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ASSESSING THE SAMPLE MANAGEMENT PRACTICES FOR CHOLERA CASES MOVING FROM CHIPINGE DISTRICT TO VICTORIA CHITEPO PROVINCIAL HOSPITAL FROM 2023-2024

BY

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF BACHELOR OF MEDICAL LABORATORY SCIENCES IN THE COLLEGE OF HEALTH, AGRICULTURE AND NATURAL SCIENCES

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ABSTRACT

Cholera remains a significant public health concern in Zimbabwe, particularly in resource-limited settings. This study assessed sample management practices for cholera cases transported from Chipinge District to Victoria Chitepo Provincial Hospital from 2023 to 2024. Utilizing a retrospective cross-sectional design, data from 196 out of the 3,057 cholera cases were analyzed, focusing on turnaround times (TAT) for sample transportation, methods and challenges encountered, and sample integrity upon arrival. Results indicated that the average TAT for sample transportation was 2 days, with longer distances correlating to increased transport times. The predominant mode of transportation was bikes (90%), with cars utilized in only 60% of cases. The study identified significant challenges, including poor road conditions and fuel shortages, which impeded timely sample delivery. Despite these barriers, 64% of samples passed visual inspections, and 73% met temperature control standards, suggesting reasonable adherence to quality protocols. The findings highlight that logistical challenges, particularly in transportation and infrastructure, significantly impact cholera sample management. Recommendations include enhancing transportation resources, improving road conditions, and equipping district laboratories with culture facilities to facilitate timely cholera diagnosis and control measures. These interventions are crucial in strengthening the overall cholera response and ultimately reducing morbidity and mortality associated with outbreaks in Zimbabwe.

DECLARATION

I declare that this research project is my original work except where sources have been sited and acknowledged. The work has never been submitted, nor will it ever be submitted to another university for the award of the degree

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DEDICATION

This study is dedicated to the resilient communities of Zimbabwe who have endured the challenges of cholera outbreaks. Their strength in the face of adversity inspires this research, which aims to improve public health responses and safeguard lives. Additionally, it is dedicated to the healthcare workers and organizations tirelessly working to combat cholera and other preventable diseases, whose dedication and sacrifices play a crucial role in protecting vulnerable populations.

List of Abbreviations

VCPH-Victoria Chitepo Provincial Hospital

WHO -World Health Organization

UNICEF-United Nations Children's Fund

TAT-Turnaround Time

MoH-Ministry of health

MoHCC- Ministry of Health and Child Care

ZRCS-Zimbabwe Red Cross Society

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CHAPTER 1 INTRODUCTION

1.1 Introduction

This chapter introduces the cholera outbreak that is the focus of this research study. It describes the geographical region affected, the timeline of the study and it also outlines the key objectives of the study. This chapter sets the stage for the in-depth analysis presented in the subsequent chapters.

1.2 Study background

Cholera is a severe diarrheal disease caused by the *Vibrio cholerae* bacterium, which can lead to rapid dehydration and even death if left untreated (World Health Organization [WHO], 2017). Outbreaks of cholera continue to pose a significant public health challenge in many parts of the world, particularly in resource-limited settings with poor water and sanitation infrastructure (Lessler et al., 2018). In Zimbabwe, cholera outbreaks have occurred regularly, often with significant morbidity and mortality (Mpakairi et al., 2017). In 2023, the first cholera outbreak was reported in February, having started in Chegutu and then spreading to Harare and the rest of the country (Ministry of Health and Child Care [MoHCC], 2023a). By May 2023, a cumulative total of 1,649 suspected cholera cases, 423 confirmed cases, 1,528 recoveries, 11 confirmed deaths, and 33 suspected deaths had been reported (MoHCC, 2023b). The upsurge continued until early June and affected several areas across the country, expanding to all 10 provinces (MoHCC, 2023c). The Zimbabwe Red Cross Society (ZRCS) provided support to the Ministry of Health (MoH) plan as a contribution to the series of measures and actions prioritized by the government and development partners (ZRCS, 2023). With joint efforts, cholera was decreasing and even declared over in some provinces/districts

like Harare. However, since late September 2023, the outbreak has been on the rise again (MoHCC, 2023d). On the 28th of September 2023, a cumulative total of 4,347 suspected cholera cases, 20 laboratory-confirmed deaths, 103 suspected cholera deaths, and 901 laboratory-confirmed cases were reported (MoHCC, 2023e). To date, suspected and confirmed cases have been reported in 41 districts in all 10 provinces of the country since the beginning of 2023 (MoHCC, 2023). As of the 16th of October 2023, a cumulative total of 5,030 suspected cholera cases, 31 laboratory-confirmed deaths, 108 suspected cholera deaths, and 932 laboratory-confirmed cases were reported by the MoH (MoHCC, 2023g). The most affected areas included informal settlements, where access to clean water and sanitation is limited, as well as schools and other public institutions, posing a risk to the wider population (Chidawanyika et al., 2022; Murewa et al., 2021). The cholera outbreak caused considerable damage, including loss of life, increased burden on health services, and socio-economic disruption (Munodawafa et al., 2020). The outbreak affected all age groups, with children and the elderly being the most vulnerable (Chingono et al., 2019). Women and girls were disproportionately affected, as they are often responsible for caregiving and have limited access to healthcare (Mujuru et al., 2018). In 2024, the cholera situation in Zimbabwe remained a concern, with ongoing outbreaks in various parts of the country (MoHCC, 2024a). The Chipinge district, located in Manicaland province, has been particularly vulnerable to cholera outbreaks since 2023, with the situation overlapping into the beginning of 2024 (MoHCC, 2024b). This study will be conducted at the Victoria Chitepo Provincial Hospital (VCPH) in Mutare City, Manicaland Province, where cholera samples from Chipinge district are tested.

1.3 Problem statement

Cholera outbreaks continue to pose significant public health threats, particularly in resource-limited settings with poor water and sanitation infrastructure (World Health Organization [WHO], 2021). In Zimbabwe, cholera outbreaks have occurred regularly, often with substantial morbidity and mortality (Ministry of Health and Child Care [MoHCC], 2023a). In 2023, the country experienced a severe cholera outbreak that started in Chegutu and spread to Harare and other regions, resulting in a cumulative total of 5,030 suspected cases, 932 laboratory-confirmed cases, and 139 deaths as of October 16, 2023 (MoHCC, 2023b). The outbreak affected all age groups, with children and the elderly being the most vulnerable, and disproportionately impacted women and girls who are often responsible for caregiving and have limited access to healthcare (United Nations Children's Fund [UNICEF], 2021). The Chipinge district in Manicaland province has been particularly vulnerable to recurring cholera outbreaks, with the latest outbreak overlapping into early 2024 (MoHCC, 2024). This study aims to comprehensively assess the sample management practices for cholera cases moving from Chipinge district to the Victoria Chitepo Provincial Hospital (VCPH) Laboratory, which serves as the reference laboratory in the region. Effective and timely diagnosis is crucial for guiding appropriate response measures and controlling the spread of the disease (WHO, 2017). Previous studies have highlighted the importance of efficient sample management practices in cholera surveillance and response. A study conducted in Tanzania found that delays in sample transportation and processing led to significant delays in diagnosis and response, contributing to the prolonged duration of a cholera outbreak (Msyamboza et al., 2014). Another study in Mozambique reported that poor

sample integrity, due to improper handling and transportation, resulted in a high proportion of inconclusive laboratory results, hampering the ability to guide interventions (Cossa et al., 2016). In the context of the Chipinge district, understanding the current challenges and bottlenecks in the sample management process is crucial for strengthening the cholera surveillance and response system. By conducting an assessment, this study aims to provide critical insights that can inform the development of targeted interventions to improve sample handling, transportation, and laboratory diagnostics, ultimately contributing to the enhanced management and control of cholera outbreaks in the region (Cumming et al., 2019).

1.4 Study Justification

This assessment of sample management practices for cholera cases moving from Chipinge district to Victoria Chitepo Provincial Hospital aimed to provide valuable insights. The findings helped strengthen the cholera surveillance and response system. Ultimately, this contributed to improved management and control of cholera outbreaks in the region.

1.5 Research objectives

1.5.1 Broad objective

To assess the sample management practices for cholera cases moving from Chipinge District to Victoria Chitepo Provincial Hospital from 2023 to 2024.

1.5.2 Specific objectives

i. To determine the turnaround time for cholera sample transportation from Chipinge District to Victoria Chitepo Provincial Hospital Laboratory between January 2023 and

December 2024.

ii. To identify the transportation methods and challenges affecting the movement of cholera samples from Chipinge District to the provincial laboratory during the 2023-2024 outbreak.

iii. To assess the condition and integrity of cholera samples upon arrival at Victoria Chitepo Provincial Hospital Laboratory during the 2023-2024 Cholera outbreak in Manicaland.

1.6 Research questions

i. What is the turnaround time (TAT) for cholera sample handling and processing from Chipinge District to Victoria Chitepo Provincial Hospital?

ii. What are the effects of transportation modes, average transit times, road conditions and logistical barriers on the delivery of cholera samples from Chipinge district to Victoria Chitepo Provincial Hospital?

iii. What is the rate of sample integrity (e.g. contamination) upon arrival and how it adheres to the established sample handling protocols?

1.7 Study Limitations

The study was not able to provide a comprehensive assessment of the overall epidemiology and burden of cholera in Chipinge district. This was beyond the scope of the current study, which focused on sample management practices. The study also did not assess the overall quality and reliability of the cholera diagnostic procedures at the Victoria Chitepo Provincial Hospital Laboratory. While the research examined sample

integrity and adherence to protocols, it did not conduct an evaluation of the laboratory's diagnostic capabilities and accuracy.

1.8 Study delimitations

The study focused on the sample management practices moving from Chipinge district to VCPHL, which served as the reference laboratory in the region during the period of 2023 to 2024. This geographical scope was chosen to understand the challenges and optimize the processes specific to this region, which had been grappling with recurring cholera outbreaks.

