


# Geographic Accessibility, Readiness, and Barriers of Health Facilities to Offer Tuberculosis Services in East Gojjam Zone, Ethiopia: A Convergent Parallel Design

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**Background:** Tuberculosis (TB) remains a foremost global public health threat. Active TB control needs geographically accessible health facilities that have quality diagnostics, equipment, supplies, medicines, and staff.

**Objective:** This study aimed at assessing the geographic distribution, physical accessibility, readiness and barriers of health facilities for TB services in East Gojjam zone, Ethiopia.

**Methods:** A convergent parallel design was applied using health facility and geographic data. Data on facility attributes, service availability and readiness were collected by interviewing TB officers, laboratory heads and onsite facility visits. Coordinates of health facilities and kebele centroids were collected by GPS. We used ArcGIS 10.6 to measure Euclidean distance from each kebele centroids to the nearest health facility. Descriptive statistics were computed by using SPSS version 25. Barriers to TB service readiness were explored by in-depth interviews. NVivo12 was used to thematically analyze the qualitative data.

**Results:** The overall TB health service coverage (THSC) was 23% (ranging: 10–85%). The mean distance from the nearest health facility was 8km (ranging: 0.5–16km). About 132 (32%) kebeles had poor geographic accessibility to TB services (over 10km distance from the nearest health facility) and had poor facility readiness. Although 114 (95%) health facilities offered at least one TB service, 44 (38.6%) of them had no sputum smear microscopy. The overall TB readiness index was 63.5%: first-line anti-TB drugs (97%), diagnostics (63%), trained staffs, diagnostic and treatment guidelines (53%) and laboratory supplies (41%). Lack of health workers (laboratory personnel), inadequate budget, poor management practice and TB program support, inadequate TB commodity suppliers, and less accessible geographic locations of health facilities were identified as barriers to TB service readiness distribution.

**Conclusion:** Considerable proportion of the population in the study area have poor access to quality TB diagnostic services due to low THSC and poor facility readiness. Barriers to TB service availability and readiness were health system related. Regular refresher training of health workers on TB, creating mechanisms to attract laboratory personnel to work in the study area and scaling up of sputum smear microscopy services, establishing an efficient mechanism for procurement, distribution, utilization and reporting of TB commodity supplies, and good management practices are crucial to enhance TB service readiness in the study zone.

**Keywords:** tuberculosis, accessibility, readiness, barriers, health facilities, TB services, East Gojjam Zone, Ethiopia

## Background

Tuberculosis is the tenth cause of death globally and the first cause of death from a single infectious agent. Although about 10 million new TB cases were reported in 2017, over a third of estimated TB cases are not yet detected globally.<sup>1</sup> Developing countries are highly affected

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by TB incidence, and deaths which might be related to high population growth, poor economy and nutrition,<sup>2,3</sup> low healthcare coverage and service quality<sup>4-8</sup> drug resistance and high comorbidities with HIV and diabetes mellitus.<sup>1,9-12</sup>

Similarly, TB is one of the top leading diseases claiming millions of lives in Ethiopia with varying magnitude across its regions.<sup>13</sup> Based on a recent data, the TB incidence in Ethiopia is estimated at 80 -172/100,000 population,<sup>1,14,15</sup>. About 60,000 TB cases are not yet detected in the country,<sup>15,16</sup> and the national TB case notification rate and treatment success rate were reported to be 56% and 84%, respectively.<sup>17,18</sup> The low TB case notification rate may be linked to use of poor TB incidence estimation methods,<sup>16,19</sup> relying only on passive case detection approach to identify TB cases,<sup>8,20,21</sup> lack of adequate TB diagnostic tools,<sup>8,20,22</sup> poor service availability and readiness,<sup>8,21,23</sup> high patient and facility delay,<sup>24-26</sup> and poor community awareness about TB.<sup>14,18,27,28</sup>

The burdens of TB could be preventable under effective preventive strategies, early diagnosis and appropriate treatment.<sup>18</sup> However, this could be possible if health facilities are easily accessible and ready to offer TB services.<sup>5-8,29</sup> Ensuring access and quality of healthcare services is one of the main functions of a health system, but most of the developing countries failed to achieve this due to continuing poverty,<sup>1-3,29,30</sup> poor facility readiness,<sup>5-8</sup> and not using advanced diagnostic technologies in the health systems.<sup>1,7,8,31</sup> Studies from Ghana,<sup>4,7</sup> South Africa,<sup>32</sup> Nigeria,<sup>33</sup> Yemen,<sup>34</sup> Mongolia<sup>35</sup> and Mozambique<sup>5</sup> showed that majority of the health facilities were geographically inaccessible, and had no TB diagnostics.

Correspondingly, the 2017 world bank and WHO report revealed that half of the world's population lacks access to essential health services and over 100 million were pushed into extreme poverty due to high health expenses.<sup>36</sup> As a result, the WHO recommends Universal Health Coverage as a key strategy to achieve the End TB goals.<sup>1</sup> Equally, making health facilities capable of offering quality TB services is vital beyond ensuring physical accessibility.

The Ethiopian healthcare delivery system has three tiers consisting of primary healthcare level (primary hospital, health center, and health posts), secondary level healthcare (general hospitals), and tertiary level (spatialized hospitals).<sup>37</sup> A 10km distance or two hours walk to a health facility from residential locations is used to measure the physical access to health facilities. Equally, geographic distribution in terms of health service coverage is measured by taking functional health facilities to total population ratio in a given year.<sup>38</sup> There is limited evidence from Ethiopia on the geographic distribution of and physical accessibility to the health facilities that offer TB services. This has an impact on decision

making for equity, resource allocation, priority setting and targeted intervention in TB control activity. This is a key problem that has contributed more to have a high TB burden in Ethiopia with different magnitudes across its districts.

One of the high TB burden regions in Ethiopia is Amhara Regional State, which is administratively divided into eleven zones (middle-level administration). The East Gojjam Administrative Zone is one of those zones which has higher TB incidence and lowest TB case notification rate compared to other administrative zones in the region.<sup>39</sup> Therefore, this study aimed at assessing the geographic distribution, physical accessibility, readiness and barriers of health facilities to offer TB control services in East Gojjam Administrative Zone, Northwest Ethiopia. The findings of this study are crucial to policy makers, health system managers, health facilities, and non governmental organizations (NGOs) to enhance universal health coverage, facility readiness and achieve the End TB targets. It will also serve as an important evidence for researchers who are interested in health equity, facility readiness, and TB service quality.

