



**UNIVERSITY OF
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**INYUVESI
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**BARRIERS AND FACILITATORS TO THE IMPLEMENTATION OF
THE COLLABORATIVE FRAMEWORK FOR THE CARE AND
CONTROL OF TUBERCULOSIS AND DIABETES IN GHANA.**

Thesis Submitted in Fulfilment of the Requirements for the Degree of Doctor of Philosophy (PhD) in
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Rita Suhuyini Salifu (Principal Investigator/PhD student)

Student Number: 218088258

Supervisor: Dr. Khumbulani W. Hlongwana

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BARRIERS AND FACILITATORS TO THE IMPLEMENTATION OF THE COLLABORATIVE FRAMEWORK FOR THE CARE AND CONTROL OF TUBERCULOSIS AND DIABETES IN GHANA.

Rita Suhuyini Salifu (218088258)

A Thesis by Manuscripts is submitted to the Discipline of Public Health Medicine, College of Health Science, University of KwaZulu-Natal, in fulfilment of the academic requirements for the Doctor of Philosophy (PhD) degree in Public Health.

This is to attest that the contents outlined in this dissertation are the original research work done and reported by the author (Rita Suhuyini Salifu). The research work detailed in this dissertation has not been previously submitted to any tertiary institution for award of a degree or diploma. The use of other researchers'/scientists' work in the text has been acknowledged accordingly. As the candidate's Supervisor, I have approved this thesis for submission

Supervisor Signature:



Name: Khumbulani W. Hlongwana

Date: 23 August 2021

Preface

The work described in this thesis was carried out in the Discipline of Public Health Medicine, School of Nursing and Public Health, College of Health Sciences, University of KwaZulu-Natal, Durban in South Africa. The study was conducted between July 2018 and August 2021 under the supervision of Dr Khumbulani W. Hlongwana.

This study is the original work conducted and reported by the author. To the best of my knowledge, this study has not been previously submitted to any other University or institution of higher learning. Some of the work has been published in accredited journals in line with the requirements and thesis guidelines of the University of KwaZulu-Natal. Due acknowledgments have been accorded where other people's work has been used in text.

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Date: 23rd August 2021

Rita Suhuyini Salifu

Declaration: Publication

The publications (published, in print, submitted, and or manuscript format) that constitute this thesis and the contribution I made to each of the manuscripts are presented underneath.

Publication 1:

Quist-Therson R*, Kuupiel D, Hlongwana KW Mapping Evidence on the Implementation of the World Health Organization's Collaborative Framework for the Management of Tuberculosis and Diabetes: A scoping review protocol. BMJ Open. 2020 (*Former name for Salifu RS)

Authors Contribution:

I conceptualized and designed the protocol, Kuupiel D and Hlongwana KW contributed to the writing and critically reviewed all the drafts. I wrote the final manuscript, and all authors approved the final draft.

Publication 2:

Salifu RS, Hlongwana KW. Facilitators to Bidirectional Screening of TB-DM in Ghana: Healthcare Workers' Perspectives. PloS one, 2020 - Journals.plos.org

Authors Contribution:

I conceptualized, conducted research for this study, and wrote the manuscript. My supervisor Hlongwana KW guided the research process, reviewed, and contributed to the drafting of the manuscript. He also approved the final manuscript.

Publication 3:

Salifu RS, Hlongwana KW. Exploring the mechanisms of collaboration between the Tuberculosis and Diabetes Programs for the control of TB-DM Comorbidity in Ghana. BMC Research Notes 2021.

Author contributions:

I conceptualized, conducted research for this study, and wrote the manuscript. My supervisor Hlongwana KW guided the research process, reviewed and contributed to the drafting of the manuscript. He also approved the final manuscript.

Publication 4:

Salifu RS, Mbuzeleni H, Hlongwana KW. Scoping review on the implementation of the World Health Organization's Collaborative Framework for the management of Tuberculosis and Diabetes. (BMJ Open)

Author contribution:

I conceptualized the study and wrote the first draft. Mbuzeleni Hlongwa and Khumbulani Hlongwana contributed to the writing and critically reviewed all the drafts. I wrote the final manuscript, and all authors approved the final draft.

Publication 5:

Salifu RS, Hlongwana KW. Frontline Healthcare workers' experiences in implementing the TB-DM collaborative framework in Northern Ghana. **(BMC Health Services Research)**

Author contributions:

I conceptualized and researched this study. I wrote the manuscript, and my supervisor Hlongwana KW guided the research process, reviewed, and contributed to the drafting of the manuscript. He also approved the final manuscript.

Signed: 

Date: 23rd August 2021

Dedication

This work is dedicated to my mother Mrs. Agnes Mogre and my daughters Charis Naa-Baake and Olive Naa-Korlei.

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Thank you to my indefatigable supervisor Dr. Khumbulani W. Hlongwana for his guidance and mentoring during this program.

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Acronyms and abbreviations

ACF	Active Case Finding
AFR	Africa Region
AIDS	Acquired Immunodeficiency Syndrome
ART	Anti-Retroviral Therapy
CDs	Communicable Diseases
DM	Diabetes Mellitus
DOTS	Directly Observed Therapy Short Course
DR –TB	Drug-Resistant Tuberculosis
GFATM	Global Fund to Fight AIDS, Tuberculosis, and Malaria
GHS	Ghana Health Service
HF	Health Facility
HCW	Healthcare Workers
IDF	International Diabetes Federation
LMICs	Low- and Middle-Income Countries
MoH	Ministry of Health
MDG	Millennium Development Goals
M&E	Monitoring and Evaluation
NCDCP	Non-Communicable Disease Control Program
NCD's	Non-Communicable Diseases
NTP	National Tuberculosis Control Program
OPD	Outpatient Department
TB	Tuberculosis
TB-DM	Tuberculosis-Diabetes
TB-HIV	Tuberculosis co-infected with Human Immunodeficiency Virus
TCH	Tamale Central Hospital
TTH	Tamale Teaching Hospital
TWH	Tamale West Hospital
Union	International Union Against Lung Disease
WHO	World Health Organization

Definition of Terms

Arksey and O'Malley framework	This is a methodological framework for conducting scoping studies
Bidirectional screening	Screening tuberculosis patients for diabetes and diabetes patients for tuberculosis.
Case Detection Rate	The number of cases reported divided by the number of incident cases estimated within a defined period, for example, a year.
Case -finding	A form of screening of which the main object is to detect disease and bring patients to treatment.
Co-morbidity	The possibility of two or more disease conditions coexisting within one patient with the occurrence of one disease condition having the potential to expose the patient to another.
Directly Observed Therapy Short Course	A strategy of treatment in which a specifically trained healthcare worker observes the patient swallowing his or her anti-TB drugs
Lipsky's Theoretical Framework of Street-level Bureaucracy	This describes the process whereby lower ranking employees of human service agencies utilize some level of discretion to determine actual public policy
Screening	Systematic activities to identify populations with a particular condition or disease.
Systems Thinking Theory	This provides a deliberate and comprehensive suite of tools and approaches to map, measure and understand these dynamics.
Sensitizing concepts	These are constructs that are derived from the research participants' perspective, using their language or expressions, and that sensitize the researcher to possible lines of inquiry.

Abstract

Background: The rising tuberculosis -diabetes mellitus co-epidemic is threatening the advances made by global policy to reduce tuberculosis and diabetes mellitus prevalence. In 2011, the World Health Organization (WHO) and International Union Against Lung Disease (Union) launched the Collaborative Framework for Care and Control of Tuberculosis and Diabetes. The recommendations provided by the framework have been adopted by many countries, globally.

The overall aim of this research was to explore the barriers and facilitators to the implementation of the WHO-Union collaborative framework in Ghana, from the perspectives of the policymakers, program managers, health facility managers, and front-line implementers (healthcare workers).

Methods: Using an explorative qualitative study design, data was generated by employing a scoping review, documents review, in-depth interviews, and non-participant observation. In-depth interviews were conducted with 27 participants from Accra and Tamale in Ghana. All interviews were audio recorded (with participants' permission) and transcribed verbatim, except for two interviews, whereby participants requested the interview not to be audio-recorded. Non-participant observation was guided by a checklist of sensitising concepts. Analysis was guided by the grounded theory to identify recurrent ideas which were coded and further grouped to develop themes.

Results: This thesis presents key findings from research on the implementation of the framework in Ghana. The major outputs of this study included: 1) a scoping review to map evidence on the implementation of the framework, globally. 2) paper one examines the systems and structures in place for implementing the collaboration of TB-DM management in the selected health facilities. 3) paper two explores the mechanisms of collaboration between the National Tuberculosis Control Program and the Non-Communicable Disease Control Program at the national, regional, and local (health facility) levels of the health care system. 4) paper three addresses the experiences of frontline healthcare workers through the lens of Lipsky's theoretical framework of street-level bureaucracy.

Conclusion: The findings of this research support the implementation of the framework in Ghana. This has been enhanced by the increased staff capacity and institutionalization of screening. However, gaps still exist which require increased awareness about TB-DM comorbidity, and increased support for in-service training to curb the rising TB-DM comorbidity.

Chapter One: Introduction and overview of the thesis

1.1 Background

This chapter presents the global and national overview of tuberculosis (TB) and diabetes mellitus (DM) comorbidity and how the World Health Organization (WHO) and International Union Against Lung Disease (Union) Collaborative Framework for Care and Control of Tuberculosis and Diabetes, proposes to address the growing TB and DM co-epidemic. This chapter also provides the problem statement, research questions, general and specific objectives, significance of the study, as well as an overview of the thesis.

1.1.1 Double burden of disease

Over the past decade, the global mortality and morbidity due to infectious disease have declined, however, low and -middle- income countries (LMICs) are still grappling with high levels of infectious disease[1]. The growing burden of chronic non-communicable diseases (NCDs) has negatively impacted the LMICs, as they are concurrently dealing with infectious diseases burden[2] . According to the WHO, chronic NCDs are well-known leading causes of mortality, globally, representing 70% of all deaths, worldwide [3] . Key amongst the common NCD risk factors is lack of physical activity, tobacco use, and obesity and these factors are of public health nature in all countries, particularly LMICs, which account for 75% of NCDs-related mortality, globally[4] . The growing NCDs combined with infectious disease, have culminated into the double burden of disease[4, 5].

For many decades, developing countries have implemented intervention strategies, aimed at reducing and ultimately eradicating communicable (infectious) diseases, including malaria, tuberculosis, and HIV and AIDS [4]. The flip side to focusing on communicable diseases has been the proliferation of chronic NCDs, such as hypertension, cancers, chronic obstructive pulmonary disease, and diabetes[4] . The consequence of NCDs poorly impacts the health status of populations, as well as adversely affect the health systems capacity with resultant inadvertent increase in health cost[5] . People living with DM worldwide are expected to reach 693 million by 2045 with approximately 50% undiagnosed[6]. Like many other developing countries, Ghana is rapidly undergoing an epidemiological transition, which is associated with ‘westernization of lifestyle’, decreased physical activity, and unhealthy diet, and this transition is culminating in overweight and obesity[7, 8].The increase of these risk factors presently results in an increased burden of chronic NCDs, like diabetes mellitus and hypertension[4] . With approximately 80% of DM cases and 90% of TB cases occurring in LMICs, this emerging phenomenon of the double burden of disease (NCD and CD) is seen in the tuberculosis (TB) and diabetes mellitus (DM) comorbidity and has become a major public health problem[4, 9].

The state of diabetes in Ghana is similar to other countries in sub-Saharan Africa with prevalence rates continuing to rise. The prevalence of DM among adult Ghanaians is estimated to be between 6 and 13.9%, and these figures vary across geographical regions, with the southern part of the country reporting the higher rates. This may be linked to level of exposure to the risk factors, including urbanization, poor dietary practices, obesity and genetic make-up with many missing cases of undiagnosed individuals in the community [10].

The association between TB and DM was observed almost one hundred years ago, and in more recent times it has become a global epidemic [11]. DM has been identified as a risk factor for TB and prevalence of DM among TB patients ranges from 1.9% to 45%, globally. A number of DM patients were also found to have TB, with a prevalence ranging from 0.3%-14%[11-13]. Countries in Asia and Africa were found to have a higher prevalence of TB among DM patients and TB patients had high prevalence of DM in countries located in the continents of Asia, North America and Oceania[14].

Estimates for TB-DM comorbidity in Ghana showed that DM prevalence among TB patients was two-fold higher than the general population. The double burden of these two diseases poses a strain on Ghana's current health systems[15].

1.1.2. The World Health Organization Collaborative Framework for Care and Control of Tuberculosis and Diabetes

In 2011, the World Health Organization (WHO) and International Union Against Lung Disease (Union) developed a collaborative framework to guide the care, prevention, and control of tuberculosis (TB) and diabetes mellitus (DM)[16] . This was in response to the rise in TB-DM comorbidity and concerns that comorbidity will derail all the gains made in the fight to reduce the prevalence of TB and DM, unless the situation is averted[9, 16] . This collaborative framework is expected to complement the core systems set up for the prevention and management of both diseases[16] .

After the launch of the WHO-Union Collaborative Framework for Care and Control of TB and DM document, it was disseminated through the WHO's offices to the various countries' ministries of health and public health programs, involved in the prevention and care of DM and TB[16]. These countries were encouraged to adapt the framework to meet the needs of their national and local contexts[16] . For the past ten years, several LMICs like Ethiopia, India, Pakistan, China, Mexico, Nigeria, and Ghana heeded the call and adapted the collaborative framework to their contexts[13]. The WHO-Union Collaborative Framework for Care and Control of TB and DM offers twelve recommendations to guide policymakers, program managers, and healthcare professionals in the management of TB and DM comorbidity[16] . These are:

- “1. Joint coordination should be established at regional, district, and/or local levels (sensitive to country-specific factors), with representation from all relevant stakeholders. Develop a joint plan of activities to be included in national plans for non-communicable diseases and TB.
2. Surveillance of TB should be initiated among diabetic patients in settings with medium to high burdens of TB.
3. Surveillance of DM should be initiated among TB patients in all countries.
4. Where collaborative activities are being established, national programs should agree to a core set of indicators and tools to collect data for monitoring and evaluating activities to improve care and prevention of both diseases. Diabetes programs should explore the possibility of adapting the Directly Observed Therapy Short Course (DOTS) system to monitor and report diabetes cases and treatment outcomes.
5. Detect and manage TB in patients with diabetes. At a minimum, people with diabetes should be screened for chronic cough (that is, a cough lasting more than 2 weeks) at the time of their diagnosis with diabetes and, if possible, during regular check-ups. Those with positive TB symptoms should be examined as per national guidelines. Other diagnostic procedures (for example, for extrapulmonary TB) should also be pursued vigorously per national guidelines.
6. Screening for TB diseases on broader indications (for example, for all people in whom diabetes is diagnosed, regardless of symptoms) should be explored as part of the research agenda to improve the diagnosis of TB among people with diabetes.
7. A referral system should be established so that patients suspected of having TB are promptly referred to TB diagnostic and treatment centres and evaluated in accordance with guidelines of the national TB control program.
8. Case-finding for TB should be intensified by increasing awareness of and knowledge about the interactions between diabetes and TB, including joint risk factors, among health-care workers and the populations they serve.
9. Health-care facilities, including diabetes clinics, should have in place an infection control plan that includes administrative and environmental control measures to reduce transmission of TB within health-care settings. These measures should adhere to the WHO’s international guidelines for TB infection control.
10. Treatment and case management of TB in people with diabetes should be provided in accordance with existing TB treatment guidelines and international standards. The same TB treatment regimen should be prescribed for people with diabetes as for people without diabetes.
11. Detect and manage diabetes in patients with TB. Patients with TB should be screened for diabetes at the start of their treatment, where resources for diagnosis are available. The type of screening and

diagnostic tests should be adapted to the context of local health systems and the availability of resources while awaiting additional evidence on the best screening and diagnostic approach or approaches.

12. Management of diabetes in TB patients should be provided in line with existing management guidelines.” [16].

The objective of the collaborative framework is to address the timeliness to providing and receiving diagnosis and treatment for TB-DM comorbidity. The other objective was to contribute to the reduction of the incidence of both TB and DM[16] . According to the framework, mechanisms of collaboration include, developing a joint plan by all relevant stakeholders at the various levels, namely: local, district, and regional levels [16].

1.1.3 The State of the Framework Implementation -Global context

In 2015, the Bali Declaration was signed as a follow up to the WHO-Union collaborative framework advocating for the implementation of the framework and research[9]. Operational and other types of research recommended by the framework are aimed at addressing queries on the proposed methods for bidirectional screening and co-management, to determine their efficiencies and cost-effectiveness [16]. Some countries, including Nigeria, the Democratic Republic of Congo, Tanzania, Kenya, Eswatini, and South Africa have piloted collaborative activities, since the launch of the framework[17, 18]. The two countries with the highest burden of TB-DM comorbidity are China and India and they have sought to find the best approaches to implementing the mechanisms of collaboration through large operational research studies[19, 20]. Notably, China and India are the highest and second highest populated countries in the world, respectively. Despite the two countries’ search for the best approaches to implementing the framework, the results from their framework implementation have not yet been published, however, authorities in both countries have given a policy directive for all TB patients to be screened for DM[19, 20]. The Cambodia Diabetes Association (CDA) developed a guideline for collaborative management of TB-DM based on the WHO collaborative framework, however, there is still insufficient evidence of drug-drug interactions in TB-DM patients[21] .

1.1.4 Bidirectional screening in Ghana

In 2007, the National Tuberculosis Control Program (NTP) in Ghana, conducted a review, which showed that TB case detection in the country was as low as 27% [22]. This necessitated the National Tuberculosis Health Sector Strategic Plan for Ghana (2009-2013) to highlight TB case detection as a priority area for intervention, leading to the implementation of bidirectional screening[22]. Almost ten years later (2017), low case detection persisted with the NTP only detecting 1/3 of the expected cases [23]. Many studies on bidirectional screening from other countries have generally been published, but the extent to which bidirectional screening is implemented and/or achieved in Ghana, has, to a large extent, been missing in the literature[22] . A study conducted in Ghana noted that there is some level of collaboration between the National Tuberculosis Control Program (NTP) and the Non-Communicable

Disease Control Program (NCDCP), however, a greater collaboration is needed, in order to ensure that TB screening in all diabetic clinics occurs[22].

1.1.5 Problem statement

In 2011, the WHO-Union collaborative framework to guide the care, prevention, and control of the TB-DM comorbidity was introduced[16]. However, Ghana continues to grapple with curbing a concurrent increase in TB and DM cases, resulting in an adverse effect on the health outcomes of populations co-infected with TB and DM[15]. In recent times, the main focus of most research in Ghana on TB and DM has been on the detection, prevalence, and incidence rates, and therefore, there is limited evidence on the factors affecting the wider systems performance, which are likely to determine the success or failure of the implementation[22, 24, 25]. It is important to investigate the barriers and facilitators from the perspectives of the different stakeholders involved in the implementation process and by extension translating this policy into practice, including its effects on TB and DM care in Ghana. This study explored the implementation of the WHO-Union collaborative framework in Ghana, from the perspectives of program managers, health facility managers, and frontline implementers (healthcare workers), including any collaborators deemed to play a meaningful role in the framework implementation.

1.1.6 Aim, objectives, and research questions

1.1.6.1 Overall research question

What are the barriers and facilitators to the implementation of the TB-DM collaborative framework in Ghana, from the perspectives of the key stakeholders?

1.1.6.2 Main objective

This research aims to explore the barriers and facilitators to the implementation of the TB-DM collaborative framework in Ghana, from the perspectives of the policymakers, program managers, health facility managers, and front-line implementers (healthcare workers).

1.1.6.3 Aim

The aim of this study was to explore and describe the implementation of the WHO-Union collaborative framework in Ghana, from the perspectives of the policymakers, program managers, health facility managers, and frontline implementers (healthcare workers).

1.1.6.4 Specific research objectives

1. To map evidence on the implementation of the WHO-Union collaborative framework, globally.

2. To explore the process followed by the Ministry of Health (MOH) in the adaptation of the framework in Ghana
3. To understand how healthcare workers conceptualize their roles in the implementation of the TB-DM collaborative framework.
4. To examine the systems and structures in place for implementing the collaboration of TB -DM management in the selected health facilities.
5. To explore the processes of detecting TB in DM and DM in TB patients at the District, Regional and Tertiary levels of the health-care system.

1.1.7 Significance of study

The significance of this research was to identify the enablers and constraints to the implementation of the collaborative framework from the perspective of program managers, health facility managers, and frontline implementers (healthcare workers), as they are key stakeholders in the health delivery system. Findings from this study are anticipated to provide a better understanding of the barriers and facilitators to framework implementation from the perspectives of the stakeholders, so that most effective and efficient methods for the implementation can be tailored. Additionally, the study results will most likely contribute to appropriate contextualization of the policy guidelines to ensure better health outcomes of both TB and DM patients in Ghana and sub-Saharan Africa.

1.2 Overall Methodology

1.2.1 Theoretical underpinnings for this study

Theories and frameworks are necessary for the design of research, to help the researcher understand health systems and human behaviour[26]. This study was guided by three theories: Lipsky's street-level bureaucratic theory, the adapted version of Systems Thinking Theory, and Grounded theory[26-28]. These theories were used to guide the design of the study, development of research tools, the review of literature, data analysis, and the discussion of findings.

1.2.2 Lipsky's street-level bureaucracy theory

Lipsky's street-level bureaucracy theory submits that in any policy implementation, the role of frontline implementers is crucial to effective implementation[28]. Healthcare workers are at the forefront of the policy implementation process and Lipsky's theory describes the outlook and conduct of frontline workers as pertinent to the application of the policy in the course of their work[28, 29]. Frontline workers are the ones who have daily interactions with citizens and exercise discretion on which services are offered, how they are offered and the benefits and sanctions to the citizens[28]. This process is important in eliciting how frontline workers use their personal discretion, establish routines and

strategize, while interacting with their patients[30]. Frontline workers can “re-make” a policy that contradicts the original policy directive or their organization's goals, taking into account what is practicable and what is not[30]. In the health systems, front liners e.g., nurses, and doctors have direct contact with patients, therefore patients experience the policy at the level of the frontline worker[28].

In this study, Lipsky's theory guided the researcher in understanding the role of the healthcare workers' “bottom-up” approach to the implementation of the WHO-Union collaborative framework. The healthcare workers' perception and understanding of the framework, their ability to adapt the framework in the process of service delivery are all the ways policy implementation is influenced by frontline implementers. An implementation strategy that recognizes “street-level bureaucrats” can negotiate and bargain to get ownership from the front liners and increase the potential of successful implementation [28].

1.2.3 The Systems Thinking Theory

This theory states that every system has many parts that interact with one another to allow it to fulfil its purpose, thus the implementation of any intervention has a consequence on the existing system directly and indirectly[31]. This theory helped the researcher to understand the full range of the effects of the intervention[31]. An understanding of the effects of the interventions allows implementers to prevent the negative results and promote the positive ones. The systems theory evaluates policy implementation by assessing key components and asking questions[31].

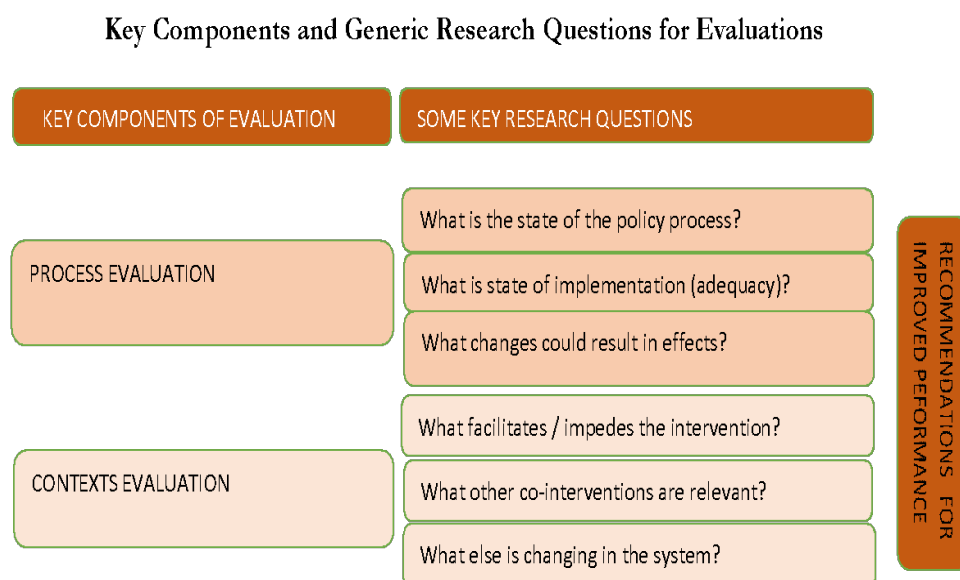


Figure 2 Systems Thinking Theory

Source: Adapted Version of Systems Thinking for Health Systems Strengthening[31].

Process evaluation- This aspect looks at how the intervention is working in the system and the outcomes. Evaluation is focused on the governance, policy, and program levels[31].

Context evaluation-This dimension focuses on the observed effects in the system and whether they are due to the intervention or the behaviours of the actors in the structured system[31]. In this study, the systems theory was adapted to focus on the Process and Context Evaluation. This adaptation enabled the researcher to optimally explore the barriers and facilitators to the implementation of the collaborative framework for TB-DM[31].The study focused on the knowledge and experiences of relevant stakeholders and deduced how these vital pieces of information influenced their thoughts and responses to the protocols used in the collaborative framework. Using the context evaluation process, some of the questions that were asked included, what facilitates or impedes the intervention? What other co-interventions are relevant? What else is changing in the system? Are there any unintended consequences?[31]

1.2.4 Grounded Theory

Grounded theory represents methods for generating and analysing data in qualitative studies. The grounded theory is used to discover and develop a theory about phenomenon with minimal information available[32]. This theory is appropriate for this study because to the best of our knowledge there is little known about the state of implementation of the collaborative framework in Ghana. The researcher conducted a literature review before collecting data for this study to gain more knowledge on the phenomenon from studies in other countries. This theory guided the researcher in data analysis to uncover the context and other factors in the implementation of the TB-DM framework from the perspective of the study participants. The context is critical in interpreting data generated[33, 34].

1.2.5. Description of study area

Ghana, a country in West Africa has an estimated population of 26 million with males accounting for 48.3% and females 51.7% of the total population[35]. The country is divided into sixteen (16) administrative regions (Figure 3), namely: Greater Accra Region, Ashanti Region, Eastern Region, Western Region, Ahafo Region, Western North Region, Bono East Region, Volta Region, Oti Region, Savannah Region, Upper East Region, Upper West Region and Northern Region, North East Region, Brong Ahafo, and Central Region. Christianity accounts for approximately 74%, whereas Islamic and traditional religions account for 18.5% and 7.5%, respectively[35]. The Northern, Upper East, and Upper West regions of Ghana continue to have the highest poverty headcount ratios above the national ratios[35].



Figure 3 Map of Ghana
Source: Ghana Maps-Ghanaweb.com[35].

The Northern Region of Ghana has, as its capital, Tamale with the Tamale metropolis being the most urbanized in the region (Figure 4). Estimates show that 50.4% of the people are poor, compared with 5.6-14.8% for the rest of Ghana, thereby making it the region with the highest number of poor people (1.3million) in the country[36]. The metropolis has a total estimated land size of 750 km sq. which is about 13% of the total land area of the Northern Region[35, 36].



Figure 4. Map of Northern Region, Ghana
Source: Ghana Maps-Ghanaweb.com [35].

1.2.5.1 Study Context

This study was conducted in three health facilities located in the Tamale metropolis (Figure 4). These sites are Tamale Teaching Hospital, Central Regional Hospital, and West District Hospital, and they were chosen because they offer TB and DM care and serve as the focal point for referrals[37].

1.2.6 Study Design

This study used qualitative methods to explore the implementation of the WHO-Union Collaborative Framework for Care and Control of TB and DM in Ghana. The grounded theory is the overarching design that guided the study processes[32]. This approach allows the theory to be generated from the data collected and suitable for research in areas with limited research evidence[32]. In this study, the researcher explored the implementation of the collaborative framework in Ghana, using the grounded theory, which allowed the data generated to render an explanatory theory of the state of the framework implementation. This theory guided the researcher in coding the data, comparing codes, and identifying analytical leads and categories[34]. Theoretical sampling, which is a method of continuously collecting data to generate theory, was employed in this study[32]. This was achieved by adding more cases, more observations and connections were made, which were then compared to the previously developed

working hypotheses[32]. Data generated were expected to either confirm or challenge the implementation of the collaborative framework[34]. Data were generated over the period of three months (July to September 2019).

1.2.6.1 Data generation techniques and tools

Data for this study were generated from a scoping review, documents review, in-depth interviews, and non-participant observation. The methods used are presented per each study objective.

Research method: To address the first objective (1.To map evidence on the implementation of the WHO-Union collaborative framework, globally), the researcher conducted a scoping review of peer-reviewed and grey literature on the available evidence on the implementation of the TB-DM collaborative framework, globally[38]. Using Arksey and O'Malley framework allowed the researcher to use an iterative approach and to engage with the following stages reflexively:

Stage 1: identifying the research question

Stage 2: identifying relevant studies

Stage 3: study selection

Stage 4: charting the inclusion and exclusion criteria

Stage 5: collating, summarizing, and reporting the results[38].

Using keywords in the databases, title screening was performed, selected articles underwent abstract and full article screening by two independent reviewers.

Sampling: Selection of eligible articles was guided by the inclusion and exclusion criteria. The inclusion criteria involved studies presenting evidence of Type 2 diabetes, TB-DM comorbidity among TB and DM populations, studies presenting evidence of bidirectional screening for TB and DM, as well as studies presenting evidence on mechanisms of collaboration in the management of TB and DM. All these studies had to have been published in the English language, between August 2011 and May 2021, given that the framework was first launched in 2011. The exclusion criteria included studies presenting evidence on Type 1 diabetes and those focusing on TB/ HIV. Also excluded were studies published prior to August 2011 and those published in languages other than English. The PRISMA extension was used as a checklist for explaining the scoping review process and findings were analysed using the thematic content analysis approach and the results were presented in the form of a narrative report.

Research method: To address the second, third and fourth objectives, namely: 2.To explore the process followed by the Ministry of Health (MOH) in the adaptation of the framework in Ghana, 3.To understand how healthcare workers conceptualize their roles in the implementation of the TB-DM collaborative framework, as well as 4.To examine the systems and structures in place for implementing the collaboration of TB -DM management in the selected health facilities, data were generated through in-depth interviews. In-depth interviews are a research technique used in qualitative research to explore

participants' perspectives on a phenomenon. This was appropriate for exploring the phenomenon from the perspectives of policymakers and program managers, with respect to how the implementation of the collaborative framework was adapted to the setting in Ghana, as well as understanding the role of frontline implementers (healthcare workers) in the implementation process. Additionally, this method was used to assess the efficiency of systems and structures available for joint management of TB-DM in Ghana.

Sampling: Process of in-depth interview-using a semi-structured interview guide with open-ended questions allowed participants to share freely and the researcher to gain greater insights into the barriers and facilitators of the implementation. Each interview guide was tailored for the different categories of participants (Appendix 2-5). The interviews were conducted by the researcher in English, in line with the language competency of all the participants. This took place in a private room at the office of the participants within the health facility and lasted for about an hour.

During interviews, questions were repeated, where and when necessary, to ensure that the correct meaning was conveyed[42] Topics explored were derived from the systems thinking model and collaborative framework [19, 34] and these included guidelines on care and control of TB and DM, challenges and opportunities affecting provision of care to TB and DM patients, experiences at health facility, the state of implementation (adequacy), exploring mechanisms for collaboration, detection, and management of TB in patients with DM and vice versa, as well as referral systems, monitoring and evaluation.

The participants were encouraged to share in-depth, their insights without leading them, but ensuring that appropriate prompts were used. In-depth interviews were conducted over the period of three months (July to September 2019).

Study population: Participants for this study were purposively selected. Health facility management and healthcare workers were drawn from TB and DM clinics at the three health facilities. Program managers were selected from NTP and NCDPC programs. In-depth interviews (IDI) were conducted with 27 participants made of two policy makers, two program managers, two health facility managers and twenty-one healthcare workers. All participants consented and interviews were audio recorded except two participants (institutional coordinator and medical doctor) who declined from their interviews being audio recorded but agreed for notes to be taken.

Research method : To address the fifth objective (To explore the processes of detecting TB in DM and DM in TB patients at the District, Regional and Tertiary levels of the health-care system), the researcher used a non-participant observation approach to describe the process in place for bidirectional screening [39]. Non-participant observation is used to collect data by observing the activity of interest in a relatively unstructured way in the natural setting[39]. This is a process of collecting data by watching

and recording how DM patients are tested for TB and vice versa, when attending the outpatient department, without asking the participants questions directly[26]. If done accurately, this approach eliminates subjective bias and often helps the researcher in identifying and getting a better understanding of the context, systems and structures in place at the various health facilities. Notes were taken, giving description of the actions and behaviours healthcare workers displayed in the process of screening[26] .

Sampling: To generate data through non-participant observation, the researcher spent time in the participating health facilities on assigned clinic days at both the TB clinic and DM clinic. The researcher generated data by watching and recording how DM patients were screened for TB and vice versa, when attending the outpatient department, without asking the questions directly to participants[39]. The process and structures in place for bidirectional screening was observed, using a checklist (Appendix 6) as a guide and taking notes recorded in a notebook. Repeated visit to these clinics in the three facilities helped the researcher get a better understanding and provide information about the process on the ground. This approach eliminated subjective bias and helped the researcher in identifying and better understanding the context, systems, structures and identification of nuances and dynamics at play during this process at the various health facilities [39].

Document review is a method employed to collect data from existing documents, which, in this study, was conducted to complement other data collection techniques. The process of document review is used to evaluate or review documents and the information analysed. Furthermore, this method is used for triangulation of data in research[40]. The researcher reviewed both printed and electronic materials related to the study to get background information to help understand the history and operation of the implementation of the TB-DM collaborative framework. Documents reviewed included screening tools, manuals, enrolment forms, patients register, and the NTP annual reports. The information revealed in the analysis was also used to verify findings from interviews and observation.

Narrative review in this study gives a broad overview of literature on the WHO-Union Collaborative Framework, diabetes, tuberculosis, and TB-DM comorbidity. Findings from this literature search were synthesized and presented in a narrative form.

1.2.7 Data Management and Storage Plan

Interviews were transcribed and saved under codes to protect the anonymity of the participants. The audio recordings were transcribed verbatim by an experienced professional transcriber and reviewed by the researcher. The researcher using a password saved all documents related to the study.

1.3 Data analysis

The overarching theory that underpinned the analysis of data generated from the in-depth interviews, was the grounded theory [34]. This analysis approach was complemented with the Lipsky's framework, which enabled us to gain further insight into frontline health workers' roles in the implementation of

collaborative framework, with a particular focus on frontline health workers' personal discretion, routines established, and strategies adopted to cope with high workload and scarce resources[29]. Audio recording from 25 participants were transcribed verbatim by a professional transcriber and the researcher reviewed the transcripts to ensure accuracy. Transcripts were systematically reviewed, while listening to the audio recordings. Two interviews which were not recorded were written up from the notes taken during the interview. Transcripts were complemented with hand written field notes, which served as a back-up in the event of audio record failure and to document non-verbal data. In the review of transcripts, the researcher coded ideas as they appeared and continued to group similar codes into themes. The researcher has been trained in qualitative research methods, which equipped her to compare the transcripts with handwritten field notes taken during interviews and from non-participant observation. Data from non-participant observation allowed the researcher to note non-verbal data to better understand the context surrounding the implementation of the collaborative framework. Document review provided important information on the guidelines for delivering care to TB and DM patients. The themes identified during the analysis of interview transcripts were triangulated with the document review and observational data to ensure the integrity of data.

1.4 Measures to Ensure Trustworthiness

1.4.1 Data Quality

In qualitative research, certain factors affect the quality of data generated. The researcher presents below measures taken to ensure data quality through transparency, credibility, transferability, dependability, and data triangulation.

1.4.1.1 Transparency

According to Malterude[39], the principles for ensuring transparency require that the research process be transparent, in order to ensure good quality data. This section discusses the processes followed to ensure that data quality was achieved. Additionally, the process of analysis must be transparent. The researcher in this study clearly outlines the research process followed in generating data as well as the analysis process. This was ensured through the verbatim transcription of audio recordings and that the transcripts compared well to the field notes and observational data. Quotes from the participants were included in the results presented to support transparency in the analysis process.

1.4.1.2 Credibility

Credibility in qualitative research allows interpretation of a phenomenon through participants' shared experiences [41]. The researcher reviewed individual transcripts of participants to identify similarities or differences from experiences shared by participants. These results and interpretations were supported

with verbatim quotes. During the interview process the researcher used member check technique through repeating answer to participants to allow them to clarify their responses and correct any errors identified.

1.4.1.3 Transferability

Transferability describes the way research findings and methods can be replicated [41]. This is validated by the context and achieving study objectives. This study was about the care and control of TB-DM patients using the collaborative framework as a guide. Generally, other researchers are likely to judge the findings of this study on the implementation of collaborative framework, as relevant for other similar settings (health facility, LMICs). Findings may also be similar to patients attending the OPDs or are hospitalized because they are likely to be dealing with the same issues in receiving care for TB-DM condition.

1.4.1.3 Dependability

This process is referred to as an audit trail. It allows another researcher to be able to follow the decision trail of the researcher[41]. The researcher documented the study design, how data were generated, analysed, as well as the interpretation and presentation of the findings.

