



DISSERTATION REPORT

FACTORS ASSOCIATED WITH TYPE 2 DIABETES MELLITUS SCREENING AMONG TUBERCULOSIS PATIENTS IN MBALE REGIONAL REFERRAL HOSPITAL: A MIXED METHODS STUDY

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ABSTRACT

The growing dual burden of Type 2 Diabetes Mellitus (T2DM) and Tuberculosis (TB) poses a significant public health challenge, particularly in low- and middle-income countries. T2DM increases the risk of developing active TB and is associated with poorer TB treatment outcomes, including delayed sputum conversion, treatment failure, relapse and mortality. Despite national and global recommendations for bidirectional screening, implementation of T2DM screening among TB patients remains suboptimal in many settings, including Uganda, leading to missed diagnoses and poor treatment outcomes. This study aimed to determine the proportion of patients with TB screened for T2DM, assess factors associated with T2DM screening, and explore healthcare worker and health system barriers and facilitators affecting implementation at Mbale Regional Referral Hospital. A sequential explanatory mixed methods design was employed. The quantitative phase used a cross-sectional review of 310 TB patient records selected from an eligible sampling frame of 532 records, while the qualitative phase used key informant interviews with healthcare workers involved in TB and diabetes care. Quantitative data were analysed using descriptive statistics, bivariate tests and multivariable logistic regression, while qualitative data were analysed thematically using the six phases described by Braun and Clarke. Overall, 18.1% (56/310) of patients with TB were screened for T2DM. Among those screened, 44.6% (25/56) had normal blood glucose, 42.9% (24/56) had prediabetes, 8.9% (5/56) were newly identified with T2DM, and 3.6% (2/56) were already known to have T2DM. In the final multivariable model, age 50 years and above and rural residence were independently associated with T2DM screening. Drug resistant TB showed a strong bivariate association with screening but was not estimated as an independent predictor because near universal screening in this group produced quasi complete separation. Qualitative findings identified commodity shortages, weak service integration, workload, documentation burden and selective screening as major barriers, while guidance, training, supervision, routine data use and availability of TB and diabetes services were facilitators. T2DM screening among patients with TB at Mbale Regional Referral Hospital was low and selective rather than routine. The findings indicate important missed opportunities for early detection, including five newly identified T2DM cases among the 56 patients screened. Strengthening screening requires reliable commodities, clearer integration of TB and diabetes services, routine documentation and review of screening indicators, and continuous healthcare worker mentorship.

DECLARATION

I have read the rules of Busitema University on plagiarism and hereby state that this work is my own. It has not been submitted to any other institution for another degree or qualification, either in full or in part. Throughout the work I have acknowledged all sources used in its compilation.

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APPROVAL

This work has been produced under the supervision of

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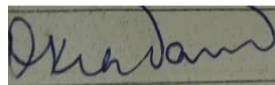
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DEDICATION

To my family, whose unwavering support, encouragement, and sacrifices have been the foundation of my academic journey. Specifically, my children, your patience, understanding, and belief in me gave me the strength to persevere through every challenge encountered along the way.

I also dedicate this work to all members of the MPH class of 2023 whose encouragement inspired me to complete this academic journey and patients affected by Tuberculosis, whose experiences continue to inspire efforts toward improving integrated care and health outcomes.

Finally, this dissertation is dedicated to all healthcare workers and researchers committed to advancing public health in resource-limited settings. Your dedication to service and innovation remains a driving force for change.

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Finally, I appreciate all individuals who contributed in one way or another to the successful completion of this study but may not be mentioned individually. Your support is highly valued.

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LIST OF ABBREVIATIONS/ACRONYMS

AOR	Adjusted odds ratio
C I	Confidence interval
CDC	Centre for disease control
DM	Diabetes mellitus
FBG	Fasting blood glucose
GPPAQ	General practice physical activity questioner
IDF	International diabetes federation
MOH	Ministry of Health
NCD	Non communicable diseases
OPD	Outpatient department
WHO	World Health Organization

DEFINITION OF KEY CONCEPTS

Term	Definition
Antibodies	Proteins in the blood that help the immune system recognize and neutralize foreign substances. Not directly used for participant inclusion but relevant to the understanding of TB pathogenesis.
Body Mass Index (BMI)	Calculated as weight (kg) divided by height (m ²). Used to categorize participants as underweight (<18.5), normal (18.5–24.9), overweight (25.0–29.9), or obese (≥30.0), based on WHO classification.
Comorbidity	Defined as the presence of one or more additional chronic conditions (e.g., diabetes, HIV) in a patient already diagnosed with TB. Identified via medical records and/or routine clinical records and qualitative healthcare worker interviews.
Fasting Blood Sugar (FBS)	Blood glucose level measured after an overnight fast of ≥8 hours. FBS ≥126 mg/dL indicates diabetes. Used as a screening tool to identify new or undiagnosed DM among TB patients.
Non-Communicable Diseases (NCDs)	Chronic diseases like DM and hypertension not caused by infectious agents. In this study, NCDs among TB patients were identified through health record reviews and/or clinical assessments.
Tuberculosis (TB)	Defined as any patient with a confirmed diagnosis in facility records using sputum smear, GeneXpert, or clinical diagnosis, following Uganda NTLP guidelines.
Type 2 Diabetes Mellitus (Type 2 DM)	A chronic metabolic condition defined as: (1) recorded clinical diagnosis or (2) FBS ≥126 mg/dL. Diagnosis criteria followed Uganda MoH and WHO guidelines.

Random Blood sugar	Refers to blood glucose test done at any time of the day, regardless of the patient's last meal. In this study, it was used to screen patients with tuberculosis for possible type 2 diabetes mellitus, with RBS ≥ 200 mg/dL, 11.1 mmol/L, considered suggestive of diabetes and requiring follow up.
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OPERATIONAL DEFINITIONS

Term	Operational Definition (as used in this study)
Diabetes Mellitus (DM)	Identified by: (1) existing diagnosis recorded in patient records or (2) an FBS ≥ 126 mg/dL taken during TB care. A patient was considered assessed for DM if FBS or any form of diabetes screening was documented.
Morbidity	Refers to the presence of TB, DM, or both during the study period. Information was extracted from patient records and clinical assessments.

CHAPTER ONE: INTRODUCTION

1.0 Introduction

Chapter One provides the background and context of the study, highlighting the relationship between TB and T2DM and the importance of routine screening. It presents the problem of inconsistent T2DM screening among TB patients at Mbale Regional Referral Hospital, the justification for the study, its objectives, and the conceptual framework guiding the investigation.

1.1 Background to the study

The convergence of communicable and non-communicable diseases has become a defining challenge in global health, particularly the interaction between Tuberculosis (TB) and Type 2 Diabetes Mellitus (T2DM). Scientific evidence demonstrates a bidirectional relationship between the two conditions. T2DM impairs immune function, increasing susceptibility to TB infection and progression to active disease, while TB infection worsens glycaemic control (Noubiap et al., 2019b; Restrepo, 2016). This interaction is associated with poor clinical outcomes such as delayed sputum conversion, treatment failure, relapse, and increased mortality (Alkabab et al., 2015; Baker et al., 2011). These findings provide a strong biological and epidemiological basis for integrating TB and diabetes care.

Globally, the burden of T2DM is rising rapidly, with over 537 million adults affected, a figure projected to increase significantly in the coming decades (International Diabetes Federation (IDF), 2025). At the same time, TB remains a leading infectious cause of death worldwide (WHO, 2023). Evidence from Asia indicates that the prevalence of diabetes among TB patients ranges between 15% and 25%, and that systematic screening improves early detection and treatment outcomes (Workneh et al., 2016; Xu et al., 2023). In response, the World Health Organization and the International Union Against Tuberculosis and Lung Disease recommended bidirectional screening as a key strategy for collaborative TB–diabetes care (World Health Organization, 2021). Despite this global consensus, implementation remains uneven across different health systems.

In sub-Saharan Africa, the dual burden of TB and T2DM is increasingly recognized, although historically underexplored. Studies have reported lower but rising prevalence of diabetes among TB patients, estimated at approximately 5–10% (Muramuzi et al., 2024). However, health systems in the region face persistent challenges, including limited diagnostic capacity, inadequate supply of screening tools, weak integration of TB and non-communicable disease services, and insufficient healthcare worker training (Fenta et al., 2023). While these studies provide insight into systemic barriers, they largely focus on prevalence and general constraints, leaving a critical gap in understanding how screening is implemented in routine clinical practice and what determines its uptake at facility level.

Uganda reflects this growing dual burden. TB remains a major public health problem, with an incidence of approximately 196 per 100,000 population (WHO, 2023), while T2DM prevalence is increasing, estimated at 4–5% among adults, and with many cases undiagnosed (International Diabetes Federation (IDF), 2025). Studies conducted in Uganda have reported diabetes prevalence among TB patients ranging from 1.3% to 13.8% depending on study setting and diagnostic methods (Kibirige et al., 2024; Nsonga et al., 2019). Despite the introduction of national guidelines recommending integrated TB–diabetes screening, implementation at facility level remains inconsistent due to resource limitations, poor documentation, and weak service integration (Nyirenda et al., 2023).

The increasing coexistence of Tuberculosis (TB) and Type 2 Diabetes Mellitus (T2DM) presents a growing public health challenge, with significant implications for disease control and patient outcomes. Scientific evidence shows that undiagnosed or poorly managed T2DM among TB patients contributes to delayed treatment response, increased risk of complications, and higher mortality.

At Mbale Regional Referral Hospital, a key tertiary facility in Eastern Uganda, both TB and diabetes services are available, yet evidence on routine T2DM screening within TB care remains limited. The key implementation gap is not the prevalence of diabetes alone, but whether patients with TB are consistently screened in routine care, which patients are more likely to be screened, and which healthcare worker and health system conditions facilitate or constrain implementation.

This study therefore focused on T2DM screening practice and the factors influencing its uptake at Mbale Regional Referral Hospital.

1.2 Problem statement

Tuberculosis remains a major public health problem in Uganda, while T2DM is increasingly important because undetected or poorly controlled diabetes can complicate TB management and worsen treatment outcomes. For this reason, the World Health Organization and Uganda Ministry of Health recommend that patients with TB should be assessed for diabetes as part of collaborative TB and diabetes care.

The principal problem is implementation of screening rather than the prevalence of diabetes alone. Ugandan evidence from a project supported setting in Kampala reported that 88.0% of patients with TB were screened for diabetes (Nsonga et al., 2019), demonstrating that high screening coverage is feasible when commodities, training, supervision and monitoring are deliberately supported. However, such project supported coverage cannot be assumed to represent routine service delivery across Uganda.

At Mbale Regional Referral Hospital, routine programme data had not been systematically used to quantify the proportion of patients with TB who were screened for T2DM, identify characteristics associated with screening, or explain the healthcare worker and health system conditions that influenced implementation. This evidence gap is particularly important for Eastern Uganda, where published evidence on routine TB and diabetes screening remains limited compared with central Uganda.

Without context specific evidence on routine screening, hospital managers and policy makers cannot determine the magnitude of missed screening opportunities or target the operational constraints that prevent implementation. The study therefore assessed the proportion screened, factors associated with screening, and healthcare worker and health system barriers and facilitators affecting T2DM screening among patients with TB at Mbale Regional Referral Hospital.

1.3 Objectives of the study

1.3.1 Main objective

To assess T2DM screening among patients with TB at Mbale Regional Referral Hospital by determining the proportion screened, identifying factors associated with screening, and exploring healthcare worker and health system barriers and facilitators affecting implementation.

1.3.2 Specific objectives

1. To determine the proportion of diagnosed TB patients screened for T2DM at Mbale Regional Referral Hospital TB Unit.
2. To identify factors associated with T2DM screening among patients with TB at Mbale Regional Referral Hospital TB Unit.
3. To explore healthcare worker and health system barriers and facilitators affecting the implementation of T2DM screening among patients with TB at Mbale Regional Referral Hospital TB Unit.

1.4 Research question

1. What is the proportion of diagnosed TB patients screened for type-2 diabetes among TB patients at Mbale Regional Referral Hospital?
2. What factors are associated with T2DM screening among patients with TB at Mbale Regional Referral Hospital TB Unit?
3. What healthcare worker and health system barriers and facilitators affect the implementation of T2DM screening among patients with TB at Mbale Regional Referral Hospital TB Unit?

1.5 Study Hypotheses

1.5.1 Null hypothesis, H_0

There is no statistically significant association between sociodemographic, clinical, behavioural, and health system factors and type 2 diabetes mellitus screening among patients with tuberculosis at Mbale Regional Referral Hospital.

1.5.2 Alternative hypothesis, H₁

There is a statistically significant association between socio demographic, clinical, behavioural, and health system factors and type 2 diabetes mellitus screening among patients with tuberculosis at Mbale Regional Referral Hospital.

1.6 Justification for the study

This study was justified by the urgent need to address persistent gaps in the implementation of type 2 diabetes mellitus (T2DM) screening among tuberculosis (TB) patients at Mbale Regional Referral Hospital (MRRH) and similar facilities in Uganda. Although national guidelines recommend integrated bidirectional screening, routine practice at the facility level remains limited, with challenges such as inadequate supplies for diagnostic tests, poor documentation, and minimal integration of TB and non-communicable disease services. These gaps hinder early diagnosis and proper management of TB–T2DM comorbidity, which is associated with delayed treatment response, higher risk of complications, and increased mortality. By systematically examining the proportion of TB patients screened for T2DM and identifying the barriers and facilitators to screening, this study will generate actionable evidence to strengthen health system practices at MRRH while also informing national and regional policy. The findings will be valuable not only for addressing local implementation bottlenecks but also for guiding the Ministry of Health and policymakers in designing strategies to enhance integrated TB–diabetes care and reduce the dual disease burden in Uganda.

1.7 Scope of the study

This study focused on assessing the factors associated with type 2 diabetes mellitus (T2DM) screening among tuberculosis (TB) patients at Mbale Regional Referral Hospital in Eastern Uganda. It was limited to TB patients receiving care at the hospital's TB clinic during the study period and examined both patient-related and health system-related factors influencing the uptake of T2DM screening. The study gathered retrospective data using data abstraction tool to determine the extent of screening practices. The findings were specific to the context of Mbale Regional Referral Hospital and are intended to inform local interventions and policy implementation aimed at strengthening integrated TB-DM care within similar resource-limited settings.

