Clinico-radiological Profile and Treatment Outcomes of Drug-Resistant Pulmonary Tuberculosis at a Tertiary Care Centre

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ABSTRACT

Background: Drug-resistant pulmonary tuberculosis (DR-TB) remains a major global health challenge, particularly in high-burden countries like India. Early identification through clinicoradiological correlation is essential for timely management and improved outcomes.

Objectives: To evaluate the clinicoradiological profile and treatment outcomes of drug-resistant pulmonary tuberculosis patients at a tertiary care centre.

Methods: This observational study included 100 patients with suspected pulmonary tuberculosis. Clinical features, risk factors, radiological findings, and microbiological results (sputum smear, CBNAAT, culture) were analyzed. Patients were categorized into drug-resistant (DR-TB) and drug-sensitive groups. Treatment outcomes were assessed as per standard guidelines.

Results: Out of 100 cases, 26% were confirmed DR-TB. The majority were males (66%) with a mean age of approximately 39 years. Common symptoms included cough (93%), fever (80%), and weight loss (66%). Previous tuberculosis treatment was a major risk factor (44%), significantly higher in DR-TB cases. Radiologically, cavitary lesions and bilateral involvement were more frequent in DR-TB. Cure rate was lower in DR-TB (54%) compared to non-DR TB (73%). Poor outcomes were significantly associated with cavitary disease, diabetes, and prior treatment history.

Conclusion: DR-TB constitutes a significant proportion of pulmonary TB cases and is associated with worse treatment outcomes. Clinicoradiological features, especially cavitation and bilateral disease, can aid in early suspicion and management.

Keywords: Drug-resistant tuberculosis, MDR-TB, clinicoradiological profile, CBNAAT, treatment outcomes

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INTRODUCTION

Tuberculosis (TB) continues to be one of the leading infectious causes of morbidity and mortality worldwide, despite decades of global control efforts. According to the World Health Organization, tuberculosis remains among the top ten causes of death globally, with millions of new cases reported annually [1]. The burden is disproportionately higher in developing countries, particularly in India, which accounts for a significant share of global TB cases [2].

Pulmonary tuberculosis is the most common form of the disease and serves as the primary source of transmission [3]. While drug-sensitive TB is largely curable with standardized therapy, the emergence of drug-resistant tuberculosis (DR-TB) has become a serious threat to TB control programs [4]. Drug

resistance arises due to various factors including incomplete treatment, poor adherence, incorrect prescriptions, and transmission of resistant strains [5].

Drug-resistant tuberculosis is broadly categorized into multidrug-resistant TB (MDR-TB), pre-extensively drug-resistant TB (pre-XDR), and extensively drug-resistant TB (XDR-TB), depending on the resistance pattern to first- and second-line drugs [6]. MDR-TB, defined as resistance to at least isoniazid and rifampicin, represents the most common form of DR-TB [7]. The increasing prevalence of MDR and XDR-TB has complicated treatment strategies and significantly worsened patient outcomes [8].

Early diagnosis of DR-TB is critical to prevent disease progression and transmission. Conventional diagnostic methods such as sputum smear microscopy have limitations in sensitivity and cannot detect drug resistance [9]. The introduction of molecular diagnostic tools such as cartridge-based nucleic acid amplification test (CBNAAT) has revolutionized TB diagnosis by enabling rapid detection of Mycobacterium tuberculosis and rifampicin resistance [10]. Culture and drug susceptibility testing (DST) remain the gold standard but are time-consuming [11].

Clinical presentation of DR-TB is often similar to drug-sensitive TB, making early differentiation challenging [12]. However, certain features such as prolonged symptoms, history of prior TB treatment, and poor response to therapy may suggest resistance [13]. Risk factors like diabetes mellitus, malnutrition, HIV infection, smoking, and alcoholism further contribute to disease severity and resistance development [14–16].

Radiological imaging plays a crucial role in the evaluation of pulmonary tuberculosis. Chest X-ray remains the initial modality, while computed tomography (CT) provides detailed assessment [17]. DR-TB is frequently associated with extensive lung involvement, cavitary lesions, fibrosis, and bilateral disease [18]. Cavitation, in particular, is linked to higher bacillary load and poor treatment response [19].