1.5. Data Triangulation

The process of triangulation allows the researcher to validate findings from different data sources[41]. To explore and understand the phenomenon of management of TB-DM comorbidity guided by the collaborative framework, the researcher corroborated findings from in-depth interviews, document reviews, and non-participant observations. This reduced bias and confirmed findings.

1.6 Role of the Researcher

In this research, the researcher played the leading role in the data collection process guided by the academic supervisor who is experienced in qualitative research. The academic supervisor further provided intellectual and technical direction throughout the research process.

1.6.1 Reflexivity

Reflexivity describes the role the researcher's own beliefs, values, social background and experiences play in influencing the research practice[41]. As the principal investigator (PI), I am a Ghanaian with a background in nutrition. I am familiar with the health-care system in Ghana, from living in Ghana for most of my life. My research at the master's level was on diabetes and this influenced my choice of topic for my PhD research. I acknowledge having knowledge of the health-care system and being Ghanaian could potentially bias the research process, outcomes, and findings. To mitigate the effects of this potential bias on the research process, I reviewed literature on tuberculosis and diabetes comorbidity

from other countries, which helped me appreciate the phenomenon as it manifested in various contexts, including the global perspective.

I acknowledged my nationality and background and repeatedly, consciously and intentionally reminded participants that I was a student and not a healthcare worker, since this allowed the participant to speak freely without fear of being judged or assessed. I also assured participants that, I was there to learn from them and not tell them what to do.

During the analysis process recognising that every one's experience was unique and contributed to the in-depth understanding of study phenomenon allowed me to detach my own interpretation from the findings. This process also allowed me to continuously develop and improve my research skills.

1.7 Ethical Consideration

1.7.1. Ethical Clearance by an Ethics Review Board

Ethical approval was obtained from the University of KwaZulu-Natal (UKZN) Biomedical Research Ethics Committee (BREC) (BE262/19) and the Ghana Health Service Ethics Review Committee (GHSERC) (GHS-ERC 012/04/19).

1.7.2. Gatekeeper permissions

Permission to begin the research was first obtained from the Ghana Health Service (GHS) who issued introductory letters to enable the researcher to gain access to the NTP and NCDPC national offices and another to the Northern regional office of the Ghana Health Service. The directors of the programs introduced the researcher to national and regional staff. The GHS Northern regional office issued an introductory letter to the three health facilities in Tamale.

1.7.3 Informed Consent

All participants were given an information sheet that contained details about the study objectives, participant selection criteria, study risk, and study benefits. They then signed an informed consent sheet before participating in the study. The aims of the study, voluntariness to participate and confidentiality were explained to participants, who were also afforded an opportunity to ask questions for further clarification. Participants were reassured of the freedom to opt out of the study anytime during the course of the study without any consequences. Real names of participants were not used in the write-up in order to maintain confidentiality. Participants also had the opportunity during interviews to clarify or correct any errors in their responses through the researcher repeating their answers. This did not only help in adhering to sound ethical standards, but also served as part of member check, an important quality check mechanism in qualitative research.

1.8 Overview of the thesis

Chapter One

This chapter presents the background of the study, and an overview of the WHO-Union Collaborative Framework for Care and Control of Tuberculosis and Diabetes. Research objectives to be achieved, significance of the study, overview of methodology, study setting, study design and the theoretical frameworks that guided this study are also explained in this chapter.

Chapter Two

This chapter provides a comprehensive summary of the existing literature on tuberculosis, diabetes, TB-DM comorbidity, and the WHO-Union collaborative framework in different contexts. This will help identify existing knowledge and gaps.

Chapter Three

This chapter presents two published papers: the protocol and scoping review paper published by BMJ Open respectively. This chapter addresses objective one, which was to: To map evidence on the implementation of the WHO-Union collaborative framework, globally.

Chapters Four

This chapter is presented in a form of a research article published in the PloS One-Journal. The paper addresses objectives four and five, which were: “To examine the systems and structures in place for implementing the collaboration of TB-DM management in the selected health facilities” and “To explore the processes of detecting TB in DM and DM in TB patients at the District, Regional and Tertiary.”

Chapter Five

This chapter is presented in a research article format published in BMC Research Notes. It addressed objective two of the overall study, i.e. “To explore the process followed by the Ministry of Health (MOH) in the adaptation of the framework in Ghana.”

Chapter Six

This chapter is presented in a form of a research article, published in the BMC Health Services Research. The paper addresses objective three, i.e. “To understand how healthcare workers conceptualize their roles in the implementation of the TB-DM collaborative framework.”

Chapter Seven

This chapter presents an overall synthesis of the study, including the main findings, study implications, as well as the overall conclusions. The objectives of the study are discussed in line with the main findings as well as the limitations and strengths of the study.

1.9 Reference

1. Safiri S, Kolahi AA, Hoy D, Smith E, Bettampadi D, Mansournia MA, et al. Global, regional and national burden of rheumatoid arthritis 1990–2017: a systematic analysis of the Global Burden of Disease study 2017. *Annals of the rheumatic diseases*. 2019;78(11):1463-71.
2. Marshall SJ. Developing countries face double burden of disease. *Bulletin of the World Health Organization*. 2004;82:556-.
3. Organization WH. Noncommunicable diseases: progress monitor 2020: World Health Organization; 2020.
4. Remais JV, Zeng G, Li G, Tian L, Engelgau MM. Convergence of non-communicable and infectious diseases in low-and middle-income countries. *International journal of epidemiology*. 2013;42(1):221-7.
5. Organization WH. Noncommunicable diseases country profiles 2018. 2018.
6. Cho N, Shaw J, Karuranga S, Huang Y, da Rocha Fernandes J, Ohlrogge A, et al. IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. *Diabetes research and clinical practice*. 2018;138:271-81.
7. Mbanya JCN, Motala AA, Sobngwi E, Assah FK, Enoru STJTI. Diabetes in sub-saharan africa. 2010;375(9733):2254-66.
8. Ghana Statistical Service. Population by Regions ,Northern 2019 [Available from: <https://www.statsghana.gov.gh>].
9. Kapur A, Harries AD, Lönnroth K, Wilson P, Sulistyowati LS. Diabetes and tuberculosis co-epidemic: the Bali Declaration. *The lancet Diabetes & endocrinology*. 2016;4(1):8-10.
10. Asamoah-Boaheng M, Sarfo-Kantanka O, Tuffour AB, Eghan B, Mbanya JC. Prevalence and risk factors for diabetes mellitus among adults in Ghana: a systematic review and meta-analysis. *International health*. 2019;11(2):83-92.
11. Crevel RV, Critchley JA. The Interaction of Diabetes and Tuberculosis: Translating Research to Policy and Practice. *Tropical Medicine and Infectious Disease*. 2021;6(1):8.
12. Organization WH. Global tuberculosis report 2020. 2020.
13. Workneh MH, Bjune GA, Yimer SAJPo. Prevalence and associated factors of tuberculosis and diabetes mellitus comorbidity: a systematic review. 2017;12(4):e0175925.
14. McMurry HS, Mendenhall E, Rajendrakumar A, Nambiar L, Satyanarayana S, Shivashankar R. Coprevalence of type 2 diabetes mellitus and tuberculosis in low-income and middle-income countries: a systematic review. *Diabetes/metabolism research and reviews*. 2019;35(1):e3066.
15. Asante-Poku A, Asare P, Baddoo NA, Forson A, Klevor P, Otchere ID, et al. TB-diabetes co-morbidity in Ghana: The importance of Mycobacterium africanum infection. *PloS one*. 2019;14(2):e0211822.
16. Organization WH. Collaborative framework for care and control of tuberculosis and diabetes. World Health Organization; 2011. Report No.: 9241502258.
17. Ogbera OA, Adeyeye O, Odeniyi IA, Adeleye O. Knowledge of diabetes mellitus in tuberculosis amongst healthcare workers in Nigeria. *Indian journal of endocrinology and metabolism*. 2013;17(4):704.
18. Lin Y, Harries A, Kumar A, Critchley J, Van Crevel R, Owiti P, et al. Tackling diabetes mellitus and tuberculosis: a new Union guide on the management of diabetes-tuberculosis. *The International Journal of Tuberculosis and Lung Disease*. 2019;23(7):771-2.
19. Anand T, Kishore J, Isaakidis P, Gupte HA, Kaur G, Kumari S, et al. Integrating screening for non-communicable diseases and their risk factors in routine tuberculosis care in Delhi, India: A mixed-methods study. *PloS one*. 2018;13(8):e0202256.

20. Li L, Lin Y, Mi F, Tan S, Liang B, Guo C, et al. Screening of patients with tuberculosis for diabetes mellitus in China. *Tropical medicine & international health*. 2012;17(10):1294-301.
21. Zheng C, Hu M, Gao F. Diabetes and pulmonary tuberculosis: a global overview with special focus on the situation in Asian countries with high TB-DM burden. *Global health action*. 2017;10(1):1264702.
22. Ohene S-A, Bonsu F, Hanson-Nortey NN, Toonstra A, Sackey A, Lonroth K, et al. Provider initiated tuberculosis case finding in outpatient departments of health care facilities in Ghana: yield by screening strategy and target group. *BMC infectious diseases*. 2017;17(1):1-11.
23. GHS/NTP. National Tuberculosis Control Programme Annual Report 2016.
24. Yahaya A, Aquah S, Sagoe K. Incidence of pulmonary tuberculosis (per 100,000 people) in Northern Ghana (A retrospective study at the Tamale teaching hospital 2004-2012). *International Journal of Research In Medical and Health Sciences*. 2014.
25. Yorke E, Atiase Y, Akpalu J, Sarfo-Kantanka O, Boima V, Dey ID. The bidirectional relationship between tuberculosis and diabetes. *Tuberculosis research and treatment*. 2017;2017.
26. Bryman A. *Social research methods*: Oxford university press; 2016.
27. Sulaiman SAS, Zain FAM, Majid SA, Munyin N, Tajuddin NSM, Khairuddin Z, et al. Tuberculosis among diabetic patient. *WebmedCentral INFECTIOUS DISEASES* 2011.
28. Erasmus E. The use of street-level bureaucracy theory in health policy analysis in low-and middle-income countries: a meta-ethnographic synthesis. *Health policy and planning*. 2014;29(suppl_3):iii70-iii8.
29. Wright TM. *Bringing Michael Lipsky's theories into the 21st century*: University of Tennessee, Knoxville; 2003.
30. Durose C. Revisiting Lipsky: Front-line work in UK local governance. *Political studies*. 2011;59(4):978-95.
31. De Savigny D, Adam T. *Systems thinking for health systems strengthening*: World Health Organization; 2009.
32. Charmaz K, Belgrave LL. *Grounded theory*. The Blackwell encyclopedia of sociology. 2007.
33. Corbin J, Strauss A. *Basics of qualitative research: Techniques and procedures for developing grounded theory*: Sage publications; 2014.
34. Charmaz K, Belgrave L. Qualitative interviewing and grounded theory analysis. *The SAGE handbook of interview research: The complexity of the craft*. 2012;2:347-65.
35. Service GS. *Ghana Demographic and Health Survey*. 2015
36. Ghana Districts.com. The Northern Region n.d [Available from: <http://www.ghanadistricts.com/>].
37. Fuseini I, Yaro JA, Yiran GAB. City profile: Tamale, Ghana [Article]. 2017 [64-74]. Available from: <http://ugspace.ug.edu.gh/handle/123456789/26920>.
38. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *International journal of social research methodology*. 2005;8(1):19-32.
39. Malterud K. Qualitative research: standards, challenges, and guidelines. *The lancet*. 2001;358(9280):483-8.
40. Bowen GA. Document analysis as a qualitative research method. *Qualitative research journal*. 2009.
41. Thomas E, Magilvy JK. Qualitative rigor or research validity in qualitative research. *Journal for specialists in pediatric nursing*. 2011.

Chapter Two: Narrative Literature Review

2.1 Introduction and scope

This chapter reviews existing literature on the manifestation of TB-DM co-epidemic, globally, including the implementation of the WHO-Union Collaborative Framework for Care and Control of TB and DM in various settings[1] . The review covered aspects, such as the burden of tuberculosis (TB) and diabetes mellitus (DM), TB-DM comorbidity, the WHO framework, bidirectional screening, and co-management of TB-DM in low- and middle-income countries (LMICs). The TB-DM comorbidity is a growing public health challenge that many countries are grappling with. There is a growing research evidence that supports the association between tuberculosis (TB) and diabetes mellitus (DM)[2] . Individuals with DM have a three-fold risk for developing TB, a phenomenon that is likely to lead to poor health outcomes[2]. LMICs are hardest hit with countries like India, China and Indonesia, which have the highest TB burdens grappling with its effects on increasing rates for DM[2, 3].

2.2 Search Strategy

The literature review for this study was sourced through searching literature on the evidence of the TB-DM comorbidity and implementation of the WHO collaborative framework globally and specifically in low- and middle-income countries. The research was guided by the aims and objectives of the study, the collaborative framework, and the theories underpinning this study. Relevant literature was sourced using electronic search engines, such as PubMed, Google Scholar, and EBSCOhost, with the following key words, used individually and/or in combination:

MeSH terms

- ‘Diabetes’
- ‘Diabetes mellitus’
- ‘Type 2 Diabetes’
- ‘Tuberculosis’
- ‘Double burden of disease’
- ‘Comorbidity’
- ‘Ghana’

Hard and soft copies of reports from the World Health Organization (WHO), Ghana Health Service (GHS), and the National Tuberculosis Control Program (NTP) were also reviewed. These databases were used to search for articles on the co-prevalence of TB and DM, globally, and in LMICs, published between 2011 to 2021. The rationale for these timelines was the fact a collaborative framework to guide the care, prevention, and control of tuberculosis (TB) and diabetes mellitus (DM) was developed by the World Health Organization (WHO) and International Union Against Lung Disease (Union) in 2011. The country-specific search for information related to the collaborative framework was for LMIC,

specifically Ghana. Articles on Type 1 diabetes were excluded because that condition does not share the socio-economic, environmental, and behavioural factors with TB.

2.3 The Global Burden of Tuberculosis Disease

Tuberculosis(TB) is a contagious and airborne bacterial infection caused by *Mycobacterium tuberculosis* and spread through expelled droplets from infected persons [4]. It mostly affects the lungs (pulmonary TB) but can also affect other parts of the body (extrapulmonary TB)[4] . TB is still one of the top 10 causes of death, globally, and a critical cause of death in persons living with HIV/AIDS[5] . In 2018, the worldwide estimate of TB-related deaths was 1.5 million, an increase from 1.3 million in 2016, with approximately 10 million falling sick from tuberculosis in 2018[4, 6]. TB infection affects about one quarter of the world's population with the global target of a 20% reduction of TB incidence in 2020. However, between 2015-2019 the rate had fallen only by 9%[5] . The WHO Africa and South-East Asia regions experience the highest TB incidence and prevalence [5]. Incident cases were highest in South-East Asia Region (44%), followed by African Region (25%), the Western Pacific Region (18%), the Eastern Mediterranean Region (8.2%), the WHO European Region (2.5%), and lastly the WHO Region of the Americas (2.9 %) [5].

LMICs, especially Asia and Africa, show a higher annual incidence rate with 82% of TB deaths occurring in the Asian and African region, as compared to high-income countries[6] . Two-thirds of the global TB burden is born by eight countries: India (26%), Indonesia (8.5%), China (8.4%), the Philippines (6.0%), Pakistan (5.7%), Nigeria (4.4%), Bangladesh (3.6%) and South Africa (3.6%) [5]. Since the year 2000, the international community has come out with various strategies to reverse the increase in TB burden – the objectives of the Millennium Development Goals (MDGs), particularly MDG6 and the Sustainable Development Goals, particularly SDG3.3 being the most recognized [7] . This eventually led to the 2030 global strategy to reduce TB incidence by 80% and mortality by 90%[6]. In 2013, a national TB prevalence survey discovered that the TB disease burden in Ghana was four times more than previously reported 290 per 100,000[8]. The national TB incidence in Ghana has steadily dropped from 160 per 100,000 in 2015 to 148 per 100,000 population in 2019 with Northern Ghana having 83.3 per 100,000[6, 9, 10]. This may be due to the intensified case finding initiatives and revised symptom screening tool instituted by the NTP to increase sensitivity [8, 11]. Despite these initiatives there still exists a large number of undiagnosed cases accounting for approximately two-thirds of undiagnosed cases leading to lower presumed number of diagnosed cases [8, 11]. This may be attributed to the existing challenges which include diagnostic delay, inadequate screening, untrained healthcare workers, stigma and poor contact tracing [8, 12, 13]. Additionally, Ghana is one of the countries with a high HIV/TB burden in sub-Saharan Africa, with the impact of HIV on TB increasing, thereby leading to 14% of TB cases attributed to HIV/AIDS in 2015 and further complicating treatment [10]. Stigma is

one of the socio-cultural factors affecting TB management in Ghana, which emerges from several factors, including association with HIV/AIDS, fear of infection, societal beliefs and practices about TB [14]. The Ghana National Tuberculosis Control Program (NTP), of the Ghana Health Service (GHS), is responsible for the prevention, care and control of TB, as well as policy and interventions.

2.4 The Global Burden of Diabetes- Mellitus Disease

Diabetes Mellitus (DM) is defined as “a chronic disease that occurs when the pancreas does not produce enough insulin, or when the body cannot effectively use the insulin, it produces”[15]. It has adverse effects on the body systems and may cause medical conditions like retinopathy, nephropathy, renal damage, heart disease, and stroke [15]. There are two main types of diabetes mellitus: Type 1 (also known as insulin-dependent, juvenile, or child-hood-onset diabetes) and Type 2 diabetes (also known as non-insulin-dependent or adult-onset diabetes) [15]. Type 1 diabetes accounts for an estimated 5-10% of all diabetic cases, while type 2 diabetes accounts for 90-95% of all diabetic cases, worldwide [15].

DM is one of the top four (4) non-communicable diseases and its global disease burden is rising due to aging populations, urbanization, and other related risk factors of obesity[16, 17]. The prevalence of DM has seen an increase over the past decade, and it is higher in urban areas, as compared to rural areas [7, 14]. According to the World Health Organization, approximately 422 million people were living with diabetes in 2014 across the globe, with approximately 425 million cases reported in 2017 and further projected increase to 629 million by 2045, globally[15, 18]. It is estimated that by 2030 diabetes will be the seventh leading cause of death, globally, with LMICs countries expected to bear 2/3 of the increased prevalence[19]. The highest TB burden is found in low- and middle-income countries, where four out of five people are co-infected with DM [20]. The countries with the highest number of people living with DM, worldwide, include India, China, U.S, Indonesia, and Japan and these numbers are expected to double by 2030 [12].

The International Diabetes Federation (IDF) is divided into 7 regions: Africa (AFR), Europe (EUR), Middle East and North Africa (MENA), North America and Caribbean (NAC), South and Central America (SACA), South East Asia (SEA) and Western Pacific (WP)[21]. In 2019, the Africa Region (AFR) had 9 million adults living with diabetes and the projections are that the increase will reach 28.6 million by 2030 and 47 million by 2045, more than twice the prevalence in 2019 and the highest among the IDF regions[22]. These are the According to the global report on DM, data for sub-Saharan Africa (SSA) and parts of Latin America are lacking, making it difficult to accurately estimate the disease burden[23]. This is in part due to the high number of undiagnosed DMs cases in AFR with approximately 59.7% of the population with DM being unaware of their DM status, making it the IDF region with the

highest undiagnosed population[21, 24]. The highest prevalence in adults (20-79 yrs.) within the AFR region is South Africa (12.7%), Seychelles (12.3%), and Comoros (12.3%) [21].

In Africa, the healthcare system does not reach a sizeable portion of the population and is mainly focused on infectious diseases while grappling with limited infrastructure and healthcare workers not adequately trained in the management of chronic diseases[25].

In Ghana, 540,000 adults were living with diabetes in 2018 a 40,000 increase from the 500,000 recorded in 2010 with many remaining undiagnosed and this figure is expected to double to 1 million in 2030[19, 26]. Overall, the prevalence of DM in Ghana is reported to be as high as 6.46% and this is associated with obesity, advanced age, female gender and urban environment, although indications are that there are still many undiagnosed cases[19, 25].

From research evidence, 95% of the population of people living with diabetes have type 2 diabetes [21]. It is projected that ending DM prevalence can avert an estimated 6 million TB cases and 1.1million TB mortality over a 20-year period in 13 countries[27]. The NCDPC of the Ghana Health Service plans and coordinates NCD activities, develops clinical practice guidelines, train and advocate[28].

2.5 TB-DM Comorbidity

The link between DM and TB was first identified as far back as 1000AD, however, it is only until recently that its relevance has been recognized and given global attention[29]. By 2010, there was mounting evidence that supports the association between the rising DM burden and increasing TB incidence[30]. The pathogenesis of the directionality of the association of TB-DM comorbidity is complicated[31, 32]. DM patients have an increased risk to respiratory infection like TB due to reduced numbers and function of T-lymphocytes[33, 34]. This impairs immune response to mycobacterium TB and TB-specific IFN- γ -producing T-cells move to the lymph nodes and lungs [31, 34]. Patients with TB have been observed to experience stress-induced hyperglycaemia and some medication used in treating TB may also have hyperglycaemic effect leading to TB patients also having an impaired tolerance to glucose, thus putting them at risk of DM [31, 34].

It is estimated that approximately 10-30% of individuals with TB develop DM causing varied immune response changes [29]. The major reason for the poor attention given to the linkage was because while TB is relatively low in high-income countries, where DM prevalence is high, DM was found to be of low prevalence in low-income countries, where the TB prevalence rate was high. The association was therefore not obvious until recently[29, 35]. The period of 2007-2008 was when the global scientific community became convinced of the significant link between TB and DM. Findings showed that the “overall risk of TB in persons with DM is two to three times higher than in the general population”[35]. Globally, the comorbidity of tuberculosis (TB) and diabetes mellitus (DM) is rising speedily and derailing the extensive achievements made in the fight against tuberculosis [29]. According to McMurphy et al [29], TB-DM comorbidity occurs in the “same populations and same individuals”. The convergence

of DM and TB shows that an estimated 15% of people infected with TB have DM as well [16]. In the 22 countries, which carry 80% of the global TB burden, TB due to DM increased from 10%-15% from 2010 to 2013 [23]. The soaring rate of growth in diabetes prevalence is affecting the disease presentation and treatment response for TB [11, 29]. It was observed that countries with a high prevalence of DM, like China and India, showed a direct correlation with the increase in TB incidence[36, 37]. Evidence shows that, generally, 15% of the population with TB also had DM in China, 17% in Russia, while South Africa, Bangladesh, and the Democratic Republic of Congo had approximately 10%, respectively[38]. TB-DM prevalence differed in sub-Saharan Africa from 1.91% to 38% [39].

A major problem with the management of TB-DM comorbidity is that the majority of people are not diagnosed, or are diagnosed too late[1]. In low resource settings, the health systems' capacity for early diagnosis is difficult, something that may explain the rising TB-DM comorbidity rates [11]. In DM patients, active screening for TB is critical, but in most LMIC this is not routine, and this is despite the guidelines that promote co-screening[40]. Additionally, the knowledge levels of healthcare workers on the management of TB-DM are inadequate[41]. In Nigeria, a study on healthcare workers' knowledge of DM in TB patients and its management showed gaps in the various aspects; screening, detection, and management[40, 42]. The presence of DM in a TB patient increases relapse and fatality rates, and TB in DM patients also affects glycaemic control and predisposes diabetic patients to glucose intolerance [43]. This phenomenon presents a complex situation of two diseases in one person imposing a strain on the existing health-care system.

2.6 The WHO Collaborative Framework for TB-DM

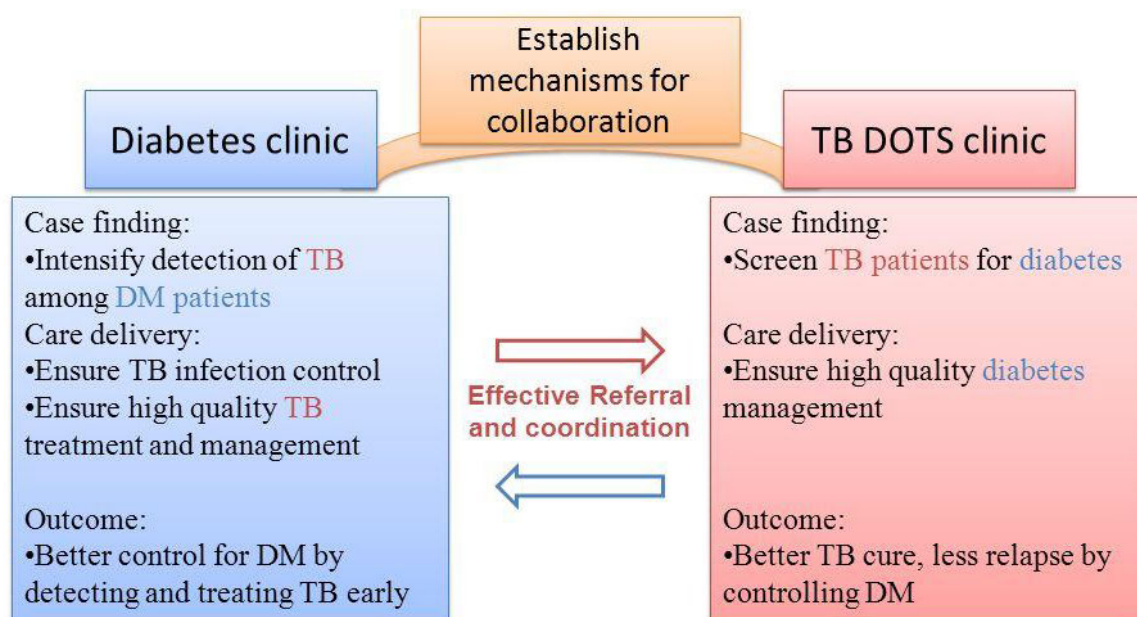
Since the year 2000, the international community has come out with various strategies to reverse the TB and DM incidence. The millennium development goals highlighted this in the expired MDG6, which included a specific target to reverse TB incidence by 2015. A significant stride made within this period was the reduction of TB deaths by 22%, thereby saving 53 million lives[30, 44]. In 2015, Millennium Development Goals (MDGs) expired, and the Sustainable Development Goals (SDGs) were introduced as a replacement[36]. SDG3 is aimed at ensuring that good health and wellbeing prioritizes infectious diseases and non-communicable diseases[36]. All these initiatives show the global commitment by world leaders to have systematically developed strategies with intentionality to reducing morbidity and mortality caused by TB and DM[36]. With the looming co-epidemic of TB and DM it was clear that without a clear strategy, this major public health problem was likely to derail all the achievements made over the past few years. In response to this, the World Health Organization (WHO) and International Union Against Lung Disease (Union) developed a collaborative framework to guide the care, prevention and control of DM and TB[30]. This framework is expected to work together and complement the core

systems set up for the prevention and management of both diseases. The framework is set up to guide the development and implementation of collaborative activities[1].

Key objectives addressed by the framework are:

1. To establish mechanisms of collaboration between DM and TB programs
2. To improve detection and management of TB in patients with DM
3. To improve detection and management of diabetes in TB patients [1].

TB-DM collaborative framework



(Stop TB, WHO WPRO, based on "Collaborative Framework for Care and Control of Tuberculosis and Diabetes", WHO/IUATLD, 2011)



World Health Organization, Western Pacific Regional Office

Figure 5 TB-DM collaborative framework.
Source: World Health Organisation.org [1]

In 2015, a global summit of representatives from governments, public health agencies, non-governmental organisations, research institutions, media and advocacy groups met in Bali as a follow up to accelerate the implementation of the WHO-Union Collaborative Framework for Care and Control of TB and DM [1]. In 2019, the Union followed up with a guide providing essential information for frontline healthcare workers for practical management of patients diagnosed with both diseases[18].

2.7 Bidirectional Screening in Low and Middle-Income Countries (LMICs)

The WHO collaborative framework advocates that the screening of both TB and DM patients is crucial in the detection and management of TB-DM comorbidity. According to Shidam et al[45], bidirectional screening reduces the burden of TB-DM comorbidity. The findings from research conducted in Ghana on dysglycemia among TB patients further confirmed the association between TB and DM and support the recommendation for the institutionalization of bidirectional screening in LMICs [13]. Unfortunately, this is not widely practiced in most LMICs. Early diagnosis is very difficult in low resource settings and may be a contributing factor for the rise in TB-DM comorbidity[37, 46].

The India Tuberculosis-Diabetes Study Group (ITDG) proposed that making testing services free is a way of encouraging testing in LMICs[40]. After the piloting of such a screening strategy, the government of India instituted a policy for nationwide implementation[40]. The feasibility of implementing bidirectional screening has been demonstrated by China and India, what is needed by further research is “optimal ways of delivering treatment”, “integration of DM and TB services” and “infection control” [1].

2.7.1 Co-Management of TB-DM in Low- and Middle-Income Countries

The rise in rates of the TB-DM epidemic has raised questions on how the current health-care system manages the overlaps burden of communicable and non-communicable disease[47]. In LMICs, health-care systems remain weak and fundamentally set up to unduly favour care for infectious diseases[48]. Since 2013, non-communicable diseases (NCDs) have contributed to 22% of deaths in Ghana, yet health facilities do not have adequate capacity to handle them[48]. Despite the large body of evidence that supports the combined effect of these two diseases[13], health-care services continue to be delivered separately in most developing countries, and this has affected early detection that can help improve care and control of both TB and DM conditions [13, 43]. Apart from the issue of risk, that TB-DM comorbidity gives to the two conditions (TB & DM); the management of TB cases gets further complicated when the patient develops DM, which leads to recurrence or even death [38]. Similarly, people living with DM who develop TB have problems managing their glycaemic levels [1, 38, 44]. With the rising TB-DM epidemic, there is now increasing pressure on existing healthcare delivery systems and an urgent need to integrate screening and management to ensure health outcomes [34, 45]. Many existing healthcare systems have limited integration of healthcare delivery for patients with TB-DM comorbidity [46]. The parallel services delivery affects patient care who struggled with going to two different clinics to access care and trying to combine treatment. Research shows that joint treatment leads to better outcomes and the health-care system needs clear guidelines and training for healthcare workers [47].

2.8 Summary

Evidence from the literature suggests that the burden of TB and DM is higher in LMICs, thereby making the adverse effects of TB-DM comorbidity more pronounced in this region. This phenomenon necessitates the deployment of extra resources and efforts to manage this condition[49]. Any attempt to address the dual rise in TB and DM would be futile if TB-DM comorbidity is not addressed [22]. In 2011, the launch of the WHO-Union Collaborative Framework for Care and Control of TB and DM was aimed at addressing this rising epidemic [1].

To date, some countries have documented aspects of the implementation; however, Ghana has had various challenges in documenting the implementation process in the manner comparable to the objectives of this study. The WHO-Union collaborative framework recommends operational research to assist in documenting countries' experiences [24]. Ghana, therefore, needs to encourage more research to explore the barriers and facilitators of the implementation, to improve the care and control of TB and DM and curb the rise of the TB-DM epidemic. A greater emphasis should be placed on interventions utilizing the collaborative framework as a guide. The literature review for this study will continue in the next chapter with a focus on the scoping review mapping evidence on the implementation of the WHO-Union framework, globally.

2.9 Reference

1. Organization WH. Collaborative framework for care and control of tuberculosis and diabetes. World Health Organization; 2011. Report No.: 9241502258.
2. Sharma P, Visnegarwala F, Tripathi V. Burgeoning double burden of tuberculosis and diabetes in India: Magnitude of the problem—Strategies and solutions. *Clinical Epidemiology and Global Health*. 2014;2(3):107-16.
3. Arini M, Sugiyo D, Permana I. Challenges, Opportunities, and Potential Roles of the Private Primary Care in Tuberculosis and Diabetes Mellitus (TB-DM) Collaborative Care and Control: A Qualitative Study 2021 [Available from: <https://assets.researchsquare.com/>].
4. Organization WH. Global Tuberculosis Report 2016. Geneva:WHO 2016 [Available from: http://www.who.int/tb/publications/global_report/en/].
5. Organization WH. Global tuberculosis report 2020. 2020.
6. Organisation, WH. Global Tuberculosis Report World Health Organization 2019.
7. Organisation WH. Progress towards the SDGs: A selection of data from World Health Statistics 2018 2018 [Available from: https://www.who.int/gho/publications/world_health_statistics/2018/EN_WHS2018_SDGhighlights.pdf?ua=1].
8. Fund G. Best Practices on TB Case Finding and Treatment: Reflections and Lessons from West and Central Africa and Beyond. World Health Organization, Geneva, Switzerland. 2018.
9. Yahaya A, Aquah S, Sagoe K. Incidence of pulmonary tuberculosis (per 100,000 people) in Northern Ghana (A retrospective study at the Tamale teaching hospital 2004-2012). *International Journal of Research In Medical and Health Sciences*. 2014.
10. Osei E, Der J, Owusu R, Kofie P, Axame WK. The burden of HIV on Tuberculosis patients in the Volta region of Ghana from 2012 to 2015: implication for Tuberculosis control. *BMC infectious diseases*. 2017;17(1):504.

11. Ohene S-A, Bonsu F, Hanson-Nortey NN, Toonstra A, Sackey A, Lonnroth K, et al. Provider initiated tuberculosis case finding in outpatient departments of health care facilities in Ghana: yield by screening strategy and target group. *BMC infectious diseases*. 2017;17(1):1-11.
12. Afoakwa E, Taylor J. Knowledge of tuberculosis and factors responsible for low case detection in the Amansie Central District, Ghana. *South Sudan Medical Journal*. 2018;11(1):8-12.
13. Yorke E, Atiase Y, Akpalu J, Sarfo-Kantanka O, Boima V, Dey ID. The bidirectional relationship between tuberculosis and diabetes. *Tuberculosis research and treatment*. 2017;2017.
14. Dodor EA, Neal K, Kelly S. An exploration of the causes of tuberculosis stigma in an urban district in Ghana. *The International Journal of Tuberculosis and Lung Disease*. 2008;12(9):1048-54.
15. WHO. Classification of diabetes mellitus. World Health Organization : Geneva; 2019. Report No.: 9241515708.
16. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. *Diabetes care*. 2004;27(5):1047-53.
17. Mbanya JCN, Motala AA, Sobngwi E, Assah FK, Enoru ST. Diabetes in sub-saharan africa. *The lancet*. 2010;375(9733):2254-66.
18. Lin Y, Harries A, Kumar A, Critchley J, van Crevel R, Owiti P, et al. Management of diabetes mellitus-tuberculosis: a guide to the essential practice. International Union Against Tuberculosis and Lung Disease (The Union), Paris. 2019.
19. Asamoah-Boaheng M, Sarfo-Kantanka O, Tuffour AB, Eghan B, Mbanya JC. Prevalence and risk factors for diabetes mellitus among adults in Ghana: a systematic review and meta-analysis. *International health*. 2019;11(2):83-92.
20. Dunachie S, Chamnan P. The double burden of diabetes and global infection in low and middle-income countries. *Transactions of the Royal Society of Tropical Medicine and Hygiene*. 2019;113(2):56-64.
21. International Diabetes Federation. IDF DIABETES ATLAS
Ninth edition 2019.
22. Cho N, Shaw J, Karuranga S, Huang Y, da Rocha Fernandes J, Ohlrogge A, et al. IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. *Diabetes research and clinical practice*. 2018;138:271-81.
23. Roglic G. WHO Global report on diabetes: A summary. *International Journal of Noncommunicable Diseases*. 2016;1(1):3.
24. Bosu WK. Accelerating the control and prevention of non-communicable diseases in Ghana: the key issues. *Postgraduate Medical Journal of Ghana*. 2013;2(1):32-3.
25. Danquah I, Bedu-Addo G, Terpe K-J, Micah F, Amoako YA, Awuku YA, et al. Diabetes mellitus type 2 in urban Ghana: characteristics and associated factors. *BMC public health*. 2012;12(1):1-8.
26. Doherty ML, Owusu-Dabo E, Kantanka OS, Brawer RO, Plumb JD. Type 2 diabetes in a rapidly urbanizing region of Ghana, West Africa: a qualitative study of dietary preferences, knowledge and practices. *BMC Public Health*. 2014;14(1):1-8.
27. Pan S-C, Ku C-C, Kao D, Ezzati M, Fang C-T, Lin H-H. Effect of diabetes on tuberculosis control in 13 countries with high tuberculosis: a modelling study. *The lancet Diabetes & endocrinology*. 2015;3(5):323-30.
28. Bosu, WK. A comprehensive review of the policy and programmatic response to chronic non-communicable disease in Ghana. *Ghana medical journal*. 2012;46(2):69-78.
29. McMurry HS, Mendenhall E, Rajendrakumar A, Nambiar L, Satyanarayana S, Shivashankar R. Coprevalence of type 2 diabetes mellitus and tuberculosis in low-income and middle-income countries: a systematic review. *Diabetes/metabolism research and reviews*. 2019;35(1):e3066.
30. Maurice J. WHO framework targets tuberculosis–diabetes link. *The Lancet*. 2011;378(9798):1209-10.

