Abstract

Background: In Sub-Saharan Africa, HIV endemic has substantially contributed to the increasing tuberculosis (TB) incidence. The joint effect of the HIV and TB pestilences has confronted the feeble systems of healthcare in resource-limited countries. Methods: The aim of this study was to determine the pathological attributes, outcomes of TB treatment, and the contributing factors of unsuccessful results among TB/HIV patients. A retrospective cohort study of all confirmed adult TB/HIV coinfected patients with drug-resistant TB reported for the treatment in two different hospitals from 2010 to 2016 in Eastern Cape, South Africa. Cox proportional hazard model was used in identifying the predictors of unsuccessful treatment. Results: Unsuccessful treatment outcomes among TB/HIV coinfected patients with treatment category were (95% confidence interval [CI]: 0.988–1.318) age, smoking (1.047; 95% CI: 0.892–1.229), pregnancy (1.940; 95% CI: 0.793–4.743), CD 4+ count (1.163; 95% CI: 0.993–1.361), and patients with comorbidity diseases such as diabetes, liver diseases, renal failure, hepatitis, and silicosis were all significantly associated with unsuccessful treatment. The preantiretroviral treatment (ART) females appear to have significantly better survival than pre-ART males. Conclusion: The study showed that the unsuccessful treatment outcomes among TB/HIV coinfected patients were slightly below the WHO target. The key predictors of unsuccessful TB treatment outcomes among the TB/HIV coinfected patients were associated with pregnancy, productive age group, gender, contraception, and comorbidity diseases.

Keywords: Cox model, hazard function, hepatitis, infection, mortality rate, survival pattern

INTRODUCTION

Tuberculosis (TB) is a global health issue and has been affecting lives and well-being of a large number of people for so many years. Globally, TB was estimated to be among ten causes of death in the year 2015 and ranked above HIV/AIDS as one of the main sources of death from a communicable disease. In Sub-Saharan Africa, HIV endemic has substantially contributed to a rise in TB incidence. South Africa was ranked fifth among the highest TB incidence globally, and first among TB/HIV coinfected cases with more than 65% of TB/HIV coinfected patients. The progression rate of HIV comorbidity changes clinical factor of TB to a high mortality rate.

The joint effect of the HIV/TB disease has created a great challenge healthcare system in resource-limited countries. In South Africa, TB treatment assessment services are classified into HIV-negative or HIV-positive TB patients. Both groups of TB patients require homogeneous anti-TB treatment; however, HIV-positive TB patients need antiretroviral treatment (ART). There is a reduction of 64%–95% mortality risk as a result of ART administration for TB/HIV coinfected patients, and ART should be started immediately after the initiation of anti-TB treatment.

However, HIV disease is possibly significantly affect TB treatment results and a major purpose behind the inability to achieve the control targets among TB/HIV settings. For systematic control of TB in HIV prevalence settings, the World Health Association (WHO) has suggested that TB/HIV...
cooperative exercises, whose targets are to make components for joint effort among TB/HIV and AIDS programs, are to decrease the weight of TB among HIV individuals and the weight of HIV infection among TB patients. In a bid to reduce the burden of TB, a large number of cases of drug-resistant TB were discovered and continue to rise. Globally, 3.3% of new cases of multidrug-resistant (MDR) TB were recorded, 20% of them were previously treated, and 23% of these cases were initiated on appropriate treatment. In 2014, the death from MDR-TB was approximately 30% and led the WHO to declare it as a global crisis. Various reviews from countries in Sub-Saharan Africa have inspected the effect of HIV disease on TB treatment results. Many of these reviews have estimated TB/HIV coinfected treatment outcomes. A few reviews have shown the unsuccessful results of TB treatment among TB/HIV coinfected patients compared with TB patients without HIV infection, while others found that TB treatment results did not vary between the two categories. However, the gains and benefits of ART on results of TB treatment were revealed in some randomized controlled trials studies and observational studies conducted.

