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ANALYSIS OF FACTORS ASSOCIATED WITH DEATH AMONG TB/HIV INFECTED PERSONS AT MASVINGO PROVINCIAL HOSPITAL, ZIMBABWE, 2022-2024

BY

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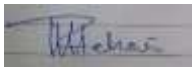
Abstract

HIV pandemic presents a significant challenge to global tuberculosis (TB) control. TB and HIV work in synergy potentiate the effect of the other. Among people living with HIV, TB is the most common cause of death. TB/HIV coinfection is still a notable public health challenge, particularly in resource-limited settings like Zimbabwe. In 2019 TB accounted for 30% of HIV related deaths. Zimbabwe has transitioned out of the 30 high TB Burdened countries but it remains in the 30 high TB/HIV and MDR or rifampicin resistant TB burdened countries. The study aimed at analyzing the prevalence of death outcome, the clinical and demographic characteristic of those who died and factors that are associated with mortality among this subgroup. This was a hospital based retrospective cohort study of HIV positive patients receiving anti-TB treatment in at Masvingo provincial hospital, Zimbabwe from 2022 to 2024. Secondary data analysis was done on all HIV positive persons who received TB treatment in the TB/OI clinic. A total of 207 people met the eligibility criteria. The outcomes were death, cured and completed treatment. The variables that were looked at include sex, age, ART status, referral type, comorbidities and residence. The mortality rate among TB/HIV persons was 17.9% while 67.6% completed treatment and 14.5% were cured. Around 70.3% of deaths happened within the first month. The average age of death was 47.0±24.5 years. The majority 30/37 (81.0%) were male and they resided in the urban area. About sixty two percent (62.2%) were not on ART. Of those who died, 90.0% had pulmonary TB. Sputum analysis was not done on 20.3% of the patients while 6.8% had rifampicin resistant TB. The majority of deaths were those who were referred from the wards. Gender was found to be a significant predictor of death with males having the higher odds of mortality compared to females with a p =0.016 and a coefficient of 1.1. Age was also a significant factor associated with death with a p value of 0.037 and a coefficient of 0.2 meaning that as age increases the likelihood of death increases. The Pearson Chi-Square result, indicated that sex significantly influences the likelihood of cure, death, or completion of treatment with a p value of 0.021. In this study ART status and being diabetic did not show any statistical significance. ART usage remains a key factor in reducing the risk of death. In this study even those who were 2 weeks on ART were classified as being on ART, this factor could have affected the effect of being on ART and late diagnosis on mortality. There is need to strengthen early HIV diagnosis and screening of opportunistic infections prior to starting ART. Gender oriented initiatives that aim at improving the health seeking behavior of men need to be strengthened. There is need to address hospital based resource constraints and enhancing diagnostic infrastructure.

Key words: TB/HIV co-infection; mortality; risk factors of death; Masvingo, Zimbabwe; gender; age; comorbidities

Declaration Page

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

Elizabeth Katsamba 

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I would like to acknowledge the unwavering support and technical guidance I received from my lecturer and my field supervisor, in writing this dissertation. I also want to acknowledge the continued support from my husband, children mother, siblings, friends and colleagues.

Dedication

I dedicate this dissertation to my mother, Constance Makasi, for being a great inspiration in my life and praying for me always

List of acronyms and abbreviations

TB Tuberculosis

HIV Human Immunodeficiency Virus

WHO World Health Organisation

AIDS Acquired Immunodeficiency Syndrome

BMI Body Mass Index

IPT Isoniazid preventative therapy

ART Antiretroviral Therapy

CMV Cytomegalovirus

ARV Antiretroviral

Definition of terms

Mortality	The state or condition of being subject to death. It is often used to describe the number of deaths in a population over a specific period, typically expressed as a rate.
Pandemic	An epidemic that has spread over several countries or continents, affecting a large number of people
Undernourished	A condition resulting from insufficient intake of nutrients, leading to deficiencies that can cause health issues. It can manifest as visible wasting of fat and muscle or be less apparent.
Extra pulmonary	Refers to conditions or diseases occurring outside the lungs.
Low Hgb (Hemoglobin)	A condition where the hemoglobin level in the blood is below normal, often indicating anemia. Hemoglobin is a protein in red blood cells that carries oxygen throughout the body
Multi-Drug Resistance	The ability of microorganisms, such as bacteria, viruses, and some parasites, to resist the effects of multiple drugs that were once effective against them.
Disseminated	Spread throughout an organ or the body. For example, disseminated tuberculosis means the infection has spread beyond the lungs to other parts of the body.
Immunosuppression	A reduction in the efficacy of the immune system, which can be caused by certain diseases, medications, or medical treatments.

Opportunistic Infection	Infections caused by pathogens that take advantage of an individual's weakened immune system, often seen in people with conditions like HIV/AIDS.
Meningitis	Inflammation of the protective membranes covering the brain and spinal cord, known as the meninges. It can be caused by infections, injuries, or other conditions.
Immunological Failure	The inability of the immune system to function properly, often leading to increased susceptibility to infections and diseases.
Viral Suppression	The reduction of viral load (the amount of virus in the body) to undetectable levels, often a goal in the treatment of viral infections like HIV.
CD4	A type of white blood cell that plays a significant role in the immune system. CD4 cells are targeted and destroyed by HIV, leading to weakened immunity.

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CHAPTER 1 INTRODUCTION

1.1 Introduction

The human immunodeficiency virus (HIV) pandemic presents a significant challenge to global tuberculosis (TB) control. TB and HIV work in synergy potentiate the effect of the other. Among people living with HIV, TB is the most common cause of death. If untreated TB is deadly leading to almost thirty percent of deaths in HIV positive people (WHO, 2023). People with HIV have a 20 – 30 times higher risk of contracting TB than those that are HIV negative and the risk of mortality is higher in this group as compared to those that are negative. However, with the use of TB preventative therapy the risk of getting TB has been reduced significantly. By identifying the key determinants of mortality in this population, the study seeks to provide insights that could inform better clinical practices and policy decisions. The research will explore various factors, including demographic characteristics, clinical presentations, treatment regimens, and socio-economic conditions, to understand their impact on patient outcomes. Understanding the interplay between TB and HIV is crucial for developing effective strategies to reduce mortality and improve the quality of life for affected individuals. This study will contribute to the existing body of knowledge by providing a comprehensive analysis of the causes of death and associated factors in a specific regional context, thereby offering targeted recommendations for healthcare providers and policymakers.

1.2 Background to the Study

In 2019 TB accounted for almost 30% of all HIV related deaths (WHO, 2020). In 2019 there were 1.4 million deaths worldwide and of these 15% (208 000) were HIV positive.

Prevalence of TB/HIV co-infection is high in Africa followed by Latin America as shown in the figure 1 below. TB/HIV co-infection is high in sub-Saharan Africa and Zimbabwe is now one of the top 30 WHO defined high TB and TB/HIV countries (Global TB report, 2022). Figure 1 below shows how Zimbabwe is heavily burdened by the twin pandemics. TB/HIV co-infection prevalence is higher in settings were diagnosis of TB was made through chest x ray and clinical presentation.

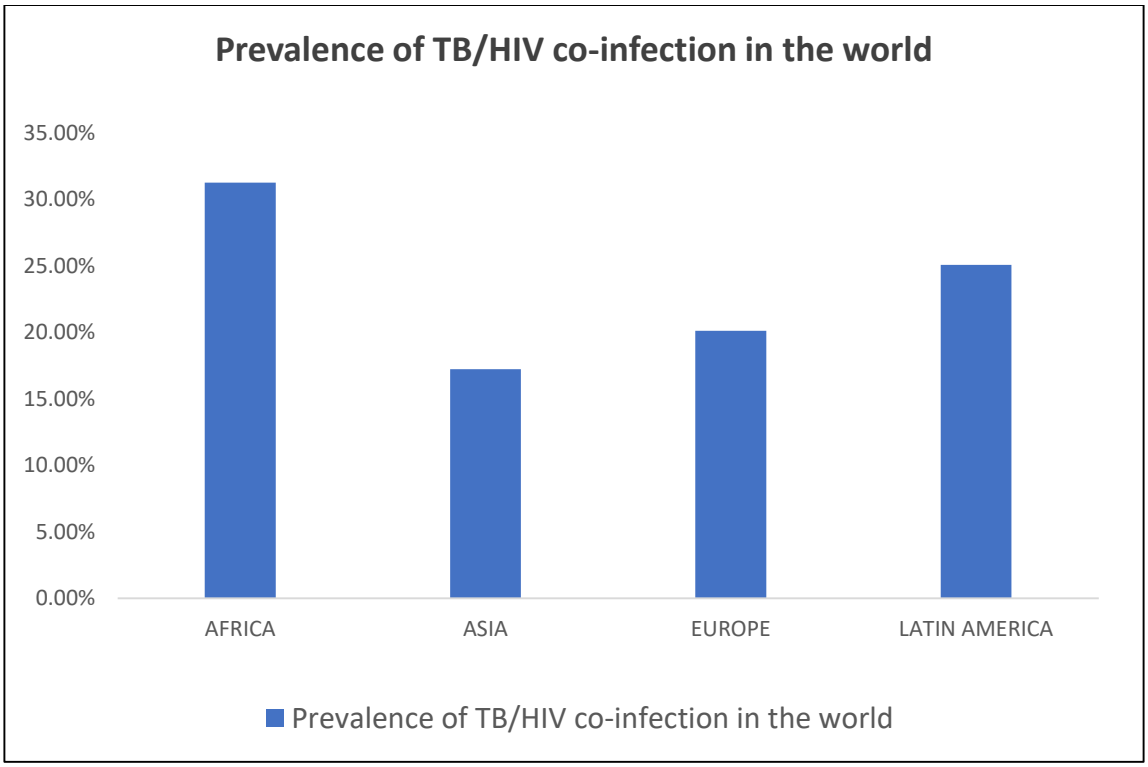

Figure 1 The prevalence of TB/HIV co-infection by continent in 2022(Global TB report, 2023)

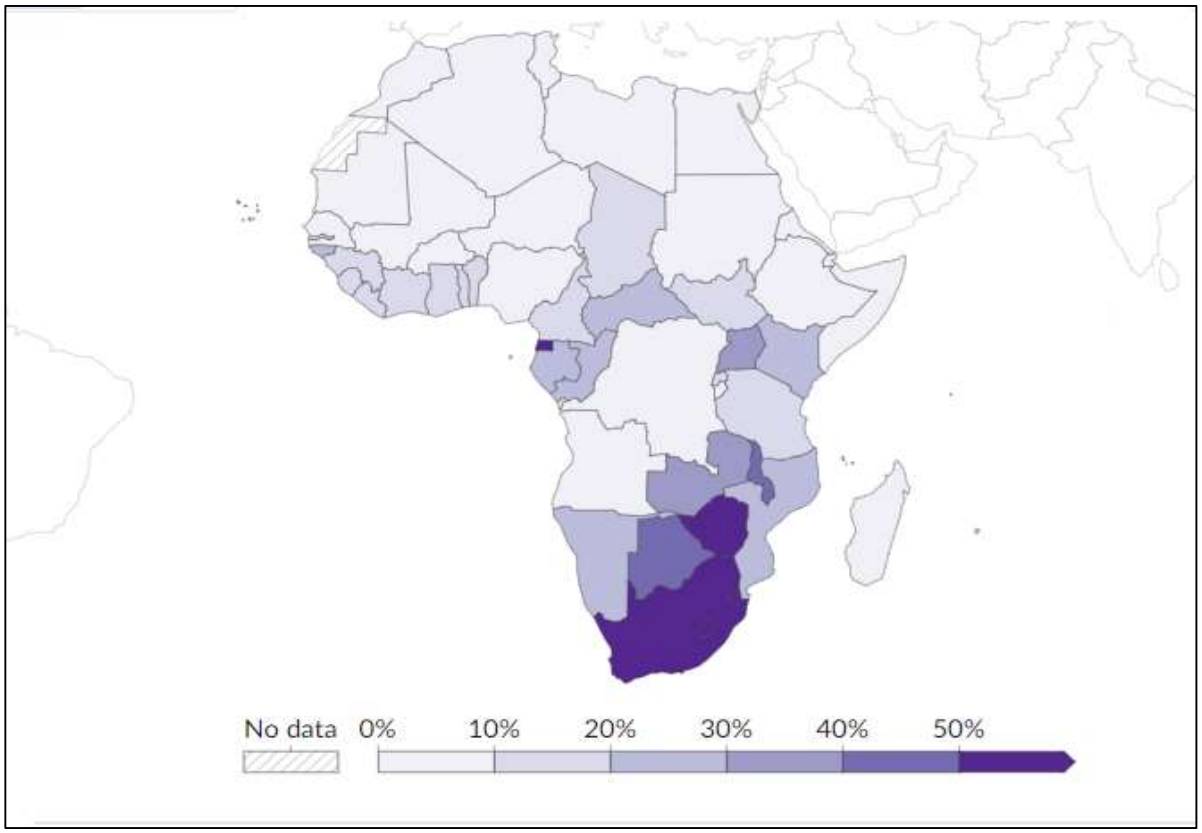

Figure 2 Share of TB patients with HIV 2022 showing a high prevalence of TB/HIV in Sub-Sahara region (WHO, 2023).

According to WHO (2023), Covid 19 has had a significantly negative impact on access to care and treatment for HIV and TB. The WHO's End TB Strategy 2025 milestones of reducing TB incidence and TB deaths are currently not on track (WHO, 2023). Between 2019 and 2021 the number of newly diagnosed TB patients fell by 18% (from 7.1 million to 5.8 million) the main reason was due to disruption of care and service provision (Karim & Karim, 2016).

TB spreads through respiratory particles and has a tendency to cause tuberculosis in people with risk factors such as undernourishment, HIV/AIDS, smoking, and existing chronic conditions. Bhatt, Syed &Sigh, (2023) states that co-infection of HIV and TB

results in a communally beneficial association that quickens the development of both diseases. TB is a major contributor to death in individuals with HIV. However diagnosing co-infected persons is challenging due to the occurrence of extra pulmonary TB and smear-negative disease.

Determinants of contracting TB in HIV positive people include a history of TB disease, being bed ridden, low Hgb, advanced HIV WHO staging III and IV and low BMI (Ahmed, Mekouneu, Shiferaw, Belayneh & Yeut, 2016). However people who took Isoniazid preventative therapy (IPT) had a protective effect and were 86% less likely to have TB (Ahmed, 2016).

In untreated or poorly managed HIV persons, advanced TB disease is a major contributor of death. TB remains the most common cause of mortality in HIV infected persons and thirty percent of all AIDS-related deaths worldwide are attributed to TB (WHO, 2023). People living with HIV have a 20 times chance of contracting TB compared to those that are HIV negative (WHO, 2013). Mortality in TB/HIV co-infected persons occurs during the earlier months of TB treatment (Lelisho et al., 2023).

Causes of death among TB/HIV persons can be directly related to either of the two conditions, indirectly related to the management of the condition or due to other causes of death not related to any of the two. Direct causes of death in TB/HIV co-infected patients are related to TB or to HIV as the primary causes of death. Complications such as multi drug resistance and disseminated TB further increase mortality risks. HIV-related complications due to progressive immunosuppression lead to opportunistic infections like pneumocystis pneumonia and meningitis. Indirect causes of mortality include delay in

diagnosis and treatment, poor adherence to treatment (Zhang, 2020), drug interactions, comorbidities like malnutrition and diabetes mellitus and socioeconomic factors.

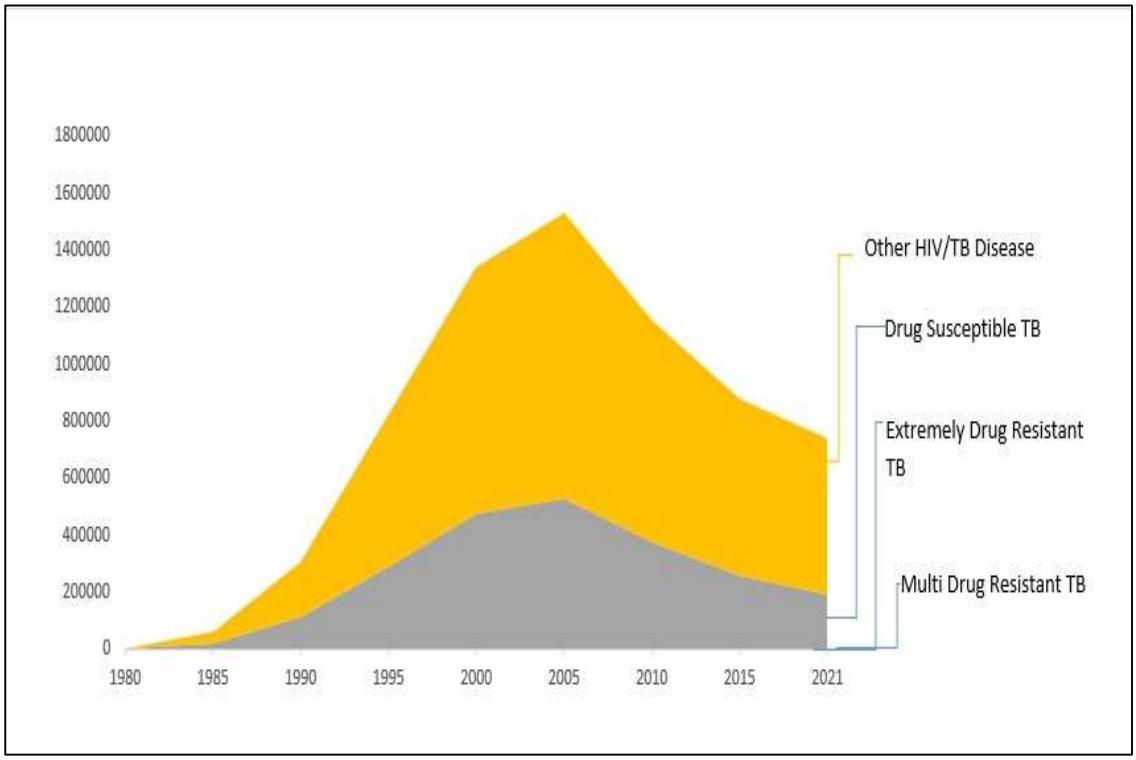

Figure 3 Estimated number of deaths from tuberculosis versus other causes among people with HIV/AIDS. This is broken down by type of tuberculosis including drug resistant TB (IHME, Global Burden of Disease, 2024)

There is need to take action in reducing the incidence of TB/HIV Coinfection especially in the face of the war in Ukraine, conflicts in many parts of the world, the crisis in energy ,food security risks which are likely going to disrupt the overall impressive trends that have been ongoing(WHO, 2023).