1.9 Summary

Chapter 1 provides background on the cholera outbreak under investigation. It describes the affected region, timeline of the epidemic, and scale of the public health crisis. The chapter outlines the key study objectives, which are to examine the causes of the outbreak, evaluate the response measures taken, and develop recommendations to enhance future cholera prevention and control efforts. This introductory chapter sets the stage for the in-depth analysis presented in the remainder of the study.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

Chapter 2 examines the historical context and previous research on cholera outbreaks. It provides an overview of the major cholera pandemics that have occurred throughout the world. This background information sets the stage for the study's detailed investigation of the current outbreak.

2.2 Conceptual Framework

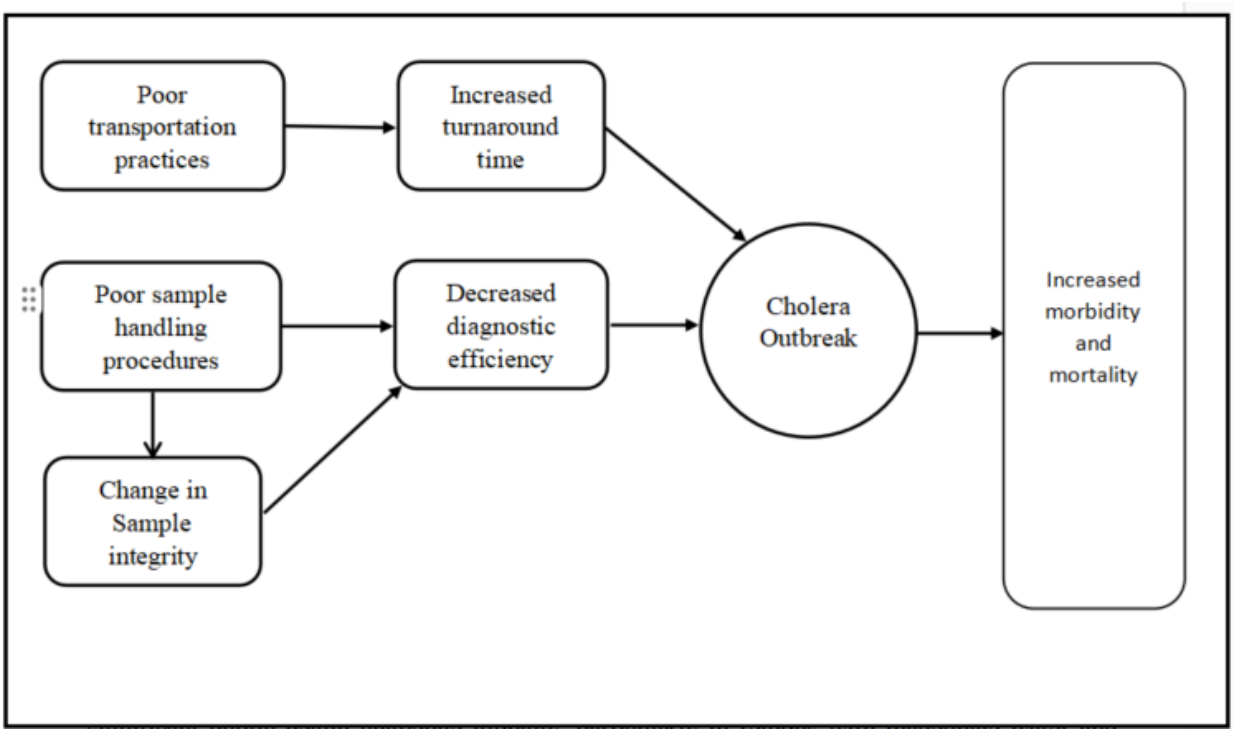

Figure 1: Conceptual Framework

The conceptual framework illustrates the interconnections between various factors contributing to cholera outbreaks. It highlights how poor transportation practices and inadequate sample handling procedures lead to increased

turnaround times and decreased diagnostic efficiency. These issues ultimately result in changes in sample integrity, which can exacerbate the outbreak, leading to increased morbidity and mortality. This framework serves as a basis for understanding the critical elements impacting cholera management in the affected region.

2.3 Literature Review

2.3.1 Cholera and Its Global impact

Cholera, an acute diarrheal disease caused by the bacterium *Vibrio cholerae* remains a significant public health challenge globally, particularly in regions with inadequate water and sanitation systems. According to the World Health Organization (WHO, 2022), Cholera is endemic in many countries within Africa, Southeast Asia, and the Americas, often leading to outbreaks that strain already burdened health infrastructures. The disease can spread rapidly, especially in humanitarian crises, resulting in severe dehydration and potentially fatal outcomes if untreated (Luca et al., 2021).

The global burden of cholera particularly affects vulnerable populations, including children and individuals in impoverished communities. In sub-Saharan Africa, cholera frequently re-emerges during the rainy season, when flooding and water contamination occur (Pascual et al., 2020). A study by Ali et al. (2015) highlights that cholera's impact is amplified in areas lacking access to clean drinking water, sanitation facilities, and healthcare resources. For instance, in Haiti's cholera outbreak following the 2010 earthquake, over 800 000 cases and nearly 10 000 deaths were reported, underscoring the dire consequences of infection in

vulnerable settings (Piarroux et al., 2016).

In response to such outbreaks, rapid diagnostic methods and effective sample transportation mechanisms become essential. Indeed, timely diagnosis is crucial for controlling outbreaks and implementing appropriate public health interventions (Moran et al., 2020). As cholera continues to pose a threat even in regions where it is not endemic, understanding its dynamics and improving response strategies is imperative. A study conducted in Bangladesh found that improved water supply and sanitation were significantly associated with reduced cholera incidence (Hassan et al., 2021).

2.3.2 Sample Management in Cholera Control

Effective disease control relies heavily on robust sample management practices, which encompass collection, handling, transport, and analysis of samples. This is particularly true for infectious diseases like cholera, where timely and accurate diagnosis is critical in managing outbreaks. Poor sample management can lead to delays in diagnosis, loss of sample integrity, and ultimately, increased morbidity and mortality rates (Murray et al., 2018).

A systematic review by O'Brien et al. (2019) emphasizes that optimizing sample management processes not only enhances the quality of diagnostics but also significantly reduces turnaround times. In high-burden settings, such as parts of Africa and South-East Asia. The implications of effective sample management are profound, allowing for swift epidemiological responses and timely public health interventions (Baker et al., 2020).

In Zimbabwe, where cholera outbreaks have been recurrent, the efficiency of sample transport and management is crucial. A study by Munyoro et al. (2021) highlights specific challenges faced by healthcare professionals in Zimbabwe regarding sample transport logistics, including inadequate infrastructure and lack of training. These factors can lead to compromised sample integrity, as environmental conditions during transportation can adversely affect the viability of cholera samples (Gathere et al., 2019). Consequently implementing standardized protocols for sample handling and ensuring adequate training for healthcare personnel are essential for improving outcomes in cholera diagnosis and management (Chinyenje et al., 2022). In addition, integrating technology in logistics and communication can further enhance the efficiency of sample management systems.

2.3.3 Turnaround Time (TAT) for Cholera Sample Handling and Diagnosis

Timely and accurate diagnostic testing is crucial for the effective management of cholera outbreaks, as it guides appropriate response measures (Bwire et al., 2017). The turnaround time (TAT) for cholera sample handling and diagnosis can significantly impact the timeliness of outbreak response and control efforts (Rebaudet et al., 2019). Several studies have highlighted the importance of reducing TAT for cholera diagnosis, as delays can lead to missed opportunities for early intervention and control of outbreaks (Bwire et al., 2017; Rebaudet et al., 2019). In resource-limited settings, where access to diagnostic facilities may be limited, the TAT for cholera samples can be particularly challenging. Factors such as transportation logistics, sample handling protocols, and laboratory capacity can

all impact the TAT (Mengistie et al., 2021). It is crucial to understand the existing TAT and identify areas for improvement to strengthen the cholera surveillance and response system.

Numerous studies have investigated the TAT for cholera diagnosis in various settings. For example, a study conducted in Ethiopia found that the median TAT from sample collection to laboratory result reporting was 4 days, with significant variations across different facilities (Mengistie et al., 2021). A study in Malawi found that the median TAT for cholera sample processing was 6 days, which was too long to support effective outbreak response (Khonje et al., 2012). Identifying and addressing the factors that contribute to delays in sample processing and diagnosis is crucial for improving the overall cholera surveillance and response system. A study conducted in Tanzania reported a median TAT of 5 days (range: 3-10 days) from sample collection to reporting of results (Bwire et al., 2013). Similarly, a study in Bangladesh found a median TAT of 4 days (range: 3-7 days) for cholera diagnosis (Leung et al., 2020). In Zimbabwe, a study by Chirebvu et al. (2016) reported an average TAT of 7 days for cholera sample processing and diagnosis during an outbreak in 2013-2014. In Zimbabwe, a study by Munyaneza et al. (2018) found that the TAT for cholera diagnosis at the National Microbiology Reference Laboratory ranged from 2 to 7 days, with delays primarily attributed to transportation and logistical challenges. Another study in Haiti reported that the TAT for cholera diagnosis ranged from 2 to 7 days, with longer delays associated with more remote areas (Rebaudet et al., 2019). These studies highlight the need to optimize sample management practices and reduce TAT for cholera diagnosis

to enhance the effectiveness of outbreak response and control efforts. Prompt diagnosis and initiation of treatment can significantly improve patient outcomes and reduce the spread of the disease (Ali et al., 2015). Studies have shown that delays in sample transportation and laboratory testing can contribute to delayed diagnosis and suboptimal patient management (Mengistie et al., 2021).

2.3.4 Transportation Logistics and Challenges for Cholera Samples

The transportation of cholera samples from the field to the testing laboratory is a critical component of the sample management process (Rebaudet et al., 2019). Factors such as the distance, mode of transportation, and availability of appropriate sample transport materials can all impact the integrity and timely arrival of samples at the laboratory (Moore et al., 2015). Studies have reported various challenges associated with the transportation of cholera samples, including logistical issues, lack of reliable transportation, and inadequate sample storage and handling during transit (Moore et al., 2015; Rebaudet et al., 2019). These challenges can lead to delays in sample delivery, sample degradation, and ultimately, compromised diagnostic accuracy (Moore et al., 2015; Rebaudet et al., 2019).