## Methods

### Study Design and Settings

A convergent parallel design/concurrent triangulation study/was conducted between September and December 2018 in East Gojjam Zone, one of the ten zones in the Amhara Region, Ethiopia. The quantitative approach aimed at assessing geographic distribution, accessibility, service availability and readiness of health facilities to offer TB services, whereas, the qualitative approach was used to explore barriers of facility readiness to offer TB service. The study zone has an estimated population of 2,632,632 (1,282,676 males, 1,349,956 females, and 85% rural farmers). Its area coverage is 14,010 square km which is divided into 18 administrative districts which are further divided into 49 urban and 392 rural *kebeles*,<sup>40</sup> the lowest administrative units.<sup>18</sup> There were nine hospitals, 102 HCs and nine private clinics eligible to offer TB services. Although the lives of many TB patients have been saved as a result of the implementation of effective TB control strategies since 1995, TB still continues to be a major public health problem in East Gojjam Zone. The zone has poor performance in TB case notification rates compared to other zones in the Amhara Region.<sup>40,41</sup>

### Sample Size Determination

Due to the nature of the study objectives, and recommendations by the WHO on service availability and readiness assessment, a census of 120 health facilities was applied.<sup>42</sup> For the quantitative data collection, we included laboratory heads and TB

officers/TB focal persons/ working at Zonal Health Department, District Health Offices and health facility levels. The main reason for the selection of these participants was their day to day exposure in the TB control activities. In the study area, there are 18 District Health Offices where the TB officers (one per office) are responsible for managing the TB control activities. Similarly, there were 120 TB focal persons (one per health facility) and 70 laboratory heads. The number of laboratory heads were limited to 70 as only 70 of 120 health facilities had TB smear microscopy services. Two TB officers (one assigned by the government and the other one representing one NGO) were working at the Zonal Health Department level to facilitate the overall TB control activities in the study zone. Therefore, by considering all these informants, a total of 200 participants were included in the quantitative study data collection. For the qualitative data, besides the above participants, we included health facility heads as study participants to assess their management roles in TB control activities. A total of 24 participants were recruited for the qualitative data collection and data saturation level was used to limit the number of participants.

## Data Collection Tools and Procedures

### Quantitative Data Collection

Data on facility attributes (facility type, managing authority, residence and district), service availability, readiness (availability of trained staff, diagnostic and treatment guidelines, diagnostics, anti-TB drugs and laboratory supplies)<sup>42</sup> were collected by interviewing TB officers and laboratory heads using a structured interviewer-administered questionnaire adapted from the WHO facility service availability and readiness assessment questionnaire. The WHO questionnaire was contextualized into the Ethiopian situation by incorporating electric power and water supply availability for TB diagnostic services as one domain to the existing WHO facility assessment domains (Annex1). The data collection tool was pretested and validated/tool reliability/ before the actual data collection (Cronbach alpha >0.85) was commenced. Coordinates of health facilities and kebele centroids were collected by geographic positioning systems (GPS). Ten data collectors (six health officers and four nurses) and three masters (MPH) holder public health practitioners (supervisors) who took training for three days collected data based on the data collection guideline book. Similarly, data on districts' populations and other spatial data were obtained from the Amhara Regional Plan Commission Office. Moreover, data on physical accessibility/Euclidean distance between kebele centroids and the nearest health facility was measured using the near function of analysis tools in the ArcGIS10.6.

### Qualitative Data Collection

Principal investigators together with three facilitators conducted an in-depth interview on ten TB officers, six laboratory heads and eight facility heads. The in-depth interview was conducted using an interview guide (focusing on barriers of TB service availability and readiness), and audio recorder. The average interview time was 50 mins (43 to 64 mins). Data were supplemented by conducting participant observation. On site visit (observation) of health facilities, TB clinics, laboratory departments, pharmacy departments, and facility stores were done to validate/cross-check/the quantitative and qualitative data.

### Variables and Operational Definitions

#### Geographic Distribution

Geographic distribution defined as the physical presence of health facilities as per the country's standard for HSC and measured by functional health facility to the population ratio. The WHO sets two facilities per 10000 population as a target for health facility density. To get the percentage of HSC, we divided the HSC by two (WHO target).<sup>38,42</sup>

#### Physical Accessibility

Physical accessibility is the ability of the population to get TB services when they need it. It is measured by taking the mean distance from the nearest health facility, and a 10km distance or two hours walk is used as a standard to measure access to health facilities in Ethiopia.<sup>38</sup>

#### TB Service Availability

It is the physical presence of TB services in each health facility. It is measured by using the proportion of health facilities that offer at least one of the following TB services: Diagnosis, treatment follow up or both.<sup>42</sup>

#### Facility Readiness to TB Services

Facility readiness to TB services is the ability of health facilities to offer TB services. It was measured by the availability of trained staff, diagnostic and treatment guidelines, diagnostics, equipment, laboratory supplies, and anti-TB drugs. Health facilities that did not offer TB services were excluded from the denominator to compute service readiness statistics.<sup>42</sup>

## Data Quality Assurance

The clarity and consistency of the questionnaire were checked by conducting a pretest in a similar setting. The tool was also validated using the Cronbach alpha test ( $\alpha > 0.85$ ). Besides these, data collectors and supervisors took three days training and

used a user-friendly data collection guide book. Supervisors and principal investigators gave regular supportive supervision to data collectors. Convenient data collection offices were arranged for data collection in each health facility. Triangulation of data sources and methods (TB officers at different levels, laboratory and facility heads), and data collection techniques (structured interview, in-depth interview and onsite observation) were applied to keep data quality/trustworthiness. Qualitative and quantitative data were supplemented by conducting onsite observation of health facilities and the respective departments.