In areas with high prevalence of TB, effective ARV therapy can reduce mortality to TB. It is early detection and treatment of both HIV and TB that improves chances of survival. In order To prevent and treat TB among HIV positive, some of the strategies include early

enrollment into HIV care, regular follow up visits, adherences to ART, Tb screen on each visit, offering TB preventative therapy and observing cough etiquette. This is what triggered the call to make a critical analyses of causes of death and the associated risk factors among TB/HIV infected persons. There is need for pragmatic study and serious consideration of these factors in particular, Masvingo Provincial Hospital.

1.3 Statement of the Problem

Tuberculosis (TB) and Human Immunodeficiency Virus (HIV) co-infection is still a notable public health challenge, particularly in resource-limited settings this is clearly demonstrated in figure 3 below. Although Zimbabwe has transitioned out of the 30 high TB Burdened countries, it remains in the 30 high TB/HIV and MDR/RR TB burdened countries (Global TB report, 2023). It is against this background of high burden of TB/HIV co-infection in Zimbabwe that has prompted this research. Despite advancements in antiretroviral therapy (ART) and TB treatment, the factors contributing to these deaths are not well understood. This study aims to analyze the causes of death and identify the associated factors among TB/HIV infected persons at Masvingo Provincial Hospital. Understanding these factors is crucial for developing targeted interventions to reduce mortality and improve the quality of care for this vulnerable population.

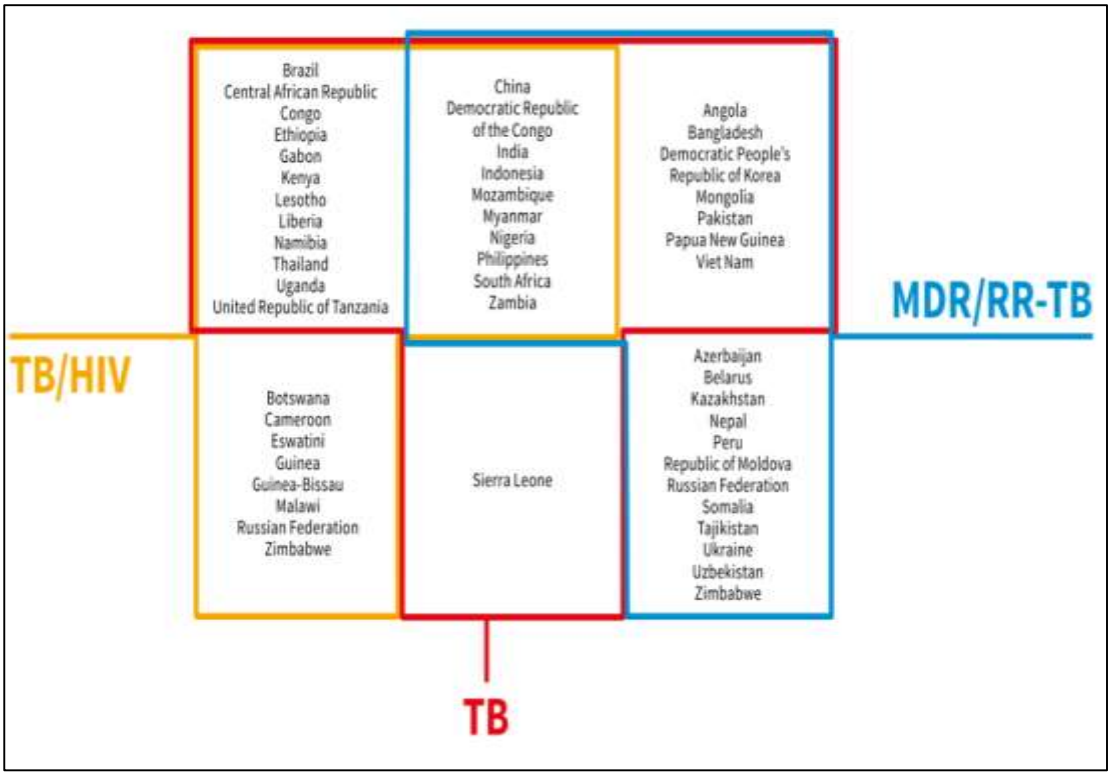

Figure 4 The 3 global lists of high burden countries for TB/HIV associated TB and MDR/RR-TB to be used by WHO in the period 2021-2025 and their areas of overlap.

1.4 Research Objectives

1.4.1 Broad objective

- To analyse the causes of death and the associated factors among TB/HIV-infected persons at Masvingo provincial hospital for the period January 2022- December 2024

1.4.2 Specific Objectives

I. To analyse the prevalence of death outcome among TB/HIV co-infected persons at Masvingo Provincial hospital, January 2022 to December 2024.

II. To determine the demographic and clinical characteristics of TB/HIV infected persons who died at Masvingo provincial hospital, January 2022 to December 2024.

III. To establish factors associated with death among TB/HIV co-infected persons at Masvingo provincial hospital, January 2022 to December 2024.

1.5 Research Questions

I. What is the prevalence of death outcome among TB/HIV co-infected persons at Masvingo Provincial hospital, January 2022 to December 2024?

II. What is the demographic and clinical characteristics of TB/HIV infected persons who died at Masvingo provincial hospital, January 2022 to December 2024?

III. Which factors are associated with death among TB/HIV persons at Masvingo provincial hospital, January 2022 to December 2024?

1.6 Significance of the study

The prime significance of this study is that it will identify mortality trends among TB/HIV patients, informing public health strategies. Identifying the key factors contributing to mortality can guide Masvingo Provincial Hospital to allocate resources more effectively. Taking for example, if adherence to antiretroviral therapy (ART) is a significant factor, more resources can be directed towards patient education and support programs. To the best of my knowledge no similar study has ever been done in the province or country.

The study will also unveil the effects of early detection and treatment. By recognizing the risk factors associated with mortality, healthcare providers at Masvingo Provincial

Hospital will provide protocols such as regular screening for TB in HIV patients and vice versa, ensuring timely and appropriate treatment. Training healthcare workers on the complexities of TB/HIV co-infection and educating patients on the importance of adherence to treatment can significantly reduce mortality rates.

1.7 Delimitations of the study

The study will be limited to people who died at Masvingo Provincial Hospital aged from 13 years and above. Patients with missing records will be excluded.

1.8 Limitations of the study

The study is limited in that private health facilities and district health centers that the provincial hospital serves will not be included. Some socio-economic parameters like situations of living, social support, and distance of health centers will not be documented, but they might be factors for survival based on literature.

CHAPTER 2 REVIEW OF RELATED LITERATURE

2.1 Introduction

TB and HIV work in synergy to suppress the immunity and co-infection with these shortens lifespan if early treatment is not accessed. Progression of disease is exacerbated by co-infection, which complicates treatment. Pawlowski (2012) notes that HIV increases the risk of progression to active TB and the mortality associated with TB. It is the immunosuppressive effects of HIV that facilitate rapid progression of TB and increase the risk of severe outcomes (Paltiel et al., 2022). In patients with HIV the most common opportunistic infection is TB (Kumae et al., 2019). In sub-Saharan Africa, a resource limited setting co-infection of TB and HIV is a major concern. The high prevalence of extra pulmonary TB and sputum negative TB makes the diagnosis of TB in co-infected person difficult (Bhatt, Quazi & Sing, 2023).This review analyses current studies that have been done on the causes and factors associated with mortality in TB/HIV co-infection with the focus on factors that are relevant to Masvingo Provincial hospital, Zimbabwe.

For instance, research conducted in Africa revealed that the HIV and TB epidemics are intertwined, while a study in Ethiopia uncovered a two-way relationship between these two diseases. The detrimental and reciprocal effects of HIV and TB are evident at both individual and population levels, particularly in sub-Saharan African nations.

2.2 Theoretical Framework

This study will employ a comprehensive hybrid conceptual framework that synthesizes two established theoretical approaches: the disease patient mortality determinants model and disease ecology theory as originally articulated by Mosley-Chen (1984) and Meade

(1977) respectively. This integrated framework offers a robust structure for examining tuberculosis mortality through multiple interconnected lenses.

The framework's hybrid nature is particularly valuable as it enables researchers to systematically incorporate and analyze three distinct but interrelated categories of variables: ecological factors, social determinants, and biological parameters. As Musenge et al. (2013) have demonstrated, this multidimensional approach provides a more complete understanding of the complex web of factors that contribute to mortality outcomes among TB patients. The framework's theoretical foundations rest on several key assumptions about how mortality determinants operate within population health contexts.

Central to this framework is the conceptualization that mortality determinants function through three distinct but connected pathways:

1. Direct variables that immediately impact health outcomes
2. Intermediate variables that mediate health effects
3. Indirect variables that exert more distal influences

These pathways collectively create a cascade of effects that ultimately determine patient survival outcomes. The framework further categorizes these variables according to their nature and relationship to outcomes. Endogenous variables represent outcome measures that are internal to the health system or patient condition, while exogenous variables encompass the external explanatory factors that influence these outcomes.

Musenge et al. (2013) developed this analytical model using structural equation modeling techniques, which allow for the examination of complex relationships between multiple

variables simultaneously. Their approach enables researchers to quantify both the direct and indirect effects of various determinants on TB mortality outcomes. The structural equation model specifically accounts for latent variables that may not be directly measurable but can be inferred from observable indicators.

As illustrated in Figure 1, the framework presents a visual representation of these interconnected relationships, showing how ecological, social and biological factors interact across different levels to influence mortality outcomes. The ecological components consider environmental determinants such as living conditions, air quality, and access to healthcare facilities. Social variables include socioeconomic status, education level, and community support systems. Biological factors encompass comorbidities, immune status, and genetic predispositions.

This comprehensive approach aligns with contemporary understandings of TB as a disease that exists at the intersection of biological and social determinants of health. By employing this hybrid framework, the study will be able to capture the multifaceted nature of TB mortality determinants, moving beyond simplistic cause-effect models to appreciate the complex interplay of factors that ultimately determine patient outcomes. The framework's strength lies in its ability to simultaneously account for individual-level clinical factors while incorporating broader contextual determinants that operate at community and environmental levels.

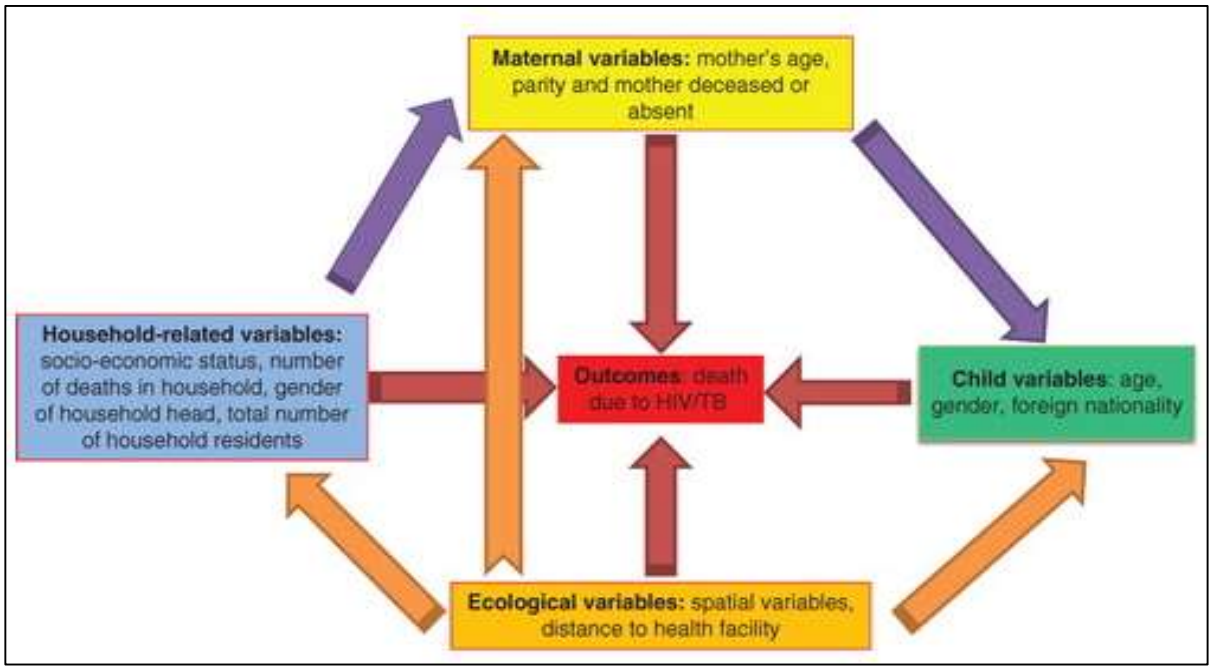

Figure 5 Theoretical framework for modelling childhood HIV/TB-related mortality (Adapted from Meade, 1977)

This study will employ a comprehensive analytical approach by examining multiple observed variables that have been empirically demonstrated to influence mortality outcomes in tuberculosis patients. Building upon recent epidemiological research by Mages and Lajore (2024), the investigation will specifically assess critical clinical indicators including depressed CD4 lymphocyte counts, advanced HIV disease staging, absence of antiretroviral therapy (ART), patterns of drug-resistant TB strains, and the presence of disseminated TB infection along with concurrent opportunistic infections and comorbidities. These clinical parameters represent crucial biological markers of disease progression and treatment response that significantly impact patient survival rates.

The study will further incorporate important socio-demographic determinants that have been shown to modify TB outcomes. As noted by Mages and Lajore (2024), fundamental

patient characteristics including chronological age, biological sex, and functional status (measured through performance scales) serve as key modifiers of mortality risk. These findings are corroborated by Ni et al. (2023), whose multivariate analysis revealed statistically significant interactions between TB mortality and an expanded set of independent variables. Their research identified that patient demographics (sex and age), occupational status, referral pathways, diagnostic confirmation status, disease localization (pulmonary versus extrapulmonary manifestations), laboratory investigation results, clinical severity indices, ART adherence, and immunological status (as measured by baseline CD4 counts) all contribute substantially to mortality outcomes.

The synthesis of these evidence-based variables from Mages and Lajore (2024) and Ni et al. (2023) will inform the development of a robust hybrid conceptual model for this investigation. This model will be structured according to the foundational theoretical templates originally proposed by Mosley-Chen (1984) in their work on disease patient mortality determinants and Meade's (1977) disease ecology framework. The integration of these two theoretical approaches allows for a multidimensional examination of TB mortality that accounts for both individual-level and contextual factors.

The analytical framework organizes these variables into four distinct but interrelated categories:

Patient-specific variables: Including fundamental demographic characteristics such as age and biological sex, which may influence immunological responses and access to healthcare services.

Ecological determinants: Encompassing occupational exposures, educational attainment levels, referral pathways (whether from community clinics, hospitals, or self-referral), and functional status assessments that reflect the patient's socioeconomic environment and healthcare access.

Disease-related factors: Incorporating the anatomical site of TB infection (pulmonary, lymphatic, meningeal, or disseminated), as well as the specific TB classification (drug-sensitive, multidrug-resistant, or extensively drug-resistant).

Clinical parameters: Including laboratory investigation results (smear microscopy, culture, molecular diagnostics), clinical severity scoring, ART regimen and adherence status, and baseline immunological function as measured by CD4+ T-cell counts.

This comprehensive categorization enables systematic examination of how biological, clinical, demographic, and environmental factors interact to influence TB mortality outcomes. The complete hybrid theoretical framework that integrates these variable categories and their hypothesized relationships is presented visually in Figure 4, providing a conceptual map for analyzing the complex determinants of TB-associated mortality. The framework's strength lies in its ability to simultaneously account for proximal clinical factors and distal ecological determinants that collectively shape disease outcomes.

