

Clinical Characteristics and Outcome Predictors in Drug-Resistant Tuberculosis: A Comprehensive Analysis

Abstract

Background: Drug-resistant tuberculosis (DR-TB) poses significant challenges to public health, with poor outcomes frequently observed in affected patients. This study aims to evaluate the characteristics and factors associated with poor outcomes in patients with drug-resistant pulmonary tuberculosis at Liwa Hospital from January 2018 to May 2023.

Methods: A retrospective, cross-sectional single-center analysis was conducted on 408 patients admitted to Liwa Hospital. Among these, 28 patients diagnosed with drug-resistant tuberculosis (DR-TB) were selected for detailed analysis based on their treatment outcomes and clinical data. Inclusion criteria encompassed patients aged 18 years or older with confirmed drug-resistant TB, while patients younger than 18, those with latent tuberculosis, and those with extra-pulmonary tuberculosis were excluded.

Results: The majority of patients were between 18-40 years old (60.7%), predominantly male (85.7%), and Asian (96.4%). Comorbidities included diabetes (46.4%) and hypertension (21.4%). Clinical characteristics revealed cough (28.6%) and fever with cough (7.1%) as common symptoms. Primary resistance was observed in 92.9% of cases, with 96.4% being newly diagnosed TB cases. Adverse drug events were minimal, with 7.1% experiencing nausea and vomiting. Radiological findings showed unilateral TB in 53.6% and cavitary TB in 57.1% of cases. Laboratory analysis indicated elevated HbA1c (9.83 ± 3.25), CRP (25.94 ± 5.16 mg/L), and white blood cell count ($9.94 \pm 4.59 \times 10^9$ cells/L). Rifampicin resistance was the most prevalent (42.9%), followed by isoniazid resistance (25.0%). Regarding treatment outcomes, age, hypertension, and diabetes mellitus were found to be significantly associated with poor outcomes in patients ($p=0.05$).

Conclusion: The study identified significant associations between treatment outcomes and age, hypertension, and diabetes status, with higher proportions of poor outcomes observed in patients. Comprehensive management strategies targeting these factors are essential to improve outcomes in patients with drug-resistant TB. Further research is warranted to develop tailored interventions for this population.

Keywords: Multi drug resistant tuberculosis, Salamtak database, epidemiology factors, treatment outcomes.

Introduction

Tuberculosis is a significant global health issue, ranking among the top 10 causes of illness and death worldwide. It is responsible for more deaths

Than any other single infectious agent[1]. According to the 2020 WHO Global Tuberculosis Report, there were a staggering 10 million cases of TB worldwide in 2019, with 1.4 million of those cases tragically resulting in death[2]. The majority of cases were reported in Europe, the Americas, the Mediterranean, the Western Pacific, Africa and South-East Asia[3].

According to global TB reports (2016), GHC member states have diverse burden trends ranging from 6.8 to 200 per million population. According

To TB notifications rate, only Bahrain (100 per million population), Oman (79 per million population), and Saudi Arabia (89 per million population)

Were among the low-incidence countries. None of these countries showed major changes in their notification rate for the last three years. The Notification rate for Kuwait, Qatar, and the UAE were 200, 190 and 6.8 per million population, respectively [4].

Although the GHC members have a better financed health system, including TB diagnosis, control, and treatment as its main components, challenges remain. Most importantly, GHC member countries have the highest comparative diabetes prevalence in the world with five members ranked among the top 10 by the International Diabetic Federation. Since diabetes has been found to increase a person's TB acquisition risk, it is pertinent to develop a collaborative platform for controlling TB in diabetics[5].

Liwa hospital has been designated as one of the centers for inpatient care of Tuberculosis patients in the emirate of Abu Dhabi. Patients are referred from Abu Dhabi city, Al Dhafra region and Al Ain region for isolation and treatment of Pulmonary Tuberculosis.

Majority of patients continue their anti-Tubercular treatment in other health care centers after discharge as they being referred from them and few of them are loss to follow-up due to repatriation to their home country due to social or financial reasons are the few challenges faced by Liwa hospital.

Despite the declining global incidence of TB, the rise of multidrug-resistant TB in recent decades is a serious public health crisis and a threat to health security [3]. According to estimates from the WHO, more than half a million new cases of MDR-TB and RIF-resistant are reported every year(6). In 2015, there were 10.4 million new cases of tuberculosis disease. Among these cases, 480,000 were confirmed to be multidrug-resistant TB, and 100,000 individuals received treatment with second-line TB drugs because they were rifampicin-resistant (6). In addition, HIV/AIDS is a widely recognized factor that increases the risk of TB disease, drug resistance, and death related to TB(7). Out of the 1.8 million TB deaths in 2015, a significant 22% were HIV infected[8]. Additionally, an alarming 35 percent of HIV expiries were attributed to TB, according to the World Health Organization[9]. MDR-TB has been linked to several risk factors. Bilateral lung disease, higher bacilli burden on sputum microscopy, history of having a previous TB treatment, HIV infection, contact with a known TB patient, and receipt of multiple treatment courses have been identified as factors in various studies[10, 11].

