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Understanding and addressing the cholera outbreak in Zambian communities

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Abstract

Cholera is a bacterial infection caused by the *Vibrio cholera* bacterium, primarily transmitted through contaminated water and food. The effects of cholera on health can be severe and potentially life-threatening. The hallmark symptom of cholera is acute watery diarrhea, which can lead to rapid dehydration and electrolyte imbalance. As the body loses large amounts of fluid and essential salts, individuals with cholera often experience intense thirst, dry mucous membranes, sunken eyes, and lethargy. If left untreated, the dehydration can progress rapidly, causing a dangerous condition known as choleric dehydration and in most cases death. Hence, the study was conducted to analyze the effects of cholera on health in selected communities of Lusaka district in Zambia. The study employed both qualitative and quantitative methods and a descriptive survey design that sampled 42 participants purposively and conveniently. Data was obtained from the respondents by means of questionnaires and record reading. The data was analyzed by the use of software; Statistical Package for Social Sciences (version 26) and Microsoft Excel (version 16). Frequency tables, graphs, figures, and pie charts were also used to analyze the data. The findings revealed that the effect of cholera on health extends beyond dehydration, affecting various organ systems. Severe cases may lead to hypovolemic shock, characterized by a significant drop in blood pressure and inadequate perfusion of organs. The study also found that Cholera outbreaks pose significant public health challenges, particularly in areas with inadequate sanitation and limited access to clean water. The study therefore recommended that since cholera is highly contagious, primarily through contaminated water and food, those affected should be isolated to prevent the spread of the bacteria. Additionally, Proper hygiene, such as regular handwashing, is essential to reduce the risk of transmission.

Keywords: Bacteria; Cholera; Effect; Health; Infection; Outbreak

1. Introduction

During the 19th century, cholera spread across the world from its original reservoir in the Ganges delta in India. Six subsequent pandemics killed millions of people across all continents. The current (seventh) pandemic started in South Asia in 1961, reached Africa in 1971 and the Americas in 1991. Cholera is now endemic in many countries (WHO, 2020). In the realm of infectious diseases, cholera stands as a historical adversary that has persistently plagued human populations for centuries. This waterborne illness, caused by the *Vibrio cholera* bacterium, has left an indelible mark on communities worldwide, affecting millions and posing a significant threat to public health infrastructure. The relentless pursuit to understand, prevent, and control cholera has become an ongoing battle, reflecting the complex interplay between the bacterium, the environment, and human susceptibility. WHO (2017) observed that cholera outbreaks have been documented throughout history, with devastating consequences on both local and global scales. Its ability to rapidly spread, particularly in areas with inadequate sanitation and limited access to clean water, has made cholera a persistent challenge, disproportionately affecting vulnerable populations. The severity of cholera epidemics is

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exacerbated by factors such as overcrowded living conditions, poor hygiene practices, and insufficient healthcare resources, creating a perfect storm for the rapid transmission of the disease. The hallmark of cholera lies in its acute watery diarrhea and dehydration, leading to potentially life-threatening complications if left untreated. Despite significant advancements in medical science and the development of oral rehydration therapy, cholera continues to pose a formidable threat in regions grappling with poverty, conflict, and environmental instability and Zambia is not an exception to this condition.

Cholera is an infectious disease caused by the bacterium *Vibrio cholera*, primarily transmitted through contaminated water and food. This waterborne illness can lead to severe dehydration and, if left untreated, can be fatal within hours. Symptoms include profuse diarrhea, vomiting, and muscle cramps (Mathews, 2013). Adequate sanitation and access to clean water are crucial for preventing cholera outbreaks. Public health measures, such as vaccination campaigns and community education on hygiene practices, play a vital role in controlling the spread of cholera. Timely diagnosis and prompt treatment with rehydration therapy are essential to reduce mortality rates. Global efforts to improve water and sanitation infrastructure, along with increased awareness and preparedness, contribute to the overall goal of promoting public health and preventing cholera outbreaks.

