

Assessing Tuberculosis Treatment Success Since the Introduction of Directly Observed Treatment: A Case Study of Chelstone Clinic, Lusaka-Zambia (2018-2023)

Mercy Phiri, Clementina Lwatula, Joseph Musona

University of Lusaka, Zambia

DOI: <https://doi.org/10.51584/IJRIAS.2026.11070205>

Received: 09 August 2026; Accepted: 15 August 2026; Published: 24 August 2026

ABSTRACT

Background: Despite being preventable and curable, tuberculosis remains a leading cause of mortality worldwide, with ten million incident cases and 1.6 million deaths reported globally in 2017. While the Directly Observed Treatment Short-course strategy (DOTS) has been the cornerstone of tuberculosis control since its endorsement by the World Health Organization in 1994, programmatic effectiveness varies substantially across settings. In Zambia, where tuberculosis-HIV co-infection rates exceed sixty percent in some regions, DOTS coverage reached one hundred percent nationally by 2010, yet rising incidence rates underscore persistent implementation gaps.

Objective: This study assessed tuberculosis treatment success rates and associated determinants at Chelstone Clinic, Lusaka-Zambia, following DOTS implementation during the period from 2018 to 2023.

Methods: A mixed-method retrospective cross-sectional study was conducted among ninety-three patients aged eighteen years and above who were treated for tuberculosis during the study period. Secondary data from clinic records were complemented by structured questionnaires administered to tuberculosis focal-point personnel and Focus Group Discussions with patients currently on treatment. Data were analyzed using SPSS version 26, with chi-square tests employed for association analysis. Results are presented as frequencies, percentages, and visual representations.

Results: Young adults aged twenty-five to thirty-four years constituted the predominant age group at 26.9 percent, with males outnumbering females at 53.8 percent versus 46.2 percent. The overall treatment success rate was 94.6 percent with a 95 percent confidence interval of 87.9 to 98.0, significantly exceeding the World Health Organization recommended threshold of 85 percent. Treatment adherence was 91.4 percent, supported by 86.0 percent DOTS monitoring coverage. Self-referral was the primary diagnostic pathway at 43.0 percent. Suboptimal understanding of the DOTS program was reported by 8.6 percent of patients. Forgetfulness at 33.3 percent and medication side effects at 26.7 percent constituted the principal barriers to adherence. Patient satisfaction was high, with 43.0 percent rating care as excellent, and medication availability stood at 96.8 percent.

Conclusion: Treatment success at Chelstone Clinic surpasses international targets, demonstrating the effectiveness of DOTS implementation. However, optimized patient education, strengthened social support systems, and decentralized service delivery through mobile outreach are imperative to address residual barriers and achieve tuberculosis elimination targets.

Keywords: Tuberculosis; Directly Observed Treatment; DOTS; Treatment Success; Adherence; Zambia; Sub-Saharan Africa; Applied Health Research

INTRODUCTION

Global Burden of Tuberculosis

Tuberculosis constitutes one of the most enduring public health challenges of the modern era. Despite the availability of highly effective curative therapy for over five decades, tuberculosis persistently ranks among the

top ten causes of mortality globally. According to the World Health Organization, the year 2020 marked the first year in which tuberculosis-related deaths increased since 2005, largely attributable to disruptions caused by the COVID-19 pandemic (WHO, 2021). The global tuberculosis burden remains disproportionately concentrated in low- and middle-income countries, which account for more than 95 percent of tuberculosis deaths (WHO, 2020).

The epidemiological transition of tuberculosis has been profoundly influenced by the HIV pandemic, particularly in Sub-Saharan Africa, where tuberculosis-HIV co-infection rates exceed fifty percent in several countries (UNAIDS, 2021). This syndemic interaction has reversed decades of progress, with the region bearing the highest incidence rates globally, approximately 212 cases per 100,000 population (WHO, 2022). The emergence and spread of multidrug-resistant tuberculosis and extensively drug-resistant tuberculosis further complicate control efforts, necessitating robust programmatic interventions. From an applied health systems perspective, understanding the determinants of treatment success is essential for designing effective interventions that can be scaled across health facilities in similar resource-constrained settings.

The DOTS Strategy: Historical Context and Global Impact

The Directly Observed Treatment Short-course strategy, endorsed by the World Health Organization in 1994, represented a paradigm shift in tuberculosis control. Developed through collective best practices, clinical trials, and programmatic operations of tuberculosis control over two decades, DOTS integrates five essential components. These include sustained political commitment, case detection through quality-assured sputum smear microscopy, standardized short-course chemotherapy with direct observation of treatment, uninterrupted supply of essential anti-tuberculosis drugs, and standardized recording and reporting systems enabling program monitoring and evaluation (WHO, 1997; Khatri & Frieden, 2002).

The evidence base supporting DOTS is substantial. Countries implementing the strategy have demonstrated dramatic improvements in treatment outcomes. In China, cure rates increased from below fifty percent to over 95 percent in DOTS-covered areas (Chen et al., 2002). Peru achieved DOTS coverage approaching 100 percent, with cure rates of 83 percent (Caminero, 2004). Vietnam similarly reported treatment success rates exceeding ninety percent (Lonnroth et al., 2010). These achievements underscore the transformative potential of systematic, patient-centered approaches to tuberculosis management and provide a benchmark against which programmatic performance can be assessed.

However, the strategy's effectiveness is not universal. Several challenges impede implementation, including the increasing impact of HIV on tuberculosis epidemiology, the resurgence of tuberculosis in Eastern Europe following healthcare system collapse, and the emergence of drug-resistant strains (Moges et al., 2017; WHO, 2022). The 2015 World Health Organization End TB Strategy subsequently broadened the focus from DOTS alone to encompass a comprehensive framework encompassing integrated patient-centered care, bold policies and supportive systems, and intensified research and innovation (WHO, 2015). This evolution reflects the recognition that biomedical interventions alone are insufficient and that health systems strengthening is essential for achieving TB elimination targets.

Tuberculosis in Zambia: National Context

Zambia inherited a tuberculosis control program from the colonial administration, with the National Tuberculosis Control Program formally established following independence in 1964 (Bosman, 2000). The National Tuberculosis Control Program was reorganized in 1980 to incorporate leprosy control, becoming the National Tuberculosis and Leprosy Control Program (Mwaba, 2001). In 1993, the National Tuberculosis and Leprosy Control Program was integrated with national AIDS and STI programs, forming the National AIDS/STD, TB, and Leprosy Control Program (Bosman & Mwaba, 2002).

A pivotal moment occurred in 1988 when the Government of the Netherlands began funding the National Tuberculosis Control Program, enabling uninterrupted drug procurement. However, evaluation in 1991 revealed low cure rates and high default rates (Mwaba, 2001). In response, a five-year development plan was implemented with continued Dutch support, resulting in conversion and treatment completion rates of 88 percent and 70 percent, respectively, by 1996 (Mwaba, 2007). Despite these gains, Zambia's tuberculosis incidence continued to rise, from 332 per 100,000 in 2000 to 416 per 100,000 in 2010, reflecting the impact of the HIV epidemic

(WHO, 2012).