31. Kumpatla S, Viswanathan V. 'Diabetes and tuberculosis'—a co-epidemic of public health importance in the developing world. *Current Science*. 2017;1296-302.
32. Ugarte Gil CA. *Tuberculosis and Diabetes: another perfect storm?* : Johns Hopkins University; 2017.
33. Yorke E, Atiase Y, Akpalu J, Sarfo-Kantanka O, Boima V, Dey IDJTr, et al. The bidirectional relationship between tuberculosis and diabetes. 2017;2017.
34. Jeon CY, Murray MB. Diabetes mellitus increases the risk of active tuberculosis: a systematic review of 13 observational studies. *PLoS med*. 2008;5(7):e152.
35. Lönnroth K, Roglic G, Harries AD. Improving tuberculosis prevention and care through addressing the global diabetes epidemic: from evidence to policy and practice. *The lancet Diabetes & endocrinology*. 2014;2(9):730-9.
36. Li L, Lin Y, Mi F, Tan S, Liang B, Guo C, et al. Screening of patients with tuberculosis for diabetes mellitus in China. *Tropical medicine & international health*. 2012;17(10):1294-301.
37. Sullivan T, Amor YB. The co-management of tuberculosis and diabetes: challenges and opportunities in the developing world. *PLoS Med*. 2012;9(7):e1001269.
38. Sachs JD. From millennium development goals to sustainable development goals. *The lancet*. 2012;379(9832):2206-11.
39. Alebel A, Wondemagegn AT, Tesema C, Kibret GD, Wagnew F, Petrucka P, et al. Prevalence of diabetes mellitus among tuberculosis patients in Sub-Saharan Africa: a systematic review and meta-analysis of observational studies. *BMC infectious diseases*. 2019;19(1):1-10.
40. Achanta S, Tekumalla R, Jaju J, Purad C, Chepuri R, Samyukta R, et al. Screening tuberculosis patients for diabetes in a tribal area in South India. *Public Health Action*. 2013;3(1):43-7.
41. Remais JV, Zeng G, Li G, Tian L, Engelgau MM. Convergence of non-communicable and infectious diseases in low-and middle-income countries. *International journal of epidemiology*. 2013;42(1):221-7.
42. Ogbera OA, Adeyeye O, Odeniyi IA, Adeleye O. Knowledge of diabetes mellitus in tuberculosis amongst healthcare workers in Nigeria. *Indian journal of endocrinology and metabolism*. 2013;17(4):704.
43. Lin Y, Li L, Mi F, Du J, Dong Y, Li Z, et al. Screening patients with diabetes mellitus for tuberculosis in China. *Tropical Medicine & International Health*. 2012;17(10):1302-8.
44. Lönnroth K. Colliding epidemics requires collaborating programmes. *The lancet Diabetes & endocrinology*. 2015;3(5):306-7.
45. Shidam U, Roy G, Sahu S, Kumar S, Ananthanarayanan P. Screening for diabetes among presumptive tuberculosis patients at a tertiary care centre in Pondicherry, India. *The International Journal of Tuberculosis and Lung Disease*. 2015;19(10):1163-8.
46. Skordis-Worrall J, Round J, Arnold M, Abdraimova A, Akkazieva B, Beran D. Addressing the double-burden of diabetes and tuberculosis: lessons from Kyrgyzstan. *Globalization and health*. 2017;13(1):1-9.
47. Dooley KE, Chaisson RE. Tuberculosis and diabetes mellitus: convergence of two epidemics. *The Lancet infectious diseases*. 2009;9(12):737-46.
48. Kushitor MK, Boatemaa S. The double burden of disease and the challenge of health access: Evidence from Access, Bottlenecks, Cost and Equity facility survey in Ghana. *PLoS One*. 2018;13(3):e0194677.
49. Asante-Poku A, Asare P, Baddoo NA, Forson A, Klevor P, Otchere ID, et al. TB-diabetes co-morbidity in Ghana: The importance of *Mycobacterium africanum* infection. *PloS one*. 2019;14(2):e0211822.

Chapter Three: Scoping Review

This chapter is a continuation of the narrative literature review in Chapter two and presents the outcome of the scoping review process aimed at addressing the objective one of this study. This review was aimed at developing a better understanding of the implementation of the Collaborative Framework for the Care and Control of Tuberculosis (TB) and Diabetes (DM), globally. This was a review of peer-reviewed and grey literature on the implementation of the TB-DM collaborative framework, globally [1]. This method allowed the researcher to use an iterative approach and to engage with the following stages reflexively.

Stage 1: identifying the research question

Stage 2: identifying relevant studies

Stage 3: study selection

Stage 4: charting the data

Stage 5: collating, summarizing, and reporting the results [1].

The protocol for the scoping review was published in the BMJ open journal (2020)

Article 1: Mapping Evidence on the Implementation of the World Health Organization's Collaborative Framework for the Management of Tuberculosis and Diabetes: A scoping review protocol. BMJ Open. 2020.

The scoping review for this study began by developing a scoping protocol which was submitted to BMJ Open and subsequently published in 2020.

BMJ Open Mapping evidence on the implementation of the WHO's collaborative framework for the management of tuberculosis and diabetes: a scoping review protocol

Rita Quist-Therson , Desmond Kuupiel , Khumbulani Hlongwana

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Discipline of Public Health Medicine, School of Nursing and Public Health, College of Health Sciences, University of KwaZulu-Natal, Durban, South Africa

Correspondence to
Rita Quist-Therson;
suhini@gmail.com

ABSTRACT

Introduction The emergence of tuberculosis (TB) and diabetes mellitus (DM) coepidemic threatens the gains made in fighting the prevalence of these two diseases. As a result, in 2011, WHO and the International Union Against Lung Disease launched a framework to address the growing TB-DM coepidemic across the world. The aim of the proposed review study is mapping evidence on the implementation of the WHO collaborative framework for the management of TB-DM using a scoping review.

Methodology and analysis This study will map literature on the global implementation of the WHO collaborative framework for the management of TB-DM, using Arksey and O'Malley's scoping review framework. An extensive literature search for the peer-reviewed articles, grey literature, unpublished studies, thesis, studies in the press and a list of references from the selected studies will be conducted to find eligible studies. PubMed, Google Scholar, Web of Science, Science Direct, the EBSCOhost platform (Academic search complete, health source: nursing/academic edition, CINAHL with full text) and the WHO library will be used to source literature. The researcher will perform title screening of articles using keywords in the databases, and two independent reviewers will then screen abstracts and full articles. The screening will be guided by the inclusion and exclusion criteria. The Mixed Method Appraisal Tool V.2018 will be used to examine the quality of studies to be included. The findings will be analysed using the thematic content analysis approach and the results presented in the form of a narrative report.

Ethics and dissemination The study did not require ethics approval because it is a scoping review protocol. Findings from this study will be disseminated by print and electronic mediums.

BACKGROUND

The association between tuberculosis (TB) and diabetes is gaining global traction, as more evidence is increasingly being documented on the adverse effect of one disease on the other.¹ The emergence of TB and diabetes mellitus coepidemic (TB-DM)² makes the diagnostic accuracy and management of the

Strengths and limitations of this study

- The use of Arksey and O'Malley's framework to guide the literature search process will ensure a clear methodological and transparent process that can be replicated.
- Findings from this research will be of value for policy-makers and health workers in countries implementing the WHO's Collaborative Framework for the management of tuberculosis and diabetes comorbidity.
- To the best of our knowledge, this study will be the first to systematically review evidence on the implementation of the WHO's Collaborative Framework for the Management of Tuberculosis and Diabetes.
- An important limitation of this study will be language since this review will only include literature published in English.

two diseases, challenging to achieve, thereby necessitating a rethink on the vertical nature of TB and DM management.^{1 2}

The coepidemic of TB and DM has serious public health consequences, mainly because TB infects one-third of the global population.³ DM is one of the top four non-communicable diseases, which in 2015, caused an estimated 3 million deaths, worldwide.³ Research demonstrates that approximately 80% and 90% of DM and TB cases, respectively, occur in low-income and middle-income countries (LMICs).⁴ Chronic conditions, such as DM, weaken the immune system and leaves populations susceptible to and at increased risk for TB infection.⁵ Having DM triples the risk of developing TB, and the risk of TB is higher in people with DM than in the general population.⁶ The clinical manifestations of TB-DM coepidemic adversely affect the treatment, increase the risk of death and the likelihood of TB recurrence.⁷ WHO estimated that



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about 15% of people with TB, globally, can be linked to DM as well.⁴ It is estimated that in 22 countries which carry 80% of the global TB burden, TB arising from DM increased from 10% in 2010 to 15% in 2013.⁸ Nine of the top 10 countries with high TB-DM incidence are from the LMICs.⁸

In 2011, an approach to curb the rising TB-DM coepidemic, otherwise known as a Collaborative Framework for the Management of TB and DM, was launched by WHO and International Union Against Lung Disease.⁹ This collaborative framework was developed to guide the care, prevention and control of TB and DM in signatory countries across the world.⁹ The aim was to outline TB-DM comanagement strategies for use by policy-makers and implementers in order to reverse the TB-DM coepidemic.² The framework is designed to complement the core systems setup for the prevention and management of both diseases and focuses on a three-broad objectives, namely: to establish mechanisms of collaboration between TB and DM programmes, to improve detection and management of TB in patients with DM and to improve detection and management of DM in patients with TB.⁹ To achieve these objectives, the framework proposed 12 interventions, which include: 'exploration of screening for active TB on broader indications (eg, in all people diagnosed with diabetes, regardless of symptoms), as part of the research agenda for improved TB diagnosis among people with diabetes,' 'provision of the management of diabetes in patients with TB in line with existing guidelines,' and the 'establishment of joint coordination at regional, district and/or local levels (sensitive to country-specific factors), with representation from all relevant stakeholders.'

Further implementation research is encouraged to gather evidence for countries to adopt these recommendations to their healthcare systems.⁹ This scoping review, therefore, aims at mapping evidence on the implementation of the WHO's collaborative framework for the management of TB and DM. Results from this scoping review are expected to demonstrate current data on the state of implementation of the WHO's TB-DM collaborative framework globally, thereby revealing gaps in current literature, and ultimately inform the refinement of questions for further primary research.

METHOD

Study design

This study will use a scoping review methodology, guided by Arksey and O'Malley's framework,¹⁰ to map literature on the implementation of the WHO collaborative framework for the management of TB-DM. Arksey and O'Malley's framework¹⁰ gives five clear steps to be used to explore core concepts in a specific research area. These steps are identifying the research question, identifying relevant studies, study selection, charting the data, collating, summarising and reporting the results. This process is expected to help identify the existing evidence

Table 1 PCC framework for defining the eligibility of the studies for the primary research question

P-Population	Individuals with TB Individuals with DM
C-Concept	WHO Collaborative Framework Implementation
C-Context	Globally

DM, diabetes mellitus; TB, tuberculosis.

in the research area. In this study, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) will be used to report the results from the screening process (online supplementary file).¹¹

Identify research questions

Main research question: What is the evidence on the implementation of the WHO's TB-DM collaborative framework?

Subquestions:

1. What is the evidence of DM detection and management in patients with TB?
2. What is the evidence of TB detection and management in patients with DM?
3. What is the evidence of collaboration between TB and DM programmes?
4. What is the evidence of a referral system for patients with DM suspected to have TB for diagnosis and management?
5. What is the evidence of a referral system for patients with TB suspected to have DM for diagnosis and management?

Eligibility of the research question

This scoping review will use the Population, Concept, Context Mnemonic (table 1) to determine the eligibility of the primary research question.¹⁰

Identifying relevant studies

We intend to conduct a scoping review to map literature on the implementation of the TB-DM collaborative framework, globally. This will be done by searching electronic databases for peer-reviewed articles, grey literature and reference lists of included articles. The databases will include the EBSCOhost platform (Academic search complete, health source: nursing/academic edition, CINAHL with full text), PubMed, Google Scholar, Scopus and WHO library databases. Grey literature will be accessed by searching for policy documents, treatment guidelines and reports by ministries of health, health agencies either through their websites or links.

We will search for articles using keywords and Boolean terms AND/OR. Additionally, a combination of the appropriate Medical Subject Headings terms will be included in the search. In conducting the 'electronic search, the proposed combinations of keywords to be used include:

Table 2 Pilot search strategy in PubMed database

Date	Database	Keywords	Search results
27/03/2019	PubMed	((("tuberculosis"[MeSH Terms] OR "tuberculosis"[All Fields]) OR ("diabetes mellitus"[MeSH Terms] OR ("diabetes"[All Fields] AND "mellitus"[All Fields]) OR "diabetes mellitus"[All Fields] OR "diabetes"[All Fields] OR "diabetes insipidus"[MeSH Terms] OR ("diabetes"[All Fields] AND "insipidus"[All Fields]) OR "diabetes insipidus"[All Fields])) AND implementation[All Fields]) AND (collaborative[All Fields] AND framework[All Fields])	36

'Diabetes,' 'Type 2 Diabetes,' 'Tuberculosis,' 'Comorbidity,' 'Implementation,' 'Framework.' Studies will be identified by searching literature that was published in English from August 2011 to December 2019. With type 2 diabetes contributing 90%–95% of all diabetes cases globally and sharing socioeconomic, environmental, and behavioural factors with TB, this study will exclude articles on type 1 diabetes.¹² Searches will be documented, detailing the date, search engine, keywords and the number of publications retrieved. The search strategies will be piloted to check the suitability of the selected databases and keywords. An illustration of how the electronic data search will be recorded is shown in [table 2](#).

Study selection and eligibility criteria

The eligibility criteria will be developed to ensure that specific information relating to the research questions is included in the studies.

Inclusion criteria

We will include studies that meet the following criteria:

- Evidence of the study among TB and DM populations.
- Evidence of study conducted from 2011 to the last search date.
- Present evidence of bidirectional screening for TB and DM.
- Present evidence of mechanisms of collaboration in the management of TB and DM.

Exclusion criteria

This will include the following:

- Studies on type 1 diabetes.
- Studies before 2011.
- Studies on TB/HIV.

The eligibility criteria will guide the researcher in conducting the title screening. Studies that qualify will be compiled into a library using the Endnote reference management software. Duplicated articles will be deleted from the EndNote library. The final list of compiled articles will be shared with two other reviewers who will conduct both abstract and full screening into two categories 'excluded' and 'included' according to the inclusion criteria detailed above. The service of the University of KwaZulu-Natal Libraries will be sought to source articles that are not available online, or the full text may be requested from the authors. During the abstract screening stage, categorisation by the two reviewers will be

compared. In the event of any disagreement, the reviewers will discuss until an agreement is reached. At the full-text stage, a third reviewer will be engaged as a decider on any unresolved disputes. Details of the process: date of search, database, keywords, number of studies and number of eligible studies will be comprehensively documented.

Screening of the results and reporting will follow the PRISMA-ScR.¹¹

Charting the data

To extract information in line with the aim of this study, an analytical method will be used. We will develop a form electronically, using google forms, pretest it and use feedback to refine the tool. During data extraction, all articles reviewed and excluded will be tracked ([table 3](#)).

Collating, summarising and reporting of results

When the extraction of data is completed, the results from existing studies will be summarised and presented in a narrative account. This summary will be analysed using thematic content analysis. Data extracted will be structured around the following outcomes: Bidirectional screening of TB and DM, mechanisms for TB and DM collaborative activities and comanagement of TB/DM comorbidity. Emerging themes will also be coded using NVivo software V.10.¹³ The themes emerging from the analysis will be examined to determine whether they address the research questions. Furthermore, the researcher will explore the linkages between the findings, study aim and the implications for future research, policy and practice.

Quality appraisal

The quality of the studies will be appraised using the Mixed Method Appraisal Tool V.2018.¹⁴ The tool is used to assess the risk of bias of the included studies. The tool will be used to assess the selected articles under the following groupings: the appropriateness of the aim of the study, adequacy of methodology, study design, data collection, data analysis, the presentation of findings, authors' discussions and conclusions. Scores will be allocated to determine the quality of the included studies. The quality of the selected articles will be determined from the examination of the aspects mentioned above.

Patient and public involvement

The conception, design and planning of this study did not directly include patients or the public.

Table 3 Data charting form

Author and date
Study title
Journal full reference
Aims or research question
Participant characteristics
Recruitment context (eg, where people were recruited)
Sampling method
Study design
Theoretical background
Data collection (what data collection methods were used?)
Data analysis (how was the data analysed?)
Most relevant findings
Conclusions
Comments

Ethics and dissemination

The study did not require ethics approval because it is a scoping review protocol. Findings from this study will be disseminated by print and electronic mediums.

DISCUSSION

This scoping review is aimed at mapping existing evidence and summarise the findings as presented across the studies on the implementation of the WHO's TB/DM collaborative framework, globally. TB is still among the top causes of mortality globally. The number of people living with DM and TB is expected to rise to as high as 592 million by 2035, globally. Therefore, TB-DM comorbidity represents a critical public health concern.^{12 15} The continued rise of TB-DM comorbidity necessitated the development of the framework to manage this epidemic. However, evidence on the extent of implementation of this framework in various settings is limited.⁹ The framework presents several recommendations, including bidirectional screening, as a critical strategy in the diagnosis and management of TB-DM comorbidity.⁹

There is no consensus on what is likely to yield better health outcomes. Some studies propose that screening all patients with TB for DM in high-income countries and screening all patients with DM for TB in low-income settings would yield better results.¹⁶ Conversely, Di Gennaro *et al*¹⁶ disagree but consider the screening for DM in patients with TB in low-income settings as sufficient. Further evidence is needed to support the feasibility of the recommendations, so that appropriate guidelines for the different settings can be developed.⁹ This study will focus on literature available from August 2011 to December 2019, in order to add to the body of evidence regarding critical issues on the state of the framework implementation, worldwide. Findings from this study are

expected to be useful to the implementation process by various countries.

A preliminary search suggests that accumulated literature since the launch of the framework in 2011 is limited,⁹ especially given that publications on type 1 diabetes will be excluded since this condition does not share socioeconomic, environmental and behavioural factors with TB.¹⁷ The findings of the scoping review will generate valuable information necessary to support initiatives aimed at curtailing the rising tide of TB and DM comorbidity.² The results of this study may interest policy-makers and stakeholders involved in the implementation of the prevention, care and control strategies for TB and DM, including the health systems strengthening. Also, the findings of this study will be of interest to researchers, as it will highlight the gaps in evidence that may require further empirical investigation.

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Contributors RQ-T conceptualised the study and wrote the protocol. DK and KH contributed to the writing and critically reviewed the draft protocol. RQ-T wrote the final manuscript and all authors approved the final draft.

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ORCID iDs

Rita Quist-Therson <http://orcid.org/0000-0001-6508-6915>

Desmond Kuupiel <http://orcid.org/0000-0001-7780-1955>

REFERENCES

- Pizzol D, Di Gennaro F, Chhaganlal KD, *et al*. Tuberculosis and diabetes: current state and future perspectives. *Trop Med Int Health* 2016;21:694–702.
- Kapur A, Harries AD, Lönnroth K, *et al*. Diabetes and tuberculosis co-epidemic: the Bali Declaration. *Lancet Diabetes Endocrinol* 2016;4:8–10.
- Kapur A, Harries AD. The double burden of diabetes and tuberculosis – public health implications. *Diabetes Res Clin Pract* 2013;101:10–19.
- Mbanya JCN, Motala AA, Sobngwi E, *et al*. Diabetes in sub-Saharan Africa. *Lancet* 2010;375:2254–66.
- Workneh MH, Bjune GA, Yimer SA. Prevalence and associated factors of tuberculosis and diabetes mellitus comorbidity: a systematic review. *PLoS One* 2017;12:e0175925.
- Harries AD, Kumar AMV, Satyanarayana S, *et al*. Diabetes mellitus and tuberculosis: programmatic management issues. *Int J Tuberc Lung Dis* 2015;19:879–86.
- Reid MJA, McFadden N, Tsima BM. Clinical challenges in the co-management of diabetes mellitus and tuberculosis in southern Africa. *Journal of Endocrinology, Metabolism and Diabetes of South Africa* 2013;18:135–40.
- Lönnroth K, Roglic G, Harries AD. Improving tuberculosis prevention and care through addressing the global diabetes epidemic: from evidence to policy and practice. *Lancet Diabetes Endocrinol* 2014;2:730–9.

- 9 WHO. *Collaborative framework for care and control of tuberculosis and diabetes*. Geneva: World Health Organization, 2011.
- 10 Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol* 2005;8:19–32.
- 11 Tricco AC, Lillie E, Zarin W, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Ann Intern Med* 2018;169:467–73.
- 12 Harries AD, Kumar AMV, Satyanarayana S, et al. Addressing diabetes mellitus as part of the strategy for ending TB. *Trans R Soc Trop Med Hyg* 2016;110:173–9.
- 13 Castleberry A. NVivo 10 [software program]. Version 10. QSR International; 2012. *Am J Pharm Educ* 2014;78:25.
- 14 Hong QN, Pluye P, Bartlett G, et al. *Mixed methods appraisal tool (MMAT), version 2018*, 2018.
- 15 The Global Fund to Fight AIDS TaM. *Best practices on TB case finding and treatment reflections and lessons from West and central Africa and beyond*, 2018.
- 16 Di Gennaro F, Marotta C, Antunes M, et al. Diabetes in active tuberculosis in low-income countries: to test or to take care? *Lancet Glob Health* 2019;7:e707.
- 17 Anand T, Kishore J, Isaakidis P, et al. Integrating screening for non-communicable diseases and their risk factors in routine tuberculosis care in Delhi, India: a mixed-methods study. *PLoS One* 2018;13:e0202256.

Article 2 : Scoping review on the implementation of the World Health Organization's Collaborative Framework for the management of Tuberculosis and Diabetes. (BMJ)

The results of the scoping review were presented in the form of a manuscript, which has since been published by the BMJ Open journal. Results from this scoping review presented current data on the state of implementation of the WHO's TB-DM collaborative framework globally and revealing gaps in current literature.

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Rita Suhuyini Salifu ^{1,2} Mbuzeleni Hlongwa ^{1,3} Khumbulani Hlongwana¹

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¹Discipline of Public Health Medicine, School of Nursing and Public Health, University of KwaZulu-Natal College of Health Sciences, Durban, KwaZulu-Natal, South Africa

²Health and Development Solutions Network, Tamale, Ghana

³Burden of Disease Research Unit, South African Medical Research Council, Cape Town, South Africa

Correspondence to
Rita Suhuyini Salifu;
suhuyini@gmail.com

ABSTRACT

Objective To map evidence on the implementation of the WHO's collaborative framework for the management of tuberculosis (TB) and diabetes mellitus (DM) comorbidity, globally.

Design Scoping review.

Methods Guided by Arksey and O'Malley's scoping review framework, this review mapped literature on the global implementation of the framework for the management of TB and DM comorbidity, globally. An extensive literature search for peer-reviewed studies, theses, studies in the press and a list of references from the selected studies was conducted to source-eligible studies. PubMed, Google Scholar, Web of Science, Science Direct, the EBSCOhost platform (academic search complete, health source: nursing/academic edition, CINAHL with full text), Scopus and the WHO library were used to source the literature.

We performed title screening of articles using keywords in the databases, after which two independent reviewers (RS and PV) screened abstracts and full articles. Studies from August 2011 to May 2021 were included in this review and the screening was guided by the inclusion and exclusion criteria. Findings were analysed using the thematic content analysis approach and results presented in the form of a narrative report. The Preferred Reporting Items for Systematic Reviews and Meta-Analysis extension was used as a checklist and for explaining the scoping review process.

Results This review found evidence of the WHO TB-DM collaborative framework's implementation in 35 countries across the globe. TB-DM comorbidity was identified in patients through bidirectional screening of both patients with TB and patients with DM in rural and urban settings.

Conclusion Due to the paucity of evidence on mechanisms of collaboration, we recommend further research in other implementing countries to identify techniques used for diagnosis and integration of TB and DM services, in order to ensure that effective and joint management of TB-DM comorbidity in populations is achieved.

INTRODUCTION

Current tuberculosis (TB)-diabetes mellitus (DM) co-epidemic imposes strain on the strategies to control rising TB and DM prevalence across the globe.^{1 2} Healthcare systems are

Strengths and limitations of this study

- The search strategy was rigorous and covered an extensive range of databases to give a comprehensive review of the global implementation of the WHO collaborative framework.
- All included studies underwent quality appraisal using an approved tool, namely: the Mixed Method Appraisal Tool.
- This review only included articles published in English language and this may have excluded some relevant studies published in other languages. This review was guided by Arksey and O'Malley's framework, a widely used framework for conducting scoping reviews, which ensures a clear methodological and transparent process that can be replicated.

also being challenged to rethink diagnostic accuracy, co-management of the two diseases, and re-evaluation of the vertical nature of TB and DM management.³ The past decade has shown that the TB-DM co-epidemic has severe public health consequences, mainly because TB affects one-fourth of the global population.⁴

DM is one of the top four non-communicable diseases causing mortality worldwide; and in the year 2019, approximately 1.5 million deaths were attributed to DM, globally.⁵ Globally, an estimated 15% of people with TB can be associated with DM.⁶ The 22 countries known to bear 80% of the global TB burden had TB infections due to DM, thereby contributing 10% of all TB cases recorded in 2010, a figure that increased to 15% in 2013.⁷ Low/middle-income countries (LMICs) carry an estimated 80% and 90% of DM and TB burden, respectively.⁶ Nine of the top 10 countries identified to have the highest TB-DM incidence, globally, are from LMICs.⁷

The increased risk of TB infections has been associated with DM, which affects the immune system leading to poor treatment

outcomes, the likelihood of disease recurrence and increased risk of death.^{8,9} Populations with DM are three to four times more likely to develop TB, as compared with the general populations.^{2,8} In 2011, the WHO and International Union Against Tuberculosis and Lung Disease (Union) launched a policy framework to address the growing TB-DM co-epidemic, known as the collaborative framework for the management of TB and DM.¹⁰ This framework outlines recommendations to guide countries in the care, prevention, and control of TB and DM worldwide.¹⁰ The recommendations are to be used by policymakers and implementers to curb the TB-DM co-epidemic and complement the existing systems set up for the prevention and management of TB and DM.³ The focus is on: (1) improving detection and management of TB in patients with DM, (2) improving detection and management of DM in patients with TB, and (3) establishing mechanisms of joint coordination at regional, district, and/or local levels (sensitive to country-specific factors), with representation from all relevant stakeholders.¹⁰

The WHO and Union encourage findings from implementation research to strengthen the existing recommendations for healthcare systems.¹⁰ In this review, we mapped evidence on the implementation of the WHO-Union collaborative framework, globally. Results from this scoping review provide current data on the state of implementation, reveal existing gaps in current literature and ultimately inform the refinement of questions for further primary research.

METHODS

Study design

The methodology for this scoping review, as outlined in the published protocol,¹¹ was guided by Arksey and O'Malley's framework and Levac *et al.*'s¹² methodological enhancement for scoping review projects.¹³ This review mapped literature on the implementation of the WHO collaborative framework for the management of TB-DM comorbidity, published between August 2011 and May 2021. We conducted a systematic search to synthesise published and unpublished literature (grey literature) articles to answer the research question. The research question considered a range of studies including qualitative, quantitative and mixed methods. Arksey and O'Malley's framework gives five clear steps to be used for exploring core concepts in a specific research area.¹³ These steps are: identifying the research question, identifying relevant studies, study selection, charting the data, collating, summarising and reporting the results.¹³ This process helped in identifying the existing evidence in the research area. We also followed guidelines from the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) extension for Scoping Reviews: checklist and explanation for reporting purposes (online supplemental file 1).¹⁴

Table 1 PCC framework

P—Population	Individuals with TB Individuals with DM
C—Concept	WHO collaborative framework implementation
C—Context	Global

DM, diabetes mellitus; TB, tuberculosis.

Eligibility of the research question

This scoping review followed the Population, Concept, Context framework to determine the eligibility of the primary research question (table 1).¹³ Based on the framework, the study population was individuals with TB and individuals with DM, the concept was the WHO collaborative framework implementation and the context was global.

Identify the research question

The main research question: What is the evidence on the implementation of the WHO's TB-DM collaborative framework, globally?

Subquestions:

1. What is the evidence of DM detection and management in patients with TB?
2. What is the evidence of TB detection and management in patients with DM?
3. What is the evidence of collaboration between TB and DM programmes?
4. What is the evidence of a referral system for patients with DM suspected to have TB for diagnosis and management?
5. What is the evidence of a referral system for patients with TB suspected to have DM for diagnosis and management?

Identifying relevant studies

Search strategy

We conducted a comprehensive search technique for published and unpublished (grey literature) articles relevant to answer our research question. We piloted our search strategy in December 2019 in PubMed and CINAHL via EBSCOhost, followed by analysis of the text words contained in the title and abstract and of the index terms used to describe the article, guided by the Joanna Briggs Institute's manual for evidence synthesis.¹⁵ Our overall search was updated in seven electronic databases in May 2021 (online supplemental appendix 1), including: PubMed and CINAHL via EBSCOhost, Web of Science, Science Direct, Scopus, Google Scholar and WHO library. Our search approach included Boolean terms (AND, OR) and Medical Subject Headings terms. The search keywords were: 'Diabetes', 'Type 2 Diabetes', 'Tuberculosis', 'Comorbidity', 'Implementation' and 'Framework'. All studies suitable for inclusion had their reference lists further assessed for potential inclusion. Grey literature articles were accessed by searching for

policy documents, treatment guidelines and reports by ministries of health, and health agencies through their websites or links. Studies obtained through database searches were exported to EndNote library for further abstract and full article screening, respectively. The 'Find full text' option in the EndNote library was used to automatically obtain PDFs of exported studies.

Study selection

The first reviewer (RS) conducted the database search based on a broad inclusion criterion. This search focused on the title of the articles. The full texts of all the articles that were selected as potentially eligible for inclusion in this review were obtained. Two independent reviewers (RS and PV) then conducted abstracts and full article screenings in order to identify articles that met all the inclusion criteria. Any disagreements between the two independent reviewers were resolved through discussion. Arrangements had been made for a third reviewer to resolve any disagreements between the two independent reviewers. However, no disagreements emerged, hence the third reviewer was not consulted.

Inclusion and exclusion criteria

The eligibility criteria were developed to ensure the inclusion of specific information relating to the research questions in the studies. Our inclusion criteria in this review involved studies presenting evidence of TB-DM comorbidity among populations with TB and DM. We also considered studies presenting evidence of bidirectional screening for TB and DM, as well as studies presenting evidence of mechanisms of collaboration in the management of TB and DM. All these studies had to be published in English language, between August 2011 and May 2021, given that the framework was first launched in 2011.

Studies presenting evidence on type 1 diabetes and those focusing on TB or HIV were excluded. This review only included articles on type 2 diabetes and excluded type 1 diabetes because type 2 diabetes contributes 90%–95% of all diabetes cases, globally, and shares socio-economic, environmental, and behavioural factors with TB.^{16 17} Also excluded were studies published prior to August 2011 and those published in other languages apart from English language.

Data charting

To extract relevant information and characteristics of studies, we developed a form electronically, using Google forms, pretested it and used feedback to refine the tool. The selected studies were thoroughly read for data extraction of bibliographical details and ensuring that relevant outcomes were extracted, including: (a) author(s) and date of publication, (b) aim(s) or research questions, (c) primary source data, study population, (d) geographical setting (rural/urban), (e) study design, (f) most relevant finding, (g) most significant finding, (h) study limitations and implications, as well as (i) interpretations and conclusions from the authors.

Collating, summarising and reporting results

The results from existing studies were summarised and presented in a narrative format. This summary was analysed using thematic content analysis. Data extracted were structured around the following outcomes: bidirectional screening of TB and DM, feasibility of screening and co-management of TB/DM comorbidity. The themes emerging from the analysis were examined to determine whether or not they addressed the research questions. Furthermore, the researchers explored linkages between the findings, study aim, and the implications for future research, policy, and practice.

Quality of evidence

Two independent reviewers conducted quality assessment by appraising the included studies using the Mixed Method Appraisal Tool (MMAT) V.2018.¹⁸ The MMAT is a critical appraisal tool designed for the appraisal stage of systematic mixed studies reviews, like reviews that include qualitative, quantitative and mixed-methods studies. The tool may also be used to assess the methodological quality of five different types of studies: qualitative research, randomised controlled trials, non-randomised studies, quantitative descriptive studies and mixed techniques studies (online supplemental appendix 2). The MMAT evaluates the appropriateness of the study aim, study design, methodology including the recruitment of participants, data collection, data analysis, results presentation, authors' discussion and conclusions. Any disagreements between the two independent reviewers were resolved through discussion. The tool does not permit for quality scoring of included studies, therefore we did not provide overall quality scores.¹⁸

The quality of evidence had little variations across the studies. Most of the 82 studies had good methodological rigour across all the MMAT criteria. Out of the 82 included studies, 4 were poorly appraised; as these studies did not report on the validity and reliability of the measurement, neither did they report on the response rate, hence the risk of non-response bias could not be determined. Furthermore, the sample of the studies was not representative of the target population, as no standard measure was used to determine the sample size. The sample strategy of the studies was not clearly stated, and this could have led to sampling bias. Additionally, one of the mixed-methods studies did not adhere to the quality criteria of each tradition of the methods used in the study.

RESULTS

The initial search through the electronic databases, including published studies and grey literature, yielded a total of 1442 articles. One thousand and seventy-two (1072) articles were excluded at a database search stage, because they did not meet the inclusion criteria. Sixty-four duplicates were removed, leaving us with 306 articles that were screened for abstracts. A total of 200 articles were removed at the abstract screening stage based on

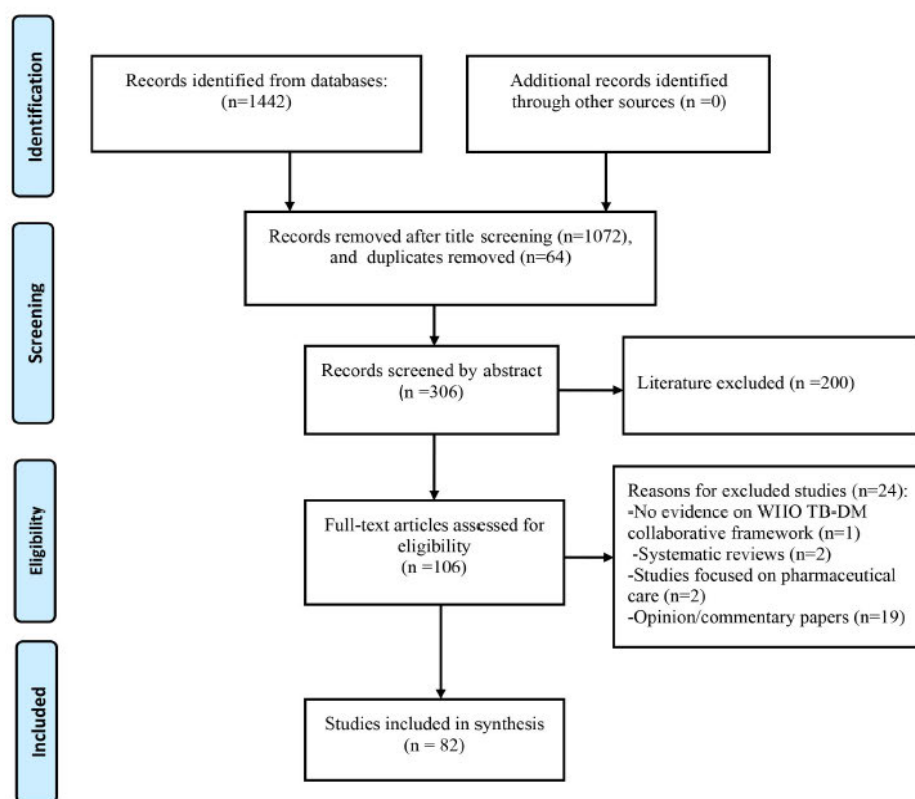


Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analysis flow diagram. From: Moher *et al.*¹²⁹ DM, diabetes mellitus; TB, tuberculosis.

the exclusion criteria. The researchers further screened the remaining 106 full-text articles and excluded 24 articles (online supplemental appendix 3) with the following reasons: 19 studies were opinion/commentary papers, 2 were systematic reviews, 2 focused on pharmaceutical care and the last one had no evidence on WHO TB-DM collaborative framework. Figure 1 shows the PRISMA flow diagram demonstrating the screening results from each stage.