1.8 Conceptual Framework

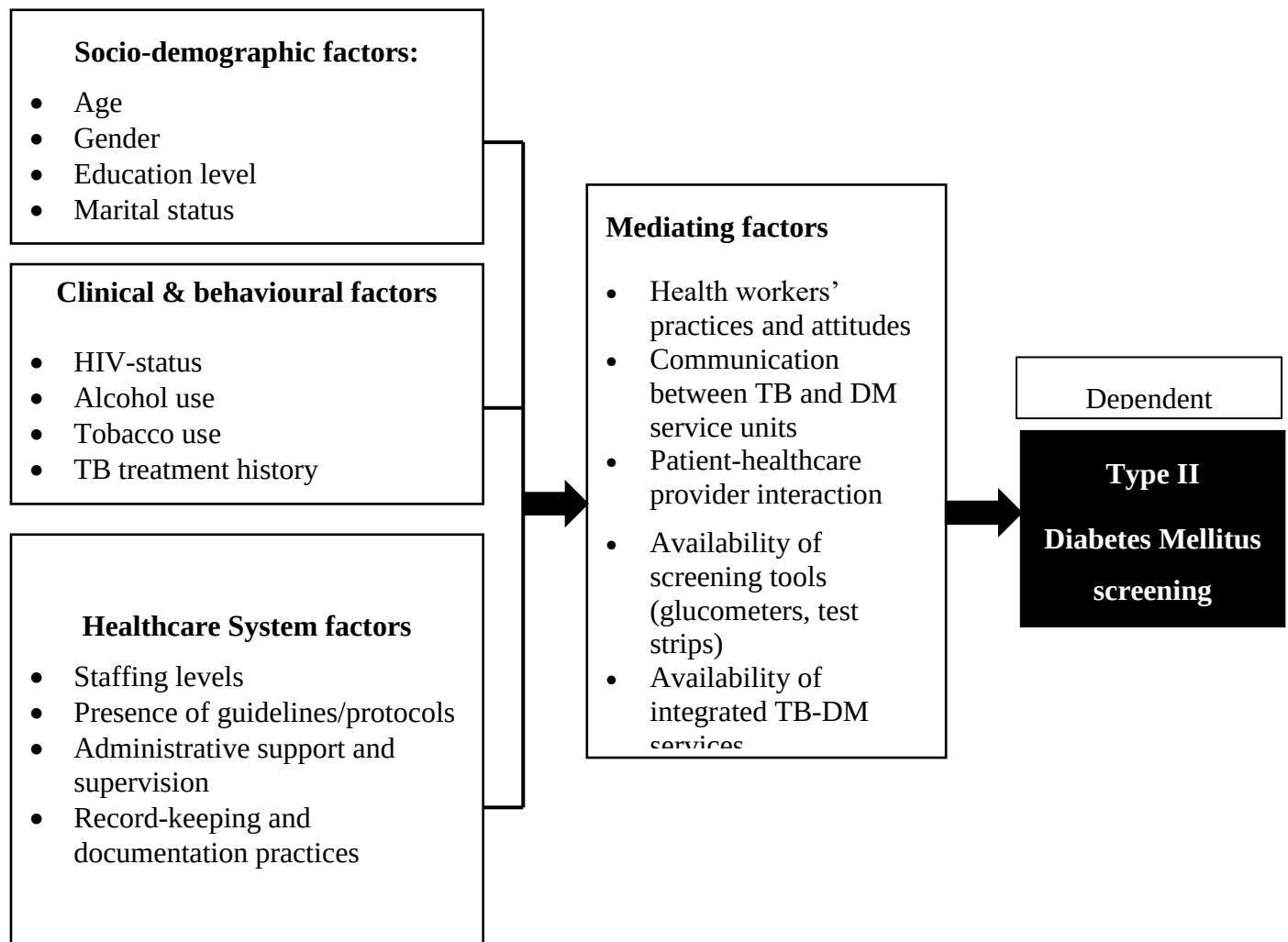


Figure 1.1: Conceptual framework

The conceptual framework demonstrates how socio-demographic factors (age, gender, marital status, and education), clinical and behavioural factors (HIV status, alcohol use, tobacco use, and TB treatment history), and healthcare system factors (availability of screening tools, integration of TB–DM services, staffing, guidelines, supervision, and documentation practices) influence the uptake of type 2 diabetes mellitus (T2DM) screening among tuberculosis (TB) patients, with mediating factors such as health workers' practices and attitudes, communication between TB and DM service units, and patient–provider interaction shaping the strength of these relationships. Socio-demographic and clinical factors affect patients' knowledge, susceptibility, and health-

seeking behaviour, while system-level readiness determines the accessibility and quality of screening services; however, even where resources are available, poor communication and negative provider attitudes may undermine implementation. Together, these factors converge to determine whether TB patients are screened for T2DM, highlighting the need for multi-level interventions targeting both systemic and patient-level barriers to improve integrated TB–diabetes care and reduce the dual disease burden.

1.9 Theoretical framework

This study is anchored in the Capability, Opportunity, and Motivation Behaviour model, (COM B Model), which explains behaviour as a product of the interaction between three core components: capability, opportunity, and motivation. In this study, the behaviour of interest is the implementation of type 2 diabetes mellitus screening among patients with tuberculosis at Mbale Regional Referral Hospital TB Unit.

Capability refers to the ability of healthcare workers to conduct type 2 diabetes mellitus screening among patients with tuberculosis. This includes their knowledge of screening guidelines, understanding of the relationship between tuberculosis and diabetes, clinical skills in performing blood glucose testing, and prior training in integrated tuberculosis and diabetes care. Where healthcare workers have inadequate knowledge, limited training, or poor technical confidence, screening may not be consistently implemented.

Opportunity refers to the external conditions within the health system that either enable or constrain screening. In this study, opportunity includes the availability of glucometers, test strips, lancets, registers, staffing levels, workload, clinic organization, referral pathways, supervision, and the level of integration between tuberculosis and diabetes services. Even when healthcare workers are knowledgeable and willing to screen, implementation may remain poor if screening commodities are unavailable, services are fragmented, or documentation systems are weak.

Motivation refers to the internal processes that influence whether healthcare workers prioritize and perform type 2 diabetes mellitus screening. This includes their attitudes toward screening, perceived importance of detecting diabetes among patients with tuberculosis, confidence in the usefulness of screening, competing clinical priorities, and routine work habits. Healthcare workers

who view screening as important and beneficial are more likely to integrate it into routine tuberculosis care.

The COM B model is relevant to this study because the implementation of type 2 diabetes mellitus screening does not depend on one factor alone. Screening may fail when healthcare workers lack capability, when the health system does not provide sufficient opportunity, or when motivation is weakened by workload, low prioritization, or poor feedback. Therefore, the model provides a useful framework for examining barriers and facilitators affecting screening implementation in a structured way.

In this study, the COM B model guided the qualitative arm by informing the development of the key informant interview guide and the interpretation of qualitative findings. Barriers and facilitators to type 2 diabetes mellitus screening were explored under the domains of capability, opportunity, and motivation. This helped to generate a deeper understanding of why screening was or was not routinely implemented among patients with tuberculosis at Mbale Regional Referral Hospital TB Unit.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

This chapter presents a review of existing literature related to type 2 diabetes mellitus (T2DM), with a particular focus on its screening among tuberculosis (TB) patients. The review explores key concepts and findings from previous studies, emphasizing the epidemiology of diabetes, the bidirectional relationship between TB and T2DM, and the factors that influence diabetes screening in TB care settings. Specifically, the chapter highlights socio-demographic factors, patient-related factors, healthcare system factors and mediating factors that may affect the uptake of diabetes screening among individuals diagnosed with TB.

2.1 T2DM screening among patients with TB and burden of TB and T2DM comorbidity

The literature distinguishes two related but different issues: the burden of diabetes among patients with TB and the proportion of patients with TB who are actually screened for diabetes. Prevalence studies establish the clinical need for bidirectional care, whereas screening studies assess whether recommended practice is being implemented. This distinction is important for the present study because its primary outcome was documented T2DM screening among patients with TB, not the prevalence of T2DM in the general population.

Globally and across sub Saharan Africa, diabetes is an important comorbidity among patients with TB, although estimates vary by population and diagnostic method. Evidence from systematic reviews and recent African studies indicates that diabetes and hyperglycaemia occur often enough among patients with TB to justify systematic screening, particularly because coexisting diabetes is associated with poorer TB outcomes (Noubiap et al., 2019b; Muramuzi et al., 2024). These studies support the clinical rationale for screening but do not, by themselves, show how consistently screening is implemented in routine TB services.

Ugandan evidence similarly shows that the prevalence of diabetes among patients with TB varies across settings. Recent Ugandan work has reported a range of approximately 1.3% to 13.8% among patients with TB, depending on setting and diagnostic criteria (Kibirige et al., 2024; Nsonga et al., 2019). This evidence should be interpreted separately from estimates of diabetes prevalence in the

general Ugandan adult population because the populations, denominators and clinical context are different.

Evidence on screening coverage in Uganda is more limited. Nsonga et al. (2019) reported that 88.0% of patients with TB were screened for diabetes in a Kampala implementation setting. Importantly, screening was supported by programme inputs such as training, screening algorithms, monitoring and logistical support. The study therefore demonstrates feasibility under supported implementation, but it does not establish that comparable screening coverage occurs in routine, non project supported TB services.

More recent implementation literature from Uganda and the region identifies persistent barriers to routine TB and diabetes integration, including gaps in commodities, documentation, staff preparation, referral systems and coordination between TB and non communicable disease services (Nyirenda et al., 2023; Mutalikdesai et al., 2024; Muttamba et al., 2024). Taken together, the evidence suggests that the central implementation question is no longer only whether patients with TB are at risk of diabetes, but whether health services consistently operationalise screening recommendations.

A clear geographical evidence gap remains in Eastern Uganda. Most directly relevant Ugandan screening evidence has come from central Uganda, while published evidence describing routine T2DM screening coverage, associated factors and implementation barriers at regional referral hospitals in Eastern Uganda is limited. This gap directly informed the objectives of the present study at Mbale Regional Referral Hospital.

2.2. Factors for T2DM among patients with TB co-morbidity

2.2.1 Socio-demographics

Age is a pivotal socio-demographic factor impacting health outcomes, including the prevalence of both T2DM and TB. Studies have documented that older age groups tend to exhibit higher frequencies of diabetes due to the natural history of insulin resistance and other age-related physiological changes (Chikhalikar et al., 2024). Particularly, research has indicated that patients over 50 years are at a higher risk for T2DM, especially when combined with other risk factors such as TB (Anasulfalah et al., 2022). The association between advancing age and both T2DM and TB

indicates a need for tailored screening programs targeting older populations to facilitate early diagnosis and management.

In addition, existing literature suggests that younger populations may often overlook health screening due to lower awareness and perceived health competence (Rajagopal et al., 2023). Addressing this age-related variance in screening behaviour is crucial for public health initiatives aimed at reducing the cumulative burden of TB and T2DM.

The influence of gender on health-seeking behaviour and disease prevalence cannot be understated. Epidemiological studies have shown distinct patterns in T2DM and TB prevalence based on gender, with men often exhibiting higher rates of TB while women are disproportionately affected by diabetes (Noubiap et al., 2019a). This gender disparity affects screening practices, as men may demonstrate less inclination to engage in preventive healthcare behaviours (Roudsari et al., 2023).

A meta-analysis highlighted that TB patients who are male tend to experience a more advanced disease stage upon diagnosis compared to their female counterparts, which may partially be attributed to lower rates of health-seeking behaviour among men (Muttamba et al., 2024). This finding underscores the importance of gender-sensitive health interventions that actively promote screening and treatment adherence among at-risk populations.

Education emerges as a critical determinant of health literacy, which in turn affects health-seeking behaviour and screening adherence. Research illustrates that patients with higher educational attainment are more likely to seek regular healthcare and engage in screening programs for chronic diseases like T2DM (Hill-Briggs et al., 2020). Conversely, those with lower educational levels are often less informed about the risks associated with TB and diabetes, leading to delayed presentations and unfavourable health outcomes (Prakoso et al., 2023).

In the context of Uganda, studies have noted that educational initiatives aimed at increasing awareness about T2DM and TB can significantly improve screening rates, particularly among populations with limited access to healthcare information (Kundu et al., 2020). Thus, effective public health strategies should focus on enhancing education and awareness campaigns tailored to the educational level of different socio-demographic groups.

Marital status plays an essential role in health behaviours, often influencing patients' health-seeking tendencies and support systems. Married individuals tend to report better health outcomes due to the supportive network available, which can facilitate early healthcare engagement (Huntington et al., 2022). However, some studies suggest that divorced or unmarried individuals may experience higher psychological stress and social isolation, which could lead to neglecting healthcare screening (Sari et al., 2019).

Moreover, individuals living alone or in unstable relational situations may lack the necessary encouragement or resources to engage in routine health screening, thus emphasizing the importance of fostering strong social support systems as part of effective intervention strategies.

2.2.2 Healthcare System factors

The presence of appropriate screening tools is paramount in identifying T2DM, particularly in resource-constrained settings. Glucometers and test strips have emerged as crucial instruments in the rapid assessment of blood glucose levels. Research indicates that their availability significantly impacts the implementation of diabetes screening programs. A study including various health centres in Uganda found that only 62% had glucometers, with a mere 13% providing urine testing strips necessary for diabetes testing (Hennein et al., 2021). This scarcity of essential tools directly hampers timely and effective diabetes screening among TB patients, ultimately leading to delayed diagnoses and poor management outcomes.

Further corroboration indicates that the installation of non-invasive blood glucose monitoring devices enhances screening capabilities in low-resource settings, suggesting that the use of handheld glucometers can facilitate early detection and management strategies (Foo et al., 2022). To support effective screening, health systems must prioritize the procurement and maintenance of glucometers and related supplies.

Moreover, public health initiatives must advocate for increased health system financing to ensure adequate supplies of glucose testing tools. A spectrum of initiatives from donation programs, local manufacturing, to public-private partnerships might improve the accessibility of these critical devices (Prakoso et al., 2023). These strategies can foster an environment conducive to enhanced screening rates among at-risk populations, including TB patients.

The integration of TB and diabetes management services emerges as a significant healthcare system factor influencing screening practices. Evidence suggests that healthcare facilities that incorporate integrated TB-DM services report better outcomes and higher rates of diabetes screenings among TB patients (Nyirenda et al., 2022; Tantipoj et al., 2022). This integrated approach facilitates a holistic management strategy, recognizing that TB patients are at heightened risk for developing T2DM due to chronic stress from TB illness and the metabolic effects of TB treatments (Akinshipe et al., 2021).

For instance, a study conducted in Indonesia highlighted that region with established screening protocols for both diseases experienced better adherence and outcomes due to the concurrent management of TB and comorbidities like diabetes (Prakoso et al., 2023). By engaging both TB and diabetes care professionals in a coordinated effort, healthcare facilities can ensure comprehensive management that addresses the interconnectedness of these illnesses, thereby increasing the likelihood of screening for diabetes among TB patients.

Furthermore, healthcare providers must undergo training to build the necessary skills for recognizing signs of T2DM among TB patients. A reported gap exists in healthcare knowledge regarding the bidirectional relationship between TB and diabetes, leading to missed opportunities for screening and early intervention (Nyirenda et al., 2022). Therefore, fostering integrated services combined with enhanced health education among healthcare workers can support improved monitoring and treatment adherence.

As an example of practical implementation, government-led initiatives in India sought to develop bi-directional screening protocols that combined TB testing and T2DM management, improving service delivery (Anand et al., 2018). Their model serves as a valuable template for developing similar protocols in resource-limited settings such as Uganda.

