








# Tuberculosis Treatment Outcome and Associated Factors Among Tuberculosis Patients Linked to Tuberculosis Treatment Clinics in Ethiopia, 2023: A Multi-Center Retrospective Study

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**Background:** Tuberculosis is a communicable disease, mainly caused by the bacillus *Mycobacterium tuberculosis*. Globally, TB is the ninth leading cause of death, with developing countries bearing most of the burden. The discovery of chemotherapy led to significant improvements in patient survival. Therefore, this study aimed to assess Tuberculosis treatment outcomes and associated factors in South Gondar Administrative Zone Governmental Hospitals, Northwest Ethiopia, 2023.

**Method and Materials:** A hospital-based retrospective study was conducted from July 1 to August 30, 2022, at South Gondar zone public hospitals. The data was entered into Epi-data version 4 and exported to STATA version 14. A binary and multivariable logistic regression was computed at a 95% confidence interval. Variables with a p-value less than 0.25 in the bivariable analysis were chosen for multivariable logistic regression analysis, and variables having a p-value of less than 0.05 in the multivariable analysis, were considered to have significant associations with the dependent variable.

**Results:** The study included 400 tuberculosis patients, and the overall successful treatment outcome was 89.0% (95% Confidence Interval: 85.5–91.7). In this study, study participants who tested positive for HIV were approximately three times more likely to have unsuccessful treatment outcomes (Adjusted odds ratio = 3.07; 95% Confidence Interval = 1.49–6.16.5; P = 0.002) relative to HIV-negative patients. On the other hand, patients with sputum-positive were more likely to have a successful treatment rate (Adjusted odds ratio = 0.08; 95% Confidence Interval = 0.011–0.638, P = 0.002) relative to sputum-negative TB patients.

**Conclusion:** The overall treatment success rate was 89.0%, which was lower than the global milestone target of > 90% set for 2025, and the prevalence of TB-HIV coinfection was 16.5%. In this study, HIV-positive was negatively associated with successful treatment outcomes, and sputum positive was independently associated with successful tuberculosis treatment outcomes.

**Keywords:** treatment outcome, tuberculosis, patient, Ethiopia

## Introduction

### Background

Tuberculosis (TB) is a communicable disease, mainly caused by the bacillus *Mycobacterium tuberculosis* (MTB). Globally, TB is the ninth leading cause of death, with developing countries bearing most of the burden.<sup>1,2</sup> The bacterium is mostly transmitted by inhaling droplet aerosols from lungs with active lung disease. It usually affects the pulmonary system (pulmonary TB (PTB)) and occasionally any other anatomic sites (extra- PTB(ETB)).<sup>3</sup> People infected with MTB may not develop symptoms of TB (latent TB); nonetheless, infected individuals have a 5–15% lifetime risk of becoming sick within 2–5 years of getting the infection.<sup>4</sup> However, contributing factors such as Human

Immunodeficiency Virus (HIV), Diabetes Mellitus, malnutrition, and smoking, as well as older adults and children, increase the development of TB infection.<sup>4-6</sup> The discovery of chemotherapy led to significant improvements in patient survival. Until the introduction of chemotherapy, 30–40% of TB patients died within a year, and 50–70% died within 5–7 years of acquiring TB infection. Chemotherapy resulted in a cure and a reduction in mortality for the vast majority of TB cases. However, drug resistance and poor adherence were reported shortly after the introduction of therapy.<sup>7</sup>

The World Health Organization's (WHO) End TB Strategy has set global targets and milestones for significant reductions in the annual number of TB infections and deaths between 2015 and 2035.<sup>8</sup> As of the WHO global TB report of 2021, the performance of WHO End TB Strategy 2020 milestones indicated that the TB incidence reduction rate from 2015 to 2020 was 11%, the number of TB deaths was 9.2%, and TB treatment coverage was 19.8 million compared to its plan; TB incidence reduction rate, the number of TB deaths, and TB treatment coverage of 20%, 35%, and 40 million, respectively.<sup>8</sup>