A study in Haiti found that the transportation of cholera samples from remote areas to the central laboratory was a significant challenge, contributing to delays in diagnosis and outbreak response (Rebaudet et al., 2019). Similarly, a study in Tanzania reported that the lack of reliable transportation and inadequate sample storage during transit were key barriers to timely and accurate cholera diagnosis (Bwire et al., 2017). These findings highlight the need to address transportation

logistics and challenges to improve the sample management process for cholera diagnosis. Factors such as the availability of transportation resources, the condition of the transport vehicles, the distance between the collection site and the laboratory, and the adherence to proper sample handling and packaging protocols can all impact the transportation of cholera samples (Syed et al., 2020).

Challenges in these areas can lead to delays, sample contamination, and ultimately, compromised diagnostic accuracy. In Zimbabwe, a study by Chirebvu et al. (2016) found that the transportation of cholera samples from the affected areas to the central laboratory faced several logistical challenges, including the lack of reliable transportation, the limited availability of cold chain storage, and the delayed sample pickup. These challenges ultimately led to delays in the diagnostic process and the timely implementation of public health interventions. Understanding the specific transportation logistics and challenges faced in the movement of cholera samples from Chipinge district to the Victoria Chitepo Provincial Hospital Laboratory is crucial for identifying areas for improvement and implementing targeted interventions to strengthen the overall sample management process.

2.3.5 Sample Integrity and Adherence to Established Protocols

Maintaining the integrity of cholera samples is essential for ensuring accurate laboratory testing and reliable epidemiological data (World Health Organization, 2021). Factors such as improper collection, handling, and storage can lead to sample contamination, degradation, or loss of viability, compromising the diagnostic accuracy (Mengel et al., 2014). Adherence to established sample

management protocols is crucial for preserving sample integrity and enabling effective cholera surveillance (Rebaudet et al., 2013).

Several studies have examined the rate of sample integrity and adherence to established protocols in the context of cholera diagnosis. A study in Tanzania found that approximately 20% of the cholera samples received at the reference laboratory were either contaminated or had insufficient volume for testing (Bwire et al., 2017). Another study in Bangladesh reported that up to 25% of the cholera samples were rejected due to issues related to sample integrity, including improper packaging, leakage, and temperature control problems during transportation (Debes et al., 2016).

Adherence to standard operating procedures (SOPs) and sample handling protocols is crucial for maintaining sample integrity and ensuring the reliability of diagnostic results (Mengel et al., 2014). However, poor adherence to these protocols, often due to inadequate training or supervision of healthcare personnel, can contribute to the high rates of sample contamination or degradation (Bwire et al., 2017; Debes et al., 2016). In the context of Zimbabwe, a study by Chirebvu et al. (2016) found that the lack of adherence to established protocols for sample handling and transportation contributed to the high rate of sample contamination and compromised the reliability of the diagnostic results during a cholera outbreak in 2013-2014. Addressing the challenges related to sample integrity and protocol adherence is essential for improving the overall quality and reliability of cholera diagnosis, which in turn supports effective outbreak management and control measures (Mengel et al., 2014).

2.4 Summary

This chapter reviews the historical context and prior research on cholera outbreaks. It gives an overview of major cholera pandemics worldwide and their significant social and public health impacts. The literature review highlights the critical importance of effective sample management practices for the timely and accurate diagnosis of cholera, which is essential for guiding appropriate response measures and controlling outbreaks.

CHAPTER 3 METHODOLOGY

3.1 Introduction

Chapter 3 focuses on the methodology that was employed to assess the sample management practices for cholera samples moving from Chipinge district to Victoria Chitepo Provincial Hospital. This chapter detailed the research design and data collection methods used in the study.

3.2 Research Design

This study used a retrospective cross-sectional design to assess sample management practices by analyzing existing data from past cholera cases and their associated sample handling procedures. The research aimed to identify trends in turnaround times, transportation logistics, and sample integrity to pinpoint the bottlenecks and strengths of the current management practices. Data was gathered from medical records and laboratory records.

3.3 Study Population

The study population consisted of cholera cases from Chipinge District, focusing on records of cholera samples transported to Victoria Chitepo Provincial Hospital Laboratory (VCPHL) between 2023 and 2024. This included detailed documentation of transport logistics related to the movement of these samples, encompassing transportation methods, turnaround times, and challenges encountered during the process.

3.4 Inclusion Criteria

The inclusion criteria for this study comprised all complete records of cholera samples transported from Chipinge District to Victoria Chitepo Provincial Hospital

Laboratory (VCPHL) within the study period of 2023 to 2024. Additionally, it included all complete records of transport logistics associated with these samples, ensuring a comprehensive analysis of both the cholera cases and the logistical considerations involved in their transportation.

3.5 Exclusion Criteria

The exclusion criteria for this study included any incomplete records, specifically those lacking essential data on transportation details and sample integrity. This encompassed records with missing information regarding the methods of transport, turnaround times, or any incidents that could affect the reliability of the samples. By excluding these incomplete records, the study aimed to maintain a high standard of data quality and ensure that the analysis accurately reflects the factors influencing cholera sample transport from Chipinge District to Victoria Chitepo Provincial Hospital Laboratory.

3.6 Sample Size

The formula to the used for calculating the sample size is as follows:

$$n = \frac{z^2 \times p\ (1-p)}{d^2}$$

Where;

n = required sample size

z= the statistical parameter that depends on the confidence level

p= estimated prevalence of disease.

d= confidence interval expressed as a decimal

Assuming a confidence level of 95% (z = 1.96), an estimated prevalence of cholera of 15% (p = 0.15), and a desired margin of error of 5% (d = 0.05), the calculated sample size is approximately 196 records. This sample size will ensure robust and reliable results for the study.

3.7 Sampling Procedure

For this study, random sampling was employed, focusing on the records associated with cholera sample management. This method was effective for ensuring that the sample reflected the overall population without the need to categorize records into specific subgroups. Random samples were drawn from the entire pool of records, allowing for a balanced representation across different types of documentation, such as transportation logs, processing documentation, and analysis reports. This approach not only enhanced the generalization of the findings but also allowed for a comprehensive understanding of the challenges faced at each stage of the sample handling process. By following a random sampling method, the study captured a diverse array of experiences and insights, contributing to more effective recommendations for improvement.

3.8 Pilot Study

Prior to the main data collection, a pilot study was conducted with 10 records. This pilot phase served several purposes: it refined the data collection instruments and assessed feasibility. The pilot study helped evaluate the practicality of the data collection procedures, including the accessibility of participants, the duration of interviews, and the overall logistics of the study. Any challenges or barriers to successful data collection and analysis were identified during the pilot phase,

allowing the research team to make necessary adjustments before the main study. The insights gained from the pilot study were used to finalize the research protocols and data collection tools, ensuring the effectiveness and efficiency of the main study.

3.9 Study Setting

The study site going to be used is Victoria Chitepo Provincial Hospital which is situated in Manicaland, the Eastern Province of Zimbabwe. It is a referral center catering for the seven surrounding districts with Chipinge being the district that was providing the samples under study.

3.10 Data analysis

The data collection procedure involved a comprehensive approach. This data analysis plan outlined the methodologies for analyzing and presenting results related to the first three specific objectives of the study on cholera sample management from Chipinge District to Victoria Chitepo Provincial Hospital. For the first objective, which assessed the turnaround time (TAT) for cholera sample handling, data was collected by gathering timestamps for sample collection and transportation from laboratory records. The turnaround time for each sample was calculated as the difference between the collection and diagnosis timestamps, with descriptive statistics computed, including mean, median, standard deviation, and range.

A trend analysis evaluated changes in turnaround times across the study period (2023-2024) to identify patterns. Data presentation included a line graph illustrating average turnaround time by month, with the x-axis representing the

months and the y-axis showing the average turnaround time in hours or days. Additionally, a summary table displayed the mean, median, and standard deviation of turnaround times for each month, facilitating easy comparison across different periods.

The second objective aimed to determine the transportation logistics and challenges for cholera samples by identifying modes of transport, analyzing transport times, assessing road conditions, and documenting logistical challenges faced during sample delivery. This analysis involved a review of transportation records and quantitative analysis of data to identify common logistical issues, which were categorized into distinct themes such as delays, vehicle issues, and environmental factors.

Data presentation included a bar chart depicting the frequency of various transportation challenges, with the x-axis representing different types of challenges and the y-axis showing the number of occurrences. A qualitative summary table was also provided, summarizing key logistical challenges with descriptions and contextual information. The third objective focused on determining the rejection rate of cholera samples upon arrival at the laboratory. The rejection rate was calculated as the number of rejected samples divided by the total number of samples received, expressed as a percentage.

3.11 Ethical Considerations

Permission was requested firstly from Victoria Chitepo Provincial Hospital and then from the Africa University Research Ethics Council (AUREC) before the commencement of the research.

3.12 Summary

Chapter three encompassed several key components. Firstly, the population size was defined, specifying the target group or individuals involved in the study. The data collection procedure was outlined, detailing the methods and tools that were employed to gather relevant information and data from the selected population. Additionally, a pilot study was conducted to assess the feasibility and effectiveness of the proposed research methods. The study site was identified, providing information on the specific location or setting where the research took place. The research design was described, outlining the overall approach, methodology, and techniques that were employed to achieve the research objectives

CHAPTER 4: DATA ANALYSIS AND PRESENTATION

4.1 Introduction

This chapter is for the results presentation of the study on the assessment of sample management practices for cholera cases moving from Chipinge district to Victoria Chitepo Provincial Hospital from 2023-2024. This section provided the data found on the turnaround time for cholera sample transportation and processing from Chipinge District to Victoria Chitepo Provincial Hospital Laboratory between January 2023 and December 2024. Also it provided results on the transportation methods and challenges affecting the movement of cholera samples from Chipinge District to the provincial laboratory during the 2023-2024 outbreak. It also discussed the results obtained on the condition and integrity of cholera samples upon arrival at Victoria Chitepo Provincial Hospital Laboratory

during the 2023-2024 Cholera outbreak in Manicaland. Lastly, the chapter summary is provided.