A systematic review of a study conducted demonstrated the advantages of ART in reducing TB mortality and was revealed 44%–71% reduction in TB risk of death. TB mortality among TB/HIV patients is an indicator measure used to know the impact of TB/HIV collaborative activities. With the advent of ART, TB, and HIV have turned out to be progressive evident that they are not a homogeneous category, and loss of lives during TB treatment vary among TB/HIV patients on ART and without ART. Understanding the TB treatment outcomes and associated factors may help in better TB disease management. Therefore, this study aims to determine the pathological attributes, outcomes of TB treatment, and the contributing factors of unsuccessful results among TB/HIV patients among TB/HIV coinfected patients in some selected TB centers in Eastern Cape, South Africa.

**Methods**

**Study setting and design**

This was a hospital-based retrospective cohort study of all confirmed adult TB/HIV coinfected patients with drug-resistant TB reported for the treatment in two different hospitals (Winterberg TB hospital and Fort Grey TB hospital) in Eastern Cape, South Africa, from 2010 to 2016. These TB hospitals are specialized provincial government-funded TB hospitals. They offer specialized care for patients with various pathologies of TB diagnosis, treatments, prevention, and patients with HIV coinfections. They serve as the referral unit for the management of adults diagnosed with TB infection in environs. They serve the following districts: Nkonkobe, Amatole, Chris Hani, O.R Tambo, and Western district in Eastern Cape. They provide services such as antiretroviral treatments (ARTs), TB services, X-ray, and other services. All TB cases diagnosed are found on the standard TB treatment used in South Africa and reported according to the national TB control guidelines. Medical history of all patients from the 1st date of initiation consultation to end date (discharge) is recorded in TB treatment registry, which is the official TB record in reporting TB treatment of Department of Health, Republic of South Africa.

**Data collection**

Data used in this study were excerpted from the TB record files and patients’ medical files of all the hospitalized TB patients with HIV coinfection through a TB card of patients’ information records. The TB card is an A4 paper format recommended by South Africa, Department of Health, for documenting the ongoing treatment of TB. It includes patients’ information such as the name of the patient, gender, age, patient’s home location, TB registration number, TB infection category (pulmonary or extrapulmonary), HIV status, and checkboxes for each anti-TB medication taking every day. Classification of TB status was done through the national TB management guidelines as at the time of the diagnosis. Clinical information excerpted from patients’ files were weight of the body, CD4 counts, AIDS-related opportunistic infections, concomitant diseases other than TB or AIDS-related diseases, TB treatment outcomes, and initiation of cotrimoxazole prophylactic therapy and ART. Treatment outcomes were categorized by the following definitions:

1. Successful treatment: Is the combination of patients who were cured and those who completed treatment or patient whose baseline smear (or culture) was positive at the beginning of the treatment and is smear/culture negative in the last month of treatment
2. Unsuccessful treatment: Patient whose baseline smear (or culture) was positive and remains or becomes positive again at 5 months or later during treatment
3. Died: Patients who die for any reason during treatment
4. Treatment default: Patient whose treatment was interrupted for 2 consecutive months or more during the treatment period
5. Transferred out: Patient who was referred to a facility in another district to continue treatment and for whom the treatment outcome is not known.

**Inclusion and exclusion criteria of the population**

TB treatment record register was used to identify TB cases as designed by the Department of Health, South Africa. We included all new adult TB/HIV coinfected patients (aged ≥15 years) registered and started TB treatment in the study, i.e., all adults TB patients (n = 3871). Of these 2112 outpatients, 234 HIV-negative and TB patients without HIV test results, 389 inpatients with incomplete information, inpatients without any results recoded, and patients died before or during TB treatment were excluded from the study. TB treatment of all TB/HIV coinfected patients with or without ART was also encompassed in the study. Thereafter, 910 TB/HIV coinfected patients remained eligible for the study analysis. The criteria are shown in Figure 1.
Multivariate statistical modeling method
In univariate analysis, the survival analysis is carried out with respect to the factor under the study, which mostly disregards the influence of other factors. Univariate analysis most use to construct survival curves (Kaplan–Meier curve) for different groups of patients and use the log-rank test to examine the difference between the groups. However, the log-rank test gives a P value for the group differences but offers no estimate for the actual effect of the covariates. In light of this, using a model will improve the methods, which can be evaluated with respect to many factors simultaneously and also expresses the effect strength of the estimates for each predictor factors.