The adequacy of staffing is a significant determinant in the effectiveness and efficiency of healthcare service delivery, particularly concerning screening for T2DM among TB patients. Insufficient staffing levels can lead to prolonged wait times, decreased patient interactions, and ultimately, a lack of follow-through with screening programs. A systematic review suggests that health facilities with adequate staffing and ongoing training initiatives demonstrate better performance in diabetes screening (Basir et al., 2019; Majumdar et al., 2019).

In Uganda, the shortage of healthcare workers has been exacerbated by the dual burden of TB and diabetes management, requiring specialized knowledge and skills (Nyirenda et al., 2022). The lack of trained personnel often results in screening and treatment processes that are not aligned with international health standards, adversely impacting patient outcomes (Mac et al., 2020). Creating a more supportive staffing environment through recruitment measures, continuous medical education, and incentive structures is essential for operationalizing effective screening protocols.

Moreover, enhancing communication and collaboration among the healthcare staff can lead to improved screening rates. Engaging healthcare workers through regular training that underscores the significance of TB-DM co-morbidities and the importance of early screening can foster a conducive environment for proactive healthcare delivery (Mutalikdesai et al., 2024). Building a workforce that understands the clinical implications of these diseases in tandem is crucial for increasing awareness and timely intervention for at-risk patients.

The establishment of clear clinical guidelines and protocols significantly influences the management of T2DM screening in healthcare settings. Effective guidelines provide a framework for clinicians, facilitating evidence-based practices that ensure timely and appropriate screening of patients. Research indicates that the availability of such guidelines is critical in enhancing health outcomes in populations with dual diseases like TB and diabetes. Guidelines assist healthcare workers in identifying at-risk patients and standardize the care process, significantly improving adherence to screening protocols.

In Uganda, there are calls for standardized protocols that encompass the screening and management of comorbidities, especially among TB patients. A qualitative study highlighted that healthcare workers felt more confident in their screening practices when there were established protocols outlining the steps for managing diabetes in TB patients (Stalin et al., 2024). Such protocols are essential in combating the rising prevalence of T2DM within TB populations and ensuring effective healthcare delivery.

Moreover, protocols that integrate diabetes care into existing TB management frameworks have shown effectiveness in increasing screening rates. Research conducted in India demonstrated that implementing a bi-directional screening protocol for TB and diabetes resulted in improved identification of undiagnosed diabetes among TB patients, highlighting the importance of

developing context-specific guidelines catered to local healthcare needs (Stalin et al., 2024). Therefore, the presence of well-defined, easily accessible guidelines is paramount to enhance the quality of care and screening for TB patients at risk for T2DM.

Administrative support is critical in the implementation of health initiatives, including diabetes screening programs. Effective leadership and supervision can create an environment conducive to improved health service delivery. Research underscores that administrative backing can bolster the integration of screening programs by providing necessary resources, training, and motivation for healthcare providers. Inadequate support often results in diminished morale among health workers, leading to suboptimal performance in screening and treatment protocols.

It has been indicated that when health facility administrators prioritize the management of dual conditions such as diabetes and TB, it leads to supportive frameworks, including training programs that educate healthcare workers on the importance of regular screening. The study emphasized that administrative commitment significantly influences the allocation of resources necessary for effective medical interventions (Hassan, 2023).

In the context of Mbale Regional Referral Hospital, administrative support could manifest in two key areas: provision of necessary healthcare resources (such as screening tools) and fostering a supportive environment that encourages healthcare staff to adhere to diabetes care protocols. When healthcare administrators actively engage in decision-making processes and support organizational change, it can yield positive choices regarding diabetes screening implementation among TB patients. Thus, prominent administrative support is essential for establishing effective TB-DM integration and screening processes at regional referral hospitals.

Effective record-keeping and documentation are foundational elements of quality health services, playing a crucial role in managing chronic diseases such as T2DM. Accurate and comprehensive patient records facilitate informed clinical decision-making, continuity of care, and monitoring of treatment outcomes. In healthcare settings where robust record-keeping practices are maintained, significant improvements in screening initiatives can be observed due to the organized flow of patient information, leading to enhanced tracking of screenings and follow-ups.

Poor documentation practices hinder healthcare providers' ability to track T2DM screening among TB patients, resulting in missed opportunities for prompt intervention. The lack of integrated

electronic health record systems further complicates this issue, as many facilities still rely on manual record-keeping, which is prone to errors and inefficiencies. Improved documentation practices are necessary to ensure accurate tracking of health interventions, enabling timely diabetes screening for patients diagnosed with TB (Baqai et al., 2023).

Additionally, training healthcare providers on effective record-keeping practices is essential in ensuring that relevant data on T2DM and TB patients are accurately documented and accessible. A comprehensive audit of record management practices among healthcare providers indicated that there is a strong correlation between well-maintained health records and the rates of disease management processes, including screening for T2DM (Gillani et al., 2017). By improving documentation practices, healthcare facilities can enhance the delivery of integrated care to patients with both diabetes and TB, resulting in better health outcomes.

2.2.3 Mediating Factors

The practices and attitudes of health workers are consistently reported as key mediators in the uptake of T2DM screening among TB patients. Evidence suggests that the level of training and the clinical mindset regarding dual disease management influence screening behaviours. For instance, Foo et al. (2022) underscore the importance of manpower and training regarding non communicable disease screening and appropriate referrals. Their findings show that when healthcare workers are well-trained and their roles clearly defined, there is enhanced detection of otherwise missed non communicable diseases (NCDs), including T2DM. Likewise, Okoro et al. (2021) reported that a low level of routine TB screening among healthcare workers may stem from their limited knowledge of the benefits associated with early diagnosis, as well as an attitude that screening should be left to designated personnel. This lack of engagement or clarity regarding responsibilities can lead to inconsistent practices and may ultimately reduce the likelihood of T2DM being promptly identified among TB patients.

Further complicating matters, qualitative research by Salifu and Hlongwana (2020) found that some healthcare workers perceive bidirectional screening as disruptive to routine clinical work. Such negative attitudes whether due to perceived increases in workload or scepticism regarding the effectiveness of dual screening challenge the integration process. Additionally, Arini et al. (2022) highlighted that private primary care providers sometimes doubted the effectiveness of bi-

directional screening, reflecting a broader resistance among certain healthcare workers when confronted with the complexities of integrated care. Thus, healthcare worker practices and attitudes are fundamental mediators that either facilitate or hinder the effective screening of T2DM among TB patients.

Integrated care models require efficient communication channels between different service units. Studies indicate that seamless communication between TB and DM service units is essential for successfully coordinating dual screening efforts. Foo et al. (2022) reported that one of the strengths of their integrated model was the robust collaboration and partnership between TB and NCD clinics. This partnership relies on clear inter-unit communication to ensure that referrals are made readily and that information pertinent to screening is shared promptly. In a similar vein, Putra et al. (2018) found that support from health providers significantly enhanced patient participation in screening programs. Their study suggested that adequate communication between the units where patients received care and those responsible for screening not only improved the dissemination of health information but also reinforced the decision-making process among patients.

Mpagama et al. (2023) further demonstrated that innovative approaches such as structured interdepartmental channels can empower frontline health workers by facilitating a collective understanding of bi-directional screening protocols. This effective communication is critical in ensuring that any signal of comorbidity is not overlooked. In settings where resources are limited, such well-coordinated efforts between TB and DM units contribute to more timely and integrated responses, ultimately improving detection rates and patient outcomes.

The quality of interaction between patients and healthcare providers serves as another crucial mediator in the screening process. Studies reveal that a positive and empathetic patient-provider relationship increases patients' willingness to engage in screening, while negative interactions may lead to disengagement. Salifu and Hlongwana (2021) reported that frontline healthcare workers, who were often not fully aware of the integrated TB-DM policy, inadvertently contributed to a communication gap that undermined patient trust. This lack of adequate engagement can affect patients' perceptions of the necessity of screening and, consequently, their overall participation in health programs.

Additionally, Putra et al. (2018) emphasized that when providers take an active role in offering comprehensive health information, it improves patient knowledge and shapes a more positive attitude toward screening. Innovative solutions, such as the SMART health application described by Joshi et al. (2022), have been introduced to streamline patient–provider interactions. This electronic decision support system enables healthcare providers to deliver guideline-based assessments and fosters a more transparent and effective communication pathway. In turn, such enhancements in patient–provider interaction contribute substantially to ensuring that screening protocols are followed, and that patients feel both heard and adequately cared for.

2.3 Barriers and facilitators affecting the implementation of T2DM screening

2.3.1 Facilitators to implementation

Implementation of Type 2 diabetes mellitus screening among tuberculosis patients is strengthened when diabetes screening is embedded within routine TB care rather than handled as a separate service. Evidence from routine programme settings shows that screening becomes more feasible when health workers are trained, screening is done at the point of care, and blood glucose testing is incorporated into the normal TB clinic workflow (Nsonga et al., 2019). Similarly, studies on bidirectional TB and DM screening have shown that integrated service delivery improves case detection because patients are screened during existing clinic visits, reducing the need for additional appointments, referrals, and movement between departments (Majumdar et al., 2019; Salifu & Hlongwana, 2020). In the context of Mbale Regional Referral Hospital TB Unit, this suggests that routine screening would be more achievable if random blood sugar testing is conducted as part of the standard TB patient assessment process, especially at registration, treatment review, or follow up visits.

Availability of functional screening tools is another major facilitator. Studies from low resource settings consistently show that the presence of glucometers, glucose test strips, lancets, registers, and clear screening algorithms enables health workers to perform diabetes screening among TB patients with minimal disruption to routine services (Nsonga et al., 2019; Salifu & Hlongwana, 2020). In Uganda, screening TB patients for diabetes in routine health facilities was possible when trained health workers used fasting blood glucose testing as part of programme implementation,

showing that even resource constrained settings can implement screening when supplies and staff preparation are available (Nsonga et al., 2019).

Health worker training and supportive supervision also facilitate implementation. Healthcare workers are more likely to screen when they understand the clinical relationship between TB and diabetes, the effect of diabetes on TB treatment outcomes, and the correct interpretation of blood glucose results (Hennein et al., 2021; Salifu & Hlongwana, 2020). Training also improves confidence in identifying patients who need confirmatory testing, counselling, referral, or follow up (Hennein et al., 2021). Supportive supervision further strengthens implementation by reinforcing guidelines, reviewing screening data, identifying gaps, and providing feedback to frontline providers (Mutalikdesai et al., 2024).

Clear referral pathways and effective communication between TB and diabetes service points are also important. Evidence from integrated TB and DM programmes indicates that screening alone is insufficient unless patients with abnormal results are linked to confirmatory testing and diabetes care (Mutalikdesai et al., 2024; Salifu & Hlongwana, 2020). Where communication between TB clinics, laboratories, and diabetes clinics is functional, patients are less likely to be lost between screening and care (Majumdar et al., 2019).

2.3.2 Barriers to implementation

Despite these facilitators, implementation remains constrained by several health system barriers. The most common barrier reported across studies is irregular availability of screening commodities. Lack of glucose strips, glucometers, lancets, and other basic diagnostic supplies makes screening difficult even when health workers know that TB patients should be screened for diabetes (Nsonga et al., 2019; Salifu & Hlongwana, 2020). In such situations, screening becomes selective, delayed, or shifted to patients who can afford testing outside the facility. This creates inequity because poorer patients, asymptomatic patients, and those without obvious diabetes risk factors may be missed (Salifu & Hlongwana, 2020).

Weak integration of TB and diabetes services is another major barrier. Studies have shown that when TB and diabetes services are organized separately, screening is often treated as an additional activity rather than an essential part of TB care (Mutalikdesai et al., 2024; Salifu & Hlongwana,

2020). Fragmentation increases patient movement across departments, weakens feedback between service points, and makes it difficult to track whether patients with abnormal glucose results receive follow up care (Majumdar et al., 2019).

Workload and competing priorities also reduce screening implementation. TB clinics in high burden settings often manage diagnosis, treatment initiation, adherence counselling, HIV related care, drug refills, infection control, and documentation within limited staffing arrangements (Salifu & Hlongwana, 2020). Adding diabetes screening without additional staff, tools, or simplified procedures may be perceived as extra work, especially where patient numbers are high and clinic time is limited (Hennein et al., 2021).

Poor documentation and weak monitoring systems further undermine implementation. Evidence from integrated care studies shows that screening may be missed, repeated unnecessarily, or not followed up when registers do not capture diabetes screening status clearly (Mutalikdesai et al., 2024). Weak documentation also makes it difficult for managers to know whether low screening reflects lack of testing, poor recording, or poor linkage between service points (Salifu & Hlongwana, 2020).

CHAPTER THREE: METHODOLOGY

3.0 Introduction

This chapter outlines the methodological approach used in the study, including the study design, setting, population, sample size, sampling procedure, data collection tools and procedures, variables, data analysis, quality control, ethical considerations and dissemination.

3.1 Study design

This study employed a sequential explanatory mixed methods design, denoted QUAN followed by QUAL. The quantitative phase was conducted first using a cross sectional review of TB patient records to estimate the proportion screened for T2DM and assess factors associated with screening. Quantitative findings then informed the qualitative phase, which used key informant interviews with purposively selected healthcare workers involved in TB care, diabetes screening, laboratory services, documentation and programme coordination. The qualitative phase was used to explain the quantitative patterns, particularly why screening was low and why some patient groups were more likely to be screened. Integration occurred during interpretation by comparing quantitative results with qualitative themes on barriers and facilitators.

The sequential explanatory sequence was therefore: quantitative data collection, quantitative analysis, qualitative data collection informed by the quantitative results, qualitative thematic analysis, and integrated interpretation of the two strands. This design was appropriate because the quantitative component measured the implementation gap, while the qualitative component provided explanatory depth on healthcare worker and health system factors affecting routine screening.

Figure 2: Sequential explanatory mixed methods design

3.2 Study setting

The study was conducted at Mbale Regional Referral Hospital (MRRH), which serves 16 districts and 1 city in the Eastern region of Uganda. The hospital provides both inpatient and outpatient services and has a TB Unit that manages patients with drug resistant tuberculosis, DR TB, and

drug susceptible tuberculosis, DS TB. The TB Unit receives approximately 40 TB patients per month from within the hospital and from lower health facilities in the surrounding districts. MRRH also has a chronic care clinic that manages patients with Type 2 diabetes mellitus, T2DM, making it an appropriate setting for studying the implementation of T2DM screening among patients with TB. The presence of both TB and T2DM services within the same hospital provides an opportunity for integrated TB and T2DM care, including screening, referral, diagnosis, and follow up of patients with possible TB and T2DM comorbidity.

3.3 Quantitative study

3.3.1 Target population

All TB patients currently receiving treatment at Mbale regional referral hospital.

3.3.2 Accessible Population

All TB patients enrolled for treatment at MRRH TB unit during the study period.