By 2019, Zambia had achieved DOTS coverage at all diagnostic and treatment centers, with treatment success rates for new cases reaching 89 percent (MOH, 2019). However, inter-regional disparities persist. In 2021, Northern Province demonstrated the highest tuberculosis coverage relative to estimated subnational burden, consistently achieving cumulative performance targets set by the National Tuberculosis Program (WHO, 2022). This uneven distribution of programmatic success underscores the need for site-specific assessments to identify contextual barriers and facilitators. Such assessments are critical for applied health systems research that can inform policy and practice in diverse settings.

Treatment Success: Conceptual Framework and Determinants

Treatment success is a composite measure encompassing cure and treatment completion, as defined by the World Health Organization (WHO, 2014). The determinants of treatment success are multifactorial, operating at multiple levels. Patient-level factors including demographic characteristics such as age, sex, education, and socioeconomic status, along with health-seeking behavior and psychosocial factors significantly influence outcomes. Studies consistently demonstrate that young adults, men, and individuals with lower educational attainment experience poorer tuberculosis outcomes (Banda et al., 2012; Melese et al., 2021).

Programmatic factors including the quality of directly observed therapy, availability of drugs, health worker competence, and patient-provider communication substantially impact treatment success (Gebrezgabiher et al., 2016; Moges et al., 2017). Structural factors including health system infrastructure, geographic accessibility, transportation availability, and socioeconomic support systems mediate treatment engagement (Chanda et al., 2020; Lule et al., 2019).

The conceptual framework guiding this study, illustrated in Figure 1, situates treatment success as a function of structural factors including facility ownership, quality assurance systems, staffing, and DOTS unit characteristics; processes including commitment to diagnosis and treatment as well as adherence monitoring; and outcomes including treatment success rates, treatment completion rates, and default rates. This framework, adapted from the International Journal of Medicine (2010), enables systematic analysis of the complex interplay between programmatic inputs and patient outcomes. The framework is particularly relevant for applied health research because it provides a structured approach for identifying intervention points within health systems.

Rationale and Research Questions

While DOTS has been implemented in Zambia for over two decades, limited published research systematically assesses its effectiveness in specific Zambian health facilities. Understanding local-level treatment success is crucial for optimizing patient outcomes, preventing further transmission, and informing policy development (Helen et al., 2010; WHO, 2020). This study addresses this gap by focusing on Chelstone Clinic, Lusaka-Zambia, with the following research questions.

What are the demographic characteristics of patients achieving tuberculosis treatment success under DOTS? What determinants influence treatment outcomes among patients enrolled in DOTS at Chelstone Clinic? What is the treatment success rate at Chelstone Clinic during the period from 2018 to 2023? What recommendations can be developed to improve DOTS implementation in tuberculosis case management?

The study aligns with the applied health research paradigm, which emphasizes the translation of evidence into practice and the generation of actionable insights for health systems strengthening. The findings are intended to inform policy makers, program managers, and healthcare providers about the effectiveness of current DOTS implementation and identify areas for targeted improvement. This applied focus is consistent with the broader goals of health systems strengthening and the Sustainable Development Goals, particularly SDG 3 which targets the end of the tuberculosis epidemic by 2030.

MATERIALS AND METHODS

Study Design and Setting

A mixed-method retrospective descriptive cross-sectional study was conducted at Chelstone Clinic, a public health facility in Lusaka Province, Zambia. The clinic, located along Great East Road in the Chelstone area, serves approximately 130,000 catchment population, receiving patient referrals from the community level and surrounding health posts. The facility provides comprehensive tuberculosis services including diagnosis through sputum smear microscopy and GeneXpert MTB/RIF, treatment through standardized short-course chemotherapy with DOTS, and monitoring.

The choice of Chelstone Clinic was informed by its accessibility, the availability of comprehensive health records, and the substantial number of tuberculosis cases managed at the facility. These characteristics made it an ideal site for conducting applied health research that could generate findings with relevance for similar settings in Zambia and the region.

Study Population and Sampling

The study population comprised all patients aged eighteen years and above treated for tuberculosis at Chelstone Clinic during the period from 2018 to 2023, with an estimated population of 1,300. Sample size was calculated using the Yamane formula (2002). With a population of 1,300, a margin of error of 0.1 at 90 percent confidence level, the sample size was calculated as 92.8, approximated to 93. Thus, a sample size of 93 was determined. Convenience sampling was employed for the secondary data component, with systematic inclusion of all records meeting criteria for completeness and accuracy. For the qualitative component, purposive sampling was used to recruit patients currently on tuberculosis treatment for Focus Group Discussions.

Inclusion and Exclusion Criteria

The inclusion criteria comprised patients aged eighteen years and above diagnosed and treated for tuberculosis at Chelstone Clinic during the period from 2018 to 2023, with complete treatment records available for review, and informed consent obtained for interviews and Focus Group Discussions. The exclusion criteria comprised patients aged below eighteen years, records incomplete for key variables, and consent not obtained or refused.

Data Collection Techniques

Data were collected through three complementary methods. Secondary records review involved systematic abstraction of data from patient treatment cards, tuberculosis registers, and clinic records using a standardized data extraction form. Variables collected included demographic characteristics, tuberculosis type distinguishing pulmonary from extra-pulmonary, diagnostic method, treatment regimen, duration, DOTS monitoring details, and treatment outcome encompassing cured, completed, defaulted, failed, or died.

Structured questionnaires were administered to the tuberculosis focal-point person and key healthcare workers involved in tuberculosis management to capture programmatic insights and contextual factors. Focus Group Discussions were conducted with patients currently on tuberculosis treatment, involving twelve participants in two groups of six, to explore lived experiences, barriers to adherence, and recommendations for program improvement. Focus Group Discussions were facilitated using a semi-structured guide, audio-recorded, and transcribed verbatim.

Data Analysis

Quantitative data were coded and entered into Microsoft Excel, then exported to SPSS version 26 for analysis. Descriptive statistics including frequencies, percentages, means, and standard deviations were generated. Chi-square tests assessed associations between demographic and clinical variables and treatment outcomes, with p-values less than 0.05 considered statistically significant. Results are presented as tables, bar charts, and pie charts.

Qualitative data from Focus Group Discussions were analyzed using thematic analysis following the six-step framework of Braun and Clarke (2006), encompassing familiarization, initial coding, theme identification, review, definition, and reporting. Themes were derived inductively and refined iteratively. Direct quotations are

used to illustrate findings and enhance methodological rigor. The integration of quantitative and qualitative data enabled triangulation of findings and provided a comprehensive understanding of treatment success determinants.

Validity and Reliability

Validity was ensured through inclusion of all relevant variables derived from existing literature, data source triangulation encompassing records review, questionnaires, and Focus Group Discussions, researcher triangulation with the principal investigator and supervisor independently reviewing data, and member checking with Focus Group Discussion participants. Reliability was established through systematic data abstraction protocols, double-entry verification for accuracy, and standardized analysis procedures using SPSS. These measures enhanced the trustworthiness of the findings and their applicability to similar settings.

Ethical Considerations

Ethical approval was obtained from the University of Lusaka Research Ethics Committee with reference number FWA00033228-296(08)/(08)/{2024} and the National Health Research Authority with reference number NHRA6659/14/12/2024. Permission was also secured from the Lusaka District Health Office and Chelstone Clinic management. All participants provided written informed consent after receiving comprehensive information about study objectives, procedures, risks, and benefits. Participants were assured of confidentiality, anonymity, and their right to withdraw at any time without consequences. Data were stored securely and accessible only to the research team. The study adhered to the ethical principles outlined in the Declaration of Helsinki and relevant Zambian research guidelines.