Charon (2006) noted that cholera is an acute diarrheal infection caused by the *Vibrio cholera* bacterium, primarily the serotypes O1 and O139. The disease is often associated with poor sanitation and contaminated water, making it a significant public health concern, particularly in developing regions with limited access to clean water and proper sanitation facilities. The hallmark symptom of cholera is profuse, watery diarrhea that can lead to severe dehydration and electrolyte imbalance. Transmission occurs through the ingestion of water or food contaminated with the bacterium, and person-to-person transmission can also occur in crowded and unsanitary conditions. Cholera outbreaks can escalate rapidly, causing widespread morbidity and mortality if not promptly addressed (Cholera Annual Report, 2022). Timely and effective rehydration therapy, usually through oral rehydration solutions, is crucial in managing cholera cases. Antibiotics may also be used to reduce the severity and duration of symptoms, although resistance to commonly used antibiotics is a growing concern. Preventive measures focus on improving sanitation, ensuring access to clean water, and promoting hygiene practices. Vaccination campaigns can be effective in high-risk areas. Cholera surveillance systems are essential for early detection and rapid response to contain outbreaks. Global efforts to control cholera involve collaboration between governments, non-governmental organizations, and international agencies to address the underlying factors contributing to the spread of the disease. Despite progress, cholera remains a persistent threat, underscoring the need for sustained investment in water and sanitation infrastructure, as well as public health education initiatives to prevent and control this potentially deadly disease.

Cholera remains a significant public health concern in Zambian communities, posing a persistent threat to the well-being of the population. The waterborne disease is primarily caused by the *Vibrio cholera* bacterium, often spreading through contaminated water sources and inadequate sanitation practices. In Zambia, where access to clean water and proper sanitation facilities is limited in certain areas, the risk of cholera transmission is heightened. One notable challenge is the recurrent nature of cholera outbreaks, indicating a need for sustained efforts in preventive measures and public health interventions (WHO, 2017). The disease tends to thrive in densely populated and economically disadvantaged communities, where access to basic hygiene infrastructure is compromised. In such settings, there is a higher likelihood of contaminated water sources, facilitating the rapid spread of the bacterium and contributing to outbreaks.

Lavis et al, 2012) narrates that health education plays a crucial role in mitigating cholera's impact in Zambian communities. Efforts to raise awareness about the importance of safe water practices, proper sanitation, and personal hygiene are essential in preventing the transmission of the disease. Community engagement programs, coupled with the dissemination of information through various channels, contribute to empowering individuals to take proactive measures in safeguarding their health. Improving water and sanitation infrastructure is a fundamental aspect of cholera prevention. Investment in the development of clean water sources and sanitation facilities is essential to break the cycle of contamination. This requires collaborative efforts from government authorities, non-governmental organizations, and the local communities themselves. Sustainable solutions, such as the construction of sanitary latrines and the implementation of water purification systems, are pivotal in reducing the vulnerability of communities to cholera outbreaks. Addressing the socioeconomic determinants of cholera is equally crucial. Poverty, limited access to healthcare, and inadequate nutrition exacerbate the impact of the disease on vulnerable populations. Comprehensive public health strategies should encompass not only medical interventions but also broader initiatives aimed at uplifting the living standards of affected communities.

1.1. Statement of the Problem

Cholera, a waterborne disease caused by the *Vibrio cholera* bacterium, continues to pose a significant threat to public health in various regions worldwide (Napier et al, 2014). Zambia, in particular, has been grappling with recurrent cholera outbreaks, highlighting the urgent need for comprehensive strategies to address the root causes of this public health crisis. Azman, et al (2013) reported that the cholera outbreak in Zambian communities represents a multifaceted challenge with several interconnected dimensions. Firstly, inadequate access to clean water and proper sanitation facilities in many Zambian communities contributes significantly to the spread of cholera. Secondly, lack of awareness about cholera transmission and prevention measures among community members exacerbates the problem. Thirdly, poverty and limited economic opportunities often force individuals to live in overcrowded and unsanitary conditions, increasing the risk of cholera transmission. Lastly but not the least, insufficient healthcare facilities and resources hinder the prompt and effective treatment of cholera cases in Zambian communities.

1.2. The Purpose of the Study

The purpose of this study was to understand and address cholera outbreaks in selected communities of Lusaka district in Zambia.