Regarding treatment, MDR-TB can be effectively treated with the use of second-line anti-TB drugs for a period of 9 to 20 months[3].

On the other hand, the treatment outcomes of MDR-TB cases are worse when compared to drug-susceptible TB cases(12). In 2019, the success rate for treating patients with MDR-TB was only 57% worldwide[2]. Managing MDR-TB can be quite challenging for countries and national health systems [1]. As an illustration, culture-based methods may require a significant amount of time to yield results [14]. Additionally, these tools can be quite costly and demand advanced laboratory facilities, skilled personnel, and rigorous quality and infection control measures [12].

Numerous case-control studies or cohorts have documented the clinical characteristics and outcomes of patients with drug-resistant tuberculosis [8, 12].

The study aims to evaluate various characteristics and factors associated with poor outcomes in patients with drug-resistant pulmonary tuberculosis.

1. Methodology

2.1 Study Design Population and Sample

A retrospective, cross-sectional single-center analysis was conducted at Liwa Hospital to evaluate various characteristics and factors associated with poor outcomes in patients with drug-resistant pulmonary tuberculosis. The study period spanned from January 2018 to May 2023.

The study included a total of 408 patients who were admitted to Liwa Hospital during the specified timeframe. Among these, 28 patients were diagnosed with drug-resistant tuberculosis (DR-TB) and selected for detailed analysis based on their treatment outcomes and clinical data (Figure 1).

2.2 Inclusion and Exclusion Criteria

Inclusion criteria included patients aged 18 years or older with confirmed drug-resistant TB based on sputum AFB culture and DST, GeneXpert MTB/RIF, and admitted to Liwa Hospital from January 2018 to May 2023.

We excluded patients younger than 18 years old, those with latent tuberculosis, and those with extra-pulmonary tuberculosis.

2.3 Data Collection Procedure

Data was extracted from Salamtak databases. A standardized data collection form was used to gather relevant information from eligible patients. Data items included demographic details (age, sex, race, marital status), clinical characteristics (BMI, smoking, alcohol consumption, comorbidities such as diabetes mellitus and hypertension, history of TB), symptoms (fever, cough, loss of appetite, weight loss, hemoptysis), clinical signs (hypotension, respiratory rate > 24/min, temperature > 38°C, SpO₂ < 94%), laboratory findings (CRP, hemoglobin, white blood cell count, creatinine, platelet count, AST, ALT), radiological findings (unilateral/bilateral disease, presence of cavitation on chest X-ray), microbiological data (sputum AFB microscopy results), drug resistance details (type, pattern), TB treatment history (new case/relapse/re-treatment), treatment regimen (directly observed treatment, number of drugs administered), adverse drug events (nausea, vomiting, abdominal pain, joint pain, weakness, jaundice/elevated liver enzymes), and treatment outcomes (death, cure, treatment completed, treatment failure, loss to follow-up/default).

2.4 Primary and Secondary Objectives:

2.4.1 Primary Objectives:

To identify the epidemiological characteristics (age, sex, smoking, co-morbidities) associated with drug-resistant TB.

To evaluate the clinical characteristics associated with drug-resistant TB.

To assess the radiological and laboratory parameters associated with drug-resistant TB.

2.4.2 Secondary Objectives

To identify epidemiological, clinical, radiological, and laboratory characteristics associated with treatment outcomes in drug-resistant TB.

2.5 Treatment Protocol

Treatment for isoniazid-resistant TB involved rifampicin, pyrazinamide, ethambutol, and levofloxacin over a 6-month duration. Ethambutol-resistant TB was managed with rifampicin and isoniazid for 6 months, with pyrazinamide included for the initial 2 months. Pyrazinamide-resistant TB required rifampicin and isoniazid for 9 months, with ethambutol continued until rifampicin and isoniazid susceptibility were confirmed.

For multidrug-resistant TB (MDR-TB), the treatment protocol begins with an intensive phase using a combination of moxifloxacin or levofloxacin, linezolid, clofazimine/Cycloserine, ethambutol, and pyrazinamide. This phase continued for 5-7 months beyond culture conversion, aiming to eradicate the resistant TB strains. The continuation phase then involved moxifloxacin or levofloxacin, linezolid, ethambutol, and pyrazinamide, maintained for a total duration of approximately 18-20 months after culture conversion.