Ethiopia is among the 30 highest TB and TB/HIV burden countries in the world, with an estimated TB incidence rate of 140 per 100,000 people (157,000 persons annually) and 21,000 TB deaths (19 per 100,000 population) in 2018.<sup>9</sup> Assessing TB treatment outcomes and identifying their predictor factors is a crucial part of the treatment process. Even though the rate of successful treatment outcomes varies by country, globally the treatment outcome has been reported as 83%.<sup>8</sup>

Although the goals of TB treatment include curing patients and preventing the spread of TB infection and the emergence of new drug-resistant strains, these goals are not being met in many parts of the world due to a variety of factors. These factors include the severity of the disease, co-infection with HIV and/or other diseases, multidrug resistance, poverty, and the support provided to patients, such as assisting them in taking their TB medications regularly and completing their TB treatment, as well as financial, social, and psychological support.<sup>10</sup>

The results of the previous studies conducted to assess TB treatment outcomes in various parts of Ethiopia showed that the overall successful treatment outcome ranged from 76.32%<sup>11</sup> to 92.5%.<sup>1</sup> In the previous studies, it was indicated that HIV coinfection,<sup>12</sup> retreatment, age less than 20 years, smear-positive PTB, and,<sup>4</sup> being male, ETB, and smear-positive PTB<sup>2</sup> were associated with unsuccessful treatment outcomes.

Routine monitoring of the extent of the TB treatment outcome and its determinants is important to achieve the END TB strategy of a 95% reduction of TB case incidence by 2025,<sup>8</sup> but no data is showing the cumulative TB treatment outcome and associated factors in the study areas. As a result, the finding of this study is essential for both the local government and the national level to reduce TB infection and factors that influence successful treatment outcomes. Therefore, this study aimed to assess TB treatment outcomes and associated factors in South Gondar Administrative Zone Governmental Hospitals, Northwest Ethiopia, 2023.

## Methods and Materials

### Study Area and Period

The study was conducted in four government hospitals in the South Gondar Administrative Zone (Debre Tabor Comprehensive Specialized Hospital, Nefas Mewucha Primary Hospital, Mekane Eysus Primary Hospital, and Addis Zemen Primary Hospital). The South Gondar Zone is an administrative subregion in Amhara, Ethiopia, with a population of approximately 2,051,738. It is found at a latitude and longitude of 11°50'18.6"N and 38°05'58.3"E in the northwest of Bahir Dar, the capital city of Amhara Regional State at 103 kilometers, and Addis Ababa, the capital city of Ethiopia, at 667 kilometers. There are eight hospitals in this zone, and the above four hospitals were selected using the lottery method. The data was collected from July 1 to August 30, 2022.

### Study Design

Retrospectively TB treatment registration books were reviewed to collect the study participants' data who were on anti-TB treatment from January 1, 2017, to December 30, 2021.

## Source and Study Population

All TB patients who were treated with anti-TB drugs in the above-mentioned hospitals were the source population. Whereas, all TB patients who were treated with anti-TB drugs during the study period and had treatment outcomes in the aforementioned hospitals and fulfilled the inclusion criteria were the study population.

## Inclusion and Exclusion Criteria

### Inclusion Criteria

The data of all patients diagnosed with TB and who started anti-TB treatment during the study period and had full information in the TB treatment registration books were included in the study.

### Exclusion Criteria

Patients who were referred and with incomplete information were excluded from the study. Patients' data that lacked full information about age, sex, year of treatment, and treatment outcomes (cured, completed, treatment failure, loss to follow-up, and death were considered incomplete data).

## Sample Size and Sampling Technique

During the study period, a total of 435 TB patients were diagnosed as having all forms of TB and were linked to TB treatment clinics at the four hospitals. All TB patients who started anti-TB treatment during the study period and had full information on TB treatment outcome records were included in the study. From all hospitals, study participants who fulfilled the inclusion criteria were selected by using consecutive sampling techniques and a total of 400 TB patients fulfilled the inclusion criteria and were included in the study. The remaining 35 TB patients were excluded from the study due to the incompleteness of their data; 32 TB patients were referred to other TB treatment centers, two TB patient missed their sex, and one patient had no recorded age.

