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Treatment Outcome and Determinant Factors of Tuberculosis among Patients Treated at Bule Hora University Teaching Hospital, West Guji zone, southern Ethiopia

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Abstract

Background: Tuberculosis (TB) is an infectious disease transmitted as an airborne disease. TB is still treatable even though it produces bacteria that are difficult to eradicate.. Early diagnosis and appropriate treatment are two clinical strategies recommended to prevent TB from spreading.

Objective: To determine trends in tuberculosis treatment outcomes and determinant factors among patients treated at Bule Hora University Teaching Hospital from January 2020 to December 2022.

Method: An institutional-based retrospective cohort study was conducted at Bule Hora University Teaching Hospital to determine the treatment outcome among all patients treated for tuberculosis. The TB treatment register found at the TB clinic was reviewed to collect three-year treatment data on TB patients. The collected data consisted of demographic and clinical data comprising treatment outcomes. The data were entered and analyzed using the Statistical Package for Social Sciences (SPSS) version 20. Bivariate and multivariate logistic regression models were used for determinant analysis. The declaration of statistical significance was a P value less than 0.05.

Result: The overall treatment success rate was 94.3% CI; 95% [90.9-97.8] of this half of the TB patients had cured their treatment, and 44.3% patients completed treatment. Of the unsuccessful treatment outcomes, 1.1% were failed treatment, 1.7% were lost to follow-up, and 2.9% died during the follow-up. Urban dwellers (AOR: 1.73; 95% CI: 1.02-2.68; P = 0.041) and HIV-negative individuals (AOR: 1.51; 95% CI: 0.95-4.90; P = 0.002) were determinants of successful TB treatment outcomes. The trend in the treatment success rate fluctuated, increasing from 2020 to 2021 and then slightly decreasing in 2022, while the death rate decreased from 2020 to 2022.

Conclusion: The current treatment success rate exceeds the recommended target. However, special attention and strict follow-up are required for tuberculosis patients with a high risk of unsuccessful treatment outcomes, including rural residents and HIV status-positive patients, throughout their treatment period.

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Introduction

Tuberculosis (TB) is the most fatal single-agent communicable disease caused by a bacillus bacterium called *Mycobacterium tuberculosis*, which discovered more than 100 years ago. It is an airborne infection that spreads when droplets carrying TB-causing bacteria are expelled by a person with active pulmonary or laryngeal TB and inhaled by another susceptible person nearby [1].

The second most common infectious disease-related cause of mortality worldwide is tuberculosis (TB). Despite being a treatable and preventable illness, tuberculosis is predicted to claim the lives of 1.5 million people in 2020 [2]. In 2019, the number of tuberculosis cases in the African region was predicted to be 2.5 million, or 25% of the global burden. More than 500,000 African lives are lost to this illness every year [3]. Ethiopia is one of the 30 nations worldwide with the highest rates of TB, TB/HIV, and MDR-TB. In 2019, the mortality rate for tuberculosis was 21 per 100,000 persons, while the incidence rate was projected to be 140 per 100,000. In the same year, 111,039 cases of tuberculosis were reported in the nation [4].

TB infection affects various body organs. Pulmonary tuberculosis (PTB) is the predominant type of TB that affects the lung; nonetheless, TB may also occur as extrapulmonary tuberculosis (EPTB), which affects organs other than the lung, including the skeletal system, genitourinary organs and lymphatic body (glands) [5]. Tuberculosis is also classified as latent TB and active TB in terms of clinical manifestation and disease progress. Latent TB is an asymptomatic stage in which an infection is controlled by immunity despite exposure, while active TB is a communicable form of tuberculosis [6].

The treatment of tuberculosis consists of two treatment stages, namely, the initial phase and the continuous phase. TB has a lengthy treatment duration of at least 6-8 months to complete the full treatment course, and patients are also expected to take multiple drugs as a fixed-dose combination drug {m/6/}. At the same time, the treatment outcome for tuberculosis may be successful or not. A TB patient must complete a full treatment course or must test negative after

completing the treatment to be certified as having a successful treatment outcome. If not, the treatment was considered unsuccessful. Treatment interruption, loss to follow-up, or death before completing the treatment are some causes of unsuccessful treatment outcomes [6][7].

