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Where can Tanzania health system integrate clinical management of patients with dual tuberculosis and diabetes mellitus? A cross-sectional survey at varying levels of health facilities

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ABSTRACT

Objective: To assess the current Tanzania health facilities readiness in integrating clinical management of dual Tuberculosis (TB) and Diabetes Mellitus (DM) by using the Service Availability and Readiness Assessment (SARA) manual of the World Health Organization prior to implementing an integrated service model.
Study design: Cross-sectional study.
Methods: A needs assessment survey was conducted at varying levels of health care facilities. The SARA manual evaluated the service delivery outcomes in terms of availability of guidelines, medicines and diagnostic equipment, training of healthcare workers in providing TB and DM care, and patient record review. Data were analyzed using Statistical Package for Social Science version 26.
Results: Among 29 health facilities selected, three were regional referral hospitals, eight were district hospitals and eighteen were health centers. Baseline investigations revealed that GeneXpert MTB/RIF machines were present in 10 (34.5%) facilities, and glycated hemoglobin devices were present in two (6.9%) facilities, while all health facilities had a glucometer. The presence of an attending medical doctor in 19 (65.5%) facilities and the presence of operating biochemistry analyzers in 15 (51.7%) facilities were two mandatory variables used to assess readiness. Among the various guidelines observed, none of the facilities had the 2016 DM guidelines. Overall, 15 (51.7%) health facilities were ready to integrate dual TB and DM services.
Conclusion: Integrative TB/DM screening and management activities can be achieved only if integration initiatives are prioritized at all levels of health facilities and among health policy makers in Tanzania. At least half of the health facilities were prepared to integrate the management of dual TB/DM. However, there is an urgent need to mobilize significant resources to improve the integration in these facilities, such as management guidelines and diagnostics..

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1. Introduction

In countries with a high burden of tuberculosis (TB), the World Health Organization (WHO) "End TB Strategy" is threatened by the rise of non-communicable diseases (NCDs) such as diabetes mellitus (DM) [1,2]. TB and DM interacts thus the frequency of TB in the DM population is three to fourfold compared to the normal population [3]. The overall prevalence of TB in the DM population ranges from 1.7% to 36%, while the prevalence of DM in the TB population is 1.9%–35% [3,4]. Furthermore, unfavorable treatment outcomes for patients with dual TB and DM are very common, as DM increases treatment failure, relapse, and death among TB patients [5], while TB can induce hyperglycemia and impair DM control [6]. The most common NCDs in Tanzania are hypertension, chronic lung disease and DM [7]. However, the prevalence of DM in TB patients ranges from 9 to 16% while the prevalence of newly diagnosed DM in TB patients was 6.1%, this indicates that DM is a common comorbidity among TB patients in Tanzania [8,9]. The prevalence of DM in TB patients in urban and rural settings in Tanzania was documented to be 16% and 1.4% [8] respectively, whereas mortality was slightly higher at five-fold [9].

DM services are largely provided by the referral health facilities. Conversely, TB clinical services have been around for more than four decades and have successfully decentralized at the primary healthcare levels [10,11]. This is not representative of the mode of health service delivery for NCDs in Tanzania or elsewhere in sub-Saharan Africa. The decentralization is organized to address infectious disease-specific conditions mainly TB and human immunodeficiency virus (HIV). This contributes significantly to missed opportunities for early diagnosis and management of patients with dual infectious and non-infectious diseases such as dual TB/DM [12].

Patients with dual TB/DM require individualized treatment not only because the majority present with extensive lung diseases and high bacillary load, but also because they fail to achieve optimal serum drug levels due to low absorptions and/or drug distribution in the internal milieu [13]. Individuals receiving TB and DM treatment in separate clinics may experience unrecognized adverse drug reactions due to drug-drug or disease-drug interactions. These patients require meticulous care including the use of appropriate hypoglycemic medications and *anti*-TB therapy [14].

