Haram is a militant Islamist group based in Northeastern Nigeria, recognized for its violent extremism and insurgency activities [10]. The group's name translates to "Western education is forbidden" in the local Hausa language, reflecting its opposition to anything it perceives as a Western-based influence, including secular education and governance systems [10]. The group was founded in 2002 by Mohammed Yusuf, initially as a non-violent religious movement, but it evolved into an armed rebellion following Yusuf's death in police custody in 2009, leading to the widespread violence and instability that characterizes the group today [10,11].

Communities in Nigeria's Northeastern provinces have been ravaged by the 14-year struggle with Boko Haram. Boko Haram has focused its attacks on both people and security forces while also causing significant damage to public structures and infrastructure. The frequent raids have seriously violated local residents' human rights. Murder, kidnapping, sexual assault, child conscription for forced labour, looting, and burning of public structures (like schools), private property (like farmland), and, in some cases, entire communities are among these atrocities [11,12]. The crisis is marked by bombing, kidnapping, and the devastation of lives and property. Boko Haram is related to bad government and religious fanaticism. Between 2009 and 2018, the Boko Haram conflict claimed over 30,000 lives, forced over 1.8 million people from their homes, and damaged property worth 16 billion naira [13]. The victims of this abuse frequently suffer from long-lasting physical and psychological anguish.

In the late 2000s, banditry in rural Nigeria started to spread. It has now developed into sophisticated violent crime, characterized by vastly influential syndicates operating across borders. According to the pattern of recent assaults in northern Nigeria, there is now an increased threat from terrorism, banditry, arms and illicit substance trafficking [14,15].

In northern Nigeria, there is evidence of a covert alliance between terrorist groups and bandits that is motivated by pragmatism or tactical

opportunism. They had grown into organized tribes of semi-sedentary criminals by the late 2010s, maintaining little fiefdom in the underground. This was especially true in certain regions of the Northwestern Nigeria States of Zamfara and Katsina [14]. Numerous variables, including bandits' connections to Islamist fanaticism, narcotics, and arms trade, have allowed banditry to evolve into a sophisticated type of organized crime. Bandits are currently active in numerous states of Nigeria's Northwestern and North-central regions. Zamfara, Katsina, Kebbi, Kaduna, Sokoto, Nasarawa, and Niger are the key hotspots. With its epicentre in the Birinin Gwari neighbourhood, the Kaduna-Katsina-Zamfara axis has seen a disproportionately high number of fatal accidents. On March 28, 2022, robbers bombed a Kaduna-Abuja train's rails in an attempt to demobilize it for assault. The incident highlighted the banditry crisis's intractability and its worsening dynamics [14]. It is estimated that at least 200 people were slain in some of the bloodiest attacks by armed bandits operating freely in the communities in Zamfara State of Northwestern Nigeria [16].

Cholera situation in the Northeastern and Northwestern Nigeria

Cholera is one of the major opportunistic diseases. The rate of the outbreak in Northeastern and Northwestern Nigeria, especially in Borno, is alarming, with concentrated cases in Gwoza and Danboa LGAs. As of December 1, 2022, 75% of the reported 696 cases and 69% of the 46 fatalities from the outbreak were accounted for. Reliefweb recorded more than 2,000 instances of cholera in 25 local government areas in Borno, Adamawa, and Yobe states, with 76 fatalities; these LGAs were among those that were severely impacted by the Boko haram insurrection in 2021 alone [9]. According to the Nigeria Centre for Disease Control (NCDC) report, from September 1 to September 4, 2022, a total of 1,677 suspected cholera cases were reported across 11 states. The number of reported cases include 853 cases in Yobe, 333 in Borno, 247 in Jigawa, 133 in Gombe, 171 Kano, 115 Katsina, 14 in Kaduna, 12 in Sokoto, 11 in Plateau, and 1 in Kebbi. Nine of these eleven states are located in Nigeria's Northeast or Northwest region [17].

