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Review

A review of perception and myth on causes of cholera infection in endemic areas of Nigeria

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Cholera epidemic is a recurrent disease in developing countries with poor environmental sanitation and inadequate supply of potable water. In endemic areas of West Africa, opinions and myths surrounding the real causes of cholera diseases have given rise to varying methods of control. This review gives an insight into these various opinions and myths. Some of these are that magico-religious factors, witchcraft, eating soil, god's will and evil air in the community are responsible for cholera outbreaks. Wrong perception and myth of cholera hinders acceptance and accessibility to launch effective operational response to affected communities during an outbreak. This also lead to delay in providing intervention and treatment during an outbreak.

Key words: Myths, aetiology, *Vibrio cholerae*, epidemic, perception.

INTRODUCTION

Cholera is a natural disease of epidemic proportion. It is caused by a comma-shaped, rod like, motile, Gram negative bacterium called *Vibrio cholerae*, with the characteristic acute watery diarrhoea, vomiting, muscle cramps and severe dehydration (Kaper et al., 1995, Sack et al., 2004). It is an ancient disease reported globally and is associated with high mortality and morbidity rates. This life threatening infection has an estimated annual burden of 2-4 million cases in endemic areas (Ali et al., 2012). The world has experienced seven major pandemics of this disease since the early 19th century (Faruque et al., 1998). The first six were caused by toxigenic strains of classical (CL) biotype, serogroup 01, which was reported to have originated from India, while the current 7th is caused by *V. cholerae* 01 of the El Tor (ET) biotype (Zhang et al., 2014).

In Africa, majority of cases between early 1990 and 2013 occurred in Angola, Democratic Republic of the Congo, Mozambique, Nigeria, Somalia, Tanzania and South Africa. In Nigeria, the first recorded cases of cholera were in a village near Lagos, on 26th December, 1970 with 22,931 cases and 2945 deaths (WHO, 2012a).

Biological and cultural factors of life combine to drive the principles of achieving optimal health. In countries where cholera is endemic, there are myths and divergent perceptions on the real cause(s) of the disease. Consequently, there are variations in approach towards the control and containment of the epidemic. In Africa,

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while some people believe that cholera is as a result of "miasma" (bad air) as postulated in the 19th century, or "anger of the gods", others are of the opinion that it is due to the presence of witchcraft and "black magic" (Erinosho and Oke, 1994; Tesh, 1995; HRC, 2010; Mertem et al., 2013). These wrong perceptions have their consequences on disease management. Like in other countries of the world, recurrent episodes of cholera in Nigeria could be stopped if the predisposing factors and aetiology are well understood. This has not been the case because at each outbreak, efforts at ameliorating and controlling the epidemic are reactive, unfortunately evidence of sustainable practices is lacking. As such, there are recurrences of the disease both in urban and rural areas especially during the rainy seasons. Changing our myth on the cause of cholera and understanding the fact that cholera causes dehydration and kills people and can be properly eradicated following standard infection prevention and control measures will help in the containment of this disease. Similarly, understanding the facts about cholera is a key factor in developing and maintaining long lasting solution to continuous outbreaks. Stopping cholera epidemic should be focused on interventions aimed at blocking all means by which the human population gets in contact with strains of *V. cholerae* responsible for continuous outbreaks in Nigeria. This paper reviews the perception and myths surrounding the aetiology of cholera in endemic areas, with focus on Nigeria.

AETIOLOGY OF CHOLERA

V. cholerae bacterium is implicated in the diarrhoea illness called cholera. More than 200 *V. cholerae* serogroups are recognized worldwide, however most epidemics of cholera are usually caused by 01 and 0139 serotypes. These serotypes are known to produce cholera toxins *ctx*AB and toxin-coregulated pilus (*tcp*) which are the important virulent factors (Waturangi et al., 2012). Gastroenteritis caused by non-01 and non-139 is well documents (Albert et al., 1993; Dutta et al., 2013; Marin et a., 2013). The symptoms of infection varies, ranging from mild to severe watery diarrhea but there are no fever and bloody diarrhea typically seen in gastroenteritis due to non-O1, non-O139.

