An assessment of the response to Cholera outbreak in Lusaka district, Zambia - October 2023 - February 2024

Ernest Kateule[1,2,&], William Ngosa[1,2], Fred Mfume[1], Chola Shimangwala[1], Sophia Msisika[1], Simulyamana Choonga[1], Angela Gama[2], Oscar Nzila[3]

[1]Lusaka Provincial Health Office, Ministry of Health, Lusaka, Zambia, [2]Zambia National Public Health Institute, Lusaka, Zambia, [3]Lusaka District Health Office, Ministry of Health, Lusaka, Zambia

ABSTRACT

Introduction: On 18 October 2023, the Zambia's Ministry of Health declared an outbreak of cholera in the capital city of Lusaka. Cholera outbreaks pose a significant threat due to their potential to spread rapidly. Examining the effectiveness of the response measures, can identify areas for improvement and enhance preparedness for future outbreaks. We assessed the response activities implemented during the 2023-2024 cholera outbreak in Lusaka district. **Methods:** We retrospectively reviewed case report, cluster reports and epidemiological data from cholera treatment centres (CTCs) and electronic integrated disease surveillance and response (eIDSR) platform. We extracted data on age, sex, area of residence and date of onset of illness and characterised the outbreak by person, time and place. To assess the gaps in detection and response timelines, we deployed the 7-1-7 framework; a tool adopted to evaluate the effectiveness of public health emergence response. We administered the WHO's cholera response assessment tool to identify major strengths and weaknesses focusing on five thematic areas: response coordination, surveillance and laboratory confirmation, case management, control of the environment, and control of the spread in the community. **Results:** Of 13,830 cases reported, majority were males (57.0%) and those aged ≥ 15 years (66.4%) were the most affected. More community deaths (62.6%) were reported than facility deaths. Majority of cases (64.6%) were clustered around two constituencies; overall case fatality rate of 3.7%. The index case was detected on 14 October 2023 at local health facility. The specific time from epidemic alert to confirmation was undefined. The epidemic was notified within 24 hours while the duration between detection and initial response exceeded 13 days. During the early stages of response, there were deficiencies in coordination and capacity to investigate and identify the source of infection at local level. Multisectoral response activities implemented included: water, sanitation and hygiene interventions, and community-based case management. **Conclusion:** Our study identified essential strengths during cholera outbreak response in Lusaka district. Timely notification and activation of multisectoral emergence preparedness and response committee, necessitated prompt implemented response activities. Strengthening local-level epidemiological capacity to respond and coordinate epidemics is crucial for ensuring effective initial responses to outbreaks in Lusaka district.

KEYWORDS: Cholera, outbreak detection, notification, response assessment, Lusaka

&CORRESPONDING AUTHOR
Ernest Kateule, Zambia National Public Health Institute, Lusaka, Zambia

ernest.kateule@znphi.co.zm

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Introduction

Zambia has experienced several Cholera outbreaks since 1977 with Lusaka district being one of the main hotspots [1]. The last major Cholera outbreak recorded between October 2017 and June 2018 affected mostly Lusaka district with 5,935 cases and 114 deaths [1-3]. The 2017-2018 outbreak spread widely across Lusaka, making containment difficult due to its scale and resource demands. A two percent case fatality rate, coupled with heavy rains and flooding, created ideal conditions for transmission and hindered control efforts [1-3]. The rapid growth of Lusaka city had resulted in overcrowding and insufficient sanitation facilities. This, combined with contaminated water sources and poor sanitation practices, contributed to the transmission of cholera among residents [4]. During the 2017 - 2018 Cholera outbreak, the Ministry of Health (MOH) with support from governmental and non-governmental organizations, distributed chlorinated water to over 500 emergency tanks, administered 1,000,000 oral vaccines in the communities, identified and closed off contaminated water points, cleaned drainage canals and market places and banned street food vendors [2-4]. In 2019, the Zambian government, in collaboration with relevant ministries, initiated the Zambia Multisectoral Cholera Elimination Plan (MCEP) for the period 2019-2025. The primary objective of MCEP was to eradicate cholera in Zambia by 2025 through a multifaceted approach that emphasized reducing morbidity and mortality rates. Key interventions focused on enhancing water, sanitation, and hygiene (WASH) infrastructure and services in high-risk areas [1].

On 18 October 2023, the MOH declared another outbreak of Cholera following confirmatory tests in two residents of Kanyama compound in Lusaka district. As of 12 February 2024, a total of 13,117 and 497 deaths have been reported with the case fatality rate (CFR) of 3.8% in Lusaka[5]. Previous reports have documented poor WASH practices as the prominent risk factors for Cholera outbreaks, exacerbated by flooding season in Lusaka. Heavy rains often lead to flooding, which can contaminate water sources with sewage and human waste. These contaminated waters can serve as breeding grounds for cholera bacteria, increasing the risk of exposure [4,6]. Since October 2023, the MOH has deployed a multisectoral approach in implementing the public health interventions such as: installation of emergency water tanks, oral rehydration points, distribution household water treatment supplies, and training frontline health worker at facility and community levels.

According to the Global Task Force on Cholera Control (GTFCC) the CFR in untreated cases may be 30-50% but if treatment is provided rapidly and appropriately, the CFR should remain below 1 percent [4,7]. By the middle of February 2024, there were still an increase in the number of cases and deaths with a CFR of around 3 percent [5]. Although public health interventions have been implemented, little on the implementation of five response aspect: response organization, surveillance, case management, environmental control, and community-based spread control measures as recommended by WHO, in the affected subdistricts. Thus, it is critical to evaluate the present epidemic response strategies in order to monitor their efficacy and inform future planning for more effective real-time response. We report the findings of the assessment of the response activities implemented to control the spread of cholera epidemic in the Lusaka district.