1.3. Research Objectives

The objectives of the study were to:

- Identify the causes of cholera outbreaks in selected communities of Lusaka district in Zambia.
- Analyze the effects of cholera outbreaks on health in selected communities of Lusaka district in Zambia.

1.4. Theoretical Framework

The theoretical framework for understanding cholera outbreaks encompasses a multidimensional approach that integrates various factors contributing to the emergence and propagation of the disease. Drawing from epidemiological, environmental, and social perspectives, the framework emphasizes the interconnectedness of water and sanitation systems, human behavior, and microbial agents. Key components include the contamination of water sources with *Vibrio cholera*, the bacterium responsible for cholera, and the subsequent transmission through fecal-oral routes. Ali, et al (2015) noted that environmental conditions, such as inadequate sanitation infrastructure and poor water quality, create breeding grounds for the pathogen. Additionally, socio-economic factors, such as poverty and overcrowded living conditions, exacerbate vulnerability. The framework underscores the importance of holistic interventions, including improvements in water and sanitation infrastructure, public health education, and early detection and response systems, to effectively mitigate and prevent cholera outbreaks. By addressing the complex interplay of biological, environmental, and social determinants, this theoretical framework provides a comprehensive understanding of the dynamics underlying cholera epidemics.

1.5. Significance of the Study

Studying cholera outbreaks in Zambian communities holds paramount significance for public health and community well-being. Zambia, like many developing nations, faces recurrent challenges in preventing and managing infectious diseases, with cholera being a prominent concern. Investigating the dynamics of cholera outbreaks in Zambian communities provides essential insights into the epidemiological patterns, risk factors, and the effectiveness of current preventive measures. This knowledge is critical for designing targeted interventions, improving water and sanitation infrastructure, and enhancing healthcare delivery. Furthermore, such studies contribute to the global understanding of cholera dynamics, aiding in the development of strategies that can be adapted and implemented in similar contexts worldwide. Ultimately, the significance of this research lies in its potential to save lives, alleviate suffering, and strengthen the resilience of Zambian communities against the threat of cholera outbreaks.

2. Research methodology

2.1. Study Design

This study adopted a mixed method approach where quantitative and qualitative data was collected. The use of two methodologies was found to enhance research findings by providing a well-rounded understanding of the phenomenon under study. The mixed methods approach allowed the study to not only ensure the validity of the findings but also collect rich information from different perspectives. This mixed methods approach was used because it enabled the

study to collect both quantified and personal verbatim which was of good help in furthering understanding of responses from the intended respondents.

2.2. Research Site

This study was conducted in Lusaka district, the capital city of Zambia from the selected for the study were communities; A (Chawama), B (Kanyama), C (George Compound), and D (Jack Compound).

2.3. Population, Sample and Sampling Procedure

The population for the study comprised selected officials at the Ministry of health, Lusaka district, health workers; medical doctors and nurses and support staff giving a total of one thousand four hundred (420). The sample size involved a total of 42 respondents which included two (2) officials from Ministry of health, four (4) medical doctors, one coming from each selected hospital. Sixteen (16) Nurses, four coming from each selected hospital. Twenty (20) support staff, five coming from each selected hospital in communities A, B, C, and D. The study used both purposive and simple random sampling on different participants.

2.4. Data Analysis

For the purpose of analysis in this research, the collected responses from the questionnaires and interviews were arranged thematically and coded accordingly using a coding scheme. The coding scheme helped to create codes and scales from the responses, which were then summarized and analyzed using a relevant statistical software package. Preferably the study made use of the statistical package for social sciences (SPSSv16) as well as through Microsoft excels.

2.5. Ethical Issues

Informed consent was sought from the respondents before collecting information from them and guaranteed them with security of the information they provided. Furthermore, the main objective of gathering such information was made clear to the respondents. The study avoided pressuring respondents to take part in the research. In this research, the study was fully conscious of the need to abide by the ethical rule of respecting the privacy of individuals taking part in the research.