Directly observed treatment short course (DOTS) is therefore the standard treatment algorithm recommended. DOTS makes a patient take medication while actively being observed by the health provider, which is of course proven to be effective for a patient not to miss a single dose and thereby decreases the possibility of negative consequences, including the risk of reinfection and emergence of resistant strains to the existing drugs [8]. Nevertheless, TB is a curable disease, and it is still difficult to kill bacteria and a global health emergency with a catastrophic impact. Therefore, TB requires well-designed control and prevention strategies to halt its impact. Active surveillance, regular screening, early detection, and both latent and active TB infection are important elements for preventing TB infection from spreading further [9].

By 2035, the world will be free of tuberculosis, predicting the WHO's END-TB strategy [10]. People with TB disease should be treated as soon as possible because doing so stops their transmission of the disease and lowers the incidence of TB in the community. More importantly, once a case of TB has been identified, it needs to receive the proper treatment in order to reduce the likelihood of its severity, mortality, rate of treatment failure, and emergence of a drug-resistant infection. There has never been a study on the effectiveness of tuberculosis treatment and the factors that influence it in Ethiopia's southern Oromia state. This study will therefore be created to close this gap.

Methods and Materials

Study Area and Period

The study was conducted at Bule Hora University Teaching Hospital (BHUTH) to determine the tuberculosis treatment outcomes and determinant factors among patients treated by reviewing the charts of patients treated for TB from January 2020 to December 2022 GC. The hospital is the largest of all hospitals in the West Guji zone located 470 km southeast of the capital Addis Ababa in the Oromia regional state, Ethiopia. The hospital has a separate TB clinic where DOTS services are provided. This study was conducted to retrieve data on treatment during the study period. The total number of TB patients registered from January 2020 to December 2022 was (1722) 823 female and 899 male patients.

Study Design and Population

The design of the study was institutional-based retrospective cohort study. The source population of the study was all patients who had been diagnosed with tuberculosis and registered for treatment of TB at BHUTH. All patients enrolled and completed their TB treatment at BHUTH from January 2020 to December 2022 were the study population.

Eligibility criteria

All TB patients enrolled in anti-TB treatment were included in the study; those with missing demographic data, those

receiving treatment during the study, and those with missing treatment-related information were removed.

Sample size Determination

The sample size was determined based on a single population proportion formula by considering the following assumption: a previous study performed in southern Ethiopia with $P=85.2\%$ [10], with a 95% confidence interval and a confidence limit of 0.5. This resulted in 194 patients who were enrolled in the study. The final sample size was adjusted for the finite population since the total number of patients treated for tuberculosis at the hospital during the study period (1722) was 823 female and 899 male patients.

$$n = \frac{Z_{\alpha/2}^2 P(1-p)}{d^2} = \frac{(1.96)^2 (0.852)(0.148)}{(0.05)^2} = 194$$

Where, P = prevalence of previous study in southern Ethiopia, n = sample size, Z =95% confidence interval, d = 5% margin of error. Since the total population is less than 10,000, the correction formula.

Where, n_f = final sample size, n =total study population, which is 194, N =source of population is \1722, total 174 patient data were used in this study.

Sampling technique

All patients who registered data and started their treatment during the study period were used as the sampling frame. To select the first eligible patient's data within the defined sampling frame, all patient data were assigned a unique identification number and arranged chronologically based on the date of treatment initiation. Registries that met the inclusion criteria were selected through a systematic sampling technique. This sampling interval (K) was obtained by dividing the total number of registered TB patients (1722) by the sample size (174) (Figure 1). $K=1722/174=10$, the first sample was selected with the lottery method. Schematic presentation of the data procedure. TB Patient admitted in 2020= $287 \times 174/1722=29$, TB Patient admitted in 2021= $613 \times 174/1722=62$, TB Patient admitted in 2022= $821 \times 174/1722=83$