## TB Diagnosis

The Ethiopian national guideline for TB, DRUG RESISTANCE-TB, AND LEPROSY recommends that the Gene Xpert MTB/RIF test as the initial diagnostic test for all people with presumptive TB. To avoid diagnostic delays, sputum microscopy should be used as the primary diagnostic test for TB if Gene Xpert MTB/RIF service is not readily available on the same day. In addition, clinical diagnosis is done by X-ray and pathological examination as the procedure is required. Furthermore, a patient is diagnosed with EPTB when there is strong clinical evidence that TB has affected organs other than the lungs and a physician decides to treat the patient with a full course of anti-TB treatment. MDR-TB is diagnosed using Ethiopia's National Diagnostic Algorithm for Multi-Drug resistant TB (MDR-TB) Patients. Regarding drug susceptibility, all individuals diagnosed with TB are subjected to a drug resistance evaluation at least for rifampicin at the beginning using the rapid drug susceptibility test technique by Gene Xpert MTB/RIF test or culture. Furthermore, At the end of TB treatment, patients' files are closed by recording their treatment outcomes in the TB treatment registration book.<sup>13</sup>

## Method of Data Collection

The data were extracted from TB treatment registration books using a standard data extraction tool. The data extraction tool was pretested at Wogeda Hospital to check its consistency. The data extraction sheet was prepared by considering the variables found in TB treatment registration books and which are needed for our study. The checklist included socio-demographics, HIV status, type of TB, year of treatment, and treatment outcome. The data were collected after giving two days of training on the data collection tool and techniques of data collection to data collectors. During the data collection, there was a close follow-up by principal investigators to check the completeness of the collected data.

## Study Variables

### Dependent Variable

TB treatment outcome status, which is a successful TB treatment outcome (cured and completed), and an unsuccessful treatment outcome (failure, loss to follow-up, and death).

## Independent Variables

Age, sex, residence, year of treatment, HIV status, types of TB regimens, type of TB (PTB, ETB), and TB patient category (New, relapse).

## Data Processing and Analysis

The data were coded and entered into Epi-data version 4 and exported to STATA version 14.0 for analysis. Descriptive statistics (frequencies, proportions, graphs, and cross-tabulation) were employed. The crude odds ratio (COR) and adjusted odds ratio (AOR) were calculated at 95% confidence intervals (CI) for binary and multivariable logistic regression to examine the association between the outcome variable and independent factors. Multi-collinearity was checked among independent variables and no collinearity was found between independent variables. To control the effect of confounding factors all variables were entered into multivariable logistic regression using the forward selection method, and variables with a p-value less than 0.25 in the bivariable analysis were entered into multivariable logistic regression model. Multivariate logistic regression analysis was employed to assess the independent association of treatment outcome with the predictors. Variables having a p-value of less than 0.05 in the multivariate logistic regression analysis were considered as having significant associations with the dependent variable. Hosmer and Lemeshow tests were used to check the assumption on the fitness of goodness of the final model and it was found fit.

## Operational Definition

### Pulmonary Tuberculosis Sputum Positive

A patient who has at least one sputum specimen positive for *Mycobacterium bacilli*.

### Bacteriologically Confirmed

A patient who has at least one sputum specimen positive for *Mycobacterium bacilli* using Microscopy or Gene Xpert.

### Pulmonary Tuberculosis-Sputum Negative

A patient with TB symptoms and at least two sputum specimens negative for *Mycobacterium bacilli* and there was no improvement after using a broad-spectrum antibiotic, and chest radiographic abnormalities indicate active PTB (including interstitial abnormal images).

### Drug-Resistant Tuberculosis

A broad term for a strain of MTB that is resistant to one or more anti-TB drugs.