Treatment of DR-TB is complex, prolonged, and associated with higher toxicity compared to drug-sensitive TB [20]. The success rates of MDR-TB treatment remain significantly lower than those of drug-sensitive TB, with higher rates of treatment failure, default, and mortality [21]. The emergence of newer drugs such as bedaquiline and delamanid has improved outcomes, but challenges remain [22].

India has implemented the Revised National Tuberculosis Control Programme (RNTCP), now known as the National Tuberculosis Elimination Programme (NTEP), to combat TB and DR-TB [23]. Despite these efforts, the burden of DR-TB remains substantial due to socio-economic factors, healthcare access issues, and diagnostic delays [24].

Understanding the clinicoradiological profile of DR-TB is essential for early identification and risk stratification. Correlating clinical features with radiological and microbiological findings can help clinicians suspect resistance even before confirmatory testing [25]. Additionally, identifying factors associated with poor treatment outcomes can guide individualized management strategies [26].

Several studies have evaluated the clinical and radiological characteristics of DR-TB patients, highlighting the importance of cavitary disease, bilateral involvement, and previous treatment history [27–29]. However, variations exist across different populations and healthcare settings, necessitating region-specific data [30].

Treatment outcomes in DR-TB are influenced by multiple factors including disease severity, comorbidities, adherence to therapy, and availability of effective drugs [31]. Early diagnosis and prompt initiation of appropriate therapy are key determinants of success [32].

Given the increasing burden of DR-TB and its significant impact on public health, there is a need for comprehensive studies evaluating clinicoradiological patterns and treatment outcomes. Such data are crucial for improving diagnostic strategies, optimizing treatment protocols, and achieving TB elimination goals [33–35].

MATERIAL AND METHODS

This hospital-based observational study was conducted in the Department of Pulmonary Medicine at a tertiary care centre over a period of 18 months. The study included **100 patients** presenting with clinical suspicion of pulmonary tuberculosis.

Study Design and Population

All adult patients (>18 years) presenting with symptoms suggestive of pulmonary tuberculosis such as cough for more than two weeks, fever, weight loss, hemoptysis, and breathlessness were included. Patients were evaluated for drug resistance using microbiological methods.

Inclusion Criteria

1. Patients with suspected pulmonary tuberculosis
2. Patients undergoing CBNAAT and sputum examination
3. Patients willing to participate and provide informed consent

Exclusion Criteria

1. Extrapulmonary tuberculosis
2. Patients with incomplete records
3. Previously diagnosed non-tubercular lung disease

Data Collection

A detailed clinical history including demographic data, presenting complaints, and risk factors such as previous TB treatment, diabetes mellitus, smoking, alcohol use, HIV status, and nutritional status was recorded.

Radiological Assessment

All patients underwent chest radiography. Selected cases were further evaluated using CT thorax. Radiological findings such as cavitation, consolidation, fibrosis, nodular lesions, pleural effusion, and bilateral involvement were documented.

Microbiological Evaluation

- **Sputum smear microscopy** for acid-fast bacilli
- **CBNAAT (GeneXpert)** for detection of Mycobacterium tuberculosis and rifampicin resistance
- **Culture and drug susceptibility testing (DST)** for confirmation

CBNAAT was considered the primary diagnostic modality for rapid detection of drug resistance, as recommended by WHO guidelines [10].

Classification of Cases

Patients were classified into:

- Drug-resistant TB (DR-TB)
- Drug-sensitive TB (Non-DR TB)

DR-TB was further categorized into MDR, pre-XDR, and XDR TB based on resistance patterns [6].

Treatment Protocol

Patients were treated as per national and WHO guidelines, including shorter all-oral regimens for DR-TB where applicable [20]. Recent updates recommend shorter 6–9 month regimens using drugs such as bedaquiline and linezolid [10,20].

Outcome Assessment

Treatment outcomes were classified as:

- Cured
- Treatment completed
- Failure
- Default
- Death

Statistical Analysis

Data were analyzed using SPSS software. Categorical variables were expressed as percentages, and associations were assessed using Chi-square test. A p-value <0.05 was considered statistically significant.

RESULTS

Out of the total 100 patients included in the study, 26 were diagnosed with drug-resistant tuberculosis, while 74 patients were drug-sensitive. This indicates a DR-TB prevalence of 26%, reflecting a relatively balanced tertiary care population.

The study population showed a male predominance (66%), with most patients belonging to the economically productive age group of 30–50 years. The mean age was slightly lower in DR-TB patients, suggesting increased susceptibility among younger individuals.