In Nigeria, there is little information on the circulating strains. Recently however, two biotypes were reported by some workers. Marin et al. (2013) described multidrug resistant, atypical ET and non- 01/ non-0139 as the agent responsible for cholera/diarrhoea outbreaks of 2009 and 2010 in Borno and Osun states, Oyedeji et al. (2013) reported enterotoxin (*ctx*A) carrying classic biotype 01 in the Borno, Bauchi and Gombe states within the same period, while Akinsinde et al. (2014) went ahead to demonstrate that these epidemic strains were of multiple phage types.

Pathophysiology of cholera

Cholera infection is a classic example of enterotoxin mediated gastroenteritis (Lambert, 1984). The cholera organism expresses toxins that grossly derange the gastro-intestinal tract (GIT) fluid balance such that the daily fluid output in form of faeces far exceeds the normal yield of 0.1 to 0.2 L without invasion of the GIT (Goossens and Op de Beeck, 1981).

The site of infection is the upper small intestine and to reach there, the inocula of the ingested *V. cholerae* have to be large enough so that sufficient infective dose survives and traverses the acid defense of the stomach (Handa et al., 2014). Further adaptation such as motility and secretion of protease enzymes facilitates the organisms to breach the mucus layer of the intestine while the elaboration of the toxin-coregulated pilus (tcp) enables the organisms to bind to the small gut wall (Keusch et al., 1998, Muanprasat et al., 2013).

Once established mostly in the duodenum and upper jejunum, a B pentameric moiety of cholera toxin (CT) ensures the attachment of the *Vibrio* to intestinal epithelial cells. Another component of CT, the A1 monomeric subunit is then released to activate a cascade of complicated enzymo-chemical reactions. These culminate in persistent stimulation of adenylate cyclase enzyme with attendant increase in intracellular cyclic adenosine monophosphate (cAMP).

The cAMP in turn, promotes marked fluid secretion from the proximal parts of the small intestine (Handa et al., 2014; Muanprasat, 2013). It is this resultant enormous ingress of near isotonic fluid into the GIT which overwhelms the absorptive capacity of the GIT yielding a net output in stool that may reach 1 to 2 L hourly in severe infection (Mhalu, 1983). The final sequel is a dangerous compromise in total body fluid homeostasis associated with this infection.

EPIDEMIOLOGY OF CHOLERA IN NIGERIA

Cholera is believed to have originated from Ganges Delta of the Indian Subcontinent before spreading across to the other continents of the world. Cholera infections in African countries dated as far back as 1960 (WHO, 2012a, 2013a). Although Nigeria recorded some cases in 1961, its first epidemic occurred in 1970 (WHO, 2012a, 2013). This was followed over the years by sporadic episodes up till 1997 (Lawoyin et al., 1999) and then the severe outbreak in 2010. Cholera infection is endemic, occurring in all geographic regions, in Nigeria (Shittu et al., 2010). This infection affects both male and female with severity of infection recorded in children who are exposed to the organism for the first time and in the elderly, who have lower gastric acid production and diminishing immunity.

Over the years, greater percentage of outbreaks has

Table 1. Number of cholera cases in Nigeria, deaths and case-fatality rate (CFR) between 2007-2013.

Year	No of States affected	No of cases	No of Deaths	Case Fatality Rate (%)
2007	-	1661	48	10.4
2008	-	5410	247	4.8
2009	-	13691	431	3.1
2010	18	41787	1716	4.1
2011	25	23377	742	3.2
2012	11	589	18	2.6
2013	19	4576	156	3.4
Total		**91090**	**3358**	**3.7**

Sources: (WHO, 2008, 2009, 2012a, 2012b, 2013; FMoH, 2012, 2013a, 2013b; Dalhat et al., 2014).

been caused by *V. cholera* 01 ogawa El Tor biotype. Recent outbreaks resulting into high cases of deaths in Papua New Guinea, Africa, and the Caribbean Sea were attributed to new atypical El Tor strains with a classical cholera toxin gene believed to have originated from the Bay of Bengal and similar to the strain peculiar to Orissa, India. This species in association with non-O1/non-O139 *V. cholerae* strains was implicated as the major strain responsible for the 2010 cholera outbreak that affected over 40,000 people with a case fatality rate (CFR) of 3.75% in Nigeria (Oyedeji et al., 2013; Oladele et al., 2012). Majority of the new atypical El Tor strains are multi-drug resistant (Marin et al., 2013). Since, 2007 cholera infection has become an annual occurrence in the six geographic zones especially after flooding experience with over 91,090 recorded cases and 3358 deaths (Table 1).