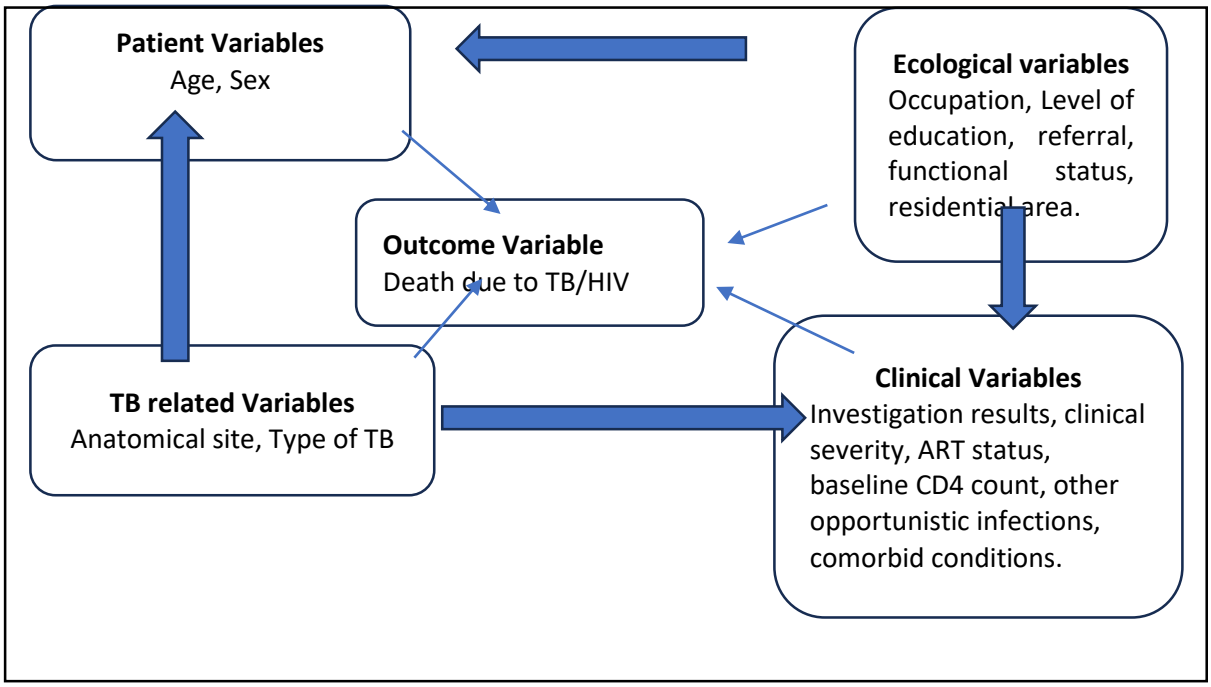

Figure 6: Hybrid Theoretical Framework for modelling TB mortality in patients of all ages.

2.3 Prevalence of TB/HIV Co-infection

The most recent Global TB Report published in 2023 by the World Health Organization (WHO, 2023) reveals significant insights into the ongoing tuberculosis epidemic, particularly concerning HIV co-infection rates. The report documents that in 2022, an estimated 6.3% of all new TB cases worldwide occurred among individuals living with HIV, highlighting the persistent interconnection between these two major global health challenges. However, this global average masks dramatic regional disparities that become apparent when examining specific WHO regions. The situation appears most severe in the WHO African Region, where surveillance data shows that more than 50% of newly diagnosed TB cases occurred in HIV-positive individuals. This alarming statistic becomes

even more concerning when considering that the African Region accounted for 23% of the world's total TB cases in 2022, making it the second highest burden region globally. The highest proportion of cases (46%) was reported from the WHO South-East Asia Region, though with notably lower HIV co-infection rates compared to Africa.

The burden of TB/HIV co-infection shows distinct demographic patterns across affected regions. In sub-Saharan Africa, which bears the greatest burden of this dual epidemic, epidemiological studies have consistently shown that more than half of all TB cases occur among younger adults aged 15-49 years (Styblo, 1989; Nunn et al., 1994). This age group, representing the most economically productive segment of the population, demonstrates particularly high rates of progression from latent TB infection to active disease, likely due to multiple factors including high HIV prevalence in this demographic, occupational exposures, and socioeconomic determinants of health.

Zimbabwe exemplifies the severe challenges posed by TB/HIV co-infection in southern Africa. The country continues to face one of the world's most serious TB epidemics and has been designated by the WHO as one of 30 high-burden countries for both TB alone and TB/HIV co-infection (WHO, 2023). This classification reflects Zimbabwe's persistently high incidence rates of both diseases, coupled with the complex clinical and programmatic challenges that arise when managing these intersecting epidemics. The situation in Zimbabwe mirrors broader patterns seen across the region, where health systems must contend with the dual burden of high TB transmission and substantial HIV prevalence, particularly among young and middle-aged adults who form the backbone of

the workforce and family structures. These epidemiological patterns underscore the urgent need for integrated TB/HIV services and targeted interventions for high-risk populations.

2.4 Mortality among TB/HIV co-infected

The spectrum of mortality causes among individuals co-infected with tuberculosis and HIV encompasses both direct and indirect pathways, reflecting the complex interplay between these two diseases. Understanding these multifaceted causes of death requires careful examination of both biological mechanisms and systemic healthcare factors.

Direct Causes of Mortality

Among untreated or inadequately managed HIV-positive individuals, advanced tuberculosis disease emerges as a predominant direct cause of death. The World Health Organization's 2023 global report underscores the devastating impact of this co-infection, revealing that TB accounts for approximately thirty percent of all AIDS-related deaths worldwide (WHO, 2023). This staggering statistic highlights TB's position as the leading cause of mortality in HIV-infected populations globally. The immunological vulnerability created by HIV infection dramatically increases susceptibility to TB, with people living with HIV facing a twenty-fold greater risk of developing active TB compared to their HIV-negative counterparts (WHO, 2013).

The temporal pattern of mortality in co-infected individuals follows a distinct trajectory, with Lelisho et al. (2023) demonstrating that deaths predominantly cluster during the initial months of TB treatment. This critical period reflects both the severity of disease at

presentation and the challenges of managing two concurrent infections. The mortality risk escalates substantially when complicated by multidrug-resistant TB strains or disseminated TB infection, conditions that significantly compromise treatment efficacy and patient outcomes.

HIV-related immunosuppression creates additional direct mortality pathways through opportunistic infections that exploit weakened immune defenses. Progressive CD4+ lymphocyte depletion facilitates the development of life-threatening conditions such as pneumocystis pneumonia and cryptococcal meningitis, which frequently complicate the clinical course of TB/HIV co-infection. These infections often present diagnostic and therapeutic challenges in the context of concurrent TB treatment.

Indirect Causes of Mortality

The indirect pathways to mortality in this population are equally concerning and frequently interrelated. Diagnostic delays represent a critical barrier, with Zhang (2020) identifying late diagnosis and treatment initiation as significant contributors to poor outcomes. These delays may stem from healthcare system limitations, atypical clinical presentations, or patient-related factors affecting healthcare-seeking behavior.

Treatment adherence presents another major challenge, with complex drug regimens, pill burden, and adverse effects frequently undermining medication compliance (Zhang, 2020). The pharmacological interactions between antiretroviral therapy and TB medications further complicate treatment, potentially reducing drug efficacy or increasing toxicity. These interactions require careful management to optimize therapeutic outcomes.

Comorbid conditions substantially influence mortality risk through multiple mechanisms. Malnutrition, a common finding in this population, impairs immune function and medication tolerance while exacerbating disease progression. Diabetes mellitus introduces additional metabolic complications that may worsen TB treatment responses and increase infection susceptibility.

Socioeconomic determinants create pervasive indirect mortality risks through limited healthcare access, food insecurity, and inadequate social support systems. These structural factors frequently intersect with clinical challenges, creating synergistic effects that amplify mortality risk. The cumulative impact of these direct and indirect mortality pathways underscores the urgent need for integrated, patient-centered approaches to TB/HIV co-infection management.

Working conditions insides mines create a high risk for TB transmission resulting from silica dust exposure as well as confined and poorly ventilated environments. Mining was seen to have a 33% higher TB incidence than non-miners(Stuckler et al., 2011). In Zimbabwe, artisanal miners and small scale miners have exposure to high levels of silica and a cross sectional study done whereby miners were screened revealed 11.2% miners affected by silicosis and 4% with TB(Moyo et al., 2021)

2.4.1 Direct causes of mortality

The direct causes of mortality in patients co-infected with tuberculosis (TB) and HIV can be distinctly categorized as either TB-related or HIV-related primary causes of death. Epidemiological evidence consistently demonstrates that TB remains the predominant direct cause of mortality among HIV-infected individuals globally (Morell et al., 2022). This association reflects the synergistic pathogenesis of these two infections, where HIV-induced immunosuppression facilitates TB progression, and TB infection accelerates HIV disease progression.

2.4.1.1 TB-Related Causes of Death

TB can be classified into pulmonary TB and extra-pulmonary TB. Pulmonary TB might be asymptomatic or discovered incidentally via radiographs, hence the access of X-rays is a programmatic vulnerability that might increase the risk of having poor TB outcomes if radiography is not available. Pulmonary TB presents with the classic symptoms of cough (productive of white frothy sputum), weight loss, fever, night sweats, chills and rigors, hemoptysis (coughing blood), chest pain and fatigue(Heemskerk et al., 2015). It is worth noting that elderly individuals with TB may not display typical signs and symptoms of TB infection due to lack of a good immune response. This predisposes the elderly to present with a severe form of disease due to late presentation leading to poor TB outcomes.

Extra pulmonary TB signs and symptoms are non-specific and can present has lymphadenitis (generalized enlarged lymph nodes), pleural TB, TB meningitis which occurs frequently in the young and immunocompromised for example people with HIV, skeletal TB, genitourinary TB and gastrointestinal TB. Extra pulmonary TB's varied

presentation can lead to late diagnosis and due to TB being deemed the great mimicry(Prapruttam et al., 2014), diagnosis of TB is difficult. TB can simulate numerous other diseases radiographically in the body systems clinical manifestation of TB is a risk factor to TB outcomes.In Pakistan, smear positivity in pulmonary TB patients was seen to be a predictor of TB treatment outcome(Atif et al., 2018)TB-related mortality manifests through both pulmonary and extrapulmonary disease pathways. Pulmonary TB represents the most frequent direct cause of death, accounting for the majority of TB-associated mortality cases. The terminal pathophysiology in severe pulmonary TB typically involves progressive respiratory failure, which Lin et al. (2014) describe as being frequently preceded by a cascade of severe complications including septic shock, acute respiratory distress syndrome (ARDS), and acute lung injury. These complications often develop rapidly and prove refractory to intensive care interventions.

Additional pulmonary complications contributing to mortality include pneumothorax and significant pleural effusions (Merchant et al., 2022). These conditions may lead to mechanical compromise of lung function and are particularly dangerous in resource-limited settings where advanced respiratory support may be unavailable. The pathophysiological mechanisms underlying these fatal outcomes involve extensive lung parenchymal destruction, airway obstruction, and secondary bacterial infections that overwhelm already compromised respiratory systems.

2.4.1.2 Extra pulmonary TB Mortality Patterns

Extra pulmonary TB presents distinct mortality patterns that vary by geographical region. Koubartova's (2016) study in the United States identified TB meningitis as the leading cause of death in extra pulmonary TB cases. This finding was corroborated by Addo et

al.'s (2017) research in Uganda, which similarly found TB meningitis to be the predominant fatal manifestation of extra pulmonary TB. However, Addo et al. note a declining trend in TB meningitis mortality attributed to increased antiretroviral (ARV) utilization, suggesting that improved HIV management may be modifying the spectrum of extra pulmonary TB mortality.

Other fatal extra pulmonary TB manifestations include spinal TB (Pott's disease) and abdominal TB. Spinal TB can lead to neurological complications from spinal cord compression, while abdominal TB may cause fatal intestinal perforation or obstructive complications. These forms demonstrate the systemic nature of TB infection and its capacity to affect virtually any organ system with potentially lethal consequences.

2.4.1.3 HIV-Related Causes of Death

The landscape of HIV-related mortality has evolved significantly with the advent of highly active antiretroviral therapy (HAART). Lartey et al. (2015) document that while HAART has reduced AIDS-related deaths, non-HIV mortality has increased due to extended lifespan in treated patients. However, in sub-Saharan Africa, including Zimbabwe, AIDS-defining illnesses remain frequent causes of death.

Advanced HIV disease precipitates mortality through several mechanisms:

1. Opportunistic infections such as Cryptococcal meningitis and Pneumocystis Jirovecii pneumonia
2. HIV-associated malignancies including lymphomas and Kaposi's sarcoma
3. Cytomegalovirus (CMV) end-organ disease

These conditions reflect the profound immunosuppression characteristic of untreated or poorly controlled HIV infection, underscoring the critical need for expanded ARV access and adherence support programs.

The initiation of ART in TB/HIV co-infected persons has been shown to reduce mortality, but treatment regimens must be carefully balanced. Interactions between anti-TB drugs and ART can complicate treatment, and drug resistance may emerge, leading to treatment failures (Lawn et al., 2021). Furthermore, patients may experience immune reconstitution inflammatory syndrome (IRIS), exacerbating TB symptoms and increasing mortality risk (Sánchez et al., 2019).

2.4.1.4 The Challenge of Multidrug-Resistant TB (MDR-TB)

MDR-TB represents an increasingly concerning direct cause of mortality in TB/HIV co-infection. In Zimbabwe, specific challenges including treatment adherence issues and high population mobility, particularly in Masvingo province, contribute to the persistence of MDR-TB. The immunological vulnerability of HIV-positive individuals increases their susceptibility to MDR-TB compared to HIV-negative persons (Timire et al., 2019).

The management of MDR-TB in co-infected patients is complicated by protracted treatment durations (often 18-24 months) ,limited therapeutic options due to drug resistance patterns ,high rates of adverse drug effect, and complex drug-drug interactions with antiretroviral regimens.

Notably, Timire et al. (2019) report that MDR-TB prevalence in Zimbabwe has remained stable since 1994, suggesting persistent transmission dynamics and potential gaps in TB control programs. This stability in prevalence despite expanded treatment access

highlights the need for enhanced infection control measures and more effective treatment regimens for co-infected patients.

The convergence of these direct mortality pathways in TB/HIV co-infection creates a complex clinical challenge that requires integrated management approaches addressing both infections simultaneously while considering the socioeconomic and healthcare system factors that influence outcomes.

2.4.2 Indirect causes of mortality

Some groups of people—such as those without homes, people in prison, refugees, those seeking asylum, and individuals with HIV—are more likely to get tuberculosis (TB) than the general population. Their life circumstances play a big role in this increased risk. Socioeconomic factors such as poverty, inadequate access to healthcare, and malnutrition exacerbate the mortality risk in TB/HIV co-infected persons. Individuals with lower socioeconomic status often experience delayed healthcare seeking, inadequate access to medications, and poor treatment adherence, all contributing to higher mortality rates (Harries et al., 2018).

Living conditions and other social factors greatly influence TB risk. For example, cramped spaces with poor airflow in homes, workplaces, or neighborhoods make it easier for TB to spread. Being poor, not having enough food, or being malnourished can also make people more likely to get sick and have worse health outcomes. People with TB symptoms, like a long-lasting cough, often struggle to get medical help due to challenges like transportation problems, fear of being judged, or not having support from others.

Where people live—whether in cities or rural areas—also affects TB treatment success. In one study from Ethiopia, TB patients who lived closer to treatment centers (within five kilometers) were more than three times as likely to recover compared to those who lived farther away. In rural areas, TB patients were more likely to die from the disease, and those with less education faced worse treatment results.

Another study in Botswana found that patients who had access to transportation or had at least some education were more likely to finish their TB treatment successfully. On the other hand, those without jobs were more likely to have poor treatment outcomes.

Individuals living with HIV face substantially greater challenges when it comes to tuberculosis, being approximately 14 times more likely to develop active TB disease compared to HIV-negative individuals. Furthermore, their TB treatment outcomes are significantly worse, with studies showing they experience three times higher mortality rates during TB treatment courses (WHO, 2024f). The devastating impact of HIV has been particularly evident across sub-Saharan Africa, where it has served as the primary driver fueling TB epidemics throughout the region (J. Creswell et al., 2011). Despite remarkable medical advancements in TB screening methods, diagnostic techniques, treatment protocols and prevention strategies over recent decades, TB continues to rank as the leading cause of death among people living with HIV worldwide. This persistent threat exists because TB acts as an opportunistic infection, taking advantage of weakened immune defenses. In HIV-positive individuals, these infections not only occur more frequently but also manifest in more severe forms throughout the body (Tornheim & Dooley, 2017).

The relationship between HIV and TB creates a particularly dangerous health situation because HIV progressively damages multiple components of the immune system. This damage leads to distinct patterns of TB disease presentation, with HIV-positive patients showing lower rates of the typical lung cavities seen in pulmonary TB but much higher rates of disseminated TB infections that spread beyond the lungs to other organs. The immune suppression caused by HIV dramatically increases susceptibility to TB infection. Even latent TB infections that might remain dormant for years in healthy individuals are far more likely to progress to active, life-threatening TB disease in people living with HIV. This creates a vicious cycle of illness - HIV-positive individuals with TB actually require increased caloric intake and enhanced nutrition to support their compromised immune systems, yet they frequently experience appetite loss and impaired nutrient absorption due to their conditions (WFP, 2024). Without proper medical intervention and nutritional support, the progressive immune destruction caused by HIV leads to severe weight loss and muscle wasting, exacerbating existing malnutrition or creating new nutritional deficiencies.

When examining the social determinants of health, we find that HIV disproportionately affects vulnerable populations living in impoverished areas with limited access to adequate food supplies. In countries bearing the highest TB burdens, alarming research shows that nearly 50% of hospitalized HIV patients present with TB bacteria circulating in their bloodstream, often progressing to life-threatening systemic infections. Complicating treatment further, when HIV-positive TB patients begin antiretroviral therapy, some experience a paradoxical worsening of TB symptoms known as immune reconstitution inflammatory syndrome (Meintjes & Maartens, 2024).