As a result of insecurity, these areas are now difficult to access and have inadequate water, hygiene, sanitary (WASH) infrastructure and

health care services. Wells, reservoirs, pipelines, transformers, and other crucial infrastructure for the provision of basic social amenities were destroyed by the Boko haram rebels [11–13]. Likewise, the relocation of internally displaced persons (IDPs) and the absence of adequate sanitation services in overcrowded settlements resulted in the overflowing of latrine pits coupled with flash floods, which exacerbated the situation. Hence, making the victims vulnerable to cholera, among other opportunistic diseases. Six LGAs in Adamawa state, including Yola, are currently home to 135 cholera cases and 7 fatalities. As a result, there have been temporary population displacements and water contamination in the impacted areas. Yobe state has yet to formally declare a cholera outbreak despite having acute watery diarrhea cases. Over 12 LGAs, an estimated 1,300 people have been impacted [7,9].

In the Northwest, armed conflict contributed to an upsurge in internal displacement; according to International Organization for Migration (IOM) 455,000 people were displaced within the three states of Katsina, Zamfara and Sokoto, out of the seven states in the Northwest [18]. As a result, Zamfara and Katsina States had the highest numbers of IDPs of 179,105 and 223,576, respectively. The remaining IDPs are dispersed in environments resembling camps, with over 80% of them living in host communities [18]. In Kaduna state, cholera outbreak claimed the lives of 196 people in 2022. The main causes of displacement are armed banditry and kidnapping. According to the multi-sectoral needs assessment (MSNA) results, the most pressing needs in these states are WASH, education and shelter [4]. As priority is now being shifted towards security, a significant data concerning cholera outbreaks are limited and unavailable from most of the remote areas of Northeastern and Northwestern Nigeria, leading to underreporting.

The risk factors that have contributed to the rapid spread of the disease across the northeast and northwest of Nigeria are the limited health and water, hygiene, and sanitary (WASH) facilities, which have been further weakened by conflict in the region, poor hygiene practices, particularly open defecation, and congestion across camps and communities hosting displaced and affected population.

Armed conflict as a driver of cholera transmission

Armed conflict acts as a direct or indirect catalyst in the transmission and exacerbation of infectious diseases [19]. Armed conflict was connected to a 3.6-fold increase in cholera outbreaks in Nigeria, and over the past two decades, the cholera disease outbreak attributable to conflict in Nigeria is 19.7% [20]. Boko Haram and bandit attacks often result in the tragic deaths of women, children, and the elderly, along with widespread kidnappings and rapes. These assaults also lead to significant destruction of homes and medical facilities [15]. Displaced by these attacks, many people are forced into hostile environments with inadequate shelter, poor access to water, sanitation, and hygiene (WASH), and insufficient healthcare, facilitating the spread of diseases like cholera, typhoid, and schistosomiasis [11].

Conflicts might worsen pre-existing vulnerabilities, making poverty worse and increasing the risk of cholera. Poverty has far-reaching implications and is a documented risk factor for illnesses like cholera [4], among others [21]. For instance, cholera epidemics have primarily affected impoverished urban areas because of overcrowding and inadequate access to water for washing [22]. People living in areas impacted by protracted crises are at a higher risk of contracting communicable illnesses, particularly diarrhoea, measles, and acute respiratory illnesses, due to the lack of access to drinkable water, filthy living conditions, overcrowding, and inadequate sewage systems [23,24]. In addition, conflict-related displacement of people may result in the usage of water polluted with toxic *Vibrio cholerae* strains due to a lack of alternate water sources, causing cholera epidemics. Conflict-related relocation can make it difficult to get sanitation (such as toilet access or soap availability), making it easier for infectious diseases to spread quickly [25].

Direct infrastructure damage might make care unavailable, and unforeseen barriers can make it difficult to get to the facilities [20]. Consequently, hospitals can become under a serious state of disrepair [10,26]. During such attacks, medical supplies such as oral rehydration solutions, pathogen-sensitive antimicrobial medications, and oral cholera vaccinations may be stolen or destroyed [27]. Moreover, medical

staff and even patients often come under attack triggering fears. Staff of humanitarian organisations may leave these places as their safety cannot be guaranteed. In this situation, health-response intervention by non-governmental organizations (NGOs) to control infectious diseases may be interrupted or withdrawn from these areas due to an inability to ensure the safety of their staff [20].