Characteristics of included studies

A total of 82^{9 19–98} articles from 35 countries including India, China, the USA, Pakistan, Taiwan, Ethiopia, Tanzania and Nigeria met our inclusion criteria and were included in the quality assessment stage. These were 5 qualitative, 75 quantitative and 2 mixed-methods studies. The WHO is made up of 194 member states, but our review found studies from only 35 countries, mostly India (n=25),^{19 20 44–51 53–55 58 60 61 63 81 82 94 95 99–101} China (n=10),^{65–67 70 71 84 85 97 102} Ethiopia (n=4),^{34 35 94 103} Nigeria (n=3)^{25 36 86} and the USA (n=2).^{26 28} Online supplemental appendix 4 summarises the characteristics of the different studies. The findings from this review provided evidence on the feasibility of screening, bidirectional screening

(screening patients with TB for DM, screening patients with DM for TB), co-management, and challenges and opportunities, in line with the recommendations of the collaborative framework.^{10 104}

Feasibility of screening

The Bali declaration was expected to accelerate the implementation of the collaborative framework for the care and control of diabetes and TB.¹⁰⁴ A major emphasis was on operational and clinical research, globally, designed to establish evidence to strengthen the current recommendations and propose appropriate indicators.¹⁰⁴ Our review of publications showed evidence supporting the feasibility of bidirectional screening. Study findings demonstrated that it was possible to conduct screening in both rural and urban settings.^{55 68} The different settings also indicated varying TB-DM prevalence rates in rural and urban regions in various countries.^{38 48 67 78} Additionally, our findings supported routine screening, especially in high-risk populations.^{20 28 55 61 63 65 72 78 79} A predominant number of publications on screening in healthcare settings revealed that screening can be integrated into routine practices in the healthcare system.^{21 32 53 60 62 65 68–70 81 98 99 105–107}

Bidirectional screening

One of the public health actions proposed for averting the impact of the looming TB-DM co-epidemic is screening patients with TB for DM and vice-versa.¹⁰⁴ This review identified publications on screening to provide evidence on suitable approaches used by various countries and settings. Majority (60%) of the included studies focused on screening patients with TB for DM.^{19 20 22 28 34–36 38 40 41 46–51 57 59 61 65–67 71 72 76–80 82 108–112} a phenomenon that permeated throughout various countries spreading across the five geographical regions, especially Asia. The DM prevalence among patients with TB varied within countries, such as India (5%–25%)^{19 20 46 48 51 54 58 59 61 82} and China (6.3%–12.4%).^{65 66} DM prevalence was reported by the studies to be higher in older male patients with TB than female counterparts and mostly in urban settings.^{19 46 72 113}

Fewer studies focused on screening patients with DM for TB, and this was attributed to the low availability of TB management strategies in DM facilities.^{33 68 70 81 86 100 114} These studies were conducted in the USA, India, Tanzania, Korea, Bangladesh, China, Taiwan, Nigeria and Iran. Generally, the risk of TB in patients with DM is about three times higher compared with the general population, a pattern that was also confirmed in our review.^{15 115} Results ranged from as low as 1.8-fold in South Korea to 7-fold in Tanzania, higher than the general population.^{21 62} In one study conducted in India, TB was not prevalent among patients with DM.⁵³ Male patients with DM were found to be at increased risk of TB than their female counterparts.^{21 26 52 60 70} Higher TB rates among older men were attributable to sedentary lifestyles, high body mass index (BMI) levels and smoking practice.^{60 70} Age and gender were identified as important risk factors for TB.⁶⁰

Co-management

Several studies highlighted the minimum or lack of integration between TB and DM units and the parallel paths of care for patients with TB-DM comorbidity. This is shown by the quotes below:

Endocrinologist treats diabetes, and we treat TB (p4).³⁷

We treat diabetes and that's it (p6).³⁷

Since our main task is TB treatment, the primary treatment is focused on TB (p6).³⁷

A TB patient should have tests for diabetes but generally diabetes patients don't go for TB tests (p7).¹⁰⁰

There was more evidence on case detection than co-management of TB and DM.^{29 37} Patients with TB-DM comorbidity did not appear to receive comparable treatment, and this may be due to more funding being available to TB, compared with diabetes and the limited number of staff trained in co-management.^{37 114}

We haven't received any funding or training, especially for this screening...I think, currently the training is not adequate. It should be given more often (p7).¹⁰⁰

Individuals with the dual TB-DM condition were found to have better outcomes when jointly managed.¹¹⁴

Opportunities and challenges

Implementation of the collaborative framework in various countries revealed the opportunities and challenges among healthcare workers, patients and the healthcare system. One of the opportunities identified was the feasibility to implement screening in the existing healthcare systems.^{22 72} However, it is still important that policies that support integrated screening in routine health service delivery be developed.⁷⁸ Timely diagnosis and management of TB-DM comorbidity were improved by implementing cost-effective measures, recording screening and user-friendly approaches.^{22 60 72 78 80 99} Some of the challenges encountered were lack of awareness of bidirectional screening by patients, while some healthcare providers were not aware of guidelines for bidirectional screening.⁵⁶

See madam, what can I tell about this [screening for DM]? Doctors can only talk about this [screening TB patients for DM] (p7).⁵⁶

I don't know about that [any national guidelines] (p7).⁵⁶

DISCUSSION

This scoping review mapped existing literature on the implementation of the TB-DM collaborative framework, globally, and provides an overview of the extent of implementation from 2011 to 2021. Our review found evidence of research in 35 countries, predominantly from LMICs. India and China showed greatest research outputs on the implementation of the collaborative framework, and this may be due to high TB burden being observed in these countries.^{10 67} Findings pointed to the feasibility of bidirectional screening, opportunities and challenges, as well as fewer publications on the collaboration of TB and DM programmes, thereby highlighting gaps in evidence on the integration of services for the management of TB-DM comorbidity.

Several studies in this review focused on screening patients with TB for DM as compared with screening patients with DM for TB and this was congruent with the findings of Workneh *et al.*¹⁰³ Additionally, there were limited articles on screening patients with TB for DM in African countries and this was consistent with what had been reported in a prior study conducted in Ghana.³⁹ This is probably because of inadequate support for DM facilities to screen for TB. Fewer articles showed evidence of screening both patients with TB and patients with DM in the same study. This review showed that screening can be implemented in both urban and rural settings with varying prevalence rates across geographical settings, thereby rendering the link between prevalence and the type of setting (rural vs urban) weak. This is in contrast with the findings of the study by Sulaiman *et al.*, who

found prevalence rates to be the same in urban and rural centres.¹¹⁶

Bidirectional screening was found to be mainly implemented in healthcare facilities and this revealed that the existing healthcare systems can be used to co-manage individuals with TB-DM comorbidity, similar to findings by a review conducted in India.¹¹⁷ Routine screening in high-risk populations was demonstrated by some studies in our review and was linked to early detection of TB or DM, subsequently leading to more effective management and outcomes. This was also reported in other studies.^{16 19 22 60 118}

The risk of patients with DM developing TB has been estimated to be threefold as compared with the general population.¹⁰ While this was generally confirmed by the findings of this review, two studies produced contrary findings, which revealed low DM prevalence in patients with TB.^{27 76} Therefore, evidence suggesting that DM is a risk factor for TB remains inconclusive and further studies are required.

Consistent with recommendations from other studies, evidence from this review points to the need for more awareness on bidirectional screening for both patients and healthcare workers.^{46 54 67 119} Individuals with the coinfection were not found to be receiving comparable care for each disease, which may be contributing to the growing TB-DM comorbidity and adversely affecting the global efforts towards the control of TB.^{37 77 78 120}

A key recommendation by the WHO-Union collaborative framework is joint management to improve health outcomes of patients with TB-DM comorbidity.¹⁰ Health systems in this review were having challenges in managing TB and DM jointly, due to existing systems of care that offered vertical healthcare,^{37 114} which is supported by a review on the double burden of TB and DM.¹²¹ The silo approach in most healthcare systems with regard to communicable and non-communicable diseases was a barrier to integrating care for individuals with the dual condition. Although not identified in this research, an article published in India showed that collaboration is also hindered due to patients with TB being largely managed in public health facilities, as compared with patients with DM, who are mostly being cared for in private health facilities.¹²²

Some studies have shown that individuals with coinfection have different experiences of care in health facilities, when compared with patients with only one condition.^{56 114} Their experiences spanned from the unavailability of joint consultation, so patients had to see a separate specialist for the different conditions, to the indecisiveness of health workers on whether to admit individuals with the comorbidity in DM or TB wards.^{37 114} This may be due to the perception that TB-DM comorbidity is a complicated condition that may lead to relapse, treatment failure, or death and requiring specialist attention.^{37 123 124} Patients and healthcare professionals had to find ways to integrate required medication, addressing medication-related issues, and more education to help

patients understand the comorbidity.¹¹⁴ There is a need for clear guidelines, diagnostics and refresher training for healthcare workers.^{114 125} Other studies support our findings that joint management improves early diagnosis and health outcomes.^{16 126}

Limitations

Our review is subject to important limitations. This review included only articles published in English language, which may have excluded some relevant studies published in other languages. We only identified one non-English article, which was in Spanish, and this too may be reflective of our incompetence in other languages. Only a single reviewer carried out title and abstract screening. The database search conducted by two independent reviewers may have yielded additional relevant studies. Despite the generally relevant key words used while searching for relevant articles in different databases, other terms may also exist. Nonetheless, the study strictly followed the framework provided by Arksey and O'Malley's framework to map evidence on the implementation of the WHO's collaborative framework for the management of TB and diabetes comorbidity, globally. Despite these limitations, we believe that our search strategy was comprehensive in reviewing relevant literature for this review.

Implications for practice

In line with other recommendations,¹²⁷ our findings suggest that free glucose tests, integration of DM and TB services, patient counselling and routine screening are factors that enhance effective screening.^{47 57} In areas where bidirectional screening was not effective, factors such as inadequate staffing, poor supply of laboratory supplies for DM diagnosis and poor patient awareness of bidirectional screening were highlighted.⁵⁶ Recommendations from screening studies emphasise the importance of policies that support integrating screening in routine health delivery, cost-effective measures, recording screening results in reports and user-friendly approaches, to improve timely diagnosis and management.^{80 128}

Conclusion

This review revealed that bidirectional screening is feasible and can potentially improve the diagnosis and co-management of individuals with TB and DM. Additionally, the study demonstrates that gaps still exist in research aimed at providing evidence of improved techniques for detecting TB-DM comorbidity. There is an urgent need for health systems to integrate TB and DM services.

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ORCID iDs

Rita Suhuyini Salifu <http://orcid.org/0000-0001-6508-6915>

Mbuzeleni Hlongwa <http://orcid.org/0000-0002-5352-5658>

REFERENCES

- Jeon CY, Murray MB. Diabetes mellitus increases the risk of active tuberculosis: a systematic review of 13 observational studies. *PLoS Med* 2008;5:e152.
- Al-Rifai RH, Pearson F, Critchley JA, et al. Association between diabetes mellitus and active tuberculosis: a systematic review and meta-analysis. *PLoS One* 2017;12:e0187967.
- Kapur A, Harries AD, Lönnroth K, et al. Diabetes and tuberculosis co-epidemic: the Bali Declaration. *Lancet Diabetes Endocrinol* 2016;4:8–10.
- World Health Organization. *Global tuberculosis report 2020*, 2020.
- World Health Organization. Diabetes - WHO, 2021. Available: <https://www.who.int>
- Mbanya JCN, Motala AA, Sobngwi E, et al. Diabetes in sub-Saharan Africa. *Lancet* 2010;375:2254–66.
- Lönnroth K, Roglic G, Harries AD. Improving tuberculosis prevention and care through addressing the global diabetes epidemic: from evidence to policy and practice. *Lancet Diabetes Endocrinol* 2014;2:730–9.
- Reid MJA, McFadden N, Tsima BM. Clinical challenges in the co-management of diabetes mellitus and tuberculosis in southern Africa. *J Endocrinol* 2013;18:135–40.
- Workneh MH, Bjune GA, Yimer SA. Prevalence and associated factors of diabetes mellitus among tuberculosis patients in south-eastern Amhara region, Ethiopia: a cross sectional study. *PLoS One* 2016;11:e0147621.
- World Health Organization. *Collaborative framework for care and control of tuberculosis and diabetes*. World Health Organization, 2011.
- Quist-Therson R, Kuupiel D, Hlongwana K. Mapping evidence on the implementation of the WHO's collaborative framework for the management of tuberculosis and diabetes: a scoping review protocol. *BMJ Open* 2020;10:e033341.
- Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. *Implement Sci* 2010;5:1–9.
- Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol* 2005;8:19–32.
- Tricco AC, Lillie E, Zarin W, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Ann Intern Med* 2018;169:467–73.
- Institute JB. JBI manual for evidence synthesis, 2020. Available: <https://wiki.jbi.global/site/JGW>
- Harries AD, Kumar AMV, Satyanarayana S, et al. Addressing diabetes mellitus as part of the strategy for ending TB. *Trans R Soc Trop Med Hyg* 2016;110:173–9.
- Maurice J. WHO framework targets tuberculosis–diabetes link. *Lancet* 2011;378:1209–10.
- Hong QN, Fábregues S, Bartlett G, et al. The mixed methods appraisal tool (MMAT) version 2018 for information professionals and researchers. *Educ Inform* 2018;34:285–91.
- Balakrishnan S, Vijayan S, Nair S, et al. High diabetes prevalence among tuberculosis cases in Kerala, India. *PLoS One* 2012;7:e46502.
- Achanta S, Tekumalla RR, Jaju J, et al. Screening tuberculosis patients for diabetes in a tribal area in South India. *Public Health Action* 2013;3:43–7.
- Heo EY, Choi N-K, Yang BR, et al. Tuberculosis is frequently diagnosed within 12 months of diabetes mellitus. *Int J Tuberc Lung Dis* 2015;19:1098–101.
- Gounder S, Harries AD. Screening tuberculosis patients for diabetes mellitus in Fiji: notes from the field. *Public Health Action* 2012;2:145–7.
- Castellanos-Joya M, Delgado-Sánchez G, Ferreyra-Reyes L, et al. Results of the implementation of a pilot model for the bidirectional screening and joint management of patients with pulmonary tuberculosis and diabetes mellitus in Mexico. *PLoS One* 2014;9:e106961.
- O'Jiaqu-Okorie A. *The prevalence and determinants of active tuberculosis among diabetes patients attending a primary health care clinic in Cape Town, South Africa*. University of Cape Town, 2016.
- Ogbera OA, Adeyeye O, Odeniyi IA, et al. Knowledge of diabetes mellitus in tuberculosis amongst healthcare workers in Nigeria. *Indian J Endocrinol Metab* 2013;17:704.
- Demlow SE, Oh P, Barry PM. Increased risk of tuberculosis among foreign-born persons with diabetes in California, 2010–2012. *BMC Public Health* 2015;15:1–8.
- Ade S, Affolabi D, Agodokpessi G, et al. Low prevalence of diabetes mellitus in patients with tuberculosis in Cotonou, Benin. *Public Health Action* 2015;5:147–9.
- Suwanpimolkul G, Grinsdale JA, Jarlsberg LG, et al. Association between diabetes mellitus and tuberculosis in United States-born and foreign-born populations in San Francisco. *PLoS One* 2014;9:e114442.
- Basir MS, Habib SS, Zaidi SMA, et al. Operationalization of bi-directional screening for tuberculosis and diabetes in private sector healthcare clinics in Karachi, Pakistan. *BMC Health Serv Res* 2019;19:1–9.
- Jabbar A, Hussain SF, Khan AA. Clinical characteristics of pulmonary tuberculosis in adult Pakistani patients with co-existing diabetes mellitus. *East Mediterr Health J* 2006;12:522–7.
- Viney K, Cavanaugh J, Kienene T, et al. Tuberculosis and diabetes mellitus in the Republic of Kiribati: a case-control study. *Trop Med Int Health* 2015;20:650–7.
- Alavi SM, Khoshkhouy MM. Pulmonary tuberculosis and diabetes mellitus: co-existence of both diseases in patients admitted in a teaching hospital in the southwest of Iran. *Caspian J Intern Med* 2012;3:421.
- Daru P, Chakraborty K, AlMossawi H, et al. Active tuberculosis case finding among diabetic patients: Bangladesh program experience. *J Infect Dis Diagn* 2019;4:2.
- Workneh MH, Bjune GA, Yimer SA. Assessment of health system challenges and opportunities for possible integration of diabetes mellitus and tuberculosis services in South-Eastern Amhara Region, Ethiopia: a qualitative study. *BMC Health Serv Res* 2016;16:1–11.
- Tenaye L, Mengiste B, Baraki N, et al. Diabetes mellitus among adult tuberculosis patients attending tuberculosis clinics in eastern Ethiopia. *Biomed Res Int* 2019;2019:1–7.
- Ojule I, Opara A. Fasting blood glucose profile of tuberculosis patients in Port Harcourt, Nigeria. *Port Harcourt Med J* 2019;13:26.
- Skordis-Worrall J, Round J, Arnold M, et al. Addressing the double-burden of diabetes and tuberculosis: lessons from Kyrgyzstan. *Global Health* 2017;13:1–9.
- Mahato RK, Laohasiriwong W, Koju R. The role of type 2 diabetes mellitus on the clinical manifestation of pulmonary tuberculosis: a study from Nepal. *JCDR* 2019;13:9–14.
- Asante-Poku A, Asare P, Baddoo NA, et al. TB-diabetes co-morbidity in Ghana: the importance of Mycobacterium africanum infection. *PLoS One* 2019;14:e0211822.
- Rajapakse W, Isaakidis P, Sagili KD, et al. Screening patients with tuberculosis for diabetes mellitus in Ampara, Sri Lanka. *Public Health Action* 2015;5:150–2.

- 41 Lu CL, Perera R, Farrah H, *et al.* Diabetes screening among active tuberculosis patients in Western Australia tuberculosis control program using HbA1c. *Intern Med J* 2019;49:630–3.
- 42 Pearson F, Huangfu P, McNally R, *et al.* Tuberculosis and diabetes: bidirectional association in a UK primary care data set. *J Epidemiol Community Health* 2019;73:142–7.
- 43 Hadžić V, Abdulović E, Hasanović E. The link between active pulmonary tuberculosis and high blood glucose level. *Respiratio*.
- 44 Anand T, Kishore J, Isaakidis P, *et al.* Integrating screening for non-communicable diseases and their risk factors in routine tuberculosis care in Delhi, India: a mixed-methods study. *PLoS One* 2018;13:e0202256.
- 45 Kumpatla S, Sekar A, Achanta S, *et al.* Characteristics of patients with diabetes screened for tuberculosis in a tertiary care hospital in South India. *Public Health Action* 2013;3:23–8.
- 46 Nagar V, Gour D, Arutagi V, *et al.* A study to assess the blood glucose level among diagnosed cases of tuberculosis registered at a tuberculosis unit of Bhopal City, Madhya Pradesh, India. *Int J Med Sci Public Health* 2015;4:245–9.
- 47 Tiwari VK, Verma P, Raj S. Factors associated with diabetes mellitus among tuberculosis patients attending tertiary care hospital in Delhi, India. *Ind J Comm Health* 2016;28:369–73.
- 48 Dave P, Shah A, Chauhan M, *et al.* Screening patients with tuberculosis for diabetes mellitus in Gujarat, India. *Public Health Action* 2013;3:29–33.
- 49 Pande T, Huddart S, Xavier W, *et al.* Prevalence of diabetes mellitus amongst hospitalized tuberculosis patients at an Indian tertiary care center: a descriptive analysis. *PLoS One* 2018;13:e0200838.
- 50 Gupte AN, Mave V, Meshram S, *et al.* Trends in HbA1c levels and implications for diabetes screening in tuberculosis cases undergoing treatment in India. *Int J Tuberc Lung Dis* 2018;22:800–6.
- 51 Verma P, Tiwari V, SR TP. Twin burden of co-morbidity (TB with DM): awareness and effect of diabetes mellitus (DM) on treatment outcome of tuberculosis among patients attending TB clinic in a tertiary care hospital in Delhi. *Indian J Prevent Soc Med* 2016;47:11.
- 52 Dutt N, Gupta A. A study on diabetes mellitus among cases of pulmonary tuberculosis in a tertiary care Hospital, Ahmedabad. *National J Med Res* 2014;4:349–53.
- 53 Mave V, Nimkar S, Prasad H, *et al.* Tuberculosis screening among persons with diabetes mellitus in Pune, India. *BMC Infect Dis* 2017;17:1–5.
- 54 Agarwal AK, Gupta G, Marskole P, *et al.* A study of the patients suffering from tuberculosis and tuberculosis-diabetes comorbidity in revised national tuberculosis control program centers of Northern Madhya Pradesh, India. *Indian J Endocrinol Metab* 2017;21:570–6.
- 55 Prakash BC, Ravish KS, Prabhakar B, *et al.* Tuberculosis-diabetes mellitus bidirectional screening at a tertiary care centre, South India. *Public Health Action* 2013;3:18–22.
- 56 Majumdar A, Wilkinson E, Rinu PK, *et al.* Tuberculosis-diabetes screening: how well are we doing? A mixed-methods study from North India. *Public Health Action* 2019;9:3–10.
- 57 Kottarath M, Mavila R, V A, Achuthan V, *et al.* Prevalence of diabetes mellitus in tuberculosis patients: a hospital based study. *Int J Res Med Sci* 2015;3:2810–4.
- 58 Manjareeka M, Palo SK, Swain S, *et al.* Diabetes mellitus among newly diagnosed tuberculosis patients in tribal Odisha: an exploratory study. *J Clin Diagn Res* 2016;10:LC06.
- 59 Raghuraman S, Vasudevan KP, Govindarajan S, *et al.* Prevalence of diabetes mellitus among tuberculosis patients in urban Puducherry. *N Am J Med Sci* 2014;6:30.
- 60 Hussain T, Bhuyan K, Prusty B, *et al.* Incidence and risk factors of tuberculosis among patients with type 2 diabetes mellitus attending a tertiary care hospital in Bhubaneswar, Odisha.
- 61 Naik B, Kumar AMV, Satyanarayana S, *et al.* Is screening for diabetes among tuberculosis patients feasible at the field level? *Public Health Action* 2013;3:34–7.
- 62 Mtwangambate G, Kalluvya SE, Kidenya BR, *et al.* 'Cough-triggered' tuberculosis screening among adults with diabetes in Tanzania. *Diabet Med* 2014;31:600–5.
- 63 Jali MV, Mahishale VK, Hiremath MB. Bidirectional screening of tuberculosis patients for diabetes mellitus and diabetes patients for tuberculosis. *Diabetes Metab J* 2013;37:291.
- 64 Faurholt-Jepsen D, Range N, Praygod G, *et al.* The role of diabetes co-morbidity for tuberculosis treatment outcomes: a prospective cohort study from Mwanza, Tanzania. *BMC Infect Dis* 2012;12:1–8.
- 65 Li L, Lin Y, Mi F, *et al.* Screening of patients with tuberculosis for diabetes mellitus in China. *Trop Med Int Health* 2012;17:1294–301.
- 66 Wang Q, Ma A, Han X, *et al.* Prevalence of type 2 diabetes among newly detected pulmonary tuberculosis patients in China: a community based cohort study. *PLoS One* 2013;8:e82660.
- 67 Zhao Q, Xiao X, Lu W, *et al.* Screening diabetes in tuberculosis patients in eastern rural China: a community-based cross-sectional study. *Int J Tuberc Lung Dis* 2016;20:1370–6.
- 68 Lin Y, Innes A, Xu L. Screening of patients with D iabetes M ellitus for T uberculosis in C ommunity H ealth S ettings in China 2015;20:1073–80.
- 69 Lin Y, Li L, Mi F, *et al.* Screening patients with diabetes mellitus for tuberculosis in China. *Tropical Medicine & International Health* 2012;17:1302–8.
- 70 Qiu H, Shi Y, Li Y, *et al.* Incident rate and risk factors for tuberculosis among patients with type 2 diabetes: retrospective cohort study in Shanghai, China. *Trop Med Int Health* 2017;22:830–8.
- 71 Lin Y, Yuan Y, Zhao X, *et al.* The change in blood glucose levels in tuberculosis patients before and during anti-tuberculosis treatment in China. *Glob Health Action* 2017;10:1289737.
- 72 Nasa JN, Brostrom R, Ram S, *et al.* Screening adult tuberculosis patients for diabetes mellitus in Ebeye, Republic of the Marshall Islands. *Public Health Action* 2014;4:50–2.
- 73 Ko P-Y, Lin S-D, Tu S-T, *et al.* High diabetes mellitus prevalence with increasing trend among newly-diagnosed tuberculosis patients in an Asian population: a nationwide population-based study. *Prim Care Diabetes* 2016;10:148–55.
- 74 Lin C-H, Kuo S-C, Hsieh M-C, *et al.* Effect of diabetes mellitus on risk of latent TB infection in a high TB incidence area: a community-based study in Taiwan. *BMJ Open* 2019;9:e029948.
- 75 Araia ZZ, Mebrahtu AH, Tewelde AG, *et al.* TB-diabetes comorbidity and associated factors in Maekel Zone, Eritrea: A cross sectional study, 2019.
- 76 Haraldsdottir TL, Rudolf F, Bjerregaard-Andersen M, *et al.* Diabetes mellitus prevalence in tuberculosis patients and the background population in Guinea-Bissau: a disease burden study from the capital Bissau. *Trans R Soc Trop Med Hyg* 2015;109:400–7.
- 77 Hoa NB, Phuc PD, Hien NT, *et al.* Prevalence and associated factors of diabetes mellitus among tuberculosis patients in Hanoi, Vietnam. *BMC Infect Dis* 2018;18:603.
- 78 Ncube RT, Dube SA, Machekera SM, *et al.* Feasibility and yield of screening for diabetes mellitus among tuberculosis patients in Harare, Zimbabwe. *Public Health Action* 2019;9:72–7.
- 79 Pablo-Villamor MP, Benedicto JP, Benedicto M, *et al.* Screening for diabetes mellitus in patients diagnosed with pulmonary tuberculosis. *Philipp J Intern Med* 2014;52:1–9.
- 80 Fwoloshi S, Hachambwa LM, Chiyenfu KO, *et al.* Screening for diabetes mellitus among tuberculosis patients: findings from a study at a tertiary hospital in Lusaka, Zambia. *Canad J Infect Dis Med Microbiol* 2018;2018:1–5.
- 81 Mave V, Meshram S, Lokhande R, *et al.* Prevalence of dysglycemia and clinical presentation of pulmonary tuberculosis in Western India. *Int J Tuberc Lung Dis* 2017;21:1280–7.
- 82 India Tuberculosis-Diabetes Study Group. Screening of patients with tuberculosis for diabetes mellitus in India. *Trop Med Int Health* 2013;18:636–45.
- 83 Arini M, Sugiyono D, Permana I. Challenges, opportunities, and potential roles of the private primary care in tuberculosis and diabetes mellitus (TB-DM) collaborative care and control: a qualitative study 2021.
- 84 Xiao W, Huang D, Li S, *et al.* Delayed diagnosis of tuberculosis in patients with diabetes mellitus co-morbidity and its associated factors in Zhejiang Province, China. *BMC Infect Dis* 2021;21:1–10.
- 85 Bei C, Deng P, Yang F. Tuberculosis screening among patients with diabetes mellitus: is it necessary and how should it be done? – A survey of endocrinologists in Hunan Province, China 2020.
- 86 Ekeke N, Aniwada E, Chukwu J, *et al.* Screening diabetes mellitus patients for tuberculosis in Southern Nigeria: A pilot study. *Adv Respir Med* 2020;88:6–12.
- 87 Kyaw Soe T, Soe KT, Satyanarayana S, *et al.* Gaps in implementing bidirectional screening for tuberculosis and diabetes mellitus in Myanmar: an operational research study. *Trop Med Infect Dis* 2020;5:19.
- 88 Habib SS, Rafiq S, Jamal WZ, *et al.* Engagement of private healthcare providers for case finding of tuberculosis and diabetes mellitus in Pakistan. *BMC Health Serv Res* 2020;20:1–8.
- 89 Araia ZZ, Mesfun AB, Mebrahtu AH. Prevalence and related factors of diabetes mellitus in tuberculosis patients in Maekel region, Eritrea: a cross-sectional study.
- 90 Gezahegn H, Ibrahim M, Mulat E. Diabetes mellitus and tuberculosis comorbidity and associated factors among bale zone health institutions, Southeast Ethiopia. *Diabetes Metab Syndr Obs* 2020;13:3879–86.
- 91 Ugarte-Gil C, Alisjahbana B, Ronacher K, *et al.* Diabetes mellitus among pulmonary tuberculosis patients from 4 tuberculosis-

- endemic countries: the TANDEM study. *Clin Infect Dis* 2020;70:780–8.
- 92 MM O, Tassanakijpanich N, Phyu MH, *et al.* Coverage of tuberculosis and diabetes mellitus screening among household contacts of tuberculosis patients: a household-based cross-sectional survey from Southern Thailand. *BMC Public Health* 2020;20:1–10.
 - 93 Salifu RS, Hlongwana KW. Barriers and facilitators to bidirectional screening of TB-DM in Ghana: healthcare workers' perspectives. *PLoS One* 2020;15:e0235914.
 - 94 Gurukartick J, Murali L, Shewade HD, *et al.* Glycemic control monitoring in patients with tuberculosis and diabetes: a descriptive study from programmatic setting in Tamil Nadu, India. *F1000Res* 2019;8:1725.
 - 95 Sembiah S, Nagar V, Gour D, *et al.* Diabetes in tuberculosis patients: an emerging public health concern and the determinants and impact on treatment outcome. *J Family Community Med* 2020;27:91.
 - 96 Hewage S, Somasundaram N, Ratnasamy V, *et al.* Active screening of patients with diabetes mellitus for pulmonary tuberculosis in a tertiary care hospital in Sri Lanka. *PLoS One* 2021;16:e0249787.
 - 97 Ji Y, Cao H, Liu Q, *et al.* Screening for pulmonary tuberculosis in high-risk groups of diabetic patients. *Int J Infect Dis* 2020;93:84–9.
 - 98 Trinidad RM, Brostrom R, Morello MI, *et al.* Tuberculosis screening at a diabetes clinic in the Republic of the Marshall Islands. *J Clin Tuberc Other Mycobact Dis* 2016;5:4–7.
 - 99 Dutt N, Gupta A. A study on diabetes mellitus among cases of pulmonary tuberculosis in a tertiary care Hospital, Ahmedabad.
 - 100 Majumdar A, Wilkinson E, Rinu PK, *et al.* Tuberculosis-diabetes screening: how well are we doing? A mixed-methods study from North India. *Public Health Action* 2019;9:3–10.
 - 101 Kottarath M, Mavila R, V. A, Achuthan V, *et al.* Prevalence of diabetes mellitus in tuberculosis patients: a hospital based study. *Int J Res Med Sci* 2015;2810–4.
 - 102 Lin Y, Harries AD. Tuberculosis infection control measures in diabetes clinics in China: a rapid assessment of 10 hospitals. *Trop Med Int Health* 2015;20:1196–200.
 - 103 Workneh MH, Bjune GA, Yimer SA. Prevalence and associated factors of tuberculosis and diabetes mellitus comorbidity: a systematic review. *PLoS One* 2017;12:e0175925.
 - 104 Kapur A, Harries AD, Lönnroth K, *et al.* Sulistyowati LSJTID, endocrinology. Diabetes and tuberculosis co-epidemic: the Bali Declaration 2016;4:8–10.
 - 105 Deng C, Wang X, Liao Y. Current recommendations on managing tuberculosis patients with diabetes & its epidemiology. *Microb Pathog* 2016;92:43–5.
 - 106 Rahmanian V, Rahmanian K, Mansoorian E, *et al.* Prevalence of active tuberculosis & MTB-infection among diabetic population in southern of Iran, 2016. *Pharmacophore* 2018;9:30–6.
 - 107 Huangfu P, Ugarte-Gil C, Golub J, *et al.* The effects of diabetes on tuberculosis treatment outcomes: an updated systematic review and meta-analysis. *Int J Tuberc Lung Dis* 2019;23:783–96.
 - 108 Wang Q, Han X, Ma A, *et al.* Screening and intervention of diabetes mellitus in patients with pulmonary tuberculosis in poverty zones in China: rationale and study design. *Diabetes Res Clin Pract* 2012;96:385–91.
 - 109 Restrepo BI, Camerlin AJ, Rahbar MH, *et al.* Cross-sectional assessment reveals high diabetes prevalence among newly-diagnosed tuberculosis cases. *Bull World Health Organ* 2011;89:352–9.
 - 110 Sariko ML, Mpagama SG, Gratz J, *et al.* Glycated hemoglobin screening identifies patients admitted for retreatment of tuberculosis at risk for diabetes in Tanzania. *J Infect Dev Ctries* 2016;10:423–6.
 - 111 Ekeke N, Ukwaja KN, Chukwu JN, *et al.* Screening for diabetes mellitus among tuberculosis patients in Southern Nigeria: a multi-centre implementation study under programme settings. *Sci Rep* 2017;7:1–8.
 - 112 Ekeke N, Ukwaja KN, Chukwu JN, *et al.* Screening for diabetes mellitus among tuberculosis patients in Southern Nigeria: a multi-centre implementation study under programme settings. *Sci Rep* 2017;7:44205.
 - 113 Ogbera AO, Kapur A, Abdur-Razzaq H, *et al.* Clinical profile of diabetes mellitus in tuberculosis. *BMJ Open Diabetes Res Care* 2015;3:e000112.
 - 114 Shayo FK, Shayo SC. Availability and readiness of diabetes health facilities to manage tuberculosis in Tanzania: a path towards integrating tuberculosis-diabetes services in a high burden setting? *BMJ Public Health* 2019;19:1104.
 - 115 Lönnroth K. Colliding epidemics requires collaborating programmes. *Lancet Diabetes Endocrinol* 2015;3:306–7.
 - 116 Sulaiman SAS, Zain FAM, Majid SA. Tuberculosis among diabetic patient. *Webmed Central Infect Dis* 2011.
 - 117 Samal J. Screening of tuberculosis patients for possible diabetes mellitus in India: a systematic review. *Egypt J Bronchol* 2017;11:1–6.
 - 118 Cadena J, Rathinavelu S, Lopez-Alvarenga JC, *et al.* The re-emerging association between tuberculosis and diabetes: lessons from past centuries. *Tuberculosis* 2019;116S:S89–97.
 - 119 Deng C, Wang X, YJMP L. Current recommendations on managing tuberculosis patients with diabetes & its epidemiology 2016;92:43–5.
 - 120 Sarker M, Barua M, Guerra F, *et al.* Double trouble: prevalence and factors associated with tuberculosis and diabetes comorbidity in Bangladesh. *PLoS One* 2016;11:e0165396.
 - 121 Kapur A, Harries AD. The double burden of diabetes and tuberculosis—public health implications. *Diabetes Res Clin Pract* 2013;101:10–19.
 - 122 Sharma P, Visnegarwala F, Tripathi V. Burgeoning double burden of tuberculosis and diabetes in India: magnitude of the problem – strategies and solutions. *Clin Epidemiol Glob Health* 2014;2:107–16.
 - 123 Lee P-H, Lin H-C, Huang AS-E, *et al.* Diabetes and risk of tuberculosis relapse: nationwide nested case-control study. *PLoS One* 2014;9:e92623.
 - 124 Mukhtar F, Butt ZA. Risk of adverse treatment outcomes among new pulmonary TB patients co-infected with diabetes in Pakistan: a prospective cohort study. *PLoS One* 2018;13:e0207148.
 - 125 Castellanos-Joya M, Delgado-Sánchez G, Ferreyra-Reyes L, *et al.* Results of the implementation of a pilot model for the bidirectional screening and joint management of patients with pulmonary tuberculosis and diabetes mellitus in Mexico. *PLoS One* 2014;9:e106961.
 - 126 Dávila Y, Castellanos M, García M. Advancement of the National strategy for integrated care in tuberculosis and diabetes mellitus in Mexico, 2015/Avance de la estrategia nacional para la atención integrada de la tuberculosis y la diabetes mellitus en México, 2015. *Int J Integr Care* 2015;15.
 - 127 Kapur A, Harries AD. The double burden of diabetes and tuberculosis—public health implications 2013;101:10–19.
 - 128 Gounder S. Screening tuberculosis patients for diabetes mellitus in Fiji: notes from the field 2012;2:145–7.
 - 129 Moher D, Liberati A, Tetzlaff J, *et al.* Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med* 2009;6:e1000097.

Chapter Four

Article 3: Barriers and Facilitators to Bidirectional Screening of TB-DM in Ghana: Healthcare Workers' Perspectives

This paper sought to address objectives 4 and 5 of the overall study:

- To examine the systems and structures in place for implementing the collaboration of TB-DM management in the selected health facilities.
- To explore the processes of detecting TB in DM and DM in TB patients at the District, Regional and Tertiary

This paper builds on a globally well-established linkage between diabetes mellitus (DM) and tuberculosis (TB), suggesting that people living with DM are three times more likely to develop TB, and an increase in DM predisposes people to develop TB. Given that it was the very same linkage that culminated in the development and implementation of the collaborative framework for the care and control of tuberculosis (TB) and diabetes (DM), globally and in Ghana, specifically, this paper focuses on the systems and structures in place for implementing the framework. In addition to that, processes followed in detecting TB in DM and DM in TB patients at the District, Regional and Tertiary facilities, are explored.

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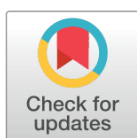
RESEARCH ARTICLE

Barriers and facilitators to bidirectional screening of TB-DM in Ghana: Healthcare workers' perspectives

Rita Suhuyini Salifu^{1,2*}, Khumbulani Welcome Hlongwana¹

1 Discipline of Public Health Medicine, School of Nursing and Public Health, University of KwaZulu-Natal, Durban, South Africa, **2** Health and Development Solutions Network, Tamale, Ghana

* suhyini@gmail.com



Abstract

Background

The tuberculosis (TB) and diabetes mellitus (DM) co-epidemic continues to increase globally. Low-and middle-income countries bear the highest burden of co-epidemic, and Ghana is no exception. In 2011, the World Health Organisation (WHO) responded to this global challenge by launching a collaborative framework with a view to guide countries in implementing their DM and TB care, prevention and control plans. Subsequently, several countries, including Ghana, adopted this framework and began implementing bidirectional screening of TB and DM patients. Almost a decade later since the launch of the framework, the implementation of bidirectional screening in Ghana has not been subjected to empirical research. This study explored the barriers and facilitators to bidirectional screening through the lenses of the implementing healthcare workers.

Methods

This was an exploratory qualitative study conducted in three public health facilities offering both TB and DM services in Northern Ghana. In-depth interviews, document review and observations, were used to generate data. In total twenty-three healthcare workers (doctors, nurses, prescriber, health managers and TB task- shifting officers delivering care in TB and DM clinics) were interviewed, using semi-structured interview guides. The interview questions solicited information on the screening process, including knowledge of the collaborative framework, comorbidity, collaboration and workload.

Results

Six themes emerged from the analysis, of which two (Increase in staff capacity, and Institutionalisation of bidirectional screening) were facilitators, and four (Delays in screening, Fear and stigmatization of TB, Poor collaboration between TB and DM units, and Skewed funding for screening) were barriers.