Methods

Study sites

Lusaka district, shown in **Figure 1**, is located in Lusaka Province of Zambia (Lat: 15°25' 0.0S, Long: 28° 16' 60 E). Lusaka city is most populated and most densely populated district, with a population of 2,204,059 and density of 5273 persons per km^2 as of 2022 [8]. Lusaka District is divided into seven constituencies also called subdistricts, namely Lusaka Central, Matero, Mandevu, Munali, Chawama, Kabwata and Kanyama. Currently, there six functional subdistricts, each with a first level hospital for administrative and management purposes. Two tertiary hospitals (Levy Mwanawasa and University Teaching Hospitals) serve as the referral hospitals in district. Lusaka is among the 29 hotspot districts in Zambia [1]. The district was an epicenter for the 2017/18 outbreak declared on 6 October 2017; the epidemic spread rapidly to other districts accounting to over 4,000 cases by March 2018 (CFR: 2) [2]. In the past two decades, Lusaka has experienced significant population growth, resulting in overcrowding in unplanned settlements that already had limited sanitation facilities. Additionally, the lack of access to clean water,

inadequate sanitation practices, and poor hygiene have made Lusaka more susceptible to cholera outbreaks [2].

Study design

This was a descriptive cross-sectional study employed to retrospectively assess the cholera epidemic response and control activities implemented between October 2023 and February 2024 in Lusaka district.

Data collection

Surveillance and Epidemiologic Data

We reviewed case report, cluster reports and epidemiological data that were available at cholera treatment centres or units (CTCs/CTUs). Data were also extracted from incident action plans and outbreak investigation updates from Lusaka District Health Office (DHO). We extracted data on age, sex, area of residence and date of onset of illness using electronic Integrated Disease Surveillance and Response (eIDSR) database generated by (CTCs/CTUs) in Lusaka district from October 2023 to February 2024.

The WHO's Cholera Assessment Tool

We administered the World Health Organization's (WHO) Cholera assessment tool to Incident Management System (IMS) command staff at the DHO in order to extract and compile the most important strengths and weaknesses regarding epidemic preparedness and response [1]. We adopted this tool as a standard framework to assess the components of the response to a cholera outbreak with the view to highlight the strengths and challenges and make recommendations to enhance preparedness and improve the response to current and future outbreaks. The tool lists the following areas for a review: case management, laboratory confirmation and surveillance activities, outbreak detection, organization of the response, control of the environment, including water, sanitation, and hygiene activities; and steps to stop the spread of cholera in the community.

The 7-1-7 Matrix

To assess the gaps in detection and response timelines, we employed the 7-1-7 matrix; a tool adopted to evaluate the effectiveness of public health emergence response. The 7-1-7 matrix defines timeliness of detection as ≤7 days from emergence, notification as ≤1 day from detection, and completion of early response actions as ≤7 days from notification targeting key informants from health facility and DHO [9]. We examined the timings for initial investigation, risk assessment, confirmatory test by the laboratory, case management, and implementing IPC measures at CTUs in order to assess the completion of early response steps. A coordination system and dates for implementing appropriate public health countermeasures in affected communities, such as RCCE, were also taken into consideration.

Data Analysis

We described the outbreak by person, time and place based on the line list of patients presented at the health centers and those admitted at CTCs in the six subdistricts. The resulting data were descriptively analysed by using proportions and presented in tables and graphs. To determine subdistrict-specific attack rates, the 2010 projected mid-year populations from the Zambia Statistics Agency were used as a denominator[8,9]. We also used QGIS to create spot maps to show cases by constituencies or residential areas. We reported and plotted the timeliness of detection, notification, and completion of early response actions on epidemic curve. In addition, we calculated the timelines in days for: outbreak detection from emergence or alert, notification from detection, and completion of early response actions notification. The response interventions collected on epidemic response thematic areas using the WHO´s cholera assessment instrument were grouped and summarised into two themes namely strengths and weaknesses. The strengths and weaknesses were classified using the criteria outlined in the tool. Responses to each activity were categorized as either "implemented" or "not implemented", "present" or "absent", and "available" or "unavailable".

Ethical considerations

Zambia National Public Health Institute has a waiver for ethical approval of outbreak investigations established in accordance with the ZNPHI Act No. 19 of 2020 which mandates the institute to generate scientific evidence through research for timely decision making during public health emergencies. Permission was sought from the DHO and subdistrict managements to review the patients´ medical reports. Informed verbal consents were obtained from those involved in interviews. There was no personal identifying information in the data collected and all data were handled with strict confidentiality.

Results

Epidemiological characterization of the Cholera outbreak

Between 18 October 2023 and 26 February 2024, 20,176 cases and 691 deaths were reported country-wide. Lusaka district accounted for the majority of total reported cases and deaths; 13,830 (68.5%) and 511 (73.9%) respectively. The first two confirmed cases were residents of Kanyama compound in Lusaka district. The index case was a 21-year-old female patient who presented at the clinic on October 14, 2023, complaining of severe watery diarrhoea, nausea, vomiting, weakness, and leg discomfort. The rapid diagnostic test and culture were all positive for *Vibrio Cholerae* O1. The second case was a brought-in-dead (community death) male identified within the same compound of the first case during active case search and contact tracing by the rapid response team on the 15 October, 2023. Since then Lusaka district had been responding to the Cholera outbreak.

Of 13,830 cases reported, majority were males (57.0%, 7,883) and those aged ≥15 years (66.4%, 9,188) were the most affected followed by those aged 1-4 years (12.5%, 1,723) (Figure 2). Community deaths constituted a significant portion of cholera fatalities, representing 62.6% (320/511) of the total. Matero and Kanyama experienced notably higher proportion of the total community deaths; at 28.0% (90/320) and 27% (86/320) respectively. Overall, the case fatality rate (CFR) was 3.7% (511/13,830). Most of the cases (64.5%, 8,889/13,830) were reported between 12 and 23 January, 2024, with the highest number (n=474) reported on January 18 (Figure 3). The epidemiological curve demonstrates a typical pattern of a continuing common source outbreak with a prolonged exposure period from October to December 2023. Cases exhibited a gradual increase, followed by a rapid surge culminating in a peak in January 2024. Cases were clustered in two constituencies namely Matero (32.3%; n=4,473) and Kanyama (31.3%; n=4,345) (Figure 4). Matero subdistrict recorded the highest attack rate of 1,368 cases per 100,000 population (Table 1).

