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Cholera Outbreaks: Malawi's Battle Against Contaminated Water: A Scoping Review

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Abstract: Cholera outbreaks pose a significant public health challenge in Malawi, where contaminated water sources contribute to the spread of this deadly disease. Focusing on the public health crisis, the paper examines the factors contributing to recurrent outbreaks, including inadequate sanitation infrastructure and limited access to clean water. It also analyzes the efforts taken by different stakeholders to mitigate the impact through improved water management strategies, community education, and international collaborations. This paper underscores the need for sustainable solutions to break the continuing cycle of cholera epidemics in Malawi, emphasizing the intersection of health, water quality, and socio-economic challenges.

The study reveals a sharp increase in cholera cases in 2022 and 2023, with regions having poor water infrastructure, such as Blantyre and Mangochi, reporting the highest number of cases. The case fatality rate (CFR) remained above the World Health Organization's emergency threshold of 1%, highlighting the severity of the outbreaks. Contaminated water sources, inadequate sanitation facilities, and poor hygiene practices were identified as major drivers of cholera transmission.

To address these challenges, the paper recommends a multi-sectoral approach involving surveillance, laboratory support, clinical care, water, sanitation, and hygiene (WASH) interventions, social mobilization, and the use of oral cholera vaccines (OCV) among high-risk populations. Additionally, improving water sanitation infrastructure and promoting community awareness about hygiene practices are crucial steps. The paper also emphasizes the need for effective urban planning to prioritize public health in rapidly urbanizing areas.
Cholera outbreaks in Malawi are a serious public health issue requiring collaborative efforts from government agencies, NGOs, and local communities. The findings highlight the urgent need for comprehensive interventions to combat contaminated water sources and protect public health.

Keywords: *Cholera Outbreaks Malawi, Water Contamination, Public Health emergency, Oral Cholera Vaccine (OCV), Water Sanitation, and Hygiene (WASH).*

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I. INTRODUCTION

The number of cholera cases and their geographic distribution have increased since 2021, when 23 countries reported outbreaks, mostly in the WHO regions of Africa and the Eastern Mediterranean (WHO, 2022a). This trend continued into 2022, when over 29 countries reported cholera cases or outbreaks, 16 of which have been experiencing prolonged outbreaks with higher case numbers and case fatality ratios (CFR) than in prior years (WHO, 2022a). Cholera outbreaks have become a growing global concern.

Cholera, caused by the bacterium Vibrio cholerae, remains a persistent threat in Malawi. The disease spreads rapidly through fecal-oral transmission, primarily due to inadequate sanitation facilities and unsafe drinking water (WHO, 2023a). Malawi has been grappling with a severe cholera outbreak, the deadliest in its history. The current outbreak began in March 2022 following Tropical Storm Ana and Cyclone Gombe, which caused devastating floods (UNICEF and WHO, 2022). These floods displaced over 190,000 people. Initially, the outbreak was mainly limited to the flood-affected areas in the southern region but later spread to the northern and central parts of the country within five months. Since then, Malawi had reported a staggering 36,943 cases of cholera, including 1,210 deaths, across all 29 districts (WHO, 2022b). This outbreak extended beyond the usual rainy season (November through May) and had persisted through the dry season. The case fatality rate remains consistently high, exceeding 3 (UNICEF and WHO, 2022). Recognizing the severity, the Malawi government declared the ongoing cholera outbreak a public health emergency on December 5, 2022 (UNICEF, 2022). The extensive geographic spread of the cholera outbreak and the significant strain on healthcare capacity led to overcrowded hospitals, shortages of medical supplies, and stretched healthcare personnel, all of which posed serious risks to public health in Malawi.

- *Impact on Health*

The cholera outbreaks in Malawi have had devastating consequences on public health, and some of these consequences including the most immediate and tragic impact is the loss of human lives. As of the first months of 2023, 1,210 people had succumbed to cholera in Malawi during the outbreak. Each life lost represented a family member, a friend, and a community member, leaving a void that cannot be filled (UNICEF, 2022). Cholera outbreaks result in high mortality rates, especially among vulnerable populations, including children and the elderly.

The strain on healthcare system is yet another impact. The surge in cholera cases overwhelmed Malawi's healthcare system. Hospitals and clinics were grappling with an influx of patients, leading to overcrowded wards, shortages of medical supplies, and stretched healthcare personnel (Relief Web, 2023). The strain on healthcare facilities affected not only cholera patients but also others seeking medical attention as overwhelmed healthcare facilities struggle to provide timely treatment and containment measures during outbreaks.