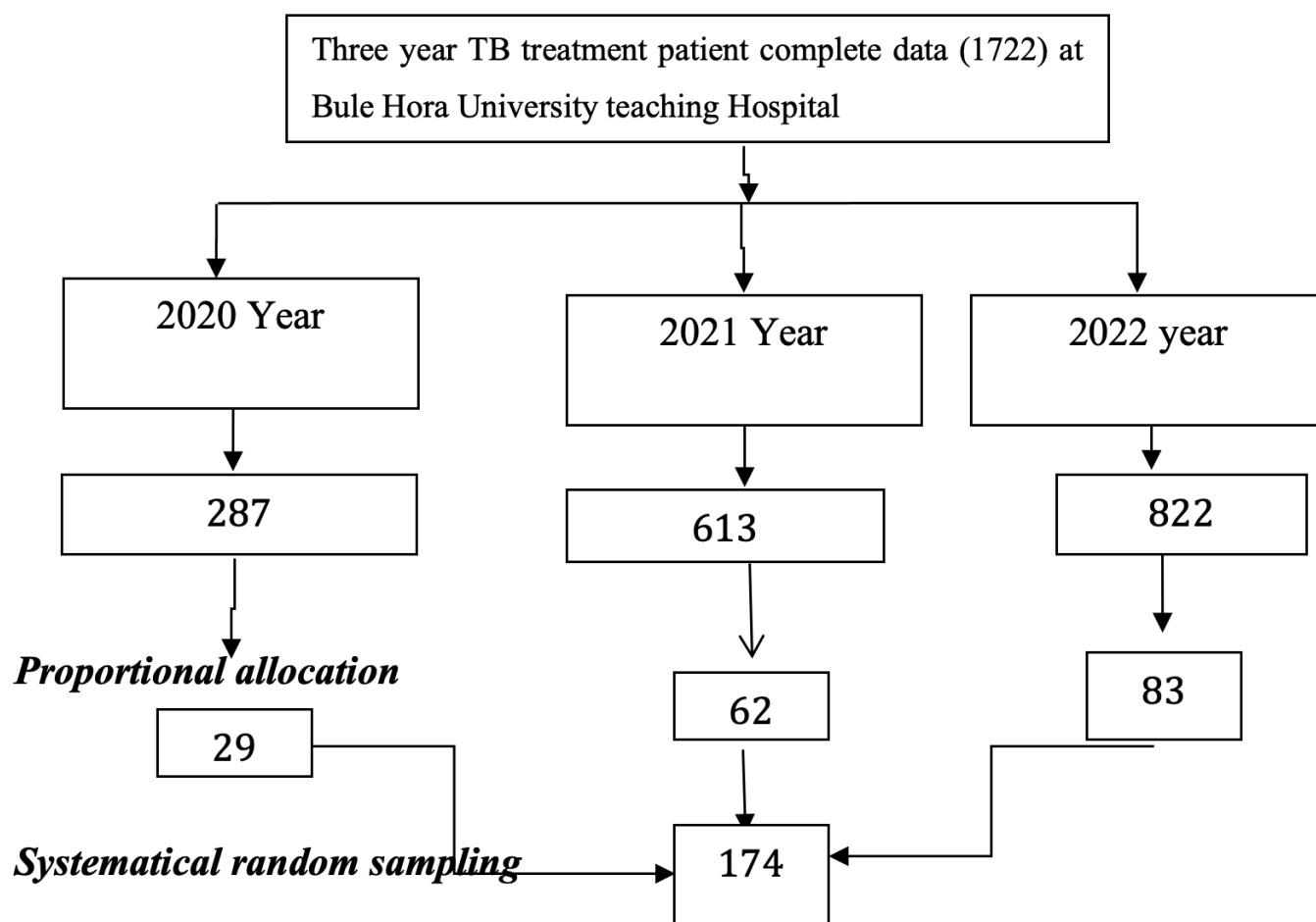


Figure 1. Sampling techniques of TB treatment out come and determinant factors in Bule Hora University teaching Hospital

Data collection

Data were collected from the TB treatment register found at the TB clinic. Data abstraction sheets used by previous similar studies were used for data collection. The data regarding the treatment outcome are retrieved based on the standard classification scheme. Accordingly, treatment outcome is categorized into two broad categories, successful and unsuccessful treatment outcome; meanwhile, these two categories comprise 6 classes, namely, cure, treatment completed, treatment failure, loss to follow-up, death, and transfer. In addition, information such as the residence of patients, HIV status (positive vs negative), and type of TB diagnosed (EPTB or PTB) was collected. Meanwhile, data regarding pulmonary TB were further classified and collected as smear positive or smear negative. Furthermore, demographic and clinical data such as age, sex, and type of TB were also retrieved from the TB registry using data extraction sheets.