3.3.3 Study population

TB patients registered at the MRRH TB clinic during the study period and documented in the facility's TB register.

3.3.3.1 Inclusion criteria

The study included records of all patients with tuberculosis who were registered at Mbale Regional Referral Hospital TB Unit between January and December 2025 and whose T2DM screening status could be determined from the TB register or corresponding patient file.

3.3.3.2 Exclusion criteria

Patient records were excluded from the sampling frame if the corresponding patient file could not be retrieved, the record did not meet the study eligibility criteria, or T2DM screening status could not be determined. Records that were eligible but had missing information on non outcome socio demographic or clinical variables were retained. Variable specific denominators were used in the analysis, and the affected tables explicitly indicate the denominator where it differed from 310.

3.3.4 Sample size determination

The study sample was determined using the Leslie Kish sampling formula (Kish, 1965) for cross-sectional studies;

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

Where, n is the desired sample size

z is the standard normal value corresponding to the required level of confidence (95%) = 1.96

P is the estimated prevalence of diabetes mellitus among TB patients was taken as 25.3% in an Indian tertiary care centre (Pande et al., 2018).

d is the desired precision of the estimate 5% (0.05)

$$N = \frac{1.96^2 \times 25.3(100-25.3)}{5^2}$$

$$N = \frac{3.8416 \times 25.3 \times 74.7}{25}$$

$$N = 290.4$$

Then Add 10% for missing data in the files: 310

Therefore, the sample sizes of respondents were 310 respondents.

3.3.5 Sampling of study subjects

Systematic random sampling was used after the eligible sampling frame had been established. A total of 665 TB records were initially identified for January to December 2025; 133 were removed before sampling because the corresponding patient files could not be retrieved or the records did not meet the eligibility criteria. The remaining 532 eligible records formed the sampling frame from which the required 310 records were selected.

The sampling interval was calculated as $k = 532/310$, approximately 1.72. A random start was selected within the first sampling interval and systematic selection then proceeded through the ordered list of 532 eligible records until 310 records had been selected. Eligibility was therefore

determined before systematic selection, rather than replacing ineligible selected records with the next record.

The 310 systematically selected records were retrieved and abstracted using the structured data abstraction form. All selected records had a determinable T2DM screening outcome and were included in the final quantitative analysis. This clarified the pathway from the 665 records initially identified, to 532 eligible records in the sampling frame, and finally to the 310 records analysed.

3.3.6 Study variables

3.3.6.1 Dependent variable

The dependent variable was screened for T2DM which was categorised as binary variable, with YES for screened for T2DM and NO for not screened for T2DM.

3.3.6.2 Independent variable

The independent variables of the study were both barriers and facilitators put under:

Socio-demographic characteristics such as age, gender, education level, marital status, and household income Patient-related factors including awareness and knowledge of T2DM, perceived susceptibility to diabetes, and individual attitudes towards screening

Healthcare system factors form including availability and quality of institutional resources that can avail essential diagnostic tools like glucometers and test strips, staffing adequacy, and the integration of TB-DM services within the facility.

3.3.7 Data collection tools and methods

Quantitative data were abstracted from the TB register and corresponding patient files using a structured data abstraction form. The form captured socio demographic characteristics, selected behavioural and clinical characteristics, TB classification and category, HIV and ART information, and documented T2DM screening status, screening method and screening outcome. No participant questionnaire was administered for the quantitative component.

The abstraction form was informed by variables relevant to TB and diabetes screening and by standard approaches to non communicable disease risk assessment. Only information documented

in routine records was abstracted. The tool was reviewed for clarity, completeness and alignment with the study objectives before data collection.

3.3.8 Data Analysis and Presentation

Completed data abstraction forms were checked for completeness, consistency and accuracy before data entry. Data were coded, entered, cleaned and analysed using Stata version 18. Cleaning included checks for duplicate records, invalid codes, outliers, missing values and inconsistencies between related variables. No statistical imputation was performed. Because the primary outcome, T2DM screening status, was available for all 310 records, all records contributed to the primary analysis. For variables with missing non outcome information, available case analysis was used and the denominator was reported explicitly, for example marital status, N=309, and ART status, N=63.

The primary outcome variable was T2DM screening status. A patient was coded as screened if a documented blood glucose screening test was recorded in the TB register or corresponding patient file. Patients without a documented screening test were coded as not screened. For analysis, screening status was coded as 1 for screened and 0 for not screened. The proportion screened was calculated by dividing the number of TB patients with documented T2DM screening by the total number of TB patient records included in the analysis and multiplying the result by 100.

At univariate analysis, categorical variables were summarised using frequencies and percentages. Continuous variables were assessed for normality and summarised using means and standard deviations when normally distributed or medians and interquartile ranges when skewed. The findings were presented using tables and narrative summaries.

At bivariate analysis, T2DM screening status was compared across socio demographic and clinical characteristics. Row percentages were calculated to show the proportion screened and not screened within each category of the explanatory variables. Pearson's chi square test was used to assess associations where its assumptions were satisfied. Fisher's exact test was used for variables with expected cell frequencies below five. Statistical significance at bivariate analysis was assessed using p values.

Binary logistic regression was used to estimate crude and adjusted odds ratios with their corresponding 95% confidence intervals. The model estimated the odds of being screened for T2DM. Variables with a p value below 0.20 at bivariable analysis were considered for inclusion in the multivariable logistic regression model. Variables identified from existing literature as potential confounders were also considered, regardless of their bivariable p values.

Before fitting the final model, explanatory variables were assessed for multicollinearity using variance inflation factors and examination of associations between categorical predictors. Variables with evidence of strong multicollinearity were assessed to determine which variable was clinically and analytically more appropriate for inclusion. Sparse observations and complete or quasi complete separation were also assessed. Variables producing unstable estimates because of separation were excluded from the ordinary logistic regression model and reported descriptively with an explanation.

A backward elimination approach was used to obtain the final multivariable model while retaining variables that were statistically significant, clinically important, or demonstrated evidence of confounding. Confounding was considered present when removal of a variable resulted in a meaningful change in the effect estimates of the variables retained in the model. Model fit was assessed using the Hosmer Lemeshow goodness of fit test. Adjusted odds ratios, 95% confidence intervals, and p values were reported. Statistical significance in the final model was set at $p < 0.05$.

Available case analysis was used for variables with missing observations. The denominator used for each variable was reported, and records were not excluded from the entire analysis solely because information was missing for a secondary explanatory variable. Reference categories were selected based on clinical relevance, logical ordering, and sufficient numbers of observations.

3.4 Qualitative design methods

The qualitative component was conducted after the quantitative phase to provide a deeper explanation of the barriers and facilitators affecting the implementation of Type 2 diabetes mellitus screening among patients with tuberculosis at Mbale Regional Referral Hospital TB Unit. The qualitative approach used key informant interviews with healthcare workers who were directly or indirectly involved in TB care, diabetes screening, patient counselling, documentation, and referral of patients for further care.

3.4.1 Target population

The target population for the qualitative component comprised all healthcare workers involved in tuberculosis care and Type 2 diabetes mellitus screening services in referral hospitals in Uganda.

3.4.2 Accessible population

The accessible population comprised healthcare workers involved in tuberculosis care, Type 2 diabetes mellitus screening, counselling, documentation, referral, and follow up of patients with tuberculosis at Mbale Regional Referral Hospital.

3.4.3 Study population

The study population comprised healthcare workers working in or linked to the TB Unit at Mbale Regional Referral Hospital during the study period. These included medical officers, clinical officers, nurses, counsellors, laboratory personnel, records personnel, and unit in charges who were considered knowledgeable about the implementation of Type 2 diabetes mellitus screening among patients with tuberculosis.

3.4.4 Inclusion and exclusion criteria

Healthcare workers were included if they were working at Mbale Regional Referral Hospital, were involved in TB care, Type 2 diabetes mellitus screening, counselling, documentation, referral, or supervision, and had worked in the relevant service area for at least six months. This ensured that participants had sufficient experience to provide meaningful information on routine screening practices.

Healthcare workers were excluded if they were on leave, unavailable during the data collection period, too ill to participate, or unwilling to provide informed consent.

3.4.5 Sample size for the qualitative component

A total of 8 key informants were purposively selected for the qualitative component. The sample size was considered adequate because the qualitative phase aimed to obtain rich explanatory information from healthcare workers with direct knowledge of TB care and Type 2 diabetes mellitus screening practices. The final number of participants was guided by relevance of the

participants to the study objective and the need to obtain diverse views from different cadres involved in service delivery.

Table: Distribution of key informants for the qualitative component

Cadre of key informant	Number selected	Justification for inclusion
Medical officer	1	Provides clinical oversight and decision making for patients with TB and possible Type 2 diabetes mellitus
Clinical officer	1	Directly involved in routine assessment, diagnosis, treatment review, and referral of patients with TB
Nurse	2	Involved in daily TB clinic care, patient preparation, follow up, documentation, and screening support
Counsellor	1	Provides patient counselling, adherence support, and health education for patients with TB
Laboratory personnel	1	Provides information on blood glucose testing processes, sample handling, and availability of testing services
Records officer or data clerk	1	Provides information on documentation of screening status, registers, and completeness of patient records
TB Unit in charge or focal person	1	Provides information on coordination, supervision, supplies, reporting, and implementation of TB and diabetes screening activities
Total	8	

3.4.6 Sampling procedure

Purposive sampling was used to select key informants with knowledge and experience relevant to the implementation of Type 2 diabetes mellitus screening among patients with tuberculosis. Participants were selected based on their role in TB care, diabetes screening, documentation, counselling, laboratory testing, referral, or supervision. This approach was appropriate because the qualitative component required information rich participants who could explain the practical barriers and facilitators affecting screening implementation at the TB Unit.

3.4.7 Data collection tool

Data were collected using a semi structured key informant interview guide. The guide contained open ended questions on current screening practices, availability of screening tools, staff knowledge and training, patient flow, referral processes, documentation, workload, supervision,

and perceived barriers and facilitators to Type 2 diabetes mellitus screening among patients with tuberculosis. The semi structured format allowed the researcher to ask consistent questions across participants while also probing for detailed explanations and examples from routine practice.

3.4.8 Testing of the data collection tool

The key informant interview guide was reviewed by the supervisors and public health experts to assess clarity, relevance, flow, and alignment with the qualitative objective. The tool was then pretested among healthcare workers in a comparable service setting who were not part of the final study participants. The pretest helped to identify unclear questions, repetitive items, and areas requiring additional probing. Findings from the pretest were used to revise the interview guide before actual data collection.

3.4.9 Data collection procedure

Data were collected through face-to-face key informant interviews conducted in a quiet and private place within the hospital to ensure confidentiality and minimize interruption. Before each interview, the purpose of the study was explained, written informed consent was obtained, and permission to audio record the discussion was requested. Each interview was conducted using the semi structured interview guide and lasted approximately 30 to 45 minutes. Field notes were taken during and immediately after the interviews to capture nonverbal observations, contextual issues, and emerging reflections.

3.4.10 Research assistants and training

Two research assistants with prior experience in health-related data collection were recruited and trained before data collection. The training covered the study objectives, ethical conduct, informed consent procedures, use of the interview guide, probing techniques, confidentiality, audio recording, note taking, and safe handling of study materials. The research assistants supported participant scheduling, consent procedures, note taking, and management of audio files. The principal investigator supervised the entire data collection process to ensure consistency and quality.

3.4.11 Data management and analysis

Audio recorded interviews were transcribed verbatim and checked against the recordings for accuracy. The transcripts were cleaned, anonymized, and stored securely using password protected files. Data were analysed using thematic analysis. The researcher first read the transcripts repeatedly to become familiar with the data.

Data were analysed using thematic analysis as described by Braun and Clarke (2006) and managed in ATLAS.ti 20. The analysis followed six phases. First, the researcher became familiar with the data through repeated reading of transcripts and review of field notes. Second, initial codes were generated systematically across the dataset. Third, related codes were collated into candidate themes. Fourth, candidate themes were reviewed against coded extracts and the full dataset to assess coherence and distinction. Fifth, themes were defined and named, with clear descriptions of the central organising concept of each theme. Sixth, the analytic narrative was produced by relating the final themes to the study objective and supporting them with illustrative participant quotations. Coding and theme development were iterative, and the final thematic structure was reviewed for consistency with the quantitative findings before integrated interpretation.

To ensure the study findings are trustworthy, we followed rigorous, transparent, and ethical practices throughout the research process. That is; using reliable and appropriate methods for data collection and analysis, ensuring credibility by accurately reflecting participants' views often through techniques like triangulation and member checking and maintaining consistency in procedures to support dependability. Transparency was essential; we clearly documented the data collection and analysis processes to allow for easy verification. We also provided rich, detailed descriptions of the study context and participants to ensure transferability, enabling others to assess the relevance of the findings to similar setting

3.4.12 Quality control for the qualitative component

Quality of the qualitative data were ensured through careful selection of information rich participants, pretesting of the interview guide, training of research assistants, use of probing questions, audio recording of interviews, and daily review of field notes and transcripts. Credibility was enhanced by comparing information across different cadres of healthcare workers. Dependability was supported by maintaining a clear record of data collection procedures, coding

decisions, and theme development. Confirmability was strengthened by using direct participant quotations to support the findings, while transferability was enhanced by providing a clear description of the study setting, participant categories, and service context.

3.5 Ethical considerations

Ethical approval for the study was obtained from the Busitema University Faculty of Health Sciences Research and Ethics Committee before data collection. Administrative permission was subsequently obtained from Mbale Regional Referral Hospital. The quantitative record review used routinely collected patient information, while written informed consent was obtained from healthcare workers who participated in the qualitative interviews.

An official introduction and permission process was completed with Mbale Regional Referral Hospital management before access to the TB Unit records and healthcare workers. The research team complied with the conditions of approval and hospital procedures throughout data collection.

Qualitative participants were informed that their responses would be kept confidential, de-identified during transcription and reporting, and used only for the approved research purposes. Quantitative data were abstracted without including patient names in the analysis dataset. Electronic files were password protected and hard copy materials were stored securely.

Participation in the qualitative component was voluntary. Healthcare workers were informed of their right to decline participation, omit any question or withdraw without penalty. Written informed consent and permission for audio recording were obtained before each interview. Privacy was maintained by conducting interviews in a suitable private setting and using participant codes in transcripts and quotations.

3.6 Plan for dissemination

The study findings will be disseminated through the final dissertation, feedback to Mbale Regional Referral Hospital and relevant health programme stakeholders, scientific presentations, policy oriented communication and, where feasible, publication in a peer reviewed journal. A copy of the approved dissertation will be submitted to Busitema University in accordance with academic requirements.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.0 Introduction

This chapter presents and discusses the study findings in relation to the three study objectives. It begins with the characteristics of patients with tuberculosis and the proportion screened for type 2 diabetes mellitus, followed by factors associated with screening. The chapter then presents the qualitative findings on healthcare worker and health system barriers and facilitators affecting implementation, and discusses the findings in relation to existing literature and their implications for practice.

