



# Outbreak of Cholera in Ghana: A Systematic Review from 2010 to 2020

John Antwi Apenteng <sup>a</sup>, Samuel Korsah <sup>a\*</sup>, Miriam Tagoe <sup>a</sup>,  
Nathaniel Nene Nortey <sup>b</sup>, Jessica Korsah <sup>a</sup>,  
Benedicta Delase Wobetsey <sup>a</sup> and Frederick Akuffo Owusu <sup>c</sup>

<sup>a</sup> Department of Pharmaceutical Sciences, School of Pharmacy, Central University, Accra, Ghana.

<sup>b</sup> Institute of Traditional and Alternative Medicine (ITAM), University of Health and Allied Sciences, Ho, Ghana.

<sup>c</sup> Department of Pharmaceutics, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

## Article Information

DOI: 10.9734/AJRID/2023/v13i2261

## Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/99305>

**Systematic Review Article**

**Received: 01/03/2023**

**Accepted: 01/05/2023**

**Published: 08/05/2023**

## ABSTRACT

**Background:** Cholera affects several hundred thousand individuals worldwide each year. According to estimates, more than 20 million individuals in Ghana are at danger of contracting the illness. However, research from Asia and other continents continues to be a major source of information for understanding cholera epidemiology in Africa, particularly in its coastal nations. The purpose of the study was to evaluate Ghana's cholera epidemics each year.

**Methods:** A thorough analysis of articles that have been published on cholera outbreaks worldwide and in Ghana. A thorough search was done in the databases of Science Direct, PubMed, and Google Scholar to retrieve and to review research works published on cholera.

**Results:** Findings suggest cholera has been a significant public health issue for Ghana every year since the first case was reported in 1970. Greater Accra is the area with the most cholera cases each year, with Accra being the district with the most cases. Greater Accra alone reported 58.5% of

\*Corresponding author: E-mail: [korsahjnr@gmail.com](mailto:korsahjnr@gmail.com), [skorsah@central.edu.gh](mailto:skorsah@central.edu.gh);

all cholera cases in Ghana from 1998 to 2017. However, the least affected regions in Ghana are the Upper West, Northern, Upper East, and Volta region. The cause of these cholera outbreaks is subpar sanitation and contaminated water. Annual cholera outbreaks occur in Ghana, where more attention is needed. Multiple deaths have been caused by these epidemics.

**Conclusion:** Improved sanitation and provision of adequate clean drinking water can help curb the incidence of cholera and its devastating effects on individuals and the country as a whole.

*Keywords: Sanitation; Ghana health service; endemic; Vibrio cholera.*

## 1. INTRODUCTION

The cholera disease is one of the main issues with public health on a global scale. In endemic nations, 2.8 million cases of cholera are reported annually, and 1.4 billion individuals are thought to be at risk [1]. Because it disproportionately affects the world's poorest and most vulnerable people, cholera has been dubbed a disease of injustice [1,2].

However, there is cause for concern given the severe effects of Ghana's cyclical cholera outbreaks. In contrast to other diarrheal illnesses, cholera can be fatal to healthy young adults, and it is more likely to do so in immunocompromised people and undernourished children [2]. According to the World Health Organization (WHO) Standard definition of a case of cholera, it may only be referred to as a case of cholera when: a person aged five years and over residing in an area not endangered to cholera develops an infection and presents with the symptoms of cholera (in this case, acute watery diarrhea with or without vomiting, leading to severe dehydration and or death). Only when the bacteria (*Vibrio cholera* O1 or O139) are isolated from the patient's diarrheal sample during laboratory culture is a case considered to be verified [3]. It is commonly linked to a lack of clean water and poor sanitation [4]. Its limited incubation period lasts about two to five days. It is an illness with acute diarrhea that, if neglected, can be fatal in a matter of hours [2]. It is simple to treat cholera. It has been demonstrated that prompt administration of oral rehydration salt (ORS) is effective in treating cholera-related dehydration [2]. Additionally, individuals who are very dehydrated have a higher chance of going into shock and will need intravenous (IV) fluids right away. Additionally, medications could be necessary to help control the diarrhea and get rid of the bug [5]. However, cholera is thought to have an annual incidence of 1.3–4.0 million cases and 21,000–143,000 fatalities worldwide [6,7]. In endemic nations, around 1.3 billion people continue to be at risk for contracting