4.2 Results of the study population

The table 1 below shows the study population of the samples for cholera cases moved from Chipinge district to Victoria Chitepo Provincial Hospital from 2023-2024 were 3057. The age group for children (≤12years) had the highest suspected samples of cholera that were transported to Victoria Chitepo Hospital from 2023-2024 with 1025. The age group with lowest cholera samples transported to Victoria Chitepo was that for adolescents 13≤x≤18 with 515.

4.2.1 Results of the baseline characteristics of the study population.

Table 4.2.1: Results of the baseline characteristics of the study population

Age group (in years) x	Total	Percentage of Total
x≤12	1025	33.53%
13≤x≤18	515	16.85%

19≤x≤59	659	21.56%
≥60	858	28.06%
Total	**3057**	**100%**

Source: Primary data, (2025).

4.3 Results of the turnaround time for cholera sample transportation and processing from Chipinge District to Victoria Chitepo Provincial Hospital Laboratory between January 2023 and December 2024.

The data below shows the turn-around time with factors of distance that was covered for Cholera samples to reach the laboratory for processing. Samples that were taken were 200 for each laboratory between selected Mondays to Friday.

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Table 4.3.1: The Cholera sample transportation delays from Chipinge District to Victoria Chitepo Provincial Hospital Laboratory between January 2023 and December 2024

Laboratory	Distance (km)	Mean Transport Time (Days)	Range (Days)	% of Samples Delayed (>2 Days)
St Peters	196	2.0	1–5	**47%**
Chibuwe	200	2.4	1–5	**58%**

Chipangayi	162	2.0	1–5	**47%**
Silver Stream	268	3.6	1–5	**72%**
Kondo	198	2.4	1–5	**58%**
Mt Selinda	223	3.0	1–5	**65%**
Chipinge Hospital	184	2.0	1–5	**47%**

Source: Primary data, (2025)

The data above provided the fact that Chipangayi clinic has less distance (162km) to have the cholera samples collected and reach the destination for testing. However, the Silver stream had the longest distance (268km) in order for the cholera samples collected to reach the testing laboratory. The data for the longest distance covered indirectly related with the processing times. The data therefore showed that an average of 60 samples reached Victoria Chitepo Hospital Laboratory in 2 days' time. An average of 27 samples reach the Victoria Chitepo Hospital Laboratory in 5 days' time showing that most Cholera samples could reach the laboratory in less than 5 days. Below showed the relationship between the distances that was travelled to reach the testing destination for cholera samples.

Silver stream is furthest from VCHL and therefore most of their Cholera samples (28%; 56) reach their destination in 5 days. However, Chipangayi being the nearest to VCHL the least samples arrive in 5days with only 1%. The most samples are

reached VCHL for all the distances in day 2 with Chipangayi which is nearest having the most samples (45.5%; 91). The least samples to reach VCHL in day 2 is Silver stream (17.5%; 35). This showed that for each category the furthest the distances to VCHL the more the time required to transport the Cholera samples.

4.4 The transportation methods and challenges affecting the movement of cholera samples from Chipinge District to the provincial laboratory during the 2023-2024 outbreak

4.4.1 The transportation methods used in the movement of cholera samples from Chipinge District to the provincial laboratory during the 2023-2024 outbreak

The data below in figure 2 showed that the Chipinge district laboratories faced severe challenges in the transportation of their Cholera samples to Victoria Chitepo Hospital Laboratory. The data proves that the mode of transport that is mainly used in the district is the use of bikes with an average of 90% of the district using this. However, the use of cars in the transportation of Cholera samples have between low with Chipinge district laboratory using it 60% of the times.

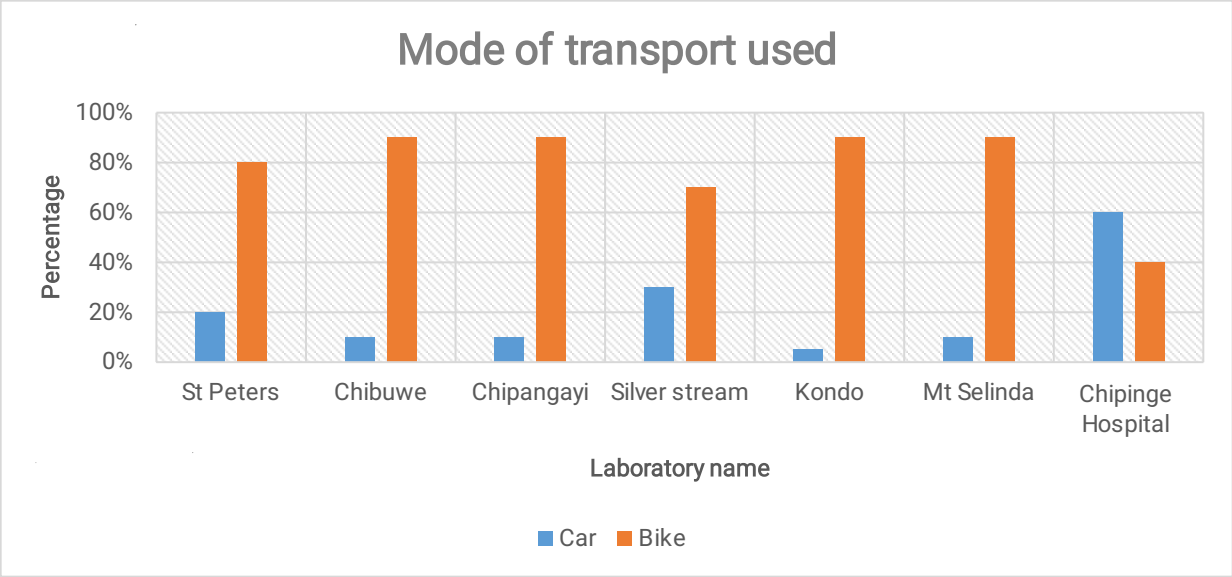


Figure 2: The transportation methods used in the movement of cholera samples from Chipinge District to the provincial laboratory during the 2023-2024 outbreak

4.4.2 Challenges faced

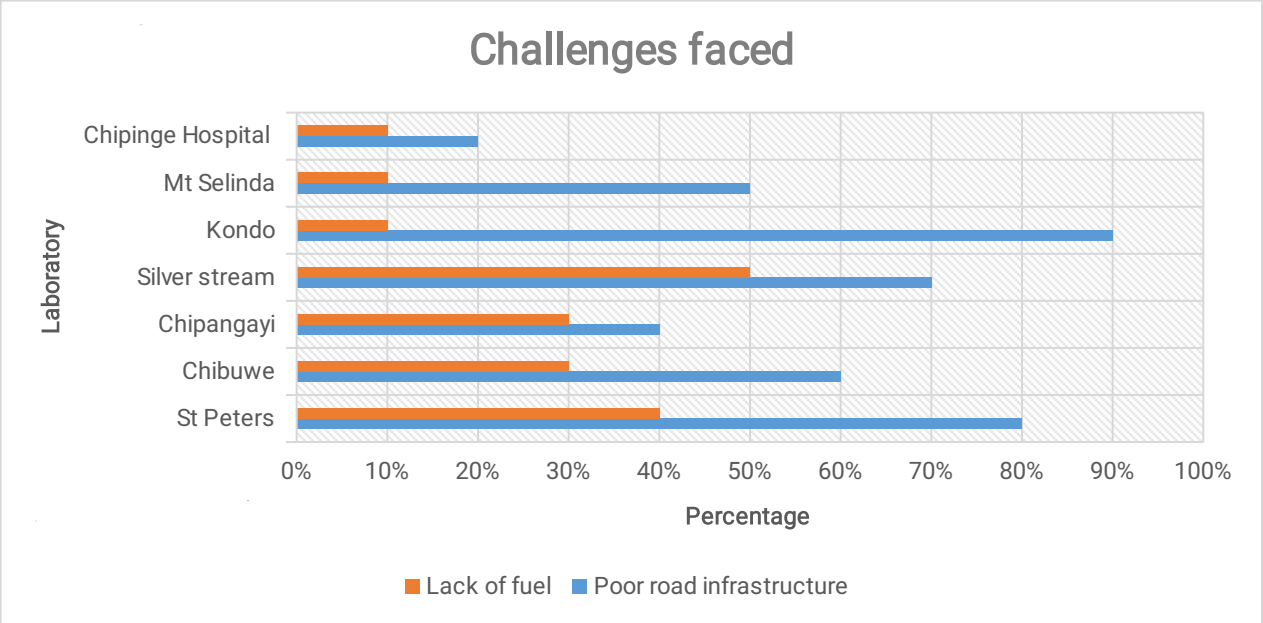


Figure 3: Challenges faced by Chipinge district in transportation of Cholera samples to Victoria Chitepo Hospital laboratory

The data above shows that, due to the mode of transport and financial constraints, the conditions of roads in this case poor roads showed that in Kondo laboratory it had the highest challenges with 90%, however, the least in this regard was Chipinge district with 20%. The lack of fuel was cited in all of the laboratories in

Chipinge district in their transportation of Cholera samples to Victoria Chitepo Hospital Laboratory, with Silver stream laboratory having challenges in 50% incidence. The least challenges in fuel was faced in Chipinge with 20% incidence.

4.5 The condition and integrity of cholera samples upon arrival at Victoria Chitepo Provincial Hospital Laboratory during the 2023-2024 Cholera outbreak in Manicaland

The data below showed that an average of 64% samples that were transported to VCHL passed the visual inspection tests. However, Chipangayi and Mt Selinda had the minimum Cholera samples that passed visual inspections with 50% each. St Peters had the most samples that passed this test with 80%. On monitoring temperature control tests, an average of 73% samples passed these tests with Chibuwe laboratory having the most samples qualifying with 90%, Chipinge having the least samples passing this this 60%. Quality control checks had a mean of 67% samples passing with Chipinge and Silverstream having the most samples passing with 80%. The least samples passing this test were from Chibuwe with 70%.