## New Case

A patient who has never received anti-TB treatment or has only received anti-TB treatment for less than four weeks.

## Relapse

A TB patient who has previously been treated for TB, was declared cured or had treatment completed at the end of their most recent course of treatment, and is now diagnosed with recurrent TB.

## Treatment Outcome

The final known status of a TB patient who started anti-TB treatment.

## Treatment Completed for Drug Susceptibility

A patient who completed treatment as recommended by the national policy whose outcome does not meet the definition of cure or treatment failure.

## Cured for Drug Susceptibility

A PTB patient with bacteriologically confirmed TB at the beginning of treatment who completed treatment as recommended by the national policy with evidence of bacteriological response and no evidence of failure.

### Cured for Multidrug Resistance

A patient with bacteriologically confirmed TB at the beginning of treatment who completed treatment as recommended by the national policy, with evidence of bacteriological response and no evidence of failure.

### Treatment Completed for Multidrug Resistance

A patient who completed treatment as recommended by the national policy, whose outcome does not meet the definition of cure or treatment failure. Died: A patient who died before starting treatment or during the course of treatment.

### Treatment Success

A cure plus treatment completion without confirmation by smear microscopy cured or complete treatment.

### Unsuccessful Treatment Outcome

The sum of loss to follow-up, death, and treatment failure.

### Previously Treated

Patients have received 1 month or more of anti-TB drugs in the past, may have positive or negative bacteriologically, and may have the disease at any anatomical site.

### Treatment Failure

A patient whose sputum smear or culture is positive at 5 months or later during the treatment period or patients found to harbor a multidrug-resistant (MDR) strain at any point of time during the treatment period, whether they are smear-negative or -positive.

### Died

A TB patient who dies for any reason during the course of treatment.

## Ethical Consideration

The ethical clearance letter was obtained from the ethics and review committee of Medical Laboratory Science with reference number CHS/LAB/2315/2022, Debre Tabor University. A permission letter was obtained from each hospital to collect the data and conduct the study. The ethics and review committee approved that, informed consent was not applicable due to the retrospective nature of the study. All data were kept confidential and used only for the intended purpose. The study was also conducted as per the Helsinki Declaration.

## Results

### Socio-Demographic Characteristics

From January 2017 to December 30, 2021, a total of 435 TB patients were diagnosed as having all forms of TB and were linked to TB treatment clinics at the four hospitals. Among these TB patients, 32 patients were referred to other treatment centers and had no treatment outcome at the study sites, two TB patients had missed data of their sex, and one patient had no recorded age. Whereas, 400 TB patients had full information and recorded treatment outcomes at four governmental hospitals in the South Gondar Zone. Among these, 50.50% of the study participants were females, and the majority of the TB patients (59.25%) were urban residents. The age of TB patients ranges from 5 years to 80 years. One hundred and sixty (40.0%) of the TB patients were in the age group of greater than 35 years, and the median age of the patients was 28 years (inter-quartile range: 22–41 years) (Table 1). The disease's case prevalence increased from 2017 to 2018 and decreased from 2018 to 2021 (Figure 1).

### Clinical Characteristics

Of the total 400 TB patients, 88.00% were new TB cases, and 16.75% had bacteriologically confirmed sputum-positive PTB. Sixteen-point-five percent of study participants were confirmed to be co-infected with HIV (Table 2).

**Table 1** Socio-Demographic Characteristics of TB Patients Enrolled for Treatment at Four Governmental Hospitals in South Gondar Zone, Northwest Ethiopia, 2023 (N=400)

Variables	Categories	Frequency (N)	Percent (%)
Sex	Male	198	49.50
	Female	202	50.50
Age in years	5–14	17	4.25
	15–24	118	29.50
	25–34	105	26.25
	≥ 35	160	40.00
Residence	Urban	237	59.25
	Rural	163	40.75