RESULTS

Socio-Demographic Characteristics

The demographic analysis, as illustrated in Figure 2, revealed that the majority of patients were aged between 25 and 34 years, accounting for 26.9 percent of the study population. This was followed by those aged 35 to 44 years at 21.5 percent, those aged 18 to 24 years at 19.4 percent, those aged below 18 years at 12.9 percent, those aged 45 to 54 years at 10.8 percent, and those aged 55 years and above at 8.6 percent. The mean age of participants was 36.5 years with a standard deviation of 12.1.

Regarding gender distribution, males slightly outnumbered females, with 53.8 percent male and 46.2 percent female participants. In terms of marital status, married individuals constituted the largest proportion at 43.0 percent, followed by single individuals at 32.3 percent, divorced or separated individuals at 16.1 percent, and widowed individuals at 8.6 percent.

The educational profile of participants showed that the majority had secondary education at 53.8 percent, followed by those with university education at 32.0 percent, those with primary education at 8.8 percent, and those with no formal education at 5.4 percent. Employment status revealed that unemployment was prevalent at 43.0 percent, employed individuals at 32.3 percent, self-employed individuals at 19.4 percent, and retired individuals at 5.4 percent. The majority of patients lived in urban areas, representing 73.1 percent, while 26.9 percent resided in rural areas.

Knowledge and Awareness of Tuberculosis and DOTS

Knowledge and awareness of tuberculosis were high, with 91.4 percent of patients being aware of tuberculosis symptoms, while 8.6 percent were not aware. The primary source of information about tuberculosis was health facilities at 64.5 percent, followed by media including radio, television, and newspapers at 32.3 percent, friends and family at 21.5 percent, and community education programs at 16.1 percent.

Familiarity with the DOTS program was reported by 75.3 percent of patients, while 24.7 percent were not familiar with the program. Regarding understanding of DOTS treatment, 26.9 percent rated their understanding as very good, 37.6 percent rated it as good, 26.9 percent rated it as fair, and 8.6 percent rated their understanding

as poor.

Tuberculosis Diagnosis and Treatment

In terms of tuberculosis diagnosis and treatment, self-referrals were the most common method of diagnosis at 43.0 percent, followed by referrals from another health facility at 26.9 percent, diagnosis during routine check-ups at 19.4 percent, and other methods at 10.4 percent. Over half of the patients at 53.8 percent were diagnosed within one month of symptom onset, while 32.3 percent were diagnosed within one to three months, and 14.0 percent experienced delays exceeding three months.

The majority of patients at 53.8 percent lived within one to five kilometers of a health facility, while 26.9 percent lived less than one kilometer, and 19.4 percent lived more than five kilometers away. Treatment initiation was immediate for 64.5 percent of patients, while 21.5 percent initiated treatment within one week, 10.8 percent within one month, and 3.2 percent took more than one month to start treatment. DOTS monitoring was extensive, covering 86.0 percent of patients, while 14.0 percent did not receive DOTS monitoring.

Treatment Adherence and Outcomes

Treatment adherence was high, with 91.4 percent of patients adhering to their treatment plans, while 8.6 percent were not adherent. Table 1 presents the detailed treatment adherence and outcomes data. The majority at 75.3 percent completed their treatment within six months, while 16.1 percent completed treatment in less than six months, and 8.6 percent required more than six months for treatment completion.

Missed doses were reported by 16.1 percent of patients, while 83.9 percent reported no missed doses. Table 2 illustrates the barriers to treatment adherence among patients who missed doses. Among those who missed doses, forgetfulness was the leading cause at 33.3 percent, followed by side effects at 26.7 percent, long distance to health facility at 20.0 percent, inability to afford transport at 13.3 percent, and feeling better at 6.7 percent. A robust support system was available for 80.6 percent of patients, which likely contributed to the high adherence rates, while 19.4 percent reported no support system.

Treatment outcomes were positive, as 94.6 percent completed their treatment successfully, while 5.4 percent did not complete treatment. Post-treatment health status was rated as excellent by 53.8 percent of patients, good by 32.3 percent, fair by 10.8 percent, and poor by 3.2 percent. Complications or relapses were rare, reported by only 8.6 percent of patients, while 91.4 percent reported no complications or relapse.

The most common challenges during treatment included side effects reported by 37.6 percent of patients, transportation difficulties reported by 26.9 percent, stigma reported by 21.5 percent, and financial difficulties reported by 14.0 percent.

Healthcare Provider and Facility Assessment

Healthcare providers and facilities were generally well-rated, with 43.0 percent of patients considering the quality of care as excellent, 37.6 percent rating it as good, 16.1 percent rating it as fair, and 3.2 percent rating it as poor. Most patients found healthcare workers supportive, with 48.4 percent describing them as very supportive, 37.6 percent as supportive, 10.8 percent as neutral, and 3.2 percent as unsupportive.

Medication availability was nearly universal at 96.8 percent, while 3.2 percent reported shortages. Weekly clinic visits were the most common frequency at 53.8 percent, followed by daily visits at 21.5 percent, monthly visits at 19.4 percent, and other frequencies at 5.4 percent. Waiting times at clinics were short or very short for 64.5 percent of patients, with 21.5 percent reporting very short waiting times, 43.0 percent reporting short waiting times, 26.9 percent reporting moderate waiting times, and 8.6 percent reporting long waiting times.

Recommendations for Program Improvement

Patients suggested several improvements to the tuberculosis program, as summarized in Table 3. In terms of program access, 43.0 percent recommended providing mobile outreach services or community-based DOTS programs to reduce travel barriers for rural patients, 32.3 percent suggested ensuring consistent availability of medication to avoid shortages and delays, 26.9 percent highlighted the need to reduce waiting times at clinics through better scheduling and staffing, and 21.5 percent proposed assigning dedicated health workers or community volunteers for more personalized monitoring and encouragement.

Regarding healthcare worker improvement, 53.8 percent emphasized the need for healthcare workers to show greater empathy and patience during consultations, especially when discussing sensitive topics like adherence and stigma, 37.6 percent suggested that healthcare workers could simplify medical jargon to make treatment plans and advice more understandable, and 26.9 percent recommended ongoing training for healthcare staff to improve their skills in handling tuberculosis patients effectively.

For tuberculosis education and awareness, 48.4 percent proposed using radio, television, and social media to educate the public about tuberculosis symptoms, treatment, and the importance of adherence, 32.3 percent advocated for door-to-door campaigns and community workshops especially in high-risk areas, 21.5 percent highlighted the need for targeted education to reduce stigma associated with tuberculosis through testimonials and success stories from cured patients, and 16.1 percent recommended introducing tuberculosis awareness as part of school health programs to reach younger audiences and their families.

Association Between Treatment Success and Selected Variables

Chi-square analysis revealed statistically significant associations between treatment success and educational level, with p equals 0.034, and residence, with p equals 0.021. Patients with secondary or university education were more likely to achieve treatment success compared to those with primary or no formal education. Urban residents demonstrated higher treatment success rates compared to rural residents, likely attributable to better health facility access and support systems. No statistically significant associations were observed between treatment success and age, gender, marital status, or employment status, with p -values of 0.187, 0.452, 0.321, and 0.267 respectively. The DOTS monitoring coverage was strongly associated with treatment success, with p equals 0.008, confirming the effectiveness of direct observation in promoting adherence.

