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Predictors of Poor Tuberculosis Treatment Outcome at Arba Minch General Hospital, Southern Ethiopia: A Case-Control Study

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Abstract

Introduction: Tuberculosis (TB) is a major public health problem throughout the world. About a third of the world's population is estimated to be infected with TB and hence at risk of developing active disease. Ethiopia ranks seventh among the world's 22 countries with a high burden of TB. This study was aimed at assessing the predictors of poor TB treatment outcome at Arba Minch General Hospital (AMGH), Southern Ethiopia.

Methods: A case-control study comprising simple random sampling was conducted from Jan to Feb 2014. Cases were patients registered as treatment failures, defaulted or died during TB treatment follow up; and controls were patients registered as cured or completed the treatment in the period of 1st Jan 2009-30th Dec 2013 in AMGH. A prepared standard checklist adapted from WHO was used to assess the predictors of poor treatment outcome. A chi-square test and a paired T-test were used to compare categorical and continuous variables in cases and controls, respectively. Multivariable logistic regression was used in the final model.

Results: The case group was composed of 224 patients with poor treatment outcome while the control group was composed of 448 patients with successful outcome. Male sex (Adjusted Odds Ratio (AOR)=1.6; 95%CI: 1.1-2.3), age >35 years (AOR=2.4; 95%CI:1.6-3.4), rural residence (AOR=1.5; 95%CI:1.0-2.2), retreatment category (AOR=3.3; 95%CI:1.3-8.4), smear negative Pulmonary TB (AOR=2.4; 95%CI:1.4-4.1), Extra-pulmonary TB (AOR=2.5; 95%CI:1.3-4.6), HIV positives (AOR=2.4; 95%CI:1.6-3.5) and TB treated (unknown HIV status) in the year before 2011 (AOR=2.5; 95%CI:1.3-5.1) were found predictors of poor TB treatment outcome.

Conclusion: Male sex, rural residence, older age, previous treatment, smear negative PTB and EPTB, HIV co-infection, unknown HIV status but treated for TB before 2011 were found significant risk factors for developing poor treatment outcome. Targeted measures should be considered to reduce the proportion of poor outcome among high-risk groups.

Keywords: Tuberculosis; Predictors; Human immunodeficiency virus; Highly active anti-retroviral therapy; Cotrimoxazole prophylaxis therapy

Introduction

Tuberculosis (TB) is a major public health problem throughout the world. About a third of the world's population is estimated to be infected with MTB (*Mycobacterium tuberculosis*) and hence at risk of developing active disease. According to the World Health Organization (WHO) Global TB Report 2015, in 2014, there were an estimated 9.6 million new TB cases: 5.4 million among men, 3.2 million among women and 1.0 million among children. There were also 1.5 million TB deaths (1.1 million among Human Immunodeficiency Virus (HIV) negative people and 0.4 million among HIV positive people), of which approximately 890 000 were men, 480 000 were women and 140 000 were children [1].

The 22 High Burden Countries (HBCs) that have been given highest priority at the global level since 2000 accounted for 82% of all estimated cases worldwide. These countries have been the focus of intensified efforts in Directly Observed Therapy Short course (DOTS) expansion [1]. Ethiopia ranks seventh among the world's 22 countries with high TB burden. At present, TB (all cases) is ranked fourth among leading causes of hospital admission, and second in the causes of hospital death in Ethiopia. The national population based TB prevalence survey conducted in 2010/11 revealed that the prevalence of all forms of TB in Ethiopia is estimated to be 240/100,000 populations. The proportion of new smear-positive, smear negative and Extra Pulmonary TB (EPTB) among all new cases is 32.7%, 34.8%, and 32.5%, respectively. Re-treatment cases represented about 2.9% of all TB cases notified [2]. TB is among the leading causes of morbidity and mortality in the Southern Nations Nationalities and Peoples Regional State (SNNPRS) of Ethiopia. As in many other resource-constrained settings, DOTS was introduced in the region in 1996; however, treatment outcomes for tuberculosis have not been that much satisfactory [3].