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Abbreviations: DHIMS, District Health Information Management System; DM, Diabetes Mellitus; GHS, Ghana Health Service; ICF, Intensified Case Finding; IUATLD, International Union against Tuberculosis and Lung Disease; LMICs, Low-and Middle-Income Countries; MOH, Ministry of Health; NR, Northern Region; NTP, National Tuberculosis Control Programme; OPD, Out- Patient Department; TB, Tuberculosis; WCA, Western and Central Africa; WHO, World Health Organisation.

Conclusions

The implementation of bidirectional screening at public health facilities in Ghana was evident in this study and increased staff capacity, funding and institutionalisation enhanced the policy implementation process. However, the screening of TB patients for DM is yet to be prioritised, and emphasis should be put on the design for cost-effective screening approaches for low- and middle-income countries.

Introduction

Globally, the linkage between diabetes mellitus (DM) and tuberculosis (TB) has been well established [1]. People living with DM are three times more likely to develop TB, and an increase in DM predisposes people to develop TB [2, 3]. In 2013, the worldwide TB-DM comorbidity was over 1 million cases, reflecting 15% of the global tuberculosis burden [4, 5]. Studies conducted in various countries from 2011–2013 found DM prevalence in TB patients to be from 25%–44% between 2011–2012 in three regions of India, 36% in Mexico, 17% in Tanzania and 40–45% in the South Pacific [5, 6]. Projections indicate that by 2045, 629 million people will be living with DM, and the greatest share will be borne by LMICs [2]. If the situation is not averted, the double burden of DM and TB is expected to adversely affect the numerous Stop TB global initiatives, which were first initiated through the Millennium Development Goals (MDGs) and rolled over to the Sustainable Development Goals (SDGs) with an ultimate goal of creating “A world free of tuberculosis” [7]. The urgency to address this co-epidemic is fuelled by the bleak picture painted in current research estimates and future projections showing that there are more people living with TB-DM comorbidity than TB-HIV comorbidity, worldwide, a trend that is likely to grow [5, 8].

The extent of this double burden of TB-DM disease on LMIC populations and how health systems have adapted and cope with this burden is yet to be fully understood [9]. The 2019 World Health Organisation (WHO) Global TB Report maintains that TB is still among the top ten causes of mortality worldwide and a single infectious agent causing more mortality even above HIV/AIDS [10]. Ghana is an LMIC where TB is still a major contributor to morbidity and mortality. The national TB incidence is 148/100,000 population; though as many as 2/3 of the country's cases are estimated to be missed due to inadequate or misdiagnoses [10, 11]. TB prevalence is found to increase with age among the adult population [10]. The national prevalence of DM is also high—3.6% in adult population, and Ghana continues to face challenges relating to undiagnosed DM cases, which in turn leads to increased complications with assessing outcomes for DM-TB [12].

To mitigate the co-epidemic of TB and DM, the WHO and International Union Against Tuberculosis and Lung Disease (The Union) have developed a collaborative framework for the care and control of DM and TB [3]. A key component of this collaborative framework is screening TB patients for DM and DM patients for TB, or bidirectional screening [3]. Since its launch in 2011, health systems of various countries, including Ghana, have adopted the collaborative framework and are at various stages of implementation [5]. Ghana's NTP begun the pilot phase of the Intensified Case Finding Initiative (ICF) between 2009–2013 and has since expanded it to all facilities offering TB care [11]. The objective of the pilot phase was to assess the feasibility of screening all patients who visit public health facilities for TB [11]. However, beyond the pilot phase, there is a paucity of empirical evidence on the implementation of bidirectional screening in Ghana [11]. This research was aimed at exploring the barriers and

facilitators to bidirectional TB and DM screening at three healthcare facilities in Northern Ghana, from the perspectives of the implementing healthcare workers, using qualitative inquiry.

Materials and methods

Setting of the study

This study was conducted in the Northern Region (NR) of Ghana, a country located in West Africa [13]. The NR is one of 16 administrative regions with a population of 1,905,628 and largely rural dispersed settlements [14, 15]. According to estimates from 2016, Ghana poverty and inequality report, 50.4% of the NR population live in poverty, compared to the 5.6%-14.8% for the rest of Ghana, thus making the NR the highest poverty-trapped region in the country [16]. The poverty profile of the region and long distances between settlements poses a challenge in healthcare delivery and health-seeking behaviour of patients [17]. This study took place in three public health facilities that offer both TB and DM care [15]. The names of these three facilities are withheld for privacy and confidentiality purposes.

Study design

This research used an exploratory qualitative design to explore barriers and facilitators to the bidirectional TB and DM screening process in Ghana [18]. Twenty-three (23) healthcare workers involved in TB and DM care were recruited using a heterogeneous purposive sampling technique to ensure that diverse perspectives were captured. Sampled healthcare workers were heterogeneous in terms of professions, age, gender and roles. To ensure rigor, data generated were further triangulated through comparing and contrasting information generated from the in-depth interviews with observational data and document reviews [19].

Data generation

Data for this study were generated over three (3) months (July to September 2019) in three public health facilities in the NR of Ghana. Introductory letters for this research from the Northern regional health administration of the Ghana Health Service were sent to medical superintendents of the selected hospitals offering both TB and DM services in the same facility. This was done after the study had obtained ethical clearance from the University of KwaZulu-Natal (UKZN) Biomedical Research Ethics Committee (BE262/19) and Ghana Health Service Ethics Review Committee (GHS_ERC 012/04/19). Superintendents of the selected health facilities, in turn, gave permission letters and introduced the researcher to the staff of the TB and DM units. The researcher introduced the study to the potential participants and sought their informed consent, prior to discussing and agreeing on the interview dates and time. The written information and informed consent form contained the aim of the study, voluntariness and confidential nature of participation, special permission for audio-recording and the fact that additional hand-written notes were going to be taken during the interviews. Furthermore, potential participants were assured that they could opt out of the study at any point and that would not have any consequences. The whole consent process was explained by the researcher who also invited questions for further clarification. The informed consent form was signed by all potential participants prior to participating in the study. The participants' names were kept anonymous by referring to them using codes, which further ensured that the confidentiality was maintained.

A semi-structured interview guide developed by the researcher was used to conduct face-to-face in-depth interviews with twenty-three (23) healthcare workers. The interview guide contained open ended questions which allowed the researcher to probe further. Topics covered in the interview guide included: the roles of healthcare workers, knowledge/awareness of

TB/DM comorbidity and collaborative framework, treatment guidelines for TB and DM, and the process followed in implementing the bidirectional screening. The healthcare workers interviewed included 3 doctors, 11 nurses, 1 prescriber (A nurse qualified to run consultations and clinics in place of a doctor for some conditions.), 2 health managers, 3 TB institutional coordinators and 3 TB task-shifting officers. Interviews were conducted in English and lasted for 45 minutes to an hour. A suitable location for in-depth interviews was selected by each potential respondent, where they were comfortable and could speak freely.

One hour-long non-participant observations of the screening process were conducted over a two-day period by the researcher in each facility during DM and TB clinic days at the three participating facilities. The researcher also requested the documents on guidelines used in the course of their work. Documents from four categories, namely: screening tools, treatment guidelines, recording forms, and reporting templates (monthly, quarterly, annual reporting templates), were retrieved and reviewed.

Data analysis

Interviews were audio-recorded, and complemented with hand-written field notes, especially to capture non-verbal data, but also served as a back-up in the event of audio-recording failure. The hand-written notes were taken by the researcher. Twenty-one (21) out of a total of twenty-three (23) participants agreed to the audio recording of interviews. All audio-recorded interviews were later transcribed verbatim by an experienced professional transcriber. Field notes for the two interviews not recorded were written by the researcher. The grounded theory approach was used to guide the data generation and analysis process [20, 21]. Transcripts were systematically reviewed while listening to the audio recordings. Repeated ideas and perspectives were identified and coded. Similar codes were grouped to identify key themes. Themes were triangulated with the document review and observational data and further categorised into facilitators and barriers of the screening process. The observational data allowed the researcher to understand the context of the bidirectional screening phenomenon, which was key for understanding and interpreting data generated. Document review gave valuable information on the guidelines followed by healthcare workers in delivering care.

Results

A total of twenty-three respondents from three health facilities participated in this study, namely: 9, 6, and 8 from Hospital X, Hospital Y and Hospital Z, respectively (Table 1). Respondents' ages ranged from 27 to 58 years (mean age = 40.7 years). Study participants comprised of males (n = 14) and females (n = 9). The respondents' roles varied, including nurse-TB care (n = 6), nurse-DM care (n = 5), task shifting officer-TB care (n = 3), institutional coordinator-TB care (n = 3), hospital manager (n = 2), medical doctor-DM care (n = 2), medical doctor-TB care (n = 1) and nurse prescriber-DM care (n = 1) (Table 1).

Six major themes were identified from the data analysis, drawing on all data sources. Two of the themes (increase in staff capacity and institutionalization of bidirectional screening) were facilitators, whereas four (delays in screening, fear and stigmatization of TB, poor collaboration between TB and DM units, and skewed funding for screening) were barriers (Table 2).

Facilitators of bidirectional screening

Increase in staff capacity

There was a convergence of views from most respondents in asserting that the creation of the "TB task-shifting officer" role promoted the implementation of bidirectional screening. The

Table 1. Profiles of the research respondents in the facility, by role, gender, age range and facility.

Hospital X*				Hospital Y*				Hospital Z*			
n	Role	Gender	Age range	n	Role	Gender	Age range	n	Role	Gender	Age range
1	Nurse-TB care	F	35–44	1	Task shifting officer-TB care	M	35–44	1	Hospital manager	M	45–54
2	Nurse-TB care	M	35–44	2	Institutional coordinator-TB care	F	55–64	2	Institutional coordinator-TB care	M	55–64
3	Nurse-TB care	M	35–44	3	Nurse-TB care	F	45–54	3	Nurse-TB care	M	25–34
4	Task shifting officer-TB care	F	25–34	4	Medical Doctor-DM care	M	35–44	4	Task shifting officer-TB care	F	25–34
5	Nurse-DM care	F	25–34	5	Nurse-DM care	F	25–34	5	Nurse-TB care	F	25–34
6	Nurse-DM care	F	35–44	6	Hospital manager	M	55–64	6	Nurse-DM care	M	35–44
7	Medical Doctor -DM care	M	55–64					7	Nurse-DM care	M	25–34
8	Medical Doctor -TB care	M	35–44					8	Nurse Prescriber-DM care	M	45–54
9	Institutional coordinator-TB care	M	25–34								

* Names of the hospitals have been withheld to protect their identities.

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Ghana National Tuberculosis Control Program (NTP) instituted this new role to boost staff capacity, as shared by one respondent:

“... they train some people; they call them task-shifting officers, and what they do is that they actively look out for the cases. When you go to the OPDs(Out-Patient Departments), they are there. They administer the screening tool. If you go to most of the hospitals, they are sitting by the desk where they are checking the vital signs of the patients they administer that questionnaire”. Male- hospital manager

“Before we had the TB Task- shifting officers, the numbers were very low. We were missing so many of them but since this active screening, it identified more cases”. Female institutional coordinator, TB care

According to the interviews, the TB task-shifting officer is responsible for screening all people visiting the health facility for TB. The screening is conducted at the OPD and specific clinics: Diabetes mellitus Clinic, Antenatal Clinic and the Wards. This TB task-shifting officer is responsible for administering a screening tool and ensuring that samples for suspected cases are taken to the lab for testing. They are also responsible for following up on the patients' results and to ensure that patients are put on appropriate medication. Weekly and monthly reports of numbers screened and confirmed cases are prepared and submitted by the TB task-shifting officer to the Institutional Coordinator, then to the district health information management system (DHIMS), an electronic national database of the Ghana Health Service as well as the National TB control program database. This was noted through document review by the researcher and interviews.

Table 2. Summary of facilitators and barriers to bidirectional screening.

Facilitators	Barriers
➤ Increase in Staff Capacity	➤ Delays in Screening
➤ Institutionalization of Bidirectional Screening	➤ Fear and Stigmatization of TB
	➤ Poor Collaboration Between TB and DM units
	➤ Skewed Funding for Screening

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Institutionalisation of bidirectional screening

The screening processes, and discrepancies between guidance and practice, became clearer through the course of this research. Healthcare workers in TB and DM exhibited adequate knowledge on the roles and routines for detecting TB among DM. All health facilities in this study had established some referral systems and guidelines between the TB and DM care units. Though these policies exist there was little guidance found within clinic documents for the operationalization of screening TB patients for DM. This was determined through document reviews and observation.

This was substantiated during the interview process, as a task-shifting officer said:

“... Any suspected case, then they call me. The nurses also refer suspected people to me for screening. After screening, they go to the public health lab with the sample to be tested by the Gene Xpert machine”. **Female TB Task shifting officer**

Another respondent indicated:

“... We have the forms here, so any patient we suspect, we make a request to the lab when it is confirmed we have a TB unit where they are referred”. **Male nurse prescriber DM care**

However, the process of screening for DM among TB patients was not as well defined as that of screening for TB among DM patients. TB health workers did not actively screen their patients for DM, therefore, any detection of DM was purely accidental. Instead, they focussed efforts on screening for HIV. Further review of documents showed that there was comparatively more documentation and guidance for TB screening among DM patients than DM screening among TB patients, or concurrent screening for TB and DM.

“... Truth must be told, the only condition we test you for is HIV. Even the NTP who says they are looking for all these things like diabetes haven't created a column where you test the TB patient for random blood sugar so that if it's high, you will suspect the person has diabetes or whether the person is a known diabetic, no column to fill that... Sometimes it's through the history that the patients mention that I have diabetes. Even when they say, we don't record those as known diabetic, so we don't have that statistics. For instance, every TB patient is counselled and tested for HIV, and we link them up for care, but we don't test for diabetes”. **Female nurse TB- care**

“The nurses also screen for other conditions like HIV, which I know they do, but for diabetes, I can't talk about that”. **Male medical doctor TB care**

Barriers to bidirectional screening

Delays in the screening process

The time taken by additional screening was viewed as an obstacle to successful implementation of the bidirectional screening processes, as this negatively affected the time duration a patient would normally spend at the hospital. Furthermore, this screening has not been fully incorporated in the triage routines at the OPD, therefore healthcare workers perceive it as a supplementary service.

“... At the OPD, we are having challenges. The directive was to screen everyone, it is supposed to be mandatory, but the patients are in a hurry and think it is a waste of time”. **Female TB task-shifting officer**

This situation was also observed by the researcher during clinic days. Patients came as early as 6 am to pick folders, join the queue and began the process to see the doctor. This would ordinarily take an average of 4–5 hours spent at the facility, at a minimum, where an average of 40 patients are seen on clinic days and in some facilities as high as 70 patients. The screening process usually took an average of 10 mins depending on the answers however any delay by the screening sometimes affected patients position in the queue and they expressed frustration at this.

A review of the screening tool by the researcher showed it contained initial questions on symptoms of TB with yes or no answers. Follow up questions were determined by patient's response, to determine a suspected case or not.

“...the screening tool is a series of question just simple ones. Whether you are coughing which is the main sign of the pulmonary TB, whether you sweat in the night and other symptoms, so those that they presume they have TB, they immediately request the laboratory test for them”.

Male- hospital manager

Fear and stigmatization of TB

Fear and stigmatization of TB, which affected both patients and healthcare workers who work with TB patients, was another very important barrier to achieving bidirectional screening. All respondents in TB care in all the three public health facilities participating in this study agreed that stigma was a serious challenge to the ideals of bidirectional screening.

“... Even the health staff are scared of TB”. **Male TB task-shifting officer**

“... You can't do away with the element of stigmatization among staff. The moment they hear this is a suspected case of TB, some will intentionally not go close”. **Male nurse TB care**

There were reports of patients being treated differently in the event of suspected TB infection. Non-TB health care workers were hesitant to continue care even if the patient had other conditions.

“The major thing is the other non-TB working staff, their knowledge on TB is an issue because once a person has TB, nobody wants to get closer and the stigma associated with it does not help the work. The patient could have other conditions, severe ones that may kill him/her other than the TB. It could be managed just for an example something medical, maybe the sugar level is so high that medical ward may need to admit, but once the report comes and they have TB, they say come and pick your patient. If you talk with the nurses, they will also tell you the same thing, it's something that is running that we all know”. **Male medical doctor TB care**

Poor collaboration between TB and DM units

This study found poor collaboration between the two units at different levels of service delivery, despite the inclusion of screening guidelines and recommendations within formal clinic policies and documents. Administratively, the two units are managed under two different divisions in the health facilities studied. The TB unit is placed under the infectious disease division and the DM under public health division. There is very little linkage or joint activities between these divisions at the hospital levels. There was little, or no joint trainings organised for TB

and DM staff to address the TB-DM comorbidity. The poor collaboration between healthcare workers in both the TB and DM units was found to be negatively affecting the identification of TB-DM patients.

“...No, we do not have any collaboration with the TB unit, we have not had any meetings in that direction”. Male Nurse DM Care

“...We used to have trainings for both our staff and staff of other units including diabetic staff, but for the past two to three years now, there has not been any effective in-service training concerning TB. NTP will tell you they don't have money, but a while back before our time they used to organize routine training, but some of those staff have gone on retirement, some transfer so the knowledge is going down and the willingness too is not there”. Female nurse TB care

Some responses pointed to the perception that DM staff did not consider bidirectional screening their responsibility.

“TB unit working with other units is always a challenge. They see the work like it is different from any other health condition. The same way when we go for a workshop, they say send the TB screening tool to the diabetic unit so that they will screen their patients. They won't do it”. Female nurse TB Care

Another response was:

“We need every health care worker to take on the role of screening as theirs. If you see someone coughing, it is very simple to pick a form and refer them to the lab. If every healthcare worker would accept these responsibilities, the work will go on well. They should make it like malaria test when someone comes to the consulting room and complains of coughing just get the sputum and refer them to the lab”. Male TB task-shifting officer

Skewed funding for screening

Screening DM patients for TB is supported by the NTP policy's Intensified Case Finding Initiative (ICF), as shared by participants. Additional staff (TB task-shifting officer) needed to implement this, is funded by the NTP program. The NTP program funds the cost of TB care continuum in its entirety, from laboratory test until patients receive their medication. This study found that general screening for DM in the three public health facilities was limited because hospitals were supposed to provide test strips, but when these were not available, patients had to pay for strips provided by the nurses. Respondents shared what happens as they screen patients:

“The challenges are so many, because the hospital does not provide strips, we buy from outside, so we have to sell to the patients. The glucometer has been given to us free by a company, but no strips are added. Some of them find it difficult paying, and some of them get annoyed for buying”. Female nurse DM care

Another nurse in diabetes care said:

“Hmmm, it is not for free, actually. The hospital does not provide the strips; patients are supposed to pay for the strips. It's not a force; if you are able to pay for it, then they will screen you”. Female nurse DM care.

Discussion

The TB-DM collaborative framework recommends active screening of TB and DM patients and encourages further research to inform adaptation to local health care systems [3]. The aim of this research was to explore the barriers and facilitators to bidirectional screening in health-care facilities in the Northern Region of Ghana. This study found that implementing bidirectional screening in public health facilities was achievable, when properly implemented, which is consistent with the findings of similar studies [6, 22, 23]. An increase in staff capacity and institutionalization of bidirectional screening were found to be enablers to the screening process, while delays in screening, fear and stigmatization of TB, poor collaboration between TB and DM units, and skewed funding for screening, were all found to hinder the successful implementation of bidirectional screening in the healthcare facility setting in the Northern Region of Ghana.

The study uncovered several gaps in the implementation process of bidirectional screening in Ghana. In particular, screening to detect TB among DM patients was more organized and focused than screening to detect DM among TB patients. Structures have been put in place, and personnel trained to implement this intervention. However, the reverse of screening TB patients for DM has not been institutionalized. This may be attributed to the little guidance on how to operationalise the policy. Screening TB patients for DM was found to be limited at the health facility level in the Northern Region of Ghana. There seems to be a stronger case made for screening DM patients for TB than TB patients for DM, which is similar to the findings by Yorke et al [24]. A number of reasons could underlie this finding. For example, dedicated funds are not allocated to support the screening of TB patients for DM, and patients end up having to pay for blood sugar strips, unlike in the case of TB screening, which is a free service for all patient. This was found in Ethiopia, where DM patients' inability to pay for service was a barrier to the co-management of TB-DM [25]. A review on co-management of TB-DM in LMICs also confirmed that funding for DM diagnosis and management is very low, and the cost of this health service to the patient is substantial [26]. The low prioritization of funding support for DM identified in this research is supported by a previous study conducted in Ghana, which revealed that funding is skewed towards infectious diseases including TB and HIV, as compared to non-communicable diseases such as diabetes [27]. With the low priority for the screening of TB patients for DM, Ghana may be having a substantial number of undiagnosed TB-DM cases passing through the public health facilities, undetected. Poor collaboration by healthcare workers of TB and DM units may also weaken bidirectional screening efforts, as was evident in this study and compares well to the findings of other research [28].

This study also found that the introduction of TB task- shifting officers by the NTP, to support existing staff, improved the process of screening DM patients for TB. The global dearth of healthcare workers has been well documented, especially with health systems in LMICs [29]. The introduction of task- shifting is aimed at helping with the shortage of healthcare workers in order to address high workloads [30]. In Ghana, task shifting is not a new phenomenon, and a similar system was seen when the medical assistant's roles were instituted to augment healthcare delivery [31]. Furthermore, the healthcare workers in this study viewed screening as an added responsibility to their already high workload, as was also found in a similar study in Ethiopia [32].

Indications from observations and interviews for the present research findings showed that there were delays in the screening process at the public health facilities. The process of screening patients for TB is an added routine at the designated clinics (OPD, diabetic clinics, antenatal, and wards). Patients were reported to find it time-consuming, and non-TB healthcare workers found it disruptive to their routines. Another study conducted in Ghana attributed

low TB case detection to delay in patients' health-seeking behaviour, but this study found delays in screening process at the health facility level to be another factor for low TB case detection, as a result, patients end up opting-out of screening [25, 33, 34].

Finally, the study highlights that stigma continues to exist and hinder TB screening and care, despite the many years of health advocacy and awareness programme implementation [34]. A paper on TB stigma in Ghana came to the same conclusion as our findings on TB stigma among health care workers [35]. These findings from our study provides useful evidence to support the implementation of bidirectional screening for improved outcomes in TB and DM.

Our study has some limitations. First, the viewpoint of patients was missed, and further studies on patients' barriers and enablers for bidirectional screening is recommended. Second, our sample includes only three of several facilities in NR. Nonetheless, some important contextual considerations to bidirectional TB and DM screening were identified. Additionally our study design did not allow for estimating prevalence of TB among DM patients and vice versa in the selected health facilities however interviews from healthcare workers gave an indication on the state of TB-DM comorbidly detection.

Conclusions

This study found that bidirectional screening at the three public health facilities in Northern Ghana is being implemented; operationalising this policy has been enhanced by the improved staff capacity, funding, and institutionalization. However, some barriers to optimal implementation continue to exist. To improve screening outcomes and overcome the barriers in LMICs such as Ghana, special attention will need to be given to screening TB patients for DM, and developing a cost-effective screening approach for DM that is comparable to the current TB screening approach in order to help identify high-risk DM individuals who can then move on to be tested. There still exist gaps in knowledge of the TB-DM comorbidity and management among healthcare workers, thereby supporting the case for initiatives that will strengthen TB-DM collaboration. Additionally, there should be health education programs to create awareness and help patients appreciate the value of having few extra minutes for additional screening.

Supporting information

S1 Checklist.

(DOCX)

S1 File.

(PDF)

S2 File.

(PDF)

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Author Contributions

Conceptualization: Rita Suhuyini Salifu.

Data curation: Rita Suhuyini Salifu.

Formal analysis: Rita Suhuyini Salifu.

Supervision: Khumbulani Welcome Hlongwana.

Writing – original draft: Rita Suhuyini Salifu, Khumbulani Welcome Hlongwana.

Writing – review & editing: Rita Suhuyini Salifu, Khumbulani Welcome Hlongwana.

References

- McMurry HS, Mendenhall E, Rajendrakumar A, Nambiar L, Satyanarayana S, Shivashankar R. Coprevalence of type 2 diabetes mellitus and tuberculosis in low-income and middle-income countries: A systematic review. *Diabetes Metab Res Rev*. 2019; 35(1):e3066. <https://doi.org/10.1002/dmrr.3066> PMID: 30144270
- WHO. Classification of diabetes mellitus. World Health Organization: Geneva; 2019. Report No.: 9241515708.
- WHO. Collaborative Framework for Care and Control of Tuberculosis and Diabetes. World Health Organization: Geneva 2011.
- Lönnroth K, Roglic G, Harries ADJTID, endocrinology. Improving tuberculosis prevention and care through addressing the global diabetes epidemic: from evidence to policy and practice. 2014; 2(9):730–9.
- Lönnroth K. The looming co-epidemic of TB-diabetes: A call to action. 2014.
- Shayo FK, Shayo SCJBph. Availability and readiness of diabetes health facilities to manage tuberculosis in Tanzania: a path towards integrating tuberculosis-diabetes services in a high burden setting? 2019; 19(1):1104.
- Kapur A, Harries AD, Lönnroth K, Wilson P, Sulistyowati LSJTID, endocrinology. Diabetes and tuberculosis co-epidemic: the Bali Declaration. 2016; 4(1):8–10.
- Harries A, Kumar A, Satyanarayana S, Lin Y, Zachariah R, Lönnroth K, et al. Diabetes mellitus and tuberculosis: programmatic management issues. 2015; 19(8):879–86. <https://doi.org/10.5588/ijtld.15.0069> PMID: 26162352
- Harries A, Lin Y, Satyanarayana S, Lönnroth K, Li L, Wilson N, et al. The looming epidemic of diabetes-associated tuberculosis: learning lessons from HIV-associated tuberculosis. 2011; 15(11):1436–45. <https://doi.org/10.5588/ijtld.11.0503> PMID: 21902876
- WHO. Global Tuberculosis Report World Health Organization 2019.
- Ohene S-A, Bonsu F, Hanson-Nortey NN, Toonstra A, Sackey A, Lönnroth K, et al. Provider initiated tuberculosis case finding in outpatient departments of health care facilities in Ghana: yield by screening strategy and target group. *BMC Infectious Diseases*. 2017; 17(1):739–. <https://doi.org/10.1186/s12879-017-2843-5> PMID: 29191155
- Bernard EN, Amoah RS, Alessandro C. Boosting diabetes and pre-diabetes detection in rural Ghana. 2019; 8. <https://doi.org/10.12688/f1000research.18497.2> PMID: 31508210
- Ghana Districts.com. The Northern Region n.d [Available from: <http://www.ghanadistricts.com/>].
- Ghana Statistical Service. Population by Regions, Northern 2019 [Available from: <https://www.statsghana.gov.gh>].
- Fuseini I, Yaro JA, Yiran GAB. City profile: Tamale, Ghana. *Cities*. 2017; 60:64–74.
- Cooke E, Hague S, McKay AJUoS. The Ghana poverty and inequality report: Using the 6th Ghana living standards survey. 2016.
- GHS/NTP. National Tuberculosis Control Programme Annual Report 2016.
- Charmaz K, Belgrave LL. Grounded theory. 2007.
- Bryman A. Social research methods: Oxford university press; 2016.
- Corbin J, Strauss A. Basics of qualitative research: Techniques and procedures for developing grounded theory: Sage publications; 2014.
- Charmaz K, Belgrave L. Qualitative interviewing and grounded theory analysis. *The SAGE handbook of interview research: The complexity of the craft*. 2012; 2:347–65.
- Castellanos-Joya M, Delgado-Sánchez G, Ferreyra-Reyes L, Cruz-Hervet P, Ferreira-Guerrero E, Ortiz-Solis G, et al. Results of the implementation of a pilot model for the bidirectional screening and joint management of patients with pulmonary tuberculosis and diabetes mellitus in Mexico. 2014; 9(9): e106961. <https://doi.org/10.1371/journal.pone.0106961> PMID: 25229236

23. Ekeke N, Ukwaja KN, Chukwu JN, Nwafor CC, Meka AO, Egbagbe EE, et al. Screening for diabetes mellitus among tuberculosis patients in Southern Nigeria: a multi-centre implementation study under programme settings. 2017; 7:44205. <https://doi.org/10.1038/srep44205> PMID: 28281682
24. Yorke E, Atiase Y, Akpalu J, Sarfo-Kantanka O, Boima V, Dey IDJTr, et al. The bidirectional relationship between tuberculosis and diabetes. 2017; 2017. <https://doi.org/10.1155/2017/1702578> PMID: 29270319
25. Yimer SA, Bjune GA, Holm-Hansen C. Time to first consultation, diagnosis and treatment of TB among patients attending a referral hospital in Northwest, Ethiopia. 2014; 14(1):19.
26. Sullivan T, Amor YBJPm. The co-management of tuberculosis and diabetes: challenges and opportunities in the developing world. 2012; 9(7):e1001269. <https://doi.org/10.1371/journal.pmed.1001269> PMID: 22911359
27. Kushitor MK, Boatema S. The double burden of disease and the challenge of health access: Evidence from Access, Bottlenecks, Cost and Equity facility survey in Ghana. 2018; 13(3). <https://doi.org/10.1371/journal.pone.0194677> PMID: 29570720
28. Zulkarnain Z, Permana I, Arini M, editors. Health Workers in The Case Management of Tuberculosis and Diabetes Mellitus at Type B Hospital, Yogyakarta. 4th International Conference on Public Health 2018: Sebelas Maret University.
29. Bangdiwala SI, Fonn S, Okoye O, Tollman S. Workforce resources for health in developing countries. 2010; 32(1):296.
30. Okyere E, Mwanri L, Ward P. Is task-shifting a solution to the health workers' shortage in Northern Ghana? 2017; 12(3):e0174631. <https://doi.org/10.1371/journal.pone.0174631> PMID: 28358841
31. McPake B, Mensah KJL. Task shifting in health care in resource-poor countries. 2008. [https://doi.org/10.1016/S0140-6736\(08\)61375-6](https://doi.org/10.1016/S0140-6736(08)61375-6) PMID: 18790295
32. Workneh MH, Bjune GA, Yimer SAJBhsr. Assessment of health system challenges and opportunities for possible integration of diabetes mellitus and tuberculosis services in South-Eastern Amhara Region, Ethiopia: a qualitative study. 2016; 16(1):135.
33. The Global Fund to Fight AIDS TaM. Best Practices on TB Case Finding and Treatment Reflections and Lessons from West and Central Africa and Beyond. October 2018
34. Osei E, Akweongo P, Binka F. Factors associated with DELAY in diagnosis among tuberculosis patients in Hohoe Municipality, Ghana. 2015; 15(1):721.
35. Dodor EA, Kelly SJ. Manifestations of tuberculosis stigma within the healthcare system: The case of Sekondi-Takoradi Metropolitan district in Ghana. 2010; 98(2–3):195–202. <https://doi.org/10.1016/j.healthpol.2010.06.017> PMID: 20637520

Chapter Five

Article 4: Exploring the mechanisms of collaboration between the Tuberculosis and Diabetes Programs for the control of TB-DM Comorbidity in Ghana

This paper sought to address objective 2 of this thesis:

- To explore the process followed by the Ministry of Health (MOH) in the adaptation of the framework in Ghana.

Building on the previous chapter, which explored the systems and structures in place for implementing the collaborative framework in Ghana, including the processes for detecting TB in DM and vice-versa, this chapter is presented in a form of a published paper, which explored the mechanisms of collaboration between the stakeholders, including NTP and the NCDPCP at the national, regional and local (health facility) levels of the health- care system in Ghana. This chapter complements the findings of the previous chapter, given that understanding the systems and structures in place for implementation, is not sufficient, unless the entire mechanism of collaboration is properly understood. The results highlighted limited mechanisms of collaboration was hindering the integration of care for TB-DM co-management, prioritization of DM care and the need for donor funding to address the growing TB-DM co-epidemic.

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RESEARCH NOTE

Open Access



Exploring the mechanisms of collaboration between the Tuberculosis and Diabetes Programs for the control of TB-DM Comorbidity in Ghana

Rita Suhuyini Salifu^{1,2*}  and Khumbulani W. Hlongwana¹

Abstract

Objectives: To explore the mechanisms of collaboration between the stakeholders, including National Tuberculosis Control Program (NTP) and the Non-Communicable Disease Control and Prevention Program (NCDPCP) at the national, regional, and local (health facility) levels of the health care system in Ghana. This is one of the objectives in a study on the “Barriers and Facilitators to the Implementation of the Collaborative Framework for the Care and Control of Tuberculosis and Diabetes in Ghana”

Results: The data analysis revealed 4 key themes. These were (1) Increased support for communicable diseases (CDs) compared to stagnant support for non-communicable diseases (NCDs), (2) Donor support, (3) Poor collaboration between NTP and NCDPCP, and (4) Low Tuberculosis-Diabetes Mellitus (TB-DM) case detection.

Keywords: Ghana, Policy, Qualitative research, National TB control program, NCD control program

Introduction

Non-communicable diseases (NCDs) have been described as a “chronic emergency” requiring urgent global public health action, particularly in low- and middle-income countries (LMICs) [1]. In Africa alone, projections suggest that 23.9 million individuals will be living with diabetes mellitus (DM) by the year 2030 [1]. Given the existing high tuberculosis (TB) burden in LMICs, a simultaneous parallel increase in DM prevalence is expected [2]. This growing public health problem has caught the attention of the global community, culminating in the development of 2030 global strategy aimed at reducing TB incidence and TB mortality by 80% and 90%, respectively [3]. Despite these initiatives, the African

continent has the second-highest TB burden in the world [3] and Ghana has not been spared from the ravages of the TB burden [3]. In Ghana, the national TB prevalence is 148/100,000 population [3], a situation that is exacerbated by the growing TB-DM co-epidemic, thereby imposing a strain on the health care systems. This phenomenon calls for a radical review of the vertical nature of TB and DM programs in the country [4].

In 2011, the World Health Organization (WHO) and the International Union Against Tuberculosis and Lung Disease (Union) took up the challenge of the rising TB-DM co-epidemic inherently linked to the vertical nature of the TB and DM programs by launching the collaborative framework for care and control of TB and DM [5].

The initiative by the WHO and Union was not new in the Ghanaian context since a comparable country-specific programme had been established seventeen years (1994) earlier. Ghana established the National

*Correspondence: suhyini@gmail.com

¹ Discipline of Public Health Medicine, School of Nursing and Public Health, University of KwaZulu-Natal, Durban, South Africa
Full list of author information is available at the end of the article



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Tuberculosis Control Program (NTP), as part of the disease control department under the public health division of the Ghana Health Service (GHS), with funding from the government and donor funds [6] and that was some years before the launch of the WHO's collaborative framework, which took place in 2011. Needless to say, the continued pre-2011 increase in TB-DM comorbidity in Ghana raised questions about the effectiveness of the 1994 program. To date, the NTP in Ghana is responsible for the policy interventions, such as the WHO-Union collaborative framework and proposes policies that the Ministry of Health (MoH) can implement to control TB [7].

Over the past decade, NCDs have become a priority in global health agenda, and Ghana, which has been experiencing a steady increase in NCDs, is no exception [1]. The formation of the NCD Control and Prevention Program (NCDPC) in 1992, under the wing of the GHS, is a sign that Ghana has grappled with these public health challenges for a long time [8]. The program's mandate is to plan, develop clinical practice guidelines, train, advocate and coordinate NCD activities [8]. Ghana's priority NCDs include hypertension, diabetes, cancers and the chronic respiratory diseases, genetic disorders (sickle cell disease) and injuries [8].

Despite notably limited individual TB/ DM program advancement, the vertical nature of these programs limits the potential contribution of implementing collaborative plans, particularly using the tools provided by the WHO-Union collaborative framework.

This study sought to explore the mechanisms of collaboration between the stakeholders, including NTP and the NCDPC at the national, regional, and local (health facility) levels of the health care system in Ghana.

Main text

Methods

Study Setting—This study took place in both Accra, the country's national capital and the Northern Region (NR) of Ghana. Accra is the capital city of Ghana, where national offices of the NTP and the NCDPC are located. The Northern Regional offices of these institutions are in Tamale, the regional capital and the TB and DM units are located at the three health facilities in the Northern region.

Study Design—Guided by the grounded theory design, this study explored the mechanisms of collaboration between NTP and NCDPC programs in Ghana at the levels of national, regional and health facilities, using key-informant interviews. Ethical approval was obtained from both the University of KwaZulu-Natal (UKZN) Bio-medical Research Ethics Committee (BREC) (BE262/19) and Ghana Health Service Ethics Review Committee

(GHSERC) (GHS-ERC 012/04/19). The researcher obtained permission and introductory letters from the GHS and presented at the NTP and NCDPC national and regional offices in Accra and Tamale, respectively, as well as the three health facilities in the Northern Region. As a gesture of study endorsement, the directors of the programs introduced the researcher to the program officers who met the selection criteria for inclusion into the study. At the health facilities, the medical directors introduced the researcher to the staff of TB and DM units.

Data generation—Twelve (12) purposively selected key informants were interviewed by the researcher, face-to-face at two locations, namely: Accra and Tamale. Two participants were recruited from NTP (national and regional), two from the NCDPC (national and regional) and eight participants from the three health facilities. All respondents read the information sheet and signed informed consent prior to being interviewed. In-depth interviews lasted for 30–45 min and were audio-recorded (with participants' permission). Two participants consented to the study, but objected to being audio-recorded, hence their interviews were only recorded through the hand-written notes. All the interviews were conducted in English, as all the participants were comfortable with English language. The researcher also took the summary notes during all the interviews. The semi-structured interview guides (Additional files 1 and 2) covered questions on existing policies to establish the mechanism of collaboration, state of TB-DM at both the national and regional levels, stakeholder inputs into the policy process and coordination of activities between NTP and NCDPC.