cholera [6]. According to recent estimates from the World Health Organization (WHO), there are 1.3–4.3 million cholera cases recorded worldwide each year, and 21,000–143,000 people die as a result [8]. Since the 1980s, Ghana has continued to track sporadic cholera outbreaks, which have increased in frequency in recent years [2]. The deadly outbreak that started in June 2014 spread into 2015 [9,10]. A case fatality rate of 0.8% was documented as of January 4th, 2015, with a total of 28 922 cases and 243 deaths [1,2]. Out of 216 districts in Ghana's 10 regions, the outbreak affected 130 of them [2].

Cholera is a public health issue in Ghana and requires significant attention, as evidenced by the figures on cases mentioned above. As a result, it's crucial to perform a study on cholera by analyzing the relevant material and providing suggestions for how to lessen the disease's impact.

In high-density neighborhoods close to urban areas associated with heavy rains, is where more than 50% of Ghana's population lives, according to a report by Global Communities [2,11]. Cholera outbreaks are more likely to occur in these communities and are also the most difficult to contain. This is because those who inadvertently contract the disease spread it quickly to those with whom they come into touch, making it challenging to contain the disease [2]. Since its first outbreak in 1970, cholera has been a significant public health issue that Ghana has to deal with every year. Greater Accra is the area with the most cholera cases each year, with Accra being the district with the most cases [12]. Greater Accra alone reported 58.5% of all cholera cases in Ghana from 1998 to 2017 [12]. However, the least affected regions in Ghana are the Upper West, Northern, Upper East, and Volta region. These cholera outbreaks are brought on by inadequate sanitation and unhygienic water sources in overcrowded urban slums especially in flood prone seasons [12]. As part of Ghana's Integrated Disease Surveillance and Response (IDSR) system, it is one of the twenty-three (23)

priority diseases and disorders that are being monitored [13]. 54% of the 132 121 cholera cases and 2420 fatalities that were reported to WHO globally in 2016 were in Africa [12]. Ghana Health Service reports that a total of 9542 cholera cases with 100 fatalities were documented in 2010, 10 628 cases with 105 deaths in 2011, 28 975 cases with 243 deaths in 2014, 618 cases with five deaths in 2015, and 150 cholera cases in 2016 [12]. Epidemiological monitoring noted 82,754 cases of cholera between 1998 and 2017 [12].

According to Ghana's IDSR system, cholera and five other communicable diseases are classified as epidemic prone (epidemic potential) diseases [14]. Although contaminated water and food are the main ways that cholera spreads, a variety of regional and demographic factors can also contribute to an individual becoming infected [13]. Therefore, it is not surprising that the Water and Sanitation Program reported that the country loses an estimated amount of more than 250 million US dollars (USD) due to premature deaths, productivity losses, and healthcare provision as a result of poor sanitation and diarrheal diseases like cholera, particularly since the majority of the working population in the country falls within the age range of 20-49 years [2]. This demonstrates the financial burden that cholera has on Ghana [2]. However, research from Asia and other continents continues to be a major source of information for understanding cholera epidemiology in Africa, particularly in its coastal nations [15]. Therefore, it is essential that additional research on cholera across the African continent, particularly in Ghana, be done. This study aims to conduct a systematic review on cholera epidemics in Ghana, discuss associated mortalities, and propose recommendations to solve them.

## 2. MATERIALS AND METHODS

The phrases "cholera OR Vibrio" AND "Africa" OR the current or former names of all sub-Saharan African nations were systematically searched in PubMed between 2010 and 2020. Using the search archives feature on the website ([www.promedmail.org](http://www.promedmail.org)) and the terms "cholera" and the nation names, ProMED-mail alerts were also looked into. Extracted information on cholera outbreaks included: the precise location and local environmental characteristics; the year and season of outbreak start, peak, and end; the population affected; the dynamics of the epidemic; the suspected source and/or

underlying risk factors; the isolation of *V. cholerae* and other *Vibrio* species in their local environments; and the genotyping of epidemic strains. This study only looked at full-length articles and reports. We also looked at papers based on the inquiry, "Is cholera still a major public health problem in Ghana?" We sought to get a response through this review and provided suggestions. The journals with titles or abstracts that discussed cholera outbreaks, epidemiology in Africa, or environmental *Vibrio* detection were those with the most successfully recovered citations.