The negative impact of HIV on TB treatment outcomes has been well-documented across multiple studies. Research from Ethiopia demonstrates that HIV-negative TB patients experience approximately 20 times greater likelihood of successful treatment completion compared to those co-infected with HIV (Tesema et al., 2020). Similarly concerning findings from another study reveal that HIV-positive individuals face seven-fold higher rates of unsuccessful TB treatment outcomes relative to their HIV-negative counterparts (Teka et al., 2023). These findings are corroborated by research conducted in Botswana, which established significantly higher cure rates among HIV-negative TB patients (Arnold Sejie & Mahomed, 2020).

The challenges extend to pediatric populations as well, with studies from Botswana identifying HIV-positive status or unknown HIV status as significant predictors of unfavorable TB treatment outcomes in children (Siamisang et al., 2022). While HIV infection itself clearly worsens TB prognosis, research from Malaysia provides additional insight by demonstrating that failure to receive antiretroviral therapy represents another critical factor associated with poor TB treatment results (Ismail & Bulgiba, 2013). This evidence collectively underscores how both HIV infection and inadequate HIV treatment contribute substantially to negative TB treatment outcomes across diverse populations.

The strength of healthcare systems, including availability of diagnostic tools, healthcare infrastructure, and quality of care, is a critical determinant of mortality among co-infected individuals. In regions with weak health systems, patients often face significant delays in diagnosis and treatment, contributing to poorer outcomes (Siddiqi et al., 2020).

2.5 Factors associated with early death in TB/HIV coinfection

Individuals co-infected with tuberculosis (TB) and human immunodeficiency virus (HIV) encounter significant barriers in accessing timely and effective treatment, which directly contributes to elevated mortality rates. Delays in diagnosing and initiating treatment for either condition often result in accelerated disease progression and poorer clinical outcomes. Research by Daria et al. (2016) highlights that TB-related mortality among HIV-positive patients is frequently associated with suboptimal initial TB treatment regimens, which may arise from inadequate drug susceptibility testing or severe immunosuppression indicated by low CD4 cell counts.

Treatment-related complications further exacerbate mortality risks in this population. These challenges stem from adverse effects of antiretroviral therapy (ART) and anti-TB medications, drug interactions between the two treatment regimens, or interruptions in therapy. Yang (2023) emphasizes that inadequate ART adherence or treatment discontinuation accelerates HIV disease progression, increasing susceptibility to life-threatening opportunistic infections. The onset of World Health Organization (WHO) stage 3 or 4 conditions—such as TB, Cryptococcal meningitis, and Pneumocystis pneumonia—often leads to fatal outcomes. Additionally, ART-related complications, including kidney injury and severe anemia, contribute to higher mortality, particularly in settings with limited laboratory monitoring capacity for early detection and management of these side effects.

2.5.1 Effects of diagnostic equipment

Diagnostic challenges further compound treatment delays and mortality risks. A retrospective cohort study conducted by Lui et al. (2014) in Hong Kong, a low HIV prevalence setting, identified diagnostic difficulties and advanced age as key factors associated with mortality among TB patients. Similar challenges persist in resource-limited settings where radiological interpretation of chest X-rays—a critical tool for TB diagnosis—remains inconsistent due to limited expertise and infrastructure.

The use of diagnostic equipment plays a crucial role in reducing the mortality rates among people co-infected with tuberculosis (TB) and human immunodeficiency virus (HIV). Early and accurate diagnosis of both TB and HIV can significantly reduce complications, enhance treatment regimens, and improve patient outcomes. However, the impact of diagnostic tools on death in these individuals is influenced by several factors, including the availability of advanced diagnostic equipment, the timing of diagnosis, and the integration of these tools into effective treatment strategies.

- **Early Detection**: Diagnostic tools such as chest X-rays, sputum smear microscopy, GeneXpert, and PCR-based tests for TB, alongside rapid HIV tests, can detect co-infection early. Early detection is key in preventing the progression of TB in HIV-infected individuals, who are at higher risk due to their weakened immune systems (Khomami , Ben and Orlow., 2020). The integration of these diagnostic technologies into routine care can prevent delayed diagnosis, which is associated with high mortality.

- **Improved Treatment Outcomes**: Diagnostic tools also help in guiding the appropriate treatment for TB and HIV, particularly in cases where drug-resistant strains are involved. Multi-drug-resistant (MDR) and extensively drug-resistant (XDR) TB are common challenges in TB/HIV co-infected individuals, and diagnostic equipment such as GeneXpert can identify resistant strains more quickly, ensuring patients receive the correct antibiotics and antiretroviral therapy (ART) in a timely manner (Bierman ,Zorratti, Van De Wall., 2019).
- **Monitoring and Management**: Regular monitoring using diagnostic technologies can help clinicians track the progression of TB and HIV, adjust treatment regimens as needed, and prevent the development of drug resistance or treatment failure. Continuous monitoring is essential for improving survival rates in these individuals (Bierman et al., 2019).

Despite the benefits of diagnostic tools, challenges remain, particularly in resource-limited settings where these technologies are not always accessible. In these contexts, the lack of access to diagnostic equipment can lead to delays in diagnosis and treatment, ultimately contributing to higher mortality rates in TB/HIV co-infected populations (Khomami et al., 2020).

2.5.2Effects of socioeconomic factors

Socioeconomic factors play a pivotal role in treatment adherence and outcomes. Rodrigues et al. (2010) identify poverty as the most common driver of treatment default, with additional contributing factors including adverse drug reactions, substance abuse, and poor patient motivation. The study further underscores that healthcare system

barriers—such as poorly designed service delivery facilities, inefficient processes, and limited accessibility—also hinder adherence to treatment regimens.

Even in high-income countries, TB/HIV co-infection remains a concern, particularly among marginalized populations. Homberg (2019) reports that despite access to advanced treatment options, Finnish males with TB/HIV co-infection exhibited high mortality rates, with intoxication and suicide being leading causes of death. The study also examined disease progression and mortality patterns among individuals born in sub-Saharan Africa, highlighting the enduring impact of socioeconomic disparities on health outcomes.

Recent research by Wekunda et al. (2023) identifies severe illness, profound malnutrition, comorbidities, and smoking as key predictors of mortality in TB/HIV co-infected patients. The study concludes that both health system deficiencies and patient-related factors contribute to poor outcomes. However, Gemuchu (2022) notes a critical gap in research focusing on mortality predictors among co-infected children, despite this population facing unique vulnerabilities.

A study examining predictors of mortality among TB/HIV co-infected children attending ART clinics in southern Ethiopia found that anemia, poor ART adherence, extrapulmonary TB, and drug-resistant TB were significant risk factors (Sileshi et al., 2013). Although limited to pediatric populations, these findings align with broader conceptual frameworks of TB/HIV mortality. The absence of ART during TB treatment emerged as a critical predictor of death, while cotrimoxazole prophylaxis demonstrated a protective effect.

Further supporting these observations, Ismail et al. (2013) identified CD4 counts below 200 cells/μL and the presence of two or more opportunistic infections as strong mortality predictors. Yang (2023) corroborates these findings, noting that additional independent risk factors include concurrent pulmonary and extrapulmonary TB infection, prior ART interruptions, and baseline CD4 levels below 200 cells/μL at HIV diagnosis. Collectively, these studies underscore the multifactorial nature of mortality in TB/HIV co-infection, emphasizing the need for integrated, patient-centered care approaches that address both clinical and socioeconomic determinants of health.

2.5.3 Comorbidities and mortality

Comorbidities significantly impact the death rate in individuals co-infected with tuberculosis (TB) and human immunodeficiency virus (HIV). These individuals face an elevated risk of mortality due to the compounded effects of both infections, along with the presence of additional health conditions. Comorbidities such as diabetes, cardiovascular diseases, hepatitis, and other chronic conditions can further compromise the immune system, complicate treatment regimens, and negatively affect overall health outcomes.

Diabetes and TB/HIV Co-Infection; Diabetes mellitus is one of the most common comorbidities seen in TB/HIV co-infected individuals. Diabetes can increase susceptibility to both TB and HIV due to its impact on immune function, making it harder for the body to fight infections. The combination of HIV and diabetes can lead to a higher risk of TB progression, more severe symptoms, and a poor response to treatment. Furthermore, diabetes complicates the management of TB and HIV by requiring more complex therapeutic regimens, potentially leading to drug interactions or side effects that

may affect patient adherence to both antiretroviral therapy (ART) and anti-TB medications (Gonçalves et al., 2020).

Cardiovascular Disease ; individuals with TB and HIV who also suffer from cardiovascular diseases have an increased mortality risk. TB infection can exacerbate cardiovascular issues by inducing inflammation and increasing the metabolic load on the heart. HIV itself also increases cardiovascular risk, with studies suggesting a higher incidence of coronary artery disease, heart failure, and arrhythmias in HIV-positive individuals. The presence of cardiovascular disease in this population may contribute to higher rates of death due to complications such as myocardial infarction, stroke, and heart failure (Muller et al., 2019).

Hepatitis and Other Liver Diseases; Co-infection with hepatitis B or C is common in TB/HIV-infected individuals, particularly in regions where both HIV and hepatitis are prevalent. Hepatitis can worsen the progression of both HIV and TB. In patients with liver disease, the use of antiretroviral drugs (ARVs) and TB medications may cause hepatotoxicity, leading to liver failure. The liver's impaired ability to process medications increases the risk of adverse drug reactions, treatment interruptions, and even death in these individuals (Santos et al., 2021).

Other Chronic Conditions; Other comorbidities, such as chronic kidney disease or pulmonary disorders, can worsen outcomes in TB/HIV co-infected patients. For example, kidney disease can complicate the treatment of both TB and HIV by affecting drug metabolism and clearance, leading to increased toxicity or reduced efficacy of medications. Pulmonary comorbidities such as chronic obstructive pulmonary disease

(COPD) may exacerbate the respiratory complications of TB, leading to respiratory failure or other fatal outcomes (Weiner et al., 2020).

The presence of comorbidities in TB/HIV co-infected individuals is a significant factor in increased mortality. The combination of TB, HIV, and other chronic conditions exacerbates immune suppression, complicates treatment regimens, and leads to poor clinical outcomes. Addressing these comorbidities through integrated care and targeted treatment strategies is essential to improving survival rates in this vulnerable population.

2.6 Impact of Covid 19 on HIV and TB

The implementation of public health measures to contain the COVID-19 pandemic has created substantial collateral damage to tuberculosis (TB) and HIV control programs worldwide. Travel restrictions and national lockdowns, while effective in limiting SARS-CoV-2 transmission, have severely disrupted essential health services for TB/HIV co-infected patients (Karim, 2020). The imposition of international travel bans and cancellation of commercial flights created critical bottlenecks in global pharmaceutical supply chains, particularly affecting the distribution of antiretroviral drugs (ARVs) and anti-TB medications. These logistical challenges resulted in stockouts and treatment interruptions for vulnerable patient populations in multiple countries.

Movement restrictions implemented during national lockdowns significantly reduced patient attendance at healthcare facilities, creating barriers to essential medical care. The World Health Organization (2022) projected that a six-month disruption in antiretroviral therapy (ART) provision could result in over 500,000 additional AIDS-related deaths

globally, demonstrating the severe consequences of service interruptions. This alarming estimate reflects the delicate balance required to maintain life-sustaining treatment for people living with HIV, particularly those with advanced disease or TB coinfection.

Hospital admission patterns for TB/HIV patients underwent dramatic changes during the pandemic, as healthcare systems prioritized urgent COVID-19 cases. Many co-infected patients faced delayed or deferred care as health facilities struggled to balance pandemic response with ongoing essential services. Compounding this issue, widespread fear of contracting SARS-CoV-2 in clinical settings kept many symptomatic patients at home, leading to delayed diagnosis and treatment initiation for both TB and HIV-related conditions.

The Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM) conducted a comprehensive survey across 106 countries that revealed the extensive reach of these disruptions (Global Fund, 2020). The findings showed that 78% of surveyed nations experienced interruptions to TB services due to COVID-19, with 17% reporting severe or very severe service disruptions. These statistics underscore the global nature of the healthcare system strain caused by pandemic response measures.

The Stop TB Partnership provided additional insights into the mechanisms through which COVID-19 affected TB/HIV services. Their analysis identified multiple pathways of disruption, including decreased healthcare-seeking behavior among patients, diversion of financial and human resources to pandemic response, repurposing of healthcare facilities and diagnostic equipment for COVID-19 management, and breakdowns in the supply of essential medications and medical consumables. These intersecting challenges created a

perfect storm that undermined years of progress in TB and HIV control, particularly in high-burden settings where healthcare systems were already operating at limited capacity.

The cumulative impact of these pandemic-related disruptions has raised serious concerns about potential long-term consequences for TB/HIV control efforts. Service interruptions may lead to increased rates of treatment failure, drug resistance, and mortality in co-infected populations. Furthermore, the diagnostic delays and reduced case detection during the pandemic could result in a surge of advanced TB/HIV cases in subsequent years, creating additional challenges for already strained healthcare systems. These observations highlight the need for resilient health systems that can maintain essential services during public health emergencies while simultaneously responding to acute crises.

2.7 Interventions to prevent early death among TB/HIV co-infected patients

The effective management of TB/HIV co-infection demands a sophisticated, multidimensional strategy that simultaneously addresses the complex medical needs of patients while accounting for the socioeconomic determinants that profoundly influence treatment success. Current research underscores the critical importance of tailored clinical approaches for high-risk patient subgroups. Lelisho et al. (2023) present robust evidence demonstrating that individuals presenting with severe immunological compromise (characterized by CD4 counts below 200 cells/μL), advanced-stage HIV disease according to WHO classification systems, and significant functional impairment can experience markedly better health outcomes when enrolled in intensive clinical monitoring programs. These enhanced surveillance protocols facilitate the early identification of treatment-related complications, enable prompt management of opportunistic infections, and allow

for timely adjustments to therapeutic regimens - all of which are particularly vital for this immunocompromised patient population that faces elevated risks of treatment failure and mortality.

The structural organization of healthcare delivery systems plays an equally crucial role in determining program success. Bhatt et al. (2023) provide comprehensive data supporting the superiority of integrated service delivery models over vertical disease-specific programs. Their research illustrates how the strategic integration of HIV and TB control initiatives creates synergistic efficiencies in healthcare delivery, substantially reducing the time between initial presentation and definitive diagnosis while simultaneously improving case detection rates through systematic screening protocols. This unified approach not only streamlines patient flow through the healthcare system but also creates opportunities for implementing comprehensive prevention strategies that can interrupt disease transmission cycles at both individual and community levels.

The pharmacological management of co-infected patients requires careful consideration of both therapeutic efficacy and preventive strategies. Sileshi et al. (2013) conducted rigorous analyses demonstrating the substantial mortality benefit associated with Cotrimoxazole prophylactic therapy in this population. This well-established intervention, notable for its low cost and widespread availability in resource-limited settings, provides critical protection against life-threatening opportunistic infections while exhibiting complementary effects when administered concurrently with standard antiretroviral and anti-tuberculosis regimens. The preventive benefits of this intervention are particularly

pronounced in patients with advanced immunosuppression, where the risk of intercurrent infections is highest.

Nutritional interventions constitute another essential pillar of comprehensive care for co-infected individuals. The work of Ruseesa, Simbi, and Ntagarira (2023) provides compelling arguments for the integration of robust nutritional support programs with early antiretroviral therapy initiation protocols. These findings are reinforced by Odone et al. (2014) in their extensive meta-analysis, which quantified the significant mortality reduction associated with timely ART initiation relative to TB treatment. However, their research also revealed the complex immunological dynamics in co-infected patients, noting that early immunological deterioration could occur independently of virological control and served as an important predictor of poor outcomes, emphasizing the need for comprehensive immunological monitoring alongside standard virological assessments.

The influence of broader social determinants on treatment outcomes cannot be overstated. Bergonzoli et al. (2016) conducted systematic evaluations demonstrating how fundamental improvements in living conditions - including reliable access to clean water, adequate sanitation infrastructure, and enhanced educational opportunities for women - correlated strongly with improved survival outcomes in TB/HIV populations. These findings highlight the inextricable link between basic human development indicators and health outcomes, suggesting that sustainable improvements in disease management will require interventions that extend beyond traditional biomedical approaches to address these foundational social determinants of health.

When synthesized, this body of evidence presents a compelling case for the implementation of truly integrated, patient-centered care models that seamlessly combine state-of-the-art clinical interventions with robust social support systems. Such comprehensive approaches offer the potential to dramatically improve both survival rates and quality of life metrics for TB/HIV co-infected individuals, while simultaneously creating secondary prevention benefits through reduced community transmission of both pathogens. Successful implementation of these evidence-based strategies will require unprecedented levels of coordination between clinical care teams, public health authorities, and social service providers to properly address the intricate web of biological, psychological, and social factors that collectively determine health outcomes in this particularly vulnerable patient population. The complexity of these interactions underscores the need for continued research into optimized service delivery models that can effectively bridge the gap between clinical and community-based interventions while remaining adaptable to diverse socioeconomic contexts.

DOTS (Directly Observed Treatment, Short-course) is an effective strategy for controlling the TB epidemic and it has 5 components : government or political commitment to sustain TB control activities, case detection by sputum smear microscopy among symptomatic patients self-reporting to health services, regular uninterrupted supply of all essential anti-TB drugs, standardized recording and reporting systems that allow assessment of treatment results for each patient and the TB control program as a whole and standardized treatment regimen of 6 to 8 months for at least all confirmed sputum smear positive cases , with directly observed treatment(DOT) for at least the initial 2 moths (intensive phase)(Davies, 2003).