DISCUSSION

Demographic Profile and Its Implications

The demographic profile of patients in this study, where the majority were aged 25 to 34 years at 26.9 percent, followed by those aged 35 to 44 years at 21.5 percent, is consistent with global and regional findings that show tuberculosis disproportionately affects younger adults. Studies conducted in high-burden countries such as India, South Africa, and China confirm that this age group faces a higher risk due to occupational exposure, urban crowding, and their active economic participation. Research by Ismail et al. (2022) in South Africa highlighted similar age-related patterns in tuberculosis prevalence, attributing this to high transmission rates in workplaces and urban environments. Similarly, a 2021 study by Liu et al. in China found the highest tuberculosis incidence among those aged 25 to 40 years, emphasizing the role of lifestyle factors and occupational exposure. Globally, World Health Organization data also points to the increased burden of tuberculosis among young adults (WHO, 2020).

The smaller representation of the youngest age group below 18 years at 12.9 percent and oldest age group 55 years and above at 8.6 percent is consistent with findings from Kenya (Omondi et al., 2022) and Ethiopia (Abebe et al., 2020). These studies noted lower tuberculosis detection in children due to underdiagnosis and atypical symptoms, while in older populations, lower incidence was often linked to limited exposure, despite vulnerability to reactivation of latent tuberculosis due to age-related immune decline.

The gender distribution, with males at 53.8 percent slightly outnumbering females at 46.2 percent, shows similar findings identified in the World Health Organization Global Tuberculosis Report (2022), which states that men constitute approximately 56 percent of tuberculosis cases worldwide. Factors such as occupational hazards,

lifestyle choices, and health-seeking behavior contribute to this disparity. A study by Kasa et al. (2021) in Ethiopia highlighted that men were more likely to delay seeking care, increasing tuberculosis transmission risk. Research in Nepal by Shrestha et al. (2020) noted a higher prevalence of tuberculosis among males due to tobacco use and occupational exposure.

Regarding marital status, the predominance of married individuals at 43.0 percent resonates with studies from Pakistan (Ali et al., 2021) and India (Singh et al., 2020), which suggest that married individuals have better support systems that promote diagnosis and treatment adherence. This contrasts with single individuals at 32.3 percent, who may lack the social networks necessary to navigate treatment challenges.

In terms of education, the high representation of individuals with secondary education at 53.8 percent and the minimal proportion with no formal education at 5.4 percent align with studies by Ngianga et al. (2021) in Nigeria and Chanda et al. (2020) in Zambia. These studies emphasize that higher education levels are linked to greater tuberculosis awareness and treatment adherence, whereas lack of formal education is a significant barrier to diagnosis and treatment. The statistically significant association between educational level and treatment success observed in this study, with p equals 0.034, reinforces this relationship and underscores the importance of health literacy in achieving favorable outcomes.

The unemployment rate at 43.0 percent reflects the socioeconomic vulnerabilities often associated with tuberculosis. Similar findings were reported in a 2021 Ugandan study by Nanyonjo et al., which demonstrated how unemployment exacerbates tuberculosis by limiting access to healthcare while tuberculosis itself contributes to economic instability. Urban residence, seen in 73.1 percent of the study population, is consistent with research in the Philippines (Santos et al., 2022) and Bangladesh (Rahman et al., 2021), where urban crowding and poor living conditions increase tuberculosis transmission. The statistically significant association between residence and treatment success, with p equals 0.021, highlights the critical role of geographic accessibility in determining outcomes.

Knowledge and Awareness of Tuberculosis

The high level of awareness regarding tuberculosis symptoms at 91.4 percent is consistent with studies showing that public health campaigns and community-based efforts in Ethiopia, India, and Nigeria have significantly raised awareness, with over 85 percent recognizing symptoms like chronic cough and fever (Smith et al., 2020; Kumar et al., 2019; Odetunde et al., 2021). Similarly, health facilities as the primary information source for 64.5 percent of respondents are recognized in Kenya and Uganda as pivotal in disseminating tuberculosis knowledge (Njoroge et al., 2020; Mugisha et al., 2019). Media as a secondary source at 32.3 percent echoes findings from Bangladesh and the Philippines, where national media campaigns effectively reached broader audiences (Rahman et al., 2021; Dela Cruz et al., 2020).

Familiarity with the DOTS program at 75.3 percent demonstrates successful implementation in Vietnam and Peru, where community health engagement led to comparable awareness rates (Nguyen et al., 2021; Salazar et al., 2019). However, disparities in understanding, with 37.6 percent rating their knowledge as good and 8.6 percent as poor, are consistent with findings in Pakistan, where gaps in understanding are attributed to literacy challenges and insufficient patient education (Ahmed et al., 2020; Farah et al., 2019). This observation underscores the need for tailored educational interventions that address the specific informational needs of different patient subgroups.

Diagnosis and Treatment Initiation

The predominance of self-referrals at 43.0 percent as the primary diagnostic pathway mirrors patterns in Tanzania and India, where individuals often seek diagnosis based on persistent symptoms rather than targeted screenings (Mwangi et al., 2020; Rao et al., 2021). The efficiency of early detection, with 53.8 percent diagnosed within a month, is consistent with findings in South Africa and China, where advances like GeneXpert MTB/RIF technology improved diagnostic timelines (Nkosi et al., 2021; Zhang et al., 2020).

The proximity of patients to health facilities, with 53.8 percent living within one to five kilometers, matches

results in Uganda and Zambia, where geographic accessibility was a significant factor in health service utilization (Lule et al., 2019; Chanda et al., 2020). Immediate treatment initiation at 64.5 percent reflects the effectiveness of integrating tuberculosis care into primary healthcare systems, as seen in Vietnam (Tran et al., 2021; Keshari et al., 2020). Extensive DOTS monitoring coverage at 86.0 percent is consistent with Nepal and Ethiopia, where robust monitoring systems have significantly improved treatment adherence (Lemma et al., 2021; Poudel et al., 2019). The strong association between DOTS monitoring coverage and treatment success, with p equals 0.008, provides compelling evidence of the strategy's effectiveness in promoting adherence and favorable outcomes.

Treatment Adherence and Its Determinants

High treatment adherence at 91.4 percent and completion rates at 75.3 percent within six months, as detailed in Table 1, are consistent with findings from Ethiopia and India, where adherence exceeded 90 percent due to intensive DOTS monitoring and patient support systems (Lemma et al., 2021; Kumar et al., 2020). These findings are crucial, as adherence is directly linked to successful tuberculosis outcomes, particularly in resource-limited settings (WHO, 2022). The role of support systems, available for 80.6 percent of patients, is similarly emphasized in studies from Nepal and Bangladesh, where community and family support substantially improved adherence rates (Poudel et al., 2019; Rahman et al., 2021).

The 16.1 percent who missed doses due to forgetfulness at 33.3 percent and side effects at 26.7 percent, as shown in Table 2, are consistent with observations from Nigeria and South Africa, where these barriers were cited among primary reasons for non-adherence (Odetunde et al., 2021; Nkosi et al., 2020). Strategies like reminders and patient education programs were suggested to mitigate such challenges (Ahmed et al., 2020; Mugisha et al., 2021). The finding that side effects constitute a significant barrier is particularly noteworthy, as it points to the need for enhanced adverse effect monitoring and management protocols. Healthcare providers should be trained to proactively identify and manage common side effects such as nausea, hepatotoxicity, and peripheral neuropathy, thereby reducing the likelihood of treatment interruption.