Data analysis
The descriptive and inferential statistics were conducted to analyze the data regarding descriptive statistics for continuous data and categorical data. For the comparison of time to unsuccessful treatment among the groups of patients and Kaplan–Meier curve was also used for the comparison. Bivariate and multiple Cox regression models with variable selection using stepwise procedure were used in identifying the predictors of unsuccessful treatment. The assumptions for the proportional hazard model were assessed graphically using log-minus-log survival curve. Variables with P < 0.25 were included in the bivariate Cox regression analysis and considered as candidate variables for multiple Cox regression analysis. P≤0.05 is a statistically significant-associated factor in the final model.

RESULTS
Baseline demographic and clinical characteristics of tuberculosis/HIV coinfected patients
From March 2010 to February 2016, 910 TB/HIV coinfected patients were selected from two different TB centers used in this study. There were 530 (58.2%) male and 380 (41.8%) female patients with a median age of 37 years and interquartile range of 27–47 years. These patients were mostly illiterates (71.0%) had body mass index (BMI) of 18.5–24.9 kg/m² (58.7%), new treatment category (56.3%), MDR-TB (62.6%), and among them (39.1%) had CD4 count of >200 cells/mm³ [Table 1].

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It appears that among those with MDR-TB (15.8%) has unsuccessful outcomes, while among those with XRD-TB (15.9%) had unsuccessful outcomes. There was the statistically significant association with gender (P < 0.001), baseline BMI (P = 0.021), education (P < 0.001), and CD4 count of patients (P = 0.04). However, drug resistance, treatment category, age group, drug use, pregnancy, and concomitant diseases were not statistically significant with treatment outcomes. Successful treatment outcomes were attained by 543 (59.7%) of the patients (with 26.7% cured and 33.0% classified as treatment completed), and 367 (40.3%) had unsuccessful treatment outcomes due to “defaulted” (12.4%; n = 113), “died” (5.1%, n = 46), “failed” (17.0%, n = 155), and 53 (5.8%) were transferred out to other facilities.

For the variables characteristics in the dataset, time until treatment outcomes of the coinfected patients was analyzed using the Kaplan–Meier estimator to compare the survival time among the patients. The estimator was used to evaluate the survival distribution function of the time from the new patient was admitted for TB treatment until patients’ complete treatment or cured or the patient died. The survival curve shows a decreasing trend of mortality rates among the coinfected patients over the study time. The figures produce product-limit estimates of the treatment of TB/HIV coinfected patients by male and female insertion [Figures 2 and 3]. In Figure 2, the comparison indicates that there is different in the treatment success of TB/HIV coinfected patients without ART. The pre-ART females appear to have significantly better survival than pre-ART males while in Figure 3, there was a different among both genders. The gender differences are significantly different between males and females receiving ART in this study.

Cox regression analysis predictors of unsuccessful tuberculosis treatment outcomes
The univariate and backward stepwise likelihood ratio in multivariate analysis of the association between the possible determining factors of unsuccessful treatment outcomes among the TB/HIV coinfected patients were performed. However, multivariate analysis was used to determine the significance of unsuccessful treatment among TB/HIV coinfected patients. The adjusted hazard ratio indicated that treatment category (95% confidence interval [CI]:

Figure 1: Inclusion and exclusion criteria of the study participants

Figure 2: Comparison between male and female tuberculosis/HIV coinfected patients without antiretroviral treatment
Table 1: Demographic and clinical characteristics of tuberculosis/human immunodeficiency virus coinfected patients stratified by tuberculosis treatment outcomes in Eastern Cape, South Africa