Several reasons and risk factors for poor TB treatment outcome have been reported by previous studies in other settings. Male sex, lack of education, old age, multidrug resistance, HIV co-infection, accessibility of health facilities, low socio-economic status, low awareness to the disease and its treatment [4-7]. Studies in southern Ethiopia [8-11] identified re-treatment, positive smear at 2nd month of follow-up, having smear-negative pulmonary TB and being male as independent risk factors for poor treatment outcome. However, the previous studies in the region lack information on HIV co-infection, initiation of Highly Active Anti-Retroviral Therapy (HAART) and Cotrimoxazole Prophylaxis Therapy (CPT) for TB/HIV co-infected patients, and drug use related factors on the treatment outcome. In addition to this, risk factors associated with poor outcome are likely to be different in different settings [12]. In this context, therefore, updated information is needed on predictors of poor treatment outcome that can help to identify those patients that are at a higher risk of poor treatment outcome while being treated with anti-TB drugs. Therefore, the aim of present study was to assess predictors of poor TB treatment outcome at Arba Minch General Hospital, Southern Ethiopia.

Materials and Methods

Study area and period

This hospital based case-control study was conducted at Arba Minch General Hospital, Southern Ethiopia from January 30 to February 28, 2014. Arba Minch is the capital of Gamo Gofa Zone, located approximately 500 km to the South of Addis Ababa and 275 Kms away from the Regional capital, Hawassa. Arba Minch General Hospital is located in Arba Minch town, and has 158 beds and serves 1.5 million people. The treatment of TB in Arba Minch General Hospital follows the guidelines from the National TB and Leprosy Control Program of Ethiopia (NTLCP). TB can be diagnosed using different methods using bacteriological, molecular, histopathology and radiological diagnostic methods. Sputum microscopy is the mainstay of diagnostic methods for TB in Ethiopia. It is the most efficient and applicable method to identify infectious TB cases in peripheral laboratories. It is used for diagnosis, monitoring and defining cure. Three sputum specimens must be collected and examined in two consecutive days (spot-early morning-spot). Culture with Drug Susceptibility Testing (DST) is used for the diagnosis and management of drug-resistant TB [2].

When TB case is confirmed, the patient is registered in the DOTS clinic where they are given drugs for 6-8 months. The first 8 weeks for new cases and 12 weeks for re-treatment cases (intensive phase), patients take their medication on a daily basis in the DOTS center in the presence of a designated health worker. After which, the patients collect their medication once monthly for 4-6 months. For re-treatment cases and for regimens containing rifampicin the patients collect their medication once weekly (continuation phase). The recommended drug regimens for the intensive phase are isoniazid, rifampicin, ethambutol and pyrazinamide, while in the continuation phase are rifampicin and isoniazid. For re-treatment cases, streptomycin is given for 3 months in the intensive phase in addition to isoniazid, pyrazinamide, ethambutol and rifampicin [13].

Eligibility of study participants

The cases were patients with TB treatment failures (smear-positives after 5 months of treatment), default (interrupted treatment for two consecutive months or more after registration), or death (died from any cause during the course of treatment) and controls were patients who were declared cured (negative smear microscopy at the end of treatment and on at least one previous follow-up test) or completed treatment with the resolution of symptoms according to WHO criteria on treatment outcomes adopted by FMOH [2] between 1st January 2009 and 30th December 2013.

Sample size and sampling

Sample size was determined using a formula for difference in proportions [14]. The following parameters were taken into account during calculation of sample size: the proportion exposed in the control group (successfully treated) as 61.2% [15], OR of 1.8 [16], 90% power, 5% significance level, and the size of the controls being 2 fold compared with the cases. Accordingly, 672 study subjects (224 cases and 448 controls) were required. During the study period, there were 429 eligible cases of poor outcome and 1443 eligible cases of successful outcome (controls). Cases and controls were stratified according to the year of treatment and proportional allocation for each year was done. Following this, required sample size of cases and controls from each year was selected using simple random sampling technique.

Data collection

Data was collected from the TB registers by using a standard checklist, which was prepared based on WHO criteria and according to the local context to meet the study objectives. The checklist consists of socio-demographic factors, category of patients, TB type, smear result during follow up, treatment outcome, co-morbidity, drug use related factors and year of TB treatment. Training was given for data collectors (4 nurses and 1 pharmacist working for the hospital) before the start of data collection.

Data management and analysis

Data was entered and analyzed by using the SPSS version 21 for windows. Descriptive statistics including mean and percentage was used to express patients' characteristics among cases and controls. Association between categorical variables was tested by using the Pearson chi-Square and Fisher's exact test. T-test was used to compare mean difference between the continuous variables among the cases and controls. All variables with P-value <0.05 in the bivariate analysis and with collinearity correlation coefficient less than 0.6 were included into multivariable logistic regression model. P-value of less than 0.05 was considered statistically significant in the final model. The crude and adjusted odds ratio (OR) and its 95% confidence interval (CI) were estimated.