## Data Management and Analysis

### Quantitative Data

The geographic distribution of health facilities was measured by using a facility to population ratio of each district. In Ethiopia, one health center is designed to serve 25,000 people: one clinic for 10,000 people, and a health post for about 5000 people.<sup>38</sup> Similarly, we described the physical accessibility to the health facilities in terms of the average Euclidean distance between kebele centroids and the nearest health facility that was measured using the near function of analysis tools in the Arc GIS 10.6. Thus, areas located beyond a 10km radius from the nearest health facility were considered poorly accessible. The geographic distribution and accessibility of health facilities were mapped using ArcGIS 10.6 based on the coordinates of facility and kebele centroids. The spatial district and health facility data were managed using the world Geodetic coordination system of 1984 (WDS84), and Universal Transverse Mercator Zone 37°N projection system.

TB service availability was measured by taking the percentage of health facilities that offer at least one TB service. Likewise, facility readiness was assessed using 16 tracer items grouped into four core domain indicators, namely trained staff and diagnostic and treatment guidelines, diagnostics, anti-TB drugs, and laboratory supplies. Then the readiness score was computed as the mean percentage in terms of those four core domains. The general service readiness index/overall readiness score/was computed by taking the mean value of the four core domain scores.<sup>42</sup>

Various descriptive data on facility attributes, health service coverage, mean distance from the nearest health facility, service availability and readiness scores were cleaned and analyzed using SPSS version 25. By taking the mean score value of 16 tracer items as a cutting of point, health facilities that scored a mean value of  $\geq 8$  were

grouped as having good readiness and those scoring below the mean score value were categorized as poor readiness.<sup>42</sup>

### Qualitative Data Analysis

Data transcription and analysis was started during data collection. The audio records were first transcribed verbatim and then translated into English for analysis. Investigators read and

**Table 1** Facility Variables on TB Service Availability and Readiness in East Gojjam Zone of Ethiopia, 2018

Variable	Number	Percent
Type of facility		
Clinic	9	7.5
Health center	102	85.0
Hospital	9	7.5
Managing authority of facilities		
Public	111	92.5
Private	9	7.5
Location of facility		
Rural	80	67.0
Urban	40	33.0
Offer TB service		
Yes	114	95.0
No	6	5.0
Type of TB service offered (n=114)		
Diagnostics, treatment, and follow up	67	58.8
Only treatment and followup	44	38.6
Only diagnostics	3	2.6
Types of TB diagnostics (n=70)		
TB microscopy	65	57.0
TB microscopy and GeneXpert	5	4.4
Reasons for absence of diagnostics services (n=44)		
No laboratory persons	37	84.0
No laboratory inputs	7	16.0
Access to TB training in the last 24 months (n=114)		
Yes	65	57.0
No	49	43.0
Trained staffs in last 24 months (n=114)		
One	45	39.0
Two	39	34.0
Three	23	20.0
Four	7	6.0
A staff working in TB clinic was trained on TB (n=114)		
Yes	64	56.0
No	50	44.0

re-read the transcripts repeatedly to understand the data and generate initial codes to texts. Then the transcribed codes were refined and organized into categories. By merging similar categories, we got six themes and more sub-themes under each theme through iteration. Data were analyzed by thematic analysis techniques using a QS NVivo12 software program. Identified themes are presented narratively by supporting them with important quotes from the respondents. Selected quotes are presented in the result section.

## Ethical Consideration

The ethical review committee of the College of Medicine and Health Sciences, Bahir Dar University reviewed and approved the research protocol, and gave an ethical clearance (protocol No: 091/18-04). The Amhara Regional State Health Bureau and East Gojjam Zone Health Department gave supporting letters. Data were collected after getting written informed consent from each study participant. Participation in the interview was voluntary based including the right to withdraw from the study at any time point without any preconditions.

## Results

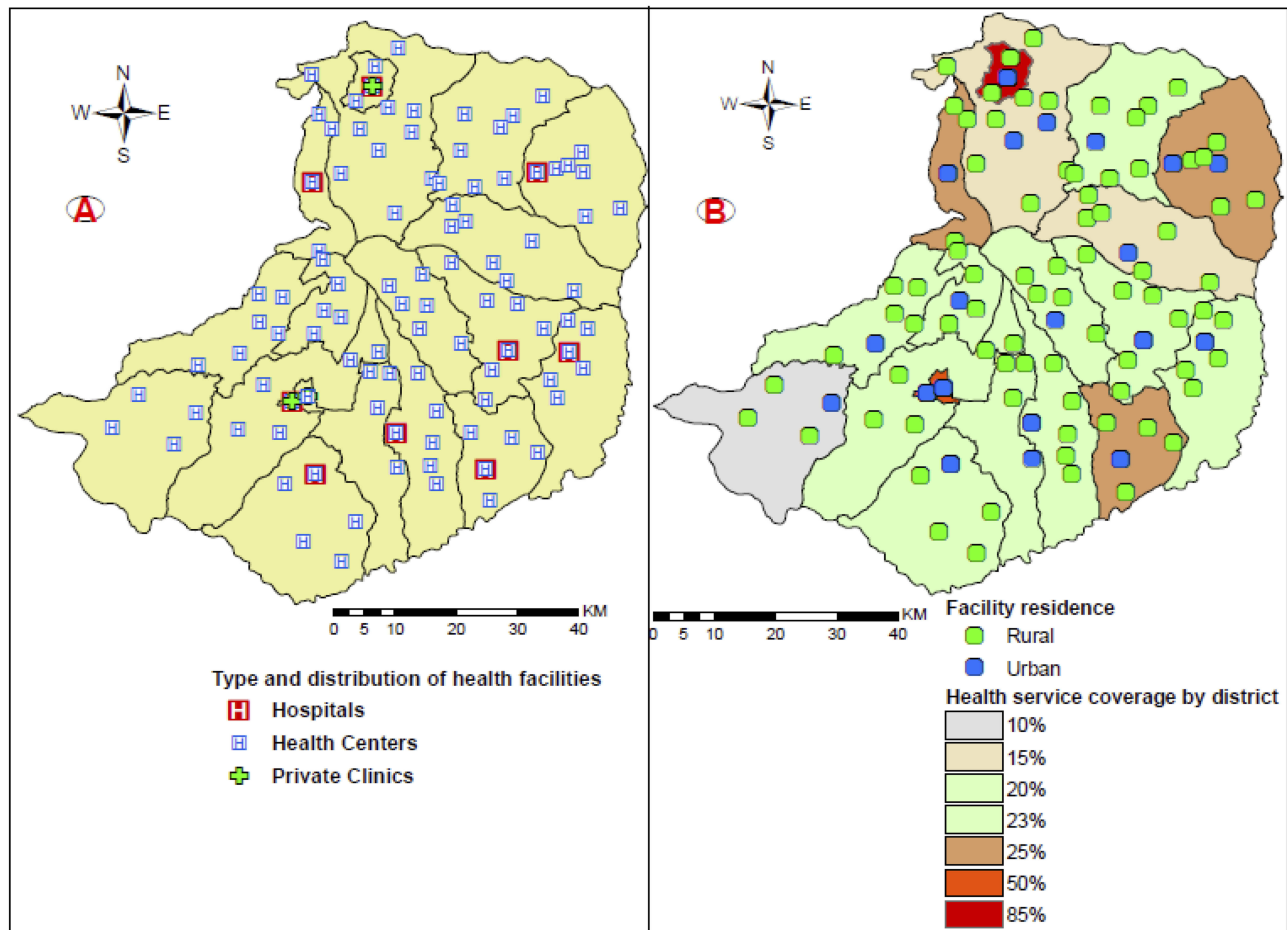
### Geographic Distribution and Accessibility of Health Facilities