3. Findings and discussions

The following findings and discussions were presented according to set research objectives:

3.1. Causes of Cholera Outbreaks in Selected Communities of Lusaka District

Table 1 Causes of Cholera Outbreaks

Responses	Percentage
Contaminated Water Sources	15%
Poor Sanitation and Hygiene	10%
Overcrowded and Unsanitary Living Conditions	15%
Contaminated Food	20%
Poor Healthcare Infrastructure	10%
Lack of Community Awareness	20%
Climate Factors	10%
Total	100

The study sought to analyze the causes of cholera outbreaks in selected communities of Lusaka district in Zambia. The findings are outlined in Table 1 above. According to the research findings, contaminated water sources play a significant role in the outbreak of cholera, a waterborne disease caused by the *Vibrio cholera* bacterium. In regions with inadequate sanitation infrastructure and limited access to clean water, cholera can rapidly spread through contaminated water supplies. The bacterium thrives in environments where sanitation is compromised, allowing fecal matter containing the

pathogen to contaminate drinking water (WHO, 2020). The ingestion of contaminated water or food can lead to severe diarrheal illness, dehydration, and, in extreme cases, death. Cholera outbreaks are particularly devastating in communities with poor hygiene practices and insufficient water treatment facilities. Addressing the root causes of contaminated water sources, such as improving sanitation infrastructure and promoting safe water practices, is crucial in preventing and mitigating cholera outbreaks. Public health interventions, community education, and investment in water sanitation systems are essential components of efforts to break the cycle of cholera transmission associated with polluted water supplies. Additionally, health workers noted that poor sanitation and hygiene are significant contributors to cholera outbreaks, perpetuating the spread of the deadly waterborne disease. Langer, et al (2015) reported that in areas lacking proper sanitation infrastructure, contaminated water sources become breeding grounds for the *Vibrio cholera* bacterium. Inadequate disposal of human waste, coupled with a lack of clean water supply and proper hygiene practices, creates a perfect environment for the rapid transmission of the disease. Cholera thrives in communities where individuals cannot access or afford clean water, and where sewage and drinking water systems are inadequately separated. Moreover, insufficient education on hygiene practices amplifies the risk, as individuals may unknowingly engage in behaviors that facilitate the transmission of the disease. To curb cholera outbreaks, addressing the root causes of poor sanitation and hygiene is crucial, necessitating improved infrastructure, education, and access to clean water sources.

Officials from Ministry of health pointed that overcrowded and unsanitary living conditions play a pivotal role in the outbreak and spread of cholera. In densely populated areas where people live in close proximity, often lacking adequate infrastructure and sanitation facilities, the risk of cholera transmission escalates significantly. In such environments, contaminated water sources and inadequate sewage disposal create a breeding ground for the *Vibrio cholera* bacterium, the causative agent of cholera. The finding was supported by Kneafsey, et al (2013) who said that the lack of proper sanitation leads to the contamination of drinking water with fecal matter, facilitating the rapid transmission of the disease. Additionally, overcrowded living spaces make it challenging to implement effective hygiene practices, further exacerbating the problem. The combination of these factors creates an ideal environment for the rapid transmission of cholera, turning overcrowded and unsanitary living conditions into a breeding ground for infectious diseases. Public health measures, improved sanitation infrastructure, and community education are crucial in preventing and controlling cholera outbreaks in such environments. They further observed that contaminated food serves as a significant contributor to cholera outbreaks, amplifying the spread of this waterborne disease. Cholera, primarily caused by the *Vibrio cholera* bacterium, often thrives in unsanitary conditions where water and food sources are contaminated with fecal matter. Inadequate hygiene during food handling, improper sewage disposal, and polluted water used in food preparation can introduce the bacteria into the food supply. Once ingested, contaminated food becomes a vehicle for transmitting the bacterium to individuals, triggering widespread outbreaks. The rapid onset of severe diarrhea and dehydration associated with cholera can lead to a rapid escalation of cases, especially in areas with limited access to clean water and proper sanitation. Therefore, addressing the contamination of food and implementing stringent food safety measures are crucial components in preventing and controlling cholera outbreaks.