Operational definition

TB treatment outcome: The final known status of a TB patient who started anti-TB treatment^[11].

Cured: An initially smear-positive patient who is sputum smear negative at or 1 'month' prior to the completion of TB treatment and on at least one previous occasion (usually at the end of the 2nd or 5th month) ^[11].

Treatment completed: Patients who completed treatment ^[12]

Treatment Failure in A patient whose sputum smear is positive at the 5th month of treatment or later ^[11]

Treatment Success: the sum of cured and treatment completed ^[11]

Died: A TB patient who dies for any reason before starting or during treatment ^[12].

Lost to follow-up: A TB patient who did not start treatment or whose treatment was interrupted for 2 consecutive months or more ^[11].

Data quality assurance

The supervisor and data collectors received training on study-related topics before the actual study was undertaken. The acceptability of the data extraction sheet whether it could pool the necessary information or not, and the data were formalized with how they were recorded.

Data analysis

Before data entry, the collected data were checked for completeness and cleaned. The data were then entered and analyzed using the Statistical Package for Social sciences (SPSS) version 20.0. Descriptive statistics were used to describe the data using percentages and frequencies. Descriptive statistics were used to present the findings, and tables and figures were used to compute the frequency distributions of the variables. To evaluate the determinants of tuberculosis treatment outcome under directly observed treatment short-course potential determinants of successful treatment outcome, sociodemographic, and clinical variables were compared between the successful and unsuccessful treatment outcome groups using bivariate and multivariate logistic regression models. The multivariate logistic regression model contained variables with a P value in the univariate analysis that was less than or equal to 0.25. Model fitness was checked by using the Hosmer–Lemeshow test of significance and the Omnibus test.

Result

Sociodemographic characteristics of TB patients treated at BHUTH

One hundred seventy-four (n: 174) TB patients had documented treatment outcomes included in this study. Out of the total enrolled data, 29(16.7%), 62(35.6%), and 83(47.7%) were from 2020, 2021, and 2022 years respectively. The majority of those patients were males (56.3%), within the age group of 15 to 24 years (26.4%), and the mean (std. deviation) age of patients was 30 ±1.55 and lived in urban areas (52.3%), as shown in Table 1.

Table 1. Sociodemographic characteristics of TB patients at BHUTH 2023.

Variable	Characteristics	Frequency	Percent
Sex	Male	98	56.3%
	Female	76	43.7%
Age(in years)	<15	26	14.9%
	15-24	46	26.4%
	25-34	41	23.6%
	35-44	22	12.6%
	45-54	21	12.1%
	>55	18	10.3%
Residence	Urban	91	52.3%
	Rural	83	47.7%

Clinical characteristics

Among 174 patients, 171 (98.3%) were new TB patients, and 11 (6.3%) were coinfectd with HIV. The predominant form of TB was sputum-positive pulmonary tuberculosis 98(56.3%), as shown in Table 2.

Table 2. Clinical characteristics of TB patients treated at BHUTH between 2020 to 2022.

Characteristics	Frequency	Percent (%)	
Treatment history	New	171	98.3
	Re-Treatment	3	1.7
HIV Status	Positive	11	6.3
	Negative	163	93.7
Tuberculosis Types	SPPTB	98	56.3
	SNPTB	47	27
	EPTB	29	16.7

SPPTB: sputum positive pulmonary tuberculosis, **SNPTB:** sputum negative pulmonary tuberculosis, **EPTB:** extra pulmonary tuberculosis.

TB Treatment outcome

The overall treatment success rate was 164 (94.3%) CI; 95% [90.9-97.75] out of this half of TB patients, 87(50%) had cured their treatment, and 77 (44.3%) patients completed treatment. Of the unsuccessful treatment outcomes, 2 (1.1%) had failed treatment, 3 (1.7%) were lost to follow-up, and the remaining 5 (2.9%) died during the follow-up (Figure 2).