Similarly, for rifampicin-resistant TB, the intensive phase included levofloxacin or moxifloxacin, linezolid, isoniazid, ethambutol, and pyrazinamide administered for 5-7 months following culture conversion. The subsequent continuation phase comprised levofloxacin or moxifloxacin, isoniazid, ethambutol, and pyrazinamide, with a total treatment duration extending to approximately 18-20 months post-culture conversion.

2.6 Statistical Analysis

Data was analyzed using SPSS. Frequency tables were used to describe demographic characteristics, clinical features (symptoms, comorbidities, cure, treatment completed, treatment failure, loss to follow-up). Continuous variables like age, laboratory parameters (e.g., CRP, hemoglobin), and BMI were presented as mean \pm SD. To assess associations between treatment outcomes and demographic, clinical, and other factors), the Chi-square test was used.

Characteristics	Domain	N=28
Age	18-40	17(60.7%)
	41-60	10(35.7%)
	>60	1(3.6%)
Body Mass Index		20.95 \pm 3.76
Gender	Male	24(85.7%)
	Female	4(14.3%)
Race		

V27. Descriptive statistics included: summarize categorical variables (age, sex, marital status), clinical features (symptoms, comorbidities), and treatment outcomes (cure, treatment completed, treatment failure, loss to follow-up). Laboratory parameters (e.g., CRP, hemoglobin), and BMI were presented as mean \pm SD. To assess associations between treatment outcomes and demographic, clinical, and other factors), the Chi-square test was used.

3. Results

3.1 Distribution Of TB patients

Out of a total of 408 tuberculosis patients, 380 (93.1%) had non-resistant TB and 28 (6.9%) have DR-TB.

(TB) patients, 380 (93.1%) had

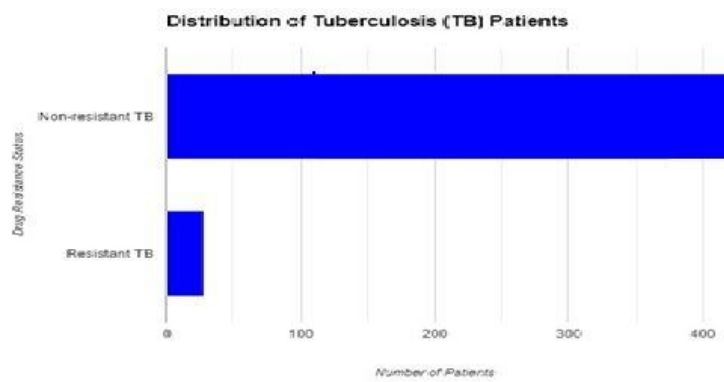


Fig 1: Distribution of TB patients

3.2 Epidemiological characteristics of MDR TB patients

The majority of patients were aged between 18-40 years (60.7%), followed by those aged 41-60 years (35.7%), and only one patient was over 60 years old (3.6%). The gender distribution showed a predominance of males (85.7%) compared to females (14.3%). Most patients were Asian (96.4%) with only one patient being African (3.6%).

The average Body Mass Index (BMI) among the patients was 20.95 \pm 3.76. In terms of marital status, a slight majority were married (53.6%) compared to unmarried (46.4%).

Regarding comorbidities, a notable proportion of patients had diabetes (46.4%), while a smaller percentage had hypertension (21.4%). All patients were HIV-negative. A significant portion of the population data reported being smokers (35.7%), while alcohol consumption was less common (14.3%). A history of previous TB was reported by 10.7% of the patients, with the majority (89.3%) having no history of TB.

Table 1: Epidemiological Characteristics

	Asian	27(96.4%)
	African	1(3.6%)
Marital Status		
	Married	15(53.6%)
	Unmarried	13(46.4)
Comorbidities	Hypertension	6(21.4%)
	Diabetes	13(46.4%)
	HIV(Negative)	28(100%)
Smoking Status	Smokers	10(35.7%)
Alcohol Status	Alcohol Consumers	4(14.3%)
History of TB	Yes	3(10.7%)
	No	25(89.3%)

3.3 Clinical Characteristics of Patients

The study revealed that among the patients diagnosed with drug-resistant tuberculosis (TB), cough was the most common symptom, reported by 28.6% of individuals. Fever with cough was observed in 7.1% of cases, while 7.1% presented with cough accompanied by loss of appetite and weight loss. The rest of the symptom's percentages can be seen in Table 2.