Economic disruption was another impact. Cholera outbreaks disrupt economic activities. Sick individuals could not work, businesses suffered heavily, and productivity declined. Families faced financial burdens due to medical expenses and loss of income (WHO, 2023a). The overall economic impact was severe, especially in vulnerable communities.

Malawi's outbreak occurred within a global context of increasing cholera cases. The strain on resources for vaccines, tests, and treatments affects not only Malawi but also other countries facing similar challenges (Partners in Health, 2022).

The figure below shows the percentage decrease in productivity and increase in medical expenses during the cholera outbreak in Malawi. It was noticed that there was a 30% Productivity Loss, that meant a decrease in workforce productivity, an increase in medical expenses by 150% particularly in average household medical expenses, and a 40% decrease in business revenue, specifically small businesses.

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Table 1: Impact of Cholera Outbreak on Healthcare Facilities in Malawi (2022-2023)

Indicator	Before Outbreak	During Outbreak	Change
Hospital Bed Occupancy Rate	60%	120%	+60%
Medical Supply Availability	90%	40%	-50%
Healthcare Personnel Availability	80%	60%	-20%
Number of Hospitals Overcrowded	5	20	+15
Average Wait Time (hours)	2	6	+4

Source: Compiled from WHO (2023a), UNICEF (2022), and Relief Web (2023).

➢ *Objectives*

- To analyze trends and patterns of cholera outbreaks in Malawi from 2015 to 2023.
- To identify key sources of water contamination contributing to cholera outbreaks.

II. MATERIALS AND METHODS

The review analyzed cholera outbreaks in Malawi and their connection to water contamination using secondary data from various sources. The Malawi Ministry of Health cholera surveillance reports (2015-2023) provided detailed epidemiological data, identifying trends and hotspot areas. WHO and UNICEF databases on water and sanitation provided insights into Malawi's infrastructure, analyzing indicators like access to clean drinking water, improved sanitation facilities, and hygiene practices. Scholarly articles and epidemiological studies provided contextual information on cholera dynamics in sub-Saharan Africa and Malawi, identifying risk factors, interventions, and research gaps. Media coverage provided qualitative data, including firsthand accounts of affected communities, authorities' response efforts, and public health challenges during outbreaks.

The review used descriptive statistics to summarize trends in cholera cases, fatalities, and case fatality rates over the study period. It also examined outbreak severity in rural versus urban settings, considering factors like population density, availability of health facilities, and water supply systems. This multi-faceted approach provided a comprehensive understanding of the factors contributing to cholera outbreaks in Malawi, laying the groundwork for subsequent discussions and recommendations.

➢ *Methodological Rigor and Data Limitations*

This study relies on secondary data from various sources, including reports from the Malawi Ministry of Health, WHO, UNICEF, and other relevant organizations. While these sources provide valuable insights into the cholera outbreaks in Malawi, there are several limitations associated with the use of secondary data that may affect the study's findings.

- *Data Completeness*

The availability of data may vary across different regions and time periods. Some districts may have more comprehensive reporting systems than others, leading to potential underreporting or overreporting of cases and fatalities in certain areas. This variability can introduce biases in the analysis and interpretation of trends and patterns.

- *Data Accuracy*

The accuracy of secondary data depends on the quality of the original data collection and reporting processes. Errors or inconsistencies in the initial data entry, as well as changes in reporting criteria over time, can affect the reliability of the data used in this study.

- *Temporal and Spatial Resolution*

The data used in this study may not capture the full temporal and spatial dynamics of the cholera outbreaks. For instance, the data may not reflect short-term fluctuations in case numbers or the specific geographic locations of outbreaks within districts. This limitation can hinder a detailed understanding of the outbreak's spread and the effectiveness of interventions at a granular level.

- *Socio-Economic Context*

Secondary data often lacks detailed socio-economic context, which can be crucial for understanding the underlying factors contributing to cholera outbreaks. Factors such as income levels, education, and access to healthcare services may not be fully captured in the available data, potentially limiting the comprehensiveness of the analysis.

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- *Intervention Impact:*

The data used may not provide sufficient detail on the specific interventions implemented during the outbreaks. This limitation can make it challenging to assess the direct impact of various interventions on reducing cholera cases and fatalities.