Furthermore, the support staff said that poor healthcare infrastructure plays a critical role in contributing to cholera outbreaks. In regions with inadequate healthcare facilities, the timely detection, treatment, and containment of cholera cases become challenging. Insufficient access to clean water, sanitation, and hygiene facilities further exacerbates the risk of cholera transmission. In such environments, the lack of proper healthcare infrastructure hampers the implementation of effective prevention and control measures, including vaccination campaigns, community education, and surveillance systems. Additionally, limited resources and personnel hinder the capacity to respond swiftly to emerging outbreaks, allowing the disease to spread rapidly and result in higher morbidity and mortality rates (Brangan, 2016). Improving healthcare infrastructure, especially in terms of water and sanitation facilities, emergency response capabilities, and healthcare personnel training, is crucial to mitigating the impact of cholera outbreaks and enhancing overall public health outcomes. They also alluded that the lack of community awareness stands as a significant cause for cholera outbreaks in various regions. Insufficient knowledge about basic hygiene practices, clean water sources, and proper sanitation contributes to the spread of the disease. Communities may not be adequately informed about the importance of maintaining clean water supplies, using safe sanitation facilities, and practicing personal hygiene. In areas where there is limited access to education and healthcare resources, the absence of community awareness campaigns exacerbates the risk of cholera outbreaks. Additionally, misconceptions and cultural practices that do not prioritize sanitation can further hinder efforts to prevent the spread of the disease. Addressing the root causes of cholera requires comprehensive community education initiatives that promote awareness, behavioral change, and the adoption of proper hygiene practices to break the cycle of infection.

Officials from Ministry of health also added that climate factors can significantly contribute to the occurrence and spread of cholera outbreaks. Cholera, a waterborne infectious disease caused by the *Vibrio cholera* bacterium, often thrives in environments with specific climate conditions. Warmer temperatures can elevate the growth and survival rates of the

bacterium in aquatic environments, particularly in brackish or estuarine waters. Additionally, heavy rainfall and flooding events can lead to the contamination of drinking water sources, as sewage and contaminated water mix more easily during such conditions. Ajuebos, et al (2018) observed that changes in precipitation patterns and temperature can also impact the abundance of the copepod species, which serves as a natural reservoir for the *Vibrio cholera* bacteria. As climate change continues to alter global weather patterns, it poses a significant risk of exacerbating cholera outbreaks, particularly in vulnerable communities with limited access to clean water and sanitation infrastructure. Addressing the intersection of climate factors and cholera is crucial for developing effective public health strategies and improving resilience in the face of evolving environmental conditions.

3.2. Effects of Cholera Outbreaks on Health in Selected Communities of Lusaka District

As outlined in Figure 1 below, the study found that cholera outbreaks pose significant health risks due to the severe dehydration and electrolyte imbalances they induce. Cholera, caused by the *Vibrio cholera* bacterium, primarily affects the small intestine, leading to profuse watery diarrhea and vomiting. The rapid loss of fluids and electrolytes, such as sodium, potassium, and chloride, can result in dehydration, a condition where the body lacks the necessary fluids to function properly. WHO (2017) pointed out that dehydration, if left untreated, can lead to shock, organ failure, and death. Electrolyte imbalances exacerbate the situation, disrupting essential physiological processes. The critical loss of sodium, for example, affects nerve and muscle function, leading to weakness and cramping. Prompt and effective rehydration, often through oral rehydration solutions or intravenous fluids, is crucial in managing cholera cases and mitigating the potentially life-threatening consequences of dehydration and electrolyte imbalance during outbreaks. Public health measures, including sanitation improvements and access to clean water, play a pivotal role in preventing and controlling cholera outbreaks. Moving on, health workers narrated that the rapid onset of symptoms is a hallmark characteristic of a cholera outbreak. Cholera is an acute diarrheal infection caused by the *Vibrio cholera* bacterium, typically transmitted through contaminated water or food. Once exposed, individuals can develop symptoms within a few hours to a couple of days (Azman, 2013). The sudden and intense nature of the symptoms, which include profuse watery diarrhea, vomiting, and dehydration, can lead to severe health consequences and, if left untreated, may result in death within hours. The swift onset of cholera symptoms poses a significant challenge for timely intervention and containment efforts during outbreaks, emphasizing the critical importance of prompt medical attention, clean water supply, and sanitation measures to control the spread of the disease.