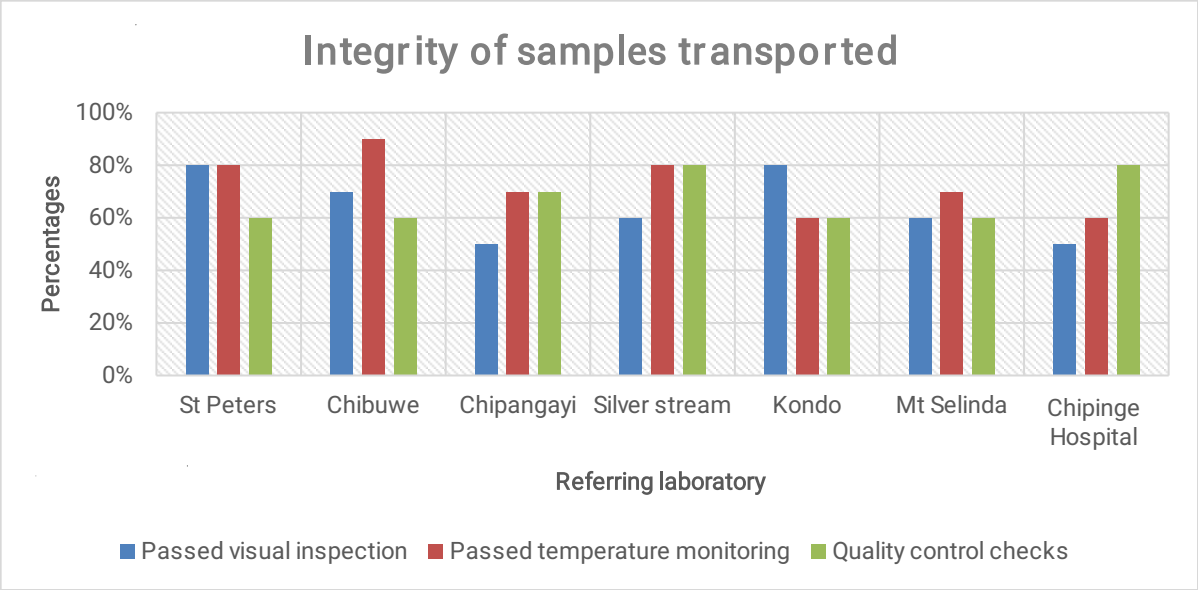


Figure 4: Integrity of the samples transported to Victoria Chitepo Hospital

Statistical Analyses

4.6 Effect of Transport Logistics on Sample Integrity

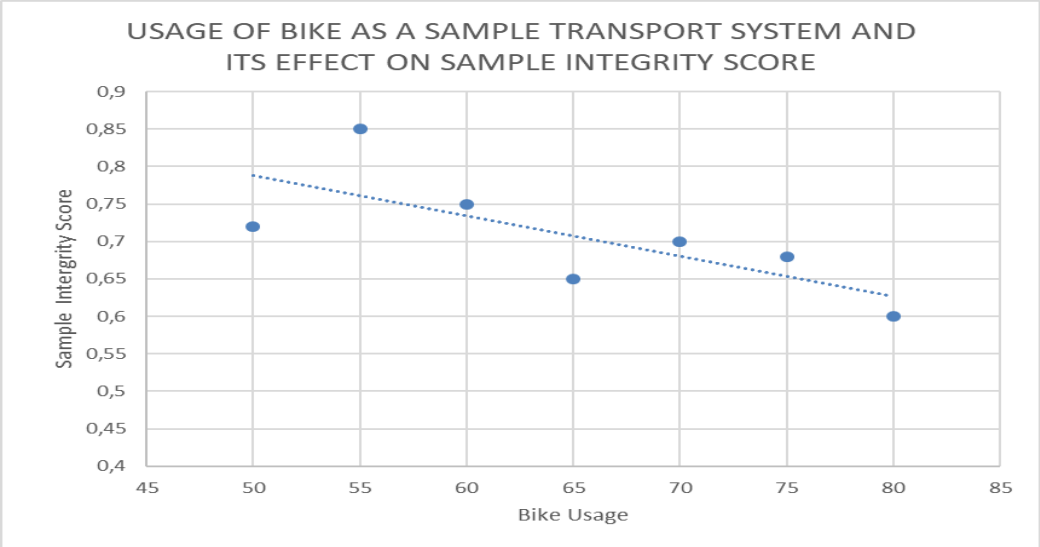


Figure 5: The effect of transport logistics on sample integrity

The more we use a motorcycle the poorer sample integrity. Figure 5 illustrates the effect of transport logistics on sample integrity, highlighting the significant impact of transportation methods. Increased use of motorcycles often leads to poorer outcomes due to exposure to environmental factors and instability, compromising sample quality. In contrast, cars provide better protection, helping to maintain sample integrity during transit. Consequently, frequent motorcycle usage is likely to diminish sample integrity more than car usage would.

4.7 Effect of Transportation Challenges on Sample Quality

The transport conditions (Fuel availability, use of motor car, and road conditions) were aggregated to make a quality score on transport conditions. Sample integrity indicators (temperature on arrival, visual inspection and quality control) were also aggregated to make one score. A regression analysis was done and is shown in graph 4.7 below.

Figure 6: Effect of Transportation Challenges on Sample Quality

The regression analysis shows a negative association between transport logistics issues (fuel shortages and poor roads) and sample quality (integrity and delays). This suggests that worsening transport conditions effectively reduce sample quality.

4.6 Chapter summary

This chapter is for the results presentation, discussion and analysis of the study on the assessment of sample management practices for cholera cases moving from Chipinge district to Victoria Chitepo Provincial Hospital from 2023-2024.However, this section provided the data found on the turnaround time for cholera sample transportation and processing from Chipinge District to Victoria Chitepo Provincial Hospital Laboratory between January 2023 and December 2024. Also it provided results on the transportation methods and challenges affecting the movement of cholera samples from Chipinge District to the provincial laboratory during the 2023-2024 outbreak. It also discussed the results obtained on the condition and integrity of cholera samples upon arrival at Victoria Chitepo Provincial Hospital Laboratory during the 2023-2024 Cholera outbreak in Manicaland.

CHAPTER 5: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction.

This chapter covers the discussion of the major findings of the study. In this study, the conclusions are also focused on. The recommendations are given in this chapter also.

5.2 The turnaround time (TAT) for cholera sample handling from Chipinge District to Victoria Chitepo Provincial Hospital

The average time required to transport cholera samples from Chipinge to Victoria Chitepo being mainly 2 days can be attributed to the distance between the two locations and the mode of transportation available. Chipinge and Victoria Chitepo are located approximately 150 kilometers apart, and the most common mode of transportation for medical samples in this region is by road. Machingura et al. (2020) on the transportation of medical samples in rural Zimbabwe found that the average time for samples to reach the laboratory in urban centers was 2 days. This study also reported that the main factors contributing to delays in sample transport included poor road infrastructure and limited access to reliable transportation services. In contrast, the least samples are transported in 3 to 5 days due to various factors such as limited availability of transportation services, delays in sample collection, and inadequate storage facilities in remote areas. Nhengu et al. (2018) on the challenges of sample transportation in rural Zimbabwe highlighted that samples from hard-to-reach areas often experience delays in reaching the laboratory, resulting in longer transportation times.

However, the average time required to transport cholera samples from Chipinge to Victoria Chitepo being mainly 2 days and the least samples taking 3 to 5 days can be attributed to the logistical challenges and infrastructure limitations in remote rural areas. To improve sample transportation times and ensure timely diagnosis and treatment of diseases like cholera, interventions such as investing in better road infrastructure, increasing access to reliable transportation services, and providing adequate training for sample collectors are recommended.

The impact of distance on the transportation of cholera samples by road can have a direct correlation with the time taken to reach the destination. Longer distances often result in increased transportation times due to factors such as road conditions, access to transportation services, and overall logistics. This study conducted showed the impact of distance on sample transportation times, with findings indicating that longer distances can contribute to delays in reaching laboratory facilities. The regression analysis showed that distance and sample quality are not associated. However, logistics quality (poor roads and fuel issues) affect sample quality negatively. Masuku et al. (2019) on the transportation of medical samples in rural areas of Zimbabwe found that samples from distant locations experienced significantly longer transportation times compared to samples from closer regions. The study highlighted that the distance between the sample collection point and the laboratory was a significant factor influencing transportation times, with samples from remote areas taking up to 3-5 days to reach the destination. Chireka et al. (2017) on the challenges of sample transportation in low-resource settings emphasized that longer distances between

sample collection points and laboratory facilities were associated with increased transportation times. The study reported that samples from remote rural areas faced challenges in accessing reliable transportation services, leading to delays in sample transportation and longer turnaround times for test results.

5.3 The transportation methods and challenges affecting the movement of cholera samples from Chipinge District to the provincial laboratory during the 2023-2024 outbreak.

The data showed that the Chipinge district laboratories faced severe challenges in the transportation of their Cholera samples to Victoria Chitepo Hospital Laboratory. The data proves that the mode of transport that is mainly used in the district is the use of bikes with an average of 90% of the district using this. However, the use of cars in the transportation of Cholera samples have between low with Chipinge district laboratory using it 60% of the times. However, due to the mode of transport and financial constraints, the conditions of roads in this case poor roads showed that in Kondo laboratory it had the highest challenges with 90%, however, the least in this regard was Chipinge district with 20%. The lack of fuel was cited in all of the laboratories in Chipinge district in their transportation of Cholera samples to Victoria Chitepo Hospital Laboratory, with Silver stream laboratory having challenges in 50% incidence. The least challenges in fuel was faced in Chipinge with 20% incidence. The results showing that laboratories are mostly using bikes rather than cars for the transportation of Cholera samples can have a significant impact on health delivery and the integrity of the samples. Bikes are often more

commonly used in resource-limited settings due to their affordability, maneuverability in congested or remote areas, and lower operational costs compared to cars. However, the choice of transportation method can affect the speed, safety, and condition of the samples during transit.