Outbreak detection and notification

On October 14, 2023, a patient presented at Kanyama Level 1 Hospital with symptoms indicative of cholera. A rapid diagnostic test administered by the hospital's out-patient department and was positive. Stool samples were collected and sent to the University Teaching Hospital for laboratory analysis. On 16 October 2023, the culture tests confirmed the presence of Vibrio cholera O1 and the Lusaka DHO was immediately notified of the cholera outbreak. On 17 October 2023, the subdistricts launched an investigation and heightened its surveillance. The index case patient lived with nine other family members, shared a piped water supply and a pit latrine with two households in the same yard. Initial investigation found that most of the residents had previously had episodes of diarrhoea and vomiting, and one housemate had recently been admitted to the hospital with same symptoms. On December 18, 2023, the Ministry of Health announced a cholera epidemic and put the whole Lusaka district on high alert. We were unable to determine the specific start date for the outbreak; the detection time was not within the 7 days. Additionally, epidemic detection and time to completion of initial response actions were longer 13 days.

Assessing the outbreak response - strengths and weaknesses

We identified various strengths and weaknesses in the response activities in the district and summarized in Table 2. The outbreak was coordinated and effectively monitored by multisectoral emergence preparedness and response committees with partners

comprising among others the local authorities, various line ministries and NGOs including international agencies. At facility level, the patients´ records were captured in real time using an enhanced online platform, the Electronic Integrated Diseases Surveillance Response (eIDSR). The eIDSR served as a live, user-friendly data visualization tool. Dashboards were developed and shared during technical meetings to facilitate planning and decision-making. Testing of cholera samples, data management and analysis during the response were conducted at the Zambia National Public Health Referral Laboratory (ZNPHRL), which also operates as a national surveillance for acute gastroenteritis. As the cases increased drastically, two referral cholera treatment centers (CTCs) were setup at Levy Mwanawasa University Teaching Hospital and National Heroes Stadium with >100 and >1,000 bed capacities respectively. The Ministry of Health, in collaboration with the Zambia Medicines and Medical Supplies Agency, ensured the availability of essential medical and non-medical supplies, including emergency stock, at all Cholera Treatment Centers at the time of assessment.

The DHO completed the implementation of early response actions by 27 December 2023 (**Figure 3**). This was twice the recommended timeliness to complete early response activities (≤7 days from notification) in reference to 7-1-7 metrics for early detection and response. During the first week of November 2023, the Lusaka Water and Sewerage Company (LWSC), Lusaka City Council (LCC) and Disaster Management Mitigation Unit (DMMU) implemented several WASH interventions. A number of cholera prevention measures, such as monitoring the quality of the water sources, installing emergence tanks to provide safe drinking water, emptying overflowing pit latrines, as well as collection and disposing of solid waste in affected communities. Environmental Health Officers from MOH and LCC Public Health Departments, supervised all cholera burials including disinfection and disposal of cholera-suspected copses reported from the communities.

Enhanced health education campaigns were implemented within communities. A variety of communication channels, including meetings, public address systems, door-to-door outreach, radio broadcasts, television programs, and short media messages, were employed to engage and inform the public. The DHO with support from partners trained community-based volunteers (CBVs) and deployed to conduct active case search, manning of oral rehydration salts corners/points and distribution of hand washing with soap and water treatment chemicals in the households. The government evoked the Public Health Act that introduced key provisions to enhance cholera prevention and control measures. Local authorities carried out inspection of schools and college to ensure quality provision of WASH services in learning institutions. In addition, targeted cholera oral vaccines (OCV) were administered to the hotspot areas - Matero, Kanyama and Chipata compounds.

However, we found a few areas in which the district and its subdistricts needed to improve their response activities. These included the inability to use the Epidemic Prepared Response (EPR) plan by the DHO, the inability to investigate and identify the source infection early on, the lack of experience in responding to cholera epidemics at the subnational level, the high number of community deaths and the lack of community knowledge about cholera preventive measures (**Table 2**).

Our review identified two primary opportunities: the acquisition of over 1.7 million doses of Oral Cholera Vaccines (OCV) through the WHO International Coordinating Group and the establishment of robust multisectoral partnerships involving the ZNPHI, government entities, non-governmental organizations, and international agencies such as the WHO, UNICEF, Red Cross Society, Catholic Relief Services, US CDC, and Africa CDC. Several factors posed significant threats during the assessment period, including inconsistent water supply by local authorities, heavy rainfall between January 3rd and 8th, and an increase in community deaths attributed to low-risk perception and stigma among certain community members.

Discussion

The 2023/2024 cholera outbreak in Zambia primarily affected Lusaka province, with 82.2% of the 20,176. Lusaka district accounted for over two-thirds of both the cases (68.5%) and deaths (73.9%), with a notably high proportion of community deaths (57.3%). The outbreak began in October 2023, with an index case in Kanyama compound. Most cases

occurred in adults (≥15 years), with peaks between January 12-23, 2024. The epidemiologic curve shows a classic delayed exponential rise, typical of an outbreak that initially spreads slowly, followed by rapid acceleration in cases. The early response interventions in the outbreak could have controlled the situation for a while. However, the substantial rise in December 2023 points to either lapses or gaps in public health measures, which were later addressed by multisectoral efforts. The case fatality rate was three times the WHO threshold. Key response strengths included multisectoral coordination, real-time data capture, enhanced surveillance, and the establishment of cholera treatment centers. However, the response was delayed, with weaknesses in early outbreak detection and completion of initial response actions. Inadequate water supply, heavy rainfall, and low risk perception among residents, were notable threats. The current assessment identified the acquisition of 1.7 million cholera vaccine doses and multisectoral partnerships as important opportunities during cholera response.