Furthermore, all secondary sources were used to collect the data for this study. Secondary data was taken out of records that were collected by looking through client folders and line lists that were already in place at different levels across different facilities.

### 2.1 Eligibility Criteria

Materials from Ministry of Health (MoH) and other international organizations that were published in English were included, including articles, reports, and data. Unpublished reports and unofficial statistics were not included. Moreover, full texts that included information on cholera morbidity or outbreak processes were also considered eligible.

### 2.2 Data Collection and Analysis

To locate studies published on Cholera cases, a thorough search was carried out in the PubMed, ScienceDirect, and Google Scholar databases. The words "cholera outbreak," "annual," and "Ghana" were used. The reviews of papers and reports span the years 1998 to 2017.

Google, Google Scholar, reference lists from important textbooks, and articles that were searched were used as well as other papers from non-indexed journals and reports from various agencies.

The data collected and analyzed using Microsoft Excel (2016) and Epi info software were use to describe pattern of the disease transmission. The case fatality rate for each year was calculated was calculated using the formula:

$$\frac{\text{Annual total number of deaths}}{\text{Annual total number of people diagnosed}} \times 100\%$$

The results of the data retrieved were further tabulated and graphically represented using Microsoft Excel application.

### 3. RESULTS

A total of seventy-two (72) articles were found to have reported on Cholera in Ghana. Out of this total only thirty (30) satisfied the inclusion criteria (41.7%). Articles used were from 2016 to 2022. The total number of cases and deaths recorded during this period (2010 to 2020) were 60,031 and 553 respectively. The case fatality rate for all the years were below 2%. In 2010, there were 9,542 cases of cholera overall, and 100 deaths (CFR 1.04%) according to the Ghana Health Service [12]. Moreover, 10,628 cases and 105 fatalities were recorded in 2011. With 9,548 cases and 100 fatalities in 2012, the disease spread to 53 districts across nine regions [12,16]. There were no data on Cholera in the year 2013 [17]. A total of 28,975 cases of cholera were reported to the Ghanaian Disease Surveillance Center from the Ashanti-, Central-, Eastern-, Greater Accra-, Western- and Volta regions in 2014. The earliest reported onset date was the 20<sup>th</sup> of May 2014 and the latest was the 11<sup>th</sup> of December 2014, with a peak number of 2,853 cases in the 35<sup>th</sup> calendar week (25–31 August) [18,19]. Age was reported for 19,863 cases and distributed with a median age of 26 years and an interquartile range (IQR) of 20–35 years [18]. The median age of cases did not change during the course of the outbreak. The majority of cases was male (58.4%; n = 11,796), and median age was not markedly different between males (26 years; IQR 20–35) and females (25 years; IQR 19–35) (Fig. 1). The Accra Metropolitan Area had the most cases (5,558) and deaths (45) of any area [2,16]. A total of 15000 cases of cholera had been reported by September, of which 126 were fatal. 23,622 instances had been reported overall by the end of October, of which 190 were fatal [2,16]. The number of cholera cases recorded during the 2014 outbreak was highest among people aged 20 to 49, accounting for 70% of cases. Nearly 30,000 new cases and more than 250 fatalities were recorded from cholera in Ghana in 2014, when 60 percent of the country's districts reported illnesses [20]. From a total of 216 districts across all 10 regions, the outbreak affected around 130 districts [2]. In Table 1, the Ghana Health Service in the year reported a cholera outbreak that had reached seven out of the country's 10 administrative regions from 2015 to 2016 [1,16] with 618 and 720 reported cases respectively, however 2016 recorded no fatality. Later that same year, 596 cases of the disease, in a short wave, were

reported in Ghana's central region but no known deaths were reported [21,22]. There were no data from 2017 to 2020 as seen on Table 1.