| Demographic and clinical characteristics | n (%) | Successful outcomes (%) | Unsuccessful outcomes (%) | P     |
|-----------------------------------------|-------|--------------------------|---------------------------|-------|
| Drug‑resistant TB                       |       |                          |                           |       |
| MDR‑TB                                  | 570 (62.6) | 480 (53.0) | 90 (9.9) | 0.67  |
| XDR‑TB                                  | 340 (37.4) | 286 (31.2) | 54 (5.9) |       |
| Treatment category                      |       |                          |                           |       |
| New                                     | 512 (56.3) | 402 (44.2) | 110 (12.1) | 0.51  |
| Relapse                                 | 398 (43.7) | 364 (40.0) | 34 (3.7) |       |
| Age (years)                             |       |                          |                           |       |
| 15‑25                                   | 266 (29.3) | 221 (24.3) | 45 (5.0) | 0.62  |
| 26‑45                                   | 436 (48.0) | 367 (40.4) | 69 (7.6) |       |
| >45                                     | 207 (22.8) | 178 (19.6) | 29 (3.2) |       |
| Gender                                  |       |                          |                           |       |
| Female                                  | 380 (41.8) | 339 (37.3) | 41 (4.5) | <0.001|
| Male                                    | 530 (58.2) | 427 (46.9) | 103 (11.3) |       |
| Weight (kg)                             |       |                          |                           |       |
| <40                                     | 130 (14.3) | 104 (12.6) | 26 (2.9) | 0.021 |
| 40‑55                                   | 534 (58.7) | 455 (49.3) | 79 (8.6) |       |
| >55                                     | 246 (27.0) | 207 (22.2) | 39 (4.3) |       |
| Education                               |       |                          |                           |       |
| Illiterate                              | 646 (71.0) | 604 (64.4) | 102 (11.2) | <0.001|
| Literate                                | 264 (29.0) | 162 (17.8) | 42 (4.6) |       |
| Alcohol used                            |       |                          |                           |       |
| Yes                                     | 558 (61.3) | 443 (48.7) | 115 (12.6) | 0.21  |
| No                                      | 352 (38.7) | 329 (35.5) | 29 (3.2) |       |
| Smoking                                 |       |                          |                           |       |
| Yes                                     | 254 (27.9) | 214 (26.0) | 40 (5.2) | 0.63  |
| No                                      | 656 (72.1) | 552 (61.6) | 104 (11.7) |       |
| Concomitant diseases                    |       |                          |                           |       |
| Yes                                     | 134 (14.7) | 126 (13.8) | 8 (0.9) | 0.98  |
| No                                      | 776 (85.3) | 640 (70.3) | 136 (14.9) |       |
| Contraception                           |       |                          |                           |       |
| Yes                                     | 164 (18.0) | 118 (13.0) | 46 (5.1) | 0.55  |
| No                                      | 746 (82.0) | 720 (79.1) | 26 (2.9) |       |
| Pregnancy                               |       |                          |                           |       |
| Yes                                     | 36 (4.0) | 31 (3.4) | 5 (0.5) | 0.47  |
| No                                      | 874 (96.0) | 761 (83.6) | 113 (12.2) |       |
| Diabetes                                |       |                          |                           |       |
| Yes                                     | 38 (4.2) | 8 (2.6) | 30 (4.2) | 0.32  |
| No                                      | 872 (95.8) | 766 (84.2) | 106 (11.6) |       |
| Hepatitis                               |       |                          |                           |       |
| Yes                                     | 23 (2.5) | 1 (0.1) | 22 (2.4) | 0.44  |
| No                                      | 887 (97.5) | 765 (84.1) | 122 (13.4) |       |
| Liver diseases                          |       |                          |                           |       |
| Yes                                     | 22 (2.4) | 3 (0.3) | 19 (2.1) | 0.98  |
| No                                      | 888 (97.6) | 763 (83.8) | 125 (13.7) |       |
| Silicosis                               |       |                          |                           |       |
| Yes                                     | 26 (2.9) | 1 (0.1) | 25 (2.7) | 0.36  |
| No                                      | 884 (97.1) | 765 (84.1) | 119 (13.1) |       |
| Renal failure                           |       |                          |                           |       |
| Yes                                     | 29 (3.2) | 1 (0.1) | 28 (3.1) | 0.15  |
| No                                      | 881 (96.8) | 766 (84.2) | 115 (12.6) |       |
| CD4 count (cells/mm³)                   |       |                          |                           |       |
| ≤50                                     | 214 (23.5) | 99 (10.2) | 121 (13.3) | 0.04  |
| 51‑200                                  | 340 (37.4) | 318 (34.9) | 22 (2.4) |       |
| >200                                    | 356 (39.1) | 355 (39.0) | 1 (0.1) |       |

MDR: Multidrug‑resistant, XDR: Extensively drug‑resistant, TB: Tuberculosis
0.988–1.318), age, smoking (1.047; 95% CI: 0.892–1.229), pregnancy (1.940; 95% CI: 0.793–4.743), CD4+ count (1.163; 95% CI: 0.993–1.361), and patients with comorbidity diseases such as diabetes, liver diseases, renal failure, hepatitis, and silicosis were all significantly associated with unsuccessful treatment [Table 2].