Our assessment into the cholera outbreak response revealed a significant increase in non-bloody diarrhea cases in the six weeks prior to the detection on October 15, 2023. The rapid geographical spread of cases within a week of detection indicates that the outbreak had been ongoing for a substantial period [10-12]. Despite prompt notification by the subnational health authority, a delay of six days between the alert and the initiation of a response was observed, which is longer than reported in other studies [13-15]. This delay may be attributed to deficiencies in the surveillance system. Although the DHO activated its incident management system and intensified surveillance efforts, the initial response proved ineffective due to insufficient investigation and the failure to identify the source of infection [14,16,17]. A comprehensive understanding of cholera's epidemiology and surveillance practices is essential for the early recognition and investigation of outbreaks, thereby preventing further spread and facilitating effective control.

In July 2023, Zambia adopted the implementation of the 7-1-7 framework as a strategy to enhance public health security and emergence response systems. As part of this implementation, the national level staff were trained by ZNPHI to improve their ability to identify bottlenecks and enablers of response that are useful for prioritizing activities in national action plans for health security. However, orientation on the use of 7-1-7 approach had not been rolled-out to all subnational staff across the country. Limited awareness and understanding about the 7-1-7 framework in epidemic preparedness and response (EPR) especially, its objectives and benefits may have delays in implementation. The rollout of the 7-1-7 framework requires significant financial and human resources. Insufficient allocation of these resources at the subnational level can hinder progress and cause delays. Therefore, it is essential to ensure adequate funding and human resource allocation to ensure the effective and sustainable implementation of the 7-1-7 framework [18,19]. In order to enhance the ability to investigate outbreaks at all levels of the health system, frontline and rapid responders must be trained in the 7-1-7 strategy. This would enable subnational response teams to evaluate their individual levels of epidemic preparedness and effectively handle any future public health emergencies or events [1]. The district reported a CFR higher than the WHO's suggested threshold, and the outbreak spread to nearby compounds with comparable sanitary conditions favorable to *Vibrio cholerae*. There were more patients who died in the communities than at the facilities.

This fatality rate was much higher than Zambia's case fatality rate for cholera outbreaks in 2017 -2018 [1]. Correct case management by qualified staff, availability of rehydration fluids and good coordination are associated with low case fatality rate [20]. The high case fatality rate in this outbreak may have been due to poor health seeking behaviors among residents, inadequate health staff to undertake active case search and contact tracing, and poor community-based case management support. A delay in initiating the early response activities and instituting appropriate measures contributed immensely to the many preventable deaths that occurred [21,22]. This is consistent with the findings of the 2010 and 2008 cholera outbreaks in Kenya and Zimbabwe respectively [23]. In Kenya, the high CFR was attributed to poor case management, inadequate skills among health staff, and weaknesses in the surveillance system and poor management support. The delay in confirming the outbreak and instituting appropriate measures contributed immensely to the many preventable deaths that occurred. In Zimbabwe, inappropriate cholera case management with inadequate use of oral rehydration therapy,

inappropriate use of antibiotics, and a shortage of experienced healthcare professionals contributed to high case fatality [17,20,21]. A break down in health service delivery was also blamed for the high case fatality rate in the Zimbabwe outbreak [4]. Poor access to health facilities and lack of knowledge among rural folk has been blamed for high case fatality rate in other outbreaks [23]. In an outbreak in Guinea Bissau, those who died were six times more likely not to have sought care in a health center [21,24]. By January 23, 2024, the outbreak had started to subside following the implementation of robust multisectoral response measures, including intensified community education and WASH interventions.

Our study shows early detection and reporting of the index case of cholera, which is vital to prevent large scale epidemics. In this study, the time from epidemic alert to confirmation was 2 days which is lower than median time of 10 days reviewed in the Democratic Republic of Congo, Malawi and Mozambique between 2015 and 2018 by Médecins Sans Frontières [25]. However, the epidemic detection and time to response in our review were comparatively longer (13 days) compared to a recently published review by Ratnayake et al which found 10 days between alert and response [15,25]. Delays between alert and confirmation or alert to response have been reported in fragile states with median delays 29 days or 55 days respectively [26,27]. Our study revealed that a significant delay of six days between alert and response could be attributed to several factors, including a shortage of epidemiological data, a lack of qualified personnel, and ineffective coordination within the local surveillance system [28,29]. Timely detection of cholera patients presenting to health facilities, facilitates the capacity of health workers to management suspected cases, and reinforcing local investigation and response [30]. Early detection and notification of cholera remains important to quickly mount a response and prevent the potential for a widespread outbreak. Studies have documented some of the largest outbreaks in recent years in South Sudan (2014-6), Ethiopia (2015), and Zambia (2017-8) attributable to late detection and/or response [15]. Lusaka district and Zambia in particular, was probably experiencing the worst since 1978, the surges in number of cases had strained health systems especially frontline workforce needed for response. The two referral cholera treatment centers were setup to curb cholera related mortalities. The National Heroes Stadium (NHS) handled all referred cases while the Levy Mwanawasa University Teaching Hospital was reserved for management of specific populations with higher risk of complications such as pregnant women, infants, children with severe malnutrition or severe anaemia, other commodities. This prompt initiative by MOH, improved management of cholera patients because the CTUs were unable to cope with increased number of cases from the community. The convention of NHS contributed to the decline in facility deaths as patients required closer observation; patients with severe dehydration or hypovolaemic shock were stabilized by trained personnel who were deployed, and readily available at the CTC [7]. At the time of assessment, the MOH through Zambia Medicines and Medical Supplies Agency, ensured availability essential medical supplies and emergency stock of supplies available in CTCs. Antibiotics reduce the volume and duration of diarrhoea and the period of *V. cholerae* shedding [31]. Antibiotics are indicated for cholera patients hospitalized with severe dehydration as well as those with high purging (at least one stool per hour during the first 4 hours of treatment) or treatment failure (the patient is still dehydrated after completing the initial 4 hours of rehydration therapy), regardless of the degree of dehydration; and patients with coexisting conditions [3].