#### Geographical Distribution of Health Facilities

The geographic distribution of health facilities seems dispersed across districts even if the rural and bordering areas had relatively poor facility density. The majority, 102 (85%) of the facilities were public health centers and 80 (66.7%) of them were from rural areas (Table 1). The overall HSC in terms of functional health facilities to TB services was 0.46 per10000 people (23%) ranging from 0.34–1.7 per10000 people. The percentage of HSC varied from 10% to 85% across districts where urban settings had relatively better HSC (Figure 1).

#### Geographic Accessibility of Health Facilities to TB Services

Regarding physical accessibility to TB services, the mean distance from the *kebele* centroids/census enumeration areas/ to the nearest health facilities was 8km ranging from 0.5 to 16 km. Over two-third, 282 (68%) of *kebeles* were located



**Figure 1** Geographical distribution of health facilities by residence in East Gojjam zone, Ethiopia, 2018.

within 10km distance from the nearest health facilities. Almost all kebeles located around the borders had a mean distance of greater than 10km from the nearest health facilities. All the health facilities located out side of the 10km distance had poor HSC ( $\leq 25\%$ ), offered only TB treatment follow up services and had poor readiness.

Besides those six health facilities that did not offer TB services, 44 (38.6%) of the TB service offering facilities had poor readiness (Figure 2).

### Tuberculosis Service Availability and Facility Descriptions

Most of the health facilities, 111 (92.5%) were public and 114 (95%) (95% CI: 91–99) of them offered at least one TB service. Sixty-seven (58.8%) of the health facilities provided both TB diagnostics and treatment follow up services. However, 44 (38.6%) of them had no sputum smear microscopy services due to lack of laboratory personnels (87%) and laboratory inputs (13%). The number of functional sputum smear microscopy service was 2.66 for 100,000 people. Only five hospitals had GeneXpert services besides sputum smear

microscopy services and none of the health facilities had sputum culture services for TB diagnosis during the study period. Over half, 65 (57%) of the facilities had opportunity to TB control training in the last 24 months and 64 (56%) of them had trained TB staff working at TB clinics during the data collection period (Table 1).

### Health Facility Readiness to Deliver TB Services

Based on the facility readiness assessment, 79 (69%) of the health facilities had guidelines for the diagnosis and treatment of TB. Similarly, 68 (60%) health facilities had guidelines for the management of TB-HIV coinfection. Over two-third, 79 (69%) health facilities had at least one staff trained on diagnosis and treatment of TB followed by 74 (65%) trained on TB-HIV coinfection. Only 40 (35%) health facilities had at least one staff trained on MDR-TB. Most of the health facilities, 111 (97%) had access to first-line anti-TB drugs. Similarly, 72 (63%) of them had HIV diagnostic capacity and only 23 (20%) had all the 16 tracer items (Figure 3).