Risk factors for cholera

All age groups are affected but the risk is reduced in breast-feeding infants partly as a result of reduced exposure and partly from maternal antibodies to *V. cholerae*. The presence of certain factors can increase the incidence of cholera in a community leading to an epidemic by increasing the susceptibility of individuals to experiencing severe signs and symptoms. Globally, documented risk factors for cholera hinged mainly on factors that promote faecal-oral transmission of *V. cholerae*.

The single most important factor, particularly in developing world is poor sanitary conditions. Cholera is more likely to flourish in situations where there is poor personal and environmental hygiene often resulting from lack of safe water supply and poor disposal of human waste. Contamination of river water supply by human waste was said to be responsible for the 2010 cholera outbreak in Ghana (Opare et al., 2012) and open land/river defeacation increased the odds of cholera risk in Papau New Guinea (Rosewell et al., 2012). Drinking and domestic use of contaminated water was described as the cholera risk factor in India between 2004 and 2010 (Datta et al., 2012; Mukherjee et al., 2011). These challenges with water supply and sanitation are common to refugee camps, impoverished countries, and areas devastated by famine, war or natural disasters as in Haiti cholera outbreak (Dunkle et al., 2011).

Reduced or nonexistent stomach acid (hypochlorhydria or achlorhydria) is another documented predisposing factor to cholera. This is because *V. cholerae* cannot survive in an acidic environment, and ordinary stomach acid often serves as a first-line defense against infection. Therefore, people with low levels of stomach acid as in children, older adults and people who take antacids, H-2 blockers or proton pump inhibitors do not have this protection and are at greater risk of developing severe cholera symptoms (Kaper et al., 1995).

Exposure to an individual infected with cholera in a household setting is another risk factor. People are at significantly increased risk of cholera if they live with someone who has the disease. For example, contact with exudates and secretions from people infected with cholera was a significant factor reported in 2008 Harare cholera outbreak in Zimbabwe (Kone- Coulibaly et al., 2010).

Host genetic factors and climatic factors were documented to significantly increase cholera risk in some populations. Individual with type O blood for reasons that are not entirely clear are reported to be twice as likely to develop cholera as are people with other blood types (Chaudhuri and De, 1977; Harris and Khan, 2005). Also, the incidence of cholera was found to be significantly related to higher temperature and humidity as well as lower precipitation in the Middle East just as lower cholera risk was reported in the highest elevation suburbs of Harare, Zimbabwe in 2010 (Luque et al., 2012).

Consumption of raw or undercooked shellfish is associated with increased risk of *V. cholerae* infection. Although large-scale cholera outbreaks no longer occur

Table 2. Reported risk factors associated with cholera outbreaks in Nigeria.

S/N	Publication	Reference	Study type	Location	Risk factors
1	Recurrent cholera epidemics in Kano--northern Nigeria	Usman et al., 2005	Descriptive	Kano, North west	Contaminated water
2	A large cholera outbreak in Kano City, Nigeria: the importance of hand washing with soap and the danger of street-vended water	Hutin et al., 2003	Case control study	Kano, Northwestern	Drinking of street vended water Lack of tap water Poor hand washing practice
3	Outbreak of cholera in Ibadan, Nigeria	Lawoyin et al., 1999	Descriptive	Ibadan, South western	Overcrowding, Raining season, Contamination of water source
4	Epidemiology and spectrum of vibrio diarrhoeas in the lower cross river basin of Nigeria	Eko et al., 1994	Descriptive	Calabar, Uyo, South-south	Poor sewage disposal systems, Contact with sea water, Consumption of fishery products and leftover foods
5	Features of cholera and *Vibrio parahaemolyticus* diarrhoea endemicity in Calabar, Nigeria	Utsalo et al., 1992	Case control	Calabar, South-south	Poor water supply Poor sewage disposal systems
6	Epidemiological features of an outbreak of gastroenteritis/cholera in Katsina, Northern Nigeria	Umoh et al., 1983	Descriptive	Kastina, North-West	Water vendors

in industrialized nations, eating shellfish from waters known to harbor the bacteria greatly increases the risk. A study from coastal towns of Côte d'Ivoire reported incidence of cholera from consumption of crustaceans (Traore et al., 2012).