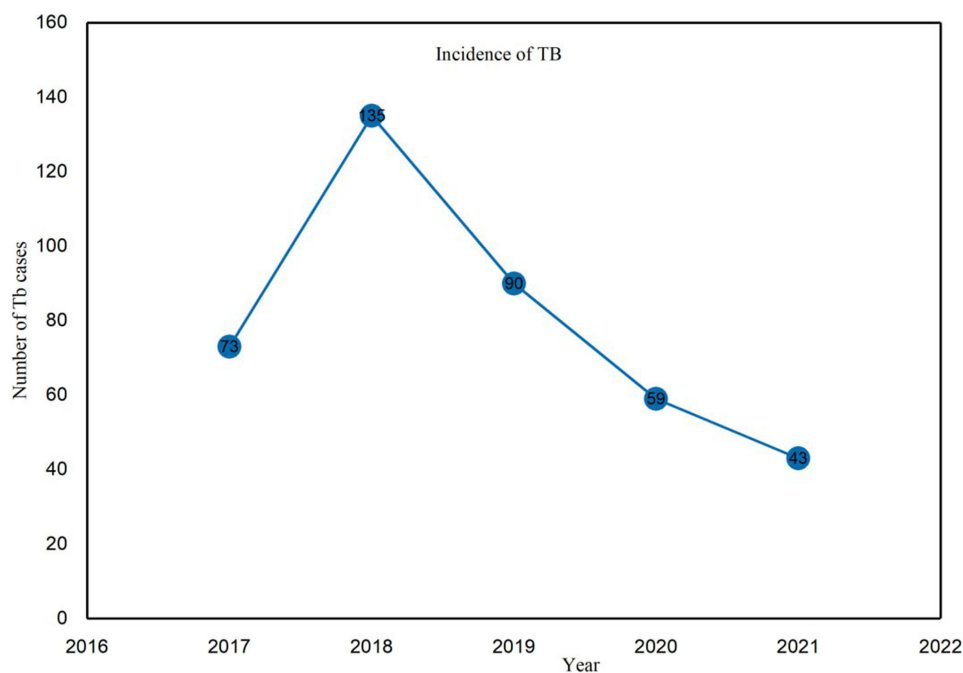
## Treatment Outcome

After six months of anti-TB treatment, the outcome of TB patients was evaluated. The overall treatment success was 89.0% and unsuccessful treatment was 11.%. Hence, 19.25% were cured, 69.75% completed their treatment, 1.50% were treatment failures, 3.75% were lost to follow-up, and 5.75% died (Figure 2).

The overall treatment success rate was 89.0%. Among the 67 TB patients with bacteriologically confirmed cases, 16 were cured, 50 completed treatments, and one died. Among ETB patients (193), 178 completed their treatment, 9 were lost to follow-up, 5 died, and 1 failed. Of the total 140 sputum-negative PTB patients, 14 were cured, 98 completed the treatment, 6 were lost to follow-up, 5 were failures, and 17 died (Table 3).

## Factors Associated with TB Treatment Outcomes

Among the variables subjected to the multivariate logistic regression analysis, the patient's HIV status had a significant association with unsuccessful treatment outcomes. After multivariable logistic regression, sputum-positive PTB and



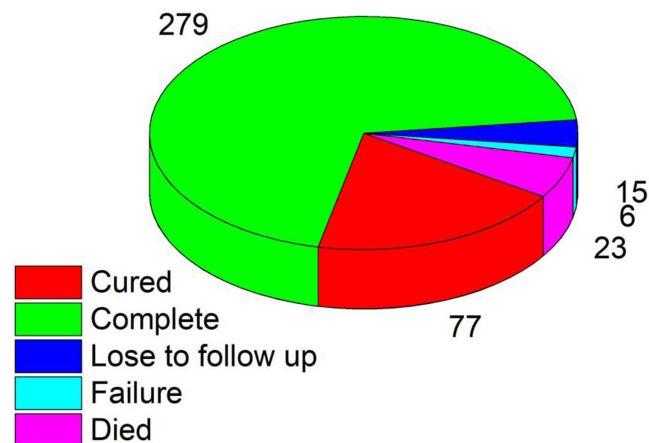
**Figure 1** Trends of TB cases at four public hospitals in the South Gondar administration Zone from 2017 to 2021 (N=400).