The wide spread escalation of cholera cases in all the six districts could be caused by movement of people within and outside the city thereby negatively affecting contact tracing and other surveillance efforts. Conversely, the cholera transmission in Lusaka district was significantly exacerbated by inadequate sanitation infrastructure and contaminated water sources, including shallow wells, boreholes, and reservoirs, within the densely populated slums of the city [3,32].

Our review of data collection processes revealed no major issues, although we identified a 20% backlog of paper-based case investigations pending upload to the electronic IDSR platform. Despite the backlog of paper-based case investigations, the aggregated surveillance and epidemiological data from reporting sites were timely, ensuring that decision-making during the response was not compromised [20,33]. Analyses of the data collected during response are essential to determine the magnitude

and progression of the cholera outbreak, to estimate the risk of a severe outbreak, to determine the potential benefit of multisectoral interventions against cholera, and to evaluate the treatment resource needs [34]. Our report found that surveillance and other IMS strategic pillars collected data and tabulated usually in an electronic database; daily and weekly totals of cases and deaths were expressed as case fatality rate. Data from all reporting treatment facilities in district were aggregated and visualized since the beginning of the outbreak to aid in decision making. The eIDSR facilitated a rapid exchange of information between the Rapid Response Teams and relevant stakeholders; daily updates were available during technical and non-technical meetings.

We observed a steady decline in the number of cases during the epidemic, particularly after January 23, 2024. The multisectoral actions implemented by the DHO with support from the MOH, Zambia National Public Health Public (ZNPHI), governmental and non-governmental including United Nations (UN) including the WHO, UNICEF, Red Cross Society, Catholic Relief Services (CRS), US CDC, Africa CDC, were probably responsible for the decline in the number of cases reported. Implementation of the WASH interventions such as the distribution of chlorine for at-home water treatment and hand-washing soap, provision of safe drinking, monitoring of water quality and emptying and disinfection of latrines in have been documented as high impact emergence response measures to interrupt the spread of Cholera outbreaks [1-4].

Cholera epidemic can be controlled quickly when the affected people know how to protect themselves and their relatives and the community is engaged to help limit the spread of the disease [5]. The DHO collaborated with environmental health stakeholders (governmental, NGO and UN agencies) to enhance community involvement in the response in hotspot areas such as Kanyama, Matero, and Chipata. This included health education to promote and improve hygiene behaviours, practices surrounding personal, food and hand hygiene to the cases and their neighbours [6,7]. As reported from other responses, the MOH, through CBVs, conducted house-to-house visits, community meetings; enhanced on mass and social media sensitisations, targeted areas or information, education and communication (IEC) materials distribution.

Setting up of Oral Rehydration Points (ORPs) serve as the primary point of care for Cholera in communities recognized as hotspots of infection [5,8,9] In addition, the ORPs assist in the screening, stabilising and timely referral of patients to CTCs, thereby preventing community deaths. Analysis conducted in Malawi, indicate that setting up of ORPs had increased chances of quick recovery and reduces Cholera deaths by 15.7% and 36.4% respectively. It also recommended the health education and distribution of chlorine are done at the same point for people to have safe water and prevent the disease [8,9].

In this study, we anticipated the short-term effect of single dose OCV administered during the on-going Cholera outbreak. Similar interventions have been previously implemented by the Zambian government during the 2018 Cholera outbreak in the high-risk subdistricts of Lusaka and other hotspot districts including fishing camps [1-3]. Studies have documented 80-90% effectiveness of one dose OVC administration in Cholera endemic and outbreak settings [10-12]. Cholera has been a historic disease in Zambia because of lack of access to basic water supply, sanitation, hygiene and sustainable waste management services in towns and unplanned settlement areas. In order to prevent future Cholera outbreaks in most affected areas of Lusaka, it is important to implement medium to long term WASH strategies, otherwise early detection and rapid response to alerts are essential for containing and stopping the spread of Cholera.

Limitations

Our study was subject to some limitations. Firstly, it was observational, focused on secondary data from reporting facilities and review of response activities at DHO. Follow-up visits could be conducted to further collect information and assess the outbreak, to generate additional evidence on response interventions and their effects on the progression of cholera cases and deaths. Secondly, we did not analyze the health outcomes to form connections and assess the risks associated with the exposure among Lusaka residents. Identification of the risk factors accountable for increased cases specially at community level would be ideal by understanding

the knowledge, attitudes and practices on cholera in the affected population.

Conclusion

This report describes the epidemiology of an outbreak of cholera, likely to have been caused by contaminated water sources in a densely inhabited slum of Lusaka. Prompt confirmation by local health authorities, and robust multisectoral response support from the governmental, NGOs and UN agencies could have contributed to decline in the number the cases in hotspot subdistricts.

Based on this review, the following recommendations are proposed to enhance cholera prevention and control efforts: (i) strengthen surveillance and epidemic intelligence; implement robust surveillance systems to ensure timely detection, notification, and response to outbreaks. (ii) enhance epidemiological capacity; invest in competency-based training, including the 7-1-7 framework, to equip healthcare professionals with the skills needed for effective outbreak management at subnational levels. (iii) operationalize the MCEP; strengthen partnerships with national, local, and other relevant agencies to implement the Multi-Sectoral Cholera Emergency Plan (MCEP) and reduce morbidity and mortality. (iv) invest in WASH infrastructure; prioritize the improvement of water, sanitation, and hygiene infrastructure and services in high-risk areas to address the root causes of cholera transmission.