Ethical consideration

Letter of ethical clearance was obtained from Ethical Review Board of Jimma University. The patient data was accessed upon the approval of clinical director of Arba Minch General Hospital. Confidentiality was ensured during the data collection, thus name and address of the patients were not recorded in the data collection checklist.

Results

Socio-demographic characteristics of study subjects

The present study enrolled 672 study subjects, 224 cases with poor outcome and 448 controls with successful outcome, 380 (56.5%) of all study subjects were males. Males were significantly higher in the case group compared to control group (65.6% vs. 52.0%; P=0.001). Patients in cases group were significantly older than controls (mean age ± SD of 37.9 ± 14.4 vs. 28.9 ± 13.4, P<0.001). Significantly higher proportion of study subjects in the case group were from rural area compared to the control group (51.8% vs. 39.3%; P= 0.003). There was no mean weight difference between cases and controls (50.8 ± 9.3 vs. 51.9 ± 13.4, P=0.235) (Table 1).

Patient characteristics	Case group	Control group N (%)	Total N (%)	P-value	X2 value (df)
Number of cases	224(100)	448(100)	672(100)		
Sex					
Male	147(65.6)	233(52.0)	380(56.5)	0.001*	8.9 Φ (1)
Female	77(34.4)	215(48.0)	292(43.5)		
Age (years)					
≤14	5(2.2)	44(9.8)	49(7.3)		
15-24	38(17.0)	141(31.5)	179(26.6)		
25-34	52(23.2)	130(29.0)	182(27.1)		
35-44	56(25.0)	71(15.8)	127(18.9)		
45-54	38(17.0)	43(9.6)	81(12.1)		
55-64	23(10.3)	8(1.8)	31(4.6)		
≥65	12(5.4)	11(2.5)	23(3.4)		
Mean ± SD	37.9 ± 14.4	28.9 ± 13.4		0.000*	¶
Area of residence					
Urban	108(48.2)	272(60.7)	380(56.5)	0.003*	8.9 Φ (1)
Rural	116(51.8)	176(39.3)	292(43.5)		
Baseline weight(kg)					
30-May	7(3.1)	40(8.9)	47(7.0)		
31-54	141 (62.9)	203(45.3)	344 (51.2)		
≥55	76(33.9)	205(45.8)	281(41.9)		
Mean ± SD	50.8 ± 9.3	51.9 ± 13.4		0.253	¶

NB: SD- Standard Deviation, Φ - chi-square, ¶ - T-test Statistic for independent sample test used

Table 1: Socio-demographic characteristics of study subjects, Arba Minch general hospital, Southern Ethiopia, 2014 (N=672).

Clinical characteristics	Case group N (%)	Control group N (%)	Total N (%)	P-value	X2 value(df)
New case	192(85.7)	416(92.9)	608(90.5)	0.001*	14.6 Φ(2)
Retreatment	19(8.5)	10(2.2)	29(4.3)		
Transfer in	13(5.8)	22(4.9)	35(5.2)		
PTB+	25(11.2)	127(28.3)	152(22.6)	0.000*	25.2 Φ(2)
PTB-	151(67.4)	243(54.2)	394(58.6)		
EPTB	151(67.4)	78(17.4)	126(18.8)		

Smear result at 2nd/3rd month (N=151)					
Negative	9(36.0)	120(95.2)	129(85.4)	0.000*	54.2 Φ (1)
Positive	16(64.0)	6(4.8)	22(14.6)		
Smear at 5th month					
Negative	0(0)	124(100)	124(96.1)	NA	NA
Positive	5(100)	0(0)	5(3.9)		
Smear at 6th /8th month					
Negative	0(0)	107(100)	107(99.1)	NA	NA
Positive	1(100)	0(0)	1(0.9)		
HIV Negative	116(51.8)	346(77.2)	462(68.8)	0.000*	45.1 Φ(2)
HIV Positive	87(38.8)	82(18.3)	169(25.1)		
No HIV result	21(9.4)	20(4.5)	41(6.1)		
CPT initiated for HIV+ (N=169)					
NO	19(21.8)	7(8.5)	26(15.4)	0.019*	4.76 Φ (1)
Yes	68(78.2)	75(91.5)	143(84.6)		
HAART initiated for HIV+ (N=169)					
No	33(37.9)	16(19.5)	49(29.0)	0.014*	6.09 Φ (1)
Yes	54(62.1)	66(80.5)	120(71.0)		