2.8 Summary

The current body of research contains significant gaps in understanding the complex interplay of factors contributing to elevated mortality rates among TB/HIV co-infected patients in Zimbabwe, particularly in resource-constrained settings like Masvingo Provincial Hospital. While existing literature has identified broad epidemiological patterns of TB/HIV mortality in sub-Saharan Africa (UNAIDS, 2022), there remains a paucity of detailed, context-specific analyses examining how socioeconomic conditions, clinical profiles, and health system factors converge to influence outcomes in Zimbabwean populations (Timire et al., 2021). This study seeks to address this critical knowledge gap through a comprehensive investigation of both socio-demographic and clinical determinants of mortality among TB/HIV patients receiving care at Masvingo Provincial Hospital.

Our research adopts a novel approach by incorporating detailed patient histories and clinical observations that are typically only obtainable through intensive ward-based monitoring and thorough social history documentation. This methodology represents a significant advancement over previous studies that have primarily relied on routine program data, as it allows for the capture of nuanced factors such as migration patterns, treatment adherence barriers, and comorbid conditions that often go unrecorded in standard clinical documentation (Daftary et al., 2021). The study's focus on Masvingo Province is particularly relevant given its status as a high-transit region characterized by substantial population mobility between Zimbabwe and South Africa - a factor known to

complicate treatment continuity but which remains understudied in the context of TB/HIV outcomes (O'Donnell et al., 2020).

The significance of this investigation is further amplified by the limited number of rigorous studies examining mortality determinants specifically among TB/HIV co-infected populations in Zimbabwe (Munyati et al., 2019). While several studies have documented treatment outcomes for TB or HIV separately in the region, there remains inadequate understanding of how these epidemics intersect to influence mortality in the Zimbabwean context (Zimbabwe Ministry of Health, 2021). Our study will contribute crucial evidence to inform the development of targeted interventions that address both the biomedical and social determinants of poor outcomes in this vulnerable population.

Furthermore, this research will provide valuable insights applicable to similar high-mobility, resource-limited settings across sub-Saharan Africa, where health systems must contend with the dual challenges of TB/HIV co-infection and population mobility (WHO AFRO, 2022). By employing a comprehensive analytical framework that considers both individual-level clinical factors and broader social determinants, this study aims to generate actionable evidence that can guide policy decisions and clinical practice improvements for managing TB/HIV co-infection in challenging environments. The findings will be particularly relevant for strengthening differentiated service delivery models in border regions and areas with highly mobile populations (Dharmadhikari et al., 2020).

Ultimately, this investigation represents a critical step toward understanding and addressing the persistently high mortality rates among TB/HIV co-infected individuals in

Zimbabwe. The study's focus on both routinely collected clinical data and typically overlooked social determinants provides a unique opportunity to develop more holistic approaches to patient management that acknowledge the complex reality of living with comorbid TB and HIV in resource-constrained, high-mobility settings. The evidence generated will be invaluable for informing the development of context-specific interventions aimed at reducing mortality and improving quality of life for this vulnerable patient population.

CHAPTER 3 METHODOLOGY

3.1 **Introduction**

This section provides a comprehensive discussion of the methodological framework employed in the study. Methodology encompasses the systematic approach to research design, including the rationale for selecting specific data collection, analysis, and interpretation procedures (Mantri, 2008). It serves as the foundation for ensuring the validity, reliability, and reproducibility of research findings. In this study, a retrospective cohort design was adopted, utilizing secondary data on TB/HIV mortality obtained from Masvingo Provincial Hospital. This approach was selected due to its effectiveness in examining associations between exposure factors (e.g., clinical and demographic variables) and outcomes (e.g., mortality) within a defined population over a specified period.

3.2 The Research Design

The study employed a hospital-based retrospective cohort design to investigate factors associated with mortality among TB/HIV co-infected patients admitted to the TB and HIV program at Masvingo Provincial Hospital between 1 January 2022 and 31 December 2024. A thorough review of medical records was conducted for all HIV-positive individuals who were commenced TB treatment during this period. The retrospective cohort design was chosen because it allows for the examination of temporal relationships between exposure variables (e.g., ART status, TB diagnosis method) and mortality outcomes without requiring prospective patient follow-up, making it both time-efficient and cost-effective (Haynes et al., 2019).

3.3 Sampling Strategy

No formal sample size calculation was performed, as the study included all eligible patient records meeting the predefined inclusion criteria. The eligibility criteria were as follows:

- Patients diagnosed with both TB and HIV between January 2022 and December 2024
- Patients initiated on TB treatment within the HIV-positive subgroup.
- Patients who died while co-infected with TB/HIV during the study period.

Records with missing or incomplete data were excluded to maintain data integrity. Hospital ward outcome registers were utilized to identify patient hospital numbers for those admitted to male, female, and pediatric wards who subsequently died from any cause. This approach ensured that all relevant cases were captured while minimizing selection bias (Porta, 2014).

3.4 Variables

<u>Primary Outcome Variable</u>

- Mortality during TB treatment, regardless of cause.
- Censoring criteria (patients not classified as deceased):
    - Cured
    - Completed treatment
    - Treatment failure
    - Lost to follow-up
    - Adverse drug reactions leading to discontinuation

- Transition to drug-resistant TB

Independent Variables

- Demographic factors: Sex, age, referral type, and residential classification (rural, peri-urban, urban).
- Clinical factors:
  - Anatomical site of TB (pulmonary vs. extrapulmonary)
  - TB diagnostic method (microbiological, radiological, clinical)
  - ART status (naïve, on treatment, interrupted
  - Time to death (duration from TB treatment initiation to mortality)
  - Comorbid conditions (e.g., diabetes, malnutrition, opportunistic infections)

These variables were selected based on their documented association with TB/HIV outcomes in prior studies (Getahun et al., 2015).

3.5 Study Site

The study was conducted at Masvingo Provincial Hospital, the primary referral center for all seven districts in Masvingo Province, located in southeastern Zimbabwe. The province has an estimated population of 1.485 million, ranking fifth among Zimbabwe's ten provinces (Zimbabwe National Statistics Agency, 2012). The hospital is strategically positioned 2 km from Masvingo City center and approximately 30 km from the Great Zimbabwe National Monument, a UNESCO World Heritage Site.

A notable characteristic of the study population is high migration mobility, as Masvingo City lies 300 km from the Beitbridge border post, a major transit point to South Africa. This mobility has implications for treatment adherence and follow-up, as many patients engage in cross-border movement for economic reasons (Dudley et al., 2020).

3.6 Data Collection Instruments

A structured data extraction tool was developed to systematically retrieve information from HIV and TB registers. Five trained nurses from the hospital's Opportunistic Infections (OI) Clinic and medical wards participated in data collection to ensure accuracy. An experienced supervisor monitored the extraction process to maintain data quality.

The checklist included fields for:

1. Demographics (age, sex, residence)
2. Clinical data (TB diagnosis method, ART history, comorbidities)
3. Treatment outcomes (death, cure, loss to follow-up)

Continuous reviews were conducted to ensure consistency and completeness of extracted data.

3.7 Pilot Study

A pilot test was conducted using 10 patient records to assess the validity and reliability of the data extraction tool. Adjustments were made to improve clarity and reduce ambiguity in variable definitions before full-scale data collection commenced (Polit & Beck, 2017).

3.8 Data Collection Procedure

Data were collected using the structured extraction tool, capturing:

- Demographics (age, sex, residence)
- TB diagnostic results (smear microscopy, GeneXpert, culture)
- Comorbidities (e.g., diabetes, cryptococcal meningitis)
- ART duration and adherence
- Clinical severity at admission
- Referral source (clinic, self-referral, other hospitals)
- TB type (drug-sensitive, MDR-TB)
- Duration on anti-TB treatment before death

Data Sources

- TB and HIV registers (OI Clinic, TB Clinic)
- Inpatient registers (male, female, pediatric wards)
- Post-mortem reports (where available)
- ICD-10 coding reviewed independently by two HIV physicians to reach consensus

Due to the absence of an electronic health record system, only paper-based records were utilized.

3.9 Data Analysis

Data Cleaning & Entry

- Collected data were cleaned to ensure completeness and accuracy.
- Outliers and inconsistencies were identified and corrected.

- Data were entered into STATA version 18 for statistical analysis.

Statistical Methods

1. Descriptive Statistics

- Frequencies, percentages (for categorical variables)
- Mean/median (for continuous variables)
- Visualization: Bar graphs, pie charts, tables

2. Inferential Statistics

- Chi-square tests: Assessed associations between categorical variables (e.g., sex and mortality).
- Logistic regression: Evaluated the impact of independent variables (e.g., ART status, comorbidities) on TB/HIV mortality.

This analytical approach aligns with best practices for retrospective cohort studies (Hosmer et al., 2013), ensuring robust and interpretable findings.

3.10 Ethical Considerations

The ethical integrity of this study was carefully maintained through a structured approval process and adherence to established research protocols. The research proposal underwent rigorous evaluation and was formally submitted to the Africa University Department of Health Sciences Research Ethics Committee for comprehensive review and official approval. This step ensured that the study design and methodology aligned with internationally recognized ethical standards for health research involving human subjects.

3.10.1 Access to Patient Records

Prior to data collection, formal written permission was sought from the relevant authorities to ensure compliance with institutional and governmental regulations. A detailed permission letter was submitted to both the Provincial Medical Director of Masvingo and the Medical Superintendent of Masvingo Provincial Hospital, outlining the study objectives, methodology, and intended use of the data. Approval from these authorities was essential to gain legitimate access to patient medical records while maintaining institutional protocols and safeguarding patient confidentiality.

3.10.2 Obtaining Informed Consent

Given that this study was a retrospective review of medical records and did not involve direct interaction with patients, individual informed consent was not required. Instead, ethical approval was obtained through institutional consent, which permitted access to anonymized patient data. This approach is consistent with established guidelines for retrospective studies where direct patient participation is not feasible, provided that patient confidentiality and data security measures are strictly enforced.

3.10.3 Right to Equity, Human Dignity, and Protection Against Harm

The study upheld the fundamental ethical principles of equity, human dignity, and protection against harm by ensuring that all collected data were used solely for research purposes. Patient records were handled with the utmost confidentiality, and no personally identifiable information was disclosed outside the scope of the study. Should there be a future need to share the findings beyond the immediate research team, additional explicit

permission will be sought from the hospital authorities to maintain compliance with ethical and legal standards.

3.10.4 Right to Anonymity, Confidentiality, and Privacy

To safeguard patient privacy, all medical records were anonymized, with case numbers replacing any personal identifiers such as names or addresses. The collected data were stored securely in a locked metal cabinet, accessible only to the principal researcher. Digital records, if any, were protected with password encryption to prevent unauthorized access. These measures align with best practices for data protection in medical research, ensuring that patient confidentiality remained uncompromised throughout the study.

3.10.5 Right to Community and Community Science

Recognizing the importance of knowledge dissemination and community benefit, the study findings will be shared with relevant stakeholders upon completion. Results will be presented in key departmental meetings, such as Primary Health Care (PHC) quarterly reviews and hospital clinical meetings, to facilitate evidence-based discussions that may inform policy and practice. This approach ensures that the research contributes meaningfully to public health knowledge while maintaining transparency and accountability to the community from which the data were derived.

By adhering to these ethical considerations, the study maintains scientific rigor while upholding the rights and welfare of patients, healthcare institutions, and the broader community. These measures ensure that the research is conducted responsibly, with due

respect for confidentiality, privacy, and the potential impact on public health decision-making.

CHAPTER 4 DATA PRESANTATION, ANALYSIS AND INTERPRETATION

4.1 Introduction

The results section seeks to inform about the findings from this statistical analysis of data obtained to operationalize the study hypothesis (Synder et al., 2019). The results of this research are presented in a way that is relevant to the questions in Chapter 1 the Introduction as articulated by Ng and Peh (2008).

4.2 Descriptive Statistics

A descriptive of the TB/HIV infected persons at Masvingo Provincial Hospital for the period 2022 – 2024 is outlined in Table 1.

Table 1 Descriptive Statistics of TB/HIV infected persons at Masvingo hospital

Variable	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Patient_ID	207	1	209	104.41	60.46	3655.93
Age	207	3	98	41.16	19.01	361.29
SEX_CODE	207	1	2	1.38	0.49	0.24
ART_CODE	207	1	2	1.53	0.5	0.25
CORMO_CODE	207	1	3	2.3	0.68	0.47
Valid N	207					

The analysis of the dataset revealed key demographic and clinical characteristics of TB/HIV-infected persons at Masvingo Provincial Hospital. The study included 207 participants, whose ages ranged from 3 to 98 years, with a mean age of 41.16 years. This indicated that both young and elderly individuals were affected. The gender distribution showed a mean SEX_CODE of 1.38, suggesting that the majority of the participants were male. ART usage was also assessed, with an average ART_CODE of 1.53, indicating that some individuals were receiving antiretroviral therapy while others were not. Additionally, the severity of co-morbid conditions, represented by CORMO_CODE, had a mean of 2.30, suggesting that many participants had moderate to severe co-morbidities. These findings provided an initial insight into the characteristics of the study population and highlighted potential factors that could have influenced mortality outcomes.

4.3 Proportion of Death Outcomes among TB/HIV Co-Infected Persons

An analysis of the proportion of death among TB/HIV con-infected patients help inform decision makers and policy makers on how best life can be prolonged among this group. An analysis was carried out and results shown in the pie chart below.

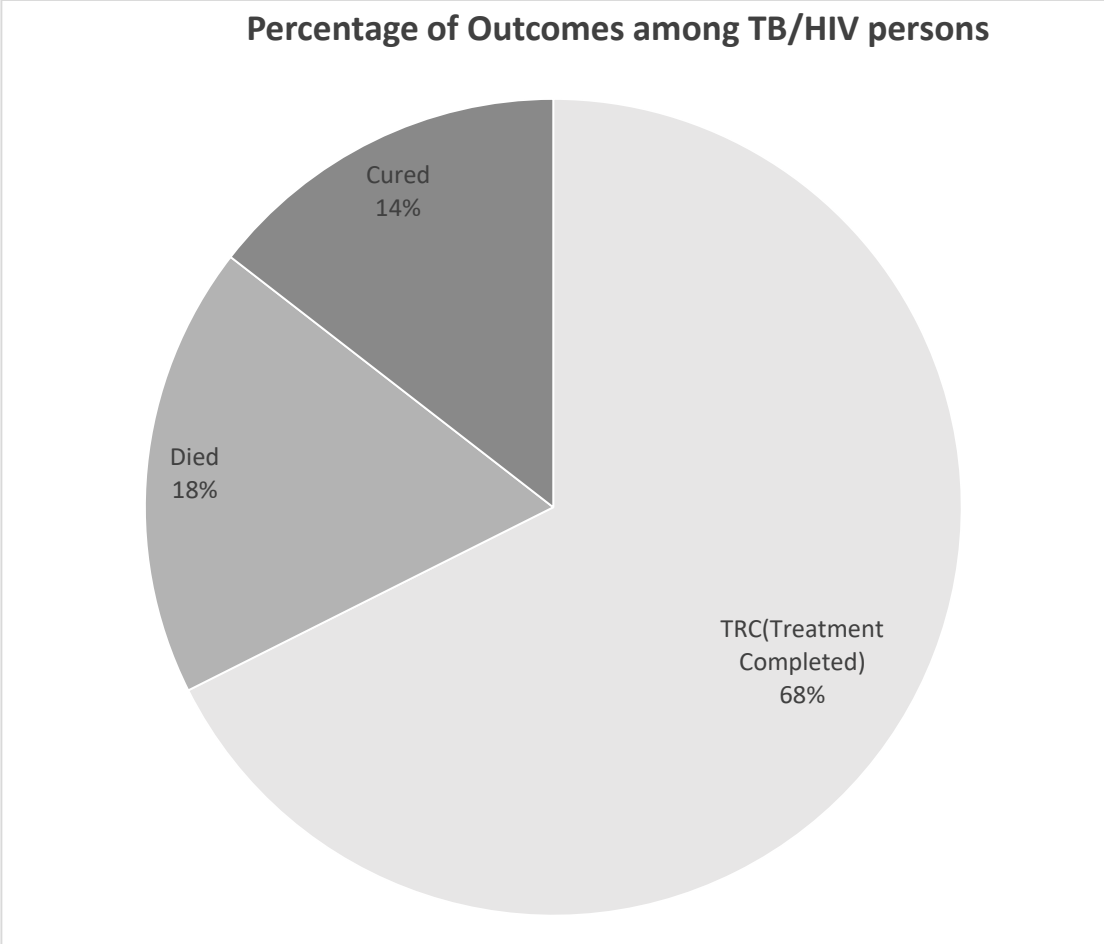

Figure 7 Proportion treatment outcomes among TB/HIV Co-Infected Persons

The analysis of death outcomes among TB/HIV co-infected persons at Masvingo Provincial Hospital revealed that the majority of patients (67.6%) were classified under the Treatment completed(TRC), indicating that they completed their treatment for the required duration. 17.9% of the patients died, highlighting a notable mortality rate among the study population. Additionally, 14.5% of patients were classified as cured, signifying successful treatment outcomes. These findings suggest that while a significant proportion of patients completed their treatment, nearly one in five individuals did not survive, emphasizing the need for further investigation into the factors associated with mortality. Identifying the demographic and clinical characteristics of those who died, as well as the

underlying determinants of these outcomes, would be crucial in improving treatment interventions and patient management strategies.