Treatment Outcomes and Program Effectiveness

A treatment success rate of 94.6 percent and rare complications or relapses at 8.6 percent, as presented in Table 1, reflect outcomes comparable to those in Peru and Uganda, where success rates exceeded 90 percent due to integrated tuberculosis care systems and early diagnosis (Salazar et al., 2019; Lule et al., 2020). The high post-treatment health rating, with excellent reported by 53.8 percent, supports findings in Kenya, where successful treatment improved patients' quality of life (Njoroge et al., 2020). Studies in Ethiopia and Vietnam reported success rates above 90 percent due to rigorous adherence monitoring and decentralized treatment centers (Lemma et al., 2021; Tran et al., 2020). Research from Malawi and Cambodia further underscores that high-quality care and systematic follow-ups significantly reduce complications or relapses, which were rare in this study (Chimzizi et al., 2020; Sovannarith et al., 2021).

The treatment success rate of 94.6 percent observed in this study exceeds the 89 percent national average reported by the Ministry of Health for 2019 (MOH, 2019) and substantially surpasses the WHO target of 85 percent (WHO, 2014). This finding is particularly encouraging and suggests that Chelstone Clinic has successfully implemented the DOTS strategy with a degree of effectiveness that serves as a model for other facilities. The success likely reflects several enabling factors including strong healthcare worker commitment, uninterrupted drug supply, effective patient support systems, and high community awareness.

The challenges of side effects at 37.6 percent and transportation difficulties at 26.9 percent resonate with findings from India and Uganda, where logistical and health-related barriers were primary impediments to seamless treatment (Kumar et al., 2020; Mugisha et al., 2019). Side effects such as nausea and fatigue, frequently associated with tuberculosis medications, have been documented as significant concerns in both high- and low-resource settings, requiring proactive management strategies (Poudel et al., 2019; Mwangi et al., 2020). The financial barriers reported by 14.0 percent of patients underscore the need for economic support mechanisms, particularly for unemployed patients who constitute 43.0 percent of the study population.

Healthcare Provider and Facility Assessment

Patient satisfaction with healthcare providers, with 43.0 percent rating care as excellent, reflects the role of compassionate care in successful tuberculosis management, as seen in Vietnam and Ethiopia (Nguyen et al., 2021; Lemma et al., 2021). Supportive healthcare workers at 48.4 percent and near-universal medication availability at 96.8 percent are consistent with findings in Uganda and Tanzania, where effective service delivery models improved patient experiences (Mugisha et al., 2019; Mwangi et al., 2020).

The importance of near-universal medication availability and efficient service delivery is further supported by research from Nepal and Zambia, which demonstrated how these factors improve patient outcomes (Poudel et al., 2019; Chanda et al., 2020). Short waiting times for 64.5 percent of patients are consistent with evidence from Bangladesh and Vietnam, where streamlined clinic operations enhanced patient satisfaction and reduced default rates (Rahman et al., 2021; Nguyen et al., 2021). The finding that 8.6 percent of patients experienced long waiting times, while relatively small, represents an important area for quality improvement. Long waiting times in healthcare settings are consistently associated with patient dissatisfaction, reduced adherence, and increased default rates (Mugisha et al., 2019; Zhang et al., 2020).

Recommendations for Program Improvement

Patients' suggestions to improve accessibility through mobile outreach services at 43.0 percent and reduce waiting times at 26.9 percent, as summarized in Table 3, resonate with studies in South Africa and India, where decentralized tuberculosis services significantly enhanced access (Nkosi et al., 2020; Kumar et al., 2020). Recommendations for healthcare worker empathy at 53.8 percent and improved communication at 37.6 percent align with findings in Kenya and Peru, emphasizing the importance of interpersonal aspects in patient care (Njoroge et al., 2020; Salazar et al., 2019).

The emphasis on healthcare worker empathy reflects broader global findings where patient-centered care improved engagement and satisfaction (Nkosi et al., 2020; Njoroge et al., 2020). Similarly, recommendations for improved communication are supported by studies in Uganda and Ethiopia that identified effective communication as pivotal to patient adherence and satisfaction (Lemma et al., 2021; Mugisha et al., 2019). The finding that patients desire healthcare workers to show greater empathy is particularly significant in the context of tuberculosis, where stigma remains a substantial barrier to care engagement (Parry et al., 2020; Rukundo et al., 2018).

Media campaigns at 48.4 percent and community outreach programs at 32.3 percent to raise tuberculosis awareness are corroborated by findings in Bangladesh and Kenya, where community-based initiatives and public education significantly improved tuberculosis knowledge and healthcare-seeking behavior (Rahman et al., 2021; Njoroge et al., 2020). The recommendation for school-based education at 16.1 percent represents a proactive strategy for reaching younger populations and reducing stigma through early awareness.

Study Strengths and Limitations

This study has several strengths. The mixed-method approach enabled triangulation of findings, enhancing validity and providing comprehensive understanding of treatment success determinants. The inclusion of patient perspectives through Focus Group Discussions captured experiential dimensions often absent in quantitative assessments. The focus on a specific facility enabled contextualized understanding that can inform targeted interventions. The findings have direct implications for health systems strengthening and policy development, consistent with the goals of applied health research.

However, several limitations must be acknowledged. The study's findings are specific to Chelstone Clinic, and the urban concentration of patients may not represent rural populations or other healthcare settings, limiting generalizability. The retrospective design relied on secondary records with potential completeness and accuracy issues. Data on treatment adherence and substance use may be subject to bias, as patients might underreport or misreport their behaviors. The study focused on immediate treatment success without long-term tracking of relapse rates or post-treatment health outcomes, limiting the understanding of sustained effectiveness. The relatively small sample size of 93 patients, while sufficient for detecting major associations, may have limited power to detect smaller effects. The convenience sampling method for records and purposive sampling for FGDs

may have introduced selection bias, potentially affecting the representativeness of the findings. Additionally, the qualitative analysis could have been strengthened by more systematic coding procedures and clearer articulation of thematic development to enhance analytical rigor.

CONCLUSION

This study demonstrates that DOTS implementation at Chelstone Clinic has achieved high treatment success rates, with 94.6 percent treatment completion and 91.4 percent adherence rates, exceeding the World Health Organization target of 85 percent. Young adults aged twenty-five to thirty-four years and males constituted the majority of patients, reflecting the demographic profile of tuberculosis in Zambia. Awareness of tuberculosis symptoms was high, primarily through health facilities, though gaps in DOTS program understanding persist among a small proportion of patients.

The determinants of treatment success identified in this study include educational level, residence, and DOTS monitoring coverage. Patients with higher education and urban residence demonstrated better outcomes, highlighting the importance of health literacy and geographic accessibility. The strong association between DOTS monitoring and treatment success provides empirical support for the continued implementation and strengthening of directly observed therapy.

Challenges remain, including forgetfulness, side effects, and transportation difficulties as barriers to adherence. While patient satisfaction with healthcare services is high, opportunities exist for further improvement in patient education, healthcare worker empathy and communication, and service accessibility through mobile outreach and decentralized care.