Ahmed et al. (2018) compared the use of bikes and cars for sample transportation in a rural area and found that the TAT was significantly shorter for samples transported by bikes. This indicates that bikes can be a more efficient mode of transportation for timely delivery of samples to the laboratory. However, the study also noted that samples transported by bikes were more prone to damage or contamination due to environmental factors, such as exposure to dust or fluctuations in temperature. Li et al. (2020) compared the impact of transportation methods on the integrity of Cholera samples and found that samples transported by cars had lower rates of contamination and better preservation of sample integrity compared to samples transported by bikes. The researchers emphasized the importance of proper handling and transportation methods in maintaining the quality of samples for accurate laboratory testing.

The choice between using cars or bikes for sample transportation should consider the balance between speed and sample integrity. While bikes may offer faster transport times in certain settings, they may pose a higher risk of sample contamination or damage. Cars, on the other hand, may provide better sample preservation but could be more expensive or less practical in remote or congested areas. The mode of transportation for Cholera samples can impact health delivery and the integrity of the samples. Research has shown that bikes may be more

efficient in terms of turnaround time, but cars may offer better sample preservation. It is essential to consider the specific context and needs of the healthcare system when deciding on the most suitable transportation method for Cholera samples.

5.4 The condition and integrity of cholera samples upon arrival at Victoria Chitepo Provincial Hospital Laboratory during the 2023-2024 Cholera outbreak in Manicaland

The results indicating that an average of 64% of Cholera samples transported to Victoria Chitepo Hospital Laboratory passed visual inspection tests, with Chipangayi and Cholera samples having the minimum pass rate of 50% each and St. Peter's having the highest pass rate of 80%, demonstrate variations in the quality and condition of samples during transportation. Visual inspection tests are important in determining the physical integrity and potential contamination of samples, which are crucial for accurate laboratory testing and diagnosis.

In a comparison between the visual inspection test results of Cholera samples transported from different locations to a central laboratory. The study found that samples from Chipangayi and Cholera had lower pass rates, indicating a higher likelihood of damage or contamination during transportation (Muzcamp et al. 2019). In contrast, samples from St. Peter's had the highest pass rate, suggesting better handling and preservation of samples during transit. The differences in pass rates of visual inspection tests among different locations highlight the importance of standardized transportation protocols and quality control measures to ensure the integrity of Cholera samples. Samples that fail visual inspection tests may be

at risk of compromised test results, leading to inaccurate diagnosis and treatment (Nyamale et al. 2020).

On monitoring temperature control tests, an average of 73% samples passed these tests with Chibuwe laboratory having the most samples qualifying with 90%, Chipinge having the least samples passing this this 60%.Having a mean of 73% pass for monitoring temperature control tests for Cholera samples transported to Victoria Chitepo Hospital Laboratory is significant as it indicates relatively good adherence to temperature control protocols during transportation. Temperature control is critical for maintaining the stability and integrity of biological samples, including Cholera samples, as deviations in temperature can lead to sample degradation and inaccurate test results (WHO, 2023).

A study by Mutumba et al. (2018) highlighted the importance of monitoring temperature control during sample transportation, particularly for infectious diseases like Cholera. The researchers found that maintaining proper temperature control significantly reduced the risk of sample contamination and ensured the reliability of laboratory test results. Having a mean pass rate of 73% suggests that a majority of Cholera samples transported to Victoria Chitepo Hospital Laboratory were within the recommended temperature range during transit. This indicates good compliance with temperature control measures, which is essential for preserving the quality of samples and obtaining accurate test results for timely diagnosis and treatment of Cholera cases.

Quality control checks had a mean of 67% samples passing with Chipinge and Silverstream having the most samples passing with 80%. The least samples

passing this test were from Chibuwe with 70%. Having a mean of 73% pass for quality control checks for Cholera samples transported to Victoria Chitepo Hospital Laboratory is significant as it indicates a relatively high level of adherence to quality control measures during sample transportation. Quality control checks are essential for ensuring the accuracy, reliability, and consistency of laboratory test results, particularly for infectious diseases like Cholera. Ngwenya et al. (2017) emphasized the importance of quality control in laboratory testing to maintain the integrity and validity of diagnostic results. Proper quality control measures help to identify and address any potential errors or variations that could affect the accuracy of test outcomes and patient care. Achieving a mean pass rate of 73% for quality control checks suggests that the majority of Cholera samples transported to Victoria Chitepo Hospital Laboratory met the required quality standards. This demonstrates a commitment to upholding the accuracy and reliability of laboratory testing procedures, which is crucial for proper diagnosis and management of Cholera cases.

On communication with transporters a mean of 71% was found with only Silver stream and Chibuwe laboratories having samples below the mean only with 70% and 65% respectively. Having a mean of 71% pass for communication with transporters for Cholera samples transported to Victoria Chitepo Hospital Laboratory is significant as it indicates the effectiveness of communication protocols between the laboratory staff and transporters. Clear and efficient communication is essential for ensuring the timely and safe transportation of samples, which in turn impacts the quality and integrity of the samples, as well as

the reliability of test results.

The study is akin to the findings where good communication practices was associated with improved sample handling, reduced transit times, and decreased likelihood of errors during transportation. A mean pass rate of 71% for communication with transporters suggests that the majority of communication processes were successful in ensuring that relevant information and instructions were effectively conveyed between the laboratory and transport personnel (Makoni et al., 2019). This level of communication proficiency plays a crucial role in maintaining the quality and accuracy of Cholera sample transportation, as well as streamlining the overall sample processing workflow

5.5 Implications of the study to public health

The challenges faced by Chipinge laboratories in terms of transportation and infrastructure directly impact the ability of healthcare facilities to accurately diagnose and treat patients in the region. The lack of fuel and poor road conditions can lead to delays in the transportation of samples, which in turn delays diagnosis and treatment initiation for patients. This can have serious consequences for public health, as patients may not receive timely care and their conditions could worsen as a result.

The use of bikes to transport samples is also concerning for public health, as the potential for sample degradation during transport can lead to inaccurate test results and compromised patient care. Inaccurate diagnoses can result in incorrect treatment plans, leading to potential harm to patients.

Addressing the infrastructure and transportation challenges faced by Chipinge laboratories is therefore crucial for improving public health outcomes in the region. Investments in road infrastructure, fuel resources, and more reliable transportation methods are needed to ensure that samples reach the laboratory in a timely manner and maintain their integrity for accurate testing and diagnosis. By addressing these challenges, healthcare facilities in the region can improve patient care and ultimately contribute to better public health outcomes.

5.6 Conclusions

The results showed that the more distance that is travelled to reach Victoria Chitepo Hospital Laboratory the more time which is required for the samples to reach their destination for testing. Also the average time taken for the cholera samples to reach VCHL is 2 days with less samples taking more than 3 days. The challenges that were faced by Chipinge laboratories included lack of resources including fuel, and poor road infrastructure. Also the mode of transportation mostly used is bike with a few using cars. Usage bikes and poor road conditions negatively affected sample integrity upon reaching VCPHL.

The use of bikes for sample transportation, combined with poor road conditions, was identified as a major factor contributing to the compromised integrity of cholera samples upon reaching the laboratory. This has implications for the accuracy of test results and the quality of patient care provided.

Addressing these challenges is crucial for improving public health outcomes in the region. Investments in infrastructure, transportation resources, and sample management protocols are needed to ensure that samples reach the laboratory in

a timely manner and maintain their integrity for accurate testing and diagnosis. By overcoming these obstacles, healthcare facilities can enhance their ability to effectively respond to cholera outbreaks and improve patient outcomes in the Chipinge district.

5.6 Recommendations

a) The ministry of Health and Child care should equip the District laboratories with culture facilities. It is cheaper and more cost beneficial if all other cultures samples are done close to site.

b) Innovative methods of stabilizing bikers sample boxes and monitoring temperatures in real time can help in improving sample integrity.

c) Shortening the distance that the bikers travel to the next available motor car might also help in improving sample integrity.

d) There should be adequate provision of quicker transportation mode and improvements of road infrastructures as well as financial resources by the Ministry of Health and Child care together with its partners like World Health Organization and other Non-governmental organizations in Cholera prone areas especially in Chipinge since it’s a border area with Mozambique were most Cholera cases emanates from.

REFERENCES

1. Ali, M. N. (2015). *AlUpdated global burden of cholera in endemic countries. PLoS Neglected Tropical Diseases, 9(6), e0003832.*

2. Azman, A. S. (2018). Outbreaks of cholera in the time of Ebola: lessons learned for managing concurrent epidemics. . *BMC medicine, 16(1),*, 1-3.

3. Baker, S. C. (2020). Baker, S., Crump, J. A., Cholera: global status. Current Opinion in Infectious Diseases, 33(5), .

4. Bwire, G. D. (2017). Assessing the performance of rapid diagnostic test for cholera in emergency settings: an outbreak in Kasese District, Uganda. . *The American Journal of Tropical Medicine and Hygiene, 97(2)*, 495-500.

5. Bwire, G. M. (2013). Bwire, G., Malimbo, M., Maskery, B., Kim, Y. E., The burden of cholera in Uganda. PLoS Neglected Tropical Diseases, 7(12), e2545.

6. Bwire, G. M. (2017). Epidemiology of cholera outbreaks and socio-economic characteristics of the communities in the fishing villages of Uganda. . *PLoS neglected tropical diseases ,11(3),e0005407*.

7. Bwire, G. S. (2013). Emerging epidemic of Vibrio cholerae O1 infection in Tanzania: the essential role of older children and adults in sustained transmission and control. . *BMC infectious diseases,13(1)*, 1-8.

8. Chidawanyika, H. M. (2022). Cholera outbreak investigation in Harare, Zimbabwe, 2018. *The Pan African Medical Journal*, 41.

9. Chingono, R. M. (2019). Cholera outbreak investigation in Chegutu district, Zimbabwe. *The Pan African Medical Journal,*, 32.