Vaccination is key to preventing infections. The output of armed conflict serves as one of the key barriers to preventing and eradicating vaccine-preventable diseases such as polio, pertussis, and measles. Insecurity concerns related to armed conflict affect vaccination energies in northern Nigeria, thwarting many children from receiving and/or impacting the immunization cycle [12]. For example, between 2019 and 2021, routine immunization in children decreased from 7.7% to 3.4% in Anka [15]. Likewise, in 2013, half of Nigeria's polio cases came from Boko Haram-affected regions, and the only polio case in 2014 came from Borno State. This is the result of inaccessibility to those who relocated to the uncomfortable area after an insurgent onslaught lowered the area's immunity compared to other comfortable locations, making a sizable number of children vulnerable to diseases [12].

Roles of governments and non-government organizations in tackling cholera in the regions

Non-governmental organizations (NGOs) have existed in developing countries for more than four decades and have played vital roles in managing the spread of communicable diseases [3,28]. The central area of concern for many NGOs involves improving healthcare systems and good governance [28], which agrees with the government's primary responsibility at both state and national levels. The Nigerian government supported the fight against cholera directly or indirectly through various government agencies and institutes. At the national level, Nigeria established the NCDC in 2007 to address the emerging outbreaks in the country. NCDC champions the forefront position in the prevention, control and provision of laboratory facilities to combat the spread of contagious diseases, including cholera, in Nigeria. The government strongly collaborates with World Health Organization (WHO), US CDC and other organizations, providing and managing disease

surveillance in the country and establishing reference laboratories [29].

Furthermore, one of the salient factors responsible for reemergence of cholera infection in most hotspot areas is poor/inadequate drinking water supply. A recent study has indicated that more than 60 million Nigerians do not have access to quality water supply, which has been shown to have a direct relationship with increasing cholera incidence in the country [30]. Most recently, an epidemiological survey showed that out of the six geopolitical zones in Nigeria, the Northeast and Northwest have higher fatality rates [31], requiring urgent government and NGO intervention. To end cholera's aetiology, the Nigerian government paid much attention to providing a safe drinking water supply and sensitization on personal hygiene and sanitation practices [32]. In 2019, Nigeria partnered with a United Nation agency, the International Organization for Migration, which supplied over 68 boreholes across Borno State as preventive measures against the cholera outbreak [33].

The role of NGOs in tackling cholera cannot be overemphasized. They provide essential information to the government on the incidence of many infectious diseases in Nigeria. For example, during the 2015 cholera outbreak in two Internally Displaced Persons (IDP) camps in the Northeastern region, they (NGOs) immediately notified the Borno State government of the incidence of 30 suspected diarrhoea cases and seven deaths, which led to the recruitment of 6 Nigeria Field Epidemiology and Laboratory Training Program (NFELTP) residents to investigate the matter properly [3].

Northeastern Nigeria, especially Borno State, is one of the vulnerable regions for cholera epidemics due to the Boko Haram insurgency, resulting in inadequate water supplies, vandalization of healthcare systems and more internally displaced persons. In 2017, the government intervention through the NCDC and Non-governmental organizations such as Médecins Sans Frontières International and WHO tremendously played vital roles in mitigating the spread of cholera and reducing the mortality rate in Borno State, Nigeria [34,35]. To combat the spread of infection, the Borno State Ministry of Health also established an emergency operating centre to curtail the epidemics with immediate effect. In 2010 cholera epidemics,

“The Nigerian Institute of Medical Research Emergency Response Team (NIMRERT)” provided laboratory and research support for the effective detection of *V. cholera* and evaluated the community health intervention as well as the extent of the epidemics in three Northeastern states which aimed at containing the outbreak in the region [36].

In the Northwest, Kano is considered one of the most endemic regions with cholera cases resurfacing annually. Due to this, successive Federal and state governments have continued to provide good quality water supply and intervene in public health hygiene and sanitation to end the disease. Despite NGOs' and governments' involvement in tackling the cholera outbreak in the Northwest, the hotspot areas in Kano State were not fully identified [37]. In line with WHO directives to identify small hotspot areas ravaged by cholera, Nigeria established the “National Strategic Plan of Action on Cholera Control (NSPCC)” to identify and administer the vaccine in such affected areas [37]. This has led to the successful vaccination of about 710,212 people in Bauchi State. To sustain the fight against cholera, the “National Cholera Emergency Operations Center (EOC)” was reinvigorated in 2021, leading to massive support by the rapid response teams in the hotspot areas in the Northwest (Kaduna and Kano), Northeast (Bauchi) and Northcentral (Plateau and Benue) regions. In Borno State, the EOC improved the coordination, management and distribution of oral cholera vaccine in IDP camps and monitored Cholera incidence daily [37]. Other organizations that helped with the cholera containment in Northern Nigeria include Gavi, The Vaccine Alliance, United Nations Children's Fund (UNICEF), and WHO [32,38]. UNICEF not only aided some Northwestern and Northeastern states (Bauchi, Borno, and Katsina) with IV fluids, oral rehydration salts, water purification tablets and other logistics in the fight against cholera, but also sponsored television and radio sensitization programs in those areas.