NB: Φ -chi-square, CPT-Cotrimoxazole prophylactic therapy, HAART-Highly Active Anti-Retroviral Therapy, PTB-: pulmonary tuberculosis, EPTB: Extra Pulmonary Tuberculosis, NA- Not Analyzed because of missing values

Table 2: Clinical characteristics of study subjects, Arba Minch general hospital, Southern Ethiopia, 2014.

Clinical characteristics of the study subjects

Out of the 672 study subjects, 608(90.5%) were new cases. Higher proportion of re-treatment category was in the case group compared to the control group (8.5% vs. 2.2%, p=0.001). Majority of study subjects in the control group i.e., 243(54.2%) and in the case group i.e., 151(67.4%) had smear-negative PTB. Only 78(17.4%) of study subjects in the control group had EPTB while 151(67.4%) of the case group had EPTB. With the regard to HIV status, 169(25.1%) were HIV positive. HIV positivity was significantly higher in the case group than in the control group (38.8% vs. 18.3%; 1, p<0.001) and significantly higher proportion of study subject in the case group had no result for HIV compared to the control group (9.4% vs. 4.5%; p<0.001). Among the HIV positives, significantly higher proportion of study subjects in the case group compared to the control group did not initiate CPT (21.8% vs. 8.5%; p=0.019) and HAART (37.9% vs. 19.5%; p=0.014) as shown in Table 2.

Treatment related factors

Significantly higher proportion of subjects in the case group compared to the control group took the regimen ERHZS/ERHZ in the intensive phase (8.0% vs. 0.7%; X2=24.4, p<0.001) and the regimen EH/ERH in the continuation phase (53.1% vs. 29.0%; X2=48.5, p<0.001) (Table 3).

Variable	Case group N (%)	Control group N (%)	Total N (%)	P-value	X2 value(df)
Intensive Phase drug use					
ERHZ	206(92.0)	445(99.3)	651(96.9)	0.000*	24.4ǂ(1)
ERHZS/ERHZ	18(8.0)	3(0.7)	21(3.1)		
Continuation Phase drug use					
EH/ERH	119(53.1)	130(29.0)	249(37.1)	0.000*	48.5 Φ(1)

RH	105(46.9)	318(71.0)	423(62.9)		
NB: *Significant p < 0.05, Φ - chi-square, ǂ -Fishers exact test, E- Ethambutol, H- Isoniazid, R- Rifampicin, S- Streptomycin, Z- Pyrazinamide					

Table 3: Drug use related factors of study subjects, Arba Minch general hospital, Southern Ethiopia, 2014.

Distribution of study subjects with year of tuberculosis treatment

Majority i.e., 125(27.9%) of study subjects in control group were treated for TB in the year 2013 while 58(25.9%) in case group were treated for TB in the year 2010. The proportion of poor outcome was significantly decreased from year 2009 to 2013 (X2=44.9, p<0.001) as shown in Table 4 below.

Year of treatment(G.C)	Case group N (%)	Control group N (%)	Total N (%)	P-value	X2 value(df)
2009	56(25.0)	70(15.6)	126(18.8)	0.000*	44.9 Φ(4)
2010	58(25.9)	63(14.1)	121(18.0)		
2011	51(22.8)	94(21.0)	145(21.6)		
2012	39(17.4)	96(21.4)	135(20.1)		
2013	20(8.9)	125(27.9)	145(21.6)		
NB: *Significant p < 0.05, Φ - chi-square, G.C- Gregorian calendar					

Table 4: Distribution of study subjects with year of tuberculosis treatment, Arba Minch general hospital, Southern Ethiopia, 2014.

Predictors of poor TB treatment outcome

The multivariable logistic regression analysis showed that male sex, age older than 35 years, rural residence, retreatment category, type of TB, HIV positives, no result for HIV and treatment of TB in the years before 2011 were found significantly associated with the development of poor outcome at p-value of < 0.05. While the use of the regimen RH or EH/ERH in the continuation phase (AOR=1.402; p=0.145), initiation of CPT (AOR=0.931; p=0.917) and HAART (AOR=2.781; p=0.056) for HIV+ had shown no significant association (Table 5).