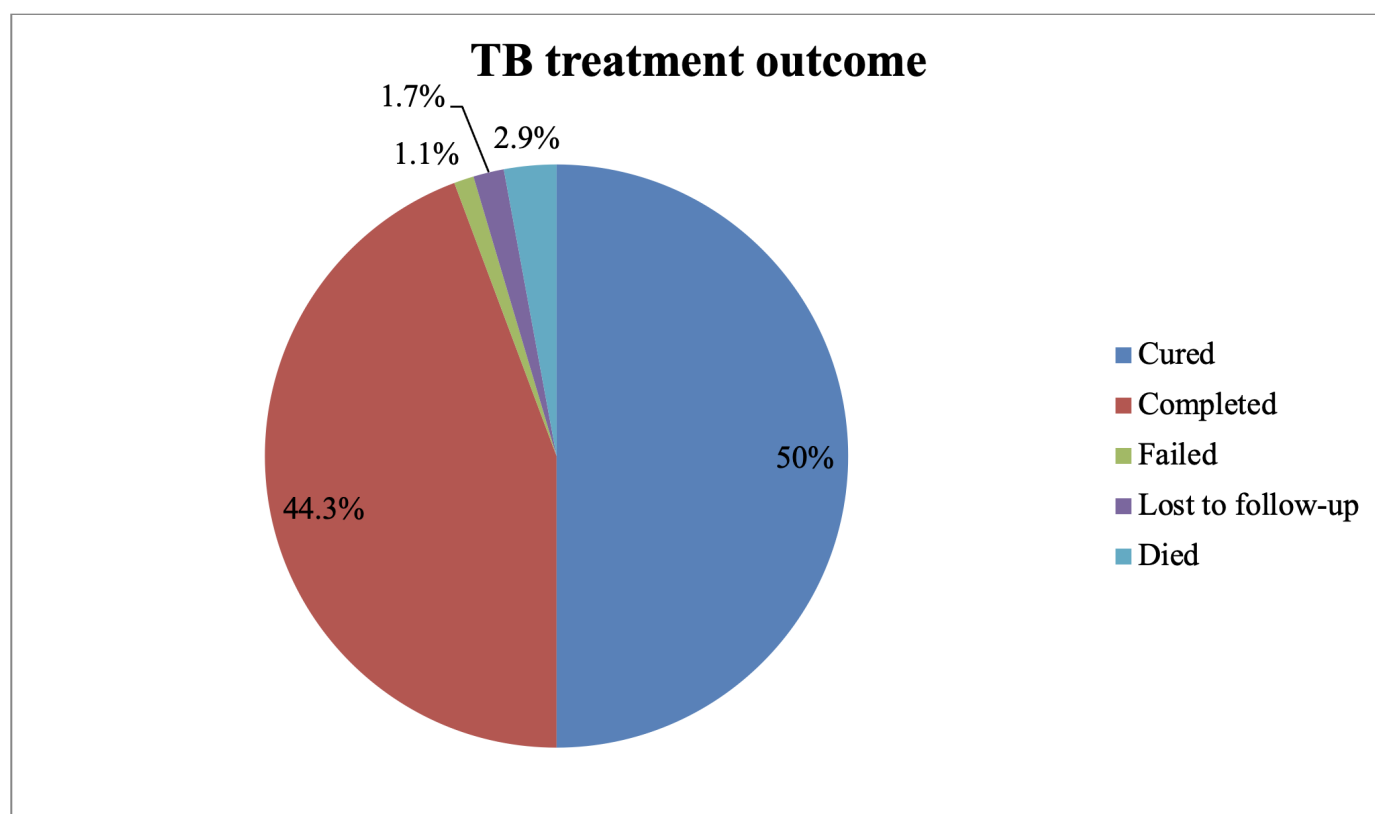


Figure 2. TB treatment outcomes among patients treated at BHUTH between 2020 to 2022

Trends in treatment outcomes

The trend in the treatment success rate of all TB patients fluctuated, increasing from 89.7% in 2020 to 96.8% in 2021, then slightly decreasing to 96.4% in 2022. On the other hand, the death rate decreased from 3.4% in 2020 to 3.2% in 2021 and 2.4% in 2022 (Figure 3).