The WHO and the International Union against Tuberculosis and Lung Disease launched a collaborative framework for TB and DM in 2011 to address the challenge of TB and DM and called on endemic TB countries to implement this framework [15]. In 2014–2015, Tanzania conducted a service provision assessment survey, which found most of the health facilities providing DM services had low availability but also readiness for TB services [10]. From 2015, Tanzania rolled out Xpert MTB/RIF to expand the capacity of TB and multidrug resistant TB diagnosis; whether this has improved the diagnosis of TB in DM clinics remain uncertain [16]. Likewise, the survey was not clear on the readiness and service availability of DM services in health facilities providing TB services. Most of the TB services are provided at the primary healthcare level where the capacity of frontline healthcare providers on DM is not known, like lack of equipment for supporting DM clinical management. Recognizing the complexities of drug-drug or drug-disease interactions particularly in TB/DM with or without HIV, this presents as a new epidemic in our time. We designed a model to create a patient centered approach and supported the health facilities with tools for optimal clinical management of TB and DM [17]. Prior to implementation of the model, we examined service availability and readiness of Tanzanian health facilities at varying levels focusing on parameters such training of clinicians, ability to monitor safety, and other factors to integrate diagnosis and clinical management of dual TB and DM services.

2. Methods

2.1. Study design and setting

A cross-sectional study was conducted in health facilities across three regions in Tanzania between March and April 2019. These regions were Dar es Salaam, Iringa and Kilimanjaro. Dar es Salaam, is a metropolitan city in Tanzania with a population of 4.4 million inhabitants by the 2012 census having an annual growth rate of 5.6% [18]. The city is among the regions with the highest DM prevalence of 9.1% [8] and also the major contributor to TB incidence of 129 per 100,000 population annually [19,20]. Iringa region is in the Southern highlands of Tanzania with a population of 0.94 million inhabitants and has the 2nd highest HIV burden rate in the country [21] with TB incidence of 184 per 100,000 population [20]; however, the burden of DM for this region is unknown. Kilimanjaro region lies in the North-Eastern part of Tanzania with a population of 1.6 million, the prevalence of DM accounts to 5.7% [22], and the burden of TB is 150 per 100,000 population [20].

2.2. Eligibility criteria and selection of health care facilities

Thirty health facilities were purposively selected in the three regions. Three of the facilities were regional referral hospitals, eight were district hospitals, eighteen were health centers and one was a dispensary. The availability of TB and/or DM services within the facilities was an inclusion criterion. The healthcare workers (HCWs) providing outpatient care in either TB or DM clinics were eligible for enrolment. The list of HCWs was provided by the respective facility which included medical doctors, assistant medical officers or clinical officers, nurses of all cadres, and health attendants.

2.3. Measures of variables

The WHO service availability readiness assessment (SARA) tool was adapted to construct assessment indicators to assess the health facilities' readiness to provide TB and DM services [23]. These indicators (Table 1)

Table 1
Study assessment variables.

Variables	Data collection instrument	Parameters
Availability of guidelines	SARA questionnaire	National guidelines on case-management of TB 2013; Standard Treatment Guideline and National Essential Medicines list 2017; National Guidelines for Tuberculosis Infection Prevention Control (TB-IPC)2019; TB and DM management guidelines 2017; DM guidelines 2016
Training	SARA questionnaire	Healthcare workers who received training in the diagnosis and management of TB and DM.
Diagnostic equipment	SARA questionnaire	Tuberculosis screening tests: gene-Xpert MTB/RIF, sputum microscopy and chest x-ray Diabetes: Glucometer, glycated hemoglobin device Renal function tests and liver enzyme tests
Medications	SARA questionnaire	Tuberculosis first-line medications RHZE and second-line regime. Diabetes: metformin, glibenclamide, glimepiride, acabose and insulin
Patient education	SARA questionnaire	Patient counseling and education on TB and DM.
Records Documentation	SARA questionnaire	Monthly report of TB and DM patient visits in the outpatient clinics