Officials from Ministry of health explained that the high mortality rate associated with cholera outbreaks is a grim consequence of the rapid and severe dehydration caused by the *Vibrio cholera* bacteria. Cholera primarily spreads through contaminated water and food, leading to widespread infection in affected communities. The finding agrees with Achotegui (2015) who said that the resulting profuse diarrhea and vomiting can quickly lead to dehydration, electrolyte imbalance, and shock. Without prompt and adequate medical intervention, affected individuals, particularly those with compromised immune systems or limited access to healthcare, face a heightened risk of succumbing to the disease. In resource-constrained regions, challenges such as inadequate sanitation infrastructure and limited access to clean water exacerbate the severity of cholera outbreaks, amplifying the impact on mortality rates. Timely public health interventions, including rehydration therapy and improved sanitation measures, are crucial in mitigating the devastating effects of cholera and reducing the overall mortality rate associated with this infectious disease. The findings also indicated that cholera outbreaks exert a profound and multifaceted impact on healthcare systems, straining their capacity and resources. The sudden surge in cases places an overwhelming burden on medical facilities, leading to shortages in essential supplies, such as intravenous fluids and oral rehydration solutions. The need for rapid response teams and isolation units further challenges the existing infrastructure. Additionally, healthcare professionals are stretched thin as they grapple with the surge in patient numbers, often compromising the quality of care. The outbreak also necessitates heightened surveillance, early detection mechanisms, and public health campaigns to educate communities on preventive measures (Mathews, 2012). Financially, the healthcare system faces increased costs associated with outbreak management and potential long-term consequences due to a decline in overall health and productivity. In essence, cholera outbreaks underscore the critical importance of a robust, well-prepared healthcare system capable of swift response and effective containment strategies.

The findings of this study also found that a cholera outbreak can have significant economic impacts on affected communities and regions. The direct costs include expenses related to healthcare provision, such as medical treatment, hospitalization, and pharmaceuticals, which can strain already limited healthcare budgets. Indirect costs arise from productivity losses due to illness, as individuals are unable to work or perform daily activities, leading to a decrease in overall economic output. Moreover, cholera outbreaks can disrupt trade and tourism, affecting businesses and livelihoods. The strain on public resources for sanitation and clean water infrastructure also imposes financial burdens on governments (Moat, et al, 2013). Additionally, the stigma associated with cholera can hinder investment and development in affected areas. Altogether, the economic consequences of a cholera outbreak extend beyond immediate

healthcare expenses, affecting both individual well-being and the broader economic stability of communities. Additionally, the support staff explained that a cholera outbreak can trigger significant social disruption, impacting communities in various ways. The fear and uncertainty surrounding the disease often lead to widespread panic, affecting social cohesion. Quarantine measures and restrictions on movement can disrupt daily life, hindering economic activities and straining social relationships. The stigma associated with cholera may result in discrimination against those affected, exacerbating social divisions. Additionally, the strain on healthcare systems and limited resources can contribute to social inequalities, as vulnerable populations may face greater challenges in accessing necessary care. The aftermath of a cholera outbreak may leave lasting scars on the affected communities, necessitating not only medical interventions but also comprehensive efforts to rebuild social structures and address the broader impact on society.