4.4: Demographic and Clinical Characteristics of Deceased Patients

The demographic and clinical classifications of deceased patients play a crucial role in decision making. Table 3 gives a breakdown of the demographic and clinical characteristics of deceased patients.

Table 2 Demographic and Clinical Characteristics of Deceased Patients

VARIABLE	CATEGORY	FREQUENCY n (%)
N		37 (100.0)
Gender		
	Male	30 (81.1)
	Female	7 (18.9)
Residence		
	Urban	25 (67.6)
	Peri-urban	5 (13.5)
	rural	7 (18.9)
ART status		
	On ART	14 (37.8)
	Not on ART	23 (62.2)
Most Common TB Site		
	Pulmonary	27 (73.0)
	extrapulmonary	7 (27.0)

The summary of demographic and clinical characteristics of deceased TB/HIV co-infected patients at Masvingo Provincial Hospital indicates that the average age of those who died was approximately 46.95 years, with a standard deviation of 24.45 years. This suggests that mortality was observed across a broad age range. The majority of the deceased were male (30 out of 37), resided in urban areas (25 out of 37), and were not on ART (23 out of 37), highlighting potential risk factors associated with death. Additionally, pulmonary TB was the most common form of TB among deceased patients, with 27 out of 34 cases. The findings suggest that lack of ART access, male gender, and pulmonary TB may have contributed to increased mortality, warranting further investigation into the factors influencing treatment outcomes and survival rates among TB/HIV co-infected individuals.

4.6: Distribution of Patients across TB Risk Groups

A distribution of patients under study across TB risk groups help ascertain areas that require more targeting. Table 5 highlight the distribution of patients across TB risk groups.

Table 3 Distribution of Patients across TB Risk Groups

Risk Group	Number of Patients n (%)	Cumulative Percentage (%)
HIV-positive	188 (90.8)	90.8
Aged 60 years and above	3 (1.4)	92.2
Diabetes	2 (1.0)	93.2
Former Mine Workers	6 (2.9)	96.1
Contact with a Known TB Case	8 (3.9)	100.0

The results in Table 5 presents the distribution of patients across different risk groups for TB. The majority of patients (90.8%) are HIV-positive, highlighting HIV as the most prevalent risk factor in this dataset. Other risk groups, such as individuals aged 60 years and above (1.4%), those with diabetes (1.0%), and former mine workers (2.9%), have relatively lower representation. Additionally, 3.9% of the patients had contact with a known TB case, which is also a significant risk factor. The cumulative percentage confirms that HIV-positive individuals make up the overwhelming majority, suggesting that TB-HIV co-infection is a major public health concern in this population. A visual view of the distribution of patients across TB risk groups is shown in figure 8 below.

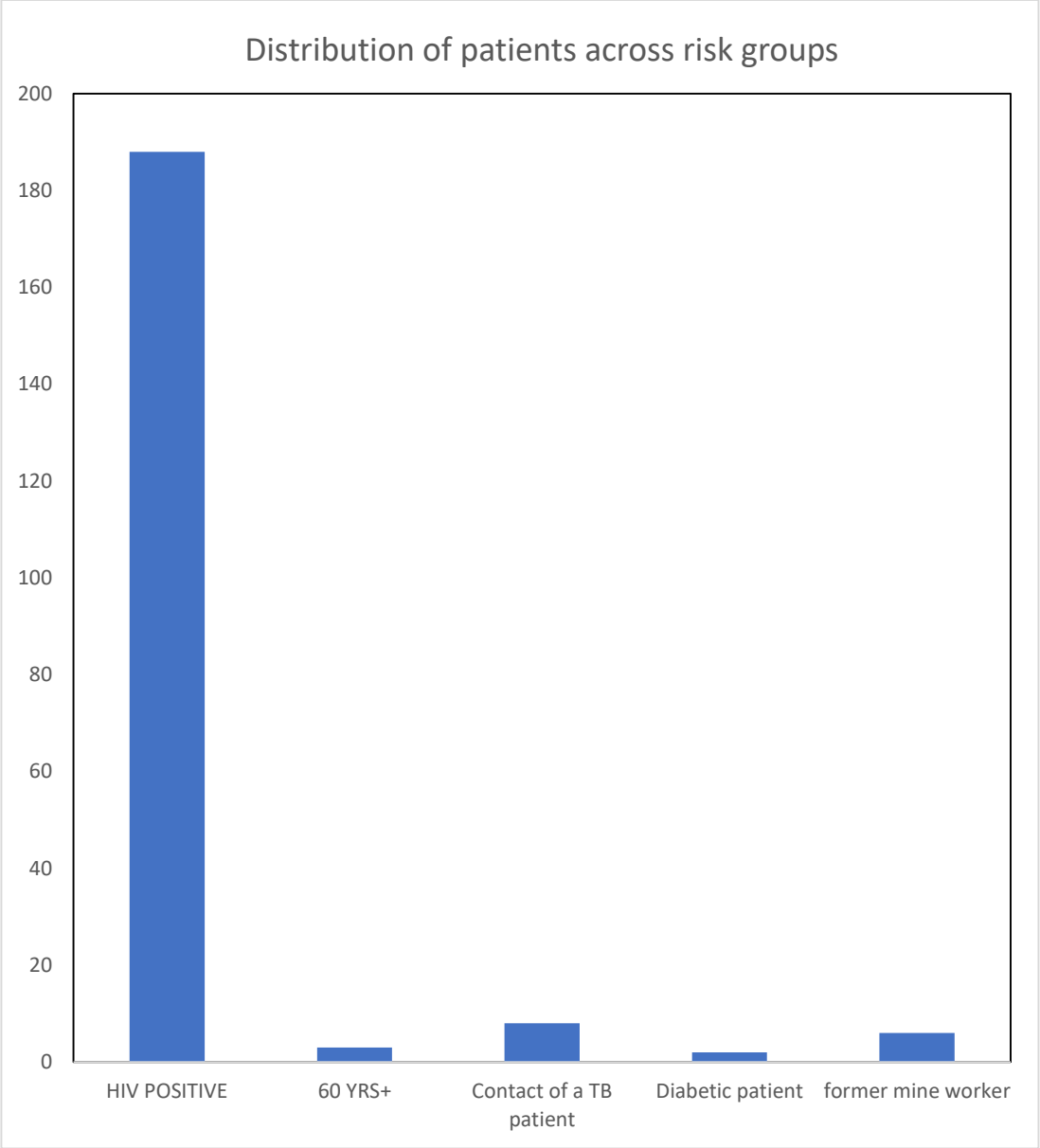

Figure 8 Distribution of Patients across TB Risk Groups

The HIV-positive group stands out as the most prevalent risk factor for tuberculosis (TB) in this dataset, comprising an overwhelming 90.8% of the total patient population. This stark representation underscores the significant role HIV plays in the spread and severity of TB within this community, positioning it as a major public health concern. The dominance of this risk factor suggests that HIV and TB co-infection is a critical issue that

requires focused healthcare intervention and resources, as individuals living with HIV are more vulnerable to contracting TB due to compromised immune systems.

Although everyone in this data set was HIV positive, the most recorded risk was being HIV positive. However, other risk groups contribute much smaller proportions to the overall patient population. For instance, only 1.4% of the patients are aged 60 years and above, indicating that age is a less common risk factor in this cohort. Similarly, patients with diabetes account for just 1.0%, and those with a history as former mine workers make up 2.9% of the total, suggesting these risk factors are less prominent. Additionally, 3.9% of the patients reported having had contact with a known TB case, which is another significant but less widespread risk factor compared to HIV status. The differences in these risk groups may be mainly due to the preference of the attending nurse

This bar graph effectively highlights the stark contrast in the prevalence of these risk groups, with HIV-positive patients clearly dominating the distribution. It visually communicates the disproportionate influence of HIV on the TB burden in this population, while also illustrating the relatively minor presence of other risk factors. Such a visual representation aids in quickly understanding the critical areas that may require targeted interventions and resources, with particular emphasis on addressing HIV as the primary risk factor contributing to TB incidence.

4.7: Distribution of TB Cases by Site

Knowledge of incidence of TB cases by site is necessary for informing decision making as shown in Table 4.

Table 4 Distribution of TB Cases by Site

TB Site	Frequency n (%)	Valid Percent (%)	Cumulative Percent (%)
Extrapulmonary	47 (22.7)	22.7	22.7
None	9 (4.3)	4.3	27.1
Pulmonary	151 (73)	73.0	100.0
Total N	**207 (100.0)**	**100.0**	**100.0**

The dataset represents the distribution of tuberculosis (TB) cases categorized by site of infection. After cleaning the data, the Pulmonary TB category was consolidated, as there were initially two separate entries due to capitalization inconsistencies. The total sample size consists of 207 cases.

The majority of cases (73.0%, or 151 cases) were classified as Pulmonary TB, indicating that TB primarily affects the lungs in most patients. Extra pulmonary TB accounted for 22.7% (47 cases), suggesting that a smaller but significant proportion of TB cases involve other organs. A minor portion of individuals (4.3%, or 9 cases) were recorded as having no TB. The cumulative percentage confirms that all cases add up to 100%, ensuring data consistency. A visual representation of TB Cases by Site is shown in figure 9.

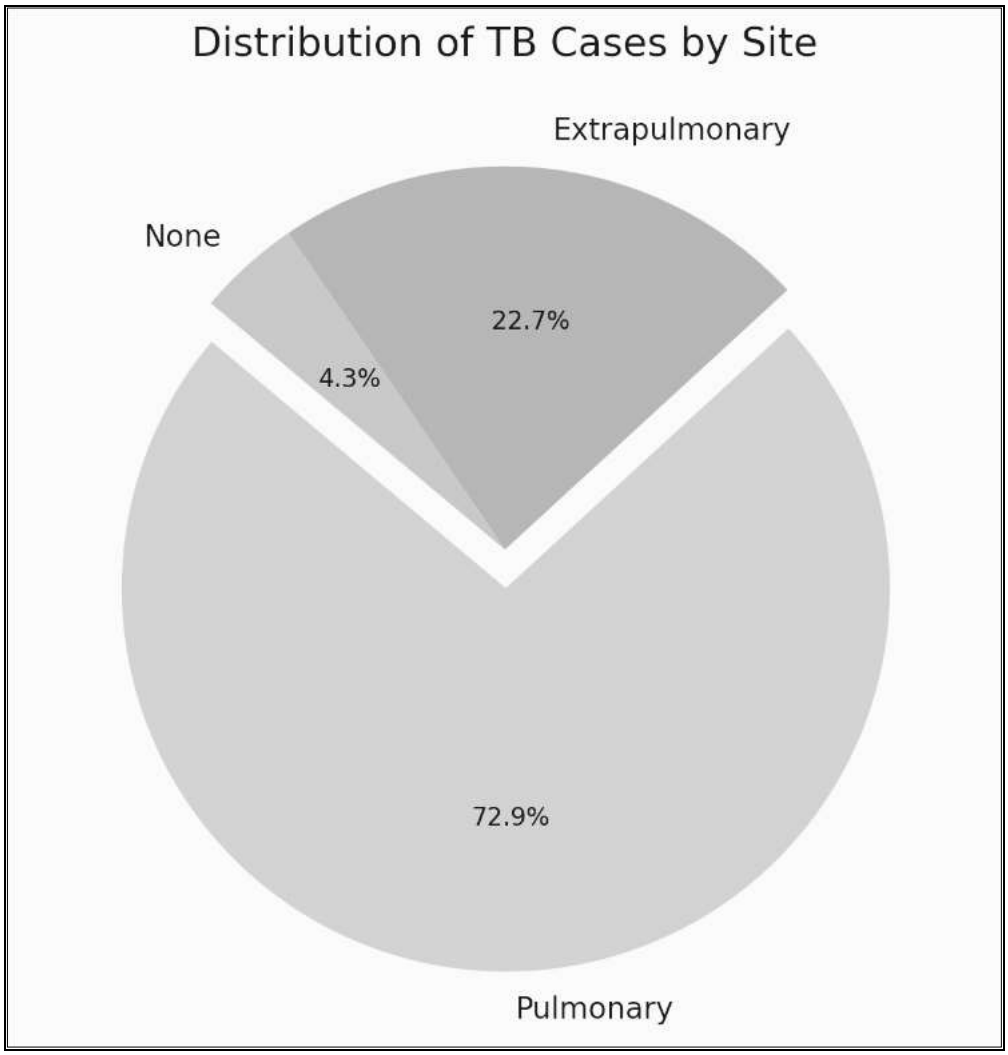

Figure 9 Distribution of TB Cases by Site

The pie chart visually represents the distribution of TB cases by site. The Pulmonary TB category dominates, comprising 73.0% of cases, followed by extra-pulmonary TB (22.7%). A small proportion (4.3%) falls under the "None" category, indicating individuals without TB. The Pulmonary TB section is highlighted to emphasize its prevalence.

This visualization clearly illustrates that most TB cases are pulmonary, reinforcing the importance of targeted interventions in respiratory health.

4.8: ART status of patients

The distribution of TB patients in Masvingo based on their Anti-Retroviral Treatment (ART) status categorized into two groups which are those on ART (Code 2.00) and those not on ART (Code 1.00) is shown in Table 5.

Table 5 ART status of TB/HIV patients

ART Status	Frequency n (%)	Valid Percent (%)	Cumulative Percent (%)
Not on ART	97 (46.9)	46.9	46.9
On ART	110 (53.1)	53.1	100.0
Total N	**207 (100.0)**	**100.0**	**100.0**

The data indicates that 53.1% (110 patients) are receiving ART, which is crucial for managing HIV/TB co-infection and improving treatment outcomes. A significant proportion, 46.9% (97 patients), are not receiving ART, which could increase health risks and treatment complications. ART is a critical intervention in TB treatment, particularly for individuals co-infected with HIV. Strengthening ART access and adherence among TB patients remains essential for improving health outcomes in Masvingo. A pictorial view of TB patients by ART status is shown in figure 10 below

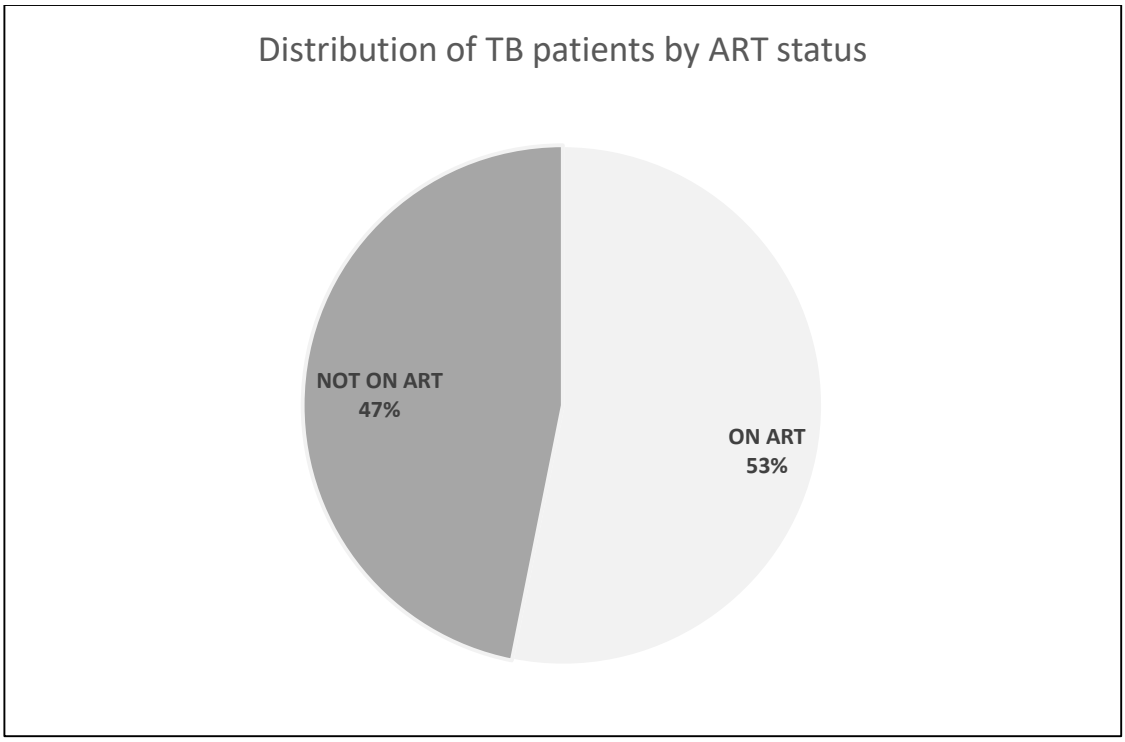

Figure 10 Distribution of TB patients by ART status in Masvingo

The bar chart clearly illustrates the distribution of TB patients based on their ART status in Masvingo. The blue bar (On ART, 53.1%) is slightly higher than the red bar (Not on ART, 46.9%), showing that more than half of the TB patients are receiving ART. However, the significant proportion of TB patients not on ART (46.9%) is concerning, as TB-HIV co-infection requires proper ART management for better health outcomes. This analysis highlights the importance of increasing ART accessibility and adherence to improve treatment outcomes for TB patients in Masvingo.

4.9: Distribution of comorbidities among the patients surveyed.

Comorbidity distribution among TB Patients in Masvingo was considered. The CORMO_CODE variable represents different comorbidities among TB patients in

Masvingo. Understanding comorbid conditions is crucial in TB management, as conditions like HIV, diabetes, and chronic lung diseases can complicate treatment outcomes. Table 6 shows the distribution of comorbidities among the 207 TB patients surveyed.