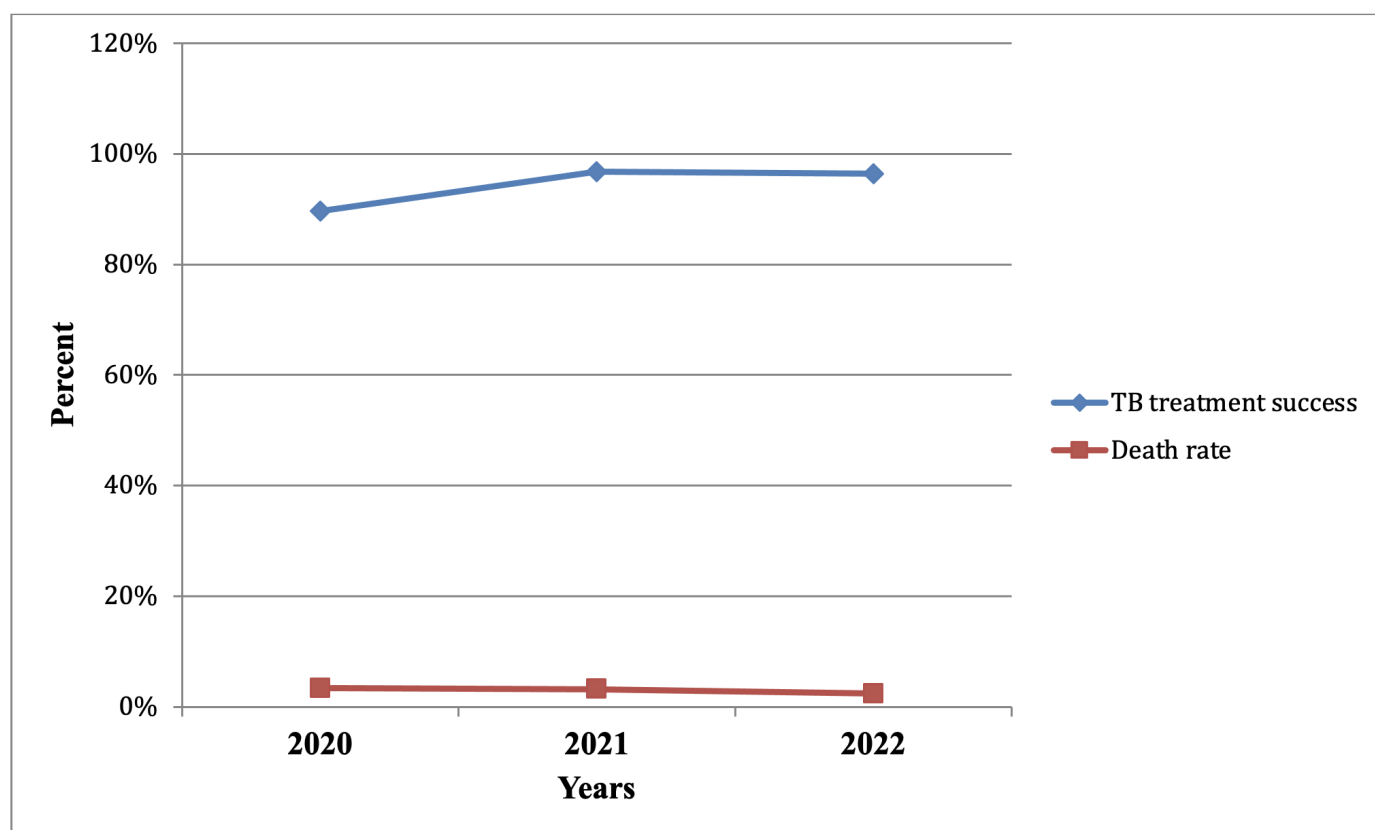


Figure 3. Trends of TB treatment outcomes among the patients treated at BHUTH between 2020 to 2022

Determinants of successful treatment outcomes

Tuberculosis success rate among patients who were treated in BHUTH who lived in urban areas was nearly 2 times higher than among rural residents (AOR: 1.73; 95% CI: 1.02-2.68; $P = 0.041$). Those who were HIV-negative were nearly 2 times more likely to be successful in TB treatment (AOR: 1.51; 95% CI: 0.95-4.90; $P = 0.002$) than HIV-positives, as shown in Table 3.