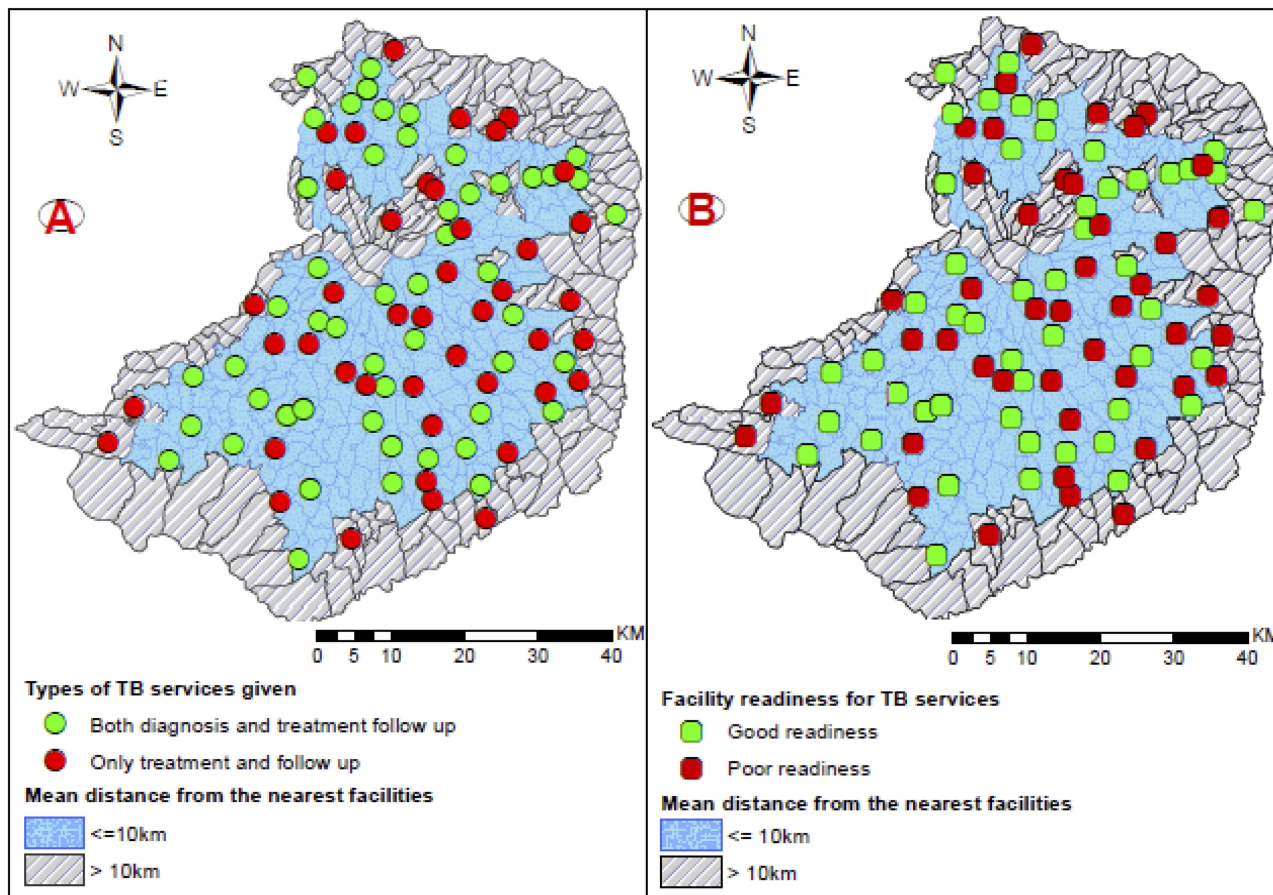


Figure 2 Physical accessibility to types of TB services and facility readiness in East Gojjam Zone, 2018.

By assuming that the four core domains have equal weight to measure facility readiness, we computed the overall readiness index by taking the mean value of four core domains, which is 63.5%(95% CI; 25%-101.8%). The first-line anti TB drugs had the highest readiness score whereas basic TB service supplies had the smallest score (Figure 4).

### Barriers of Service Availability and Readiness for TB Services

A total of 24 participants: 10 TB officers, eight facility heads and six laboratory heads were interviewed. The majority (18 of 24) participants were males, 14 had ≥10 years work experiences, and only five were second-degree graduates (Table 2).

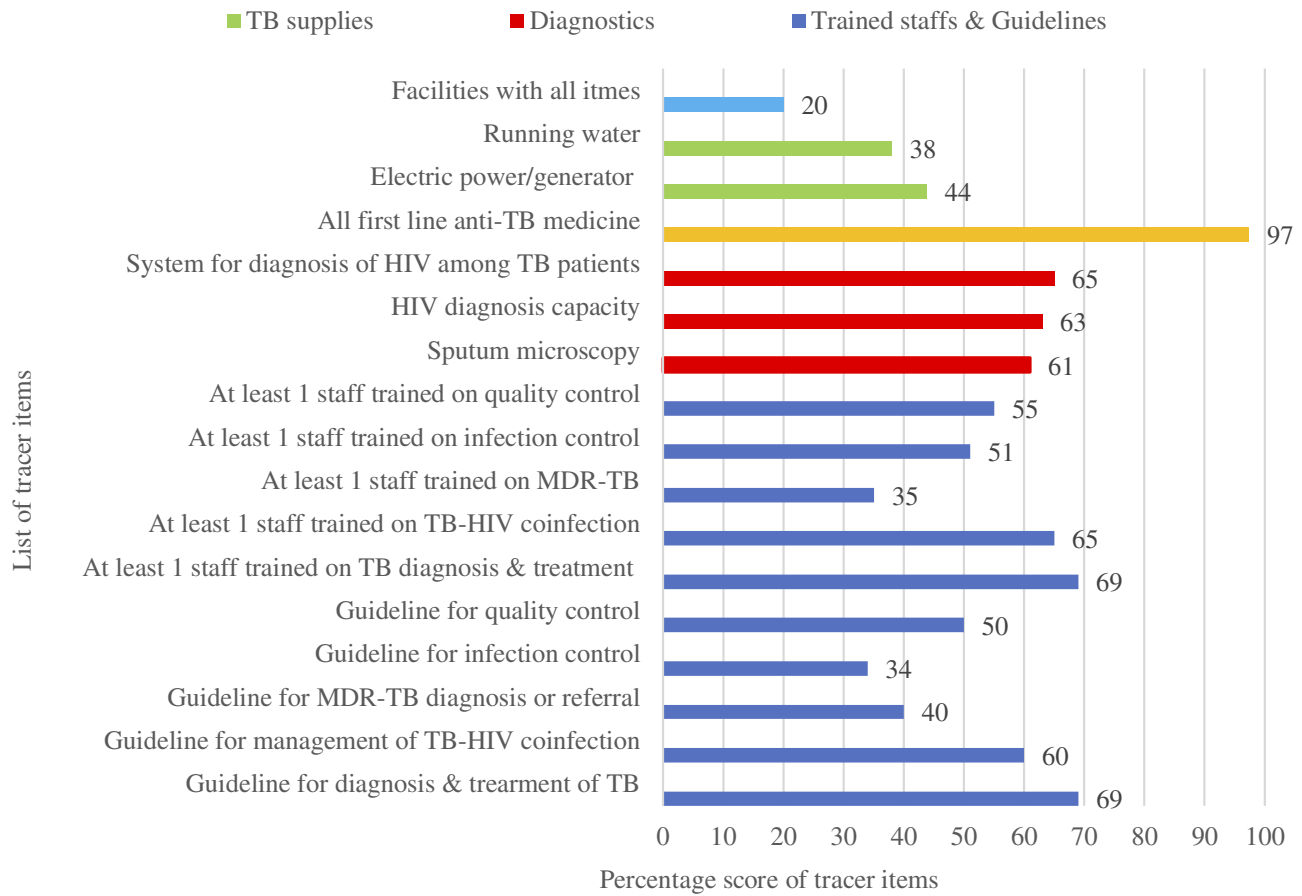


Figure 3 Percentage score of 16 tracer items on TB service readiness in the East Gojjam zone of Ethiopia.