What is known about this topic

- Cholera is an acute diarrhoeal infection caused by ingestion of food or water contaminated with the bacterium *Vibrio cholerae*
- Cholera transmission is closely linked to inadequate access to clean water and sanitation facilities,
- In outbreak settings, a combination of surveillance, water, sanitation and hygiene, social mobilization, treatment, and oral cholera vaccines are used control cholera transmission

What this study adds

- As of 26 February 2024, Lusaka district accounted for 68.5% of the total 20,176 cases reported during 2023-2024 cholera epidemic in Zambia,
- Enhanced epidemiological capacity is essential through competency-based training, including the 7-1-7 framework, to equip healthcare professionals with the skills needed for effective outbreak management at subnational level,
- The delayed implementation of initial response measures, with a duration at least 13 days between epidemic detection and response, hindered the effectiveness of the response by the subnational level.

Competing interests

The authors declare no competing interests.

Authors´ contributions

Ernest Kateule, William Ngosa and Oscar Nzila conceived the investigation, participated in its design and coordination, drafted the manuscript, initiated the investigation, interpreted the results and drafted the final manuscript. Fred Mfume, Chola Shimangwala Sophia Msisika, Simulyamana Choonga conducted data quality checks, interpreted the data and analysed the findings. Angela Gama revised the methods, guided the discussion and wrote up the manuscript. All authors read and approved the final manuscript.

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Table and figures

Table 1: Distribution of Cholera Cases and Attack Rates by Subdistrict, October 2023 –February 2024, Lusaka – Zambia
Table 2: Strengths and weaknesses identified during cholera response assessment in Lusaka district – January, 2024
Figure 1: Study site for the assessment of the response to Cholera outbreak – Lusaka district, Zambia (Supplementary)
Figure 2: Cholera cases by age and sex, October 2023 – February 2024, Lusaka –Zambia
Figure 3: Cholera cases by date onsite of illness, October 2023 – January 2024, Lusaka district – Zambia
Figure 4: Geographic distribution of Cholera Cases, October 2023 – February 2024, Lusaka – Zambia

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Table 1: Distribution of Cholera Cases and Attack Rates by Subdistrict, October 2023 – February 2024, Lusaka – Zambia

Subdistrict/Constituency	Population*	Cases	Deaths	CFR (%)	AR per 100,000
Kabwata	232,584	1090	8	0.7	469
Kanyama	540,875	4345	137	3.2	803
Chawama	212,586	691	28	4.1	325
Matero	326,990	4473	131	2.9	1,368
Munali	321,595	1823	25	1.4	567
Mandevu	472,646	978	41	4.2	207
Lusaka Central	140,865	356	5	1.4	253
Total	2,248,140	13,830	511	3.7	615

** 2010 projected population; CFR: Case Fatality Rate; AR: Attach Rate*

Table 2: Strengths and weaknesses identified during cholera response assessment in Lusaka district – January, 2024

Response thematic area	Components	Activities/Strengths	Weakness/Area for Improvement
Organization of the response	Organization of the response cholera coordination committee control measures monitoring of the activities Involvement of international partners coordination of partners project proposals Information management information dissemination media involvement coordination with media	District Health Office (DHO) activated the IMS; all the six subdistricts had similar structures with defined technical and non-technical roles District IMS held daily meetings to review the performance and plan the activities and set daily targets Multisectoral Emergence Preparedness and Response committee activated; partners, governmental and NGOs including International Agencies implemented activities through DHO Public health activities were coordinated and monitored effectively	Inadequate experience in Cholera epidemic response Inadequate coordination at subdistrict level; daily update meetings were inconsistently conducted Some IMSs did not proactively implement response activities. Failure to use the Epidemic Prepared Response (EPR) plan by the DHO
Surveillance and laboratory confirmation	Surveillance data for action outbreak investigation Outbreak detection quality of early warning system quality of background information flow of epidemiological information when the first cases reported first control measures taken Outbreak confirmation laboratory confirmation of diagnosis turnaround time case definition	Good early warning system, surveillance alerted the DHO team when the non-bloody diarrhea started increasing in September 2023 Timely detection (within 24 hours) and notification of DHO by 1st Level Hospital Authority (within 48 hours) of initial cases Data were captured in real time using an enhanced online platform (eIDSR) Live and user-friendly data virtualization; dashboards generated and shared for planning and decision making A sufficient supply of reagents for laboratory confirmatory testing and genotyping Case definition communicated timely and adhered to by rapid response teams	Failure to identify the source infection in the early stages due to inadequate capacity in outbreak investigation
Case management	Case management: treatment rehydration therapy antibiotics preventive measures (isolation, hygiene) Reduction of mortality case-fatality rate training of health care workers cholera treatment units in place Hygiene measures in health care facilities organization of cholera treatment units disinfection water supply	Qualified staff in cholera case management; >300 community health volunteers trained and deployed to support ORPs/ORCs operations Availability essential medical and non-medical supplies Emergency stock of supplies available in CTCs at the time of assessment Up grading of ORCs to ORPs in selected hotspots for quick assessment, stabilizing of patients and facilitation timely referral to CTCs	Some local CTUs did not meet minimum standards according to the IPC assessment done December 2023 Case management less supervised at subdistrict levels High case fatality rate at >1% WHO's threshold Inadequate capacity to manage cases in the initial stages
Control of the environment **(including IPC in HFs)**	Safe water measures to ensure safe drinking-water chlorination of water sources Sanitation access to sanitation facilities hygiene Funeral practices official recommendations to communities, health care workers and funeral organizers	Daily monitoring of free chlorine residual in the water sources All cholera funerals were restricted and burials were supervised by the environmental health officers IPC control measures observed in CTUs CTCs had adequate supply of water, proper disposal of waste and disinfection of linen The overflowing pit latrines emptied in Kanyama, Chipata and Matero compounds following outbreak	Most pit latrines were full and overflowing due to floods Indiscriminate disposal of solid water in communities Underserviced drainages Inconsistent supply of water by the municipal authority
Control of the spread in the community	Involvement of the community education campaign active case-finding Safe food marketplaces street food handlers	Communities were actively engaged through door to door health education CBVs were trained and deployed to conduct active case search Emergence water tanks installed in hotspots compounds The Public Health Act (Laws, Vol.17, Cap. 295); (Infected Areas) (Cholera) (Amendment), the 2024 regulations introduce key provisions to enhance cholera prevention and control measures. The government postponed the opening of the schools Target OVC campaigns implemented in hotspot areas	Selling of food in undesignated places continued despite a full-blown outbreak Delay in informing the community about the cholera outbreak Inadequate community knowledge about cholera preventive interventions