**Table 2** Clinical Characteristics of TB Patients Who Were on Anti-TB Treatment at South Gondar Administration Zone Governmental Hospital, Northwest Ethiopia, 2023 (N=400)

Variables	Category	Frequency (N)	Percentage (%)
TB patient category	New	352	88.00
	Relapse	20	5.00
	Treatment failure	7	1.75
	Transferred in	21	5.25
HIV status	Negative	334	83.50
	Positive	66	16.50
HIV treatment	Started	66	100
	Not started	0.00	0.00
Type of TB	Sputum-positive PTB	67	16.75
	EPTB	193	48.25
	Sputum-negative PTB	140	35.00
Treatment regimen	First line	327	81.75
	Second line	73	18.25

having EPTB were variables associated with a successful treatment outcome. As a result, study participants who tested positive for HIV were approximately three times more likely to have unsuccessful treatment outcomes (AOR = 3.07; 95% CI = 1.49–6.16.5; P = 0.002) relative to HIV-negative patients. On the other hand, patients with positive sputum PTB were more likely to have a successful treatment rate (AOR = 0.08; 95% CI = 0.011–0.638, P = 0.002) relative to sputum-negative TB patients (Table 4).

### Treatment Outcome of TB patients



**Figure 2** Treatment outcomes of the TB patients at four public hospitals in the South Gondar administration Zone from 2017 to 2021 (N=400).

**Table 3** Distribution of Treatment Outcome with Socio-Demographic and Clinical Characteristics of TB Patients Attending Public Hospitals of South Gondar Administration Zone, Northwest Ethiopia, 2023 (N=400)

Characteristics	Treatment Outcome (N)					Total
	Cured	Complete	Loss to Follow Up	Failure	Died	
Age in years						
5–14	3	14	0	0	0	17
15–24	26	83	4	0	5	118
25–34	14	79	3	3	6	105
≥35	34	103	8	3	12	160
Sex						
Male	41	136	5	1	15	198
Female	36	143	10	5	8	202
HIV status						
Negative	69	238	12	1	14	334
Positive	8	41	3	5	9	66
Type of TB						
Sputum positive PTB	16	50	0	0	1	67
ETB	–	178	9	1	5	193
Sputum-negative PTB	14	98	6	5	17	140
TB patient category						
New	66	249	12	6	19	352
Relapse	0	14	2	0	4	20
Treatment failure	2	4	1	0	0	7
Transferred in	9	12	0	0	0	21
Treatment regimen						
First line	68	230	6	6	17	327
Second line	9	49	9	0	6	73
Year of treatment						
2017	10	57	0	1	5	73
2018	30	102	0	0	3	135
2019	14	57	10	0	9	90
2020	13	37	3	3	3	59
2021	10	26	2	2	3	43



**Table 4** Associated Factors with TB Treatment Outcomes Among TB Patients Attending Public Hospitals of South Gondar Administration Zone, Northwest Ethiopia, 2023 (N=400)

Variables	Category	COR (95% CI)	P -value	AOR (95% CI)	P -value
Age	0–23	1		1	0.153
	24–44	2.074 (0.94–4.58)	0.071	1.45 (0.63–3.36)	
	≥45	1.214 (0.44–3.28)	0.7	0.61 (0.202–1.796)	
Type of TB	Sputum positive	0.06 (0.008–0.456)	0.006	0.08 (0.011–0.638)	0.002
	Extra PTB	0.34 (0.17–0.66)	0.001	0.347 (0.17–0.709)	
	Sputum negative	1		1	
HIV status	Negative	1			0.002
	Positive	3.94 (2.003–7.77)	0.000	3.07 (1.49–6.16)	
Types of TB regimen	1st line	1		1	0.049
	2nd line	2.66 (1.34–5.26)	0.005	2.143 (1.005–4.57)	

## Discussion

The present study showed a decrement in the incidence of TB from 2018 to 2021, which may imply the prevention strategies implemented were effective. The Ethiopian, Ministry of Health was planned to achieve a treatment success rate of 90% by the year 2020. The magnitude of the overall treatment outcome was 89.0%. Among these, 19.25% were cured, 69.75% completed their treatment, 1.50% were treatment failures, 3.75% were lost to follow-up, and 5.75% died. Our study also showed that most of the study participants were newly diagnosed TB patients.