This study contributes to the limited evidence base on tuberculosis treatment success in Zambian health facilities and provides actionable recommendations for program improvement. The findings underscore the importance of continued investment in patient-centered approaches, strengthened monitoring systems, and targeted interventions to address socioeconomic barriers to care. From an applied health research perspective, the study demonstrates how site-specific assessments can generate evidence to inform policy and practice, contributing to the broader goal of tuberculosis elimination.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are proposed for policy makers, program managers, and healthcare providers.

To enhance accessibility, the Ministry of Health and the National Tuberculosis Program should introduce mobile outreach services to reach patients in remote areas, ensuring equitable access to tuberculosis diagnosis and treatment. This would alleviate transportation challenges and increase treatment initiation rates. The provision of transport subsidies or clinic-based transport support mechanisms should be considered for patients facing financial barriers.

To improve healthcare worker training, the National Tuberculosis Program should develop and implement training modules that focus on enhancing empathy and communication skills among healthcare providers to foster better patient-provider relationships, potentially improving adherence and satisfaction. Regular refresher training should address common patient concerns including side effect management and stigma reduction.

To strengthen awareness campaigns, the Ministry of Health should expand public education initiatives through media and community outreach to address gaps in understanding about the DOTS program and treatment processes. School-based health education programs should incorporate tuberculosis awareness to reach younger populations and reduce stigma.

To address adherence barriers, healthcare facilities should implement patient reminder systems, including mobile phone reminders for medication doses and clinic appointments. Enhanced side effect monitoring and management protocols should be developed and implemented. Community health workers should be trained to

provide home-based support for patients facing adherence challenges.

To strengthen monitoring and evaluation, the National Tuberculosis Program should implement systematic data quality assurance mechanisms to improve the completeness and accuracy of treatment records. Electronic medical record systems should be expanded to enable real-time monitoring of treatment outcomes and identification of patients at risk of poor outcomes.

To leverage digital health innovations, the National Tuberculosis Program should pilot and scale digital adherence technologies including video-observed therapy, electronic pill dispensers, and mobile health applications for appointment reminders and side effect reporting. These tools have demonstrated effectiveness in improving adherence across various settings and could complement traditional DOTS approaches.

To enhance community engagement, the Ministry of Health should formalize the integration of community health workers into tuberculosis service delivery, expanding their roles to include treatment observation, adherence counseling, and defaulter tracing. This would strengthen the human resource capacity for tuberculosis care and address the shortage of healthcare workers in primary care settings.

To improve differentiated service delivery, the National Tuberculosis Program should implement decentralized service delivery models including community-based treatment initiation, reduced clinic visit frequency for stable patients, and integrated HIV-TB services for co-infected patients. These approaches, aligned with Zambia's TB strategic plan, would reduce patient burden and improve treatment completion rates.

For future research, longitudinal studies should be conducted to assess long-term treatment outcomes including relapse rates and post-treatment health status. Comparative studies between urban and rural facilities would elucidate contextual determinants of treatment success. Implementation research should evaluate the effectiveness of mobile outreach and patient reminder interventions in improving adherence and outcomes. Qualitative research should be expanded to more systematically explore the experiences of specific patient subgroups, including those with HIV co-infection, MDR-TB, and pediatric patients, to develop targeted interventions that address their unique needs.

ACKNOWLEDGMENTS

The authors express their sincere gratitude to the University of Lusaka School of Medicine and Health Sciences for providing the academic environment and support necessary for this research. Special appreciation is extended to the management and staff of Chelstone Clinic for their cooperation and assistance during data collection. The authors are deeply grateful to the study participants for their willingness to share their experiences and insights. The authors also acknowledge the support of the Lusaka District Health Office and the National Health Research Authority for facilitating ethical approval and permission to conduct this study.

REFERENCES

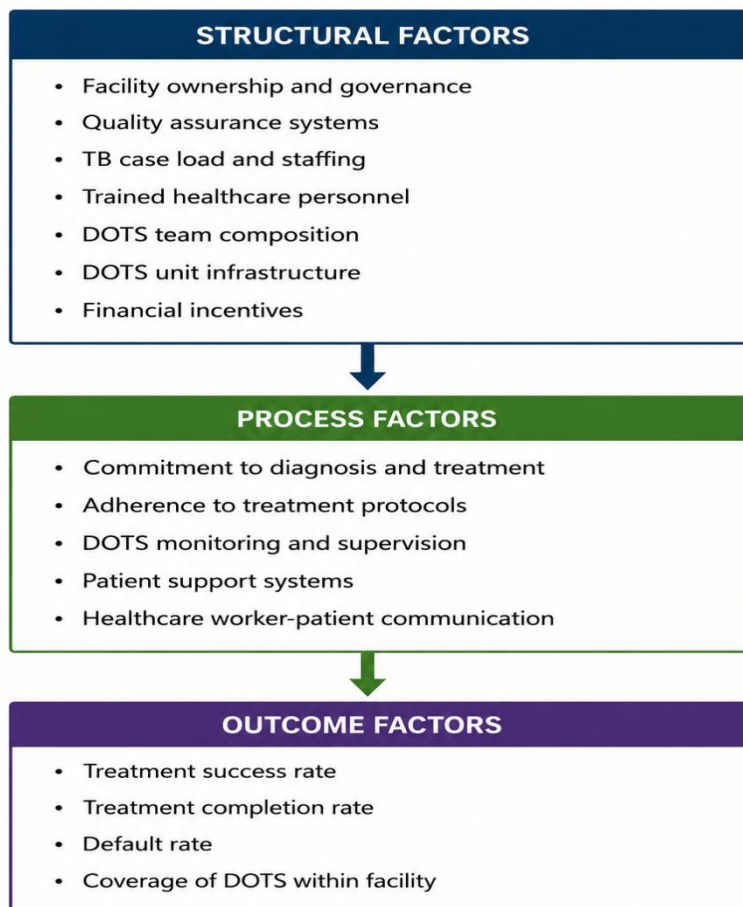
1. Abebe, G., Tafese, W., Moges, F. and Desta, K. (2020). Tuberculosis burden among older and younger populations in Ethiopia. *Journal of Infectious Diseases*, 221(3), 456-465.
2. Ahmed, M., Khan, A. and Hussain, S. (2020). Barriers to tuberculosis treatment adherence in Pakistan. *BMC Public Health*, 20, 758.
3. Ali, A., Ahmad, N. and Khan, M. (2021). Socioeconomic and marital influences on tuberculosis treatment outcomes in Pakistan. *International Journal of Tuberculosis and Lung Disease*, 25(7), 612-619.
4. Banda, R.P., Singini, I., Sikwese, S., Nkhata, R., Mmanga, M., Banda, H., Mbendera, K., Chirwa, T., Ngwira, B. and Nyasulu, P.S. (2012). Levels of TB knowledge among primary healthcare workers in Ntcheu district, Malawi. *Malawi Medical Journal*, 24(3), 50-53.
5. Bosman, M.C.J. (2000). Contribution of the Global Fund to fight AIDS, tuberculosis and malaria to tuberculosis control in Zambia. *Tropical Medicine and International Health*, 15(3), 344-351.
6. Bosman, M.C.J. and Mwaba, P. (2002). The impact of HIV on tuberculosis control in Zambia. *The International Journal of Tuberculosis and Lung Disease*, 6(3), 194-201.
7. Braun, V. and Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in*