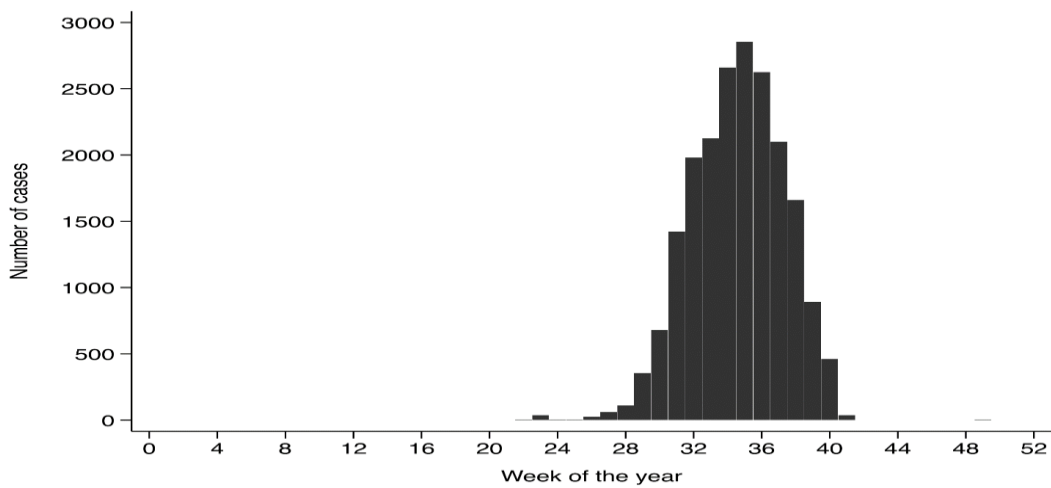
### 4. DISCUSSION

*Vibrio cholerae*, a bacterium, can be found in water and food, which can lead to the extremely contagious and fatal diarrheal illness cholera (*V. cholerae*). Vibrios can endure for a very long time in feces-filled coastal waters [21]. The years 2010 to 2020 were covered by this study's examination of cholera outbreaks in Ghana throughout the previous ten years. From Table 1. there increase of 1,086 cases and 5 fatal cases from 2010 to 2011. This increase pattern is consistent with data from years 1990 to 1991, 1993 to 1994, 1998 to 1999 and 2005 to 2006 as shown in Fig. 2. This sudden increase maybe due to poor measures to contain and manage endemics which is a problem in most developing countries [16]. The measures put in place from 2011 by the GHS seem to have been able to contain the condition in 2012 where there were decrease in the number of cases and fatalities as seen in the Table 1. Almost no information was made public regarding the assessment of the 2013 outbreak response efforts, despite the periodic cholera outbreaks [23]. The largest epidemic was noted to occur in 2014 since 1991 [16]. 6,018 cases were reported on August, 18 in 34 districts across the five regions, with 47 fatalities (a fatality rate of 0.9%). Throughout the spike in cholera epidemic outbreaks between 2011 and 2014, Greater Accra had the hardest afflicted area because of the overpopulation and poor waste management in this region leading to a lot of slums therein [2,12,16]. Despite the high number of cases, the fatality rate remained below the WHO target of 1% during the 2014 outbreak, which is in contrast to reported numbers from other major cholera outbreaks on the African continent, such as from Kenya (CFR = 2.3%) or Zimbabwe (CFR = 4.7%) [18].