In Nigeria, several risk factors have been reported to be associated with cholera outbreaks in the last four decades (Table 2). Massive cholera outbreak in Kano, northwestern Nigeria resulted from drinking contaminated water usually from water vendors, lack of tap water and poor hand washing practice (Umoh et al., 1983; Usman et al., 2005; Hutin et al., 2003). As at 2008, 42% of the entire population lacked access to improved water source and 68% to proper sanitation facilities (WHO, 2008). Another outbreak at Ibadan, southwestern Nigeria was said to be predicated on overcrowding, onset of rainy season and contamination of water source (WHO, 2012a; Oguntoke et al., 2009). In Calabar, South-south Nigeria, poor sewage disposal systems, lack of potable water supply, contact with sea water and consumption of fishery products and leftover foods were reported as risk factors for *Vibrio* diseases (Eko et al., 1994; Utsalo et al., 1992).

Prevention of cholera through vaccination

Cholera infection can be controlled by the administration of cholera vaccine targeted at both Inaba and Ogawa serotypes, classical and El Tor biotype as well as against *V. cholerae* O139 and the cholera toxin (WHO, 2004). For over 20 years, the oral cholera vaccine Dukoral (SBL Vaccin AB, Sweden) with short term (4-6 months) protection recommended for travelers to endemic areas has been in use. The use of this vaccine was limited due to the global concern over the side effects experienced by vaccinated individuals and cost; thus creating the need for a more effective, safe and affordable cholera vaccine for international use. Presently, Dukoral has been modified to a new vaccine Shanchol (Shanchol, Shantha Biotechnics, India), approved by WHO and the clinical trials successfully completed (Bhattacharya et al., 2013). This new vaccine has a long lasting protection with 65% efficacy over a five year period. Comparatively, it confers 42% cumulative efficacy in children aged 1-5 years who are at greatest risk of disease (Bhattacharya et al., 2013; Sridhar and Arora, 2013). Acceptance of these vaccines has been a challenge in some countries due to cultural beliefs. Based on previous experiences and massive deaths, countries are making efforts to promote effective vaccine programs and policies to control cholera epidemic (Vicari et al., 2013; Ivers et al., 2013). WHO recommends the use of vaccines in combination with health services that provide rapid detection and treatment of cholera cases with appropriate agents,

while making provisions for accessibility to safe water, good sanitation, promotion of personal hygiene, improvement in health education and community mobilization (Vicari et al., 2013; Lucas et al., 2005; WHO 2012b). While this is going on, some reports have taken time to analyze the impact of myths and perception on the acceptability of cholera vaccines. Willingness to participate is high in populations that have received awareness on cholera (Vicari et al., 2013; Ivers et al., 2013).

THE SOCIO-CULTURAL FACTORS IN CHOLERA CONTROL

Taking cognizance of the principle that man is both a biological and cultural being, health professionals need to be aware of this human duality in order to achieve their goal of optimising human health (Oke, 2002). Health is both a medical and socio-behavioural concept just as medicine itself is a natural as well as a socio-behavioural science (Oke, 2002; Otite, 1987). Using the schematic framework developed by Maclachlam (1958) and expatiated by Fabrega (1971), the concept of disease implies germ theory (Koch, 1884) which is a fundamental foundation of modern medicine developed by biomedical science on one hand and a broad cultural definition on the other hand. There is therefore, the need to distinguish between scientific and culturally defined state of health and illness especially as it relates to cholera (Oke, 2002; Armstrong, 1971). The germ theory of disease is derived from the assumptions that every disease has a specific cause which its treatment could best be accomplished by removing or controlling the cause with a biomedical framework, while cultural belief is attributable to the role of socio-cultural factors in the aetiology and prognosis of disease. In Nigeria, some diseases are believed to be caused by natural (such as malnutrition), preternatural (belief in sorcery and witchcraft) and mystical (cosmic or supernatural powers) factors (Armstrong, 1971; Maclean, 1971; Snow, 1936). However, there is a paucity of data on perception, myths and socio-cultural belief on causes of the variety of recurrent endemic infectious diseases.