Challenges facing cholera eradication in Nigeria

The use of culture-based diagnostic techniques is constrained in many cholera-prone areas in northeastern Nigeria due to low or inappropriate laboratory capacity, unstable security circumstances, limitations on movement, lack of necessary resources, the high population in the

camps and insufficient funding to the humanitarian response plans and WASH [6].

Culture-based diagnostic techniques are constrained in many cholera-prone areas due to low or inappropriate laboratory capacity. Issues with personnel management, a lack of skilled laboratory personnel, a shortage of laboratory supplies, difficulties with sample storage and transit, and unreliable reporting bring about this restriction. Access issues brought on by persistent insecurity in affected and vulnerable areas are influencing the response, movement of essential supplies and the inability to preposition supplies, lack of resources necessary to manage cholera and obtain delivery supplies promptly, which affects preparedness, mitigation and case management. It is impacting all pillars of the response and scale up plans, with some of the worst-affected locations, such as Damboa and Gwoza towns in Borno State, already reporting shortages of vital kits and medicines. Camps have a relatively high population density, which makes it challenging to control a cholera outbreak [3].

As of August 2021, the Humanitarian Response Plan's (HRP) funding for the health and water, hygiene, and sanitation (WASH) components remains insufficient. Only 17 per cent of the requirement for Health (\$14 million received out of \$83 million requirement) and 1 per cent funded for WASH (\$612,000 received out of \$92.7 million required) as of the end of August 2021. Due to these difficulties, outbreak identification and control measure execution are delayed, which raises morbidity and mortality. Additionally, this reduces the capacity for investigating outbreaks and monitoring *Vibrio cholerae* circulating strains, particularly the potential to detect the introduction of novel strains that would necessitate quick modifications in response (such as adapted antibiotics or vaccines).

RECOMMENDATIONS

1. Joint Armed Forces Campaign against Banditry and Insurgencies: As a top priority, a united effort from the armed forces should be initiated to quell banditry and insurgencies. Until terrorist organizations are effectively dealt with, the impact of other relief programs will remain limited.
2. Providing Security for Aid Workers and Healthcare Professionals: In conflict-affected areas, aid workers and healthcare professionals may face threats. Ensuring their safety is essential for them to provide necessary aid and medical treatment.
3. Enhancing Security of Health Facilities: As healthcare institutions may be targeted during conflicts, enhancing their security is crucial to protect patients, employees, and medical supplies and equipment.
4. Establishing Safe Corridors for the Movement of Aid: Insurgents and other armed organizations can obstruct the movement of medical personnel, patients, and humanitarian workers. Establishing safe corridors for the movement of aid will ensure that relief and medical care reach individuals in need.
5. Coordinating with Local Authorities and Community Leaders: Building relationships with local authorities and community leaders can help identify security concerns and ensure that relief and medical assistance are delivered securely and efficiently.
6. Improve Access to Clean Water and Sanitation: Constructing sanitation facilities such as latrines and wells, and promoting good hygiene habits can significantly help in controlling the spread of cholera.
7. Increase Access to Cholera Vaccines: Administering cholera vaccines to at-risk groups can provide crucial protection against the disease.
8. Implementing Public Health Campaigns: Educational programs can be launched to raise cholera awareness, its prevention methods, and the importance of seeking immediate medical assistance.
9. Coordinating with International Organizations: Collaborating with organizations such as the WHO and MSF can bring additional resources and support to tackle the cholera outbreak.
10. Providing Medical Treatment: Ensuring the availability of medical resources and personnel to swiftly and effectively treat cholera cases is vital.
11. Implementing Community-Based Surveillance Systems: Training locals to recognize cholera symptoms and report

cases can enhance the detection and response to potential cholera outbreaks.