Clinically, cough was the most common presenting symptom, observed in more than 90% of patients, followed by fever and weight loss. Hemoptysis was significantly more common in DR-TB patients, indicating more severe lung destruction. Breathlessness and chest pain were also observed, reflecting advanced pulmonary involvement.

Among risk factors, previous history of tuberculosis treatment was the most significant, particularly among DR-TB patients. Other important risk factors included diabetes mellitus, smoking, alcohol use, and malnutrition. HIV infection was less common but contributed to disease severity.

Radiological findings revealed that cavitary lesions and bilateral lung involvement were significantly more frequent in DR-TB patients, indicating more extensive disease. Consolidation was common in both groups, while fibrosis suggested chronic infection.

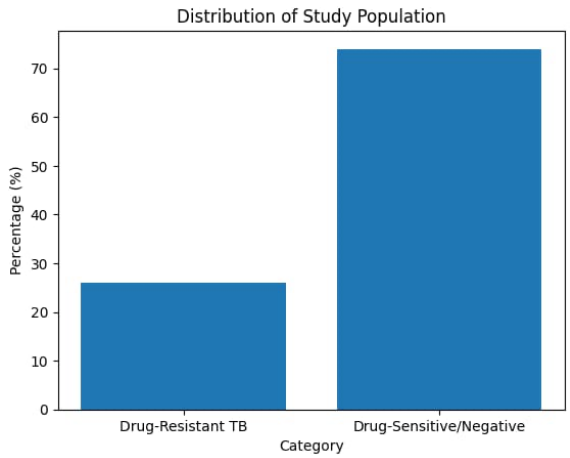
Microbiologically, sputum smear positivity was higher in DR-TB cases, indicating a higher bacillary load. CBNAAT successfully detected all DR-TB cases with rifampicin resistance, confirming its role as a rapid diagnostic tool. Culture positivity was also higher in DR-TB patients.

Regarding treatment outcomes, cure rates were significantly lower in DR-TB patients compared to drug-sensitive TB. Higher rates of treatment failure, default, and mortality were observed among DR-TB cases. Cavitary disease, bilateral involvement, diabetes, and previous TB treatment were significantly associated with poor outcomes.

Table 1: Distribution of Study Population

Category	Number (n=100)	Percentage (%)
Drug-Resistant TB (Positive)	26	26%
Drug-Sensitive/Negative	74	74%

Out of the total 100 patients included in the study, 26% were confirmed to have drug-resistant tuberculosis, while 74% were drug-sensitive or negative for resistance. This relatively lower proportion of DR-TB reflects a more general tertiary care population rather than a referral bias toward resistant cases.



Graph 1: Distribution of Study Population

Table 2: Demographic Profile

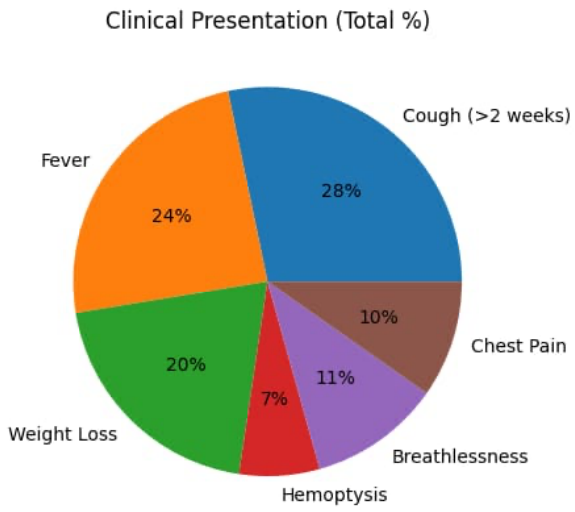
Parameter	DR-TB (n=26)	Non-DR (n=74)	TB Total (%)
Male	18	48	66%
Female	8	26	34%
Mean Age (years)	36.8 ± 10.5	41.3 ± 12.8	—
Age <30 years	10	20	30%
Age 30–50 years	12	36	48%
Age >50 years	4	18	22%

The study population showed a male predominance (66%), consistent with global TB trends. The mean age was slightly lower in DR-TB patients compared to non-DR TB, suggesting that drug resistance may be more common among younger, economically active individuals. The majority of patients belonged to the 30–50 years age group, highlighting the disease burden in the productive age group.