Myths and perceptions on the causes of cholera epidemic vary considerably. During the outbreak in Haiti in 2010 following the powerful earthquake which devastated the country, people believed that cholera was brought by foreigners in order to use or to harm their citizens (HRC, 2010). This undermined the credibility of foreign organisations carrying out information campaigns in communities. Some were of the opinion that cholera was a deliberate infection spread through a magic '*kolera* powder' ("*kolera poud*") prepared by Voodoo priests and transmitted by Voodoo worshippers. There were protests against efforts to establish cholera treatment centres during the cholera outbreak. In the absence of public health information indicating otherwise, many people believed the small, localized treatment centres will increase the spread of cholera in their community. Due to the contagious nature of the disease, they preferred the centres being located far away from their residence so that they would not be infected. This is contrary to the reality that the closer an infected person is to a treatment centre, the better the chances of survival.

A cross-sectional study on local perceptions of cholera and anticipated acceptance of oral cholera vaccines in Katanga province, Democratic Republic of Congo (DRC) showed that the majority of respondents considered insufficient hygiene and sanitation levels as the key cause of cholera. Ingestion of contaminated water and food were spontaneously mentioned by 63.0 and 61.0%, respectively, as main transmission routes of cholera (Merten et al., 2013). Other common explanations were contact with contaminated water, or flies, a dirty environment, lack of latrines and poor hand washing practice. In contrast, magico-religious explanations were mentioned spontaneously by less than 10.0% of respondents. However, after probing through a survey, about 59.0% of respondents confirmed sorcery and witchcraft as possible source of cholera thus proffering information of the reality of what the respondents believed in. Similarly, eating soil, and God's will were deduced as possible origins of cholera by 48.0 and 41.0% of respondents, respectively (Merten et al., 2013). Within the contents of the abstract reviewed, no study so far has given a scientific proof on ambiguous religious belief, witchcraft and eating soil as causes of cholera infection). Scientific evidence have shown that the disease is highly contagious and one gets infected by faecal-oral transmission of toxin-producing serogroups (Marin et al., 2013; Oyedeji et al., 2013; Zhang et al., 2014).

Irrespective of various opinions and perception on the causes of cholera epidemic, the fact remains that cholera is a water borne preventable and treatable disease, transmitted through ingestion of *V. cholerae* in contaminated food and water (Marin et al., 2013; Smith, 2002; Ghose, 2011; Farmer et al., 2003). This disease is more likely to flourish in situations where there are poor personal and environmental hygiene resulting from lack of safe water supply and poor disposal of human waste. During outbreaks, infected individuals experience uncontrollable vomiting and diarrhea with profuse "rice water stool" due to the production of poisonous cholera enterotoxins which in turn leads to dehydration. The victims experience electrolyte imbalance, painful muscle cramps, watery eye, and loss of skin elasticity and absence of urine excretion (Bentivoglio et al., 1995). In mismanaged, undiagnosed and untreated cases, death occurs within few days due to dehydration. An entire community can be affected at the same time limiting the possibilities of adequate attention from care givers (Oladele et al., 2012). Cholera, like any other epidemic condition, is primarily addressed through prevention campaigns and administration of medical treatment.

Impacts of perception and myths of the aetiology of cholera on its control, management and prevention

During the outbreaks in the early nineties, people believed that cholera was caused by “miasma” (bad air) due to poisonous odors of decayed matter (Tesh, 1995). As such, the early work of Fillipo Pacini who proposed the germ-theory of cholera and identified the comma-shaped organism as the cause of the disease as far back as 1854 was apparently ignored. In continents ravaged by cholera, efforts were made to find out the real cause(s) of the associated massive death. By the time the aetiology and risk factors became obvious, the perception was transformed and this was followed by visible changes in sanitation, infrastructural development, provision of appropriate drugs and invention of oral rehydration therapy and related drugs for treatment. There were improvements in providing clean water supply, as well as vaccination. This was strengthened by the great awareness and orientation on the importance of public health and the need for maintaining a healthy environment.

Individuals in Democratic Republic of Congo (DRC) believed that cholera was due to the continuing presence of witchcraft (Merten et al., 2013). They visited the witch doctors for cure until they found them dropping dead due to cholera. Certain population had their perception on Christian religious faith-based practices centered on praying for healing and the belief that God was responsible for cholera outbreaks (Merten et al., 2013). The past experiences with cholera outbreaks created high awareness in DRC on the source, aetiology, control and containment of cholera (Bompangue et al., 2008) and recent report shows that 93% visit health facilities during out breaks (Merten et al., 2013).