Table 3. The determinants of successful treatment outcome among TB patients at BHUTH 2023.

Variable	Category	Treatment out come		COR [95%CI]	AOR [95%CI]	P. value
		Successful	Unsuccessful			
Sex	Male	90(91.8%)	8(8.2%)	1	1	0.19
	Female	74(97.4%)	2(2.6%)	3.29 [1.65-11.43]	1.94 [1.23-2.64]	
Residence	Urban	88(96.7%)	3(3.3%)	2.70 [1.04-6.11]	1.73 [1.02-2.68]	0.041*
	Rural	76(91.6%)	7(8.4%)	1	1	
Treatment History	New	161(94.2%)	10(5.8%)	8.05 [2.16-15.54]	2.43 [0.95-5.25]	0.09
	Retreated	2(66.7%)	1(33.3%)	1	1	
Types of TB	Smear positive	91(92.9%)	7(7.1%)	0.66 [1.54-2.43]	1.25 [0.88-7.87]	0.051
	Smear negative	46(97.9%)	1(2.1%)	1.60 [0.85-2.66]	1.41 [0.80-2.43]	
	Extra pulmonary	27(93.1%)	2(6.9%)	1.17 [0.60-2.25]	1.08 [0.56-2.11]	
HIV Status	Positive	10(90.9%)	1(9.1%)	1	1	0.002*
	Negative	154(94.5%)	9(5.5%)	1.71 [0.75-4.86]	1.51[0.95-4.90]	

COR=crude odds ratio, AOR=adjusted OR with CI=confidence interval, *P-value<0.05

Discussion

The overall treatment success rate was 94.3%, CI, 95% [90.9-97.75]. The result was comparable to other findings in India (93% [11], Tefera Hailu Memorial General Hospital, Northeast Ethiopia (93.8% [13], Goba Referral Hospital, Southeast Ethiopia (91.2% [14], 92.4% in Hawassa [15], Public Hospitals of Harar Town, Eastern Ethiopia (92.5% [16], and Dilla Referral Hospital, southern Ethiopia (92.3% [17]), and health facilities in East Wollega, Western Ethiopia (91.9% [12]. This finding exceeded the WHO 2030 international target and Ethiopian national strategic goals set for 2020, which were above or equal to 90% [18][19].

However, the current finding was higher than in other reports from studies done in Pakistan, 68% [20], Wolayta Sodo Teaching and Referral Hospital, Southern Ethiopia, 82.5% [21], Gibe Woreda, Southern Ethiopia 85.5% [22], Tepi public health centre Southwest Ethiopia 82.5% [23], Debre Tabor, Northwestern Ethiopia 87.1% [24], Dilla University referral hospital, southern Ethiopia 85.2% [10], Jabitehinan and Fenoteselam administrative town health facilities, North West Ethiopia 82.5% [25], Addis Ababa, Ethiopia 82.6% [26], Ethiopian University Hospital 60.1% [27], Jimma University Specialised Hospital and Omonada training health centre, Southwest Ethiopia 85.9% [28], Gambella Regional State (88.1%) [29]. This discrepancy may be brought on by variations in the management of transfer-out cases, socioeconomic patient characteristics, geographic setting, counseling on treatment, knowledge, HIV coinfection prevalence, DOTS performance, community health care utilization patterns, and coordination of TB activities.

Regarding the death rate of the treated cases, 2.9% died during the follow-up, which is consistent with studies conducted in Jabitehinan and Fenoteselam health facilities. North West Ethiopia reported 3.1% [25], but lower than studies from Wolayta Sodo (4.7% [21], East Wolega (4.8% [12]), and Goba (5.1% [14]). In the present study, 1.7% of the TB patients were identified as lost to follow-up. The findings were similar to those of the studies conducted in Tefera Hailu Memorial

General Hospital, Northeast Ethiopia, at 1.3% [13] and Hosanna at 1.4% [30], but lower than the reports from Wolayta Sodo at 11.2% [21], Dilla at 11.1% [17], and East Wollega at 2.9% [12]. These discrepancies may be due to changes in how well the community implements the DOT's strategy, offers counseling services, and encourages ethical healthcare utilization and seeking behavior.