SARA=Service Availability and Readiness Assessment. RHZE = Rifampicine, Isoniazide, Pyrazinamide, Ethambutol.

included availability of guidelines which were assessed individually as "Yes" if present and "No" if absent; diagnostic supplies for TB and DM which were grouped as "available and seen" or "reported but not seen" or "not available"; training of HCWs who received training "in-service" or "pre-service", and those "never trained"; counseling and education provided indicated as "Yes" or "No"; availability of essential first-line and second-line TB treatment and oral-hypoglycemic agents and insulin were categorized as "observed" or "not observed" accordingly, and the staffing levels and service operation were assessed in each health facility.

2.4. Study variable

The main outcome was the readiness of the health facilities to integrate clinical management of dual TB and DM. Readiness was measured by the capacity of the facilities to provide screening and management for both TB and DM through:

1. An attending medical doctor in the health facility.
2. The laboratory's ability to use the biochemistry analyzer to perform alanine and aspartate transaminases (liver enzyme tests) for drug toxicity monitoring, as well as urea and creatinine tests for dose adjustment in renal insufficiency. The chemistry analyzer did not include measurements of the plasma glucose concentration.
   Other variables added included the availability of implementing guidelines and trained HCWs on TB and DM within selected facilities which met the integration criteria.

2.5. Data management and analysis

Data were collected using paper forms, which were then entered, cleaned, and analyzed using Statistical Package for Social Science version 26. The main study outcomes included in the analysis were: the characteristics of all health facilities and service provision, the availability of guidelines and supplies, the management and training systems, and the facility readiness. The results were summarized with frequencies and percentages.

3. Results

3.1. Characteristics of the healthcare facilities

A total of 30 healthcare facilities were surveyed. The dispensary was excluded because it neither provided TB nor DM services. Therefore, 29 health facilities were analyzed. Among the included facilities, three were regional referral hospitals, eight were district hospitals and 18 were health centers. Of these, 27 (93%) were owned and managed by the Tanzanian government and two (6.9%) were faith-based facilities. The various levels of healthcare facilities are described in Fig. 1.

3.2. Healthcare workers within the health facilities

A total of 575 HCWs were recorded in the survey, 41 (7.1%) were medical officers and 271 (47.1%) were nurses of whom the majority

Table 2
The characteristics and distribution of healthcare workers (n=575) among health facilities in Tanzania.

Cadre	Regional referral hospitals (n = 41) n (%)	District hospitals (n = 197) n (%)	Health centers (n = 333) n (%)	Total (n = 575) n (%)
Medical officers	12 (29.3)	23 (11.7)	6 (1.8)	41 (7.13)
Assistant Medical Officers and Clinical officers	7 (17.1)	49 (24.9)	74 (22.2)	130 (22.6)
Nurses (all Cadres)	15 (36.6)	90 (45.7)	166 (49.8)	271 (47.1)
Health attendants	11 (26.9)	35 (17.8)	87 (26.1)	133 (23.1)
Total	45 (100)	197(100)	333 (100)	575 (100)