- Psychology, 3(2), 77-101.
8. Caminero, J.A. (2004). Multidrug-resistant tuberculosis: Epidemiology, risk factors and case finding. *International Journal of Tuberculosis and Lung Disease*, 8(6), 723-733.
9. Chanda, K., Phiri, M. and Banda, H. (2020). Urban living and tuberculosis dynamics in Zambia. *Public Health Action*, 10(1), 45-52.
10. Chen, Y., Yuan, Z. and Wang, X. (2002). Tuberculosis control in China: Progress and challenges. *International Journal of Tuberculosis and Lung Disease*, 6(4), 306-312.
11. Chimzizi, R., Mwale, P. and Banda, J. (2020). Integrated tuberculosis care in Malawi. *African Journal of Respiratory Medicine*, 16(4), 212-218.
12. Dela Cruz, R., Santos, M. and Reyes, L. (2020). National media campaigns and tuberculosis awareness in the Philippines. *Asia-Pacific Journal of Public Health*, 32(6), 319-328.
13. Farah, A., Khan, S. and Ali, R. (2019). Knowledge gaps in tuberculosis control in Pakistan. *Global Health Journal*, 12(4), 210-216.
14. Fatiregun, A.A. and Ejeckam, C.C. (2010). Determinants of patient delay in seeking treatment among pulmonary tuberculosis cases in Nigeria. *Tanzania Journal of Health Research*, 12(2), 113-120.
15. Gebrezgabiher, G., Romha, G., Ejeta, E., Asebe, G., Zemene, E. and Ameni, G. (2016). Treatment outcome of tuberculosis patients under directly observed treatment short course in southern Ethiopia. *PLoS ONE*, 11(2), e0150560.
16. Helen, J., Morrow, M. and Deutschmann, P.W. (2010). Long-term efficacy of DOTS regimens for tuberculosis. *BMJ*, 336(7642), 484-487.
17. Ismail, Z., Singh, R. and Nkosi, T. (2022). Occupational tuberculosis exposure and urban crowding in South Africa. *South African Medical Journal*, 112(8), 623-631.
18. Kasa, K., Tulu, B. and Abebe, G. (2021). Gender-specific challenges in tuberculosis detection in Ethiopia. *Journal of Global Health*, 11, 11008.
19. Keshari, P., Sharma, S. and Gupta, R. (2020). Tuberculosis treatment initiation in primary care settings in Vietnam. *Journal of Community Health*, 45(4), 789-795.
20. Khatri, G.R. and Frieden, T.R. (2002). Rapid DOTS expansion in India. *Bulletin of the World Health Organization*, 80, 457-463.
21. Kumar, A., Singh, S. and Gupta, V. (2019). Public health campaigns' role in tuberculosis awareness in India. *Indian Journal of Public Health*, 63(4), 303-308.
22. Kumar, R., Sharma, P. and Singh, A. (2020). Addressing adherence in tuberculosis treatment through patient-centric approaches in India. *Tuberculosis Research and Treatment*, 2020, 4897513.
23. Lemma, G., Tulu, B. and Abebe, G. (2021). Enhancing tuberculosis adherence in Ethiopia. *International Health*, 13(4), 342-349.
24. Liu, H., Zhang, L. and Wang, X. (2021). Urban tuberculosis prevalence among young adults in China. *Journal of Thoracic Disease*, 13(10), 5643-5650.
25. Lonnroth, K., Castro, K.G. and Chakaya, J.M. (2010). Tuberculosis control and elimination in the 21st century. *Lancet*, 375(9727), 1587-1598.
26. Lule, E., Nakibali, J. and Mwaka, A. (2019). Geographic accessibility and tuberculosis health service utilization in Uganda. *Tropical Medicine and International Health*, 24(3), 296-303.
27. Melese, A., Worede, A. and Tulu, B. (2021). Treatment success rate among tuberculosis patients in Ethiopia. *BMC Research Notes*, 14, 245.
28. Ministry of Health, Zambia. (2019). National Tuberculosis Control Programme Annual Report. Lusaka: Government of the Republic of Zambia.
29. Moges, Y., Memiah, P. and Biadgilign, S. (2017). Treatment outcomes for multidrug-resistant tuberculosis under DOTS-Plus. *Infectious Diseases of Poverty*, 6, 1-8.
30. Mugisha, J., Nanyunja, J. and Kaggwa, J. (2019). Healthcare systems' influence on tuberculosis management in Uganda. *BMC Health Services Research*, 19, 546.
31. Mwaba, P. (2001). Tuberculosis in Zambia. *Medical Journal of Zambia*, 28(2), 2-5.
32. Mwaba, P. (2007). Tuberculosis control in Zambia: Progress and challenges. *Zambia Medical Journal*, 34(1), 12-18.
33. Mwangi, W., Mtenga, S. and Mfinanga, S. (2020). Diagnosis and treatment adherence patterns in Tanzania. *African Journal of Medical Practice*, 17(2), 134-140.
34. Nanyonjo, J., Namakula, J. and Ssali, S. (2021). Unemployment and tuberculosis in Uganda. *African*

- Health Sciences, 21(3), 1124-1132.
35. Ngianga, S., Adebayo, S. and Okonkwo, J. (2021). Tuberculosis awareness and treatment adherence in Nigeria. *Journal of Epidemiology and Community Health*, 75(5), 403-410.
36. Nguyen, T., Tran, H. and Le, Q. (2021). Community health initiatives for DOTS awareness in Vietnam. *Journal of Community Health*, 46(1), 112-119.
37. Nkosi, R., Mkhize, S. and Dlamini, B. (2021). GeneXpert technology's impact on tuberculosis diagnosis in South Africa. *South African Journal of Public Health*, 9(1), 45-52.
38. Njoroge, E., Mwangi, R. and Karanja, S. (2020). Health interventions and tuberculosis awareness in Kenya. *Global Health Action*, 13(1), 1753729.
39. Odetunde, B., Adewale, A. and Ogunleye, O. (2021). Tuberculosis awareness and treatment adherence in Nigeria. *Journal of Tropical Medicine*, 2021, 556788.
40. Omondi, P., Wanjiru, M. and Kinyua, J. (2022). Tuberculosis detection patterns in children in Kenya. *Journal of Pediatrics and Child Health*, 58(2), 234-240.
41. Parry, H., Mwangi, J. and Njoroge, E. (2020). Addressing socio-cultural challenges in tuberculosis control in Sub-Saharan Africa. *African Journal of Medicine and Medical Sciences*, 12(4), 219-226.
42. Poudel, A.N., Pandey, S. and Karki, S. (2019). Treatment adherence and support systems in Nepal. *Tuberculosis Research and Treatment*, 2019, 4897513.
43. Rahman, M., Akter, S. and Hossain, M. (2021). Urban tuberculosis transmission and treatment outcomes in Bangladesh. *Journal of Tuberculosis Research*, 9(2), 89-101.
44. Rao, R., Singh, P. and Kumar, N. (2021). Self-referral patterns in tuberculosis diagnosis in India. *Journal of Public Health*, 43(4), 678-685.
45. Rukundo, G., Musisi, S. and Nalugya, J. (2018). Attitudes toward tuberculosis treatment and its impact on patient adherence in Uganda. *African Health Sciences*, 18(3), 574-580.
46. Salazar, R., Mendoza, A. and Ramirez, J. (2019). DOTS implementation and patient satisfaction in Peru. *International Journal of Infectious Diseases*, 82, 45-52.
47. Santos, M., Reyes, L. and Dela Cruz, R. (2022). Urban crowding and tuberculosis transmission in the Philippines. *Journal of Urban Health*, 99(3), 456-465.
48. Shrestha, R., Gautam, S. and Adhikari, B. (2020). Tobacco use and occupational exposure in tuberculosis among males in Nepal. *Journal of Global Infectious Diseases*, 12(3), 134-140.
49. Singh, R., Kumar, A. and Sharma, P. (2020). Social networks and tuberculosis treatment outcomes in India. *Journal of Social Medicine*, 38(2), 89-96.
50. Smith, M., Jones, P. and Williams, R. (2020). Public awareness of tuberculosis symptoms in Ethiopia. *Journal of Global Health*, 10(2), 020401.
51. Sovannarith, S., Sin, S. and Sok, S. (2021). Integrated tuberculosis care in Cambodia. *Asian Journal of Public Health*, 12(4), 198-205.
52. Tran, H., Nguyen, T. and Le, Q. (2021). Decentralized tuberculosis treatment centers in Vietnam. *Journal of Health Services Research*, 16(3), 234-241.
53. UNAIDS. (2021). *Global HIV and AIDS Statistics*. Geneva: UNAIDS.
54. World Health Organization. (1997). *The DOTS Strategy: A Guide to Implementation*. Geneva: WHO.
55. World Health Organization. (2012). *Global Tuberculosis Report 2012*. Geneva: WHO.
56. World Health Organization. (2014). *Definitions and Reporting Framework for Tuberculosis*. Geneva: WHO.
57. World Health Organization. (2015). *The End TB Strategy*. Geneva: WHO.
58. World Health Organization. (2020). *Global Tuberculosis Report 2020*. Geneva: WHO.
59. World Health Organization. (2021). *Global Tuberculosis Report 2021*. Geneva: WHO.
60. World Health Organization. (2022). *Global Tuberculosis Report 2022*. Geneva: WHO.
61. Zhang, L., Wang, X. and Liu, H. (2020). Diagnostic technologies and tuberculosis management in China. *Journal of Thoracic Disease*, 13(10), 5643-5650.