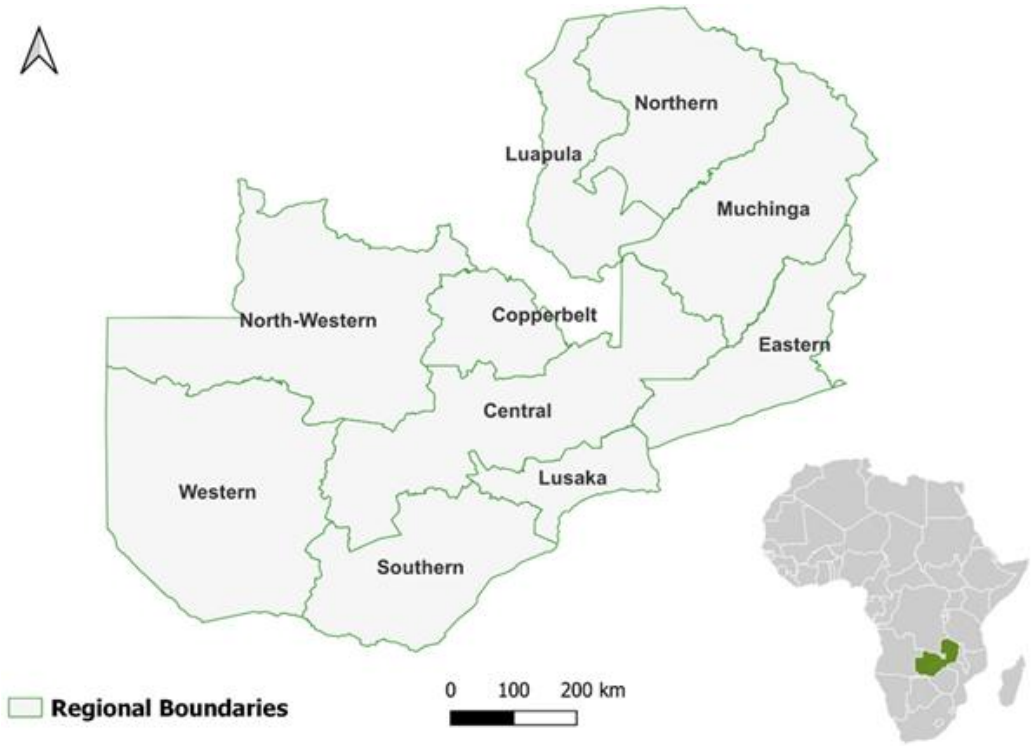

Figure 1: Study site for the assessment of the response to Cholera outbreak - Lusaka district, Zambia (Supplementary)

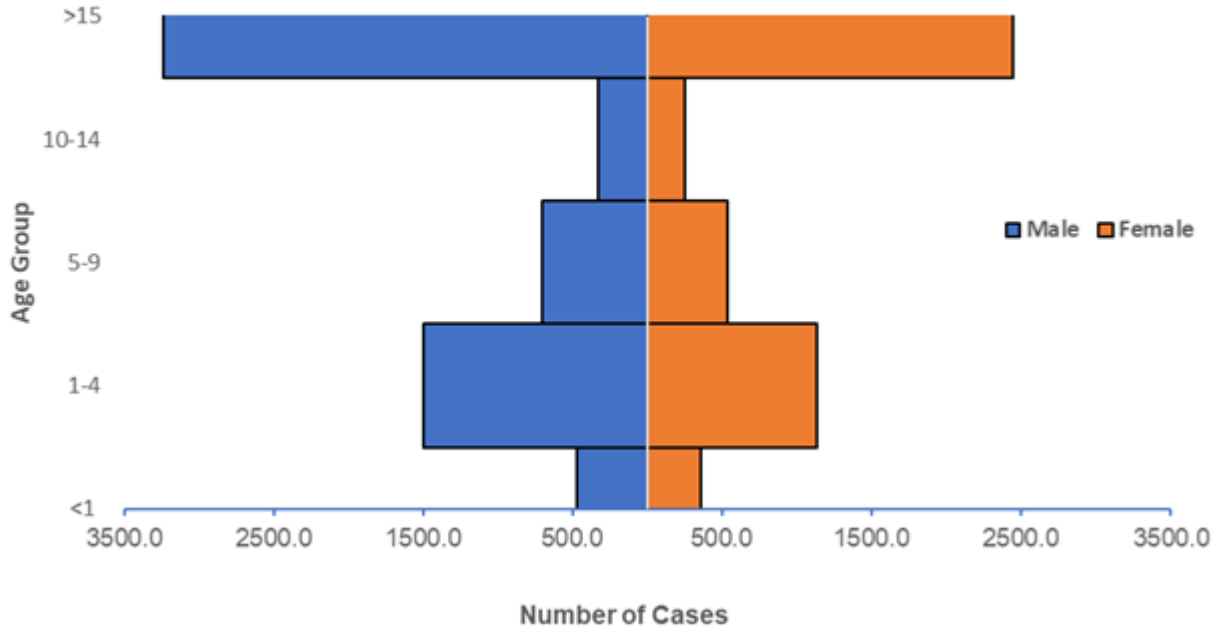

Figure 2: Cholera cases by age and sex, October 2023 – February 2024, Lusaka -Zambia