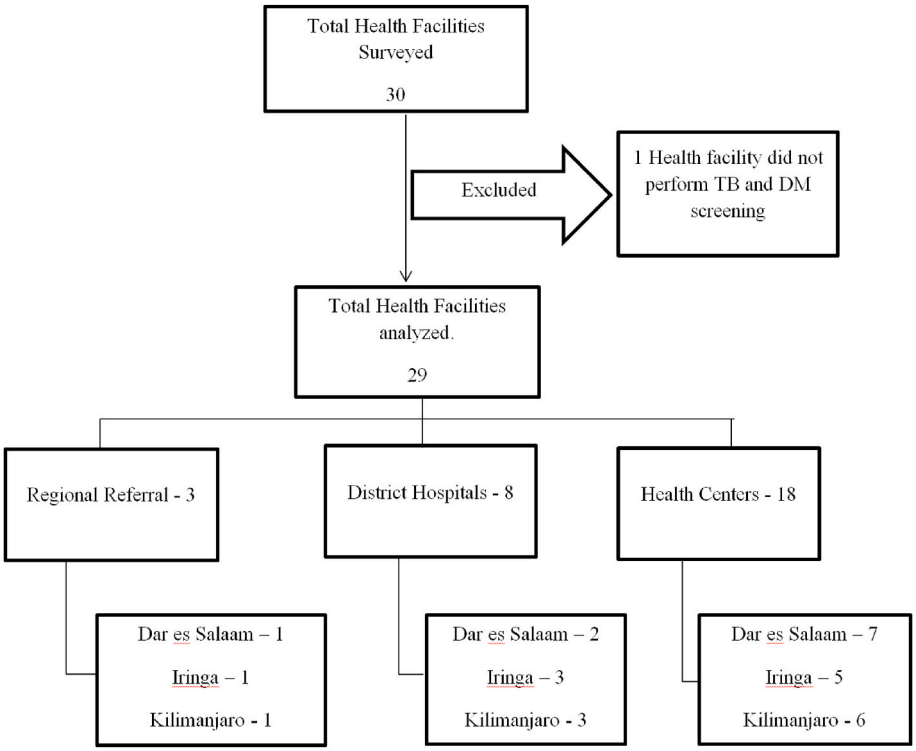

Fig. 1. Selection of Health facilities (n=29) included in the assessment in Dar es Salaam, Iringa and Kilimanjaro regions in Tanzania.

n=166 (49.8%) were in health centers as shown in Table 2.

3.3. Availability of guidelines for TB and DM services in the healthcare facilities

The national TB case-management guideline of 2013 was observed in 27 health facilities. The standard treatment guideline and national essential medicines list of 2017 were available in 24 health facilities. National guidelines for tuberculosis Infection Prevention Control (TB-IPC) of 2019 were observed in 18 health facilities, and dual TB and DM management guidelines of 2017 were observed in 10 health facilities. Among the various guidelines observed, none of the facilities had the 2016 DM guidelines (Table 3).

3.4. Availability of diagnostics, medicines and health education in the health facilities

Diagnostic equipment for TB through sputum microscopy was observed in all 29 health facilities, chest x-ray machines were available in 12 (41.4%) facilities and the GeneXpert MTB/RIF machines were observed in 10 (34.5%) facilities as shown in Table 3. The screening of DM using a glucometer was available and observed in all 29 health facilities, but glycated hemoglobin devices were only observed in two (6.9%) facilities. Laboratories capable of monitoring renal function tests and liver enzyme tests were observed in 17 (58.6%) and 14 (48.3%) health facilities, respectively. However, 13 (45%) of the facilities reported that the biochemistry analyzers were not functional due to reagents stock out.

Health education and counseling were conducted in 28 (96.6%) health facilities among TB patients and nine (31.0%) facilities provided health education on DM. Valid first-line *anti*-TB medications were available in all 29 health facilities, but all health facilities lacked full coverage of second-line *anti*-TB medications (Table 3). Oral hypoglycemic medications, particularly metformin and second-generation sulfonylureas (glibenclamide), were available in all 29 facilities, whereas insulin was available in nine (28.1%) facilities as shown in Table 3.

Table 3
Analysis of Service Availability within the Healthcare Facilities surveyed in Tanzania (n=29).