Data Analysis—Using the grounded theory analytical approach, the digital audio recordings from the interviews were carefully transcribed in verbatim by a professional transcriber and the researcher, who has training in qualitative research methods, verified transcriptions, to confirm data quality. Furthermore, the researcher meticulously read through all the transcripts and compared them with field notes and audio-records, to ensure the integrity of data. Recurring ideas were grouped into themes, and emerging themes were coded manually by the researcher. Similar codes were grouped under major themes—the analysis generated 4 main themes.

Results

The key informants in this study were staff of the NTP and NCDPC at the national and regional offices, Hospital managers and TB and DM Unit managers in three health facilities. A total of 12 participants comprised of National program managers (n=2), Regional program managers (n=2), Hospital managers (n=2), TB unit manager (n=3), and DM unit managers (n=3) (Table 1).

Table 1 Characteristics of the study participants

	Participant	Age range	Years of experience	Stakeholder
Policy makers	Participant 1	35–44	9	NTP
	Participant 2	35–44	10	NCDCP
	Participant 3	45–54	25	NTP
	Participant 4	45–54	15	NCDCP
Implementers	Participant 5	25–34	9	Hospital TB Unit
	Participant 6	35–44	9	Hospital NCD Unit
	Participant 7	35–44	12	Hospital NCD Unit
	Participant 8	45–54	23	Hospital manager
	Participant 9	55–64	26	Hospital Manager
	Participant 10	55–64	33	Hospital TB Unit
	Participant 11	55–64	35	Hospital TB Unit
	Participant 12	55–64	35	Hospital NCD Unit

Participants' responses reflected their perception of the extent of integration, challenges, and opportunities to implementing the collaborative framework (Table 2). The main themes from the analysis were (1) Increased support for communicable diseases compared to stagnant support for non-communicable diseases, (2) Donor support (3), Poor collaboration between NTP and NCDCP, and (4) Low TB-DM Case detection.

The results of this study revealed that NTP introduced task-shifting officers in some facilities to circumvent the additional burden imposed by screening on the nurses (Participant 1).

Research participants who were the custodians of the policy (national level) identified the dependency on donor support to fund the NCDCP as one of the key challenges, which negatively affected the TB-DM collaboration (Participant 2). The fact that donor support was mainly targeted at health conditions, like maternal and child health, did not advance the agenda of TB-DM collaboration (Participant 4).

Findings from this study showed no evidence of collaboration between the NTP and NCDCP at the national and regional levels (Participant 2, & 7). However, at the facility level, some pockets of informal collaboration were observed, however, these were based on the healthcare workers' personal initiatives (Participant 2).

Respondents attributed low TB-DM detection to poor screening among DM patients (Participants 2), limited DM clinics in most health facilities (participant 1) and

limited data for TB-DM comorbidity, mainly due to the lack of designated diabetic clinics in most health facilities (participant 3).

Discussion

To the best of our knowledge, this is the first study to explore the mechanisms of collaboration between the NTP and NCDCP at the national, regional, and local levels, using qualitative methods.

Health care systems in resource-constrained settings are grappling with responding to the co-existence of both CDs and NCDs in the same populations or individuals, hence our findings have reiterated that there still exists an imbalance between health delivery for CDs and NCDs in Ghana [9]. The findings of this study found that the delivery of care was biased towards CDs. This was supported by views expressed in this study showing that NCDs were not a top priority as CDs. These findings are consistent with the results of a study previously conducted in Ghana, confirming that diagnostic and care services to infectious diseases are more accessible than that of NCDs [10]. This may be due to the health system structure in Ghana, which is generally skewed towards managing CDs, a phenomenon that is not peculiar to the Ghanaian context, as it has also been reported in other low-to-middle-income countries [10–12]. In Ethiopia and India, there was poor quality of care for DM patients, and NCD services lacked systems for monitoring and evaluation [13, 14]. Along the same lines, Critchley and colleagues [15] shared that there is considerable support and funding for TB treatment by the WHO, and this is in contrast to financially deprived DM care in LMICs [15]. Limited health insurance is available for DM care in LMICs, leading to high out of pocket cost and poor outcomes in detection and management of DM patients [15, 16]. Further studies in Ghana and Bangladesh highlighted the lack of infrastructure, guidelines, and supplies to be able to deliver NCD care [10, 12]. This study found that healthcare workers were concerned that screening of patients was an additional responsibility to their existing workload, and this was consistent with the findings of other studies [16]. However, in Ghana, the NTP with funding from the Global Fund augmented this by recruiting extra staff as task shifting officers to support the integration.

According to participants' views, donor support was a critical source of funding to complement the limited budget of the MoH/GHS. This funding from donors was largely tied to specific health conditions and outcomes, which influenced the strategic direction of the diseases program in receipt of the funding. The reliance on donor support may be due to the limited national budgets for health ministries which were not a priority for funding in

Table 2 Themes and quotes from participants on mechanism of collaboration

Themes	Comments/quotes
Increased support for communicable diseases compared to stagnant support for non-communicable diseases	<p>"In some facilities, the NTP brought in task shifting officers because screening is a role the nurses are supposed to do, but they are saying it is another load, so we are shifting it. The aim is that they see it as their routine work". (Participant 1)</p> <p>"The other policy is to have separate clinics for DM apart from the normal OPD [outpatient department], but because of human resource challenges, not all health facilities are able to do this". (Participant 4)</p> <p>The standard thing is to screen patients for DM, but it is expensive, so no hospital can do that because of the strips. It should have been part of the insurance package, especially if you are coming for the first time you are checked for DM. We should deliberately make it a policy that DM is checked, just as blood pressure". (Participant 4)</p> <p>"One of the initiatives is the wellness clinic [for NCDs]. We asked all hospitals to set up the wellness clinic. The challenge is how to fund it". (Participant 4)</p> <p>"The whole NCDCP itself is not even funded so what are you going to use to follow-up [TB-DM cases]?" (Participant 2)</p>
Donor support	<p>"Most support from partners go to maternal and child health, not NCD'S. Depending on what the partners prioritize, that is where the money goes ". (Participant 4)</p> <p>"We [NCDCP] rely on partners because we don't have any direct source of funding for the program, these collaborations become essential. If you intend to get anything done, you need funding." (Participant 2)</p> <p>Another challenge is funding. We get support from the WHO and the government of Ghana, but the main support is from the Global Fund." (Participant 3)</p>
Poor collaboration between TB and DM programs	<p>"There is currently no collaboration between the NCDCP and TB programs. There are ongoing talks, now issues have come up because of the Malaria-HIV-TB funding structure. They are directly global funded, and the way their lines of funding are, most times, they are stuck on those activities and don't veer horizontally to other programs." (Participant 2)</p> <p>"No, we do not have any collaboration with the TB unit, we have not had any meetings in that direction. I do not remember being invited to any TB workshop". (Participant 7)</p> <p>"We are not seeing collaboration from the diabetic side. We [NTP] say they should screen, but they should also know it is for the best management ". (Participant 1)</p> <p>"It will be much smoother from the TB side to get things along than the DM side. A lot of hospitals have done that in-house usually based on personal initiatives. It's not a nationwide thing". (Participant 2)</p>
Low TB-DM case detection	<p>"We [NTP] have not really zoned into TB-DM screening, our challenge is case detection, but from where I am sitting, the screening among the DM [patients] is very poor and because most of the places do not have a specialized diabetic clinic, it's difficult to detect. Since they all pass through the OPD". (Participant 3)</p> <p>"In the few places where there are diabetic clinics, it's easier to implement but, in most places, where they go through the OPD its likely to miss them [TB-DM] because not everyone is asked questions related to DM". (Participant 2)</p> <p>"We are interested in our TB cases, so we are asking the DM clinic to screen but the other way round we are not screening for DM, so we have no data. We always talk of looking for TB comorbidity but testing for DM is not captured in our register". (Participant 1)</p> <p>"We need to show more evidence of the TB-DM data and provide feedback to practitioners". (Participant 3)</p> <p>We know risk factors for TB is HIV and DM, so we have included screening at DM clinics." (Participant 1)</p> <p>"Because it is difficult to segregate the data it's difficult to get TB-DM cases" (Participant3)</p> <p>"There is no such tool for screening TB patients for DM (participant 4)</p> <p>The success of policies is on engaging the people and making sure they have the capacity to do it, the large numbers and workload give the health workers stress". (Participant 2)</p> <p>The emphasis should be more on screening the TB cases for DM rather than DM for TB. When it's the other way around, we need more orientation. Most of the comorbidity cases have been picked up from the TB clinic. TB clinics are fairly well run in Ghana because of the HIV-TB structures. (Participant 2)</p>

comparison with other ministries as observed by Puchner et al. [2]. In Kyrgyzstan, funding for TB was 44% financed by external donors with diabetes receiving no direct external funding [17].

The low TB-DM case detection may be due to the limited collaboration between the NTP and NCDPCP at all levels of the healthcare system. This research found that integration at the program levels was largely hindered because of sources of funding and structured objectives of the programs, which did not leave room for integrating other health conditions. Therefore, funding appears to be one of the most important factors that would influence the mechanism of collaboration between NTP and NCDPCP. Currently, the screening for DM is seen as burdensome due to poor funding of DM programs.

Additionally, the low awareness of the TB-DM comorbidity and how to integrate services was adversely affecting the rate of case detection, as reported in other research conducted in Ghana [18]. According to a publication on Ghana's NCD policy, poor screening is also attributable to low awareness of implementers in the northern region [19].

Conclusions

There exist limited mechanisms of collaborations between the NTP and NCDPCP mainly at the health facility level, with the lack of funding identified as one of the important impediments. There is still a gap at the national and regional program levels with regards to joint coordination of activities geared towards TB and DM collaboration. Therefore, the results of this study can be used to advocate for better TB-DM collaboration and lobby policymakers and politicians to prioritise integrative services for these two health conditions. Development of different health insurance schemes for DM patients may potentially help support in the high cost of DM care, as suggested by some study participants. Further awareness and training are required on the TB-DM comorbidity, and the recommendations by the WHO collaborative framework for the care and control of TB and DM will promote further integration. Lastly, there is a need for advocacy groups to highlight the importance of prioritizing DM, alongside TB, in donor funding, to circumvent low uptake of DM screening services and improve DM health outcomes.

Limitations

- This study was confined to key informants and may have benefited from a larger group of stakeholders working in the non-governmental health sector.

- The study was unable to explore the collaboration of the TB and DM programs at the district and sub district levels of Ghana.

Abbreviations

CDs: Communicable Diseases; DM: Diabetes mellitus; GHS: Ghana Health Service; HIV: Human Immunodeficiency Virus; LMICs: Low- and Middle-Income Countries; MoH: Ministry of Health; NCDs: Non-Communicable Diseases; NCDPCP: Non-communicable Disease Control and Prevention Program; NTP: Ghana National Tuberculosis Control Program; TB: Tuberculosis; TB-DM: Tuberculosis-Diabetes; Union: International Union Against Tuberculosis and Lung Disease; WHO: World Health Organization.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s13104-021-05637-1>.

Additional file 1. Interview guide 1-Health Managers.

Additional file 2. Interview guide 2- Policy Makers.

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Authors' contributions

RS conceptualized the study and wrote the research proposal. KWH contributed to the writing and critically reviewed the draft. RS wrote the final manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

All data generated or analyzed during this study are included in this published article [and its additional files].

Declarations

Ethics approval and consent to participate

Participants in this study signed informed consent forms. Ethical approval was from the University of KwaZulu-Natal (UKZN) Biomedical Research Ethics Committee (BREC) (ref.BE262/19) and Ghana Health Service Ethics Review Committee (GHSERC) (GHS-ERC 012/04/19).

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Author details

¹Discipline of Public Health Medicine, School of Nursing and Public Health, University of KwaZulu-Natal, Durban, South Africa. ²Health and Development Solutions Network, Tamale, Ghana.

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References

- Bosu WK. Accelerating the control and prevention of non-communicable diseases in Ghana: the key issues. *Postgraduate Med J Ghana*. 2013;2(1):32–3.
- Puchner KP, Rodriguez-Fernandez R, Oliver M, Solomos Z. Non-communicable diseases and tuberculosis: anticipating the impending global storm. *Glob Public Health*. 2019;14(9):1372–81.
- WHO. Global tuberculosis report World Health Organization. Geneva: World Health Organization; 2019.
- Harries A, Kumar A, Satyanarayana S, Lin Y, Zachariah R, Lönnroth K, et al. Diabetes mellitus and tuberculosis: programmatic management issues. *Int J Tuberc Lung Dis*. 2015;19(8):879–86.
- WHO. Collaborative framework for care and control of tuberculosis and diabetes. Geneva: World Health Organization; 2011.
- Amo-Adjei J. Political commitment to tuberculosis control in Ghana. *Glob Public Health*. 2014;9(3):299–311.
- Amo-Adjei J, Awusabo-Asare K. Reflections on tuberculosis diagnosis and treatment outcomes in Ghana. *Arch Public Health*. 2013;71(1):22.
- Bosu WK. A comprehensive review of the policy and programmatic response to chronic non-communicable disease in Ghana. *Ghana Med J*. 2012;46(2):69–78.
- Marais BJ, Lönnroth K, Lawn SD, Migliori GB, Mwaba P, Glaziou P, et al. Tuberculosis comorbidity with communicable and non-communicable diseases: integrating health services and control efforts. *Lancet Infect Dis*. 2013;13(5):436–48.
- Kushitor MK, Boatemaa S. The double burden of disease and the challenge of health access: evidence from access, bottlenecks, cost and equity facility survey in Ghana. *PLoS ONE*. 2018;13(3):e0194677.
- Temu F, Leonhardt M, Carter J, Thiam S. Integration of non-communicable diseases in health care: tackling the double burden of disease in African settings. *Pan Afr Med J*. 2014;18:202.
- Rawal LB, Kanda K, Biswas T, Tanim MI, Poudel P, Renzaho AM, et al. Non-communicable disease (NCD) corners in public sector health facilities in Bangladesh: a qualitative study assessing challenges and opportunities for improving NCD services at the primary healthcare level. *BMJ Open*. 2019;9(10):e029562.
- Sharma P, Visnegarwala F, Tripathi V. Burgeoning double burden of tuberculosis and diabetes in India: magnitude of the problem—Strategies and solutions. *Clin Epidemiol Global Health*. 2014;2(3):107–16.
- Workneh MH, Bjune GA, Yimer SA. Assessment of health system challenges and opportunities for possible integration of diabetes mellitus and tuberculosis services in South-Eastern Amhara Region, Ethiopia: a qualitative study. *BMC Health Serv Res*. 2016;16(1):1–11.
- Critchley JA, Restrepo BI, Ronacher K, Kapur A, Bremer AA, Schlesinger LS, et al. Defining a research agenda to address the converging epidemics of tuberculosis and diabetes: part 1: epidemiology and clinical management. *Chest*. 2017;152(1):165–73.
- Riza AL, Pearson F, Ugarte-Gil C, Alisjahbana B, van de Vijver S, Panduru NM, et al. Clinical management of concurrent diabetes and tuberculosis and the implications for patient services. *Lancet Diabetes Endocrinol*. 2014;2(9):740–53.
- Skordis-Worrall J, Round J, Arnold M, Abdraimova A, Akkazieva B, Beran D. Addressing the double-burden of diabetes and tuberculosis: lessons from Kyrgyzstan. *Glob Health*. 2017;13:1–9.
- Obirikorang Y, Obirikorang C, Anto EO, Acheampong E, Batu EN, Stella AD, et al. Knowledge of complications of diabetes mellitus among patients visiting the diabetes clinic at Sampa Government Hospital, Ghana: a descriptive study. *BMC Public Health*. 2016;16(1):637.
- Nyaaba GN, Stronks K, Masana L, Larrea-Killinger C, Agyemang C. Implementing a national non-communicable disease policy in sub-Saharan Africa: experiences of key stakeholders in Ghana. *Health Policy Open*. 2020;1:100009.

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Chapter Six

Article 5: Frontline Healthcare workers' experiences in implementing the TB-DM collaborative framework in Northern Ghana.

Chapter 6 addresses objective 4 of the overall study, which is to understand how healthcare workers, conceptualize their roles in the implementation of the TB-DM collaborative framework.

The growing TB-DM epidemic raises issues on how to manage this comorbidity and its impact on TB and DM incidence, especially from frontline healthcare workers' perspective. The management of this dual disease in the health system is primarily led by healthcare workers, hence their perspectives on how they experience the implementation process, is paramount. This chapter revealed the experiences of the frontline healthcare workers, including how they understand their roles through the lens of Lipsky's theoretical framework of street-level bureaucracy.

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RESEARCH ARTICLE

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Frontline healthcare workers' experiences in implementing the TB-DM collaborative framework in Northern Ghana



Rita Suhuyini Salifu^{1,2*}  and Khumbulani W. Hlongwana¹

Abstract

Background: Over the past decade, global health policy has increased its focus on measures to halt further increase in tuberculosis (TB) incidence and management of diabetes mellitus (DM). However, the vertical management of these two diseases have not achieved much in addressing the adverse effects of the rising tuberculosis-diabetes co-epidemic. This necessitated the World Health Organisation and the International Union Against Tuberculosis and Lung Disease to develop a framework to manage this dual disease burden. TB-DM co-epidemic is a public health concern in Ghana, adversely threatening the country's fragile health systems. Since frontline healthcare workers are critical in health policy implementation, this study used Lipsky's theoretical framework of street-level bureaucracy to explore their experiences in implementing the collaborative framework at the health facility level in Ghana.

Methods: This qualitative study was conducted between July to September 2019 using an exploratory design. Data was generated using a semi-structured interview guide designed to elicit information on knowledge of TB-DM comorbidity as well as systems for co-management. Twenty-three in-depth interviews were conducted among purposively selected frontline healthcare workers (doctors, nurses, TB task-shifting officers, TB institutional coordinators and hospital managers) from three health facilities in the Northern Region of Ghana. The lead author also conducted observations and document reviews, in order to fully address the study objectives. Thematic analysis was guided by the Lipsky's theoretical framework of street level bureaucracy.

Results: The findings revealed three main themes and six sub-themes. Main themes were Prioritisation of TB/HIV co-infection while negating TB-DM comorbidity, Poor working conditions, and Coping mechanisms, whereas sub-themes were *Low knowledge and awareness of TB-DM comorbidity, Limited awareness of the collaborative framework, High workload in TB & DM Clinics, Multiple roles, Inadequate training, and Space shortage.*

Conclusions: Frontline healthcare workers had limited knowledge of TB-DM comorbidity and the collaborative framework, which, in turn adversely affected the effectiveness in implementing the framework. The effective implementation of the framework begins with raising awareness about the framework through in service training amongst the frontline healthcare workers. Additionally, an integrated screening tool to detect both TB and DM would help achieve early detection of TB-DM comorbidity.

Keywords: Frontline implementers, Ghana, WHO collaborative framework, Tuberculosis-Diabetes Comorbidity

* Correspondence: suhyini@gmail.com

¹Discipline of Public Health Medicine, School of Nursing and Public Health, University of KwaZulu-Natal, Durban, South Africa

²Health and Development Solutions Network, Tamale, Ghana



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Background

It has been over three decades since the global acknowledgement of the connection between tuberculosis (TB) and diabetes mellitus (DM), but efforts to address the comorbidity only intensified around 2007 and 2008, owing to the rise in the TB-DM co-epidemic, worldwide [1]. In 2012, approximately 15 % of TB cases globally, were connected to DM, with China (highest populated country in the world) and India (second highest populated country in the world) alone, accounting for as high as 40 % of comorbid TB-DM [2, 3].

Individuals with DM are three times more susceptible to being infected with TB compared to their non-TB infected counterparts, pointing to the DM-induced immuno-suppression in infected patients. The projections indicate that 366 million people across the globe will be living with DM by 2030 [4, 5]. TB adversely affects individual's glucose tolerance and leads to increased DM incidence [6]. If this trend is not averted, these projections will be a serious blow to the world's goal of reducing TB incidence and mortality rates by 80 and 90 %, respectively, in the year 2030 [7]. The co-existence of DM and TB leads to poor treatment outcomes in both diseases [1, 8].

TB remains a serious infectious disease causing mortality and morbidity in most low-and middle- income countries (LMICs), including Ghana, with an incidence rate of 148/100,000 population per year reported in 2019 [2]. TB, a disease that is further complicated by the increasing prevalence of DM, is still a public health problem in Ghana [9]. DM prevalence among adult Ghanaians ranges from 6 to 13.9 %, with many missing cases of undiagnosed individuals in the community [10]. Estimates for TB-DM comorbidity in Ghana is limited, as reported in the study by Asante-Poku et al. [11], which discovered that DM prevalence among TB patients was two times higher than the general population. The double burden of these two diseases impose a strain on Ghana's current health systems [12], against the backdrop of competing health priorities, such as HIV/AIDS. TB/HIV has been recognised as a public health problem in most sub-Saharan countries, including Ghana, with the World Health Organisation (WHO) classifying Ghana as a high TB/HIV co-infection burdened country [13]. Efforts to address the double burden of TB-DM resulted in the development of a collaborative framework for the care and control of TB and DM by the WHO and the International Union Against Lung Disease (Union) [6]. This framework has set out guidelines to help national programs to adapt their health systems in order to effectively and efficiently manage patients with TB-DM comorbidity [14]. The framework makes 12 recommendations under 3 key areas; namely: (i) establishing mechanisms of collaboration, (ii) detecting

and managing TB in DM patients and (iii) detecting and managing DM in TB patients [6].

Literature suggests that the successful implementation of health policies is determined by how well healthcare workers implement these policies at various levels of care, a phenomenon that can be better understood through Lipsky's theory of street-level bureaucracy [15]. Lipsky's theory of street-level bureaucracy (SLB) explains the attitudes and behaviour of frontline workers as they apply policy in the course of their work [15]. Lipsky's theory is based on (i) personal discretion (ii) routines they establish and (iii) strategies frontline workers use to cope with excessive workload and uncertainties while interacting with patients [15]. Lipsky's theory of SLB places healthcare workers at the pinnacle of the policy implementation process [16]. Therefore, healthcare workers' understanding and perception about the policy play a pivotal role in influencing how and which aspects of the policy gets or does not get implemented, including the implementation modifications thereof [16]. Frontline healthcare workers do interact with patients daily in the course of service delivery, hence it is during this interaction that they use the resources available to them and their discretion to "re-make" the policy, based on their subjective assessment of the situation [16–18].

Methods

Study setting

Data collection for this study took place from July 2019 to September 2019, in the Northern region (NR) of Ghana. Ghana is a West African country with an estimated population of over 28 million people [19]. The country shares borders with Togo in the east, Ivory Coast in the west and the Burkina Faso in the north, all of which are French speaking countries and the Gulf of Guinea to the south [20]. The NR is one of the 16 regions of Ghana, with a population 1,905,628 and the capital Tamale is the 3rd largest urban centre in the country [19]. This study took place in 3 purposively selected hospitals, as they all offer both DM and TB services at the same facility.

Study design

This exploratory qualitative study was aimed at understanding the experiences of frontline healthcare workers in implementing the TB-DM collaborative framework in Ghana [21]. Healthcare workers were drawn from TB and DM units in the selected facilities, using heterogenous purposive sampling techniques. This approach allowed us to recruit diverse participants with respect to roles, age and gender, in order to obtain multiple perspectives on the phenomenon.

Ghana health system and theoretical framework

While it is important to understand the application of Lipsky's theory of SLB in the implementation of TB-DM collaborative framework in Ghana, this should be done within the context of full appreciation of the country's health care system. Ghana's healthcare system is comprised of both public and private health facilities, which are divided into three levels of care, namely: primary, secondary and tertiary levels [22]. Health services delivered at primary level of care cover community based health planning services compounds (CHPS), health centres, clinics and hospitals, which serve community, subdistricts and districts (Fig. 1) [20, 22]. Secondary care is offered at the regional level, and teaching hospitals offer tertiary care and training of healthcare workers (Fig. 1) [20, 22, 23].

The multi-level healthcare system in Ghana has Teaching hospitals, Regional hospitals, Primary hospitals at the district level and health centres at the sub-district [23]. At the national level, teaching hospitals are set up to receive referrals of complicated health conditions from all over the region or country, which cannot be handled at the other levels of care. These teaching hospitals are by design linked to universities in order to improve service delivery [23]. Regional hospitals offer specialised healthcare, and they are a referral point for health conditions from the district hospitals. Sub-districts are equipped to manage basic preventive and curative health conditions [23].

The aim of this study was to explore the frontline healthcare workers' experiences in implementing the TB-DM collaborative framework, using the bottom-up

approach, including how they understand their roles as front liners and the negotiations they make in the course of implementation. This study took place at different levels of care, but these facilities have been hidden to protect the anonymity and confidentiality of the participants.

Data generation

Data were generated using in-depth interviews, observations, and document reviews. In-depth interviews (Supplementary files 1 and 2) were conducted by the lead author with twenty-three healthcare workers purposively selected from three health facilities. The main stakeholders interviewed were doctors ($n = 3$), nurses ($n = 12$), institutional coordinators ($n = 3$), task shifting officers ($n = 3$), and hospital managers ($n = 2$) (Table 1). The lead author spent time at the various health facilities during the clinic days to conduct non-participant observation of the clinic sessions. The lead author also reviewed a number of documents related to care and management of TB and DM. The reviewed documents included screening tools, manuals, enrolment forms, patients registers and NTP annual reports.

Data analysis

Twenty-one in-depth interviews conducted in English for a duration of 45 min to 1h were audio-recorded (with participants' permission). Two respondents (institutional coordinator and medical doctor) declined to have interviews audio-recorded, but field notes were taken during the interviews. Audio recordings were transcribed verbatim, and the field notebook was used to

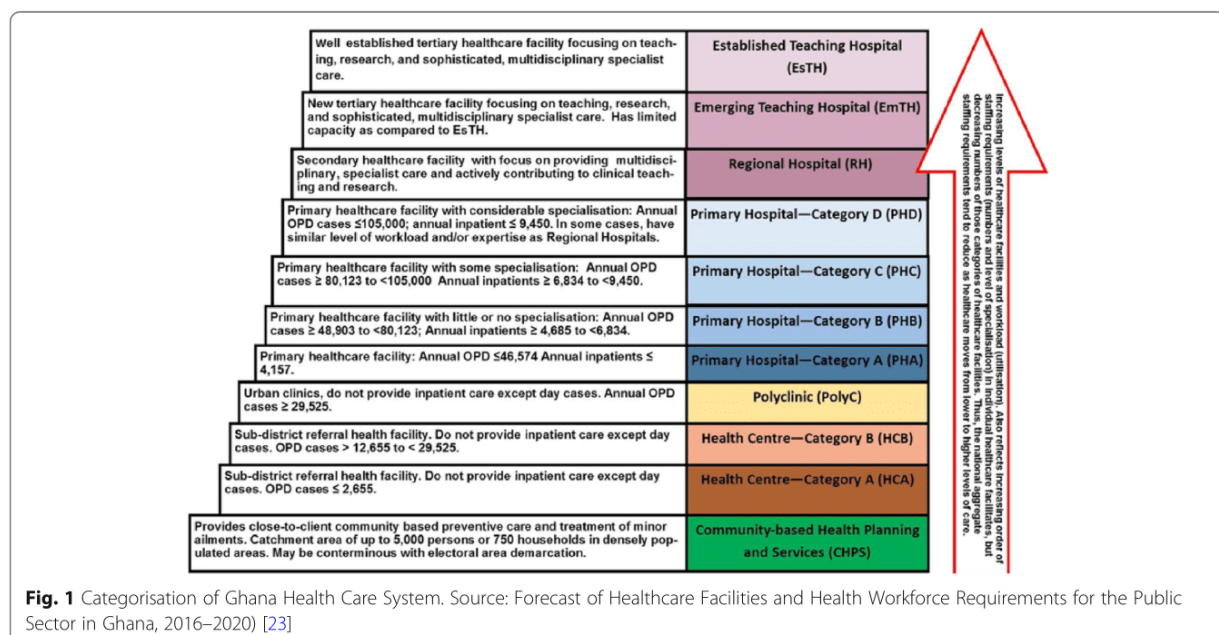


Fig. 1 Categorisation of Ghana Health Care System. Source: Forecast of Healthcare Facilities and Health Workforce Requirements for the Public Sector in Ghana, 2016–2020 [23]

Table 1 Sociodemographic profile of frontline healthcare workers

Role	Gender	Years of experience	Educational level
Nurse-TB care	F	11	Dip. Nursing, BSc Nutrition
Nurse-TB care	M	9	Dip. Nursing
Nurse-TB care	M	9	Dip. Nursing
Nurse-TB care	F	25	Dip. Nursing
Nurse-TB care	F	9	BSc Nursing
Nurse-TB care	M	5	BSc Nursing, MPH
Nurse-DM care	F	9	Dip. Nursing
Nurse-DM care	F	6	Dip. Nursing
Nurse-DM care	F	5	Dip. Health assistant
Nurse-DM care	M	12	BSc Nursing, MA Clinical leadership
Nurse-DM care (AD)	M	8	Dip. Nursing
Nurse Prescriber-DM care	M	17	BSc. Nursing
Task shifting officer-TB care	F	7	Dip. Nursing
Task shifting officer-TB care	M	5	BSc. Community Development
Task shifting officer-TB care	F	10	Dip. Management
Medical Doctor -DM care	M	35	MB ChB
Medical Doctor -TB care	M	10	MB ChB, MPH
Medical Doctor-DM care	M	8	MB ChB
Institutional coordinator-TB care	M	9	PharmD
Institutional coordinator-TB care	F	35	Dip. Nursing, Midwifery
Institutional coordinator-TB care	M	33	Dip. Comm. Disease, BSc. Pub.Health
Hospital manager/Medical Doctor	M	23	MB ChB
Hospital manager/Medical Doctor	M	26	MB ChB

record observations. Transcripts were primarily reviewed by the lead author prior to being shared with the second author for quality check and verification. Similar responses were coded and grouped into main and sub-themes. Observation and document review provided useful information for the better understanding of the contexts in which healthcare workers performed their duties. Analysis was guided by Lipsky's framework, focusing on personal discretion, routines established, and strategies adopted to cope with high workload and scarce resources. This approach proved helpful to gaining further insights on how frontline healthcare workers' day-to-day activities affect and/or are affected by the health policy implementation.

This study obtained ethical approval from both the University of KwaZulu-Natal (UKZN) Biomedical Research Ethics Committee (BREC) (Reference Number: BE262/19) and Ghana Health Service Ethics Review Committee (Reference Number: GHS_ERC 012/04/19). The Northern regional health directorate sent formal letters about the research to the managers of the three selected hospitals. Health facility managers gave the researcher permission to conduct the research. Selected healthcare workers in the TB and DM units who met

the criteria and were willing to participate in the study were recruited. The participants were also reassured that they could opt out of the interview process at any time if they were uncomfortable and that would not affect them in anyway whatsoever. All study participants read the information sheet and signed the informed consent forms. Interviews were conducted at the participants' preferred private locations, with limited interruptions, to ensure they were comfortable to share. To ensure the credibility of data generated from the interviews, the lead author used the member check technique, through repeating the answers to participants to allow them to clarify or correct any errors in their response. This was further strengthened by supporting the findings produced through the analysis with verbatim quotes.

Results

Twenty-three healthcare workers from the 3 purposively selected health facilities with TB and DM units participated in this study. These comprised of 12 Nurses, 3 Task-shifting Officers, 3 Medical Doctors, 3 TB Institutional Coordinators and 2 Hospital Managers. The work experience of participants ranged from 5 to 35 years

with the mean experience of 14 years and gender distribution of fourteen males and nine females (Table 1).

This research revealed three major themes and six sub-themes pertaining to the frontline healthcare workers' experiences and these themes/ sub-themes aligned well with Lipsky's explanation on how frontline healthcare workers translate policy in their day-to-day practice [15]. These themes were: (1) Prioritisation of TB/HIV co-infection while negating TB-DM Comorbidity, (2) Poor working conditions, and (3) Coping mechanisms, with the emergent sub-themes being: (1) Low knowledge and awareness on TB-DM comorbidity, (2) Limited awareness of the collaborative framework among healthcare workers, (3) High workload in TB & DM clinics, (4) Multiple roles, (5) Inadequate training, and (6) Space shortage (Table 2).

Healthcare workers shared their experiences in implementing the collaborative framework in their arguably challenging work environment, navigating dual roles with inadequate training to be competent in both. However, in order to cope with the dual roles, these healthcare workers initiated self-funded activities and community visits, in order to continue with the delivery of healthcare to their patients in line with the provisions of the policy.

Prioritisation of TB/HIV co-infection while negating TB-DM Comorbidity

Ghana has a high burden of TB and HIV/AIDS co-infection with a well-established system, covering the continuum of care for patients with TB/HIV co-infection, as observed during the implementation of this study in the Northern Region. There exist clear guidelines on screening and referrals, as well as monitoring mechanisms between the TB unit and the HIV/AIDS unit. These structures guide health workers in managing patients with dual infection. Interview of frontline healthcare workers participating in this research revealed that they were more knowledgeable about the management of TB/HIV co-infection, compared to TB-DM comorbidity. One frontline healthcare worker shared her view as follows:

*When the patient is positive for TB, we also do HIV screening. The HIV unit also does screening for TB. They have our [TB] screening tool and when they have an HIV positive patient, they also run the test. We refer their cases [HIV-positive] there and they also refer our cases [TB positive] here."***Female-TB task shifting officer.**

*"... the HIV /AIDS guideline says you test anyone who has TB for HIV but there is no information on testing TB patients for the diabetes."***Male TB institutional coordinator.**

*"In this facility there is no collaboration between the diabetes clinic and TB unit."***Male-DM care nurse.**

*"The two programs, namely: HIV /AIDS and TB have a better collaboration, where anybody who is HIV positive is screened for TB and anybody who is TB positive is screened for HIV because of the high frequency of the two conditions existing together."***Male-Hospital Manager.**

*"It's a routine that any client you put on TB treatment you test for HIV. At the HIV clinic they are also given the TB kits because people living with HIV are prone to TB. likewise, they also leave the HIV test kit here for us to test TB patients."***Male -TB care nurse.**

Low knowledge and awareness on TB-DM comorbidity

This research found that there was low knowledge about TB-DM comorbidity among healthcare workers in the three facilities, which may inadvertently contribute to it being profiled as low priority. The researcher observed that staff working with TB patients exhibited signs of being more aware of the comorbidity than DM staff. They appeared more confident and shared more information on TB-DM comorbidity than their counterparts in the DM unit. Most of the participants did not know about TB-DM comorbidity. and had not encountered a patient with the comorbidity.

Table 2 Summary of Themes and Sub-themes

Theme	Sub theme
Prioritisation of TB/HIV co-infection while negating TB-DM comorbidity	Low knowledge and awareness on TB-DM comorbidity Limited awareness of collaborative framework.
Poor working conditions	High workload in TB & DM Clinics Multiple roles Inadequate training Space shortage
Coping mechanisms	

"For now, we don't have any information about the TB-Dm comorbidity." **Male-DM care Nurse.**

"..... I have not seen a client with the TB-DM comorbidity." **Male-DM care nurse.**

Limited awareness of collaborative framework

The framework outlines strategies for bidirectional screening of TB and DM patients, as well as the collaboration between the two programs (TB and DM). However, this study found low awareness of the framework by the frontline healthcare workers, which compromised their full appreciation of the true value of all the components of the framework, including the objectives it aims to achieve.

"... it's just recently we heard of it [TB-DM], someone doing a research into TB-diabetes comorbidity shared with us about this just about a month ago. We have not yet encountered anyone with the comorbidity. Because the work is so much, sometimes we even forget to check and there is no place in the form we fill to check for diabetes." **Female- TB care institutional coordinator**

Screening for TB among patients in the three facilities participating in this research was more widely known than screening for DM.

"What we want to make sure is that nobody comes to the hospital and goes without being screened for TB, hence the emphasis on TB screening." **Male-TB care medical doctor.**

"For the diabetic side we don't have any kit to test our TB patients for diabetes. We have sent the screening tool and lab request form and sputum containers to the diabetic clinic. With the diabetic clinic we normally give them our screening tools to screen clients suspected of TB". **Male-TB care nurse.**

The review of documents from the TB units also showed clear guidelines on screening DM patients for TB. This was particularly evident in, symptom-based screening tool, sputum examination request form, charts, TB treatment card, and reports. However, there were no clear guidelines on how to test the TB patients for DM at the TB departments visited. Healthcare worker however agreed that there was a need to know more about this rising comorbidity and were open to getting more information.

I have heard that someone with diabetes can have TB. The TB unit should organize more workshops for us [DM care], so we can know more." **Female-DM care nurse.**

Poor working conditions

Respondents in this study expressed concerns about factors that hindered their effectiveness in service delivery, mainly the working conditions and how this impacted on the manner in which they performed their roles of caring for TB and DM patients. These were high workload, being involved in playing multiple roles, inadequate training, and space shortage.

High workloads in TB & DM Clinics The gravity of the current workload expressed by healthcare workers appeared to influence their reluctance to take on TB-DM co-management as an additional function. This concern was shared by all healthcare workers offering DM and TB in the facilities that participated in this study. Routine DM care in all the facilities was only available for two days in a week, leading to high work volumes, and this was considered inadequate.