4.1 Quantitative findings

4.1.1 Participants flow chart

A total of 665 TB patient records registered at Mbale Regional Referral Hospital TB Unit between January and December 2025 were initially identified. Before sampling, 133 records were excluded because the corresponding patient files could not be retrieved or the records did not meet the eligibility criteria. The remaining 532 eligible records formed the sampling frame. Systematic random sampling was then applied to this eligible frame, and 310 records were selected. All 310 selected records had documented T2DM screening status and were included in the final quantitative analysis, as presented in Figure 3.

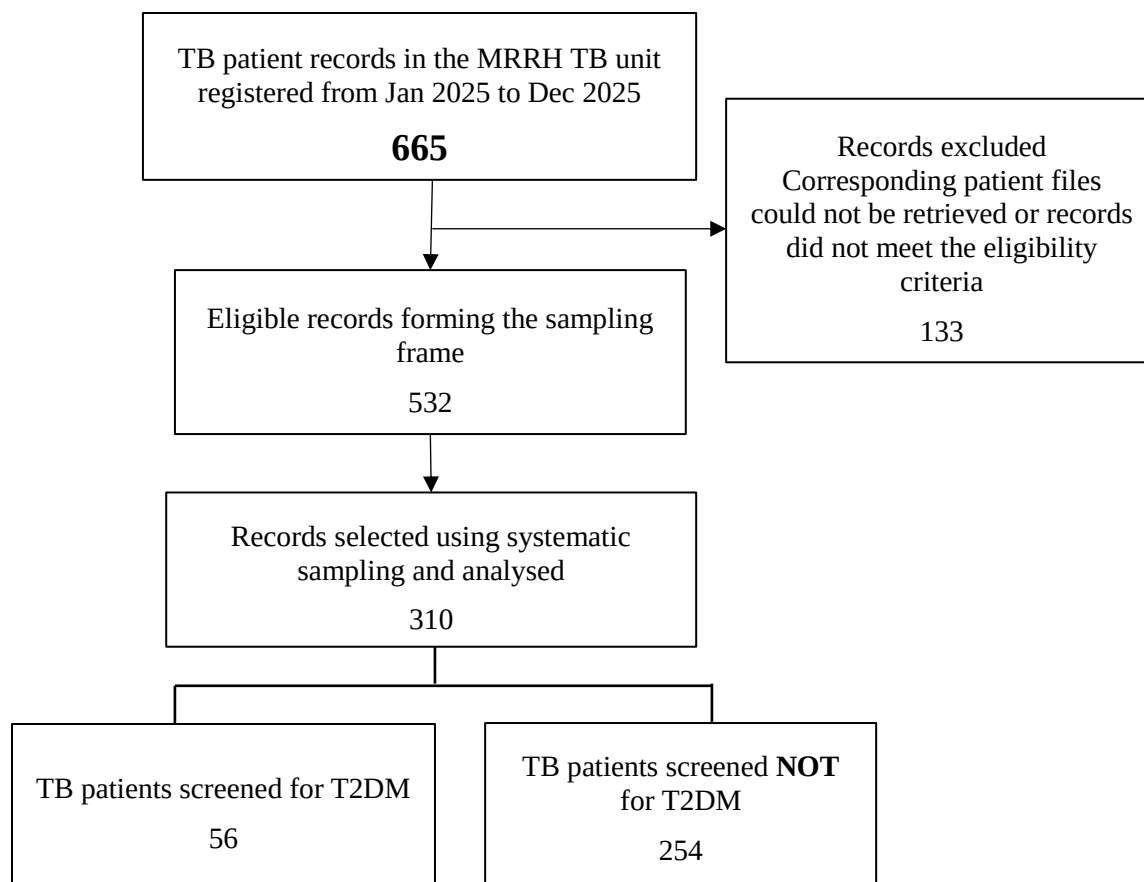


Figure 3: Participants flow chart

4.1.2 Socio demographic and clinical characteristics of TB patients

A total of 310 TB patients' files were included in the analysis. The mean age of the participants was 41.39 years with a standard deviation of 15.23 years. Regarding age distribution, the highest proportion of participants were aged 30 to 40 years, 29.7% (92/310), followed by those aged 50 years and above, 26.8% (83/310). The lowest proportion was observed among participants aged 41 to 50 years, 18.1% (56/310). Most participants were male, 62.9% (195/310). Marital status was documented for 309 participants; among those with available marital status, 70.6% (218/309) were married, 23.3% (72/309) were single and 6.1% (19/309) were widowed or separated. One participant had missing marital status information. Nearly two thirds of participants were from rural areas, 64.2% (199/310), while 35.8% (111/310) were from urban areas. Almost all participants had no documented history of smoking, 98.1% (304/310), and 95.5% (296/310) had

no documented history of alcohol use. Table 1 below presents the socio demographic and selected clinical characteristics; denominators are 310 unless otherwise indicated.

Table 1: Socio demographic and clinical characteristics of patients with TB included in the quantitative analysis at MRRH TB Unit (N=310)

Variable and category	Frequency	Percentage
Age in completed years, mean (SD)		
Age category		
<30	79	25.5
30 to 40	92	29.7
41 to 50	56	18.1
50+	83	26.8
Sex of patient		
Female	115	37.1
Male	195	62.9
Marital status (N=309)		
Married	218	70.6
Single never married	72	23.3
Widowed or separated	19	6.1
Residence		
Rural	199	64.2
Urban	111	35.8
History of smoking		
No	304	98.1
Yes	6	1.9
History of alcohol use		
No	296	95.5
Yes	14	4.5

4.1.3 Proportion of patients with TB screened for T2DM

Out of the 310 diagnosed TB patients included in the study, only 18.1% (56/310) were screened for T2DM, as shown in Figure 4 below.

Among the 56 TB patients who were screened for type 2 diabetes mellitus, random blood sugar was the most commonly used screening method, 98.2% (55/56), while fasting blood sugar was used for only 1.8% (1/56). Regarding the screening outcomes, 44.6% (25/56) had normal blood

sugar findings, while 42.9% (24/56) were classified as pre diabetic. Newly diagnosed type 2 diabetes mellitus was identified among 8.9% (5/56) of those screened, while 3.6% (2/56) were already known to have type 2 diabetes mellitus.

Figure 4. T2DM screening status among patients with TB included in the quantitative analysis (N=310)

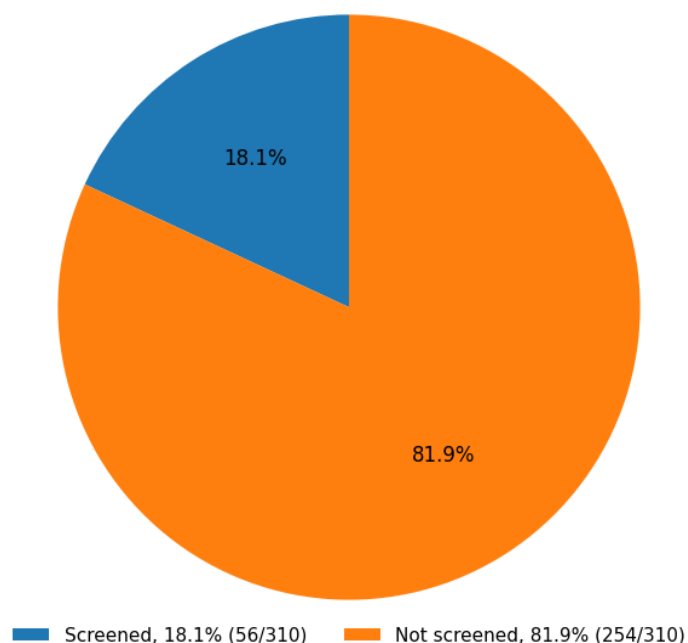


Figure 4: T2DM screening status among patients with TB included in the quantitative analysis (N=310)

4.1.4 Socio-demographic and clinical characteristics of patients with TB by T2DM screening status

Bivariate analysis assessed T2DM screening status across socio demographic and clinical characteristics. Screening differed significantly by age category, marital status, residence, TB classification and TB category. For example, 31.3% (26/83) of patients aged 50 years and above were screened compared with 11.4% (9/79) among those aged below 30 years. Among married participants, 22.0% (48/218) were screened and 78.0% (170/218) were not screened; these percentages describe screening status within the married category and should not be interpreted as the proportion of all screened patients who were married. Similarly, 23.6% (47/199) of rural residents were screened compared with 8.1% (9/111) of urban residents.

Regarding clinical characteristics, 17.1% (50/292) of new TB cases were screened. Screening was markedly higher among patients with drug resistant TB, 97.0% (32/33), than among patients with drug susceptible TB, 8.7% (24/277), demonstrating a strong bivariate association. HIV status, analysed in the three categories shown in Table 2, was not statistically significant at the bivariate level, $p=0.074$. The bivariate HIV result was therefore interpreted separately from the multivariable model, and the revised dissertation does not present HIV status as an independent predictor because the previously reported adjusted estimate was not internally consistent with the screening distribution in Table 2.

Table 2: Socio demographic and clinical characteristics of patients with TB by T2DM screening status (N=310, unless otherwise indicated)

Variable and category	T2DM screening status		Total	P-Value
	Not screened	Screened		
Age category				0.003
<30	70 (88.6)	9 (11.4)	79	
30 to 40	80 (87.0)	12 (13.0)	92	
41 to 50	47 (83.9)	9 (16.1)	56	
50+	57 (68.7)	26 (31.3)	83	
Sex of patient				0.708
Female	93 (80.9)	22 (19.1)	115	
Male	161 (82.6)	34 (17.4)	195	
Marital status (N=309)				0.015
Married	170 (78.0)	48 (22.0)	218	
Single never married	67 (93.1)	5 (6.9)	72	
Widowed/separated	16 (84.2)	3 (15.8)	19	
Residence				<0.001
Rural	152 (76.4)	47 (23.6)	199	
Urban	102 (91.9)	9 (8.1)	111	
History of smoking				0.928
No	249 (81.9)	55 (18.1)	304	
Yes	5 (83.3)	1 (16.7)	6	
History of alcohol use				0.738
No	243 (82.1)	53 (17.9)	296	
Yes	11 (78.6)	3 (21.4)	14	
Type of TB				0.679
Extra pulmonary	7 (87.5)	1 (12.5)	8	
Pulmonary	247 (81.8)	55 (18.2)	302	
Classification of TB				<0.001
New	242 (82.9)	50 (17.1)	292	

Others	0 (0.0)	2(100.0)	2	
Relapse	12 (85.7)	2 (14.3)	14	
Treatment failure	0 (0.0)	2(100.0)	2	
TB category				<0.001
DR TB	1 (3.0)	32 (97.0)	33	
DS TB	253 (91.3)	24 (8.7)	277	
HIV status				0.074
Known positive	35 (83.3)	7 (16.7)	42	
Negative	198 (80.2)	49 (19.8)	247	
New positive	21(100.0)	0 (0.0)	21	
ART status (N=63)				0.121
Already on ART	34 (82.9)	7 (17.1)	41	
New on ART	21(100.0)	0 (0.0)	21	
Not on ART	1(100.0)	0 (0.0)	1	
Basis of TB diagnosis				0.052
Clinical	4(100.0)	0 (0.0)	4	
Laboratory confirmation	201 (79.4)	52 (20.6)	253	
Radiological	49 (92.5)	4 (7.5)	53	

**Percentages presented under T2DM screening status are row percentages. Pearson's chi square test was used where its assumptions were satisfied. Fisher's exact test was used for variables with small expected cell frequencies.*

4.1.5 Factors associated with T2DM screening among patients with TB

The multivariable logistic regression model assessed factors associated with T2DM screening among patients with TB at Mbale Regional Referral Hospital TB Unit. In the revised interpretation, age category and residence were retained as independent predictors. HIV status was not interpreted as an independent predictor because the adjusted estimate reported in the submitted version was inconsistent with the bivariate screening distribution and three category HIV analysis shown in Table 2. This conservative correction prevents an unsupported adjusted HIV conclusion from being carried into the abstract, discussion and conclusion.

Patients aged 50 years and above had 3.3 times the odds of being screened for T2DM compared with those aged below 30 years, adjusted odds ratio (AOR) 3.3, 95% CI 1.424 to 7.876, $p=0.006$. Rural residents had 2.9 times the odds of being screened compared with urban residents, AOR 2.9, 95% CI 1.337 to 6.318, $p=0.007$. Sex, smoking history, alcohol use and type of TB were not independently associated with screening in the adjusted model.

Table 3: Multivariable analysis of factors associated with T2DM screening among patients with TB

Variable	COR (95% CI)	P value	aOR (95% CI)	P value
Age category				
<30	1		1	
30 - 40	1.2 (0.464 - 2.933)	0.743	1.5 (0.604 - 3.780)	0.377
41 - 50	1.5 (0.551 - 4.029)	0.433	1.7 (0.642 - 4.582)	0.282
50+	3.5 (1.540 - 8.175)	0.003	3.3 (1.424 - 7.876)	0.006
Sex				
Female	1		1	
Male	0.9 (0.493 - 1.617)	0.708	0.7 (0.372 - 1.381)	0.320
Residence				
Urban	1		1	
Rural	3.5 (1.645 - 7.463)	0.001	2.9 (1.337 - 6.318)	0.007
History of Smoking				
No	1		1	
Yes	0.9 (0.104 - 7.905)	0.928	0.5 (0.044 - 6.611)	0.627
Alcohol use				
No	1		1	
Yes	1.3 (0.337 - 4.638)	0.738	1.1 (0.236 - 4.830)	0.933
Type of TB				
Extra pulmonary	1		1	
Pulmonary	1.6 (0.188 - 12.928)	0.681	1.2 (0.135 - 10.821)	0.866

*TB category was not included in the final multivariable logistic regression model because near universal screening among patients with drug resistant TB produced quasi complete separation. Of the 33 patients with drug resistant TB, 32 were screened, resulting in an unstable ordinary logistic regression estimate. Drug resistant TB is therefore reported as a strong bivariate association and descriptive finding, not as an independent predictor. *The previously reported adjusted HIV estimate was also not interpreted in the revised model because it was internally inconsistent with the bivariate screening distribution and requires verification against the original analysis dataset before any adjusted claim is made.*

4.2 Qualitative findings

4.2.1 Barriers and facilitators affecting the implementation of T2DM screening

This section presents qualitative findings for Objective Three, which explored the barriers and facilitators affecting the implementation of type 2 diabetes mellitus screening among tuberculosis patients in Mbale Regional Referral Hospital TB Unit. Below is the table showing the summary of the themes that were obtained

Summary of themes and subthemes

Main theme	Subthemes
Barriers to type 2 diabetes mellitus screening among TB patients	Commodity and equipment constraints Weak service integration Workload and documentation burden Provider perceptions and selective screening
Facilitators of type 2 diabetes mellitus screening among TB patients	Availability of TB and diabetes screening guidance Previous training and sensitisation on TB and diabetes screening Supportive supervision and routine data review Availability of TB registers with a diabetes screening column Existing hospital services for both TB and T2DM care

4.2.2 Barriers to type 2 diabetes mellitus screening among TB patients

4.2.2.1 Commodity and equipment constraints

Participants consistently identified inadequate screening commodities as the most immediate barrier to implementation. The accounts suggested that the gap was not merely about low motivation among providers, but about the absence of basic tools needed to translate guidelines into practice. Glucose strips, glucometers, lancets and other point of care supplies were described as irregular, insufficient, or unavailable within the TB unit. As a result, health workers sometimes relied on verbal history, asked patients whether they were already on diabetes treatment, borrowed equipment from other wards, or referred patients to test outside the facility. This made screening dependent on opportunity rather than routine care. The narratives also showed that drug resistant TB patients were more likely to benefit from screening because they sometimes received partner

supported strips, while drug susceptible TB patients were more easily missed. This created an implementation gap in which screening was formally expected, but materially unsupported in daily practice.