Variables	Regional Hospitals (n = 3)	District Hospitals (n = 8)	Health Centers (n = 18)	Total (n = 29)
Guidelines	n (%)	n (%)	n (%)	n (%)
- National Guidelines for TB 2013	3 (100)	8 (100)	16 (88.9)	27 (93.1)
- Guideline for Disease Management 2017	2 (66.7)	7 (87.5)	15 (83.3)	24 (82.8)
- Guidelines for DM 2016	0	0	0	0
- Guidelines for TB-IPC 2019	1 (33.3)	5 (62.5)	12 (66.7)	18 (62.1)
- Guidelines for TB-DM 2017	2 (66.7)	2 (25.0)	6 (33.3)	10 (34.5)
Counseling/Health Education				
- Provided to TB patients	3 (100)	8 (100)	17 (94.4)	28 (96.6)
- Provided to DM patients	3 (100)	2 (25.0)	4 (22.2)	9 (31.0)
Diagnostics Equipment				
- Sputum Microscopy	3 (100)	8 (100)	18 (100)	29 (100)
- Chest X-ray	3 (100)	3 (37.5)	6 (33.3)	12 (41.4)
- GeneXpert MTB/RIF	2 (66.7)	5 (62.5)	3 (16.7)	10 (34.5)
- Glucometer	3 (100)	8 (100)	18 (100)	29 (100)
- Glycated Hemoglobin Device	1 (33.3)	1 (12.5)	0	2 (6.9)
- Renal Function tests	3 (100)	4 (50.0)	10 (55.6)	17 (58.6)
- Liver enzyme tests	3 (100)	3 (37.5)	8 (44.4)	14 (48.3)
Medicines				
- First line TB medications	3 (100)	8 (100)	18 (100)	29 (100)
- Second line TB medications	0	0	0	0 (0)
- Oral Hypoglycemic medications	3 (100)	8 (100)	18 (100)	29 (100)
- Insulin	3 (100)	5 (62.5)	1 (5.6)	9 (31)

3.5. Service provision for TB and DM through patient records

Monthly service provision for TB and DM within the health facilities were reviewed using medical patient records. The findings showed that on average per month, TB was diagnosed among 115 patients within the regional referral hospitals, 137 patients in district hospitals and 237 patients in health centers. On the other hand, follow-up and newly diagnosed DM, were reported in 905 patients in regional referral hospitals, 550 patients in district hospitals and 491 patients in health centers as shown in Fig. 2.

3.6. Identified healthcare facilities for the integration of dual TB/DM services

The availability of an attending medical doctor was observed as a prerequisite for health facility integration of dual TB/DM services for eligibility in 19 (65.5%) health facilities. Accessibility of functioning biochemistry analyzers were evident in all three regional referral hospitals, four (50%) district hospitals and eight (44.4%) health centers. Overall, a total of 15 (51.7%) facilities were eligible based on these criteria to initiate integration of dual TB/DM services. Other additional variables found within the selected 15 health facilities included the TB-IPC implementation policy guideline in seven (46.7%) facilities, trained HCWs on diagnosis and treatment for TB in 13 (86.7%) and HCWs trained for DM diagnosis and treatment eight (44.47%) facilities as shown in Table 4.

4. Discussion

Tanzania endures a high burden of TB and a current emergence of DM. In this setting of double burden disease, the management of TB and DM needs to be integrated as DM can exacerbate the clinical manifestation of TB and vice versa [5,6]. In this study, we observed collectively 15 (51.7%), all three regional referral hospitals, half of the district hospitals, and approximately half of the health centers met the mandatory criteria for integrating clinical management of dual TB and DM. The observed finding shows a considerable improvement in number of health facilities with ability of integrating dual TB and DM compared

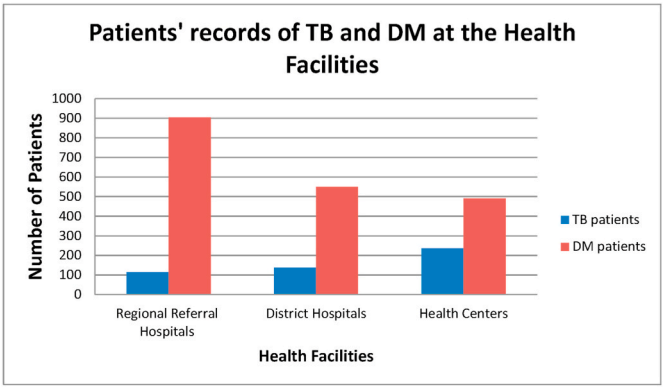

Fig. 2. Attendance of TB and DM patients per month within the health facilities.