However, drug‑resistant TB, gender, weight, education, alcohol intake, and contraception were not significantly associated with unsuccessful treatment outcomes in the adjusted multivariate hazard ratio analysis of treatment outcomes.

Discussion

Sub-Saharan Africa estimated to be the most prevalence of TB/HIV coinfection as public health challenges. In this study, we found that many of the TB/HIV coinfected patients with unsuccessful outcomes were new patients or defaulted from the treatment. It was found that TB/HIV coinfection contribute independently to each other’s progress that adds to the unsuccessful TB treatment outcomes, in which, the result of unsuccessful outcome in this study (51.3%) greater than other studies from Thailand and Nigeria was their unsuccessful treatment outcome were 29.6% and 34.2%, respectively. While the successful outcomes (48.7%) were lower compared to studies from India (84.1%) and Malawi (86.0%), one of the possible reasons for this difference might be due to the number of participant in the study. However, the handling of the defaulted cases among the patients as one of the case definitions of the TB treatment outcome may have an increased effect of unsuccessful treatment outcome. This may also be affected by the high record of patients’ death and/or transferred outpatients cases. It is indicated in studies conducted in Malaysia where 21.0% recorded for patients who died and 25.6% for defaulted patients in Ethiopia, 17.4% were recorded for death and 10.0% for defaulters.

One of the factors of unsuccessful treatment outcomes in our study might be due to loads of TB drugs and HIV drugs interactions. TB/HIV coinfected patients will have more drugs to use and more liable to experience higher drug side effects compared to patients who are taking only HIV ART drugs or only anti-TB drugs. Others studies have also reported that coinfection of TB/HIV drug interactions has more side effects treatment outcomes.

Our study suggested that pregnancy among TB/HIV coinfected patients was found to be a predictor of unsuccessful treatment outcomes (AHR: 1.72, 95% CI: 1.26–2.35), which might be due to ephemeral and constant immune suppression with pregnancy. This is in accordance with some studies conducted in Ethiopia, China, and South Africa.

From this study, it was found that the age group of 26–45 and newly diagnosed cases (P < 0.05) were significantly associated with unsuccessful treatment outcomes [Table 2]. It is a fact that TB/HIV coinfection affects the reproductive age group of any population. More than half of the patients were cases of newly diagnosed patients who had diagnosis through chest X-rays was compared with relapsed cases, which was not significantly associated with unsuccessful outcomes. This could be that the vulnerability of the new cases is higher than the retreatment cases or interrupted treatment, which is consistent with other studies.

In a study from Kelantan showed that smoking is one of the factors associated with unsuccessful treatment outcome among TB/HIV coinfected patients. This is consistent with the current study, which found that smoking is 1.07-fold of risk factor associated with unsuccessful outcomes (AHR: 1.05 95% CI: 0.89–1.23). This is the fact that smoking increases the susceptibility of patients to acquire TB infection because smoking damages the lungs and reduce the immune system of the body.

From this study, diabetes mellitus, liver disease, and renal failure were significant risk factors associated with unsuccessful treatment outcomes. Diabetes mellitus was by far the most common medical comorbidities among the studied patients in Egypt. This is in accordance with a study conducted by on 5000 TB patients to evaluate the association between diabetes and TB was found that the TB-DM comorbidity was higher than that of TB-HIV coinfection.

On the contrary, studies conducted in Taipei, Finland, and Thailand were found that diabetes mellitus was not associated with treatment outcomes.