“We are not actually screening all drug sensitive tuberculosis patients as required. What usually happens is that when a patient says that he or she is already on diabetes treatment, that is when the health worker may pick it up and ask to look at the card. The column for diabetes screening is there, but the hospital has no glucose strips. Sometimes we ask a patient to pay money outside, or we borrow a glucometer from the medical ward. Even for drug resistant tuberculosis patients, we sometimes borrow a glucometer from the medical ward, and at times we are told that the one in medical ward is spoiled. Therefore, the major challenge is the availability of the equipment and supplies needed for screening. (Healthworker 004)”

The same constraint was expressed by a doctor, who emphasised that screening gaps should not be interpreted only as reluctance by health workers. The doctor’s account showed that when the test cannot be done at the point of care, staff may defer the activity, send the patient elsewhere, or fail to complete the process. The implication is that commodity constraints transform a simple clinical task into an uncertain referral process, especially for weak, poor, or severely ill TB patients.

“The screening remains low mainly because the system has not fully institutionalised diabetes testing as a compulsory step in TB care. Many staff know that it is important, but knowing alone does not translate into routine practice when the tools are missing or the clinic is congested. The most obvious challenge is the irregular availability of glucose strips and sometimes the absence of a functional glucometer within the unit. Once staff realise that testing cannot be done immediately, they may postpone it, refer the patient, or leave it for another visit that may never happen. (Healthworker 008, Doctor)”

4.2.2.2 Weak service integration

A second barrier was weak integration between TB services and diabetes or non-communicable disease services. Participants described a service arrangement in which TB patients are seen within the TB unit, while diabetes screening supplies, diabetes registers, and follow up systems may be

located elsewhere. This fragmentation means that screening is not consistently embedded into the TB patient flow. Instead, screening depends on whether the provider remembers, whether the patient can move to another department, whether the receiving unit has supplies, and whether feedback is returned to the TB unit. The narratives also showed that the hospital had examples of reverse integration, such as screening diabetes patients for TB, but the reverse pathway of screening TB patients for diabetes was less reliable. This subtheme therefore points to a structural problem: TB and diabetes are clinically linked, but service delivery processes remain insufficiently linked.

“Yes, weak integration is part of the problem because TB and diabetes services still operate as related but separate service points. A TB patient may be assessed in the TB unit, but diabetes commodities, registers, or clinicians may be located elsewhere in the hospital system. When the two services do not share a simple pathway, screening depends on the initiative of individual staff rather than a predictable process. If a patient is referred to the diabetes clinic, there may be no clear feedback loop to confirm whether the test was done and what result was obtained. Integration would be stronger if blood glucose screening was physically available where TB patients are reviewed and if the result was captured in one standard place. (Healthworker 006)”

Participants also contrasted the relatively organised diabetes clinic with the TB unit’s limited capacity to screen for diabetes. In their view, diabetes patients often understood the need for glucose monitoring and some had their own devices, while TB patients depended more on the facility to provide screening. This imbalance meant that the system could identify TB among diabetes patients more easily than it could identify diabetes among TB patients, even when both directions of screening were clinically important.

“At the diabetes clinic, patients often know that they need to check their sugar, and some even move with their own glucometers. The health workers there also know how to talk to patients about buying what they need. For us in the tuberculosis unit, when patients have confirmed tuberculosis, we should also screen them for diabetes mellitus. However, the diabetes clinic has what they need to screen for diabetes, while our unit often does not. That is why we are trying to compensate by taking tuberculosis screening services to the

diabetes clinic, but tuberculosis patients still need diabetes screening in our unit. (Healthworker 004)”

4.2.2.3 Workload and documentation burden

Participants described diabetes screening as a simple test that becomes difficult to implement within a busy and documentation heavy TB care environment. Health workers reported managing many competing tasks, including patient assessment, treatment initiation, medicine refills, adherence counselling, sputum follow up, HIV related services, infection prevention, electronic entry, and paper register completion. In such a setting, a task that is not strongly embedded into the patient flow can be missed. The documentation burden was particularly important because participants described parallel electronic and paper systems, which increased workload and created opportunities for incomplete recording. Thus, low screening may reflect both failure to perform the test and failure to document screening when it is performed.

“The main barrier I see is workload. A staff member may be expected to treat patients, attend to patients from the outpatient department, enter patients into the system, and also fill the paper registers. Here, there are two systems to be used, the electronic system and the registers. Because of that, the staff can become overwhelmed, and some activities like diabetes screening may be missed even when they are expected to be done. (Healthworker 003)”

Records related participants further showed that the problem is not limited to clinical workload. The organisation of documentation, the availability of fields in HMIS tools, and the consistency of data entry were all described as central to understanding screening gaps. Participants warned that screening may appear low if older tools did not capture blood glucose information, or if staff asked screening questions but failed to record them in the correct place. This points to a measurement and implementation problem, where weak documentation can both obscure the true level of screening and reduce accountability for missed screening.

“The screening remains low mainly because the system has not fully institutionalised diabetes testing as a compulsory step in TB care. There are also competing priorities because TB care has many tasks, including symptom review, sputum follow up, adherence counselling, HIV testing, treatment monitoring, and documentation. When the clinic is

busy, the task that is not strongly supervised may be the one that is skipped, and diabetes screening often falls in that category. Documentation may also understate what is being done because some staff ask screening questions but fail to record them in the right place. (Healthworker 007)”

4.2.2.4 Provider perceptions and selective screening

The fourth barrier was selective screening shaped by provider perceptions, risk assumptions, and uneven task ownership. Participants reported that some health workers still associate diabetes mainly with older age, hypertension, or already known diabetes. Such perceptions may lead staff to screen older patients, HIV positive patients, drug resistant TB patients, or visibly symptomatic patients, while younger patients, drug susceptible TB patients, or patients without obvious symptoms may be missed. The findings suggest that selective screening is not only a knowledge gap but also a practical response to limited supplies. When supplies are few, providers may ration screening to those they perceive as most at risk. However, this undermines universal screening and risks missing undiagnosed diabetes among TB patients who do not fit the expected profile.

“From my view, the attitude may not necessarily be bad, but some staff may think that because the patient has tuberculosis, the patient does not need diabetes screening. That may be more of a knowledge gap than a bad attitude. Some staff are simply not aware that all tuberculosis patients should be screened. That is why I keep saying staff need sensitisation. Every patient who comes with tuberculosis should be screened for diabetes mellitus, irrespective of age. (Healthworker 003)”

Age related assumptions emerged clearly in participant narratives. Health workers were described as more likely to think about diabetes when an elderly patient arrived, because diabetes and hypertension are commonly associated with older people. While this risk perception may be understandable, it may also create blind spots in the care of younger TB patients. The subtheme therefore shows how clinical judgement, when not anchored in standard protocols, can reproduce selective screening.

“That is the common mentality among many people, that elderly people are more prone to diabetes mellitus and hypertension. Because of that, when an elderly patient comes, the health worker is more likely to think about diabetes screening. However, even young people

can have diabetes mellitus. Some staff may assume that a young person is less likely to have diabetes, and therefore they may fail to screen that younger patient. This selective thinking can make screening appear more focused on elderly patients than on all tuberculosis patients. (Healthworker 003)”

4.2.3 Facilitators of type 2 diabetes mellitus screening among TB patients

The qualitative findings identified several existing facilitators that enabled the implementation of type 2 diabetes mellitus screening among patients with tuberculosis at Mbale Regional Referral Hospital TB Unit. These facilitators were not recommendations, but resources, systems, practices, and experiences that were already present within the facility and could support screening, even though screening was not consistently done for all eligible patients.

4.2.3.1 Availability of TB and diabetes screening guidance

Participants reported that the presence of national and facility level guidance on TB and diabetes screening was an important facilitator. The guidance helped health workers understand that diabetes screening among patients with tuberculosis was part of good clinical care, rather than an optional or unrelated activity. However, the findings also showed that the existence of guidance alone was not sufficient to ensure universal screening, especially when staff were not regularly reminded or when other implementation gaps existed. One participant explained that guidance made screening easier to recognize as a clinical responsibility.

“The first facilitator is the presence of clear national and facility level guidance that recognises the relationship between TB and diabetes. When staff are reminded that diabetes screening is part of good TB care, they are more likely to treat it as a clinical responsibility rather than an extra activity. The second facilitator is availability of working equipment, especially a glucometer, glucose strips, lancets, gloves, and a safe place for sharps disposal. The third facilitator is training or mentorship because even simple procedures become more consistent when staff understand why they matter.”
Healthworker 002

4.2.3.2 Previous training and sensitisation on TB and diabetes screening

Previous training and sensitisation were also reported as facilitators of diabetes screening among patients with tuberculosis. Participants indicated that sensitisation helped health workers appreciate that screening should not be limited to patients who are elderly, symptomatic, hypertensive, or already known to have diabetes. This suggests that prior exposure to TB and diabetes screening information created awareness among health workers, although repeated reminders were still needed to promote consistent practice across all cadres involved in TB care.

“Some health workers may think that only patients who are already known to be diabetic, hypertensive, or elderly are the ones who should be screened. Staff need to be reminded that every patient who comes with tuberculosis is supposed to be screened for diabetes mellitus. The message should be clear that diabetes screening is not only for those already suspected or known to have the condition.” Healthworker 003

Participants further noted that sensitisation through routine team discussions made screening more visible in daily practice. Morning briefings were described as useful because they reminded staff of what needed to be done during the clinic day. This implies that existing team meetings created a platform through which screening could be reinforced without creating a separate activity.

“The first strategy is sensitising the staff. The second is making sure that there is a working glucometer on the unit and that glucose strips are available. Another helpful practice is having a brief team meeting every morning, where staff are reminded about what they are supposed to do during the day. If staff are reminded that every tuberculosis patient has to be screened for diabetes mellitus, they will take it up. Screening does not take long; it only takes a few minutes. If it is included in the daily briefing, it can become part of routine work.” Healthworker 004

4.2.3.3 Supportive supervision and data use

Supportive supervision and data use were described as facilitators that convert policy into practice. Participants noted that screening improves when supervisors review registers, identify missed patients, provide feedback, and help staff solve the reasons behind the gaps. This type of supervision was not framed as blame, but as a practical quality improvement process. It enables

the team to distinguish between missed screening due to stock out, missed screening due to workload, and missed screening due to provider knowledge or attitude. Data use also creates accountability because it makes screening performance visible over time. Without regular review, gaps may only be noticed at the end of a study or reporting period, when opportunities for correction have already passed.

“If teams understand the rationale for screening, they will do it. If they have the required supplies, they will do it. If they understand the impact of not doing it, they will also do it. The procedure itself is easy, so it is not mainly a technical capacity problem. The important issues are availability of supplies, knowledge of the importance of screening, and follow up. If somebody regularly tracks the data and shows the team what is missing, that acts as a reminder. Supportive supervision, monitoring, and feedback are therefore important facilitators. (Healthworker 005)”

Supervision was also linked to staffing, accountability, and task distribution. Participants reported that when staffing is adequate and roles are clear, screening can be distributed across the patient flow. A person can triage, another can screen, another can document, and another can counsel. Supervision then reinforces the workflow by ensuring that missed patients are identified and discussed constructively.

“Staffing is important because screening is simple, but it still requires someone to take responsibility for doing it and recording it correctly. If only one or two staff are available on a busy clinic day, they may prioritise immediate TB treatment tasks and leave out diabetes screening. When staff are adequate, one person can triage, another can do screening, another can document, and another can counsel the patient on the meaning of the result. Supervision helps because it creates accountability and prevents diabetes screening from becoming a forgotten recommendation. (Healthworker 007)”

4.2.3.4 Availability of TB registers with a diabetes screening column

The availability of revised HMIS tools and TB registers with space for recording blood glucose screening was identified as another facilitator. Participants explained that the inclusion of a blood glucose field made diabetes screening more visible within routine TB documentation. This was important because it provided a place for recording whether screening had been conducted and

made it easier for staff and supervisors to track screening status. However, participants also noted that documentation still depended on whether health workers consistently used the available tools.

“They recently revised the HMIS tools, and it gave room for blood glucose to be captured. The tools before did not have it. So even when they did it, unless you looked for a patient file, you would say it was not done. As we improve on the tools that we are using, currently now we have gone to the digital system. We will also have to support staff on the need to document. In one year’s time, you will come and you will say, check the system. If it is there, you will capture. If it is not there, that is it.” (Healthworker 005)

4.2.3.5 Existing supportive supervision and data review

Supportive supervision and routine data review were also described as facilitators because they helped to keep diabetes screening visible to health workers. Participants explained that when screening data are tracked and shared with the team, missed screening can be identified and corrected. Supervision was therefore seen as useful because it created accountability, encouraged follow up, and helped staff distinguish between missed screening due to stock outs, workload, or lack of attention.

“If teams understand the rationale for screening, they will do it. If they have the required supplies, they will do it. If they understand the impact of not doing it, they will also do it. The procedure itself is easy, so it is not mainly a technical capacity problem. The important issues are availability of supplies, knowledge of the importance of screening, and follow up. If somebody regularly tracks the data and shows the team what is missing, that acts as a reminder. Supportive supervision, monitoring, and feedback are therefore important facilitators.” (Healthworker 008)

Participants also linked supervision to role clarity and task distribution. Screening was described as a simple activity, but one that still required a specific person to perform and document it. Where staffing was adequate and roles were clear, participants felt that screening could be incorporated into patient flow more easily.

“Staffing is important because screening is simple, but it still requires someone to take responsibility for doing it and recording it correctly. If only one or two staff are available

on a busy clinic day, they may prioritise immediate TB treatment tasks and leave out diabetes screening. When staff are adequate, one person can triage, another can do screening, another can document, and another can counsel the patient on the meaning of the result. Supervision helps because it creates accountability and prevents diabetes screening from becoming a forgotten recommendation.” (Healthworker 001)

4.2.3.6 Existing hospital services for both TB and T2DM care

Participants further identified the presence of both TB services and diabetes related care within the same hospital as an important facilitator. Since TB patients may pass through different service points, including the TB Unit, casualty, and medical ward, the hospital setting provided an opportunity for broader identification and screening. This existing service structure could enable diabetes screening to occur beyond the TB Unit, especially when staff across departments understand that patients with tuberculosis should be screened for diabetes.