The present study revealed that patients from urban dwellers were more likely to have a successful treatment outcome than rural residents. This finding was consistent with studies done in Tepi, Southwest Ethiopia [23], Debre Tabor, Northwestern Ethiopia [24], Jabitehinan, and Fenoteselam health facilities, North West Ethiopia [25]. However, this result was contrary to other reports elsewhere in Ethiopia East Wollega [12]. The reason for the difference may be due to counselling availability, the level of community awareness, or the intervention of the government.

This study found that HIV status was significantly associated with successful TB treatment outcomes. Patients who were HIV negative were more likely to have a successful TB treatment outcome when compared to those who were HIV positive. This finding is supported by a study conducted at Dilla Referral Hospital, southern Ethiopia [17], Goba [14], Tefera Hailu Memorial General Hospital, northeast Ethiopia [13], and Harar Town, eastern Ethiopia [16] that reported HIV-negative TB cases had higher treatment success than HIV-positive TB cases. HIV-positive patients may not take medication as directed due to worries about drug interactions and side effects, whereas HIV-negative TB patients may have stronger immune systems than HIV-positive patients.

The trend analysis of the study indicated that the treatment success rate of TB cases varied, increasing from 2020 to 2021 and then gradually decreasing in 2022. This finding was in agreement with previous studies [11][24][23]. In addition, the trend of the death rate among treated TB cases decreased. The possible reason might be due to supporting adherence, program delivery, and better DOTS performance.

Limitations

Since just three years' worth of data from a single health facility were used for the study, it was challenging to extrapolate the results to all TB cases. Since the information was taken from a secondary source, we were unable to evaluate further related elements.

Conclusion

The treatment outcome of all forms of tuberculosis patients in Bule Hora University Teaching Hospital was satisfactory when compared with other estimates of national and WHO 2030 international targets of >90%. Factors that were significantly associated with successful TB treatment outcome, such as urban residents and HIV negative. To increase the success rate of treatment results, it is essential to improve client supervision and treatment monitoring, as well as to work towards establishing TB treatment facilities at neighbouring hospitals. It is also advised to conduct more research to analyse the crucial elements that the current study did not cover.

Annex

8.1. Data extraction sheet	
Date: _____	
Patient Id: _____	
Sociodemographic status of the study	
1. Sex	A, Male B, female
2. Age of patient	A. <15 B. 15-24 C. 25-34 D. 35-44 E. 45-55 Above 55
3. Residency	A Urban B rural
4. year of treatment	A. 2020 B. 2021 C.2022

Tuberculosis treatment outcome

1. Patient category	A .New B.Re treatment
2. Types of TB	A. p/pos B. P/neg C.EPTB
3. HIV Status	A negative B. positive C Unknown
4. Smear result	A. smear positive B. smear negative
5. Outcome	A. cured B. Complete C. Defaulter D. death F. Treatment failure

Abbreviations and Acronyms

- AIDS Acquired Human Immune deficiency Syndrome
- AFB Acid Fast Bacilli
- DOTS Directly Observed Treatment Short course (DOTS)
- EPTB Extrapulmonary Tuberculosis
- HIV Human Immunodeficiency Virus
- PTB Pulmonary Tuberculosis
- TB Tuberculosis
- SPSS Statistical Package for Social Sciences
- WHO World Health Organization

Statements and Declarations

Ethical Clearance

Before data collection, ethical clearance and approval letters were obtained from the Bule Hora University institutional ethical committee (BHUIRB/2022). A supportive letter was given to the hospital, and permission was obtained from the hospital to collect the data. The study was conducted only after necessary approval by the office of the medical director. To ensure confidentiality and anonymity of patient data, all retrieved information was kept undisclosed throughout the study and thereafter, except for the research team.

Availability of data and materials

The corresponding author will provide the datasets used and/or analysed during the current work upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

Consent for publication

Not applicable

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Authors' contributions

AA: conceptualization, resources, laboratory analyses, and analyzing data. **GT:** data curve and analysis supervised and visualized the data collection, prepared and edited the manuscript, and approved the final version. All authors read and approved the final manuscript.

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