Table 6 Distribution of comorbidities among the patients surveyed.

Comorbidity Category	Frequency n (%)	Valid Percent (%)	Cumulative Percent (%)
1.00 (Diabetis mellitus)	26 (12.6)	12.6	12.6
2.00 (Not diabetic)	92 (44.4)	44.4	57.0
3.00 (Unknown)	89 (43)	43.0	100.0
Total N	**207 (100.0)**	**100.0**	**100.0**

Results in Table 6 highlight that comorbidities significantly impact the treatment outcomes of tuberculosis (TB) patients, making it essential to assess the prevalence of other health conditions among affected individuals. The CORMO_CODE classification categorizes TB patients based on their comorbid conditions. The only comorbidity recognized in the registers is diabetes mellitus. This analysis provides insight into the health status of TB patients and helps in designing effective treatment strategies.

The findings indicate that not diabetic (CORMO_CODE 2.00) is the most prevalent, affecting 44.4% (92 patients) of the total 207 patients surveyed. This shows that patients are intentionally being screened for diabetes by the use of random blood sugar results. This is a well-documented public health concern, as individuals living with HIV have a

weakened immune system, making them highly susceptible to TB infections. The presence of diabetes mellitus further worsens the immunity leading to death.

Another 43.0% of patients (89 individuals) were classified under CORMO_CODE 3.00, representing those with unknown diabetic status. These patients had no random blood sugar done. The main reasons that were stated were that some patients were initiated on treatment from the wards and sometimes there shortage of gluco sticks used in measuring blood sugar. Other comorbid conditions such as chronic lung diseases, or malnutrition were only classified under risk groups of which the major risk group recorded was being HIV positive. Special interventions, such as nutritional support, regular monitoring of blood sugar levels in diabetic patients, and lung function assessments, may be necessary to improve treatment outcomes for this group.

A small proportion of patients (12.6%, or 26 individuals) had diabetis mellitus (CORMO_CODE 1.00), indicating that they suffer from Diabetes Mellitus as well. These patients require further interventions in controlling the condition as this has an impact on morbidity and mortality. Early detection and consistent adherence to TB therapy remain crucial to prevent disease progression and transmission.

The findings emphasize the urgent need for an integrated healthcare approach that combines TB treatment with the management of co-existing illnesses. Given the high prevalence of HIV among TB patients, strengthening collaborative TB-HIV care programs should be a priority. Healthcare providers should also screen TB patients for chronic conditions like diabetes and respiratory diseases to ensure comprehensive treatment.

Furthermore, public health interventions should focus on patient education, adherence counseling, and nutritional support to improve overall treatment success rates. By addressing comorbid conditions effectively, healthcare systems can enhance patient outcomes and reduce TB-related mortality in Masvingo as distribution of TB patients is shown in Chart 5.

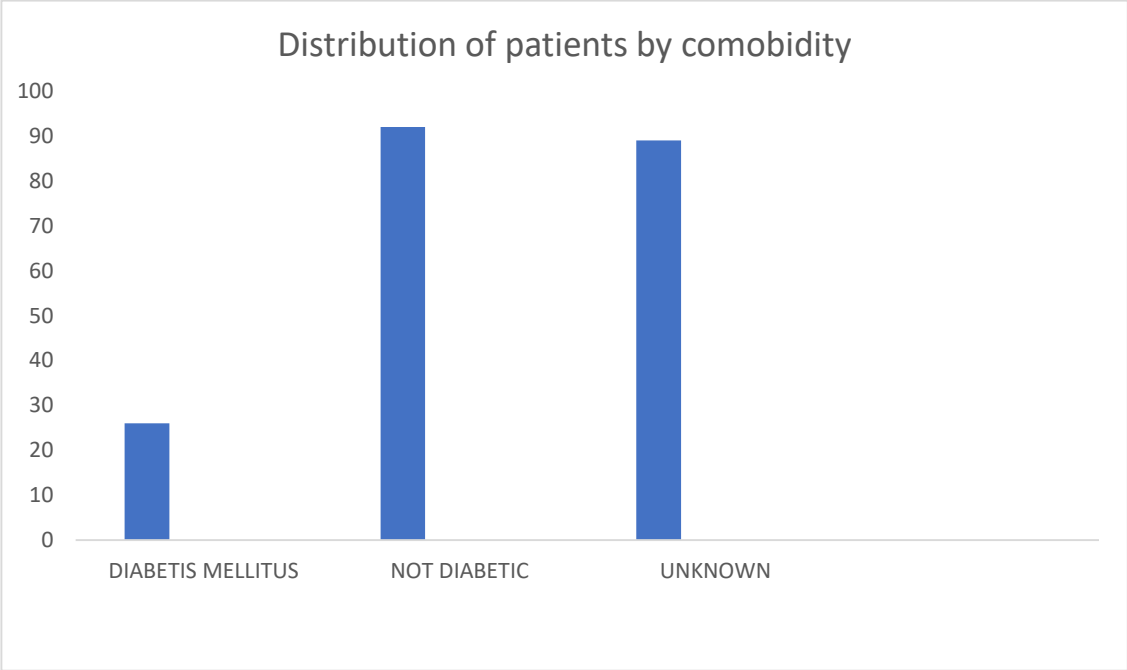

Figure 11 Distribution of TB/HIV patients by comorbidity

4.10: Outcome of patients during treatment

Analysis of treatment outcome among TB/HIV Co-Infected Persons at Masvingo Provincial Hospital (2022–2024) was done and summarized in Table 7. The variable Death Outcome, representing the distribution of cases across three possible outcomes: cure, died, and treatment completed (TRC) provides four key statistical measures: Frequency, Percent, Valid Percent, and Cumulative Percent.

Table 7 Distribution Table of the patients' outcome

Death Outcome	Frequency n (%)	Valid Percent (%)	Cumulative Percent (%)
Cure	30 (14.5)	14.5	14.5
Died	37 (17.9)	17.9	32.4
TRC	140 (67.6)	67.6	100.0
Total N	207 (100.0)	100.0	100.0

Among the 207 TB/HIV co-infected individuals at Masvingo Provincial Hospital, 37 (17.9%) died, indicating a notable mortality rate and 30 (14.5%) were cured. These patients represent those who were sputum positive on initiation of anti TBs and had their sputum tested after completing anti TBs. A majority, 140 (67.6%), fall under the TRC category, indicating they completed taking their 6 months TB course. This group includes people whose sputum had no MTB and those who didn't have sputum collected.

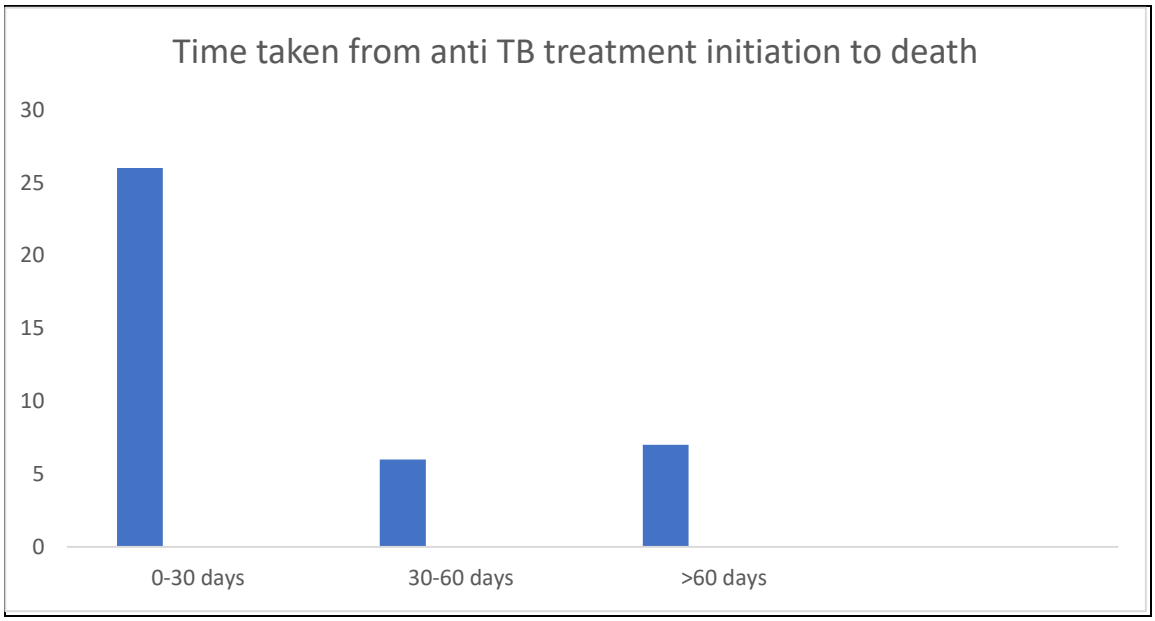

Figure 12 Time taken from anti-TB treatment initiation to death

Figure 12, shows that the majority of the people died within the first months as compared to the second month and months that follow. Demographic and clinical characteristics of deceased patients was done to examine age, gender, ART status, TB drug resistance, and comorbidities among the deceased patients (17.9%) as an informative way in tailoring interventions for improved treatment outcomes. The mortality rate among TB/HIV co-infected persons at Masvingo Provincial Hospital is 17.9%, surpassing the proportion of those who recovered (14.5%). A significant percentage (67.6%) of patients remain in the TRC category, implying that additional follow-ups are required to determine their final outcomes. Understanding these demographic and clinical risk factors associated with mortality may help reinforce as well as formulating strategies that help in reducing TB/HIV-related deaths. A pie chart of the proportion of death outcomes among TB/HIV infected people is shown in figure 13.

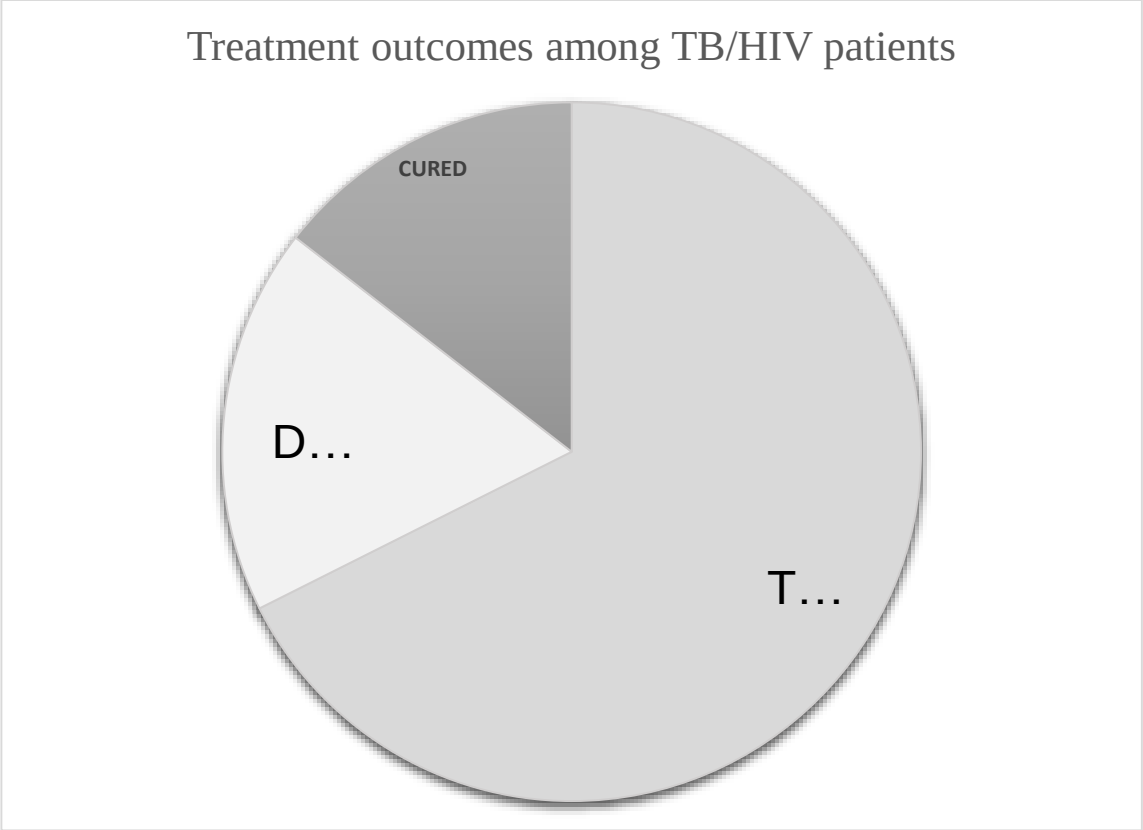

Figure 13 Outcomes of treatment among TB/HIV infected persons at Masvingo Hospital

The pie chart in figure 13, illustrates the proportional representation of each outcome category in relation to the total sample. The TRC category dominates the chart, making up 67.6% of the total cases, which indicates that a significant number of patients completed their treatment or their final status has not yet been determined. The died category represents 17.9%, which is higher than the cure category (14.5%), emphasizing that mortality among TB/HIV co-infected individuals is a major concern. The pie chart visually reinforces the fact that only a small fraction of patients have achieved full recovery, suggesting the need for improved treatment strategies and follow-up care. The lower proportion of recovered cases suggests challenges in treatment success, while the notable number of deaths raises concerns about the severity of co-infection and potential

gaps in healthcare intervention. Therefore, figure 13 provide critical insights into the prevalence of mortality, treatment progress, and recovery rates among TB/HIV co-infected patients for further investigation into patient demographics, clinical characteristics, and potential risk factors influencing treatment outcomes.

4.11: Laboratory tests for TB diagnosis

An analysis of laboratory tests for TB diagnosis outcomes was also done as shown in Table 8.

Table 8 Distribution of laboritory tests for TB diagnosis

TB Diagnosis	Frequency n (%)	Valid Percent(%)	Cumulative Percent(%)
MTB Detected	48 (23.2)	23.2	23.2
MTB Not Detected	103 (49.8)	49.8	72.9
Not Done	42 (20.3)	20.3	93.2
Rifampicin Resistant	14 (6.8)	6.8	100
Total N	207 (100.0)	100.0	100.0

Table 8 shows the results of TB diagnosis for 207 patients. The categories of the diagnosis include the MTB Detected, MTB Not Detected, Not done and the Rifampicin Resistant. Of MTB Detected, 48 cases (23.2%) tested positive for MTB, indicating active TB infection while 103 cases (49.8%) tested negative for MTB, meaning they did not have active TB detected in their sputum and this group includes patients who had extra-pulmonary TB. 42 cases (20.3%) had no test performed, possibly due to logistical issues

or clinical decisions. Of the patients surveyed, 14 cases (6.8%) were found to have Rifampicin-resistant TB, highlighting a concern for multidrug-resistant TB (MDR-TB). These findings suggest a significant proportion of patients remain untreated or undiagnosed, underscoring the need for improved diagnostic coverage and monitoring, particularly for drug-resistant TB cases.

4.12: Death Outcome by Sex

A cross tabulation of death outcome by sex was done as shown in Table 9 as this help in informing targeted gender initiatives.

Table 9 Cross tabulation of Death Outcome by Sex

Death Outcome	**Male n (%)**	**Female n (%)**	**Total n (%)**
Cure	16 (12.4)	14 (17.9)	30 (14.5)
Died	30 (23.3)	7 (9.0)	37 (17.9)
Treatment Completed (TRC)	83 (64.3)	57 (73.1)	140 (67.6)
Total N	129 (100.0)	78 (100.0)	207 (100.0)

The results in Table 9 displays the distribution of death outcomes among male and female patients. Among the cured, a slightly higher number of males (16) were cured compared to females (14) as well as a significantly higher mortality rate of 30 male deaths compared to only 7 female deaths. A large number of patients (140) completed their treatment Treatment Completed (TRC) with 83 males and 57 females in this category. This suggests that male patients were at risk of acquiring TB as compared to females.

4.13: Logistic Regression

Logistic regression play a crucial role in analyzing count data. In determining the effect of the variables understudy towards mortality, a logistic regression model was done and results obtained were tabulated in Table 4.

Table 10 Logistic Regression Results

Variable	Coefficient z(β)	Std. Error	z-value	p-value	95% Confidence Interval
Intercept	-2.7	0.754	-3.5	<0.001	(-4.2, -1.2)
Male (vs. Female)	1.1	0.456	2.4	0.016	(0.2, 2.0)
On ART (vs. Not on ART)	-0.6	0.394	-1.6	0.100	(-1.4, 0.1)
Not Diabetic (vs. Diabetic)	-0.4	0.566	-0.7	0.507	(-1.5, 0.7)
Unknown Comorbidities	-0.3	0.554	-0.5	0.647	(-1.3, 0.8)
Age	0.0	0.010	2.1	0.037	(0.0, 0.0)

The logistic regression analysis was conducted to determine the factors associated with mortality among TB/HIV co-infected individuals at Masvingo Provincial Hospital. The model successfully converged, indicating reliable results. The log-likelihood value was -90.116, and the likelihood ratio test yielded a p-value of 0.015, suggesting that the overall

model was statistically significant. This means that at least one of the predictor variables had a meaningful effect on the likelihood of death. However, the pseudo R-squared value of 0.073 suggests that while the model explains some variability in mortality, other factors may contribute to patient outcomes.