Regarding drug resistance type, primary resistance was predominant, affecting 92.9% of patients, while acquired resistance was noted in 7.1% of cases. The majority of patients (96.4%) had newly diagnosed TB, with only one case (3.6%) classified as TB relapse.

Directly observed treatment (DOT) was implemented for 75% of patients, while 7.1% did not undergo DOT, and it was unavailable for 17.9% of patients. More than four drugs were prescribed to 82.1% of patients, indicating complex treatment regimens.

Adverse drug events were reported in a minority of cases, with nausea and vomiting affecting 7.1% of patients, and elevated liver enzymes, neuritis, and hepatitis each observed in 3.6% of patients. The majority (82.1%) did not experience any adverse drug events.

All patients (100%) had positive sputum smear results, indicating active TB infection at the time of diagnosis.

Clinical Characteristics	Domain	N=28
Symptoms	Cough	8(28.6%)
	LOW	2(7.1%)
	Fever +Cough	2(7.1%)
	Cough+ Loss of Appetite+ Loss of weight	2(7.1%)
	Fever + Cough +Loss of Appetite +Loss of Weight	8(28.6%)
	Hemoptysis	1(3.6%)
	Loss of Appetite +Loss of weight	2(7.1%)
	All symptoms	1(3.6%)
	None	2(7.1%)
Drug resistance Type	Primary	26(92.9%)
	Acquired	
Type of TB	New	27(96.4%)
	Relapse	1(3.6%)
Directly Observed Treatment	Yes	21(75%)
	No	2(7.1%)
	Not available	5(17.9)
Number of	<4	5(17.9%)

Table 2: Clinical Characteristics Of Patients

Drugs prescribed	Pre-	>4	23(82.1%)
Adverse Events	Drug	Nausea and Vomiting	2(7.1%)
		Elevated Liver Enzymes	1(3.6)
		Neuritis	1(3.6%)
		Hepatitis	1(3.6%)
		None	23(82.1%)
Sputum Smear		Positive	28(100%)
		Negative	0(0%)

3.4 Radiological Characteristics of Patients

Disease distribution revealed that 53.6% of individuals had unilateral TB involvement, while 46.4% exhibited bilateral disease. Cavitory TB was present in 57.1% of cases, indicating the presence of cavities in the lungs, while 42.9% did not show signs of cavitory TB.

Table 3: Radiological Characteristics

Radiological Characteristics	Domain	N=28
Disease Side	Unilateral	15(53.6%)
	Bilateral	13(46.4%)
Cavitory TB	Yes	16(57.1%)
	No	12(42.9%)

3.5 Laboratory Characteristics of Patients

HbA1c was measured in 14 patients, with a mean of 9.83 ± 3.25 . C-reactive protein (CRP) levels were available for 19 patients, averaging 25.94 ± 5.16 mg/L. Hemoglobin levels were assessed in 24 patients, showing a mean of 129.46 ± 19.65 g/L. White blood cell count (WBC) results from 24 patients averaged $9.94 \pm 4.59 \times 10^9$ cells/L. Creatinine levels were measured in 25 patients, with a mean of 69.18 ± 19.88 μ mol/L.

Platelet counts from 23 patients averaged $358.57 \pm 99.75 \times 10^9$ cells/L. Aspartate aminotransferase (AST) levels were recorded in 25 patients, with a mean of 24.74 ± 21.35 U/L. Alanine aminotransferase (ALT) levels were also assessed in 25 patients, averaging 29.29 ± 34.09 U/L.

Table 4: Laboratory Characteristics

Laboratory Characteristics	N	Mean \pm SD
HB1AC	14	9.8307 \pm 3.25323
CRP	19	25.94212 \pm 5.16363
Hemoglobin	24	129.4583 \pm 19.65126
WBC	24	9.9442 \pm 4.58622
Creatinine	25	69.1760 \pm 19.88373
Platelets	23	358.5652 \pm 99.74551
AST	25	24.7400 \pm 21.34520
ALT	25	29.2922 \pm 34.08677