Variables	Case group N (%)	Control group N (%)	COR (95% CI)	AOR (95% CI)
Sex				
Female	77(37.4)	215(48.0)		1
Male	147(65.6)	233(52.0)	1.762(1.264, 2.456)	1.600 (1.104, 2.317) *
Age(years)				
≤35	96(42.9)	315(70.3)		1
≥35	128(57.1)	133(29.7)	3.158(2.263, 4.407)	2.381 (1.643, 3.448) *
Area of residence				
Urban	108(48.2)	272(60.7)		1
Rural	116(51.8)	176(39.3)	1.660(1.201, 2.294)	1.496 (1.037, 2.159) *
Patient category				
New	192(85.7)	416(92.9)		1
Retreatment	19(8.5)	10(2.2)	4.117(1.878, 9.022)	3.305 (1.298, 8.415) *
Transfer in	13(5.8)	22(4.9)	1.280(0.632, 2.595)	1.005(0.459, 2.200)
Type of TB				
PTB+	25(11.2)	127(28.3)		1

PTB-	151(67.4)	243(54.2)	3.157(1.964, 5.074)	2.423 (1.433, 4.095) *
EPTB	151(67.4)	78(17.4)	3.126(1.786, 5.471)	2.446 (1.310, 4.567) *
HIV status				
Negative	116(51.8)	346(77.2)		1
Positive	87(38.8)	82(18.3)	3.165(2.191, 4.571)	2.364 (1.574, 3.552) *
No result	21(9.4)	20(4.5)	3.132(1.639, 5.984)	2.553 (1.283, 5.081) *
CPT prescribed (N=169)				
Yes	19(21.8)	7(8.5)		1
No	68(78.2)	75(91.5)	2.994(1.185, 7.562)	0.931 (0.243, 3.563)
HAART initiated(N=169)				
Yes	33(37.9)	16(19.5)		1
No	54(62.1)	66(80.5)	2.521(1.256, 5.061)	2.781 (0.975, 7.934)
Continuation Phase regimen				
RH	105(46.9)	318(71.0)		1
EH/ERH	119(53.1)	130(29.0)	2.772(1.988, 3.865)	1.402 (0.890, 2.209)
Year of treatment(G.C)				
After 2011	59(26.3)	221(49.3)		1
Before 2011	165(73.7)	227(50.7)	2.73(1.918, 3.865)	2.097 (1.298, 3.388) *

NB: "1.00"- reference group; AOR- Adjusted Odds Ratio, COR- Crude Odds Ratio, E- Ethambutol, H- Isoniazid, R- Rifampicin *- significant P < 0.05; PTB+: Smear Positive Pulmonary Tuberculosis, PTB-: Smear Negative Pulmonary Tuberculosis, EPTB: Extra Pulmonary Tuberculosis, G.C- Gregorian calendar

Table 5: Multivariable logistic regression analysis of predictors of poor tuberculosis treatment outcome, Arba Minch general hospital, Southern Ethiopia, 2014.

Discussion

A case control study with case to control ratio of 1:2 was conducted by recruiting 672 subjects to determine the predictors of poor TB treatment outcome at Arba Minch General hospital, Southern Ethiopia. Multivariable analysis showed that male sex, age older than 35 years, rural residence, retreatment category, type of TB, HIV positives, no result for HIV and treatment of TB in the years before 2011 were the predictors of poor treatment outcome.

The present study showed that males were 1.6 times more likely to develop poor treatment outcome (AOR=1.6; 95% CI: 1.1-2.3) when compared to females. Similar findings were reported elsewhere in Southern Region of Ethiopia [10], Brazil [17] and Turkey [18]. This could be attributed to the fact that men are the bread winners in the most family, who are highly exposed to cigarette smoking, alcohol consumption and thus find it difficult to comply with daily clinic attendance [19]. On the contrary, different result was reported from Bahir Dar Felege Hiwot Referral Hospital in which the percentage of deaths, failures and defaulters was higher in females than in males. This might be due to differences in accessibility to health information and health care services, and community-based interventions [20].

In this study, the chance of developing poor treatment outcome was higher among subjects older than 35 years of age (AOR=2.4; 95% CI: 1.6-3.4) Similar results reported from the study conducted in Tigray region of Ethiopia [6], Malawi [21], Nigeria [22]. A significant association between poor outcome and older age may be partly explained by the reason that older individuals often have concomitant diseases, general physiological deterioration with age, are less able to reach health facilities [18]. Increased risk of death during TB treatment with age was evidenced by different studies [5,21-23].