10. Chinyenje, C. M. (2022). Chinyenje, C., Munyaneza, T., Duri, D. H.Cholera outbreak response challenges in Zimbabwe, 2018-2019: a qualitative study. BMC Public Health, 22(1), 1-10.

11. Chirebvu, E. C. (2016). Assessment of risk factors associated with cholera

outbreak and mapping of cholera risk hot spots in Chikwarigwi, Zimbabwe. . *South African Journal of Infectious Diseases, 31(1),* , 25-30.

12. Chirebvu, E. C. (2016). Chirebvu, E., Chimbari, M. J., & Ngwenya, B. N. (2016). Assessment of risk factors associated with cholera outbreak in Chiredzi district of Zimbabwe. . *The Pan African Medical Journal, 23.*

13. Cossa, H. A. (2016). The cholera outbreak in mozambique, 2013-2014: a review and lessons learned. *The Journal of Infectious Diseases, 213(suppl_3),* , S86-S90.

14. Cumming, O. C. (2019). Cholera outbreak in Yemen, 2016–18: an analysis of surveillance data. *The Lancet Global Health, 7(6),* , e715-e723.

15. Debes, A. K. (2016). Cholera cases cluster in time and space in Matlab, Bangladesh: implications for targeted preventive interventions. . *International journal of epidemiology, 45(6),* , 2134-2139.

16. Gathere, S. O. (2019). Gathere, S., Odhiambo, D., Ngere, I., Challenges and opportunities in implementing the integrated disease surveillance and response strategy in Kenya. . *The Pan African Medical Journal*, 33.

17. Hassan, A. I. (2021). Hassan, A., Ijaz, M. K., Sarwar, F., Bhutta,Cholera Outbreaks in South Asia: Causes, Epidemiology, Impact, and Recommendations for Control. *The American Journal of Tropical Medicine and Hygiene, 104(2)*, 454.

18. Khonje, A. M. (2012). Cholera outbreak in districts around Lake Chilwa, Malawi: lessons learned. *The Malawi Medical Journal, 24(2)*,, 29-33.

19. Khonje, A. M. (2012). Khonje, A., Metcalf, C. A., Diggle, E., Mlozowa, D., Jere, C., Akesson, A.Cholera outbreak in Blantyre, Malawi: Urban communities hit hard. . *The Malawi Medical Journal, 24(2)*,, 29-33.

20. Leung, D. T. (2020). Immune responses to cholera in an era of changing epidemiology. Vaccine, 38, A31-A39.

21. Leung, D. T. (2020). Leung, D. T., Chowdhury, F., Bhuiyan, T. R., Nishat, N. S., Rashu, R., Paul, A., ...Comparison of stool and rectal swab specimens for the detection of Vibrio cholerae O1 and O139. . *The American Journal of Tropical Medicine and Hygiene,103(1)*, 58-62.

22. Luca, C. V. (2021). Luca, C. V., Garrone, V., Bonino, S., Serafino, L., Mantovani, A., Crespi, S.,Cholera outbreak response: a systematic review. . *BMC Public Health, 21(1),*, 1-10.

23. Mengel, M. A. (2014). Cholera outbreaks in Africa. . *Current topics in microbiology and immunology, 379,*, 117-144.

24. Mengistie, Y. H. (2021). Mengistie, Y., Hagos, K. G., Tadesse, D. T., Woldeamanuel, Y., Yeshitela, B., Bekele, A., Timeliness and Completeness of Cholera Reporting in Ethiopia: Findings from a Cross-Sectional Study. . *Mengistie, Y., Hagos, K. G., Tadesse, D. T., Woldeamanuel, Y., Yeshitela, B., Bekele, A., ... & Beyene, B. (2021). Timeliness and Completeness of C The American Journal of Tropical Medicine and Hygiene,104(2)*, 643-651.

25. Moore, S. R. (2001). Early childhood diarrhoea and helminthiases associate with long-term linear growth faltering. . *International Journal of Epidemiology, 30(6),* , 1457-1464.

26. Moran, G. J. (2020). *Moran, G. J., Talan, D. A., Khan, S., HasanRegional variation in travel-associated and locally acquired Vibrio infections in the United States (2013-2016). Open Forum Infectious Diseases, 7(4), ofaa101.*

27. Mpakairi, K. S. (2017). Cholera outbreaks in Zimbabwe. . *Epidemiology & Infection, 145(5),* , 871-878.

28. Msyamboza, K. P. (2014). Cholera outbreak in Malawi in 2009: lessons learned. . *The Pan African Medical Journal, 18(Suppl 1).*

29. Mujuru, A. T. (2018). Gender disparities in cholera mortality in Harare, Zimbabwe, 2012. *The Pan African Medical Journal,*, 30.

30. Munodawafa, M. N. (2020). The impact of cholera epidemics on the

Zimbabwean economy. International Journal of Disaster Risk Reduction, 49, 101720.

31. Munyaneza, T. U. (2018). Cholera surveillance during an outbreak in Rusizi and Nyamasheke districts, Western Rwanda, 2016. . *The Pan African Medical Journal, 30.*

32. Munyaneza, T. U. (2018). Cholera Surveillance in Zimbabwe, 2015-2016: Challenges and Opportunities. Health Security, 16(S1), S-9.

33. (MoHCC)., .. M. (2024a). *Cholera outbreak situation report 7. .* Harare, Zimbabwe.

34. (MoHCC)., M. o. (2023a). *Cholera outbreak situation report 1. .* Harare, Zimbabwe.

35. (MoHCC)., M. o. (2023b). *Cholera outbreak situation report 2.* Harare, Zimbabwe.

36. (MoHCC)., M. o. (2023c). *Cholera outbreak situation report 3.* Harare, Zimbabwe.

37. (MoHCC)., M. o. (2023d). *Cholera outbreak situation report 4. .* Harare, Zimbabwe.

38. (MoHCC)., M. o. (2023e). *Cholera outbreak situation report 5.* Harare, Zimbabwe.

39. (MoHCC)., M. o. (2023g). *Cholera outbreak situation report 6. .* Harare, Zimbabwe.

40. (MoHCC)., M. o. (2024b). *Cholera outbreak situation report 8. .* Harare, Zimbabwe.

41. (ZRCS)., Z. R. (2023). *Cholera response activities.* Harare, Zimbabwe.

42. Lessler, J. M. (2018). Mapping the burden of cholera in sub-Saharan Africa and implications for control: an analysis of data across geographical scales. . *The Lancet, 391(10133)*, 1908-1915.

43. Munyoro, D. N. (2021). Factors influencing transportation of cholera samples for diagnosis in Zimbabwe. . *BMC Public Health, 21(1),* , 1-10.

44. Murewa, R. G. (2021). Cholera outbreak investigation in Dzivarasekwa, Harare, Zimbabwe, 2020. *The Pan African Medical Journal*, 38.

45. Murray, C. J. (2018). The impact of poor sample management on disease surveillance and outbreak response: the case of cholera in Somalia. . *BMC Public Health, 18(1),* 1-7.

46. O'Brien, K. M. (2019). Biospecimen transport and quality control practices in research studies. *The Journal of Applied Laboratory Medicine, 3(4),,* 676-687.

47. Pascual, M. R. (2000). Cholera dynamics and El Niño-Southern Oscillation. Science, 289(5485). 1766-1769.

48. Piarroux, R. B. (2011). Understanding the cholera epidemic, Haiti. Emerging infectious diseases, 17(7), 1161.

49. Rebaudet, S. B. (2019). The case-area targeted rapid response strategy to control cholera in Haiti: a four-year implementation study. PLoS Neglected Tropical Diseases, 13(4), e0007296.

50. Rebaudet, S. S. (2013). Environmental determinants of cholera outbreaks in inland Africa: a systematic review of main transmission foci and propagation routes. *Journal of Infectious Diseases, 208(suppl_1),,* S46-S54.

51. Stockman, L. J. (2006). Evaluation of the rapid diagnostic test cholera dipstick to detect Vibrio cholerae serogroup O1 and O139 in two cholera-endemic areas. . *Clinical infectious diseases, 42(12),* 1777-1779.

52. Syed, S. A. (2020). Novel rapid diagnostic test for cholera: assessing performance and potential for impact. . *BMC infectious diseases, 20(1),* , 1-8.

53. WHO. (2023b, December 11). *World Health Organization*. Retrieved from

Cholera. https://www.who.int/news-room/fact-sheets/detail/cholera

54. World Health Organization (2023, D. 1. (2023, December 11). *WHO & World Health Organization: WHO.* Retrieved from Cholera. https://www.who.int/news-room/fact-sheets/detail/cholera

APPENDICES

Appendix 1: Timeframe

Month	Week	Activity
January	1	Preparation and submission of project to AUREC
	2	Preparation and submission of project to AUREC
	3	Preparation and submission of project to AUREC
	4	Preparation and submission of project to AUREC
February	1	Pretesting
	2	Data Collection
	3	Data collection
	4	Data processing and analysis
March	1	Data processing and analysis
	2	Data processing and analysis
	3	Project final writing
	4	Project final writing
April	1	Project submission to Africa University

	2	Project submission to Africa University
	3	Project submission to Africa University
	4	Project submission to Africa University

Appendix 2: Budget

ITEM	Unit Cost (US$)	Multiplying factor	Total Cost (US$)
Stationery (Pens, Pencils etc.)	10	1	10
Data collection materials	20	1	20
Transportation	20	1	20
Printing costs for reports	15	1	15
lunch	10	1	10
Miscellaneous expenses	5	1	5
Total			80

Appendix 3: Data Collection Plan

Data Collection Method	Description	Data Source	Timeframe
Review of Laboratory Records	Analyze laboratory records to determine turnaround times for cholera sample transportation and processing	Victoria Chitepo Provincial Hospital Laboratory Records	January 2023 - December 2024
Transportation logs	Examine logs related to the transportation of cholera samples to assess method used and any recorded challenges	Transportation logs from transportation manager, health authorities and the laboratory.	January 2023 - December 2024
Sample integrity Assessment	Evaluate the conditions of samples upon arrival at VCPH including any noted contamination recorded in laboratory.	Laboratory quality control reports and sample handling records	January 2023 - December 2024