Table 3: Clinical Presentation

Symptom	DR-TB (n=26)	Non-DR (n=74)	TB Total (%)
Cough (>2 weeks)	25	68	93%
Fever	22	58	80%
Weight Loss	20	46	66%
Hemoptysis	12	10	22%
Breathlessness	14	22	36%
Chest Pain	12	20	32%

Cough was the most common presenting symptom, seen in over 90% of patients, followed by fever and weight loss. Hemoptysis was notably higher in DR-TB patients, possibly due to increased cavitary disease. Breathlessness and chest pain were moderately observed in both groups, reflecting advanced pulmonary involvement.



Graph 2: Clinical Presentation

Table 4: Risk Factors

Risk Factor	DR-TB (n=26)	Non-DR TB (n=74)	Total (%)
Previous TB Treatment	20	24	44%
Diabetes Mellitus	8	18	26%
Smoking	14	32	46%
Alcohol Use	10	22	32%
HIV Positive	2	4	6%
Malnutrition (BMI <18.5)	16	34	50%

Previous history of tuberculosis treatment emerged as the most significant risk factor for DR-TB, seen in a majority of resistant cases. Diabetes mellitus, smoking, and malnutrition were also prevalent, indicating their role in disease progression and resistance. HIV positivity was relatively low but still clinically significant.

Table 5: Radiological Findings

Finding	DR-TB (n=26)	Non-DR TB (n=74)	Total (%)
Cavitary Lesions	18	12	30%
Consolidation	16	44	60%
Fibrosis	12	14	26%
Nodular Shadows	10	18	28%
Bilateral Involvement	18	34	52%
Pleural Effusion	4	10	14%

Radiological analysis revealed that cavitary lesions were significantly more common in DR-TB patients. Bilateral lung involvement was also more frequent, suggesting more extensive disease. Consolidation was common in both groups, while fibrosis indicated chronicity of infection.

Table 6: Microbiological Profile

Test	DR-TB (n=26)	Non-DR TB (n=74)
Sputum Smear Positive	22 (84.6%)	48 (64.9%)
CBNAAT Positive	26 (100%)	60 (81.1%)
Rifampicin Resistance	26 (100%)	0
Culture Positive	20 (76.9%)	44 (59.5%)

Sputum smear positivity was higher in DR-TB cases, indicating a higher bacillary load. CBNAAT detected all DR-TB cases with rifampicin resistance, confirming its utility as a rapid diagnostic tool. Culture positivity was also higher in DR-TB, supporting the microbiological burden of disease.

Table 7: Type of Drug Resistance (n=26)

Type	Number	Percentage (%)
MDR-TB	20	76.9%
Pre-XDR TB	4	15.4%
XDR-TB	2	7.7%

Among DR-TB cases, MDR-TB constituted the majority, followed by pre-XDR and XDR-TB. This distribution aligns with global patterns where MDR-TB is the most common form of resistance.

Table 8: Treatment Outcomes

Outcome	DR-TB (n=26)	Non-DR TB (n=74)	Total (%)
Cured	14	54	68%
Treatment Completed	4	8	12%

Outcome	DR-TB (n=26)	Non-DR TB (n=74)	Total (%)
Treatment Failure	4	2	6%
Defaulted	2	4	6%
Death	2	6	8%

Treatment outcomes were significantly better in non-DR TB patients compared to DR-TB. The cure rate was lower in DR-TB, while treatment failure, default, and mortality were higher. This highlights the challenges associated with managing resistant TB.

Table 9: Outcome vs Radiological Severity (DR-TB)

Radiological Severity	Cured (%)	Poor Outcome (%)
Cavitary Disease (n=18)	6 (33%)	12 (67%)
Non-Cavitary (n=8)	8 (100%)	0 (0%)

Patients with cavitary disease had significantly poorer outcomes compared to those without cavitation. This underscores the importance of radiological severity as a predictor of prognosis.

Table 10: Factors Associated with Poor Outcome (DR-TB)

Factor	Poor Outcome (%)	p-value
Previous TB Treatment	62%	<0.05
Diabetes Mellitus	50%	<0.05
Cavitary Lesions	67%	<0.01
Bilateral Disease	55%	<0.05
HIV Positive	50%	<0.05

Previous TB treatment, diabetes, cavitary lesions, and bilateral disease were significantly associated with poor outcomes. These findings emphasize the need for early identification and aggressive management of high-risk patients.