“In my view, this should not end only in the tuberculosis ward. We should also talk to casualty and the medical ward, because some tuberculosis patients may start treatment from elsewhere, may be admitted on the medical ward, or may present with another problem. If the focus remains only on the tuberculosis unit, we may miss some of these patients. The message should run throughout the hospital, so that everybody knows that whoever comes with tuberculosis should be screened for diabetes mellitus.” (Healthworker 007).

4.3 Discussion

The findings were interpreted in relation to the three study objectives. Objective One determined the proportion of diagnosed patients with TB who were screened for T2DM. Objective Two assessed factors associated with T2DM screening. Objective Three explored healthcare worker and health system barriers and facilitators affecting implementation. The discussion integrates quantitative and qualitative evidence and, for each major finding, considers comparison with existing literature, plausible explanations and implications for practice.

Overall, the study found that type 2 diabetes mellitus screening was low and not yet consistently implemented as a routine component of tuberculosis care. The main facilitators identified were the

availability of TB and diabetes screening guidance, previous training and sensitisation of health workers, availability of TB registers with a blood glucose documentation column, supportive supervision and data review, and the presence of both TB and diabetes care services within the hospital. The main barriers were irregular availability of screening commodities, selective screening practices, workload and unclear task allocation, weak integration between TB and diabetes services, and incomplete documentation of screening. These findings suggest that screening was influenced by both patient related factors and health system implementation conditions.

4.3.1 Proportion of TB Patients Screened for Type 2 Diabetes Mellitus

This study found that only 18.1% of patients with TB were screened for T2DM during TB care. WHO and Uganda Ministry of Health guidance recommend routine screening of patients with TB for diabetes, but the guidance is expressed as a universal practice recommendation rather than a specific numerical facility coverage target. The 18.1% observed at Mbale Regional Referral Hospital therefore indicates a substantial implementation gap because fewer than one in five eligible patients had documented screening.

Interviews with health workers provided important insights into the reasons for the low screening rate observed in the quantitative phase. Participants consistently reported that T2DM screening was **not implemented routinely** but was often performed selectively when patients presented with symptoms suggestive of diabetes, were older, or had a known family history of diabetes. Health workers attributed this practice to frequent shortages of glucometers and test strips, lack of designated screening points within the TB clinic, inadequate integration between TB and diabetes services, and competing clinical priorities due to heavy patient workloads. These findings suggest that screening decisions were largely influenced by resource availability and provider judgement rather than routine implementation of the national screening guideline.

The findings differ markedly from those reported by **Nsonga et al. (2019)**, who found that **88.0%** of TB patients in Kampala were screened for diabetes. However, that study was conducted under a **project-supported implementation**, where health facilities received additional training, supervision, screening algorithms, monitoring, and logistical support to strengthen bidirectional

screening. The qualitative findings from the present study suggest that these enabling conditions are largely absent under routine programme implementation, which may explain the substantially lower screening rate observed at Mbale Regional Referral Hospital. Consequently, the high screening coverage reported by Nsonga et al. may not reflect routine practice in Uganda once external implementation support is withdrawn.

The low screening proportion observed in this study is, however, consistent with reports from several low- and middle-income countries where routine implementation of bidirectional screening remains limited because of health system constraints. Studies from Ethiopia, Nigeria, and other sub-Saharan African settings have reported that shortages of screening commodities, inadequate healthcare worker training, weak integration of TB and non-communicable disease services, and limited institutional support contribute to poor implementation of diabetes screening among TB patients. These findings reinforce the importance of strengthening health system capacity to ensure routine delivery of bidirectional screening services.

When the quantitative and qualitative findings are considered together, they indicate that the low T2DM screening rate was primarily driven by **health system barriers rather than patient-related factors**. Although national guidelines recommend universal screening of TB patients for diabetes, implementation in routine practice appears to depend on the availability of screening commodities, provider capacity, and the level of integration between TB and diabetes services. As a result, screening becomes selective rather than universal, leading to missed opportunities for early diagnosis and management of diabetes among TB patients. These findings underscore the need for sustained investment in screening commodities, healthcare worker capacity building, and integration of TB and diabetes services to improve adherence to national and international recommendations.

Thank you. This changes the discussion substantially, and it actually makes it **stronger** because the significant factors are more epidemiologically plausible. We should only discuss factors that remained significant in the **multivariable logistic regression** (Adjusted Odds Ratios), not variables that lost significance. We also should not discuss TB category if it was excluded from the final model due to collinearity or sparse data.

4.3.2 Factors Associated with Type 2 Diabetes Mellitus Screening among Tuberculosis Patients

In the final multivariable interpretation, older age and rural residence were independently associated with T2DM screening. Patients aged 50 years and above had higher adjusted odds of screening than those aged below 30 years. This pattern is consistent with literature showing that providers frequently perceive older adults as having a higher diabetes risk and are therefore more likely to initiate blood glucose assessment (Chikhalikar et al., 2024; Anasulfalah et al., 2022). A plausible explanation is selective risk-based screening, in which scarce testing resources are prioritised for patients considered more likely to have diabetes. The implication is that younger patients with TB may be missed even though routine screening guidance is intended to apply across the eligible TB population.

Rural residence was also independently associated with higher odds of T2DM screening. This finding should not be interpreted as evidence that rural residence causes screening. Rather, it may reflect referral patterns at a regional hospital, where rural patients reaching tertiary care may have more complex clinical presentations, may pass through several service points, or may receive broader assessment than some urban patients managed earlier in the care pathway. The finding differs from the common assumption that urban residence necessarily confers better access to screening, and it highlights the need to examine how referral and service pathways shape screening opportunities.

Drug resistant TB showed the most pronounced bivariate screening difference: 97.0% of patients with drug resistant TB were screened compared with 8.7% of patients with drug susceptible TB. Qualitative interviews suggested that drug resistant TB care sometimes had more intensive follow up and partner supported access to screening commodities. However, TB category was not an independent predictor because the near universal screening among the drug resistant TB group produced quasi complete separation in ordinary logistic regression. The finding is therefore interpreted as a strong bivariate and programme pattern, not an adjusted causal or independent effect.

HIV status was not retained as an independently interpreted predictor in the revised dissertation. The submitted version contained an internal inconsistency: the three category bivariate table showed $p=0.074$ and no screening among newly HIV positive patients, whereas the adjusted table reported a statistically significant positive association. Because the original dataset and model coding are required to resolve that discrepancy, the revised text does not make an adjusted HIV claim. This correction ensures that the discussion, abstract and conclusion are aligned with results that can be supported by the presented data.

4.3.3 Barriers and Facilitators to Type 2 Diabetes Mellitus Screening among Tuberculosis Patients

The qualitative findings identified several health system barriers that help explain the low T2DM screening rate observed in the quantitative phase. The most frequently reported barriers included inadequate availability of glucometers and test strips, limited healthcare worker knowledge and confidence in managing TB–diabetes comorbidity, weak integration of TB and diabetes services, high patient workload, inadequate staffing, poor documentation of screening activities, and the absence of routine monitoring of diabetes screening among TB patients. These barriers suggest that, despite national recommendations for bidirectional screening, implementation remains constrained by weaknesses within the health system.

The shortage of screening commodities emerged as the most important barrier. Healthcare providers consistently reported that diabetes screening could only be conducted when glucometers and test strips were available, resulting in selective screening of patients perceived to be at high risk. This finding provides a direct explanation for the low screening proportion observed in the quantitative phase. Similar challenges have been reported in Uganda by Nsonga et al. (2019), who noted that sustained implementation of TB–diabetes screening requires a reliable supply of screening commodities and continuous programme support. Comparable findings have also been reported in Ethiopia, where shortages of diagnostic supplies were identified as a major obstacle to routine diabetes screening among TB patients Asefa et al. (2016).

Participants also described limited knowledge and confidence among some healthcare providers regarding the implementation of bidirectional TB–diabetes screening. Although clinicians were generally aware of the association between TB and diabetes, many reported uncertainty about the national screening algorithm, interpretation of blood glucose results, and referral pathways for patients diagnosed with diabetes. Similar observations have been reported in studies from Ethiopia and Tanzania, where inadequate training and limited continuing professional development were associated with poor implementation of collaborative TB–diabetes activities (Nigatu et al., 2021; Mkopi et al., 2018). These findings highlight the importance of regular mentorship and in-service training to improve healthcare workers' competence and confidence in diabetes screening.

Weak integration of TB and diabetes services was another prominent barrier. Participants explained that TB and diabetes clinics operated independently, with separate patient records, reporting systems, and clinic schedules. Consequently, diabetes screening depended largely on the initiative of individual healthcare providers rather than being embedded within routine TB care. Similar challenges have been described in Uganda and other low- and middle-income countries, where fragmented service delivery limits implementation of bidirectional screening and continuity of care (Nsonga et al., 2019; Harries et al., 2016). Strengthening integration between communicable and non-communicable disease services has therefore been recommended as a key strategy for improving collaborative TB–diabetes management.

Heavy patient workload and inadequate staffing were also identified as important operational barriers. Participants reported that large patient volumes, particularly in outpatient and TB clinics, reduced consultation time and limited opportunities to perform additional screening procedures. Similar findings have been documented in studies from India, Ethiopia, and Pakistan, where competing clinical priorities and insufficient human resources were associated with reduced implementation of diabetes screening among TB patients (Jali et al., 2013; Nigatu et al., 2021; Javaid et al., 2021). These findings suggest that strengthening the health workforce is essential for improving adherence to bidirectional screening recommendations.

Poor documentation and the lack of routine monitoring of diabetes screening further contributed to inconsistent implementation. Healthcare providers reported that diabetes screening was not

routinely captured in TB registers and that programme performance indicators rarely included monitoring of T2DM screening among TB patients. Consequently, missed screening opportunities often went unnoticed. Similar documentation challenges have been reported in routine TB programmes across sub-Saharan Africa, where incomplete recording and weak health information systems limit monitoring of collaborative TB–diabetes activities (WHO, 2023).

Despite these challenges, the qualitative phase also identified several facilitators that could strengthen implementation of routine T2DM screening. Participants highlighted the availability of national guidelines, the commitment of healthcare workers, the presence of trained TB focal persons, and existing TB/HIV integration platforms as important opportunities for improving collaborative TB–diabetes care. Providers believed that incorporating diabetes screening into existing TB clinic workflows, ensuring uninterrupted availability of screening commodities, strengthening mentorship, and integrating diabetes indicators into routine supervision would substantially improve screening coverage. Similar facilitators have been reported in Uganda and other high TB burden settings, where supportive supervision, staff training, integrated service delivery, and reliable commodity supply have been associated with improved implementation of bidirectional TB–diabetes screening (Nsonga et al., 2019; Harries et al., 2016; WHO, 2023).

When considered together, the quantitative and qualitative findings indicate that the low T2DM screening rate observed in this study was primarily a consequence of modifiable health system constraints rather than patient unwillingness to be screened. While healthcare providers recognized the importance of diabetes screening among TB patients, implementation was limited by shortages of commodities, inadequate training, fragmented service delivery, heavy workload, and weak monitoring systems. Addressing these barriers through strengthened health system support, improved integration of TB and diabetes services, continuous mentorship, and reliable availability of screening commodities will be essential for translating national policy into routine clinical practice.

4.3.4 Integration and Implications of the Mixed Methods Findings

The sequential explanatory mixed methods design used in this study provided a more comprehensive understanding of T2DM screening among TB patients than either the quantitative or qualitative findings could have achieved independently. While the quantitative phase established that only 18.1% of TB patients were screened for T2DM and identified factors associated with screening, it did not explain why screening remained low despite national recommendations. The subsequent qualitative phase addressed this gap by exploring healthcare providers' experiences and perceptions, thereby providing context and explanations for the observed quantitative findings.

Integration of the quantitative and qualitative findings showed that the low screening proportion was primarily driven by health system constraints rather than patient-related factors. Although the quantitative analysis demonstrated that only a small proportion of TB patients were screened, interviews with healthcare providers revealed that screening was frequently selective rather than routine because of shortages of glucometers and test strips, inadequate staffing, heavy workload, weak integration of TB and diabetes services, and inconsistent implementation of national screening guidelines. These findings indicate that the observed low screening rate reflects limitations in health system capacity rather than poor patient acceptance of diabetes screening.

The integrated findings further demonstrated that screening practices were influenced by provider judgement rather than standardized clinical protocols. Quantitatively, older patients, HIV-positive patients, and those with pulmonary bacteriologically confirmed TB had significantly higher odds of being screened. Qualitative interviews explained that healthcare providers intentionally prioritized these patients because they perceived them to be at greater risk of diabetes or because they had more frequent clinical encounters. Although this targeted approach may maximize the use of limited resources, it is inconsistent with the WHO and Uganda Ministry of Health recommendation for universal bidirectional screening of all TB patients (WHO, 2022; Ministry of Health Uganda, 2021).

The integration of findings also highlights an important distinction between implementation feasibility and routine programme implementation. The project-supported study by Nsonga et al. (2019) demonstrated that high diabetes screening coverage can be achieved when health facilities receive additional training, supervision, screening algorithms, and logistical support. In contrast, the present study assessed routine service delivery under normal programme conditions and found substantially lower screening coverage. The qualitative findings suggest that the absence of sustained technical support, reliable screening commodities, and integrated service delivery largely explains this difference. This indicates that successful pilot implementation does not necessarily translate into sustained routine practice once external support is withdrawn.

The findings have important implications for policy and practice. First, strengthening implementation of bidirectional TB–diabetes screening requires more than the existence of national guidelines. Health facilities must have uninterrupted access to screening commodities, adequately trained healthcare workers, integrated TB and diabetes services, and routine monitoring of screening performance. Second, incorporating diabetes screening indicators into routine supervision and performance review could improve accountability and promote consistent implementation across TB treatment units. Finally, integrating diabetes screening into established TB/HIV service delivery platforms may provide an efficient and sustainable approach for expanding bidirectional screening within resource-constrained settings.

From a methodological perspective, this study demonstrates the value of using a sequential explanatory mixed methods design to evaluate implementation of health programmes. The quantitative findings identified the magnitude of the implementation gap and the factors associated with T2DM screening, while the qualitative findings provided the contextual explanations necessary to understand why these patterns occurred. The integration of both phases therefore generated a more comprehensive understanding of routine implementation than would have been achieved through either quantitative or qualitative methods alone. This illustrates the added value of mixed methods research in informing programme improvement and health policy, particularly for complex health system interventions.

Overall, the integrated findings suggest that improving T2DM screening among TB patients will require strengthening routine health system capacity rather than relying on selective provider practices or externally supported interventions. Addressing the identified barriers while building on existing facilitators will be essential for achieving universal bidirectional TB–diabetes screening and improving patient outcomes in Uganda.