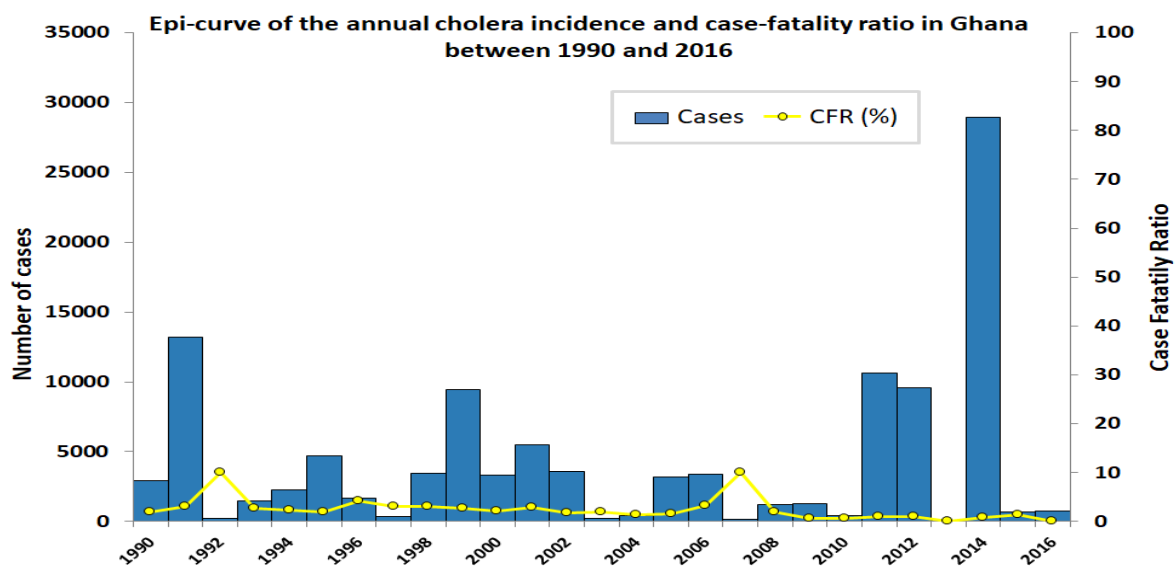
According to estimates from the World Health Organization (WHO), cholera caused 21,000 to 143,000 fatalities worldwide in 2018 and between 1.3 and 4.0 million infections [21,24]. From 2017 to 2019, Ghana consistently reported no cholera cases, hence there were no cholera cases reported [25]. Additionally, according to the Ghana Health Service (GHS), there were no cholera cases in Ghana in 2020 [1,2,24].

**Table 1. Distribution of cholera epidemic mortality, morbidity & fatality rate from 2010 to 2020 [17]**

| Year | Number of cases | Number of deaths | Fatality rate (CFR %) |
|------|-----------------|------------------|-----------------------|
| 2010 | 9,542           | 100              | 1.04                  |
| 2011 | 10,628          | 105              | 0.98                  |
| 2012 | 9,548           | 100              | 1.0                   |
| 2013 | -               | -                | -                     |
| 2014 | 28,975          | 243              | 0.83                  |
| 2015 | 618             | 5                | -                     |
| 2016 | 720             | -                | -                     |
| 2017 | -               | -                | -                     |
| 2018 | -               | -                | -                     |
| 2019 | -               | -                | -                     |
| 2020 | -               | -                | -                     |



**Fig. 1. Epidemiology of the 2014 outbreak in Ghana; year with the largest outbreak of cholera [18]**



**Fig. 2. Epi –curve of the annual cholera incidence and case - fatality ratio in Ghana between 1990 and 2016 [16]**

#### **4.1 Factors that Led to Decrease in Cholera Cases for the Year 2015 to 2020**

Despite the ongoing cholera outbreaks, virtually little information about the evaluation of the outbreak response efforts made in 2013 was published [23]. However, this may be a result of cases being missed or not being reported that were handled at home but not reported to the hospital [1,12]. This however could be attributed to missed or unreported cases which were managed at home, and not reported to the hospital.

Cholera cases have decreased recently as a result of several government efforts. The adoption of National Sanitation Day is one of the policies. National Sanitation Day is a day set aside for the nation to perform environmental cleanup activities [26]. Another policy that was implemented was the one house one toilet policy; in that every household was to have a toilet facility available, if not will face the law [27]. Also, all of the country's provinces and districts received cholera epidemic alerts from the Ghana Health Service on a nationwide basis. Additionally, the country's 10 regions received standard operating procedures for cholera surveillance and case management [28]. Again the control was aided by prompt case management, contact tracing, health education, limiting access to cholera treatment centers, and implementing water sanitation and hygiene measures [20]. The National Cholera and Emergency Preparedness and Response Plan was also updated and put into operation, and supplies and other logistics were sent to the outbreak locations that were affected [2]. Through various media sources and some health organizations, such the Red Cross Society, public health messages about cholera, its prevention, and control methods were spread throughout the regions which also help control and to contain the infection [1,2]. Health facilities handled cholera cases in accordance with national protocols. District health management teams (DHMTs) in Ghana educated districts, particularly rural populations, on sanitation and hygiene in coordination with district assemblies [2]. The cholera preventive strategies, however, did not have much of an impact despite the fact that these response measures were successful for a variety of reasons, including a change in government [29]. Moreover, according to the Ghana Health Service (GHS), there were no cholera cases in

Ghana in 2020 in spite of the advent of COVID-19 [20]. Dr. Patrick, Director-General of the Ghana Health Service, who talked to Joy News, however, credited the safety measures put in place to deal with the Covid-19 outbreak for the success [30].