CONCLUSION

Cholera remains one of Nigeria's major public health problems, particularly in the conflict-hit northern regions. A lack of information due to very little humanitarian access, dangerous security circumstances, and limitations on movement remain the major challenges facing the eradication of cholera in the regions. Others include low or inappropriate laboratory capacity, shortage of laboratory supplies, difficulties with sample storage and transit, unreliable reporting, and a general lack of financial assistance. These factors, together, have provided a breeding ground for cholera in the regions. It is, therefore, necessary to increase access to clean water by constructing a deep aquifer borehole and monitoring the water's quality. Prioritizing a joint campaign against banditry and insurgencies is crucial, as is ensuring the safety of aid workers and healthcare facilities. Establishing safe passages for aid, coordinating with local leaders, and improving sanitation and water access are also key measures. Increased access to cholera vaccines, public health education, international collaboration, and community surveillance systems, along with readily available medical treatment, round out a comprehensive approach to managing and eventually eradicating the cholera outbreak. Also, the health sector's budget shortfalls must be quickly addressed to maintain and expand current responses. Importantly, to end problems associated with banditry in the Northwest and insurgency in the Northeast, a lasting solution to the uprisings must be implemented.

Declarations

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Consent for publication

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B.H.G and U.A. conceived the idea. All authors wrote, reviewed and approved the manuscript.

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HIGHLIGHTS:

- Cholera remains a significant public health issue in Nigeria, with over 10,000 probable cases reported in the first nine months of 2022, particularly in conflict-hit northern regions where floods, lack of access to hygiene services, and water contamination exacerbate the spread of the disease.
- The northeastern states of Borno, Adamawa, and Yobe reported a combined total of 7,700 cholera cases, including 324 deaths, as of 24 December 2022, with Borno state alone accounting for 5,400 of these cases.
- Addressing the cholera crisis in northern Nigeria requires a multifaceted approach, including increasing access to clean water, improving communication with authorities, addressing health sector budget shortfalls, and finding lasting solutions to the ongoing insurgency and banditry issues in the region.

REFERENCES

- 1- Mukhopadhyay AK, Takeda Y, Balakrish Nair G. Cholera Outbreaks in the El Tor Biotype Era and the Impact of the New El Tor Variants, 2014, p. 17–47. https://doi.org/10.1007/82_2014_363.
- 2- Lee K. The Global Dimensions of Cholera. *Global Change and Human Health* 2001;2:6–17. <https://doi.org/10.1023/A:1011925107536>.
- 3- Abubakar AT, Dalhat M, Nguku P. Cholera outbreak - IDP camps in Maiduguri, northern Nigeria, September 2015. *International Journal of Infectious Diseases* 2016;45:132. <https://doi.org/10.1016/j.ijid.2016.02.326>.
- 4- Penrose K, Castro MC de, Werema J, Ryan ET. Informal Urban Settlements and Cholera Risk in Dar es Salaam, Tanzania. *PLoS Negl Trop Dis* 2010;4:e631. <https://doi.org/10.1371/journal.pntd.0000631>.
- 5- Ajoke OA, Solayide AA, Francisca ON, Mary-Theresa N, Akitoye OC. Cholera epidemiology in Nigeria: an overview. *Pan Afr Med J* 2012;12.