Accordingly, HIV-positive patients were about three times more likely to have unsuccessful treatment outcomes (AOR = 3.07; 95% = 1.49–6.16; P = 002). This finding is similar to the findings of studies done in Harar, Ethiopia,<sup>1</sup> Asella Teaching Hospital, Ethiopia,<sup>14</sup> Southeast Ethiopia,<sup>12</sup> and Cameroon.<sup>15</sup> This is due to HIV-positive patients might not take the drug as prescribed due to the fear of drug interaction and side effects, mortality as a result of co-infection is higher than TB infection alone, and the immunity of HIV-positive TB patients is low.

Identification of factors associated with TB treatment outcomes is critical for addressing those factors causing poor TB treatment outcomes. In this study, logistic regression analysis showed that being HIV-positive, being on second-line anti-TB treatment, being sputum-positive, and having ETB were associated with TB treatment outcomes. However, the regression analysis of our study showed that TB treatment outcome was not significantly associated with the patient's age, sex, and residence of the participants. This finding is similar to a study done in Debre Tabor, Ethiopia,<sup>10</sup> and Adama City, Ethiopia.<sup>3</sup>

In our study, 50.5% (95% CI: 45.5–55.4) of the TB patients were females. This finding is similar to a study done in Addis Ababa, Ethiopia, 49%,<sup>16</sup> Woldia General Hospital, Northeast Ethiopia, 46.7%,<sup>17</sup> Southern Ethiopia, 45.7%, and Asella Hospital, Oromia Region, Ethiopia, 47.2%.<sup>14</sup> However, this finding is lower than with previous studies conducted in Ashanti Region, Ghana, 67.23%,<sup>4</sup> and Cameroon, 56.3%.<sup>18</sup> Furthermore, the result of this study is higher than studies done in Harar, Ethiopia, 40.2%,<sup>1</sup> Ghana, 31.2%,<sup>5</sup> Adama, Ethiopia, 44.1%,<sup>3</sup> and East Wollega, Western Ethiopia, 41.1%.<sup>19</sup> The disparity could be attributed to sampling size as well as sociodemographic, cultural, and socioeconomic differences.

In this study, the majority of TB patients, 45.75%, were in the reproductive age group. The result is comparable with studies done in East Wollega, Western Ethiopia,<sup>19</sup> and Harar, Eastern Ethiopia.<sup>1</sup> This could be because TB primarily affects the productive age group of society as these people move from place to place other than other age groups due to their active age stage, which can add to the economic burden of society, particularly in developing countries. In our study majority of TB patients, 59.25% were urban dwellers. This finding is similar to a study conducted in the East Gojjam Zone, Ethiopia,<sup>20</sup> and Southern Ethiopia.<sup>2</sup>

According to the findings of our study, the overall successful treatment outcome was 89.0% (95% CI: 85.5–91.7). Of these, 19.25% were cured, and 69.75% had treatment completed. The current study's overall success rate is consistent with previous studies conducted in northwest Ethiopia, 90.1%,<sup>10</sup> the global milestone target of > 90% set for 2025,<sup>8</sup> and Western Ethiopia, 91.9%.<sup>19</sup> However, the result of this study is lower than studies done in Eastern Ethiopia, 92.5%,<sup>1</sup> Addis Ababa, Ethiopia, 94.6%,<sup>21</sup> and higher than studies done in Addis Ababa, 79.6%,<sup>10</sup> East Gojjam Zone, Ethiopia, 68.4%,<sup>20</sup> Western Oromia, Ethiopia, 74%,<sup>22</sup> and Southern Ethiopia, 82.5%.<sup>2</sup> This disagreement might be due to differences in the handling of transfers of TB patients, socio-economic characteristics of patients, geographic setting, sample size, study period, HIV co-infection, and coordination of HIV and TB activities.