#### **5. CONCLUSION**

In order to raise Ghana's public health to levels of acceptability on the international stage, the cyclical nature of the cholera outbreak is a health predicament that necessitates quick intervention. Response measures to prevent recurrence of cholera epidemics in Ghana require a multi-sectoral approach, which should also encompass the cooperation and participation of the public. Especially, because for a public health preventive intervention to be feasible and sustainable like that of cholera, it must involve the affected community from the scratch thus from planning to implementation. Cholera epidemics should be recognized and given top priority by the Ministry of Health in cooperation with the Ministry of Sanitation and Water Works, Ministry of Local Government and Rural Development, Ministry of Works and Housing, Ministry of Communications, Ministry of Education, municipal and district assemblies, and the Food and Drug Authority thus further enforcing the multi-sectoral approach to preventing and where possible, eradicating cholera in Ghana. With such an approach, they will be able to address issues associated with the scarcity of drinkable water sources, the existence of urban slums, the enforcement of regulations governing environmental sanitation and food hygiene, as well as the correct disposal of garbage. The best chance of success is found in a WASH (Water Sanitation and Hygiene) intervention that has been specially designed with component activities to address the unique needs of the targeted populations in a way that will be both most effective and efficient. In order to lower the mortality and morbidity linked to cholera outbreaks, it is crucial to give the recommendations stated top priority when making policy choices about Ghana's sanitation situation.

#### **DATA AVAILABILITY**

The data used to support the findings of this study are included in the article and also available from the corresponding author upon request.