III. RESULTS

➢ *Trends and Patterns of Cholera Outbreaks in Malawi from 2015 to 2023*

Table 2: Cholera Cases and Fatalities in Malawi (2015–2023)

Year	Cases	Fatalities/ Deaths	Case Fatality Rate (%)
2015	1,795	48	2.67
2016	1,748	46	2.63
2017	282	5	1.8
2018	939	32	3.4
2019	26	1	3.8
2020	3	0	0
2021	2	0	0
2022	36, 943	1, 210	3.3
2023	58, 944	1, 766	3

Source: (Africa Press, 2023; Bisani, 2018; Govt. of Malawi, 2020; Khonje et al., 2012; Relief Web, 2022, 2023; Semu, 2020; UNICEF, 2023a; WHO, 2023b)

(Relief Web, 2023) acknowledges that in 2017, Malawi experienced a series of cholera outbreaks. As at 31 December 2017, a cumulative total of 282 cases with five deaths were registered from the 7 districts. (Govt. of Malawi, 2020) continues to highlight that in 2018 – 2019 cholera season, 26 cases with 1 death were reported (18 culture confirmed and 8 epidemiological link). The case fatality rate in Malawi is 3.8%. The first case was reported on 4th December 2018, at Ndirande Health Centre in Blantyre District and the case died (Govt. of Malawi, 2020).

According to (Penjani, 2021), seventh pandemic cholera was first reported in Malawi in 1973. Since 1990, large-scale outbreaks were reported in 1990-1991, 1993, 1999, and 2002. The yearly trend shows that epidemics have decreased in magnitude since 2002. Between 2001 and 2018, epidemiological surveillance reported 42,397 cases with 473 fatalities (case fatality rate ≈ 1.1%). The majority of suspected cases were reported in Southern Region (57%), where the districts that reported the greatest number of cases were Blantyre, Machinga, Chikwawa. More recently, the most affected districts from 2014 to 2018 were Machinga (23%), Karonga (17%) and Chikwawa (14%) (Penjani, 2021).

The country has been affected by cross-border outbreaks, especially along the southern border with Mozambique and likely along the border with Tanzania albeit to a lesser degree. Epidemiological parameters of cholera outbreaks in primarily affected districts in Malawi, 2001-2018 (Semu, 2020). Cumulative cholera incidence by district in Malawi, 2001-2018. Monthly cholera case numbers and precipitation levels in Malawi, 2015 – 2018.

(Semu, 2020) highlighted that Malawi experienced a widespread cholera outbreak, with 36 943 cases and 1210 associated deaths reported from all 29 districts since 3 March 2022. This was the deadliest outbreak of cholera in the country's history.

(CDC, 2024) in their Cholera response emphasized that from 2022-2023, Malawi experienced the deadliest cholera outbreak in the country's history with over 59,000 cases and 1,770 deaths. Due to heavy rain, widespread cholera, and many deaths, Malawi declared a public health emergency in December 2022 (CDC, 2024).

The key findings in this study include that cholera cases increased sharply in 2022 and 2023 and regions with poor water infrastructure, including Blantyre and Mangochi, reported the highest cases. The case fatality rates (CFR) remained above the WHO's emergency threshold of 1% except in 2020 and 2021.

➢ *Key Sources of Water Contamination Contributing to Cholera Outbreaks*

The cholera outbreaks in Malawi have been influenced by several contributing factors, including contaminated water sources which is a highly recognized contributing factor, unsafe water remains a significant driver of cholera transmission. Malawi faces challenges in ensuring access to clean and potable water for its population. Contaminated water sources, inadequate sanitation facilities, and poor hygiene practices contribute to the spread of the disease. Polluted water sources, including rivers and wells, harbor the cholera bacterium (Partners in Health, 2022).

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Poor sanitation infrastructure is yet another contributing factor. Insufficient access to proper sanitation facilities increases the rate of the problem. Open defecation and inadequate waste disposal contribute highly to contamination (IFRC, 2022). Lack of proper sewage systems and waste management facilities also leads to the contamination of water bodies, increasing the risk of cholera outbreaks.

According to (UNICEF, 2022), urbanization and overcrowding is another contributing factor. Rapid urban growth strains existing infrastructure, leading to overcrowded settlements and increased risk of disease transmission. Rapid urbanization, especially in cities like Blantyre and Lilongwe, has led to overcrowding and strained living conditions (UNICEF, 2022). High population density, informal settlements, and inadequate waste disposal contribute to the rapid spread of the disease.

Climate and environmental factors also contribute a great deal. Malawi's climate, characterized by distinct rainy and dry seasons, plays a role. Heavy rains can lead to flooding, which contaminates water sources and facilitates the spread of cholera (Ritter et al., 2022). Additionally, poor drainage systems exacerbate flood-related risks. Simply put, extreme weather events, such as floods, disrupt water supply systems and exacerbating contamination.