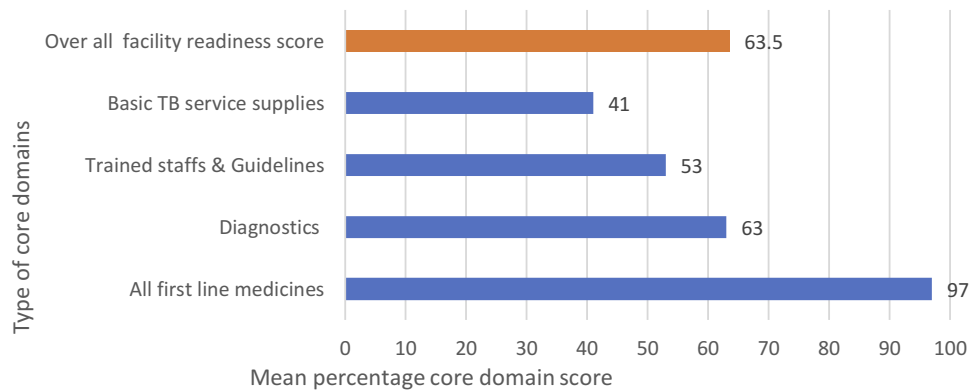


Figure 4 Mean percentage score of four core domain TB readiness indicators in East Gojjam zone of Ethiopia, 2018.

Barriers to TB service availability and readiness were summarized into six themes: 1) Shortage of trained manpower; 2) Shortage of suppliers; 3) Scarcity of budget; 4) Poor TB program supports; 5). Poor health system management practices and 6) geographic location and community settlements.

### Shortage of Trained Manpower

All participants agreed that skilled manpower is the backbone of TB control programs. The shortage of laboratory professionals was identified as a key challenge in the study area. They said that TB detection and treatment follow up were unthinkable without quality laboratory services. They pointed out that the absence of laboratory graduates and high staff turnover were reasons for the manpower shortage.

“... laboratory services are the cornerstones of TB control programs, but the scarcity of laboratory staffs poses a serious problem on access to laboratory services that contribute to poor readiness of health facilities and low TB case detection. Because of laboratory staff shortage, many health facilities are not offering sputum smear microscopy

services, and we have started sample transportation system to transfer samples to other facilities that have TB diagnostic services.” TBO2

All the interviewed participants agreed that the government is accountable for the laboratory staff shortage since this has happened following the government decision to stop the training of laboratory technicians as there was less demand of these professionals in the job market for some years. Participants stated that decision making based on a snapshot observation is very dangerous to the overall health system. The health system managers need to be visionary and make decisions based on evidence and thinking about the future.

“... the absence of laboratory professional University graduates is due to the directions given to the Universities by the government to stop producing laboratory professionals by assuming that there were adequate numbers of graduates, but it was not supported by evidence.” LH1

“... staff turnover and change of profession due to poor management practice, absence/low level of incentives

**Table 2** Profile of Interviewed People in East Gojjam Zone of Ethiopia, 2018

Codes	Age	Sex	Education Level	Residence	Working Experience	Interviewee Category
TBO1	38	Male	MSc	Urban	12 years	Zonal TB officer
TBO2	50	Male	MPH	Urban	22 years	NGO TB officer
TBO3	40	Female	BSc	Urban	11 years	Facility TB officer
TBO4	35	Male	BSc	Urban	5 years	Facility TB officer
TBO5	30	Male	BSc	Rural	12 years	Facility TB officer
TBO6	34	Male	BSc	Urban	4 years	Facility TB officer
TBO7	36	Male	BSc	Urban	4 years	Facility TB officer
TBO8	36	Female	BSc	Rural	7 years	Facility TB officer
TBO9	35	Male	BSc	Rural	4 years	Facility TB officer
TBO10	35	Male	BSc	Rural	5 years	Facility TB officer
FH1	45	Male	BSc	Urban	14 years	Facility head
FH2	40	Female	BSc	Rural	12 years	Facility head
FH3	38	Male	MPH	Rural	6 years	Facility head
FH4	42	Male	MPH	Urban	14 years	Facility head
FH5	38	Female	BSc	Urban	11 years	Facility head
FH6	40	Male	BSc	Rural	13 years	Facility head
FH7	45	Male	BSc	Rural	18 years	Facility head
FH8	37	Male	BSc	Urban	7 years	Facility head
LH1	46	Male	MSc	Urban	18 years	Laboratory head
LH2	36	Male	BSc	Urban	10 years	Laboratory head
LH3	32	Female	MSc	Rural	3 years	Laboratory head
LH4	35	Female	BSc	Urban	8 years	Laboratory head
LH5	35	Male	BSc	Urban	5 years	Laboratory head
LH6	37	Male	BSc	Rural	10 years	Laboratory head



and unfair staff treatment have become challenges in the study area.” TBO3

### Shortage of Suppliers

All the interviewed participants agreed that giving every responsibility to distribute all materials, equipment, anti-TB drugs, and laboratory supplies of health facilities to a single organization, Pharmaceutical Fund and Supply Agency (PFSA), has many limitations. They described that one single organization may not have the, capacities, resources, and strategies to manage the procurement and timely distribution of TB commodities to all health facilities. It is because of these limitations that most health facilities are suffering from shortage of materials, equipment, anti-TB drugs, reagents and other supplies. procurement and delivery delays of TB commodities is the most frequently observed problems of PFSA.

“... The limitations of PFSA, and the lengthy procurement bureaucracies practiced in the respective government institutions have been the topic of discussions and reported several times, but it remains to cause an unexpected delay in accessing supplies and is affecting facility readiness for TB services. Shortage of reagents, anti-TB drugs, and supplies are common challenges that are affecting TB control activities.” FH2

In addition, all the study participants stated that the Ethiopian government procurement system and procedures have played a major role in poor PFSA performance which greatly affects the readiness of health facilities to deliver TB services.