## ACKNOWLEDGEMENTS

The authors are grateful to the Ghana Health Service for their support in the study.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Tutu RA, Gupta S, Elavarthi S, Busingye JD, Boateng JK. Exploring the development of a household cholera-focused health literacy scale in James Town, Accra. *Journal of Infection and Public Health*. 2019;12(1):62-9
2. Mireku-Gyimah N, Apanga PA, Awoonor-Williams JK. Cyclical cholera outbreaks in Ghana: Filth, not myth. *Infectious Diseases of Poverty*. 2018;7(1):1-5.
3. Ebob TJ. Epidemiological distribution of different *Vibrio cholerae* strains causing cholera disease in endemic countries: A review. *J. Adv. Med. Res*. 2019;31:1-5.
4. Idoga PE, Toycan M, Zayyad MA. Analysis of factors contributing to the spread of cholera in developing countries. *The Eurasian Journal of Medicine*. 2019;51(2):121.
5. Khurana K. Cholera: Transmission and symptoms, treatment. *Archives of Clinical Microbiology*. 2022;13(9):1-2.
6. Ganesan D, Gupta SS, Legros D. Cholera surveillance and estimation of burden of cholera. *Vaccine*. 2020;38:A13-7.
7. Roux WJ, Schaefer LM, Venter SN. *Vibrio cholerae* and cholera: A recent African perspective. In *Current Microbiological Research in Africa*, Springer, Cham. 2020:69-113.
8. Lonappan S, Golecha R, Nair GB. Contrasts, contradictions and control of cholera. *Vaccine*. 2020;38:A4-6.
9. Basiru I, Arkorful VE, Ashu HA, Lukman S. Challenges affecting sustainability of National Sanitation Day (NSD) programme in Ghana. *Journal of Health and Medical Sciences*. 2019;2(1):58-67
10. Awalime DK, Davies-Teye BB, Vanotoo LA, Owoo NS, Nketiah-Amponsah E. Economic evaluation of 2014 cholera outbreak in Ghana: a household cost analysis. *Health Economics Review*. 2017;7(1):1-8.
11. Amediavor RL. The persisting threats of cholera: A cyclical public health problem in Ghana (Doctoral dissertation, Wright State University).
12. Donkor AG, Namaitijiang M. The cholera outbreak in Ghana. *Estüdam Halk Sağlığı Dergisi*. 2019;4(3):371-6.
13. Kogi R, Takramah WK. The trend and prone areas of cholera outbreaks: A review of the cholera line list form (2011-2015) in Ho Municipality, Ghana. *Diverse Journal of Multidisciplinary Research*. 2020;2(1):1-9.
14. Noora CL, Issah K, Kenu E, Bachan EG, Nuoh RD, Nyarko KM, Appiah P, Letsa T. Large cholera outbreak in Brong Ahafo region, Ghana. *BMC Research Notes*. 2017;10(1):1-8.
15. Mogasale V, Ngogoyo SM, Mogasale VV. Model-based estimation of the economic burden of cholera in Africa. *BMJ open*. 2021;11(3):e044615.
16. Mondiale de la Santé O, World Health Organization. *Weekly Epidemiological Record*, 2022;97:37. [full issue]. *Weekly Epidemiological Record= Relevé épidémiologique hebdomadaire*. 2022;97(37):453-64.
17. Basiru I, Arkorful VE, Ashu HA, Lukman S. Challenges affecting sustainability of National Sanitation Day (NSD) Programme in Ghana. *Journal of Health and Medical Sciences*. 2019;2(1):58-67
18. Eibach D, Herrera-Leon S, Gil H, Hogan B, Ehlikes L, Adjabeng M, Kreuels B, Nagel M, Opare D, Fobil JN, May J. Molecular epidemiology and antibiotic susceptibility of *Vibrio cholera*; 2016.
19. Ohene-Adjei K, Kenu E, Bando DA, Addo PN, Noora CL, Nortey P, Afari EA. Epidemiological link of a major cholera outbreak in Greater Accra region of Ghana, 2014. *BMC Public Health*. 2017;17(1):1-10.
20. Communities G. A race against time: responding to cholera outbreaks in Ghana. *Relief Web*; 2017.
21. Danso EK, Asare P, Otchere ID, Akyeh LM, Asante-Poku A, Aboagye SY, Osei-Wusu S, Opare D, Ntoumi F, Zumla A, Duodu S. A molecular and epidemiological study of *Vibrio cholerae* isolates from cholera outbreaks in southern Ghana. *Plos one*. 2020;15(7):e0236016.
22. Issahaku G, Asiedu-Bekoe F, Kwashie S, et al. Protracted cholera outbreak in the Central Region, Ghana, 2016. *Ghana Medical Journal*. 2020;54(2):45-52.

23. Ohene SA, Klenyuie W, Sarpeh M. Assessment of the response to cholera outbreaks in two districts in Ghana. *Infectious diseases of poverty*. 2016;5(06): 71-81.
24. Cholera Annual Report 2020 Weekly Epidemiological Record 37. 2021;96:445-460.
25. Deen J, Mengel MA, Clemens JD. Epidemiology of cholera. *Vaccine*. 2020; 38:A31-40.
26. Mensah J. Effectiveness of national sanitation day as a community-participatory approach for improving environmental sanitation in Edina traditional area, Ghana. *Management of Environmental Quality: An International Journal*; 2019.
27. Antwi-Agyei P, Monney I, Dwumfour-Asare B, Cavill S. Toilets for tenants: A cooperative approach to sanitation bye-law enforcement in Ga West, Accra. *Environment and Urbanization*. 2019;31(1): 293-308
28. Cudjoe E. WASH in national elections: Water, sanitation, and hygiene (WASH) in National Development. *Water Aid*; 2016.
29. Barnett-Quaicoo P, Ahmadu A. Business continuity and disaster recovery in Ghana—a literature review. *Continuity & Resilience Review*; 2021.
30. Ohene-Adjei K, Kenu E, Bando DA, et al. Epidemiological link of a major cholera outbreak in greater Accra region of Ghana, 2014. *BMC Public Health*. 2017;17(1):1-0.

© 2023 Apenteng et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

*Peer-review history:*  
*The peer review history for this paper can be accessed here:*  
<https://www.sdiarticle5.com/review-history/99305>