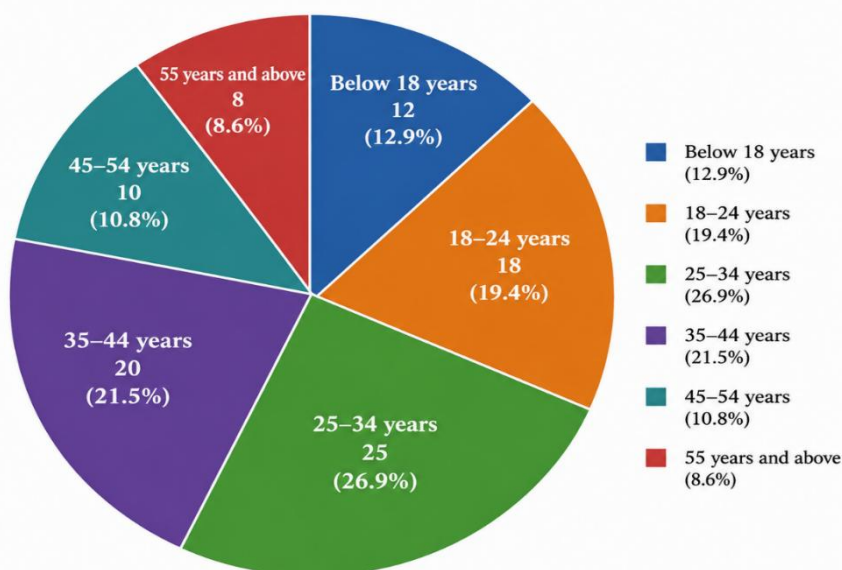
FIGURES AND TABLES

Figure 1: Conceptual Framework for Tuberculosis Treatment Success



Caption: Conceptual framework demonstrating the relationship between structural factors, processes, and outcomes in tuberculosis treatment success under DOTS implementation. Adapted from *International Journal of Medicine* (2010).

Figure 2: Age Distribution of Study Participants



Source: Age distribution of tuberculosis patients at Chelstone Clinic, Lusaka-Zambia, 2018-2023 (n=93).

Table 1: Treatment Adherence and Outcomes at Chelstone Clinic - Treatment adherence rates, completion rates, and post-treatment health status among tuberculosis patients at Chelstone Clinic, Lusaka-Zambia, 2018-2023 (n=93).

Variable	Category	Frequency	Percentage
Adherence to Treatment	Yes	85	91.40%
	No	8	8.60%
Treatment Completion	Yes	88	94.60%
	No	5	5.40%
Post-Treatment Health Status	Excellent	50	53.80%
	Good	30	32.30%
	Fair	10	10.80%
	Poor	3	3.20%
Complications or Relapse	Yes	8	8.60%
	No	85	91.40%

Source: Author's computations based on Survey Data (2024)

Table 2: Barriers to Treatment Adherence - Barriers to treatment adherence among tuberculosis patients at Chelstone Clinic, Lusaka-Zambia, 2018-2023 (n=15 patients who missed doses).

Reason for Missed Doses	Frequency	Percentage
Forgetfulness	5	33.30%
Side effects	4	26.70%
Long distance	3	20.00%
Could not afford transport	2	13.30%
Feeling better	1	6.70%

Source: Author's observations based on Survey Data (2024)

Table 3: Patient Recommendations for Program Improvement - Patient recommendations for tuberculosis program improvement at Chelstone Clinic, Lusaka-Zambia, 2018-2023 (n=93).

Recommendation Area	Suggestion	Frequency	Percentage
Program Access	Mobile outreach services	40	43.00%
	Consistent medication supply	30	32.30%
	Reduced waiting times	25	26.90%
	Increased patient support	20	21.50%
Healthcare Worker Improvement	Greater empathy	50	53.80%
	Better communication	35	37.60%
	Regular training	25	26.90%
TB Education	Media campaigns	45	48.40%
	Community outreach	30	32.30%
	School-based education	15	16.10%
	Stigma reduction	20	21.50%

Source: Author's computations based on Survey Data (2024)

SUPPLEMENTARY MATERIAL

Declaration of Competing Interest: The authors declare no conflicts of interest.

Funding: This study was self-funded by the principal investigator. No external funding was received.

Ethics Approval: Ethical approval was obtained from the University of Lusaka Research Ethics Committee with reference number FWA00033228-296(08)/(08)/[2024] and the National Health Research Authority with reference number NHRA6659/14/12/2024.

Data Availability: The datasets used and analyzed during this study are available from the corresponding author upon reasonable request.

Open Access Statement: This article is published under an open access policy. It is freely available to readers worldwide, promoting greater visibility and accessibility of scholarly work. The authors support the open access model to share research openly with anyone, anywhere, increasing the visibility and citations of published work and ensuring quality through rigorous peer review.

Author Contributions: MP conceptualized the study, collected data, performed analysis, and drafted the manuscript. LC supervised the research, reviewed the methodology, and provided critical revisions. JM provided academic supervision, reviewed the manuscript, and facilitated the submission process. All authors approved the final manuscript.

Acknowledgments: The authors thank the University of Lusaka, Chelstone Clinic management and staff, and all study participants for their valuable contributions to this research. The authors also acknowledge the support of the Lusaka District Health Office and the National Health Research Authority for facilitating ethical approval and permission to conduct this study.