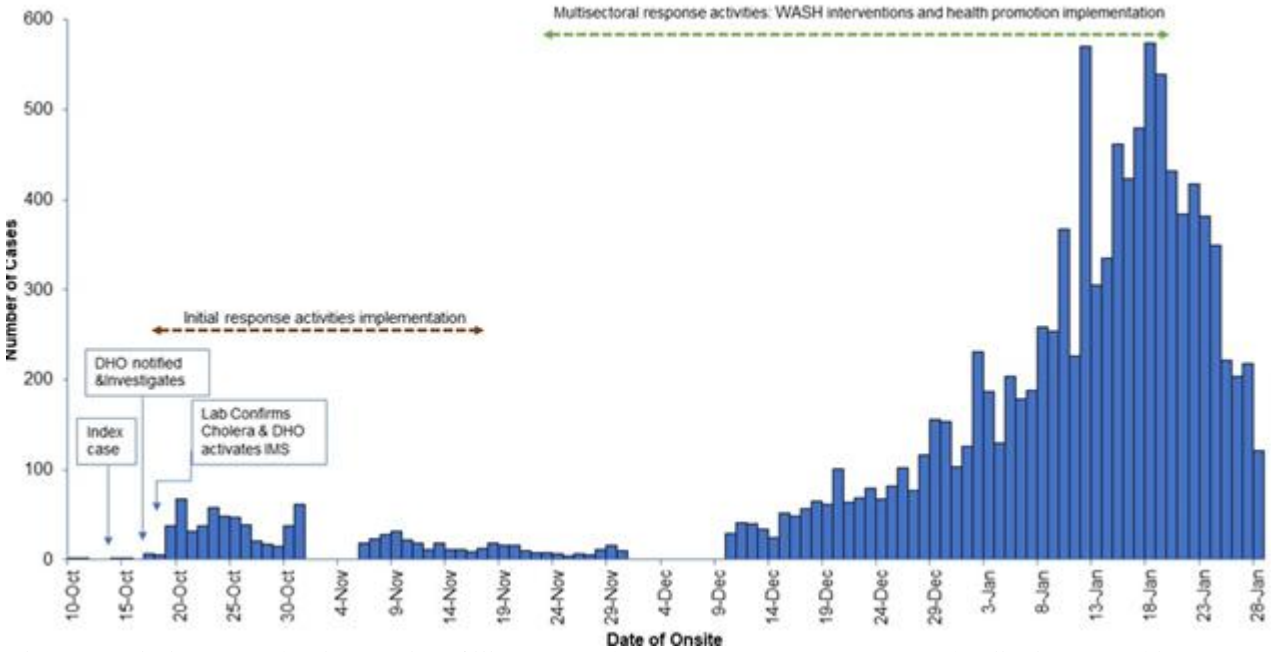

Figure 3: Cholera cases by date onsite of illness, October 2023 - January 2024, Lusaka district – Zambia

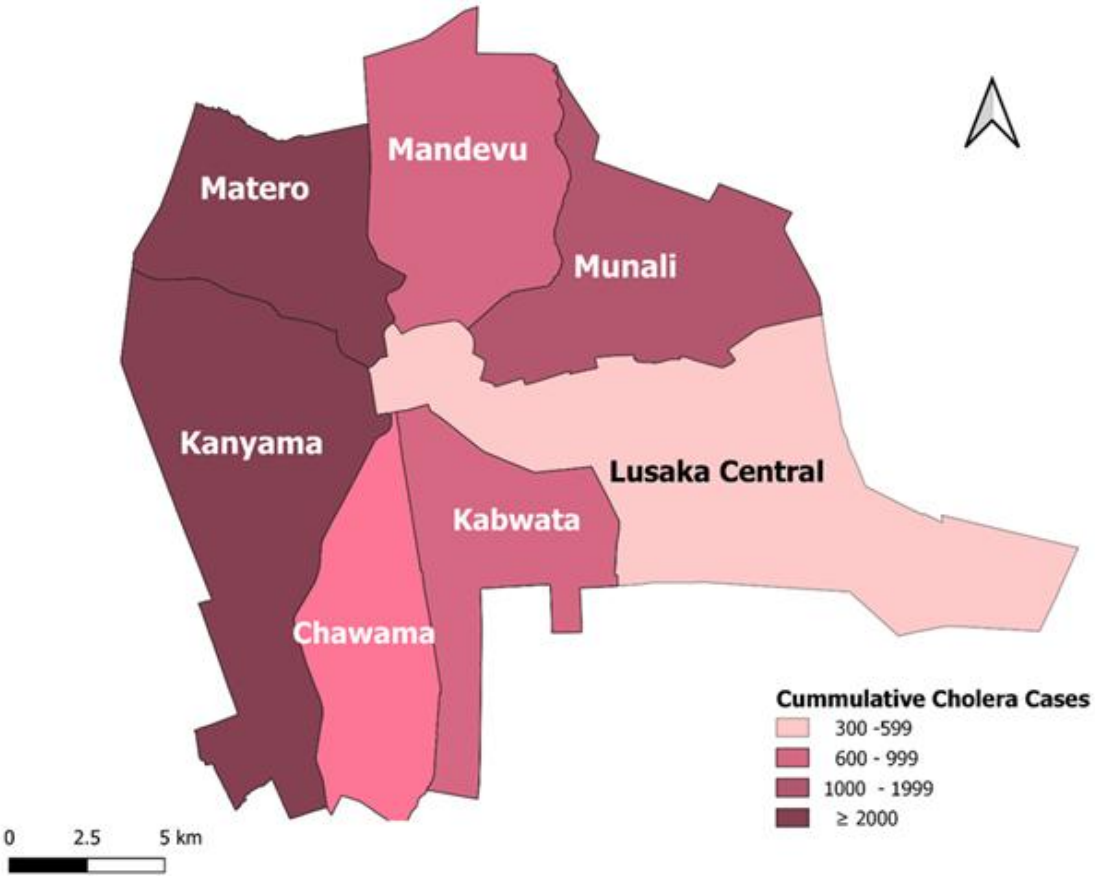

Figure 4: Geographic distribution of Cholera Cases, October 2023 – February 2024, Lusaka – Zambia