"... we see averagely 30 or 35 patients but today we have 50 patients my head is even aching. I came as early as 7am, there is so much pressure and you can't leave till the last patient leaves the pharmacy because if they don't get the medication you need to rewrite the medication and those using insulin for the first time have to come back for training on how to use it." **Female-DM care nurse.**

Newly diagnosed patients and patients who already had diabetes came for care and regular review only on the given days with less flexibility for care outside the stipulated days. The researcher observed this situation during time she spent at the facility on clinic days, reviewing the registration book and treatment guidelines, as well as when respondents shared on their work routines.

Multiple roles

Responses from some participants and the researcher's own observations corroborated data on the multiple roles played by the healthcare workers. Healthcare workers in some health facilities had to perform multiple roles in addition to delivering TB or DM services, as expressed by the respondents in the quotes below:

The work is a lot, you saw the number of people at the OPD. I am at the OPD, there are other roles I had to pick up. I have learnt how to take vital signs, whilst I am helping the nurses, I can also screen the patients for TB." **Male-TB Task-shifting officer.**

"Presently one nurse has to manage the patient with both diseases, the one they came reporting for and the TB detected in the course of testing, that is also a challenge." **Female-TB care nurse.**

*"Staffing is a big issue; we were three [staff] and one went on retirement and one left for school [studying], so I am the only prescriber [now]. We are hoping others will join."***Male-DM care nurse.**

*"One of the challenges in TB, is human resources. Apart from care for the patients, there is so much reports to write and data to enter, it makes the work tedious."***Female-TB care institutional coordinator.**

*"We close clinical work around 4:30. I am just coming from there, then I come to the office to do administrative work. I was about climbing the steps when you called me. The number of doctors you know is low and it's the rainy season, malaria etc., the facility is supposed to run 24 hours emergency and other things and you have two people running emergency, so I try to get myself involved."***Male-hospital manager.**

Inadequate training

Healthcare workers did not feel adequately equipped to handle cases of TB-DM comorbidity, as they, reportedly, neither been trained or had received inadequate training. DM healthcare workers had not been trained in managing this comorbidity, and on the TB side, either very few trainings had been provided or trainings had insufficient depth. Healthcare workers felt that training on the guidelines for co-management of TB and DM was woefully inadequate and when conducted, it was irregular and far in between. Training for TB staff was mostly organised from the Ghana National TB control program. One respondent noted:

*"...We don't normally train with other departments, mostly trainings are longitudinal from the National TB control program."***Female-TB care nurse.**

*No training since I came- I have never attended any TB workshop not one. How will I know more about the TB?***Female-TB task-shifting officer.**

*"The other thing has to do with the staffing and skills training, because all of us are general nurses. After a year or two you [staff] are sent to a specialized place to work, without necessary giving you any training to handle such conditions so you learn on the job. Maybe the senior [staff] you meet will take you through. these are some of the challenges."***Female-DM care nurse.**

"I went for a TB training, but it's been a while more than 4 years ago. I recommend that more in-service trainings should be given to staff at the facility level,

*because medicine is dynamic and day-in day out there are updates."***Female-TB care nurse.**

Retirement and transfers also affected the retention of knowledge gained through trainings.

*"No joint training that I can remember. We used to have the training but there were changes and they took those nurses out of here and two people went on retirement. About five staff have gone away they have not been replaced."***Female-DM care nurse.**

Space shortage

Respondents identified infrastructural challenges as constraining factors to the delivery of services to DM and TB patients. The lack of permanent space dedicated to DM clinics forced healthcare workers to restrict patient care to only 2 days a week.

*"... at the moment our main problem is space, we don't have a place of our own so we hold our clinics only twice in a week and that makes it very tiring because we have a whole lot of patients who will come only on Tuesdays and Fridays. Sometimes it makes it difficult to give them the necessary care they need."***Female-DM care nurse.**

*"We are lobbying for a permanent place so patients can come every day. So, the number of patients will also reduce per day."***Male-DM care nurse.**

In one health facility the TB unit had to share the same space with HIV unit, which may have an effect on the stigmatisation of the patients and also negatively affected the strict adherence to confidentiality and privacy protocols during the screening and treatment.

*"Many patients don't like to be screened they are afraid of the condition TB. Even staff are hesitant to be screened. The TB people take their drugs with the ART people in one room, so anyone seen coming from the room is suspected to have HIV."***Male-DM care nurse.**

The respondents also shared the challenges faced during counselling sessions with TB patients in congested consulting rooms with patients with other conditions. The researcher observed them trying to be discreet by speaking in low tones to prevent the other patients from hearing the discussion.

"Space is our challenge, this room is not a TB unit alone, we do PMTC, give ART services here, and dispense drugs for both TB and ART. There is not

enough space to see all these patients.” **Female-TB care institutional coordinator.**

“Secondly, human resource is a problem; we are the only two [staff] in this room handling all the services I have mentioned and managing the units.” **Female-TB care nurse.**

“We have a challenge with space, we don’t have a specific ward for TB patients. We have only one room for isolation of TB patient with only one bed and the room is for both male and female. So, if a female patient is there and a male patient is diagnosed with TB, you can imagine what will happen. So, one is forced to put patients in the general ward where you nurse with other patients.” **Female-DM care nurse.**

“We need a bigger place because privacy is key in our management. Some of the patients fail to come to the clinic because they come and sit in an open place and we do our education together. Patients prefer to be seen as individuals but because of the space we are not able to do so. If we are given a larger place, we can partition, and each nurse will have a place and invite the patient to sit and discuss his or her condition.” **Female-DM care nurse.**

Coping mechanisms

Healthcare workers developed coping mechanism by using their “discretion” to find ways to “cope” with the challenges presented in this paper to deliver care, despite the challenging work environment and scarce resources. Some of these initiatives were follow-ups to patients’ homes by hospital staff and supporting patients with money for transportation.

“... contact tracing for everybody is based on my own initiative. We are supposed to go out, but we have not been given the resources, so I go on my own. I go to the patients’ houses. If I look at the patients’ area and it’s in town I just go to their house when I’m coming to work. I leave very early and pass by their home talk to the family get a few samples from the family members.” **Male-TB task-shifting officer.**

“Sometimes the patient default because of money for transportation, sometimes we take from our own pockets. We need some funding to support the patients who cannot afford to come to the hospital.” **Female-TB care nurse.**

“The hospital does not have the resources for transportation. Sometimes I have to use my personal

money to trace and follow-up on patients. We don’t have that support. If we can get those things, I know we can detect more cases because I know TB now is back.” **Female-TB task shifting officer.**

Discussion

This research explored healthcare workers’ experiences in implementing the collaborative framework at three selected health facilities in Ghana guided by Lipsky theory of street level bureaucracy. Three main themes and six sub-themes emerged from the data analysis and these were: (I) Prioritisation of TB/HIV co-infection while negating TB-DM comorbidity (*Low knowledge and awareness of TB-DM comorbidity*), Limited awareness of the collaborative framework) (II) Poor working conditions (*High workload in TB & DM Clinics, Multiple roles, Inadequate training and Space shortage*) (III) Coping mechanisms. The manner in which frontline healthcare workers managed high workloads, handled space shortage, navigated multiple tasks and coped with the challenges, aligned well with Lipsky’s theory. For example, frontline healthcare workers restricted patient care to only 2 days a week, leading to the high workloads owing to a lack of permanent space dedicated to DM clinics. These frontline healthcare workers also learned to perform multiple roles all at once. For these frontline healthcare workers, coping mechanisms came with personal sacrifice, both physically and financially. For example, frontline healthcare workers have had to use their personal monies to trace and follow-up on patients. All these actions by the frontline healthcare workers directly talk to Lipsky’s theory of street-level bureaucracy.

Apart from the aspects of the results that align with Lipsky’s theory, these result of this study are also consistent with literature, which has shown that a challenge posed by HIV/AIDS to TB control, has led to many countries efficiently implementing policies to manage TB/HIV coinfections [1, 13]. Our research found that staff were well versed with Ghana’s policy on TB/HIV integration than they were with the TB/DM collaborative framework [13]. The observations in this study, showed screening TB patients for HIV/AIDS and vice versa was routinised and its implementation can provide key lessons to guide effective implementation of the WHO–Union collaborative framework. This could be explained by Lipsky’s theory which argues that the success of a policy is largely dependent on how well the healthcare worker understands it and communicates to the citizens [15].

In this study TB healthcare workers knew more about the policy to screen DM patients for TB and were better equipped but had little or no knowledge about screening TB patients for DM. Similar findings were reported in studies from Nigeria and India [24–26]. DM health care

workers were mostly not aware of the policy and the need for bidirectional screening. This may be as a result of healthcare workers having little or no knowledge of the comorbidity and the devastating effect of TB on DM and vice versa, as supported by a few studies [26–28]. Frontline healthcare workers therefore were not well equipped to handle the TB-DM comorbidity, the same situation was reported in other studies [24, 27, 28]. The findings highlight that limited trainings were organised on bidirectional screening, hence healthcare workers were not adequately equipped for the additional role of detecting and managing patients with the dual condition of TB and DM [29]. Consistent training of healthcare workers caring for TB and DM patients is anticipated to yield better results in identifying TB-DM comorbidity and early care and control, as demonstrated by Agarwal et al. [30], where training of healthcare workers and established infrastructure resulted in significant improvements in service delivery.

This study revealed high workload in TB and DM clinics, which was consistent with findings in Mexico [31]. This situation was further exacerbated by staff going on retirement, study leave and transfers similar to other studies [26, 31]. The pressure of high workload and limited space allocation found in this study gave rise to healthcare workers having to perform multiple roles. This was how they managed and coped with the high workload [32]. However, healthcare workers found this situation taxing and overburdening, which differed from the findings of some studies, where healthcare workers embraced other duties as growth opportunity [29, 33].

In this study healthcare workers caring for TB and DM patients faced a number of challenges in implementing the collaborative framework at the health facility level. Consistent with Lipsky's theory of street level bureaucracy [18], the healthcare workers, in spite of these challenges, also had developed innovative ways to achieve unhindered delivery of care services to their patients. The initiatives of healthcare workers in this study was to self-finance in order to conduct follow up visits to patients, an approach that differed from a Nigerian study, where some healthcare workers collected gifts and informal payments from patients or even asked for a fee for home visits [34]. However, the follow-up done in this study are likely to have favoured patients living in nearby urban areas, as opposed to those in the distant countryside, given that home visits made by the healthcare workers were self-financed and within the travel routes of healthcare workers. One study found healthcare workers' coping strategy to be positive attitude [26], this was not explicit in our study, but the actions of the healthcare workers showed their positive attitude and commitment.

Limitations and recommendations

The limitations of the study were two-fold, namely: non-inclusion of health facilities from the private sector and non-participation of community-based health planning services compounds (CHPS).

These limitations are important given that the perspectives from the study participants miss insights from private sector frontline healthcare workers and CHPS compounds.

Despite these limitations, we considered that the impact of the policy under review is more pronounced among the frontline healthcare workers in public health facilities, as they receive high volume of patients requiring TB and DM care services, compared to their private sector counterparts. Secondly, the public health sector employs a large proportion of frontline healthcare workers, hence any improvements in their implementation of the TB-DM collaborative framework are likely to make a real difference in reducing TB-DM morbidity and mortality. Therefore, while the incorporation of private for-profit health facilities may have added a unique perspective, this does not affect the utility of the results.

The CHPS compounds is Ghana's primary healthcare strategy with the basic package of primary health services, which include maternal and reproductive health, child health services, treatment of minor ailments, health education and follow-up on defaulters and discharged patients. It is worth noting that TB and DM care is not offered at the basic primary healthcare level, which we considered to be a plausible reason for their exclusion.

Further research exploring the perspectives of frontline healthcare workers in private for-profit health facilities, is required. It will be through understanding the perspectives from both the public and private sectors that opportunities for public-private partnership in addressing TB-DM care and control, can be explored. The plausibility of involving community-based health planning services compounds (CHPS), whose primary responsible is prevention and treatment of minor diseases, in the TB-DM care and control, is worth exploring.

Conclusions

Our findings reiterate the need for the Ministry of Health (MOH/GHS) to prioritise and fund consistent in-service training programs for both TB and DM healthcare workers, so that healthcare workers will be better equipped to manage the growing TB-DM co-epidemic. Healthcare workers' personal sacrifices in funding the departmental functions advantaged certain patients over others based merely on geography. Despite the inadvertent consequences of healthcare workers' financial interventions, they are an important gesture and commendable commitment to their work specifically and patient care generally.

In line with the findings of this study and the evidence from the literature, HIV/TB integration holds a promise that an integrated screening tool for TB and DM, can be achieved. This integrated approach to screening is anticipated to further improve care and strengthen the healthcare system's co-management of TB and DM. To achieve this integrated approach, investment in additional infrastructural and human resource support for health facilities, would be required in order to promote better collaboration with frontline healthcare workers delivering TB and DM care.

Our research offers valuable insights into the experiences of healthcare workers implementing health policy in public health facilities and serve as an important contribution to inform the implementation of WHO-Union framework in similar settings.

Abbreviations

DM: Diabetes Mellitus; DOT: Direct Observed Treatment; GHS: Ghana Health Service; HCWs: Health Care Workers; Union: International Union against Tuberculosis and Lung ; LMICs: Low-and Middle-Income Countries; MOH: Ministry of Health; NR: Northern Region; NTP: National Tuberculosis Control Programme; NCDP: Non-Communicable Disease Control Program; OPD: Out- Patient Department; TB: Tuberculosis; UNION: International Union Against Tuberculosis and Lung Disease ; WHO: World Health Organisation; CHPS: Community based health planning services compounds ; SLB: Street-Level Bureaucrats

Supplementary Information

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Additional file 1.

Additional file 2.

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Authors' contributions

RS conceptualized the study and wrote the research proposal. KH contributed to the writing and critically reviewed the draft protocol. RS wrote the final manuscript and all authors approved the final draft.

Authors' information

RS: Holds MA and currently a PhD candidate in the Discipline of Public Health School of Nursing and Public Health, University of Kwazulu-Natal, South Africa.

KH: He is a senior lecturer at the School of Nursing and Public Health, University of KwaZulu-Natal, South Africa.

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Availability of data and materials

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study obtained ethical approval from both the University of KwaZulu-Natal (UKZN) Biomedical Research Ethics Committee (BREC) (Reference Number: BE262/19) and Ghana Health Service Ethics Review Committee (Reference Number: GHS_ERC 012/04/19). Information sheets on the study, voluntariness and confidentiality were shared with participants. The participants signed informed consent forms.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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References

- Harries AD, Kumar AMV, Satyanarayana S, Lin Y, Zachariah R, Lönnroth K, et al. Addressing diabetes mellitus as part of the strategy for ending TB. *Transact Royal Soc Trop Med Hyg.* 2016;110(3):173–9.
- WHO. Global Tuberculosis Report World Health Organization 2019.
- Zheng C, Hu M, Gao F. Diabetes and pulmonary tuberculosis: a global overview with special focus on the situation in Asian countries with high TB-DM burden. *Global Health Act.* 2017;10(1):1264702.
- Pizzol D, Di Gennaro F, Chhaganlal KD, Fabrizio C, Monno L, Putoto G, et al. Tuberculosis and diabetes: current state and future perspectives. *Trop Med Int Health.* 2016;21(6):694–702.
- Organization WH. Tuberculosis & Diabetes WHO Fact Sheet. 2016.
- WHO. Collaborative framework for care and control of tuberculosis and diabetes. Geneva: World Health Organization; 2011.
- Harries AD, Lin Y, Kumar AM, Satyanarayana S, Takarinda KC, Dlodlo RA, et al. What can National TB Control Programmes in low-and middle-income countries do to end tuberculosis by 2030? F1000Research. 2018;7:3.
- Kheang S, Theang H, Eam K, Eang M, Kong S, Loun C. Bidirectional Screening of Diabetes Mellitus and Tuberculosis in Cambodia. *J Trop Dis.* 2019;7:326.
- Blanco-Guillot F, Delgado-Sanchez G, Mongua-Rodriguez N, Cruz-Hervert P, Ferreyra-Reyes L, Ferreira-Guerrero E, et al. Molecular clustering of patients with diabetes and pulmonary tuberculosis: a systematic review and meta-analysis. *PLoS one.* 2017;12(9):e0184675.
- Asamoah-Boaheng M, Sarfo-Kantanka O, Tuffour AB, Eghan B, Mbanya JC. Prevalence and risk factors for diabetes mellitus among adults in Ghana: a systematic review and meta-analysis. *International health.* 2019;11(2):83–92.
- Asante-Poku A, Asare P, Baddoo NA, Forson A, Klevor P, Otchere ID, et al. TB-diabetes co-morbidity in Ghana: The importance of *Mycobacterium africanum* infection. *PLoS one.* 2019;14(2):e0211822.
- Sullivan T, Amor YB. The co-management of tuberculosis and diabetes: challenges and opportunities in the developing world. *PLoS Med.* 2012;9(7):e1001269.
- Osei E, Der J, Owusu R, Kofie P, Axame WK. The burden of HIV on Tuberculosis patients in the Volta region of Ghana from 2012 to 2015: implication for Tuberculosis control. *BMC Infect Dis.* 2017;17(1):504.
- Lönnroth K. The looming co-epidemic of TB-diabetes: a call to action. *Int Union Against Tuberc Lung Dis.* 2014. p. 9. Retrieved from: https://theunion.org/sites/default/files/2020-08/TBDM_epidemic_Report.pdf.
- Wright TM. Bringing Michael Lipsky's theories into the 21st century. Knoxville: University of Tennessee; 2003.
- Erasmus E. The use of street-level bureaucracy theory in health policy analysis in low-and middle-income countries: a meta-ethnographic synthesis. *Health Policy Plan.* 2014;29(suppl_3):iii70–8.
- Aniteye P, Mayhew SH. Shaping legal abortion provision in Ghana: using policy theory to understand provider-related obstacles to policy implementation. *Health Res Policy Syst.* 2013;11(1):1–14.
- Rowe M. Going back to the street: revisiting Lipsky's street-level bureaucracy. *Teach Public Admin.* 2012;30(1):10–8.
- Ghana Statistical Service. Population by Regions, Northern 2019 [Available from: <https://www.statsghana.gov.gh>].

20. Ghana Statistical Service. Service GH, International ICF, Ghana Demographic and Health Survey 2014, Rockville: GSS G, and ICF International 2015. Ghana Demographic and Health Survey 2014. 2015.
21. Corbin J, Strauss A. Basics of qualitative research: techniques and procedures for developing grounded theory. Thousand Oaks: Sage Publications; 2014.
22. State of the Nation's Health Report. 2018. Available from: <http://ugspace.ug.edu.gh/handle/123456789/30195>.
23. Asamani JA, Chebere MM, Barton PM, D'Almeida SA, Odame EA, Oppong R. Forecast of healthcare facilities and health workforce requirements for the public sector in Ghana, 2016–2026. *Int J Health Policy Manage*. 2018;7(11):1040.
24. Ogbera OA, Adeyeye O, Odeniyi IA, Adeleye O. Knowledge of diabetes mellitus in tuberculosis amongst healthcare workers in Nigeria. *Indian J Endocrinol Metab*. 2013;17(4):704.
25. Anand T, Kishore J, Isaakidis P, Gupta HA, Kaur G, Kumari S, Jha D, Grover S. Integrating screening for non-communicable diseases and their risk factors in routine tuberculosis care in Delhi, India: a mixed-methods study. *PLoS One*. 2018;13(8):e0202256.
26. Majumdar A, Wilkinson E, Rinu P, Maung T, Bachani D, Punia J, et al. Tuberculosis-diabetes screening: how well are we doing? A mixed-methods study from North India. *Public Health Act*. 2019;9(1):3–10.
27. Zulkarnain Z, Permana I, Arini M, editors. Health Workers in The Case Management of Tuberculosis and Diabetes Mellitus at Type B Hospital, Yogyakarta. 4th International Conference on Public Health 2018: Sebelas Maret University.
28. Bakari A. Knowledge of diabetic patients and care providers on diabetes and tuberculosis conditions in Tamale metropolis in Northern Region of Ghana University for Development Studies; 2015 [Available from: uds.edu.gh].
29. Okyere E, Mwanri L, Ward P. Is task-shifting a solution to the health workers' shortage in Northern Ghana? *PLoS One*. 2017;12(3):e0174631.
30. Agarwal AK, Gupta G, Marskole P, Agarwal A. A study of the patients suffering from tuberculosis and tuberculosis-diabetes comorbidity in revised National Tuberculosis Control Program Centers of Northern Madhya Pradesh, India. *Indian J Endocrinol Metab*. 2017;21(4):570.
31. Castellanos-Joya M, Delgado-Sánchez G, Ferreyra-Reyes L, Cruz-Hervert P, Ferreira-Guerrero E, Ortiz-Solis G, et al. Results of the implementation of a pilot model for the bidirectional screening and joint management of patients with pulmonary tuberculosis and diabetes mellitus in Mexico. *PLoS One*. 2014;9(9):e106961.
32. Cooper MJ, Sornalingam S, O'Donnell C. Street-level bureaucracy: an underused theoretical model for general practice? *Br J Gen Pract*. 2015; 65(636):376–7.
33. Workneh MH, Bjune GA, Yimer SA. Assessment of health system challenges and opportunities for possible integration of diabetes mellitus and tuberculosis services in South-Eastern Amhara Region, Ethiopia: a qualitative study. *BMC Health Serv Res*. 2016;16(1):1–11.
34. Akwataghibe N, Samaranyake D, Lemiere C, Dieleman M. Assessing health workers' revenues and coping strategies in Nigeria—a mixed-methods study. *BMC Health Serv Res*. 2013;13(1):387.

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Chapter Seven: Integrative Concluding Chapter

This chapter presents an integrative synthesis of key findings of this thesis, in line with the objectives of the study, as addressed in various articles/manuscripts. The chapter further discusses the major strengths of the study, overall limitations, as well as policy implications and recommendations for future research and practice.

7.1 Main Study Findings

This research, which was conducted through the qualitative research methods, explored the barriers and facilitators to the implementation of the TB-DM collaborative framework in Ghana, from the perspectives of the policymakers, program managers, health facility managers, and front-line implementers (healthcare workers). Initially, a scoping review was conducted to map out the evidence on the implementation of the collaborative framework for TB and DM across the globe, with at least 35 countries showing evidence of research on the implementation of collaborative framework. The fact that the majority of these studies were from the LMICs, was encouraging, given that TB/DM co-morbidity is likely to be considerably high in these countries, compared to their counterparts in high income countries. However, in most instances, TB proved to be better resourced than DM and screening equipment was biased towards the TB. Subsequent to the scoping review, the primary study was conducted through qualitative research methods, using in-depth interviews, non-participant observation, and document review. Table 7.1 below provides the details of outputs that emerged from this study, including the objectives, each output sought to address, as well as the themes and subthemes covered in each article/ manuscript.

Table 7.1: Summary of the findings tabulated by each objective and articles/manuscripts:

Objectives	Title of Articles	Main Themes	Sub-Themes	Status
OBJ 1: To map evidence on the implementation of the TB-DM collaborative framework globally.	Mapping Evidence on the Implementation of the WHO's Collaborative Framework for the Management of Tuberculosis and Diabetes: A Scoping Review Protocol			Published
	The Implementation of the World Health Organization's Collaborative Framework for the Management of Tuberculosis and Diabetes: A Scoping Review.	Feasibility of detecting DM in TB patients and detecting TB in DM patients.		Published
		Bidirectional screening.		
		Collaboration of TB & DM programs.		
OBJ 2: To explore the process followed by the Ministry of Health (MOH) in the adaptation of the framework in Ghana	Exploring the Mechanisms of Collaboration Between the Tuberculosis and Diabetes Programs for the Control of TB-DM Comorbidity in Ghana.	Increased support for communicable diseases compared to stagnant support for non- communicable diseases.		Published
		Donor support.		
		Poor collaboration between NTP and NCDCP.		
		Low TB-DM case detection.		
OBJ 3: To understand how healthcare workers conceptualize their roles in the implementation of the	Frontline Healthcare Workers' Experiences in Implementing the TB-DM Collaborative Framework in Northern Ghana.	Prioritization of TB/HIV co-infection while negating TB-DM comorbidity.	Low knowledge and awareness of TB-DM comorbidity	Published
			Limited awareness of the collaborative framework	

TB-DM collaborative framework.			High workload in TB & DM Clinics	
			Multiple roles	
			Inadequate training	
		Poor working conditions.	Space shortage.	
		Coping mechanisms		
OBJ 4: To examine the systems and structures in place for implementing the collaboration of TB-DM management in the selected health facilities.	Barriers and Facilitators to Bidirectional Screening of TB-DM in Ghana: Healthcare Workers' Perspectives	Increase in staff capacity		Published
		Institutionalization of bidirectional screening.		
		Delays in screening.		
		Fear and stigmatization of TB.		
		Poor collaboration between TB and DM units.		
		Skewed funding for screening		
OBJ 5: To explore the processes of detecting TB in DM-and DM in TB patients at the District, Regional and Tertiary.				

State of Implementation of the Collaborative Framework in Ghana

The findings of this study on the state of implementation of the WHO-Union collaborative framework can be grouped into three categories, namely: policy-related issues, healthcare system-related issues, and healthcare workers-related issues. However certain issues do permeate throughout all the objectives, and these include greater focus on communicable diseases as compared to non-communicable diseases, limited collaboration of TB and DM programs and skewed funding [1-4] .

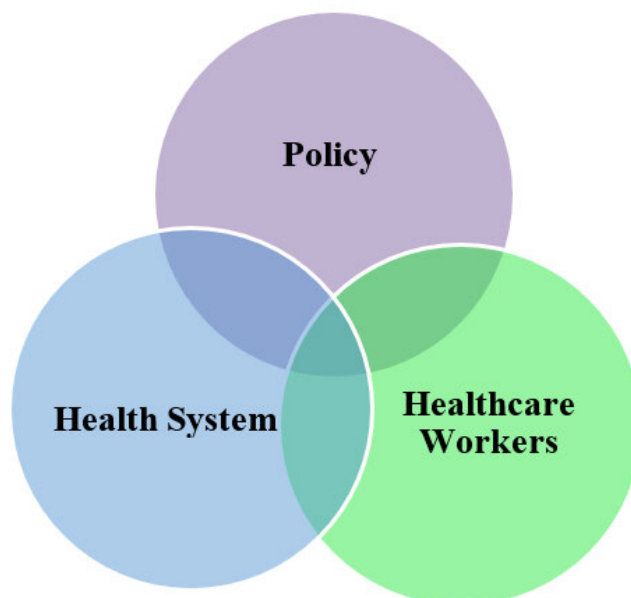


Fig. 7.1 Key domains in the implementation of the WHO-Union collaborative framework.

Source: Developed by the researcher using study data

The systematic scoping review conducted in this study, provided global evidence to support the feasibility of detecting DM in TB patients and vice versa, [3]. However, gaps were identified in the implementation of integration between TB and DM programs in the co-management of individuals with TB-DM and a need for improved techniques for detecting TB-DM comorbidity exists [3].

The participants in this study comprised of policymakers, program managers, hospital managers, and frontline healthcare workers [1, 2], hence the perspectives shared during data collection can be categorised into three domains, namely: policy, health systems and healthcare worker domains. Policy makers largely shared about the policy aspects of the implementation of the collaborative framework, whereas managers and frontline healthcare workers viewed the implementation from health systems, barriers and challenges facing frontline healthcare workers, respectively.

Based on the views shared by participants, the disproportionate quality of healthcare given to TB and DM patients emerged as an overarching theme at the policy, healthcare system and healthcare workers

levels [1-4]. The responses from participants in this study showed that optimal support to provide free screening for TB patients was available, alongside additional human resource for screening and donor funding for the NTP. However, diabetes care did not receive the same kind of support. This is consistent with other studies conducted elsewhere in the world, which revealed that TB programs have better packaged care services in most countries when compared to poor availability or inadequate DM management services [5, 6].

At the policy level, this study found evidence of enabling policies for the increased support of communicable diseases compared to non-communicable diseases and this was also supported by the findings of our systematic scoping review [1, 3].

Healthcare Workers Role

Even though healthcare workers in this study were able to conceptualize their role as vital in the implementation process, challenges relating to poor working conditions, high workload, inadequate TB-DM knowledge and low awareness of the framework, were experienced, and these were, in turn, linked to low detection of TB-DM comorbidity [1, 4]. Healthcare workers used their discretion to overcome these challenges in the delivery of care to TB and DM patients by performing multiple roles, initiating patient home follow-up visits and supporting patients with money for transportation to and from healthcare facilities [4].

Barriers and Facilitators

Majority of the participants in this study had low awareness of the collaborative framework and their knowledge about TB-DM comorbidity was inadequate [1, 4]. Similar observation has also been reported in studies conducted in Nigeria and India [7, 8]. Findings further revealed that there was limited engagement at the program level between NTP and NCDPC, a phenomenon that was consistent with a prior study conducted in Ghana [9]. Limited engagement was also pervasive at the health facility levels, where poor collaboration existed between TB and DM units with clear parallel care pathway for patients [1]. This study showed that it was feasible to conduct bidirectional screening and integrate the screening process into the existing routine services in health-care settings, as seen in Ethiopia and India [10, 11]. Despite the feasibility of screening in healthcare settings, one of the barriers pertinent to fully integrating TB and DM services, as discovered by our study, was the lack of integrated management for individuals with both diseases [1, 2]. This was largely due to the structural configuration of the TB-DM programmes, which promoted silo mentality, thereby limiting the healthcare systems' capacity to deliver care for TB and DM patients [12].

Enablers to the successful implementation of the collaborative framework were observed at the health facility level, which mainly included the introduction of task shifting officers by the NTP to address the

understaffing of health facilities [13]. While this is expected to improve TB control outcomes, this innovation was not reciprocated in the delivery of care for the DM patients, owing to funding challenges experienced by DM programmes [14]. These challenges undermine the goal of diagnosing TB patients for DM and ultimately put the ideals of the WHO-Union collaborative framework in jeopardy.

7.2 Implications of the study findings on future research

- The findings of this study have given rise to a need for further research into cost effectiveness of implementing the collaborative framework in Ghana. These studies should evaluate the cost of implementing the collaborative framework against the cost of not implementing it, given that chances of treating these conditions at advanced stages become real without a collaborative intervention. These studies should be extended to evaluating the effectiveness of implementing the framework in reducing the morbidity and mortality associated with TB/DM comorbidity, using two arms, that is intervention arm and control arm.
- Further implementation research on TB and DM patients' experiences of bidirectional screening, are required.
- There is also a need to extend similar studies to include private health facilities providing the TB and DM care services.
- Further research into community-based health planning services compounds (CHPS) systems to detect TB-DM comorbidity, is required, since this is the first point of healthcare delivery at the community level.

7.3 Implications of the study findings on future on policy

- The NCDPC and NTP will need to jointly develop guidelines on the development of health education programs and policies on integrated screening of TB-DM comorbidity and its management. These guidelines will need to be disseminated to the regional and district levels for implementation.
- The Ministry of Health should prioritize and consistently fund in-service training programs for both TB and DM healthcare workers.
- The Ministry of Health in partnership with the NCDPC should review the national health insurance scheme to include diabetes screening as part of the package of care, given that the collaborative partnership is still skewed towards the screening for TB, at the neglect of DM.

7.4 Implications for clinical practice

- Implementation of consistent in-service training by the Ghana Health Service will equip healthcare workers with updated knowledge and skills to deliver improved healthcare to TB-DM patients.
- Health education programs in health facilities and communities will inform the public about TB-DM comorbidity, including the available options for disease management.
- Utilization of social media to disseminate information on prevention and management of TB-DM comorbidity will likely optimise health outcomes.

7.5 Strength of study

To the best of our knowledge, this is the first study to explore the implementation of the WHO-Union collaborative framework for care and control of TB and DM in Ghana, using qualitative research methods [15] and one of the few in sub-Saharan Africa (SSA) region. Most of the research in TB and DM in Ghana focus on the disease prevalence and incidence, but this research used qualitative methods to bring insights into the broader healthcare systems factors affecting this phenomenon from the perspectives of three important stakeholders, namely: policy makers, programme managers and frontline healthcare workers.

This study highlighted the barriers and facilitators at the various levels of the implementation process through the lenses of the various stakeholders: policy, program, and frontline implementers perspectives. Complementing the primary research with the systematic scoping review, was one of the unique strengths of this study. The systematic scoping review used Arksey and O'Malley's framework with clearly outlined steps to maintain transparency in the research process. The findings of this study should be viewed as an important contribution to Ghana's efforts of adapting the collaborative framework to the country's local context and the African context in general, with an overall goal of reducing the burden of TB/DM comorbidity.

7.6 Limitations of the study

Although this study investigated the barriers and facilitators to the implementation of the Collaborative Framework for the Care and Control of Tuberculosis (TB) and Diabetes (DM) in Ghana, the exclusion of the perspectives of the patients who are beneficiaries of the policy implementation, was an important limitation, hence their insights are missing.

Another noteworthy limitation is that this research focused solely on public (government) hospitals, thus the phenomenon was not explored in private health facilities, despite the fact that some of them also

offer TB and DM care. Their experiences in implementing the framework could have deepened our understanding of the phenomenon.

Furthermore, the study was limited to the Northern Region of Ghana and therefore the phenomenon was not explored in the other 15 regions, owing to time and resource constraints. Despite these limitations, this study provides valuable insights for the Northern Region of Ghana and other comparable settings.

7.7 Recommendations

- The NTP and NCDCP to develop a national plan for joint activities to address the TB-DM Comorbidity guided by the Collaborative Framework for the Care and Control of Tuberculosis (TB) and Diabetes (DM).
- The Ghana Health Service should put in place measures to improve the human resource capacity at the health facility level to support co-management of TB-DM comorbidity in individuals in an unbiased manner.
- The Ministry of Health and Ghana Health Service should increase support for free diabetes screening and supplies for management of diabetes

7.8 Conclusion

Nearly ten years after the launch of the WHO -Union Collaborative Framework for Care and Control of TB and DM, information on the implementation remains sparse. The overarching aim of this study was to identify barriers and facilitators to the implementation of the Collaborative Framework for Care and Control of TB and Diabetes DM in Ghana.

The study's findings provide evidence supporting the feasibility of bidirectional screening, despite the limited integration in delivery of care for TB and DM patients. While the study revealed that opportunities and challenges exist, the identified challenges are not insurmountable. The screening, detecting and co-management of individuals with TB-DM comorbidity in Ghana face challenges from the policy level, and these challenges manifest through the imbalances in the diseases focus and prioritization of communicable diseases over non-communicable diseases. This posturing runs through the healthcare system to the facility level. The low detection of TB-DM by healthcare workers may be attributed to their limited knowledge on the TB-DM comorbidity and collaborative framework, coupled with the high workload, and this negatively affected care of patients grappling with both diseases.

This study, however, found that the boosting of human resource by the NTP was facilitating the implementation and holds promise for a more effective bidirectional screening, if fully extended to the DM services. The institutionalization of screening of all patients visiting the facility and specifically

DM patients for TB is helpful in the detection of the TB-DM comorbidity. Finally, the fear and stigmatization of TB had a potential to derail efforts to implement the recommendations of the framework.

References

1. Salifu RS, Hlongwana KW. Barriers and facilitators to bidirectional screening of TB-DM in Ghana: Healthcare workers' perspectives. *PloS one*. 2020;15(7):e0235914.
2. Salifu RS, Hlongwana KW. Exploring the mechanisms of collaboration between the Tuberculosis and Diabetes Programs for the control of TB-DM Comorbidity in Ghana. *BMC Research Notes*. 2021;14(1):1-6.
3. Salifu RS, Hlongwa M, Hlongwana K. The Implementation of the World Health Organization's Collaborative Framework for the Management of Tuberculosis and Diabetes: A Scoping Review. Unpublished. *BMJ Open*. 2021.
4. Salifu RS, Hlongwana K. Frontline Healthcare Workers' Experiences in Implementing the TB-DM Collaborative Framework in Northern Ghana. Unpublished. *BMC Health Services Research*. 2021.
5. Shayo FK, Shayo SC. Availability and readiness of diabetes health facilities to manage tuberculosis in Tanzania: a path towards integrating tuberculosis-diabetes services in a high burden setting? *BMC Public Health*. 2019;19(1):1104.
6. Lönnroth K. Colliding epidemics requires collaborating programmes. *The lancet Diabetes & endocrinology*. 2015;3(5):306-7.
7. Ogbera OA, Adeyeye O, Odeniyi IA, Adeleye O. Knowledge of diabetes mellitus in tuberculosis amongst healthcare workers in Nigeria. *Indian journal of endocrinology and metabolism*. 2013;17(4):704.
8. Anand T, Kishore J, Isaakidis P, Gupte HA, Kaur G, Kumari S, et al. Integrating screening for non-communicable diseases and their risk factors in routine tuberculosis care in Delhi, India: A mixed-methods study. *PloS one*. 2018;13(8):e0202256.
9. Kushitor MK, Boatemaa S. The double burden of disease and the challenge of health access: Evidence from Access, Bottlenecks, Cost and Equity facility survey in Ghana. *PLoS One*. 2018;13(3):e0194677.
10. Tenaye L, Mengiste B, Baraki N, Mulu E. Diabetes mellitus among adult tuberculosis patients attending tuberculosis clinics in Eastern Ethiopia. *BioMed research international*. 2019;2019.
11. Mave V, Meshram S, Lokhande R, Kadam D, Dharmshale S, Bharadwaj R, et al. Prevalence of dysglycemia and clinical presentation of pulmonary tuberculosis in Western India. *The International Journal of Tuberculosis and Lung Disease*. 2017;21(12):1280-7.
12. Skordis-Worrall J, Round J, Arnold M, Abdraimova A, Akkazieva B, Beran D. Addressing the double-burden of diabetes and tuberculosis: lessons from Kyrgyzstan. *Globalization and health*. 2017;13(1):1-9.
13. Riza AL, Pearson F, Ugarte-Gil C, Alisjahbana B, van de Vijver S, Panduru NM, et al. Clinical management of concurrent diabetes and tuberculosis and the implications for patient services. *The lancet Diabetes & endocrinology*. 2014;2(9):740-53.
14. Sullivan T, Amor YB. The co-management of tuberculosis and diabetes: challenges and opportunities in the developing world. *PLoS Med*. 2012;9(7):e1001269.
15. Organization WH. Collaborative framework for care and control of tuberculosis and diabetes. World Health Organization; 2011. Report No.: 9241502258.