- 6- Ajayi A, Smith SI. Recurrent cholera epidemics in Africa: which way forward? A literature review. *Infection* 2019;47:341–9. <https://doi.org/10.1007/s15010-018-1186-5>.
- 7- Abdulrahim A, Gulumbe BH, Liman UU. A catastrophic flood in Nigeria, its impact on health facilities and exacerbations of infectious diseases. *PAMJ - One Health* 2022;9. <https://doi.org/10.11604/pamj-oh.2022.9.21.38023>.
- 8- Elimian KO, Mezue S, Musah A, Oyebanji O, Fall IS, Yennan S, et al. What are the drivers of recurrent cholera transmission in Nigeria? Evidence from a scoping review. *BMC Public Health* 2020;20:432. <https://doi.org/10.1186/s12889-020-08521-y>.
- 9- Reliefweb. Northeast Nigeria: Flash Update #1 - Cholera outbreak and AWD cases in Borno, Adamawa and Yobe (BAY) states (As of 3 September 2021) 2021. <https://reliefweb.int/report/nigeria/northeast-nigeria-flash-update-1-cholera-outbreak-and-awd-cases-borno-adamawa-and> (accessed January 12, 2023).
- 10- Dunn G. The impact of the Boko Haram insurgency in Northeast Nigeria on childhood wasting: a double-difference study. *Confl Health* 2018;12:6. <https://doi.org/10.1186/s13031-018-0136-2>.
- 11- Omole O, Welye H, Abimbola S. Boko Haram insurgency: implications for public health. *The Lancet* 2015;385:941. [https://doi.org/10.1016/S0140-6736\(15\)60207-0](https://doi.org/10.1016/S0140-6736(15)60207-0).
- 12- Ogundele O. Insurgency in Northern Nigeria: Implication for Polio Eradication in Nigeria. *Sudan Journal of Medical Sciences* 2019. <https://doi.org/10.18502/sjms.v14i4.5903>.
- 13- Raji S, Adekayaola FA, Agaku EA, Akujobi J, Hamzat AA. North-eastern Nigeria: assessing the response capacity of National Emergency Management Agency to the plights of internally displaced persons. *Heliyon* 2021;7:e07274. <https://doi.org/10.1016/j.heliyon.2021.e07274>.
- 14- Okoli AC. Toxic mix of bandits, arms, drugs and terrorism is alarming Nigerians: what now? 2022. <https://theconversation.com/toxic-mix-of-bandits-arms-drugs-and-terrorism-is-alarming-nigerians-what-now-181205> (accessed January 11, 2023).
- 15- Luke IO, Bawa AA. Impact of Armed Banditry on Health Care Delivery in Anka Local Government Area of Zamfara State. *Gusau International Journal of Management and Social Sciences* 2022;5.
- 16- Emmanuel A. At least 200 villagers killed by bandits in north-west Nigeria 2022.
- 17- OCHA. NCDC Cholera Situation Report Monthly Epidemiological Report 07 Epi Week 31-35: (1 August to 4 September 2022) 2022. <https://reliefweb.int/report/nigeria/ncdc-cholera-situation-report-monthly-epidemiological-report-07-epi-week-31-35-1-august-4-september-2022> (accessed January 13, 2023).
- 18- IOM. IDP Atlas as of October 2022, Mobility Tracking – North Central and North-West Nigeria 2022. https://displacement.iom.int/sites/g/files/tmzbd11461/files/reports/IDP%20Atlas%20-%20NCNW_1.pdf (accessed January 13, 2023).
- 19- Ottolini M, Cirks B, Madden KB, Rajnik M. Pediatric Infectious Diseases Encountered During Wartime—Part 1: Experiences and Lessons Learned From Armed Conflict in the Modern Era. *Curr Infect Dis Rep* 2021;23:27. <https://doi.org/10.1007/s11908-021-00770-1>.
- 20- Charnley GEC, Jean K, Kelman I, Gaythorpe KAM, Murray KA. Association between Conflict and Cholera in Nigeria and the Democratic Republic of the Congo. *Emerg Infect Dis* 2022;28:2472–81. <https://doi.org/10.3201/eid2812.212398>.
- 21- Fallah MP, Skrip LA, Gertler S, Yamin D, Galvani AP. Quantifying Poverty as a Driver of Ebola Transmission. *PLoS Negl Trop Dis* 2015;9:e0004260. <https://doi.org/10.1371/journal.pntd.0004260>.
- 22- Eisenstein M. Disease: Poverty and pathogens. *Nature* 2016;531:S61–3. <https://doi.org/10.1038/531S61a>.
- 23- Lam E, McCarthy A, Brennan M. Vaccine-preventable diseases in humanitarian emergencies among refugee and internally-displaced populations. *Hum Vaccin Immunother* 2015;11:2627–36. <https://doi.org/10.1080/21645515.2015.1096457>.
- 24- Ogbu TJ, Scales SE, de Almeida MM, van Loenhout JAF, Speybroeck N, Guha-Sapir D. Predictors of exceeding emergency under-five mortality thresholds using small-scale survey data from humanitarian settings (1999 – 2020): considerations for measles vaccination, malnutrition, and displacement status. *Archives of Public Health* 2022;80:160. <https://doi.org/10.1186/s13690-022-00916-0>.
- 25- Nguyen V-K. An Epidemic of Suspicion — Ebola and Violence in the DRC. *New England Journal of Medicine* 2019;380:1298–9. <https://doi.org/10.1056/NEJMp1902682>.