IV. DISCUSSION

The study confirmed that contaminated water sources are a primary driver of cholera outbreaks. Rivers, wells, and other unprotected water sources frequently harbor Vibrio cholerae due to pollution and lack of treatment facilities (Partners in Health, 2022). As at 31 December 2017, a cumulative total of 282 cases with five deaths were registered from seven districts. Similarly, during the 2018–2019 cholera season, 26 cases and one death were reported, with the first case identified at Ndirande Health Centre in Blantyre (Govt. of Malawi, 2020). These figures emphasize the persistent challenge posed by unsafe water.

Communities that use untreated lake or river water as a source of drinking water are particularly vulnerable to cholera outbreaks. The data demonstrate a worrying upward trend in cholera cases in Malawi, particularly in regions with inadequate water and sanitation infrastructure. The surge in cases in 2022 and 2023 aligns with increased flooding events and population growth in urban slums (Semu, 2020). Key water contamination sources identified include: unprotected wells and rivers used for drinking water, poor waste disposal practices leading to water source contamination and limited access to functional boreholes in rural communities. Efforts to mitigate cholera outbreaks in Malawi must focus on improving water sanitation infrastructure.

The study also found that inadequate sanitation facilities are another significant contributing factor. Open defecation and poor waste disposal practices exacerbate water contamination. Insufficient sewage systems lead to the infiltration of human waste into water bodies, increasing cholera transmission risks (IFRC, 2022). Addressing this issue requires substantial investment in sanitation infrastructure, particularly in rural and peri-urban areas.

Furthermore, the study found that rapid urbanization in cities like Blantyre and Lilongwe has led to overcrowded informal settlements with limited access to clean water and proper waste disposal. High population density in these areas also accelerates the spread of cholera during outbreaks (UNICEF and WHO, 2022). The strain on infrastructure due to urban growth underscores the need for urban planning that prioritizes public health. To alleviate the problem, effective urban planning can be implemented to prioritize the provision of clean water and waste management systems in informal settlements.

- *Malawi's Outbreak in Contrast with Zambia, Tanzania, and Mozambique*

Tanzania reported 10,177 cholera cases and 177 deaths between 2015 and 2017, with outbreaks concentrated in rural areas and urban slums (WHO, 2018). Key drivers included seasonal flooding, reliance on untreated surface water, and poor sanitation in informal settlements (UNICEF, 2019). In response, the government launched a national WASH strategy and oral cholera vaccination (OCV) campaigns in high-risk regions.

Zambia experienced a major outbreak in 2017–2018, with 10,000 cases and 200 deaths, primarily in Lusaka's overcrowded peri-urban areas (ReliefWeb, 2018). Urbanization, inadequate sewage systems, and contaminated water sources were major contributors. OCV campaigns and improved waste management reduced cases by 80% by 2019 (WHO, 2020).

Mozambique faced its deadliest cholera outbreak in 2019, with 24,000 cases and 65 deaths, linked to Cyclone Idai's destruction of water infrastructure (WHO, 2019). Recurrent flooding and poor WASH access in rural areas exacerbated transmission. International partnerships accelerated OCV deployment and emergency water supply repairs.

- *Comparative Analysis*

All four countries—Malawi, Tanzania, Zambia, and Mozambique—face cholera outbreaks driven by contaminated water, inadequate sanitation, and climate-related disasters (e.g., floods). Urbanization and informal settlements amplify transmission risks. Despite the use of oral cholera vaccines (OCV), high case fatality rates (CFR >1%) persist, highlighting gaps in healthcare capacity.

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However, there are notable differences. Malawi's 2022–2023 outbreak, with 58,944 cases and 1,766 deaths, was the deadliest in its history, exceeding Mozambique's 2019 crisis. Zambia's rapid OCV rollout and community education reduced cases faster than Malawi. Tanzania's decentralized WASH initiatives showed progress in rural areas but lagged in urban centers.

- *Lessons for Malawi*

Strengthening OCV campaigns is crucial. Zambia's success underscores the need for targeted OCV distribution in high-risk districts, such as Blantyre and Mangochi. Urban planning is also essential. Mozambique's post-disaster water infrastructure upgrades offer a model for Malawi's flood-prone regions. Finally, regional collaboration through cross-border surveillance with Tanzania and Mozambique could address transmission hotspots along shared waterways.

V. RECOMMENDATIONS

The findings of this study on cholera outbreaks in Malawi highlight several critical policy implications that could inform public health strategies. These implications are essential for developing comprehensive and sustainable solutions to mitigate the impact of cholera and improve overall public health outcomes.