3.6 Drug Resistance Patterns

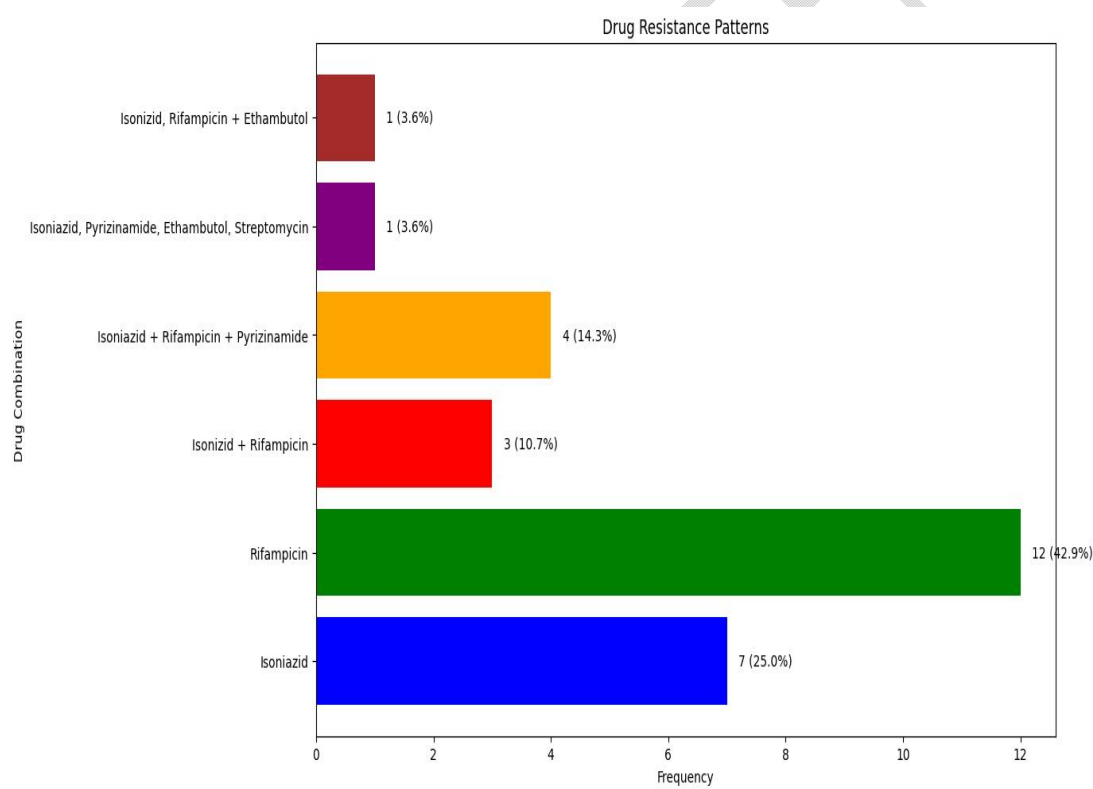


Fig 2. Drug Resistance Patterns

The graph shows the distribution of drug resistance patterns observed in the studied cases. Among the cases of tuberculosis analyzed, rifampicin resistance was the most prevalent, observed in 42.9% of cases. Isoniazid resistance followed closely, affecting 25.0% of cases. Resistance to both isoniazid and rifampicin was found in 10.7% of cases, while resistance to isoniazid, rifampicin, and pyrazinamide was seen in 14.3% of cases. More complex resistance patterns, such as resistance to isoniazid, pyrazinamide, ethambutol, and streptomycin combined, were present in 3.6% of cases. Additionally, a similar percentage showed resistance to isoniazid, rifampicin, and ethambutol.