Results from this study suggest that CD4+ count is significantly associated unsuccessful treatment outcomes among patients with CD4+ count <200 cell/µl (AHR: 0.95; 95% CI: 0.75–1.21) and higher among patients with CD4+ count <50 cell/µl (AHR: 1.16; 95% CI: 0.99–1.36). This finding is consistent study conducted in Uganda where the failure of early ART during treatment of TB was found to be significantly associated with mortality among patients with CD4+ count <200 cell/µl and similar to other studies in clinical trials where delayed ART was found to be a factor associated with death among patients with CD4+ count <50 cell/µl.

One of the limitations of this study is that we do not have information on opportunistic diseases, the timing of ART,
| Determinant factors                             | Unsuccessful outcomes (%) | Hazard ration (95% CI) | P       | Adjusted hazard ratio (95% CI) | P       |
|------------------------------------------------|---------------------------|------------------------|--------|-------------------------------|--------|
| Drug-resistant TB                               |                           |                        |        |                               |        |
| MDR-TB                                          | 90 (9.9)                  | 1.00                   | 0.763  |                               |        |
| XDR-TB                                          | 54 (5.9)                  | 1.02 (0.88-1.19)       |        |                               |        |
| Treatment category                              |                           |                        |        |                               |        |
| New                                             | 110 (12.1)                | 1.00                   | 0.069  | 1.00                          | 0.003  |
| Relapse                                         | 34 (3.7)                  | 1.14 (0.99-1.32)       |        | 1.14 (0.99-1.32)              |        |
| Age of patients (years)                         |                           |                        |        |                               |        |
| 15-25                                           | 45 (5.0)                  | 1.00                   | 0.049  | 1.00                          | 0.043  |
| 26-45                                           | 69 (7.6)                  | 0.84 (0.68-1.03)       |        | 0.84 (0.69-1.02)              | 0.004  |
| >45                                             | 29 (3.2)                  | 0.79 (0.66-0.96)       |        | 0.79 (0.66-0.95)              | 0.013  |
| Gender                                          |                           |                        |        |                               |        |
| Female                                          | 41 (4.5)                  | 1.00                   | 0.718  |                               |        |
| Male                                            | 103 (11.3)                | 1.03 (0.89-1.19)       |        |                               |        |
| Weight (kg)                                     |                           |                        |        |                               |        |
| <40                                             | 26 (2.9)                  | 1.00                   | 0.736  |                               |        |
| 40-55                                           | 79 (8.6)                  | 1.08 (0.85-1.37)       |        | 0.548                         |        |
| >55                                             | 39 (4.3)                  | 1.06 (0.89-1.26)       |        | 0.468                         |        |
| Education                                       |                           |                        |        |                               |        |
| Illiterate                                      | 102 (11.2)                | 1.00                   | 0.923  |                               |        |
| Literate                                        | 42 (4.6)                  | 1.01 (0.84-1.21)       |        |                               |        |
| Alcohol used                                    |                           |                        |        |                               |        |
| No                                              | 115 (12.6)                | 1.00                   | 0.916  |                               |        |
| Yes                                             | 29 (3.2)                  | 0.99 (0.86-1.15)       |        |                               |        |
| Smoking                                         |                           |                        |        |                               |        |
| No                                              | 40 (5.2)                  | 1.00                   | 0.507  | 1.00                          | 0.051  |
| Yes                                             | 104 (10.7)                | 1.06 (0.89-1.25)       |        | 1.05 (0.89-1.23)              |        |
| Drug substances used                            |                           |                        |        |                               |        |
| No                                              | 16 (1.8)                  | 1.00                   | 0.765  |                               |        |
| Yes                                             | 128 (14.1)                | 1.04 (0.83-1.29)       |        |                               |        |
| Concomitant diseases                            |                           |                        |        |                               |        |
| No                                              | 8 (0.9)                   | 1.00                   | 0.839  |                               |        |
| Yes                                             | 136 (14.9)                | 0.98 (0.78-1.23)       |        |                               |        |
| Contraception                                   |                           |                        |        |                               |        |
| No                                              | 46 (5.1)                  | 1.00                   | 0.001  | 1.00                          | 0.001  |
| Yes                                             | 26 (2.9)                  | 1.70 (1.24-2.34)       |        | 1.72 (1.26-2.35)              |        |
| Pregnancy                                       |                           |                        |        |                               |        |
| No                                              | 5 (0.5)                   | 1.00                   | 0.147  | 1.00                          | 0.146  |
| Yes                                             | 113 (12.2)                | 1.94 (0.79-4.77)       |        | 1.94 (0.79-4.74)              |        |
| Diabetes + TB/HIV                                |                           |                        |        |                               |        |
| No                                              | 30 (4.2)                  | 1.00                   | 0.922  | 1.00                          | 0.022  |
| Yes                                             | 106 (11.6)                | 0.01 (0.00-0.09)       |        | 0.010 (0.00-0.09)             |        |
| Hepatitis + TB/HIV                              |                           |                        |        |                               |        |
| No                                              | 22 (2.4)                  | 1.00                   | 0.023  | 1.00                          | 0.023  |
| Yes                                             | 122 (13.4)                | 0.10 (0.02-0.73)       |        | 0.101 (0.014-0.73)            |        |
| Liver diseases                                  |                           |                        |        |                               |        |
| No                                              | 19 (2.1)                  | 1.00                   | 0.050  | 1.00                          | 0.046  |
| Yes                                             | 125 (13.7)                | 0.32 (0.09-1.01)       |        | 0.31 (0.09-0.98)              |        |
| Silicosis + TB/HIV                               |                           |                        |        |                               |        |
| No                                              | 25 (2.7)                  | 1.00                   | 0.094  | 1.00                          | 0.090  |
| Yes                                             | 119 (13.1)                | 0.19 (0.03-1.33)       |        | 0.18 (0.03-1.31)              |        |
| Renal failure                                   |                           |                        |        |                               |        |
| No                                              | 28 (3.1)                  | 1.00                   | 0.933  | 1.00                          | 0.032  |
| Yes                                             | 115 (12.6)                | 0.013 (0.00-0.02)      |        | 0.011 (0.00-0.12)             |        |