- 26-Akinrolie O, Masta AM, Jasper US, Fawole HO, Onyeso OK, Akinrolie O, et al. Physical inactivity among internally displaced persons in Nigeria. *J Migr Health* 2022;6:100140. <https://doi.org/10.1016/j.jmh.2022.100140>.
- 27-Cartwright EJ, Patel MK, Mbopi-Keou FX, Ayers T, Haenke B, Wagenaar BH, et al. Recurrent epidemic cholera with high mortality in Cameroon: persistent challenges 40 years into the seventh pandemic. *Epidemiol Infect* 2013;141:2083–93. <https://doi.org/10.1017/S0950268812002932>.
- 28-[28] Brass JN, Longhofer W, Robinson RS, Schnable A. NGOs and international development: A review of thirty-five years of scholarship. *World Dev* 2018;112:136–49. <https://doi.org/10.1016/j.worlddev.2018.07.016>.
- 29-Njidda AM, Oyebanji O, Obasanya J, Ojo O, Adedeji A, Mba N, et al. The Nigeria Centre for Disease Control. *BMJ Glob Health* 2018;3:e000712. <https://doi.org/10.1136/bmjgh-2018-000712>.
- 30-Ighalo JO, Adeniyi AG. A comprehensive review of water quality monitoring and assessment in Nigeria. *Chemosphere* 2020;260:127569. <https://doi.org/10.1016/j.chemosphere.2020.127569>.
- 31-Elimian KO, Musah A, Mezue S, Oyebanji O, Yennan S, Jinadu A, et al. Descriptive epidemiology of cholera outbreak in Nigeria, January–November, 2018: implications for the global roadmap strategy. *BMC Public Health* 2019;19:1264. <https://doi.org/10.1186/s12889-019-7559-6>.
- 32-Sow AU, Haruna UA, Amos OA, Olajide EO, Amene T, Odususi OD, et al. Tackling Cholera Outbreak Amidst COVID-19 Pandemic in Nigeria: Challenges and Recommendations. *Public Health Rev* 2022;43. <https://doi.org/10.3389/phrs.2022.1604776>.
- 33-Troeger C, Blacker BF, Khalil IA, Rao PC, Cao S, Zimsen SR, et al. Estimates of the global, regional, and national morbidity, mortality, and aetiologies of diarrhoea in 195 countries: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet Infect Dis* 2018;18:1211–28. [https://doi.org/10.1016/S1473-3099\(18\)30362-1](https://doi.org/10.1016/S1473-3099(18)30362-1).
- 34-Ricau M, Lacan L, Ihemezue E, Lantagne D, String G. Evaluation of monitoring tools for WASH response in a cholera outbreak in northeast Nigeria. *Journal of Water, Sanitation and Hygiene for Development* 2021;11:972–82. <https://doi.org/10.2166/washdev.2021.056>.
- 35-Ngwa MC, Wondimagegnehu A, Okudo I, Owili C, Ugochukwu U, Clement P, et al. The multi-sectorial emergency response to a cholera outbreak in Internally Displaced Persons camps in Borno State, Nigeria, 2017. *BMJ Glob Health* 2020;5:e002000. <https://doi.org/10.1136/bmjgh-2019-002000>.
- 36-Oladele DA, Oyedeji KS, Niemogha M-T, Nwaokorie F, Bamidele M, Musa AZ, et al. An assessment of the emergency response among health workers involved in the 2010 cholera outbreak in northern Nigeria. *J Infect Public Health* 2012;5:346–53. <https://doi.org/10.1016/j.jiph.2012.06.004>.
- 37-Ngwa MC, Ihekweazu C, Okwor T, Yennan S, Williams N, Elimian K, et al. The cholera risk assessment in Kano State, Nigeria: A historical review, mapping of hotspots and evaluation of contextual factors. *PLoS Negl Trop Dis* 2021;15:e0009046. <https://doi.org/10.1371/journal.pntd.0009046>.
- 38-Kim J-H, Mogasale V, Burgess C, Wierzbza TF. Impact of oral cholera vaccines in cholera-endemic countries: A mathematical modeling study. *Vaccine* 2016;34:2113–20. <https://doi.org/10.1016/j.vaccine.2016.03.004>.