3.7 Treatment Outcomes

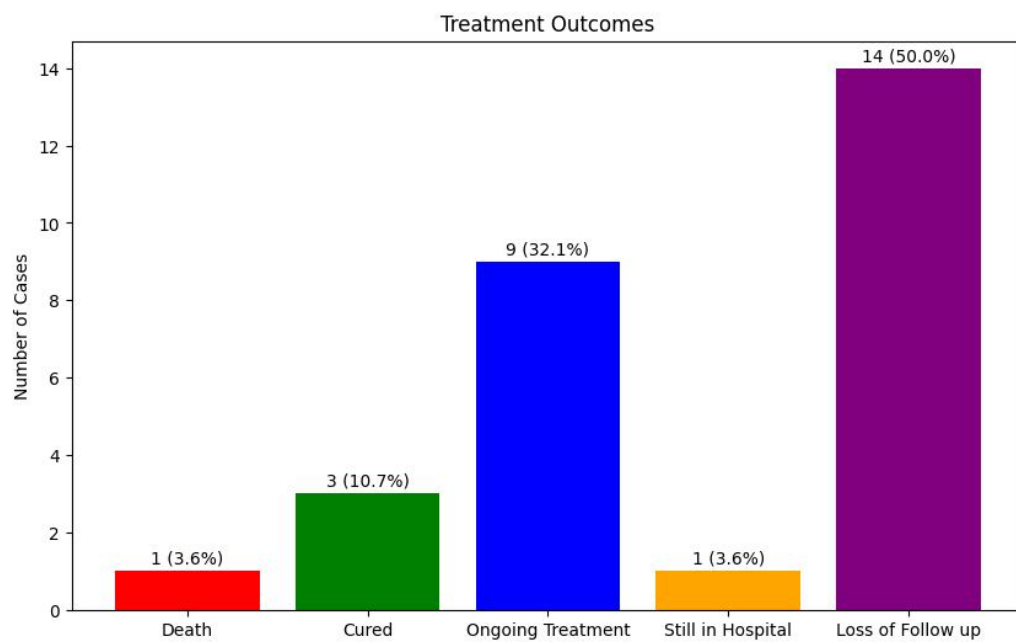


Fig 3. Treatment Outcomes

Regarding treatment outcomes for tuberculosis patients, 3.6% of the patients died. 32.1% of the patients were cured, followed by 10.7% who are still undergoing treatment. A small number of patients (3.6%) were still in the hospital, and (50%) were lost to follow-up.

3.8: Treatment Outcomes by Epidemiological Characteristics

Table 5: Distribution of Treatment Outcomes by Epidemiological Characteristics in Tuberculosis Patients

Characteristics	Treatment Outcomes					X ²	P value
	Death	Cured	Ongoing treatment	Loss of Follow up	Still in hospital		
Age Category							
18-40	0 (0.0%)	0 (0.0%)	6 (21.4%)	10 (35.7%)	1 (3.6%)	34.40	<0.01
41-60	0 (0.0%)	3 (10.7%)	3 (10.7%)	4 (14.3%)	0 (0.0%)		
>60	1 (3.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)		
Gender Distribution							
Male	1 (4.2%)	2 (8.3%)	8 (33.3%)	12 (50.0%)	1 (4.2%)	1.29	0.862
Female	0 (0.0%)	1 (25.0%)	1 (25.0%)	2 (50.0%)	0 (0.0%)		
Race Distribution							
Asian	1 (3.7%)	3 (11.1%)	9 (33.3%)	13 (48.1%)	1 (3.7%)	1.03	0.90
African	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	0 (0.0%)		
Marital Status							
Married	1 (6.7%)	3 (20.0%)	5 (33.3%)	6 (40.0%)	0 (0.0%)	5.28	0.260S
Unmarried	0 (0.0%)	0 (0.0%)	4 (30.8%)	8 (61.5%)	1 (7.7%)		
Smoking Sta-							

tus							
Yes	0 (0.0%)	1 (10.0%)	3 (30.0%)	6 (60.0%)	0 (0.0%)	1.45	0.835
No	1 (5.6%)	2 (11.1%)	6 (33.3%)	8 (44.4%)	1 (5.6%)		
Alcohol Status							
Yes	0 (0.0%)	0 (0.0%)	2 (50.0%)	2 (50.0%)	0 (0.0%)	1.29	0.862
No	1 (4.2%)	3 (12.5%)	7 (29.2%)	12 (50.0%)	1 (4.2%)		
Diabetes							
Yes	1 (7.7%)	3 (23.1%)	5 (38.5%)	4 (30.8%)	0 (0.0%)	7.57	0.05
No	0 (0.0%)	0 (0.0%)	4 (26.7%)	10 (66.7%)	1 (6.7%)		
Hypertension							
Yes	1 (16.7%)	2 (33.3%)	2 (33.3%)	1 (16.7%)	0 (0.0%)	9.28	0.05
No	0 (0.0%)	1 (4.5%)	7 (31.8%)	13 (59.1%)	1 (4.5%)		
History Of TB							
Yes	0 (0.0%)	1 (33.3%)	1 (33.3%)	1 (33.3%)	0 (0.0%)	2.03	0.730
No	1 (4.0%)	2 (8.0%)	8 (32.0%)	13 (52.0%)	1 (4.0%)		

The analysis of treatment outcomes in tuberculosis (TB) patients revealed significant associations with age category, diabetes and hypertension status. Specifically, patients aged 18-40 years exhibited a notable relationship with treatment outcomes ($\chi^2 = 34.40$, $p < 0.01$), showing higher proportions in ongoing treatment. Additionally, hypertension status ($\chi^2 = 9.28$, $p = 0.05$), and diabetes status ($\chi^2 = 7.57$, $p = 0.05$) demonstrated significant associations with treatment outcomes showing higher proportions in the death, cured, and still in hospital categories compared to those without hypertension and Diabetes. A considerable proportion of patients were lost to follow-up during the study period.