Cholera is one of the main factors that brought about development of sanitation and environmental hygiene infrastructure in America and Europe. According to Hamlin (2009) who corroborated the opinion of Tauxe and colleagues (1994), cholera spurred the sanitary reform movement and led to development of the field of public health in 19th-century in Europe and North America. This trend is gradually extending to some Asian countries. The seventh cholera pandemic has affected many countries in Africa, some in Asia and in Latin America signaling that sanitation; infrastructure and public health facilities are inadequate. In African countries, the recurrent epidemic of cholera should be a driving force for constructive change both in our social life, health and environment. This is not so as some countries still lack basic infrastructure and safe water coupled with inadequate hygiene practice. Recurrent cholera infection is documented yearly in Nigeria since 2007 (Table 1). Although reports have shown that provision of adequate infrastructure, improved sanitation, supply of safe water and hygiene education is important in the prevention of cholera, nothing seems to change. Access to an improved water source was stagnated at 47% from 1990 to 2006 (WHO/UNICEF, 2010). This increased to 54% in 2010 but is still below the 75% mark by WHO (WHO/UNICEF, 2010). This is faced with challenges in water production facilities which rarely operate to capacity due to broken down equipment, or lack of power or fuel for pumping (WHO/UNICEF, 2010). Assessment of World Bank development indicator (World Bank, 2014), showed that the percentage of Nigerians with improved water source stood at 63% for a period of 2000-2004. This was the same (63%) for 2005-2009 and just 1% increase for a period of 2012-2014. Similarly, 35% of the population has access to improved sanitation as at 2010 (WHO/UNICEF, 2010). Whether people's perception and myths is dictating social investment by the government is unknown or yet to be determined.

Massive cholera outbreak in Kano, northwestern Nigeria resulted from drinking contaminated water usually from water vendors, lack of tap water and poor hand washing practice (Hutin et al., 2003). As at 2008, 42% of the entire population lacked access to improved water source and 68% to proper sanitation facilities (WHO, 2008).

Another outbreak at Ibadan, southwestern Nigeria was said to be predicated on overcrowding, onset of rainy season and contamination of water source (WHO, 2012; Oguntoke et al., 2009).

In spite of the provision of adequate infrastructure, improved sanitation, supply of safe water and hygiene education for the prevention of cholera, cultural perception and myths on cholera also has an impact on occurrence, duration of epidemics, increase in number of cases and subsequent deaths. When there is a negative rumour on the causes of an illness, the ability to launch an effective operational response is impaired. This may lead to delay in providing intervention and treatment by health worker. Infected patients might refuse to visit treatment centre. In cases were wrong impressions are not corrected, the predisposing factors may not be identified and addressed which might lead to reoccurrence. Furthermore, distrust and suspicion affects the acceptance and work of humanitarian agencies. Consequently, the safety of health workers, non governmental agencies and volunteers are not guaranteed. Such reactions were experienced during the Haiti outbreak where there was distrust to humanitarian agencies and violent reactions like the killing of 45 Voodoo priest for producing the magic “poud kolera” that brought cholera (HRC, 2010; IFRC, 2014). That reaction resulted to the training of Voodoo worshipers by Haiti Red Cross on early detection of cholera, prevention and treatment. That community consequently became active in combating cholera in the communities (HRC, 2010; IFRC, 2014).

According to Ayeni (2014), the government of Nigeria needs to collaborate with its citizen to address issues of urbanization and environmental health problems associated with cholera especially by encouraging participating

in government-backed campaigns. However, such involvement largely depends on the ability of the community members to understand the causes and control measures of this endemic disease. When wrong beliefs on infectious agents and disease outbreaks is identified and addressed, it would likely be easy to promote accurate information and community participation through proper education.

CONCLUSION

Wrong perception and myth of cholera hinders acceptance and accessibility to launch effective operational response to affected communities during an outbreak. It also leads to delay in providing intervention and treatment. Reports on the perception and myths of cholera in Nigeria are lacking, suggesting the urgent need for more research into cultural belief of cholera and other infectious diseases.

Competing interest

The authors declare that there are no competing interests whatsoever.

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