Continued...
Table 2: Contd...

| Determinant factors | Unsuccessful outcomes (%) | Hazard ratio (95% CI) | P | Adjusted hazard ratio (95% CI) | Adjusted hazard ratio (95% CI) |
|---------------------|---------------------------|-----------------------|---|-------------------------------|--------------------------------|
| CD4 count (cells/mm³) |                           |                       |   |                               |                                |
| >200                | 121 (13.3)                | 1.00                  | 0.109 | 1.00                         | 0.098                          |
| 51-200              | 22 (2.4)                  | 0.95 (0.75-1.21)      | 0.661 | 0.95 (0.75-1.21)             | 0.003                          |
| ≤50                 | 1 (0.1)                   | 1.16 (0.99-1.36)      | 0.072 | 1.16 (0.99-1.36)            | 0.031                          |

MDR: Multidrug-resistant, XDR: Extensively drug-resistant, TB: Tuberculosis, CI: Confidence interval, HIV: Human immunodeficiency virus

Conclusion

The study showed that the unsuccessful treatment outcomes among TB/HIV coinfected patients were slightly below the WHO target. The key predictors of unsuccessful TB treatment outcomes among the TB/HIV coinfected patients were associated with pregnancy, productive age group (26–45 years), and contraception and comorbidity diseases. Many of these predictors are markers of clinical and epidemiological vulnerability with adaptation to environmental risk. These findings have TB program implications of the policy framework: Provide support to female TB patients and sexually productive age group should be given priorities regarding awareness and intervention to improve the success rate. There is a need to improve the evaluation policy and control framework among TB and HIV coinfected patients. Comorbidity among TB/HIV coinfected patients was found to be more risky. Hence, the involvement of medical and laboratory professional is sorted for in detecting infectious cases earlier, and government involvement in providing adequate funding and support should be put in place. In addition, the early diagnosis of new cases of pulmonary TB and extrapulmonary TB should be implemented rapidly. Furthermore, for more drastic reduction in unsuccessful treatment outcome, community-based DOTS program should be effectively organized to reduce mortality of TB/HIV coinfected.

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Conflicts of interest

There are no conflicts of interest.

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