Table 4
Mandatory and additional variables in assessing readiness of healthcare facilities for the provision of dual TB and DM services.

Mandatory Variables	Regional Hospital (n = 3)	District Hospitals (n = 8)	Health Centers (n = 18)	Total (n = 29)
	n (%)	n (%)	n (%)	n (%)
Medical doctor	3 (100)	8 (100)	8 (44.4)	19 (65.5)
Alanine and aspartate transaminases done	3 (100)	4 (50)	8 (44.4)	15 (51.7)
Urea and Creatinine done	3 (100)	4(50)	8 (44.4)	15 (51.7)
Overall Facilities readiness score	**3 (100)**	**4 (50)**	**8 (44.4)**	**15 (51.7)**

Additional Variables	**Regional Hospital (n = 3)** n (%)	**District Hospitals (n = 4)** n (%)	**Health Centers (n = 8)** n (%)	**Total (n = 15)** n (%)
TB-IPC Guideline	1(33.3)	3(75.0)	3 (37.5)	7 (46.7)
Trained HCWs for TB diagnosis and treatment	3 (100)	4 (100)	6 (75.0)	13 (86.7)
Trained HCWs for DM diagnosis and treatment	3 (100)	4 (100)	1(12.5)	8 (44.4)

to 13% described previously by Shayo and Shayo perhaps due to increase of Xpert MTB/RIF roll-out in the country [10,16]. Although, Shayo and Shayo described the readiness before the country set policy and guideline for TB/DM, they only focused on the health facilities that offered DM services. Yet, their assessment did not consider minimum qualification of clinicians and availability of equipment for monitoring safety particularly the renal, and liver to monitor drug-drug or drug-diseases interaction. Our study considered assessment of the HbA1c equipment and cartridges for estimating the glycated red blood cell to estimate the severity of DM and guide hypoglycemic drug selections. The minimum qualifications addressed, guided the ADEPT program to strengthen health facilities to establish integrations of dual TB and DM with knowledge and equipment for clinical management of dual TB and DM in patient centered approach [17].

Hence, bidirectional screening for TB in DM patients and DM in TB patients is vital and integrated clinical management will minimize harm to patients with dual disease [24].

Additional findings showed only 34.5% of health facilities at all levels had the TB/DM guidelines of 2017. This is despite their basic ongoing provision of TB and DM services. The Ministry of Health, Community Development, Gender, Elderly and Children in Tanzania developed these guidelines for TB-DM collaborative care as an initiative towards implementing bidirectional screening of TB/DM in all facilities [25]. Worryingly, none of the facilities visited proactively organized service delivery for dual TB and DM. Integrating DM screening among TB patients in principle is doable due to the availability of sputum microscopy and glucometers in all health facilities. Chest x-ray, GeneXpert MTB/RIF, and glycated hemoglobin devices as well as laboratory services to facilitate bidirectional screening and follow-up management of TB/DM comorbidity appeared to be in short supply. TB services were available at all levels of the health facilities with the majority of patients attending the primary healthcare levels. As seen in South Africa, where drug-resistant TB patients were managed at the primary health care level, established TB screening activities through the National Tuberculosis and Leprosy Program provide a platform for incorporating the management of DM and other non-communicable diseases [26,27]. On the contrary, DM services are centralized in the referral regional hospitals (Fig. 2) and none of the facilities had the 2016 DM guidelines. The high frequency of DM among patients observed in health facilities indicate the growing burden of DM will attribute to an increase of TB cases over time. TB treatment cards are used at the primary healthcare level for patient management as recommended by the International Union Against Tuberculosis and Lung Diseases [28]. In Malawi, a single card with TB on one side and DM on the other has been in use successfully [29]. The existing guidelines should provide practical information on how to implement and strengthen the management of TB/DM as a whole, while also taking into account other co-morbidities such as HIV, hypertension and chronic obstructive pulmonary diseases.