6.0 Appendices

Appendix 1: Information Sheet and Consent to Participate in Research

Information Sheet and Consent to Participate in Research

Date:

Good morning/ Good Afternoon Sir/Madam,

My name is Rita Quist-Therson, a student from School of Nursing and Public Health, Department of Public Health, College of Health Sciences, University of KwaZulu-Natal in South Africa. My contact details are Tel+233(0)502574909, E-mail-suhyini@gmail.com.

You are being invited to consider participating in a study titled: *Barriers and Facilitators to the Implementation of the Collaborative Framework for Care and Control of Tuberculosis (TB) and Diabetes (DM) in Ghana*. The purpose of this research is to explore the achievements and challenges faced by the stakeholders involved in the implementation of the TB/DM collaborative framework. It is expected that the findings from this research will help to improve the healthcare system generally and delivery of care to TB and DM patients specifically.

The study is expected to enroll 27 persons in total, working in TB and DM care in the Northern Region of Ghana. This study will involve the following procedures, In-depth interviews (IDI) with policy makers, program managers, health facility managers and health workers using an interview guide. The interviews will be conducted in English, audio recorded and transcribed. The interviews will take place in a private room/space agreed by the participants, and anticipated to last for 45-60minutes. In addition, observations will be made on the process followed in screening TB patients for DM and DM patients for TB.

No foreseeable physical risks are anticipated from this study. However, some inconveniences and discomforts during the discussion, may arise from participating in the study. All potential participants have a right to participate or not to participate in the study. Participation or non-participation will bear no negative consequences. There will be no compensation for your participation in this study either in kind or in cash. We hope that the study will provide information and/or raise awareness pertinent to improved care of TB and DM patients in Ghana. This study has been ethically reviewed and approved by the UKZN Biomedical research Ethics Committee (approval number_____). In the event of any problems or concerns/questions you may contact the researcher at Tel+233(0)502574909, E-mail-suhyini@gmail.com. or the UKZN Biomedical Research Ethics Committee, contact details as follows:

BIOMEDICAL RESEARCH ETHICS ADMINISTRATION

Research Office, Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban
4000
KwaZulu-Natal, SOUTH AFRICA
Tel: 27 31 2604769 - Fax: 27 31 2604609

Email: BREC@ukzn.ac.za

Your participation in this study is voluntary and you are free to opt out of the interview now or at any point in time without any consequences. You can skip questions you don't feel comfortable answering. Also be rest assured that your identity or name as a respondent will not appear anywhere in the study, it will be kept confidential. I will therefore protect information about you to the best of my ability. I will, however, with your permission, take down notes and a digital voice recording, to be able to cross check later with the notes to be sure I captured the right information. Thank you.

I, Mr. / Mrs. / Miss / Master..... have been informed about the study entitled: *"Barriers and Facilitators to the Implementation of the Collaborative Framework for Care and Control of Tuberculosis (TB) and Diabetes (DM) in Ghana"* by Rita Quist-Therson. I understand it is a research study for academic purpose and the information generated is just for the purpose of the research and nothing else.

I understand the purpose and procedures of the study.

I have been given an opportunity to ask questions about the study and have had answers to my satisfaction.

I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any treatment or care that I would usually be entitled to.

I have been informed about any available compensation or medical treatment if injury occurs to me as a result of study-related procedures. I hereby give my consent to participate in the research study.

If I have any further questions/concerns or queries related to the study I understand that I may contact the researcher at Tel+233(0)502574909, E-mail-suhyini@gmail.com. If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

BIOMEDICAL RESEARCH ETHICS ADMINISTRATION

Research Office, Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban
4000
KwaZulu-Natal, SOUTH AFRICA
Tel: 27 31 2604769 - Fax: 27 31 2604609
Email: BREC@ukzn.ac.za

Signature of Participant

Date

Appendix 2: Interview Guide – Health Managers

C. INTERVIEW GUIDE – HEALTH MANAGERS ***West District, Central Regional and Tamale Teaching Hospitals***

Good My name is Rita Quist-Therson, a student from School of Nursing and Public Health , University of KwaZulu-Natal. I am currently carrying out a research on the *Barriers and Facilitators to the Implementation of the Collaborative Framework for Care and Control of Tuberculosis (TB) and Diabetes (DM) in Ghana*. You have been invited as a participant in this research and I will like to have a discussion with you concerning this topic. I will need between 45-60minutes of your time. You are free to opt of the interview now or at any point in time you don't feel comfortable or skip questions you don't feel comfortable answering. You can also be rest assured that your identity or name as a respondent will not appear anywhere in the study, it will be kept confidential. I will however take down notes and a digital voice recorder to be able to cross check later with the notes to be sure we captured the right information. However, you are free to reject to any of them or both. Thank you.

Introduction

- ❖ Kindly tell me about your current role in this health facility? For example, describe your typical day at work, what do you do?

Probe: *How long have you worked with the Ghana Health Service and in what capacities?*

- ❖ Please share briefly about the services offered by this health facility/ department (the cases you normally see etc) .

Probe: *Please describe your catchment area as a District/Regional/Teaching hospital,*

Probe: *Where do you get referrals from?*

- ❖ Kindly describe your supervision style

Probe: *can you share how this style yields results?*

Probe: *How do you introduce new guidelines/interventions to you?*

Policies and Guidelines

- ❖ Kindly share the kinds of services you usually provide for TB and DM care in this facility?

Probe: *Can you elaborate on the guidelines followed in the care of TB and DM patients?*

Probe: *Describe some of the challenges faced in providing these services.*

- ❖ Could you share your understanding of what the framework aims to achieve? Kindly elaborate

Probe: *Can you describe how this is being implemented in this health facility?*

Probe: *How has this implementation impacted on the management /administration of this department? Please elaborate*

- ❖ How has this framework been received by your staff? Please elaborate

- ❖ Can you describe any contribution of the collaborative framework in the care of DM and TB? Please elaborate.

Systems and Structures for Co-Management

- How has been your experience of TB and DM links in this facility? Please elaborate.
- Kindly describe the process followed in this facility for the screening of TB patients for DM and DM patients for TB?
- Please describe the process followed in managing a TB patient if DM is detected and vice versa?
- Can you share any contribution screening has on prevention and care of TB and DM? Please elaborate?

Probe: Can you share some of the challenges you face in screening for these two diseases (TB & DM)?

- Are you aware of any collaborative activities between TB and DM care organized by the Ghana Health Service? Would you share any experience of collaborative activities in this facility?
- Please share your advice on what you think will hinder the implementation of the Collaborative Framework? Kindly elaborate
- Kindly tell me briefly about yourself
- Patient code
- Age
- Educational background/training

GENERAL IMPRESSIONS

I have attempted to pose some questions in relation to your experience in the implementation of the collaborative framework. I may not have been able to capture all the issues in relation to the subject matter. Is there anything you consider important in this respect but which I did not touch on? Can you shed some light on this?

Thank you for your time. Do you have any questions for me?

Appendix 3: Interview Guide – Health Workers

D. INTERVIEW GUIDE -HEALTH WORKER

Good My name is Rita Quist-Therson, a student from School of Nursing and Public Health, University of KwaZulu-Natal. I am currently carrying out a research on the *Barriers and Facilitators to the Implementation of the Collaborative Framework for Care and Control of Tuberculosis (TB) and Diabetes (DM) in Ghana*. You have been invited as a participant in this research and I will like to have a discussion with you concerning this topic. I will need between 45-60minutes of your time. You are free to opt of the interview now or at any point in time you don't feel comfortable or skip questions you don't feel comfortable answering. You can also be rest assured that your identity or name as a respondent will not appear anywhere in the study, it will be kept confidential. I will however take down notes and a digital voice recorder to be able to cross check later with the notes to be sure we captured the right information. However, you are free to reject to any of them or both. Thank you.

Introduction

- ❖ Kindly share with me your current role in this health facility? For example, describe your typical day at work, what do you do?
- ❖ How are the TB/DM clinic sessions organized in this health facility? Please elaborate

Health Care Delivery to TB or DM Patients

- ❖ What are the key challenges entailed in your work/ you face during the course of doing your work? Please elaborate
Probe: How do you deal with this?

Knowledge/ Awareness of TB/DM Comorbidity

- ❖ How would you describe the condition of DM among TB patients/ TB among DM patients? Please elaborate.
- ❖ Please describe the process you follow in this clinic for detecting TB in DM patients? /DM in TB patients?
- ❖ Can you share your experiences in managing TB/DM comorbidity in patients?
Probe: Please elaborate on some of the issues you face?
- ❖ From your experience, please share how has TB/DM comorbidity impacted on the care and control of TB and DM?

Probe: In the area of care pathways at the TB and DM clinics

Probe: Staff capacity/training,

Probe: Work load

- ❖ Kindly elaborate on any recommendations you have that can help improve TB/DM co-management?

Bidirectional Screening

- ❖ Kindly list guidelines /policies guiding detection of DM among TB patients/ TB among DM patients and elaborate on what each entails? (Request for the copies of these)
- ❖ Kindly share about how TB screening among DM patients impacts TB case detection and vice versa? Please elaborate
- ❖ How has the framework impacted your role? Please elaborate

Probe: Please describe the issues you face in screening?

- ❖ Kindly share about any collaborative activities between staff in TB and DM clinics?
- ❖ Please describe the process followed in this facility in managing a TB patient if DM is detected and vice versa?
- ❖ Can you share some practices that demonstrate acceptance or rejection of the collaborative framework? Please elaborate

Probe: In your opinion, are the practices listed above peculiar to only the Northern region?
Please elaborate

- ❖ Please share any recommendations that you think will help improve the TB/DM care and control. Kindly elaborate
- ❖ Please share your advice on what you think will hinder the implementation of the Collaborative Framework? Kindly elaborate
- ❖ Kindly tell me briefly about yourself
 - Participant code
 - Age
 - Educational background/training

GENERAL IMPRESSIONS

I have attempted to pose some questions in relation to your experience in the implementation of the collaborative framework. I may have not been able to capture all the issues in relation to the subject matter. Is there anything you consider important in this respect but which I did not touch on? Can you shed some light on this?

Thank you for your time. Do you have any questions for me?

Appendix 4: Interview Guide – Program Managers

B INTERVIEW GUIDE -PROGRAM MANAGER

National Tuberculosis Program (NTP)/ Non-Communicable Disease Program (NCDP)

Good My name is Rita Quist-Therson, a student from School of Nursing and Public Health, University of KwaZulu-Natal. I am currently carrying out a research on the *Barriers and Facilitators to the Implementation of the Collaborative Framework for Care and Control of Tuberculosis (TB) and Diabetes (DM) in Ghana*. You have been invited as a participant in this research and I will like to have a discussion with you concerning this topic. I will need between 45-60minutes of your time. You are free to opt of the interview now or at any point in time you don't feel comfortable or skip questions you don't feel comfortable answering. You can also be rest assured that your identity or name as a respondent will not appear anywhere in the study, it will be kept confidential. I will however take down notes and a digital voice recorder to be able to cross check later with the notes to be sure we captured the right information. However, you are free to reject to any of them or both. Thank you

Introduction

- ❖ Kindly tell me about your current role in this organization? For example, describe your typical day at work, what do you do?

Probe: How long have you worked with the National Tuberculosis Program (NTP)/ Non-Communicable Disease Program (NCDP), and in what capacities?

- ❖ Kindly describe the activities of your organization, paying attention to the organizational focus in the past five years? Please elaborate

Probe: Could you please explain the reason for this?

- ❖ Can you share the partners to the NTP/NCDP and describe the key roles they play in the partnership?

The Burden of TB or DM and Comorbidity in Ghana

- ❖ From your program's perspective, describe the state of TB or DM in Ghana and the Northern region?

Probe: Can you share the factors accounting for this?

Probe: How would you describe TB/DM comorbidity in Northern region and Ghana?
Please elaborate

WHO Collaborative Framework Implementation in Ghana

- ❖ Could you share your understanding of what the framework aims to achieve? Kindly elaborate

Probe: Please explain the contribution of your program (NTP/NCDP) to the implementation of the WHO Collaborative Framework

Probe: Please share your experiences with regards to the implementation of this framework in Ghana specifically the Northern Region?

- ❖ Kindly describe other initiatives that are relevant to the collaborative framework?
- ❖ Can you share some issues that are promoting or hindering the implementation process?

B INTERVIEW GUIDE -PROGRAM MANAGER

- ❖ If there were any regions in Ghana that are not implementing the framework, would you recommend the framework to them? Please elaborate your answer.

Co-Management of TB and DM

- ❖ How has the health care system changed with the introduction of this framework? Please elaborate

***Probe:** Please share how this framework has impacted on the human resource capacity*

- ❖ Kindly describe the structures available for collaborative activities between TB and DM? please elaborate

***Probe:** Please explain how feasible it is to screen for DM among TB patients and DM among TB patients at the clinics*

- ❖ Can you share any contribution screening has on the prevention and care of TB and DM? Please elaborate?
- ❖ From your experience, are there some practices that demonstrate acceptance or rejection of the collaborative framework? Please elaborate

***Probe:** In your opinion, are the practices listed above peculiar to only the Northern region? Please elaborate*

- ❖ Please share some recommendations which you think can improve the implementation of the Collaborative Framework? Kindly elaborate
- ❖ Please share your advice on what you think will hinder the implementation of the Collaborative Framework? Kindly elaborate
- ❖ Kindly tell me briefly about yourself:
 - Participant code
 - Age
 - Educational background/training

GENERAL IMPRESSIONS

I have attempted to pose some questions in relation to your experience in the implementation of the collaborative framework. I may not have been able to capture all the issues in relation to the subject matter. Is there anything you consider important in this respect, but which I did not touch on? Can you shed some light on this? Thank you for your time. Do you have any questions for me?

Appendix 5: Interview Guide – Policy Makers

A. INTERVIEW GUIDE -POLICY MAKERS **Ministry of Health (MOH/GHS)**

Good My name is Rita Quist-Therson, a student from School of Nursing and Public Health, University of KwaZulu-Natal. I am currently carrying out a research on the *Barriers and Facilitators to the Implementation of the Collaborative Framework for Care and Control of Tuberculosis (TB) and Diabetes (DM) in Ghana*. You have been invited as a participant in this research and I will like to have a discussion with you concerning this topic. I will need between 45-60minutes of your time. You are free to opt of the interview now or at any point in time you don't feel comfortable or skip questions you don't feel comfortable answering. You can also be rest assured that your identity or name as a respondent will not appear anywhere in the study, it will be kept confidential. I will however take down notes and a digital voice recorder to be able to cross check later with the notes to be sure we captured the right information. However, you are free to reject to any of them or both. Thank you.

Introduction

- ❖ Kindly tell me about your current role in this institution? For example, describe your typical day at work, what do you do?

Probe: *How long have you worked at the Ministry of Health (MOH)/ Ghana Health Service (GHS) and in what capacities?*

- ❖ Can you share briefly about the role/ function of your institution with regards to health care system in Ghana?

Probe: *Please describe the areas this institution is responsible for? Kindly elaborate*

Tuberculosis and Diabetes Burden in Ghana

- ❖ Kindly share from your experience on the TB and DM overview in Ghana? And Northern Region specifically?

Probe: *How would you describe the TB/DM comorbidity in Ghana? kindly elaborate*

- ❖ Please elaborate on the other organizations you collaborate with (stakeholders), when it comes to TB and DM policy and its implementation. Please elaborate .

Understanding the existing policy landscape on TB & DM in Ghana

- ❖ Can you share an overview of policy formulation process at the MOH/GHS? please elaborate

Probe: *Also policy implementation process explain the policy process*

- ❖ Kindly list the priority areas of policy focus by MOH/GHS over the past five years? Please elaborate .

Probe: *Can you share what is planned for the next 5 years*

- ❖ Can you list all the existing TB & DM policies in Ghana and kindly elaborate on each of these policies? (request for copies)

- ❖ Please list the various stakeholders involved in TB and DM policy development.

A. INTERVIEW GUIDE -POLICY MAKERS

***Probe:** Kindly describe the roles of various stakeholders involved in TB and DM policy development. Please elaborate*

- ❖ How has the international context if any, influenced TB and DM issues/policies in Ghana?
Please elaborate

WHO Collaborative Framework Implementation in Ghana

- ❖ Can you share your understanding of what the collaborative framework aims to achieve? Please elaborate

***Probe:** How are the key actors involved in and affected by the policy? Please elaborate*

- ❖ Please describe the public/stakeholder input in the policy process? Can you elaborate

***Probe:** How is this policy process facilitated?*

- ❖ Kindly elaborate on MOH/GHS role in the implementation of the collaborative framework?

***Probe:** Please share your perspective on the implementation process so far.*

Dissemination/Decentralization of Framework

- ❖ How would you describe the impact of the implementation of the collaborative framework on existing policies? Please elaborate

***Probe:** Human resource capacity?*

Collaboration of TB and DM Activities

- ❖ Please share any measures MOH/GHS has in place for coordinating TB and DM activities (Ghana/Northern region)? Please elaborate

***Probe:** Kindly share any factors that facilitate / impede this collaborative activities? Please elaborate*

- ❖ Kindly tell me briefly about yourself:

- Participant code
- Age
- Educational background/training

GENERAL IMPRESSIONS

I have attempted to pose some questions in relation to your experience in the implementation of the collaborative framework. I may have not been able to capture all the issues in relation to the subject matter. Is there anything you consider important in this respect but which I did not touch on? Can you shed some light on this? Thank you for your time. Do you have any questions for me?

Appendix 6: Observation Guide

Barriers and Facilitators to the Implementation of the Collaborative Framework for the Care and Control of Tuberculosis (TB) and Diabetes (DM) in Ghana

Observation Guides Bidirectional Screening: Sensitizing concepts/ phrases
(West district hospital, Central regional hospital, Tamale teaching hospital)

As part of the research to explore “*Barriers and Facilitators to the Implementation of the Collaborative Framework for the Care and Control of Tuberculosis (TB) and Diabetes (DM) in Ghana*”, this guide will be used for observation during clinic sessions. The researcher will use this approach to describe the process in place for bidirectional screening at the health facilities. This is a process of collecting data by watching and recording how DM patients are tested for TB and vice versa, when attending the outpatient department, without asking the participants questions directly. It will help the researcher identify and better understand the context, systems and structures in place at the various health facilities. Notes will be taken, giving description of the actions and behaviors of healthcare workers in the process of screening.

Indicators	Description
Atmosphere	To be able to describe the atmosphere in the outpatient department the researcher will observe <ul style="list-style-type: none">Any educational materials on the walls of the room?Educational materials on the walls properly labelled?Patients seem anxious or relaxed in meeting the health workers?
Information sharing	<ul style="list-style-type: none">Any form of oral information on the screening process given to the patients by health workers?Any print materials distributed to patients by health workers?Any posters or models used to give information on the TB/DM condition or process of testing?
Types of test, diagnosis, results	<ul style="list-style-type: none">Kind of test recommended by the health workers to the patients.Do the patients bring the results back to the health worker for explanation?
Average time spent in screening procedure	This will be done to estimate approximately how much time patients spend in screening <ul style="list-style-type: none">Do patients complain, grumble or applaud the efficiency of the process?Do patients stay for the whole duration of the screening process or leave at a point?
Language used in discussion.	<ul style="list-style-type: none">Languages used in presenting information to the patients.Are technical terms explained or not?Do the patients seem to comprehending the information shared (e.g. nodding, asking questions, looking lost, etc)
Management systems- Referrals, Treatment	<ul style="list-style-type: none">To observe the stages patients go through in screening and locationsAre the referral points in different departments or same department?

Appendix 7: Biomedical Research Ethics Committee-Ethics Approval Letter



UNIVERSITY OF
KWAZULU-NATAL
INYUVESI
YAKWAZULU-NATALI

12 July 2019

Mrs R Quist-Therson
School of Nursing and public Health
College of Health Sciences
suhyini@gmail.com

Dear Mrs Quist-Therson

Protocol: Barriers and facilitators to the implementation of the collaborative framework for the care and control of Tuberculosis (TB) and Diabetes (DM) in Ghana
Degree: PhD
BREC Ref No: BE262/19

EXPEDITED APPLICATION: APPROVAL LETTER

A sub-committee of the Biomedical Research Ethics Committee has considered and noted your application received on 28 March 2019.

The study was provisionally approved pending appropriate responses to queries raised. Your response received on 13 June 2019 to BREC letter dated 11 June 2019 has been noted by a sub-committee of the Biomedical Research Ethics Committee. The conditions have been met and the study is given full ethics approval and may begin as from 12 July 2019. Please ensure that site permissions are obtained and forwarded to BREC for approval before commencing research at a site.

This approval is valid for one year from 12 July 2019. To ensure uninterrupted approval of this study beyond the approval expiry date, an application for recertification must be submitted to BREC on the appropriate BREC form 2-3 months before the expiry date.

Any amendments to this study, unless urgently required to ensure safety of participants, must be approved by BREC prior to implementation.

Your acceptance of this approval denotes your compliance with South African National Research Ethics Guidelines (2015), South African National Good Clinical Practice Guidelines (2006) (if applicable) and with UKZN BREC ethics requirements as contained in the UKZN BREC Terms of Reference and Standard Operating Procedures, all available at <http://research.ukzn.ac.za/Research-Ethics/Biomedical-Research-Ethics.aspx>.

BREC is registered with the South African National Health Research Ethics Council (REC-290408-009). BREC has US Office for Human Research Protections (OHRP) Federal-wide Assurance (FWA 678).

The sub-committee's decision will be noted by a full Committee at its next meeting taking place on 13 August 2019.

Yours sincerely

Prof V Rambiritch
Chair: Biomedical Research Ethics Committee

cc: Postgrad administrator: ramlalm@ukzn.ac.za Supervisor: hlongwanak@ukzn.ac.za

Biomedical Research Ethics Committee

Professor V Rambiritch (Chair)

Westville Campus, Govan Mbeki Building

Postal Address: Private Bag X54001, Durban 4000

Telephone: +27 (0) 31 260 2466 Facsimile: +27 (0) 31 260 4609 Email: brec@ukzn.ac.za

Website: <http://research.ukzn.ac.za/Research-Ethics/Biomedical-Research-Ethics.aspx>



Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville

Appendix 8: The Ghana Health Ethics Review Committee -Ethics Approval Letter

19/135

GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

*In case of reply the
number and date of this
Letter should be quoted.*



MyRef. GHS/RDD/ERC/Admin/App 19/135
Your Ref. No.

Research & Development Division
Ghana Health Service
P. O. Box MB 190
Accra
GPS Address: GA-050-3303
Tel: +233-302-681109
Fax + 233-302-685424
Email: ghserc@gmail.com
29th April, 2019

Rita Salifu Quist-Therson
University of KwaZulu-Natal
College of Health Sciences
School of Nursing and Public Health

The Ghana Health Service Ethics Review Committee has reviewed and given approval for the implementation of your Study Protocol.

GHS-ERC Number	GHS-ERC 012/04/19
Project Title	Barriers and Facilitators to the Implementation of the Collaborative Framework for the Care and Control of Tuberculosis (TB) and Diabetes (DM) in Ghana
Approval Date	29 th April, 2019
Expiry Date	28 th April, 2020
GHS-ERC Decision	Approved

This approval requires the following from the Principal Investigator

- Submission of yearly progress report of the study to the Ethics Review Committee (ERC)
- Renewal of ethical approval if the study lasts for more than 12 months,
- Reporting of all serious adverse events related to this study to the ERC within three days verbally and seven days in writing.
- Submission of a final report after completion of the study
- Informing ERC if study cannot be implemented or is discontinued and reasons why
- Informing the ERC and your sponsor (where applicable) before any publication of the research findings.
- Please note that any modification of the study without ERC approval of the amendment is invalid.

The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Kindly quote the protocol identification number in all future correspondence in relation to this approved protocol

SIGNED.....
DR. CYNTHIA BANNERMAN
(GHS-ERC CHAIRPERSON)

Cc: The Director, Research & Development Division, Ghana Health Service, Accra

Appendix 9: Approval Letter -Central Hospital

GHANA HEALTH SERVICE

OUR CORE VALUE

1. People Centered
2. Professionalism
3. Team Work
4. Innovation
5. Discipline
6. Integrity



NORTHERN REGIONAL HOSPITAL
P. O. BOX TL 2649
TAMALE. N/R.
Tel: 233 – 71 26542
Email: tamalecentral@yahoo.com

22th July, 2019

My Ref No. GHS/NRH/

Your Ref. No.

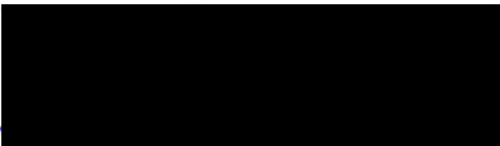
TO WHOM IT MAY CONCERN

APPROVAL TO COLLECT DATA FOR RESEARCH PURPOSES

This is to introduce Ms. Rita Salifu Quist-Therson, a PHD candidate in public health medicine of the University of KwaZulu-Natal, School of Nursing and Public Health, College of Health Sciences, Durban – South Africa.

Ms. Quist-Therson has been granted permission to conduct a study on “Barriers and Facilitators to the implementation of the Collaborative Framework for the care and control of Tuberculosis (TB) and Diabetes (DM) in Ghana.

Kindly give the necessary assistance to enable her collect data from the relevant units in the hospital.


Dr. Mahamadu Mbiniwaya
Medical Superintendent

Appendix 10: Approval Letter -West Hospital

OUR CORE VALUE

People Centered
Professionalism
Teamwork
Innovation
Discipline
Integrity

GHANA HEALTH SERVICE



Tamale West Hospital
P.O. Box TL 1714
Tamale, Ghana

Tel: 0372-024419
Tel: 0372-027197

My Ref No: GHS/TWH/NR/G.19
Your Ref No:

17th July, 2019

Email : westhospital@yahoo.com


To Whom It May Concern

APPROVAL TO COLLECT DATA FOR RESEARCH PURPOSES

Madam Rita Salifu Quist-Therson has been granted permission to access units within the hospital in order to collect data for research purposes.

Madam Rita is a PhD student of the University of KwaZulu Natal researching on "Barriers and Facilitators to the Implementation of the Collaborative Framework for the Care and Control of Tuberculosis(TB) and Diabetes (DM) in Ghana" and therefore seeking data from this hospital to facilitate that research.

Thank you.


Dr. Patrick O. Bampoh
Medical Superintendent

Medical Superintendent
TAMALE WEST HOSP.

Appendix 11: Approval Letter -Tamale Teaching Hospital



Department of Research & Development Tamale Teaching Hospital

TTH/R&D/SR/086
24/06/2019

TO WHOM IT MAY CONCERN

CERTIFICATE OF AUTHORIZATION TO CONDUCT RESEARCH IN TAMALE TEACHING HOSPITAL

I hereby introduce to you **Ms. Rita Salifu Quist-Therson**, a PhD candidate in Public Health Medicine of the University of KwaZulu-Natal, School of Nursing and Public Health, College of Health Sciences, Durban-South Africa. The candidate has been duly authorized to conduct a study on **"Barriers and Facilitators to the Implementation of the Collaborative Framework for the Care and Control of Tuberculosis (TB) and Diabetes (DM) in Ghana."**

Please accord the student the necessary assistance to enable her complete this study. If in doubt, kindly contact the Research Unit on the second floor of the administration block or on Telephone 0209281020. In addition, kindly report any misconduct of the Researcher to the Research Unit for necessary action.

Please note that this approval is given for a period of six months, beginning from 24th of June, 2019 to 23rd of December, 2019.

Thank You.


ALHASSAN MOHAMMED SHAMUDEEN.
(HEAD, RESEARCH & DEVELOPMENT)

Appendix 12 : BMJ Open Decision Letter

8/13/2021

Gmail - BMJ Open - Decision on Manuscript ID bmjopen-2019-033341.R2



Rita Salifu <suhyini@gmail.com>

BMJ Open - Decision on Manuscript ID bmjopen-2019-033341.R2

5 messages

BMJ Open <onbehalf@manuscriptcentral.com>
Reply-To: info.bmjopen@bmj.com
To: suhyini@gmail.com, 218088258@stu.ukzn.ac.za

Thu, Jan 9, 2020 at 2:30 PM

09-Jan-2020

Dear Mrs. Quist-Therson:

It is a pleasure to inform you that your manuscript "Mapping Evidence on the Implementation of the World Health Organization's Collaborative Framework for the Management of Tuberculosis and Diabetes: A scoping review protocol" has been accepted for publication in BMJ Open.

To enable all research published in BMJ Open to be fully open access, an Article Processing Charge is levied. This charge supports the peer review process, production costs (typesetting, copy editing, etc.), and the costs of maintaining the content online and marketing it to readers.

Therefore, your payment of £1350 (excluding VAT) for manuscript bmjopen-2019-033341.R2 is now due.

A separate e-mail will follow shortly with a link to payment options (please check your spam if this has not arrived). Please note that it can sometimes take a few days before you receive this email.

Once you have received the payment email, please ensure you place an order for the open access fee within 48 hours so that we can process your article. You can choose to pay by card or invoice, using our secure 3rd party online system.

BMJ has partnered with the Copyright Clearance Center to offer a payment method via their RightsLink system. If payment is due, you will receive a separate email from Copyright Clearance Centre with instructions on how to pay. Your article will not be processed further until payment is completed.

If you have reviewed for the journal within the 12 months prior to submitting this paper, please contact the editorial office (info.bmjopen@bmj.com) about your discount. Information regarding waivers and discounts is included in our instructions for authors; however, we anticipate that most authors will have the resources to pay.

Please note, a number of institutions have taken out open access memberships with BMJ, which either covers the cost of open access publishing for authors at participating institutes, or allows authors to receive a discount on the Article Processing Charge. Please visit our open access page to see a full list of participating institutions, find out if you are eligible and how to obtain your discount code - <http://journals.bmj.com/site/authors/openaccess.xhtml#open-access-institutional-memberships>.

All accepted papers are reviewed for their media potential by our PR office within two weeks of acceptance. If your paper is selected for press release by the journal, we will let you know within this timeframe.

Once your article is published online you will be able to keep track of usage. Each article published in BMJ Open has individual usage statistics which are updated daily and can be accessed from the Article Usage Statistics link in the Services section of the right hand column on each page of the article. In this column you can also sign up to be alerted about any e-letter responses to your article.

Thank you for your contribution, and we hope that you will continue to submit to the journal in future.

Sincerely,
Dr Edward Sucksmith
Assistant Editor
BMJ Open

Appendix 13 : PLOS ONE Acceptance Letter

8/13/2021

Gmail - PONE-D-20-05391R2: Final Decision Being Processed - [EMID:67741244c44aa80e]



Rita Salifu <suhyini@gmail.com>

PONE-D-20-05391R2: Final Decision Being Processed - [EMID:67741244c44aa80e]

1 message

PLOS ONE <em@editorialmanager.com>
Reply-To: PLOS ONE <plosone@plos.org>
To: Rita Suhuyini Salifu <suhyini@gmail.com>

Thu, Jun 25, 2020 at 4:57 PM

CC: "Khumbulani Welcome Hlongwana" hlongwanak@ukzn.ac.za

Barriers and Facilitators to Bidirectional Screening of TB-DM in Ghana: Healthcare Workers' Perspectives
PONE-D-20-05391R2

Dear Dr. Salifu,

We're pleased to inform you that your manuscript has been judged scientifically suitable for publication and will be formally accepted for publication once it meets all outstanding technical requirements.

Within one week, you'll receive an e-mail detailing the required amendments. When these have been addressed, you'll receive a formal acceptance letter and your manuscript will be scheduled for publication.

An invoice for payment will follow shortly after the formal acceptance. To ensure an efficient process, please log into Editorial Manager at <http://www.editorialmanager.com/pone/>, click the 'Update My Information' link at the top of the page, and double check that your user information is up-to-date. If you have any billing related questions, please contact our Author Billing department directly at authorbilling@plos.org.

If your institution or institutions have a press office, please notify them about your upcoming paper to help maximize its impact. If they'll be preparing press materials, please inform our press team as soon as possible -- no later than 48 hours after receiving the formal acceptance. Your manuscript will remain under strict press embargo until 2 pm Eastern Time on the date of publication. For more information, please contact onepress@plos.org.

Kind regards,

Amrita Daftary
Academic Editor
PLOS ONE

Appendix 14 BMC Research Note Decision Letter

6/11/2021

Gmail - Decision on your Submission to BMC Research Notes - RESN-D-21-00262R3 - [EMID:c8499d2ebe4e6e04]



Rita Salifu <suhyini@gmail.com>

Decision on your Submission to BMC Research Notes - RESN-D-21-00262R3 - [EMID:c8499d2ebe4e6e04]

5 messages

BMC Research Notes Editorial Office <em@editorialmanager.com>

Mon, May 24, 2021 at 9:44 AM

Reply-To: BMC Research Notes Editorial Office <rashmi.jenna@springernature.com>

To: Rita Salifu <suhyini@gmail.com>

RESN-D-21-00262R3

Exploring the mechanisms of collaboration between the Tuberculosis and Diabetes Programs for the control of TB-DM Comorbidity in Ghana

Rita Salifu; Khumbulani Hlogwana

BMC Research Notes

Dear Ms Salifu,

I am pleased to inform you that your manuscript "Exploring the mechanisms of collaboration between the Tuberculosis and Diabetes Programs for the control of TB-DM Comorbidity in Ghana" (RESN-D-21-00262R3) has been accepted for publication in BMC Research Notes.

If any final comments have been submitted from our reviewers or editors, these can be found at the foot of this email for your consideration.

Before publication, our production team will also check the format of your manuscript to ensure that it conforms to the standards of the journal. They will be in touch shortly to request any necessary changes, or to confirm that none are needed.

Articles in this journal may be held for a short period of time prior to publication. If you have any concerns please contact the journal.

Please do not hesitate to contact us if you have any questions regarding your manuscript and I hope that you will consider BMC Research Notes again in the future.

If you wish to co-submit a data note to be published in BMC Research Notes (<https://bmcresearchnotes.biomedcentral.com/about/introducing-data-notes>) you can do so by visiting our submission portal <http://www.editorialmanager.com/resn/>. Data notes support open data (<https://www.springernature.com/gp/open-research/open-data>) and help authors to comply with funder policies on data sharing. Please note that this additional service is entirely optional.

Best wishes,

Omid Eslami

BMC Research Notes

<https://bmcresearchnotes.biomedcentral.com/>

Appendix 15 BMJ Open Acceptance Letter.

11/9/21, 4:40 AM

Gmail - Your submission to BMJ Open has been accepted



Rita Salifu <suhyini@gmail.com>

Your submission to BMJ Open has been accepted

6 messages

BMJ Open <onbehalf@manuscriptcentral.com>
Reply-To: info.bmjopen@bmj.com
To: suhyini@gmail.com, 218088258@stu.ukzn.ac.za

Mon, Nov 1, 2021 at 7:06 PM

COVID-19: A message from BMJ: <https://authors.bmj.com/policies/covid-19>

01-Nov-2021
bmjopen-2020-047342.R3 - The implementation of the World Health Organization's Collaborative Framework for the management of Tuberculosis and Diabetes: A scoping review

Dear Miss Salifu:

We are pleased to accept your article for publication in BMJ Open.

Within 2-3 working days, you will receive an email with payment options and instructions from BMJ's e-commerce partner, Copyright Clearance Center. You will be able to choose either to pay by credit card or invoice. If you are not making the payment yourself, you may forward the email to the person or organisation that will be paying on your behalf. Your article will not be processed by production until you have paid the article processing charge or requested an invoice. For more details on open access publication please visit our Author Hub: <https://authors.bmj.com/open-access/>.

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Once payment is confirmed and your article is sent to Production, copyediting and typesetting will be completed. We will email you a proof to check via our online tool usually within 10-15 days of this time; please check your junk mail folder.

The proof is your opportunity to check for typesetting errors and the completeness and accuracy of the text; including author names and affiliations, tables and figures; including legends, numerical, mathematical, or other scientific expressions. We ask that you only make minor corrections at this stage. Please provide any comments within 48 hours. There will be no further opportunities to make corrections prior to publication.

See <https://authors.bmj.com/after-submitting/accepted/> for more information about what to expect once your article has been accepted.

We publish most articles online in their final form around three weeks after acceptance. See <https://authors.bmj.com/after-submitting/online-publication/> for more information about online publication. BMJ will deposit your article in all indexes affiliated with the journal.

Any final comments from the reviewer(s) are included at the foot of this email. The comments are for your information only, but in the case of minor requests (e.g. typos) these can be corrected when you receive your proof. These comments will be included in the peer review history published alongside your article

If your article is selected for press release by BMJ's Press Office you will be informed as soon as possible.

If you have any queries, please contact the Editorial Office at info.bmjopen@bmj.com.

Sincerely,

Natasha Leeson
Senior Assistant Editor
BMJ Open