3.9: Treatment Outcomes by Epidemiological Characteristics

Table 6: Distribution of Treatment Outcomes by Clinical Characteristics in Tuberculosis Patients

Clinical Characteristics	Death	Cured	Ongoing treatment	Loss of Follow up	Still in hospital	X ²	P value
Symptoms							
Cough	0 (0.0%)	0 (0.0%)	3 (37.5%)	5 (62.5%)	0 (0.0%)	43.72	0.081
LOA	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (50.0%)	1 (50.0%)		
Fever + Cough	1 (50.0%)	0 (0.0%)	0 (0.0%)	1 (50.0%)	0 (0.0%)		
Cough + LOA + LOW	0 (0.0%)	0 (0.0%)	1 (50.0%)	1 (50.0%)	0 (0.0%)		
Fever + Cough + LOA + LOW	0 (0.0%)	2 (25.0%)	3 (37.5%)	3 (37.5%)	0 (0.0%)		
Hemoptysis	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)		
LOA + LOW	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (100.0%)	0 (0.0%)		
ALL	0 (0.0%)	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)		
NONE	0 (0.0%)	0 (0.0%)	1 (50.0%)	1 (50.0%)	0 (0.0%)		

Drug resistance Patterns	Death	Cured	Ongoing treatment	Loss of Follow up	Still in hospital		
Isoniazid	1 (14.3%)	0 (0.0%)	2 (28.6%)	3 (42.9%)	1 (14.3%)	16.886	0.660
Rifampicin	0 (0.0%)	3 (25.0%)	5 (41.7%)	4 (33.3%)	0 (0.0%)		
Isoniazid + Rifampicin	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (100.0%)	0 (0.0%)		
Isoniazid + Rifampicin + Pyrizinamide	0 (0.0%)	0 (0.0%)	1 (25.0%)	3 (75.0%)	0 (0.0%)		
Isoniazid, Pyrizinamide, Ethambutol, Streptomycin	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	0 (0.0%)		
Isoniazid, Rifampicin + Ethambutol	0 (0.0%)	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)		
Type of TB							
New case	1 (3.7%)	3 (11.1%)	9 (33.3%)	13 (48.1%)	1 (3.7%)	1.037	0.904
Relapse	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	0 (0.0%)		
Directly Observed Treatment							
Yes	0 (0.0%)	3 (14.3%)	7 (33.3%)	10 (47.6%)	1 (4.8%)	7.80	0.453
No	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (100.0%)	0 (0.0%)		
Number of drugs							
<4	<4	1 (3.6%)	0 (0.0%)	1 (3.6%)	3 (10.7%)	5.87	0.209
>4	>4	0 (0.0%)	3 (10.7%)	8 (28.6%)	11 (39.3%)		
Adverse Drug Events							
Nausea and Vomiting	0 (0.0%)	1 (33.3%)	0 (0.0%)	1 (7.1%)	0 (0.0%)	15.31	0.51
Elevated liver enzymes	0 (0.0%)	1 (33.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)		
Neuritis	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (7.1%)	0 (0.0%)		
Hepatitis	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (7.1%)	0 (0.0%)		
None	1 (100.0%)	1 (33.3%)	9 (100.0%)	11 (78.6%)	1 (100.0%)		

Regarding clinical characteristics none of the clinical characteristics was found to be significantly associated with treatment outcomes.

3:10: Treatment Outcomes by Radiological Characteristics

Table 7: Distribution of Treatment Outcomes by Radiological Characteristics in Tuberculosis Patients

Radiological Characteristics	Death	Cured	Ongoing treatment	Loss of Follow up	Still in hospital	X ²	P value
Disease Side							
Unilateral	1 (6.7%)	3 (20.0%)	4 (26.7%)	7 (46.7%)	0 (0.0%)		

Bilateral	0 (0.0%)	0 (0.0%)	5 (38.5%)	7 (53.8%)	1 (7.7%)	4.99	0.288
Cavitary TB							
Yes	1 (6.3%)	1 (6.3%)	6 (37.5%)	7 (43.8%)	1 (6.3%)	2.81	0.588
No	0 (0.0%)	2 (16.7%)	3 (25.0%)	7 (58.3%)	0 (0.0%)		

None of the radiological characteristics was found to be associated with treatment outcomes. Additionally, For laboratory characteristics, we employed a linear regression test. None of the laboratory parameters predicted poor or better treatment outcomes for TB patients having resistant type as p values of >0.05 were obtained.

Discussion

This retrospective, cross-sectional study conducted at Liwa Hospital aimed to evaluate various characteristics and factors associated with poor outcomes in patients diagnosed with drug-resistant pulmonary tuberculosis. The study period spanned from January 2018 to May 2023, encompassing a total of 400 TB patients, among whom 28 were diagnosed with multidrug-resistant TB and selected for detailed analysis based on their treatment outcomes and clinical data.

In our study, the majority of patients were aged between 18-40 years (60.7%), a study also revealed that individuals in the age range of 21-30 years and 31-40 years were more frequently impacted, with an average age of 28.43 ± 14.32 years, compared to other age groups [15].