“... PFSA’s procurement system and procedures are extremely time-consuming and have created unnecessary delays in accessing facility inputs. A single procurement procedure will take a minimum of half a year or more. This will affect facility readiness and service provision. The TB control program by its nature requires uninterrupted supply of program inputs. However, facilities are frequently facing shortage of acid-fast-bacilli (AFB) smear microscopy reagents, sputum cups, slides and anti-TB drugs.” TBO1

### Shortage of Budget

The interruption of the TB control program budget from the national and local NGOs due to the absence of funders and economic crisis added a huge burden to the Ethiopian government in allocating TB control program budgets. The allocated budget has been inadequate to cover the TB program activities since the nature of the program is

resource-intensive, and majority of the budget goes to the procurement of TB commodities, covering costs for outreach services and community mobilization

“... this limited budget has a direct impact on accessing equipment, anti-TB drugs, reagents, facility equity, supervision, transportation and supports to TB patients.” FH7

### Poor TB Program Supports

During the indepth interview, most of the participants mentioned that TB program supports included program management, technical, training, materials and financial supports which were mostly covered by NGOs. They also stated that a significant number of non-health political leaders did not give proper attention to TB control programs compared to other health intervention programs. All these directly/indirectly affect TB control program belongingness, budget allocation and other supports which can affect facility readiness to TB services.

“... many political leaders assumed that TB is only the responsibility of the World Health Organization (WHO) and NGOs. As a result, less attention was given to TB control from political leaders that compromised the performance of TB control programs and staffs’ motivation at large these days. Integration of TB control activities with other programs such as HIV/AIDS is limited.” LH3

Study participants noted that lack of regular supportive supervision can affect facility readiness and TB control program performance.

“... the trend of supervision is just a type of superficial inspection, and is biased towards facilities which are easily accessible and located at urban and semi-urban settings than facilities located at rural areas that have poor infrastructures. Also, there is no proper and timely post-supervision feedback .” TBO4

### Poor Health System Management Practices

Study participants described that poor management practice has become an issue to the health system. We are hearing frequent complaint from health workers and are also observing high staff turnover that is possibly linked to poor management practice. This is usually manifested by exercising unfair decision making in terms of staff motivation and provision of incentives. The problem is observed at the time of new staff recruitment or assignment of staff members at the different departments in the health facilities.

“... exercising partiality among staff members, denying incentives and working with intentionally formed and favored groups have become common practices among many facility managers. Poor program management practice contributes to high staff turnover, poor access to TB control inputs such as anti-TB drugs, equipment, reagents, inadequate electric power and water supplies, lack of training, and poor staff motivating strategies. These can directly affect the quality of TB control program activities.” LH6

### Geographic Location and Community Settlement

Geographic location of health facilities highly affects population access to health services, distribution of health facilities, service provision and facility readiness to TB services. East Gojjam zone has many hard to reach areas, and the scattered settlement of the community has a great impact on the provision of quality TB control services.

“There are difficult geographic features in East Gojjam zone and over 85% of the population is living in rural settings in a scattered manner. This affects access to transportation, water sources, communication and quality health service. For example, transportation is a key challenge to access anti-TB drugs, equipment, laboratory reagents, to conduct supervision, and seek health care service.” TBO9

## Discussion

This study indicated that there is a need for more efforts to improve health facility readiness for the provision of quality TB services to the population in East Gojjam Zone of Amhara Region, Ethiopia. The status of health service coverage for TB services was low and greatly varied across the districts (10%-85%). Rural and border areas had poor health service coverage,  $\leq 25\%$  (Figure 1). The HSC based on sputum smear microscopy services was 13% (0.26 per 10000 people). This is very far from the national and WHO HSC targets: 2 facilities per 10000 population.<sup>42</sup> This implies that many people are not getting TB diagnostic services and/or those limited functional health facilities are overloaded to serve the whole population in the study area. This might be due to limited functional health facilities, population size, and geographic location. The overall HSC for TB services (23%) in the study zone was lower compared to findings from Southern Ethiopia where the TB control service coverage was 73%.<sup>23</sup> This variation could be due to differences in population size and the number of functional health facilities. In the Southern Ethiopia study, there were 81 facilities

offering sputum smear microscopy which were 70 in our study. Former study findings also showed that most of the developing countries had low HSC<sup>4-6,34,43</sup> which might be related to poor facility readiness, lack of adequate budget, high population size and poor infrastructure. The health authorities in the study zone should work in scaling up of sputum smear microscopy services in the areas where this service is not available.

Concerning physical accessibility to TB services, a third of kebeles were located out side of the 10km radius from the nearest health facilities. Most of the rural and bordering areas had poor physical accessibility to TB services (Figure 2). This indicates that the population residing in those areas are underserved as a result of geographic locations and low HSC which is related to the uneven health facility distribution and scattered population settlements. We also know that access to health facilities is not necessarily a guarantee for TB service utilization.<sup>29</sup> The distant location of health facilities will affect access to transportation, delivery of TB program inputs and information sources. This will then lead to low facility readiness, poor health seeking behavior, and high patient delay which encourages patients to search for alternative health care including self treatment, visiting traditional healers and religious places for treatment.<sup>23,32</sup> Similarly, the qualitative part of this study identified that geographic location and scattered community settlements were barriers to TB service availability and readiness.

The present physical accessibility status, estimated at a mean distance of 8km from the nearest facility, was higher compared to findings from Southern Ethiopia,<sup>23</sup> where the mean distance from the nearest health facility was 3.2km (1.5–12.4km). The potential explanation for this variation might be differences in population settlement and distribution of functional health facilities. This finding is supported by previous study results from Ghana,<sup>4,6</sup> Mozambique,<sup>5</sup> and South Africa<sup>32</sup> where many localities had limited access to health facilities ( $\geq 10$ km distance).

Although 114 of the 120 facilities offered at least one TB service in the study area, 44 of the 114 had no sputum smear microscopy services in addition to those six facilities that did not offer any of the TB services. Forty seven (41%) health facilities also had poor readiness scores for TB services. This indicates that the problems of TB control in East Gojjam Zone are not only poor facility distribution and accessibility, but also poor TB service readiness as only 70 health facilities were serving the total population for TB diagnostic services at the time of the study period. This may suggest that many TB cases

remain undetected in the community. This is supported by recent study findings from the study area<sup>39</sup> where the total TB infectious pool was estimated at 56,496 infectious person-days, which is alarming. This is mainly due to the shortage of laboratory staff and facility inputs.<sup>39,44</sup> The qualitative part of this study also supported this where manpower shortage, limited facility input suppliers, poor management practices and TB program supports were barriers of TB service availability and readiness.