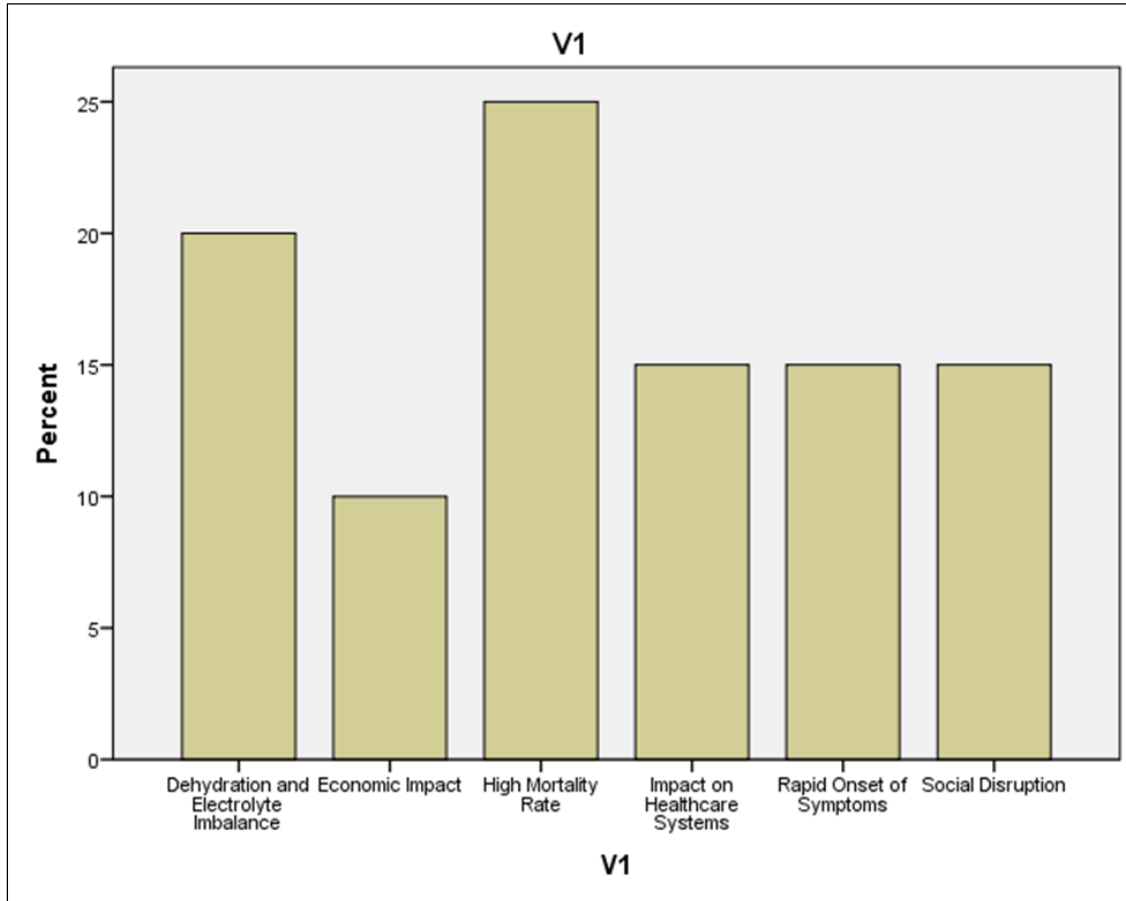


Figure 1 Showing Effects of Cholera Outbreaks on Health in Selected Communities of Lusaka District

4. Conclusion

In conclusion, the cholera outbreak in Zambian communities has had a profound and devastating impact on public health. The widespread dissemination of the cholera bacterium has led to a surge in cases, overwhelming healthcare systems and exacerbating existing health challenges. The consequences extend beyond the immediate health implications, affecting the socio-economic fabric of the communities. The lack of access to clean water, inadequate sanitation infrastructure, and limited healthcare resources have fueled the outbreak, emphasizing the urgent need for comprehensive public health interventions. The Zambian government, in collaboration with international organizations and stakeholders, must prioritize investments in infrastructure, healthcare facilities, and community education to mitigate the long-term repercussions of cholera outbreaks and build resilient health systems. This crisis underscores the interconnectedness of health, sanitation, and socio-economic factors, emphasizing the importance of a holistic approach to address and prevent such outbreaks in the future.

Recommendations

The following are actions that should be taken on the basis of the findings of this study:

- The Ministry of Health should invest in healthcare infrastructure to enhance the capacity to diagnose, treat, and contain cholera cases.
- The Ministry of Health should develop and regularly update emergency response plans to streamline coordination during outbreaks.
- There is a need to prioritize the development and maintenance of clean water sources and improved sanitation facilities in the selected communities where this study was carried out.
- There is a need to launch targeted awareness campaigns to educate the selected communities about cholera transmission, prevention, and the importance of hygiene.
- There is a need for the Government to empower the selected communities to take ownership of their health by addressing underlying economic challenges.
- There is a need to implement socio-economic programs to alleviate poverty, providing the selected communities with the means to improve living conditions.
- There is a need to incorporate climate change adaptation measures into public health policies to mitigate the impact of environmental factors on cholera outbreaks.

Compliance with ethical standards

Disclosure of conflict of interest





No conflict of interest to be disclosed.

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Author's Short Biography

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