In this study, HIV was found in 16.5% (95% CI: 13.1–20.4) of TB patients. This finding is similar to a study conducted in Hosanna, Ethiopia,<sup>22</sup> Southern Ethiopia, 17%.<sup>2</sup> However, our study revealed a lower HIV-positive prevalence than a study done in Harar, Ethiopia,<sup>1</sup> and Debre Tabor, Ethiopia.<sup>10</sup> The differences might be the difference in health care service provided in different parts of the country, the health care utilization behavior of the community, and access to the health care facility.

Among the HIV-positive TB patients, the treatment success achieved was 74.2%, which is lower than a study done in Southern Ethiopia.<sup>2</sup> This unsuccessful treatment outcome among HIV co-infected TB patients could be attributed to factors such as underlying HIV and other undiagnosed opportunistic infections, as well as sample size because the number of TB-HIV coinfection in this study was higher than in the Southern Ethiopia study.

In the present study, the proportion of PTB-positive, PTB-negative, and EPTB cases were 16.75%, 35%, and 48.25%, respectively. The proportion of PTB- in this study is similar to the finding of a study done in Oromia, Ethiopia<sup>14</sup> and Southern Ethiopia.<sup>2</sup> On the other hand, its proportion is lower than the studies done in eastern, Ethiopia<sup>1</sup> and Hosanna, Ethiopia.<sup>23</sup> The proportion of PTB positive is lower than in studies done in Hosanna, Ethiopia,<sup>23</sup> Easter, Ethiopia,<sup>1</sup> Southern Ethiopia,<sup>2</sup> and Oromia Region, Ethiopia.<sup>14</sup> In this study, the proportion of EPTB is higher than the result of studies done in Hosanna Ethiopia,<sup>23</sup> Easter, Ethiopia,<sup>1</sup> Southern Ethiopia,<sup>2</sup> and Oromia Region, Ethiopia.<sup>14</sup> This variation might be due to sample size variation, socio-economic status, and geographical location.

## Limitations of the Study

Since secondary data were obtained retrospectively from the TB registration log books, it was not possible to identify all factors that could influence the patient's treatment outcomes.

## Conclusion and Recommendation

The overall treatment success rate was 89.0%, which was lower than the global milestone target of > 90% set for 2025, and the prevalence of TB-HIV coinfection was 16.5%. In this study being HIV-positive, and being on second-line anti-TB treatment was associated with poor treatment outcomes while being sputum-positive, and having ETB were associated independently with successful TB treatment outcomes. Increased HIV prevention and health education activities are critical for improving TB patients' treatment outcomes. In addition, more prospective studies are required to identify other predictors of TB patient treatment success.

## Abbreviations

AOR, Adjusted Odds Ratio; CI, Confidence Intervals; COR, Crude Odds Ratio; ETB, Extra-Pulmonary TB; HIV, Human Immunodeficiency Virus; MDR-TB, Multi-Drug Resistant Tuberculosis; MTB, Mycobacterium Tuberculosis; PTB, Pulmonary TB; TB, Tuberculosis; WHO, World Health Organization.

## Data Sharing Statement

The datasets used and/or analyzed during the current study are included in the manuscript.

## Ethics Approval and Consent to Participate

The ethical clearance letter was obtained from the ethics and review committee of Medical Laboratory Science with reference number CHS/LAB/2315/2014, Debre Tabor University. A permission letter was obtained from each hospital to

collect the data and conduct the study. The ethics and review committee approved that; informed consent was not applicable due to the retrospective nature of the study. All data were kept confidential and used only for the intended purpose. The study was also conducted as per the Helsinki Declaration.

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## Disclosure

The authors declare that they have no competing interests.

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