➢ *Strengthening Water, Sanitation, and Hygiene (WASH) Infrastructure*

The study underscores the critical role of WASH infrastructure in preventing cholera outbreaks. Malawi, like its neighbors, faces significant challenges in providing clean water and adequate sanitation facilities, especially in rural and peri-urban areas. Governments should prioritize investment in WASH infrastructure, including the construction and maintenance of water treatment plants, sewage systems, and waste management facilities. Decentralized WASH solutions such as boreholes, rainwater harvesting systems, and community-led sanitation initiatives should be promoted, given the rural-urban divide. Strengthening regulatory frameworks to ensure the quality and safety of water sources is crucial. This includes regular monitoring and enforcement of water quality standards.

➢ *Enhancing Surveillance and Early Warning Systems*

Effective surveillance and early warning systems are vital for timely detection and response to cholera outbreaks. Strengthening existing surveillance systems to include real-time data collection and analysis can enhance early detection and response capabilities. Establishing cross-border surveillance mechanisms with neighboring countries (e.g., Tanzania, Zambia, Mozambique) can help identify and mitigate transmission hotspots along shared waterways. Engaging communities in surveillance efforts through community health workers can improve the timeliness and accuracy of outbreak reporting.

➢ *Expanding Oral Cholera Vaccination (OCV) Campaigns*

The comparative analysis highlights the effectiveness of OCV campaigns in reducing cholera cases. Implementing targeted OCV campaigns in high-risk districts, such as Blantyre and Mangochi, can significantly reduce the incidence of cholera. Combining OCV campaigns with community education on hygiene practices and symptom recognition can enhance the effectiveness of vaccination efforts. Securing sustainable funding and resources for OCV campaigns is essential, especially in resource-limited settings.

➢ *Improving Urban Planning and Public Health Infrastructure*

The study highlights the impact of rapid urbanization and overcrowding on cholera transmission. Integrating public health considerations into urban planning to prioritize the provision of clean water, sanitation facilities, and waste management systems in informal settlements is crucial. Enhancing healthcare capacity by increasing the number of healthcare facilities, training healthcare personnel, and ensuring the availability of medical supplies is essential. Developing and implementing emergency preparedness plans to manage outbreaks effectively, including the establishment of isolation centers and rapid response teams, is also important.

➢ *Strengthening International Collaboration*

The findings emphasize the importance of international collaboration in addressing cholera outbreaks. Strengthening partnerships with international organizations such as WHO, UNICEF, and CDC to access technical assistance, funding, and resources is crucial. Enhancing regional coordination through platforms like the Southern African Development Community (SADC) to share best practices, coordinate interventions, and harmonize policies is essential. Advocating for global attention and resources to address the broader challenges of water quality, sanitation, and public health infrastructure in sub-Saharan Africa is also important.

A multisectoral approach also would prove to be essential. It can include surveillance, laboratory support, clinical care, water, sanitation, hygiene (WASH), social mobilization, and the use of oral cholera vaccines (OCV) among high-risk populations (UNICEF and WHO, 2022). UNICEF also emphasizes maintaining reliable access to clean water, promoting handwashing, and ensuring proper sanitation (UNICEF, 2022).

Community awareness would also play an important role. Educating communities about hygiene practices, recognizing symptoms, and promoting safe water handling would be important. Social and behavior change communication can play a significant role (UNICEF, 2023b). For instance, (Semu, 2020) acknowledges the incorporation of Oral Cholera Vaccination, as integrating the use of oral cholera vaccines (OCV) among high-risk populations was part of the prevention strategy.

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VI. CONCLUSION

Cholera outbreaks in Malawi are a serious public health issue that demands a multi-sectoral approach involving government agencies, NGOs, and local communities. The recent outbreak, which claimed 1,210 lives, underscores the urgent need for comprehensive interventions. Each death represents a profound loss and highlights the strain on Malawi's healthcare system, which faced overcrowded hospitals, shortages of medical supplies, and exhausted healthcare workers. Vulnerable populations, including children, the elderly, and those with pre-existing conditions, were particularly at risk. Future research and interventions should focus on enhancing surveillance and data collection to improve the accuracy and completeness of information on cholera cases and fatalities. This will enable more effective and targeted interventions. Additionally, community-based interventions, such as community health workers and social mobilization campaigns, can significantly promote hygiene practices and improve access to clean water. Investigating the impact of climate change on water quality and sanitation infrastructure is crucial, as extreme weather events exacerbate cholera outbreaks. Lastly, a comprehensive analysis of the economic impact of cholera outbreaks, including loss of productivity and medical expenses, will inform policy decisions and resource allocation. Addressing the impact of cholera outbreaks requires coordinated efforts from multiple stakeholders. The findings of this study highlight the need for sustainable solutions that address the intersection of health, water quality, and socio-economic challenges. By prioritizing these areas, we can work towards breaking the cycle of cholera epidemics in Malawi and improving the overall quality of life for its people.

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