In this study, screening and diagnosis of DM were done using a glucometer across all health facilities. However, it was difficult to retrieve information on DM patients due to the lack of a formal registry and even DM guidelines. The same scenario was observed in South Africa, where DM patient records were not accessible in the facilities because patients took their records home [27]. The availability of the glycated hemoglobin devices in health facilities was very low at approximately 7%, making monitoring adequacy of glycemic control un achievable. This proposes the need to strengthen and equip primary healthcare levels to deliver DM services, which will subsequently lead to successful dual TB/DM services. In Malawi, management integration of HIV, TB, and DM has been possible [29].

Our study highlights the need of training HCWs in the provision of collaborative management of dual TB/DM. We observed that education and management among TB and DM patients were provided separately within the individual clinics, with the nurses being the primary providers. None of the sessions conducted addressed dual TB/DM comorbidity, as stipulated in the 2016 national guideline [21]. TB and DM patient visits offer an opportunity to provide patient-centered counseling on the risks of TB/DM comorbidity, signs and symptoms of TB and DM healthy lifestyles, when to seek care and supporting patient self-management [30,31]. The priority actions of the current Tanzania NCDs strategic plan II (2016–2020) was to train health care providers on collaborative TB/DM care, through stepwise escalation for phase implementation, strengthen referral and linkage mechanisms [25].

The provision of DM health education was insufficient at 31%, a finding similar to Adinan et al. where the percentage was 25.6% [11]. This is mainly due to experienced challenges in providing NCDs services in developing countries for NCDs [32]. The availability of insulin was mostly in the regional referral hospitals, and the presence of second-line TB medications was not seen because none of the health facilities had follow-up patients with multi-drug resistance TB. In our study, laboratory infrastructure for renal functioning tests and liver enzymes was found in 58.6% and 48.3% respectively in the facilities. Medicine and reagent stock-outs accompanied with inappropriate decentralization processes, pose a great challenge in providing appropriate management [33]. Equipping laboratory services will help in the diagnosis and treatment of TB/DM [34].

There are limitations in the availability and readiness of DM facilities to manage TB, and this calls for an urgent need to mobilize resources to enhance the integrations of TB services in DM facilities [10]. Regional referral and the district hospitals were better equipped to integrate the management of dual TB/DM.

4.1. Limitations

TB and DM health financing services, medication stock-outs, and governance capacities were not explored. The one month observation period may not reflect fluctuations in the burden of disease, and the selection of government run facilities only in Dar es Salaam could underestimate the capabilities of private and faith-based facilities to provide services. Qualitative research, such as in-depth interviews with key stakeholders would be beneficial in revealing underlying causes of difficulties and paving the way for implementing recommendations on dual TB/DM screening and management to be implemented.

5. Conclusion

The majority of Tanzanian health facilities need to initiate, strengthen, and provide integrated service management of dual TB/DM since the DM burden is crippling the existing fragile health system. While ADEPT model focuses on supporting some of the key elements like training of health care workers and equipment for DM in studied health facilities, integrative screening and management of TB/DM can be achieved if integration is initiated in health facilities through policy implementation in Tanzania [17]. There is a need for training HCWs in the provision of collaborative management of dual TB/DM, and to achieve this, feasible measures such as staff training, capacity building, and integration of TB/DM units in facilities should be prioritized for implementation in Tanzania.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Competing interests

None declared.

Ethical approval

The study was approved by the Kilimanjaro Christian Medical University College Ethical Review Board (No:2474) and Tanzanian National Institute for Medical Research (NIMR/HQ/R.8a/Vol.IX/2988), and permission was obtained from the regional medical authorities.

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Data availability

The database used during this study analysis will be available on request from the corresponding author.

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