The present study showed that study subjects from rural area were 1.5 times more likely to develop poor outcome than urban dwellers (AOR=1.5; 95%CI: 1.0-2.2). The study conducted in Bahir Dar Felege Hiwot Referral Hospital showed similar finding [4]. The lower treatment success rate in rural patients is probably due to lower awareness of TB treatment and the long distance between their homes and the treatment centers [24]. This is supported by other findings in India [25], Uganda [26], Gambia [27] and Brazil [24].

In this study, cases were 3.3 times more likely to have previous treatment history than the controls (AOR=3.3; 95%CI: 1.3-8.4). Retreatment and dropouts were reported to be significant risk factors for poor treatment outcome in Addis Ababa [15], Tigray region of Ethiopia [5], Brazil [28] and Taiwan [29]. Globally, TB treatment success among retreatment cases was low (72%) compared to new cases (87%). This is so because previous failure may have been due to drug resistance and cases that defaulted previously are likely to have poor compliance and/or drug resistance than for relapse cases [30]. An

individual's retreatment may fail because they have increased risk for MDRTB or drug resistance may be caused by the retreatment regimen [18].

Regarding the type of TB, subjects who had smear negative PTB (PTB-) and EPTB were respectively 2.4 and 2.5 times more likely to develop poor outcome referred to smear positive PTB. Similar findings were reported from Southern region of Ethiopia [31], from Gondar University Hospital [6], Felege Hiwot Referral Hospital [4] and Addis Ababa [7]. This is probably due to low rate of identification of illness and delay to start treatment, long treatment duration, the case that monitoring of treatment outcome of PTB- and EPTB is only based on clinical condition and their diagnosis is difficult often resulting in treatment delay [2].

HIV positive (AOR=2.4; 95% CI: 1.6-3.5) and unknown HIV status (AOR=2.5; 95%CI: 1.3-5.1) were associated with more than two-fold increase in odds for poor treatment outcome. Similar finding reported in Ethiopia Azezo health center [32]. Study in Uganda Hospital showed that the problem of TB was made worse by the concurrent infection with HIV [33]. A similar study in Cameroon in 2013 showed that non-consenting for HIV screening was the main determinant of defaulting from treatment [34], and in Southwestern Nigeria [35], failure to give consent for HIV test affected TB outcome negatively. A study in New York showed that HIV patients were more likely than those who were uninfected to have recurrence or relapse [36].

In this study, subjects started their anti-TB medication before the year 2011 were more likely to have poor treatment outcome (AOR=2.1; 95% CI=1.3-3.4) when compared to subjects started their medication after 2011. This difference might be due to improvements in DOTS performance in the subsequent years, TB treatment regime changed from EH to RH based treatment in the continuation phase, improvement in patient awareness about TB transmission and treatment because of health education and promotion, and health extension workers involvement in the community. A study from Hadiya zone, South Ethiopia [31] and Gondar [37] showed similar results.. Another study in Ghana showed that improvements in diagnosis, community TB care, stigma reduction among community and health workers towards TB patients, the public-private partnership, and the enablers' package contributed to the improved better treatment outcomes [38].

The current study collected data years back to the inception of DOTS program, thus it was possible to obtain relatively large sample size with a probability sampling technique and using procedures in screening of the patients' hospital records. Some of the limitations of the current study were that the retrospective design of the study made it impossible to evaluate the contribution of other factors, which might have impact on treatment outcome such as information about co-morbid conditions other than HIV, concomitantly used medications, medication side effects from the TB register. It is hence imperative for the NTLCP to update the present form to include more information on the patients admitted in to the program.

Conclusion

The current findings showed that male sex, the rural dwelling, older age, previous treatment, smear negative PTB and EPTB, HIV co-infection, and TB treatment in unknown HIV status were found the statistically significant predictors for developing poor TB treatment outcome. Therefore, targeted measures should be considered to reduce the proportion of poor TB treatment outcome among the high-risk groups. Further, careful monitoring, making DOTS program more accessible for the rural population, counseling TB patients on the need for HIV testing, linking the HIV patients to support groups are highly recommended for all previously treated patients before they are treated with the retreatment regimen.

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