The intercept of the model was -2.676, which represents the baseline log odds of death when all predictor variables are set to zero. This negative value suggests that, in the absence of additional risk factors, the likelihood of death was relatively low. However, when demographic and clinical characteristics were included in the model, certain variables showed significant associations with mortality. The p-value for the intercept was less than 0.001, indicating that it was significantly different from zero, reinforcing the importance of including additional predictors in the analysis.

Gender was found to be a significant predictor of death, with male patients having higher odds of mortality compared to females. The coefficient for males was 1.1, with a p-value of 0.016, indicating a statistically significant relationship. This suggests that male patients had greater vulnerability to poor outcomes, possibly due to delayed healthcare-seeking behaviors, differences in immune response, or higher prevalence of risk factors such as smoking or alcohol use. These findings highlight the need for targeted interventions aimed at improving treatment adherence and follow-up among male TB/HIV patients.

Age also emerged as a significant factor associated with death, with a coefficient of 0.02 and a p-value of 0.037. This positive relationship indicates that as age increases, the likelihood of mortality rises. Older patients may have weakened immune systems, increased comorbid conditions, or lower tolerance to TB and HIV treatments, making

them more susceptible to adverse outcomes. This finding emphasizes the importance of early detection and aggressive management strategies for elderly patients, who are at a heightened risk of complications and mortality.

The impact of ART status on mortality was examined, but the results did not show statistical significance. The coefficient for patients on ART was -0.6, and the p-value was 0.100, meaning that while being on ART was associated with lower odds of death, the relationship was not strong enough to be considered significant. This could be due to factors such as late ART initiation, poor adherence, or advanced disease progression at the time of diagnosis. Although ART is known to improve survival among HIV patients, its effectiveness in this specific cohort may have been influenced by unmeasured variables such as treatment interruptions or drug resistance.

Comorbidities were also included in the model, but they did not exhibit a significant relationship with mortality. Patients who were not diabetic had a coefficient of -0.4 and a p-value of 0.507, indicating no meaningful effect on death outcomes. Similarly, those with unknown comorbidity status had a coefficient of -0.3 and a p-value of 0.647, further suggesting that comorbidities, as recorded in this dataset, did not play a crucial role in predicting mortality. This lack of significance could be due to limitations in data collection, underreporting of conditions, or the presence of other stronger determinants of mortality that were not captured in this model.

The logistic regression model suggests that demographic factors such as age and gender were the most influential predictors of mortality among TB/HIV patients, whereas ART status and comorbidities did not show statistically significant associations. However, the

relatively low pseudo R-squared value indicates that other important factors influencing death outcomes were not accounted for in this model. These could include socioeconomic status, nutritional deficiencies, treatment adherence levels, and severity of TB infection. Incorporating these variables in future studies could enhance the predictive power of the model and provide a more comprehensive understanding of mortality risks.

4.14: Chi-Square test for Independence

A test for independence using the Chi-Square test was performed to determine if there is a significant relationship between sex and death outcome as shown in Table 11.

Table 11 Chi-Square Test Results for Association between Sex and Death Outcome

Test	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7.1	2	0.028
Likelihood Ratio	7.7	2	0.021
Nunber of Valid Cases	207	-	-

The results of the Chi-Square test in Table 12 show a Pearson Chi-Square value of 7.1 with a p-value of 0.028 which suggests a statistically significant relationship between sex and death outcome at the 5% significance level. The Likelihood Ratio of 7.694 with a p-value of 0.021 also supports the Pearson Chi-Square result, indicating that sex significantly influences the likelihood of cure, death, or treatment continuation.

4.15: Summary

A total of 207 participants were considered for this study. The logistic regression results indicated that only age and gender had a significant effect on TB/HIV death for the sampled population in Masvingo. The mortality rate among TB/HIV persons was 17.9% while 67.6% completed treatment and 14.5% were cured. 70.3% of deaths happened within the first month. The average age of death was 46.95±24.45 years. The majority 30/37 (81.0%) were male and they resided in the urban area. 62.2% were not on ART. 90.0% of those who died had pulmonary TB. Gender was found to be a significant predictor of death with males having the higher odds of mortality compared to females with a p =0.016 and a coefficient of 1.1. Age was also a significant factor associated with death with a p value of 0.037 and a coefficient of 0.2 meaning that as age increases the likelihood of death increases.

CHAPTER 5 SUMMARY, CONCLUSIONS ND RECOMMENDATIONS

5.1 Introduction

This chapter discusses the study's key findings on TB/HIV mortality at Masvingo Provincial Hospital, aligning them with the research objectives. It also integrates recent literature to contextualize the results and highlight their implications. The discussion explores factors such as age, gender, ART usage, co-morbidities, hospital-related challenges, and treatment adherence, among others. The chapter concludes with recommendations aimed at improving TB/HIV management and reducing mortality rates.

5.2 Discussion of Key Findings in Relation to Objectives

5.2.1 Causes of Death among TB/HIV-Infected Persons

One of the primary objectives of this study was to determine the key causes of death among TB/HIV co-infected individuals. The findings revealed that late diagnosis, advanced disease progression, poor ART adherence, and severe co-morbidities were major contributors to mortality. According to a 2023 WHO report, late-stage TB diagnosis remains a challenge in many African countries, with nearly 40% of cases detected only in advanced stages. This delay in diagnosis allows the infection to progress, reducing the chances of successful treatment.

Age was also identified as a major mortality determinant. The study found that patients' ages ranged from 3 to 98 years, with a mean of 41.16 years. This is consistent with recent literature indicating that both young and elderly individuals face a heightened risk of mortality due to weaker immune responses. Research from The Lancet (2023) suggests

that elderly TB/HIV patients have a mortality rate nearly double that of younger adults due to age-related immune decline. Additionally, young children are at risk due to their underdeveloped immune systems and increased likelihood of severe TB complications.

5.2.3 Impact of ART Usage on Survival Rates

ART (antiretroviral therapy) is a critical intervention in reducing mortality among TB/HIV co-infected individuals. The study found a mean ART_CODE of 1.53, indicating that some individuals were on ART while others were not. According to WHO (2024), patients who initiate ART within two weeks of TB diagnosis have a 60% higher survival rate compared to those who delay treatment. The findings in this study align with global recommendations, reinforcing the need for early ART initiation and strict adherence.

However, several patients were found to have poor ART adherence, leading to higher mortality rates. Non-adherence to ART is often linked to treatment side effects, stigma, financial barriers, and lack of healthcare access. A 2023 study in BMJ Global Health reported that non-adherent patients have a 3.5 times higher risk of mortality compared to those who strictly follow their ART regimen.

5.2.4 The Role of Co-Morbidities in Mortality

The presence of co-morbid conditions significantly increased mortality among the study participants. The mean CORMO_CODE of 2.30 indicated moderate to severe co-morbidities, highlighting the impact of additional health complications. Patients with

diabetes, hypertension, and malnutrition face higher mortality risks. Literature suggests that TB/HIV patients with diabetes have a mortality risk nearly three times higher than non-diabetic individuals (The Lancet, 2023).

5.2.5 Delays in TB Diagnosis and Treatment Initiation

The study highlighted a significant challenge related to delayed diagnosis and treatment initiation. Many patients were diagnosed at advanced stages, which drastically reduced their survival chances. A 2023 Global TB Report indicated that late diagnosis is responsible for nearly 30% of TB-related deaths worldwide. This problem is worsened by limited access to healthcare facilities, inadequate diagnostic tools, and long turnaround times for laboratory results. One key issue is the underutilization of GeneXpert technology, a rapid molecular diagnostic tool recommended by WHO. Despite its effectiveness, many healthcare facilities in low-resource settings still rely on traditional smear microscopy, which has a lower sensitivity and delays diagnosis (WHO, 2024). In this study 20.3% of the patients had not done sputum tests.

5.2.6 Hospital-Based Factors Affecting Mortality

Hospital-related challenges, including resource constraints, understaffing, and medication shortages, contributed to higher mortality rates. A review of TB/HIV treatment programs in sub-Saharan Africa found that patients in underfunded hospitals are twice as likely to experience treatment interruptions (PLOS Medicine, 2023).

Healthcare workers in high-burden TB/HIV settings often face excessive workloads, leading to delays in treatment administration and follow-ups. The study also found that some patients were not receiving the full recommended TB treatment regimens due to drug stock outs. These systemic challenges highlight the urgent need for healthcare infrastructure improvements and better resource allocation.

5.2.2 Gender Disparities in TB/HIV Mortality

The study found that more males were affected than females, with a mean SEX_CODE of 1.38, suggesting a male-dominated sample. This aligns with global trends, as men are generally less likely than women to seek early treatment. A 2024 study in the International Journal of Tuberculosis and Lung Disease found that men delay seeking TB treatment by an average of 6 weeks longer than women, significantly increasing their mortality risk. Socio-cultural factors, including stigma, fear of job loss, and lower health-seeking behavior among men, contribute to these disparities. The association of smoking, mining and contracting TB has been significantly proved. Man become more at risk due to these other confounding factors.

5.3 Conclusion

This study successfully addressed its objectives by identifying key factors influencing mortality among TB/HIV co-infected individuals at Masvingo Provincial Hospital. The findings highlight late diagnosis, ART non-adherence, co-morbidities, and hospital-related constraints as major mortality contributors. The results align with global research, reinforcing the need for early diagnosis, improved ART adherence, and better hospital resource management.

5.4 Recommendations

Based on the findings of this study, several targeted recommendations are proposed to reduce mortality among TB/HIV co-infected individuals and improve treatment outcomes. These recommendations focus on strengthening ART adherence, improving nutritional support, enhancing diagnostic infrastructure, addressing hospital resource constraints, and promoting gender-sensitive health interventions.

Table 12 Recommendations

Recommendation	Person responsible	Timeline
Promotion of gender sensitive interventions • The targeted screening at and around the workplaces of vendors and traders • Targeted screening of miners and smokers • Actively offering testing and counselling services to males	Provincial health promotion officer (Masvingo province)	1st Quarter 2025(immediate)
Strengthen ART adherence programs • Personalized care • Empowerment and education • Support network and address stigma • Transportation and network • Regular monitoring and drug adherence		
Enhance diagnostic infrastructure • Build and upgrade laboratories • Invest in diagnostic equipment • Mobile diagnostics • Train health care workers	National TB and Leprosy program, Provincial pharmacist, Provincial HIV and TB focal person	2nd quarter of 2025

• Integrate diagnostic platforms • Increase accessibility of diagnostic infrastructure (point of care testing)		
Address hospital resource constraints • Channel more funds toward procurement of resources to be used in the department	Hospital administration(procurement department	1st quarter 2025
Strengthen risk assessment skills by health workers • Monthly audits of registers • Training on registers • Training on the risk factors associated with TB	Provincial nursing officer, Sister in charge OI and TB Unit	1st quarter 2025

5.4.1 Strengthening ART Adherence Programs

One of the major findings of this study was that poor ART adherence significantly increases the risk of mortality among TB/HIV patients. Therefore, strategies to improve ART compliance must be prioritized. Implementing community-based ART adherence support groups can provide patients with peer encouragement, psychosocial support, and regular follow-ups to ensure they remain on treatment. These groups have been shown to increase ART adherence rates by up to 30% in similar settings (Global HIV/AIDS Report, 2023).

Additionally, providing incentives for ART adherence—such as food supplements, transport allowances, or financial support for vulnerable patients—can encourage continued treatment uptake. Studies show that malnourished TB/HIV patients who receive food support are 50% more likely to adhere to ART compared to those without nutritional assistance (WHO, 2024).

5.4.2 Improving Nutritional Support for TB/HIV Patients

Malnutrition was a significant risk factor for mortality in the study population. TB and HIV both contribute to severe weight loss, muscle wasting, and weakened immunity, making nutritional support a crucial intervention. Establishing structured nutrition programs within hospitals and community health centers can improve patient survival rates and treatment effectiveness. These programs should include nutrient-dense meal provisions, vitamin supplementation, and nutrition counseling to support immune function.

Routine BMI assessments should also be conducted to identify malnourished patients early and initiate targeted interventions. Research has shown that TB/HIV patients with a BMI below 18.5 kg/m^2 have a 45% higher risk of mortality (Lancet, 2023). Early nutritional interventions can prevent disease progression and improve recovery outcomes.

5.4.3 Enhancing Diagnostic Infrastructure

Late diagnosis of TB remains a significant contributor to mortality, as many patients are diagnosed only at advanced stages of the disease. To improve early detection, it is essential to increase the availability of GeneXpert diagnostic tools in all health centers. GeneXpert

provides rapid and highly sensitive TB detection, which reduces diagnosis time from weeks to hours, enabling faster treatment initiation. Reducing turnaround times for TB test results is also crucial, as delayed test processing leads to treatment postponements and increased mortality risk. Investing in automated laboratory systems, expanding TB testing facilities, and training more diagnostic personnel can enhance efficiency and improve survival rates. A study by the Global TB Program (2024) found that early TB detection and treatment initiation reduce mortality rates by 60%. Risk groups for HIV positive patients need to be explored more. The major risk for these co-infected persons in the TB registers was recorded as being HIV positive. There is need to address the other 11 risk groups when registering the patients.

5.4.4 Addressing Hospital Resource Constraints

The study found that hospital-related factors, such as drug stock outs, inadequate staff, and poor healthcare infrastructure, contributed to TB/HIV mortality. Improving drug supply chain management is necessary to prevent stock-outs of essential TB and ART medications. Implementing real-time inventory tracking systems and ensuring timely procurement of essential drugs can reduce treatment disruptions and improve patient survival rates.

Additionally, increasing funding for TB/HIV healthcare facilities will help strengthen healthcare worker capacity, improve diagnostic equipment, and expand patient support services. This was made worse by the withdrawal of USAID in funding the program in

Masvingo province. Studies show that well-resourced healthcare facilities have TB/HIV mortality rates up to 40% lower than underfunded centers (PLOS Medicine, 2023). Investing in healthcare infrastructure is, therefore, a critical step toward achieving better patient outcomes.

5.4.5 Promoting Gender-Sensitive Health Interventions

The study highlighted gender disparities in TB/HIV mortality, with men being less likely to seek early diagnosis and treatment. To address this issue, male-focused health campaigns should be designed to encourage early TB/HIV screening and treatment uptake. These campaigns should leverage trusted community leaders, male-focused support groups, and workplace health initiatives to reach at-risk men and promote health-seeking behavior. Reducing stigma through community education and awareness programs is another key strategy. Many TB/HIV patients delay treatment due to fear of discrimination or misconceptions about ART and TB treatment. Public awareness campaigns using radio, television, social media, and community meetings can challenge negative perceptions and encourage affected individuals to seek timely medical care. Countries that have successfully implemented anti-stigma programs have seen a 25% increase in early TB/HIV treatment enrollment (International Journal of Public Health, 2024).

Conclusively, reinforcement of existing strategies and adopting these recommendations, TB/HIV mortality can be significantly reduced, and patient outcomes can be improved. A multi-faceted approach, including health system strengthening, community engagement,

and targeted interventions, will be essential in addressing the current challenges. Future policies should also focus on sustained funding, technological advancements in TB diagnosis, and comprehensive nutritional support programs to enhance TB/HIV management in high-burden settings. Future research should explore longitudinal interventions that track patient outcomes over time to assess the effectiveness of treatment strategies.

5.5 Areas of further study

The researcher recommends a study that focuses on specific causes of death in patients with TB/HIV co-infected persons be carried out in order to address other factors leading to death in this sub group other than the risk factors addressed in this study.

The researcher recommends a secondary data analysis of more than 5 years length to analyze the factors associated with mortality in TB/HIV persons at Masvingo provincial hospital. This lengthy study will help in shedding more light on the factors associated with mortality among TB/HIV co-infected persons.

An area of further study will be a prospective study on the assessment of risk factors to mortality among TB/HIV persons.

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APPENDICES

APPENDIX 1: DATA COLLECTION TOOL

CASE NUMBER																			
DATE OF DATA COLLECTION																			
Date of registration(for TB treatment)	Date of TB diagnosis	sex	age	Educational status	Residence (rural, urban, peri-urban)	TB Treatment initiation		Occupation	Referral type	TB risk group	TB diagnosis	Anatomical site	Date of HIV test	Art status	Art initiated within 8 weeks of TB diagnosis	CD4 count	comorbidities	Type of patient	0utcome	Time to death
						date	If no then reason													

APPENDIX 2: PROVINCIAL MEDICAL DIRECTOR'S APPROVAL LETTER

Elizabeth Katsamba
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4 November 2024

The Provincial Medical Director
Masvingo Province
P O Box 147
Masvingo
Zimbabwe

Dear Sir

RE: REQUEST FOR PERMISSION TO CONDUCT AN ANALYSIS OF THE CAUSES OF DEATH AND ASSOCIATED FACTORS IN TB/HIV INFECTED PERSONS AT MASVINGO PROVINCIAL HOSPITAL, 2022-2024

I am kindly requesting permission to allow me to conduct an analysis of the causes of death and the associated factors in TB/HIV infected persons at Masvingo provincial hospital. This will be part of my academic module under the tutorage of Africa University's MPH programme.

The intention is to use ward notes and death records to establish the cause we will also triangulate with the OI TB registers to establish the factors. Assistance will be sort from the registry , ward nurses and OIC health workers.

Names of patients and participants will not appear in the manuscript. All information will be considered confidential and utilised for academic purposes only. I have attached the research proposal for your perusal.

Your permission and assistance in this regard will be greatly appreciated.

Yours sincerely

Elizabeth Katsamba
MBChB (UZ)
Master of Public Health student (AU)