Similarly, in research directed by Mukherjee et al [16] a group of individuals between the ages of 21-30, with an average age of 32.52 years, were found to be frequently affected by MDR-TB. Studies conducted by Gaude et al. and Kapadia et al. also found that individuals in similar age groups were commonly affected [16, 17]. Increased participation from the middle age group may be attributed to their active lifestyles and interactions with individuals who have various health conditions.

In the present study, there were a total of 28 patients. Out of these, 24 (85.7%) were males and 4 (14.3%) were females and had MDR TB. Studies conducted by Gaude and Kapadia have consistently shown a significant male presence in the research [16, 17]. Male dominance can be explained by their greater participation in outdoor activities compared to females.

Regarding resistance patterns, in a study out of a total of 277 cases, multidrug-resistant/rifampicin-resistant tuberculosis (MDR/RR-TB) accounted for 265 cases (95.67%), cases of isoniazid monoresistance were 8 (2.89%), and extensively drug-resistant tuberculosis (XDR-TB) cases were 4 (1.44%). In the present study, among the cases of drug resistance tuberculosis analyzed, rifampicin resistance was the most prevalent, observed in 42.9% of cases. Isoniazid resistance followed closely, affecting 25.0% of cases. Resistance to both isoniazid and rifampicin was found in 10.7% of cases, while resistance to isoniazid, rifampicin, and pyrazinamide was seen in 14.3% of cases. More complex resistance patterns, such as resistance to isoniazid, pyrazinamide, ethambutol, and streptomycin combined, were present in 3.6% of cases.

Regarding treatment outcomes, in our study, 3.6% of the patients died. 32.1% of the patients were cured, followed by 10.7% who are still undergoing treatment. A small number of patients (3.6%) were still in the hospital, and (50%) were lost to follow-up.

Likewise, in a study, a significant majority of 177 (63.9%) cases were able to achieve successful treatment outcomes. Out of these, 153 individuals (55.2%) successfully recovered, while 24 individuals (8.7%) finished their treatment. Out of the remaining 100 patients who did not have successful outcomes, 60 unfortunately passed away, 32 were lost to follow-up, and 8 were deemed to have treatment failure [18].

In the present study, the researchers discovered that having other medical conditions was linked to a higher chance of experiencing a negative treatment outcome in patients with drug-resistant tuberculosis. This study result aligns with a meta-analysis [19] and a study conducted in Brazil and Yemen [20, 21]. In our study, both hypertensive and diabetic patients were associated with negative outcomes as they were still receiving the treatment and were not fully recovered. Additionally, in the present study, both age (18-40) and (41-60) groups were still receiving treatment and were not cured. This finding is aligned with another study, in which the middle age group faced poorer treatment outcomes [18].

The study revealed 50% of patients were lost to follow-up and highlighted the importance of better awareness, motivational counselling of Patients and family members, and community involvement in TB diagnosis and treatment. The enhanced efforts of treatment supporters, health Staff, and family & community persons are required to motivate and support the patients. Further research to devise appropriate strategies to Improve treatment compliance should be undertaken as part of TB control in high endemic areas/communities.

Our study has also several limitations. First, the retrospective nature of the study limited the data on detailed medical information on the participants. Second, being a single-center study, the findings may not be generalizable to other settings with different patient populations or healthcare

systems. Third, the relatively small sample size of 28 MDR-TB cases limits the statistical power to detect significant associations. Despite these limitations, the study has notable strengths. It provides a comprehensive analysis of various epidemiological, clinical, radiological, and laboratory characteristics associated with drug-resistant TB, contributing valuable insights to the existing body of knowledge. Furthermore, the use of standardized data collection forms ensures consistency and reliability in the gathered data. To enhance future research, we recommend conducting multi-center studies with larger sample sizes to improve generalizability and statistical power. Additionally, prospective studies could provide more accurate and detailed data, helping to identify and mitigate factors associated with poor outcomes in drug-resistant TB patients more effectively.

Conclusion:

The study identified significant associations between treatment outcomes and age, hypertension, and diabetes status, with higher proportions of poor outcomes observed in patients. DM patients often present with other comorbidities such as heart and renal diseases, thus making the treatment more complex with unfavorable outcomes. Comprehensive management strategies targeting these factors are essential to improve outcomes in patients with drug-resistant TB. Further research is warranted to develop tailored interventions for this population.

Ethical Approval:

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

Consent

As per international standards or university standards, patient(s) written consent has been collected and preserved by the author(s).

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc have been used during writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

- 1.
- 2.
- 3.

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