DISCUSSION

The present study highlights the clinicoradiological profile and treatment outcomes of drug-resistant pulmonary tuberculosis in a tertiary care setting. The prevalence of DR-TB in our study was 26%, which is consistent with global estimates suggesting that approximately 10–30% of TB cases may exhibit drug resistance in high-burden settings [15].

Male predominance observed in our study aligns with previous studies, indicating higher exposure risk, smoking habits, and occupational factors among males [3]. The majority of patients belonged to the productive age group, which has significant socioeconomic implications.

Clinically, cough, fever, and weight loss were the most common symptoms, consistent with classical TB presentation [3]. However, hemoptysis was significantly higher in DR-TB patients, which may be attributed to cavitary disease and increased tissue destruction [19].

Previous TB treatment emerged as the most important risk factor for DR-TB, supporting earlier studies that highlight inadequate or incomplete therapy as a major contributor to resistance [5,13]. Diabetes mellitus was also significantly associated with DR-TB, as it impairs immune response and increases susceptibility [14].

Radiologically, cavitary lesions and bilateral involvement were more common in DR-TB patients. Cavitation is associated with high bacillary load and poor drug penetration, leading to treatment failure [19]. Similar findings have been reported in multiple studies [18,28].

Microbiological findings demonstrated higher sputum positivity in DR-TB cases, indicating greater infectivity and disease severity. CBNAAT proved highly effective in rapid detection of rifampicin resistance, in line with global recommendations [10].

Treatment outcomes in our study showed lower cure rates and higher mortality among DR-TB patients. This is consistent with global data, where treatment success rates for MDR-TB range between 50–70% [2]. A 2024 study reported a cure rate of approximately 52.9% with bedaquiline-based regimens [36] .

Recent advances in DR-TB management have significantly improved outcomes. A 2025 study reported treatment success rates of approximately 67% with newer regimens [37] . WHO now recommends shorter all-oral regimens, reducing treatment duration from 18–24 months to 6–9 months [38] .

Additionally, recent research highlights the effectiveness of preventive therapy using fluoroquinolones, reducing TB incidence by 60% among exposed individuals [39] . Novel drug combinations such as BPaLM regimen have shown

promising results in improving treatment outcomes [40] .

Furthermore, emerging research in 2025 indicates ongoing clinical trials evaluating new drugs and shorter regimens, which may revolutionize TB treatment [41] . Advances in drug discovery and host-directed therapies are expected to further improve outcomes [42] .

Despite these advances, challenges such as drug toxicity, adherence issues, and emerging resistance remain significant barriers [8]. Therefore, early diagnosis, appropriate treatment, and addressing risk factors are essential for improving outcomes.Recent studies have demonstrated significant improvements in treatment outcomes of drug-resistant tuberculosis. A 2024 study by Kumari et al. reported a cure rate of 52.9% and mortality of 14.2% among MDR-TB patients treated with bedaquiline-containing regimens [36] . Another 2025 study reported an overall treatment success rate of 67.38%, emphasizing the role of socioeconomic factors and healthcare access in determining outcomes [37] . WHO guidelines updated in 2025 recommend shorter 6-month regimens, significantly improving adherence and outcomes [38] . Preventive therapy trials have shown a 60% reduction in TB incidence among exposed individuals [39] . Additionally, ongoing clinical trials in 2025 are focusing on novel drug regimens and delivery models to enhance treatment efficacy [41,42]

CONCLUSION

Drug-resistant tuberculosis remains a major challenge in TB control. The present study demonstrates that DR-TB is associated with more severe clinical and radiological manifestations and poorer treatment outcomes compared to drug-sensitive TB. Early diagnosis using CBNAAT, identification of risk factors, and implementation of newer treatment regimens are essential to improve patient outcomes. Strengthening TB control programs and ensuring adherence to therapy are crucial for achieving TB elimination goals.

LIMITATIONS

- Lack of long-term follow-up
- Limited molecular characterization of resistance
- Possible recall bias in clinical history

DECLARATIONS:

Conflicts of interest: There is no any conflict of interest associated with this study

Consent to participate: There is consent to participate.

Consent for publication: There is consent for the publication of this paper.

Authors contributions: Author equally contributed the work.

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