Appendix 4: Data Collection Tool 1

Cholera Sample Turnaround and Condition Review Form

Sample ID	Date of Collection	Time of Collection	Transportation Start Time	Arrival Date	Arrival Time	Temperature on Arrival	Sample Condition on Arrival (Tick all that apply)	Remarks
							☑ Intact □ Leaked ☑ Contaminated	
							□ Intact □ Leaked ☑ Contaminated	
							□ Intact □ Leaked ☑ Contaminated	
							☑ Intact	

							□ Leaked □ Contaminated	

Appendix 5: Cholera Sample Transportation Data Collection Tool

Category	Details/Question	Response Options
Transportation Methods	What mode of transport was used to deliver the sample?	☐ Motorbike ☐ Car ☐ Ambulance ☐ Other (Specify): _____
	Was the transport vehicle appropriate for sample delivery?	☐ Yes ☐ No (Specify issues): _____
	Was refrigeration or a cold box used during transportation?	☐ Yes ☐ No ☐ Not Applicable
Transport Times	Time sample left the collection point (Chipinge):	: (hh:mm)
	Time sample arrived at the provincial laboratory:	: (hh:mm)
	Total transport time:	__ hours __ minutes
Road/Route Conditions	Were there any delays due to road conditions?	☐ Yes ☐ No
	If yes, describe the road issue (e.g., poor roads, blocked routes):	_____
Logistical	What logistical	☐ Delays ☐ Vehicle breakdown ☐ Lack of

Challenges	challenges were encountered during transport?	fuel ☐ Other (Specify): _____
	What environmental factors impacted transport?	☐ Heavy rain ☐ Heat ☐ Poor visibility ☐ Other (Specify): _____
	Were there any staffing issues affecting the transportation process?	☐ Yes ☐ No (Specify): _____
	Did logistical challenges compromise sample condition?	☐ Yes ☐ No
	If yes, describe how:	_____

Appendix 6: Letter requesting for permission

The Medical Superintent

Victoria Chitepo Provincial Hospital

I hope this letter finds you well. My name is Nyasha Ordain Dzobo, and I am writing to request permission to conduct a study at Victoria Chitepo Provincial Hospital as part of my research on sample management practices for cholera cases. The study aims to assess the handling and transportation of cholera samples from Chipinge District to your esteemed hospital during the 2023-2024 period.

Given the recurrent cholera outbreaks in Chipinge District and the critical need for timely and effective diagnosis, this research seeks to evaluate the turnaround time, transportation logistics, and sample integrity upon arrival at your laboratory. I believe that insights gained from this study could significantly contribute to improving public health responses in our region.

I assure you that the research will adhere to all ethical guidelines and will prioritize the confidentiality and well-being of all participants involved. I would be grateful for the opportunity to discuss this study further and address any questions or concerns you may have.

Thank you for considering my request. I look forward to your positive response.

Sincerely,

Nyasha Ordain Dzobo

Appendix 7: AUREC APPROVAL LETTER

"Investing in Africa's future"
AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE (AUREC)

P.O. Box 1320 Mutare, Zimbabwe, Off Nyanga Road, Old Mutare-Tel (+263-20) 60075/60026/61611 Fax: (+263 20) 61785 Website: www.africau.edu

Ref: AU 3627/25

20 February, 2025

NYASHA ORDAIN DZOBO
C/O Africa University
Box 1320
MUTARE

RE: ***ASSESSING THE SAMPLE MANAGEMENT PRACTICES FOR CHOLERA CASES MOVING FROM CHIPINGE DISTRICT TO VICTORIA CHITEPO PROVINCIAL HOSPITAL FROM 2023-2024***

Thank you for the above-titled proposal you submitted to the Africa University Research Ethics Committee for review. Please be advised that AUREC has reviewed and approved your application to conduct the above research.

The approval is based on the following.

a) Research proposal

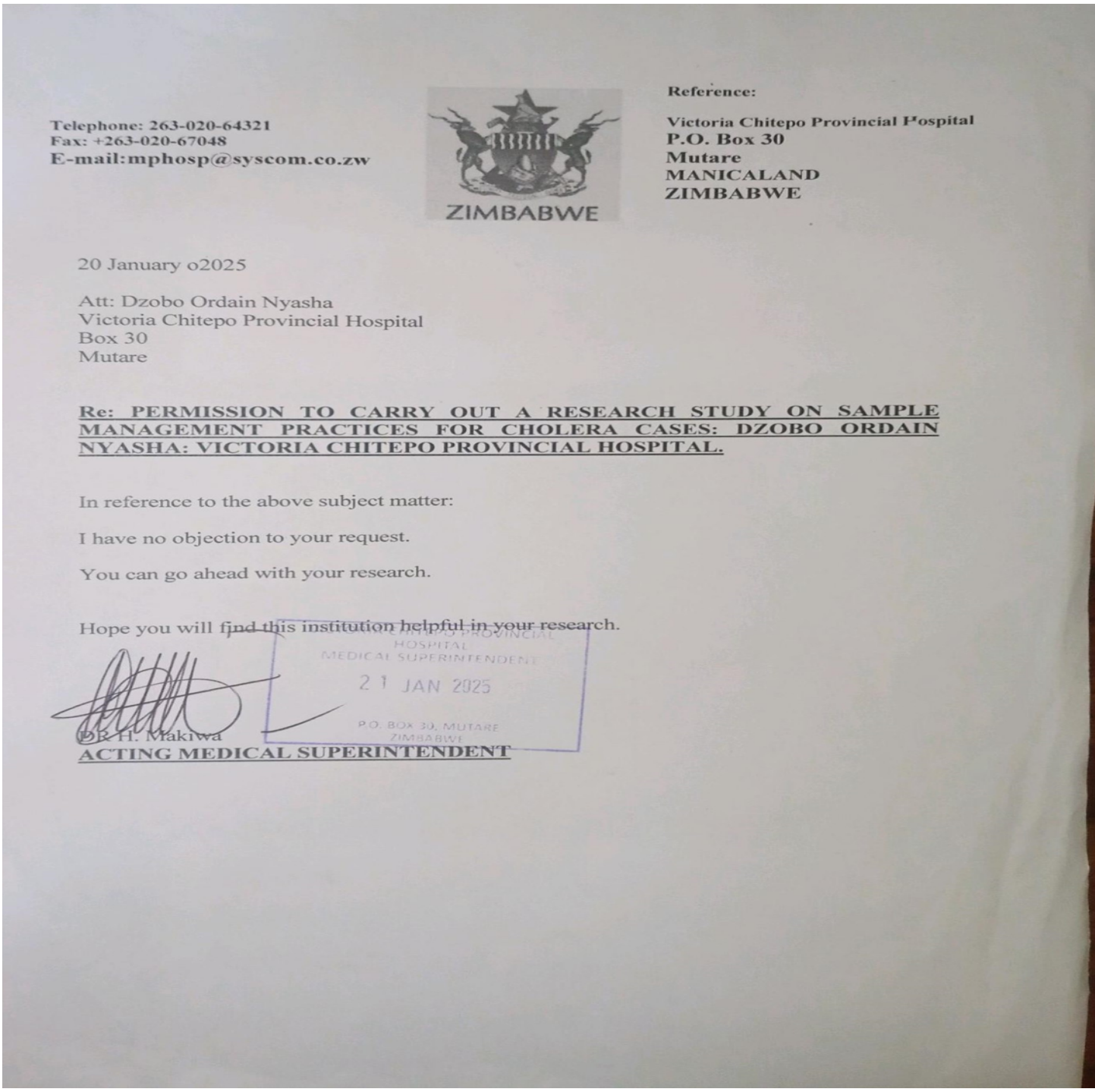
- **APPROVAL NUMBER** AUREC 3627/25
  This number should be used on all correspondences, consent forms, and appropriate document
- **AUREC MEETING DATE** NA
- **APPROVAL DATE** February 20, 2025
- **EXPIRATION DATE** February 20, 2026
- **TYPE OF MEETING**: Expedited
  After the expiration date, this research may only continue upon renewal. A progress report on a standard AUREC form should be submitted a month before the expiration date for renewal purposes.
- **SERIOUS ADVERSE EVENTS** All serious problems concerning subject safety must be reported to AUREC within 3 working days on the standard AUREC form.
- **MODIFICATIONS** Prior AUREC approval is required before implementing any changes in the proposal (including changes in the consent documents)
- **TERMINATION OF STUDY** Upon termination of the study a report has to be submitted to AUREC.

AFRICA UNIVERSITY
RESEARCH ETHICS COMMITTEE (AUREC)
APPROVED
P.O. BOX 1320, MUTARE, ZIMBABWE

Yours Faithfully

MARY CHINZOU
FOR CHAIRPERSON
AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE

Appendix 8: STUDY SITE APPROVAL LETTER



Telephone: 263-020-64321
Fax: +263-020-67048
E-mail:mphosp@syscom.co.zw

ZIMBABWE

Reference:

Victoria Chitepo Provincial Hospital
P.O. Box 30
Mutare
MANICALAND
ZIMBABWE

20 January o2025

Att: Dzobo Ordain Nyasha
Victoria Chitepo Provincial Hospital
Box 30
Mutare

Re: PERMISSION TO CARRY OUT A RESEARCH STUDY ON SAMPLE MANAGEMENT PRACTICES FOR CHOLERA CASES: DZOBO ORDAIN NYASHA: VICTORIA CHITEPO PROVINCIAL HOSPITAL.

In reference to the above subject matter:

I have no objection to your request.

You can go ahead with your research.

Hope you will find this institution helpful in your research.

VICTORIA CHITEPO PROVINCIAL HOSPITAL
MEDICAL SUPERINTENDENT
21 JAN 2025
P.O. BOX 30, MUTARE
ZIMBABWE

DR H. Makiwa
ACTING MEDICAL SUPERINTENDENT