4.4 Strengths and Limitations of the Study

4.4.1 Strengths

This study had several strengths. It evaluated routine T2DM screening implementation in a regional referral hospital setting and used a sequential explanatory mixed methods design to combine measurement of screening coverage with contextual explanation from healthcare workers. The quantitative component included 310 patient records, while the qualitative component included information rich healthcare workers directly involved in TB care, laboratory services, documentation and service coordination. Using routine facility records increased the relevance of the findings to everyday programme implementation. The study also addresses a relatively under described implementation problem in Eastern Uganda. The wording has deliberately been limited to this context and does not claim that the study is the first in Uganda because no systematic review was conducted to substantiate such a claim.

4.4.2 Limitations

This study had several limitations. First, the cross-sectional quantitative component identifies associations and cannot establish causation. Second, reliance on routine records may have underestimated screening if blood glucose testing was performed but not documented. Third, selection bias may have occurred because 133 initially identified records were excluded before sampling when patient files could not be retrieved or eligibility could not be confirmed; if excluded records differed systematically from eligible records, the estimated screening proportion may not fully represent all TB patients registered during the study period. Fourth, the study was conducted at one regional referral hospital, which limits generalisability to facilities with different patient flows, staffing and commodity availability. Fifth, healthcare worker interviews may have been affected by social desirability bias. Sixth, only 56 patients had documented T2DM screening,

which limited detailed analysis of glycaemic outcomes. Finally, an internal inconsistency was identified between the categorical bivariate HIV analysis and the previously reported adjusted HIV estimate; the adjusted HIV result was therefore not interpreted in the revised dissertation pending verification against the original analysis dataset.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This chapter presents the conclusions and recommendations arising from the study findings. The conclusions are aligned with the study objectives and integrate the quantitative and qualitative findings, while the recommendations address the key implementation barriers and facilitators identified in strengthening routine T2DM screening among TB patients.

5.1 Conclusion

This study assessed factors associated with type 2 diabetes mellitus screening among tuberculosis patients at Mbale Regional Referral Hospital TB Unit. The findings showed that T2DM screening among diagnosed TB patients was low, with only 18.1% of patients screened. This indicates a substantial missed opportunity for early detection of T2DM among TB patients, despite the clinical importance of integrated TB and diabetes care.

The study further found that older age and rural residence were independently associated with T2DM screening. Drug resistant TB showed a strong bivariate association with screening but could not be estimated reliably in the ordinary multivariable model because of quasi complete separation. The revised dissertation does not interpret HIV status as an independent predictor because the adjusted estimate in the submitted version was inconsistent with the bivariate screening distribution.

The qualitative findings showed that implementation of T2DM screening was constrained mainly by irregular screening commodities, weak integration between TB and diabetes services, workload and documentation burden, and selective screening based on provider perceptions. Facilitators included availability of screening guidance, previous training and sensitisation, supportive supervision with routine data review, a TB register that captures diabetes screening, and the presence of both TB and T2DM care services within the hospital. Overall, the findings indicate that low screening largely reflected modifiable health system implementation gaps.

5.2 Recommendations

Priority 1, Mbale Regional Referral Hospital management, procurement and pharmacy units: ensure uninterrupted availability of functional glucometers, glucose test strips, lancets and related point of care supplies within the TB Unit. Commodity availability should be monitored as a routine TB and non-communicable disease service indicator because screening cannot be institutionalised without reliable supplies.

Priority 2, Mbale Regional Referral Hospital TB Unit: institutionalise T2DM screening as a routine step for all eligible patients with TB at treatment initiation, with repeat assessment where clinically indicated. Screening responsibility should be clearly assigned within the patient flow and documented in the TB register or another standard location.

Priority 3, Mbale Regional Referral Hospital TB and diabetes services: establish a clear referral and feedback pathway for patients with abnormal screening results. The five newly identified T2DM cases in this study, representing 8.9% of those screened, demonstrate the practical value of screening and the need for prompt confirmatory assessment and linkage to diabetes care.

Priority 4, TB Unit leadership and clinical supervisors: provide regular mentorship on TB and T2DM comorbidity and use monthly register review, supportive supervision and data feedback to identify missed screening opportunities. Screening should not be restricted to older patients, people living with HIV, patients with drug resistant TB or those with obvious diabetes symptoms.

Priority 5, Ministry of Health through the National Tuberculosis and Leprosy Program and the Non-Communicable Diseases Prevention and Control Program: strengthen operational guidance, monitoring indicators, commodity planning and integrated TB and diabetes service models for regional referral hospitals and lower-level facilities.

Patients with TB should receive brief education on the importance of diabetes screening and the need to complete confirmatory assessment when screening results are abnormal. Patient education should complement, rather than substitute for, health system responsibility to offer routine screening.

5.3 Suggestions for future research

Future research should assess the feasibility, cost and effectiveness of routine point of care T2DM screening within TB services, examine patient level barriers to completing confirmatory testing and referral, and verify multivariable predictors using prospectively collected data with complete covariate information.

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APPENDICES

Appendix 1: Informed consent form

Title of Study: Factors Associated with Type-2 Diabetes Mellitus Screening Among Tuberculosis Patients in Mbale Regional Referral Hospital: A Mixed Methods Study

Principal Investigator:

Musana Henry Godfrey

Department of Community and Public Health, Busitema University

Email: harryorwells@gmail.com

Tel: +256-772534512/702534512

Hello Sir/Madam,

My name is _____, a researcher from Busitema University, Faculty of Health Sciences. I am part of a team conducting a study on factors associated with screening for type-2 diabetes mellitus (T2DM) among tuberculosis (TB) patients at Mbale Regional Referral Hospital.

Background and Purpose of the Study

Tuberculosis and type 2 diabetes mellitus are both significant public health concerns. Evidence suggests that people with diabetes are more susceptible to TB and may have worse outcomes if co-infected. However, screening for diabetes among TB patients is not routinely done in many hospitals, including Mbale Regional Referral Hospital. This study aims to determine the proportion of TB patients who are screened for T2DM and to identify the barriers and facilitators to screening.

Study Procedures

If you agree to participate, we will ask you some questions through a one-on-one interview lasting approximately 30–45 minutes. The questions will relate to your health background, experiences with TB treatment, and any screening for diabetes you may have received. No invasive procedures will be performed, and your responses will be treated with strict confidentiality.

Voluntary Participation

Your participation in this study is entirely voluntary. You are free to decline or withdraw from the study at any point without any consequences for your treatment or relationship with healthcare providers.

Risks and Discomforts

This study does not involve any medical procedures or physical risks. However, you may be asked questions of a personal nature. You are free to skip any question you are uncomfortable answering.

Benefits

While you may not receive direct personal benefits, your participation will contribute to improved understanding and possibly better integration of diabetes screening into TB care in hospitals like Mbale Regional Referral Hospital.

Confidentiality

All information collected will be kept confidential. Your name will not appear in any publication or report, and responses will be stored securely with access limited to the research team.

Compensation

There is no financial compensation for participating in this study. However, there will be no cost to you for participating either.

Questions and Further Information

If you have any questions or concerns about the study, please contact:

Principal Investigator: Musana Henry Godfrey

Busitema University Faculty of Health Sciences Research and Ethics Committee (BUFHS-REC)

Chairperson: Dr. Richard Katuramu

Tel: 0787641051

STATEMENT OF CONSENT

I have been informed about the study, including its purpose, procedures, risks, and benefits. I understand that participation is voluntary and that I may withdraw at any time. All my questions have been answered to my satisfaction. I consent to participate in this study.

Participant's Name: _____

Signature/Thumbprint: _____ Date: _____

Witness Name (if participant cannot read/write): _____

Witness Signature: _____ Date: _____

Name of Person Obtaining Consent: _____

Signature: _____ Date: _____

Appendix 2: Data abstraction tool

Study title: Factors associated with type 2 diabetes mellitus screening among TB patients attending MRRH.

Instructions: Use this tool to extract relevant TB data from the Unit TB register and patient files.

TB reg No.....		Date:	
SECTION A: DEMOGRAPHIC DATA			
QN O.	Question and filter	Coding category	Skip
101	How old was the patient at registration?	Age in completed years.....	
102	What is the gender of the patient?	1. Male 2. Female	
103	What is the residence?	1. Village/cell..... 2. Parish/Ward 3. Subcounty/division 4. District/city	
104	What is his/her residence?	1. Rural 2. Urban	
105	Does the participant have the history of smoking?	1. No 2. Yes	
106	Does the participant have the history of alcohol use?	1. No 2. Yes	

	SECTION B: Clinical/TB information		
201	Type of TB	Pulmonary Extra pulmonary	
202	Classification of TB	New Relapse RLF Treatment failure Others	
203	HIV status	1. Negative 2. New positive 3. Known positive	If Neg go to section C
204	ART status	2. New on ART 3. Already on ART 1. Not on ART	
205	What was the basis of TB diagnosis?	1. Laboratory confirmation 2. Radiological (based on chest Xray) 3. Clinical (basing on symptoms)	
	SECTION C: T2DM screening Information		

301	Screened for T2DM?	1. Yes 2. No	If 2 go to section D
302	Date of T2DM screening	Dd/mm/yyyy	
303	T2DM screening Method?	1. RBS 2. FBS 3. HBA1C 4. OGTT	
304	T2DM screening outcome?	1. T2DM 2. pre diabetic 3. not diabetic	

Key Informant Interview (KII) Guide

Study Title: Factors Associated with Type 2 Diabetes Mellitus Screening Among Tuberculosis Patients at Mbale Regional Referral Hospital

Purpose of the Interview:

To gain expert insights into the systemic, institutional, and policy-level factors influencing T2DM screening among TB patients.

Target Key Informants:

- City TB and leprosy supervisor
- TB focal person
- Regional TB and leprosy focal person
- Physician attending to Tb patients
- Clinicians/MOs/ Nurses
- Lab or diagnostic unit heads
- Implementing partners (e.g., NGOs supporting TB/DM care)

Objective 3: Barriers and Facilitators Affecting the Implementation of Type 2 Diabetes Mellitus Screening Among Tuberculosis Patients in Mbale Regional Referral Hospital TB Unit

Greetings!

My name is _____, and I am part of the research team conducting a study on type 2 diabetes mellitus screening among tuberculosis patients at Mbale Regional Referral Hospital TB Unit. The purpose of this interview is to explore your professional views and experiences regarding the barriers and facilitators affecting the implementation of type 2 diabetes mellitus screening among tuberculosis patients. This qualitative phase is being conducted to help explain the quantitative findings from the first phase of the study because the study uses a sequential explanatory mixed methods design.

Your participation in this interview is entirely voluntary. There are no right or wrong answers, and your responses will remain strictly confidential. The information you provide will be used solely for research purposes to inform strategies aimed at strengthening integrated TB and diabetes care at Mbale Regional Referral Hospital. This discussion will take about 20 to 30 minutes, and I kindly request you to share your honest views based on your professional experience. You are free to skip any question or withdraw from the interview at any point. Do I have your permission to proceed? Wait for verbal consent before beginning.

Social Demographics Table

Question	Response
ID	_____
Age	_____
Gender	☐ Male ☐ Female

Job Title, Position	_____
Department, Unit	_____
Number of years working in TB care or related services	_____
Level of education	☐ Certificate ☐ Diploma ☐ Bachelor's ☐ Postgraduate

Interview Questions

1. From your experience, how would you describe the current practice of type 2 diabetes mellitus screening among tuberculosis patients at Mbale Regional Referral Hospital TB Unit? **Probes:** *How often screening is done; whether screening is routine or selective; who is more likely to be screened; changes over time.*
2. The quantitative findings showed that only a small proportion of TB patients were screened for type 2 diabetes mellitus. In your view, why is screening still low in this facility? **Probes:** *Lack of routine systems; competing priorities; limited supplies; weak integration; low provider emphasis; patient flow challenges.*
3. In your opinion, what health system factors facilitate the implementation of type 2 diabetes mellitus screening among TB patients in this unit? **Probes:** *Availability of glucometers and strips; staffing; training; support supervision; management support; existence of guidelines; partner support.*
4. What health system barriers make it difficult to implement type 2 diabetes mellitus screening among TB patients in this facility? **Probes:** *Stock outs; inadequate equipment; staff shortages; high workload; limited space; funding gaps; poor documentation systems.*

5. How do healthcare workers' practices and attitudes influence whether TB patients are screened for type 2 diabetes mellitus? **Probes:** *Provider knowledge; confidence in screening; motivation; perceptions of importance; task ownership; differences between cadres.*
6. How does communication and coordination between the TB unit and diabetes or non communicable disease services affect screening implementation? **Probes:** *Referral systems; feedback mechanisms; collaboration between units; joint planning; communication gaps; follow up of screened patients.*
7. The quantitative phase suggested that screening differed by age, residence, and HIV status. In your view, what could explain these differences in screening across patient groups? **Probes:** *Older versus younger patients; rural versus urban patients; social support among married patients; differences between drug resistant and drug sensitive TB care; influence of HIV related service linkages.*
8. What patient related factors affect whether TB patients are screened for type 2 diabetes mellitus in this facility? **Probes:** *Awareness of diabetes; willingness to be screened; financial challenges; fear of another diagnosis; health beliefs; symptom burden; understanding of instructions.*
9. What strategies or practices are currently helping to promote type 2 diabetes mellitus screening among TB patients at this facility? **Probes:** *Existing screening protocols; mentorship; supportive supervision; integrated clinics; availability of screening tools; teamwork; implementing partner support.*
10. In your opinion, what should be done to improve the implementation of type 2 diabetes mellitus screening among TB patients in Mbale Regional Referral Hospital TB Unit? **Probes:** *Strengthening guidelines; routine screening protocols; staff training; improved supplies; better documentation; stronger TB DM integration; supervision; policy and administrative support.*

Closing

Thank you very much for your time and for sharing your views.

Appendix 3: Proposed budget

NO.	ITEMS	QUANTITY	UNIT COST	AMOUNT (UGX)
1	Training of research assistants	2	240000	480,000
2	Research assistant reimbursement for data collection	2	800000	1,600,000
3	Internet	50GB	10,000	500,000
4	Protocol review fees	1	150,000	150,000
5	Research fees	1	1,500,000	1,500,000
6	Reimbursement and time compensation	1	1	200,000
7	Photocopying and printing interview materials	300copies	100	30,000
8	Photocopying and printing informed consent	100 copies	200	20,000
9	Flash disk	2	35,000	70,000
10	Typing proposal and report	2	20,000	40,000
11.	Stationery accessories		150,000	150,000
12.	Dissertation	5 copies	20,000	60,000
13.	Transport	1	100,000	100,000
14.	Coordination	1	100,000	100,000

15.	Miscellaneous		300,000	300,000
	Total			5,300,000

Appendix 4: Work plan and time frame

Activity	Jan-Apr			May	Jun	Jul	Aug	Sep	Oct
Proposal writing									
Proposal review and approval by IRB									
Procurement of stationery and other accessories									
Data collection and processing									
Data analysis									
Discussion, presentation and dissemination									