Based on the 2018 East Gojjam Zone Health Department's annual report, 112 laboratory staff were working in those 120 health facilities. The Ethiopian facility standard guideline, however, requires 285 laboratory staff for those facilities (2 for each clinic and health center, and 6–11 for each hospital).<sup>45</sup> But there were only 112/285 (39.3%) laboratory staff, hence most of the facilities did not fulfill the standard requirements (Table 1). This finding is related to the absence of new laboratory University graduates, high staff turnover and change of profession as a result of poor incentives, poor management and desire for better position and work at other preferred work places.

The present service availability score was higher compared to findings from the Ethiopian national service availability and readiness assessment<sup>8</sup> where the average national TB service availability was 57% (34% to 83%) and sputum smear microscopy was 50%. The variation could be due to differences in area coverage, sampling (census vs sampled), study period and sample size. The finding was also larger compared to study results from other countries including Ghana,<sup>7</sup> Somalia<sup>46</sup> and Tanzania<sup>43</sup> where only 10%, 8%, and three facilities offered TB services, respectively. The low service availability observed in these countries were attributed to lack of diagnostic tests, anti-TB drugs, laboratory staff and poor infrastructures.

In contrast, the service availability score in our study was lower than a study finding from Nepal<sup>47</sup> in which about 90% of health facilities offered TB services. The probable explanation for this disparity might be variations in HSC, facility readiness, TB service inputs, and TB program supports. Likewise, the present 70 (61.4%) sputum smear microscopy service was lower compared to findings from a former Ethiopian study [23] where 81 (71%) health facilities had sputum smear microscopy services. This variation was due to differences in facility readiness, presence of laboratory staff, training access, and TB control inputs. In the former study, about 90% of

staff were trained on TB control, no report on staff shortage, 80% facilities had necessary reagents and supplies for sputum smear microscopy, and 65% facilities had electric power. But, in our study, only 57% had training access, 77 facilities had laboratory staff, 61.4% facilities had necessary reagents and supplies for sputum smear microscopy, and only 44% facilities had electric power/functional generator. This implies that significant number of health facilities lacked the required inputs for implementing the TB control activities that lowered the TB control program performance in the study zone.

Similarly, the overall TB readiness score of this study was 63.5% ranging from 41% (basic supplies) to 97% (first line anti-TB drugs supplies). This shows that there is a 36.5% readiness gap to offer TB services, which is another problem in addition to low HSC. This finding was lower compared to the national TB readiness score (68%). The variation was due to differences in the scores of core domains (staff and training, and diagnostics availability) that had higher scores during the national assessment. However, the first-line anti TB drug domain had a higher score (97%) in this study compared to the national score (94%). Besides this, the national readiness score was only based on 12 tracer items, but was based on 16 items in our study including four items which are basic to evaluate TB readiness (Figure 3). The sample size could also be a factor for the variation where the national assessment used a larger sample size than ours.

On the other hand, the current readiness score (63.5%) was relatively higher compared to research findings from Mongolia<sup>35</sup> where the readiness index score for TB services was 53%. This was due to unavailability of diagnostic tests and essential drugs where only 44% of the health facilities could provide basic health services.

This study also showed that most of the rural health facilities had poor readiness and offer only treatment and follow up services (Figure 2). Since more than 85% of the population in the study area is living in rural areas,<sup>40</sup> the population are not getting the appropriate TB diagnostic services mainly due to the absence of laboratory staff, electric power, AFB reagents, sputum smear microscopy and water supply services (Figure 3). This finding agrees with study results from other part of Ethiopia<sup>44</sup> where lack of laboratory staff, electric power, reagents and water sources were barriers to TB diagnosis. The qualitative part of this study also supported this where staff shortage, poor TB program support, lack of budget, shortage of suppliers, poor management and distant

geographic location of health facilities were barriers to TB service availability and readiness.

Similar results were also reported from previous studies in Ethiopia,<sup>8,23,39,44</sup> Ghana,<sup>4,6,7</sup> Mozambique,<sup>5</sup> South Africa,<sup>32</sup> Nigeria,<sup>33</sup> Tanzania,<sup>43</sup> Nepal<sup>47</sup> and Mongolia<sup>35</sup> where most of the rural health facilities had uneven health facility distribution, inaccessible, and poor readiness (lack of staff, reagents, electric power, and equipment) of health facilities.

Although this is the first study in Ethiopia that considers geographic distribution of and access to TB services, TB service readiness status and barriers to readiness for TB services, it has potential limitations that need to be considered while interpreting the findings of the current study. The THSC was determined using only hospitals, health centers and private clinics. If health posts were considered, the THSC would be slightly changed since they have roles in DOTS.<sup>8</sup> Similarly, this study did not assess road accessibility, which can determine accessibility to TB services. The distance we measured between *kebele* centroids and nearest health facility was Euclidean/straight line distance, which might not always be true. Moreover, we only assessed the availability of TB diagnostic and treatment guidelines, but not the adherence to those guidelines.

## Conclusions

The geographical distribution of and accessibility to TB services were low in the study area compared to the previous studies and were worse in rural and border areas. A third of the studied *kebeles* had poor accessibility (>10km) to the nearest health facility. Many health facilities had poor readiness score and no sputum smear microscopy service was available. Absence of adequate laboratory personnel, inadequate TB commodity supplier, lack of budget, poor TB program support, lack of good management practice, and distant geographic location of health facilities were identified as barriers of health facility readiness to offer quality TB services. Improving the laboratory personnel shortage and scaling up sputum smear microscopy availability, exercising good management practices at health facilities, and providing regular refresher training to health workers will improve the current low level of readiness to TB services in the study area.

## Ethical Clearance

This study was conducted in accordance with the declaration of Helsinki. The research was ethically cleared and got approval from the ethical review committee of the College

of Medicine and Health Sciences, Bahir Dar University (Protocol No: 091/18-04). Data were collected after getting written informed consent from each study participant. Participation was fully voluntary based and data confidentiality was ascertained through anonymity.

## Data Sharing Statement

All the raw data supporting the findings can be obtained from the corresponding author with a reasonable request.

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## Disclosure

The authors declared that they have no competing interests to this work.

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