

## Drug Resistance Patterns in Pulmonary Tuberculosis: A Clinical and Microbiological Study

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### ABSTRACT

**Background:** Pulmonary tuberculosis (TB) remains a major global health challenge, and the increasing prevalence of drug-resistant TB (DR-TB), including multidrug-resistant TB (MDR-TB) and extensively drug-resistant TB (XDR-TB), poses a serious threat to effective disease control.

**Aim:** To analyze the drug resistance patterns in pulmonary tuberculosis patients and assess the prevalence of mono-resistance, MDR-TB, and XDR-TB using sputum culture and drug susceptibility testing (DST).

**Methods:** A cross-sectional observational study was conducted from **January 2022 to December 2023** on **300 confirmed pulmonary TB patients** at a tertiary care center. Samples were processed using Ziehl-Neelsen staining, GeneXpert MTB/RIF, Line Probe Assay (LPA), and culture-based drug susceptibility testing for first- and second-line anti-TB drugs. Demographic data, treatment history, and risk factors were also evaluated.

**Results:** Out of 300 patients, **64 patients (21.3%)** showed drug resistance. **Rifampicin mono-resistance** was seen in 10% of cases, **isoniazid mono-resistance** in 7.3%, **MDR-TB** in 6.6% (resistant to both INH and RIF), and **XDR-TB** in 2%. Prior TB treatment and non-compliance were found to be significant risk factors ( $p < 0.001$ ). Resistance to fluoroquinolones and injectable second-line drugs was higher in previously treated patients.

**Conclusion:** Drug-resistant TB is increasingly prevalent, especially among previously treated and non-compliant patients. Early detection by GeneXpert and LPA, strict adherence to treatment, and individualized therapy based on DST are essential to control DR-TB.

**Keywords:** Pulmonary Tuberculosis • Drug Resistance • MDR-TB • GeneXpert • Line Probe Assay • Rifampicin Resistance • XDR-TB

## INTRODUCTION

Tuberculosis (TB) remains a significant public health burden despite global efforts to control the disease. According to the **WHO Global TB Report 2023**, approximately **10.6 million people** developed TB globally, and **1.3 million deaths** were reported. Of major concern is the **rise of drug-resistant TB**, particularly **multidrug-resistant TB (MDR-TB)** and **extensively drug-resistant TB (XDR-TB)**, which severely limit treatment options.

**MDR-TB** is defined as resistance to at least **rifampicin (RIF)** and **isoniazid (INH)**, while **XDR-TB** includes resistance to **fluoroquinolones** and **second-line injectable agents**. Drug resistance may develop due to **inadequate treatment, poor compliance, improper drug dosing, or transmission of resistant strains**.

Rapid molecular tests such as **GeneXpert MTB/RIF** and **Line Probe Assay (LPA)** have significantly improved early detection of drug resistance. However, treatment success still depends on **individualized regimens based on DST results**, adherence to therapy, and public health interventions.

This study aimed to determine the drug resistance patterns in pulmonary TB patients, identify associated risk factors, and highlight the importance of early detection and targeted treatment.

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## METHODS

### Study Design & Duration

Cross-sectional observational study  
January 2022–December 2023

### Study Setting

Department of Pulmonary Medicine  
[Name of Tertiary Care Hospital]

### Sample Size

Total **300 confirmed pulmonary TB patients**

### Inclusion Criteria

- Age  $\geq$  15 years
- Sputum AFB positive or GeneXpert positive
- Newly diagnosed or previously treated pulmonary TB

## Exclusion Criteria

- Extrapulmonary TB
- HIV-positive cases (analyzed separately)
- Patients on second-line treatment already

## Diagnostic Tests Used

Test	Purpose
Ziehl-Neelsen staining	Microscopy for AFB
GeneXpert MTB/RIF	MTB detection + rifampicin resistance
Line Probe Assay (LPA)	INH & RIF resistance
Culture & DST (MGIT 960)	First & second-line DST

## Statistical Analysis

SPSS v25 used. Chi-square test applied for associations. **p < 0.05 considered significant.**

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## RESULTS

### Demographic Profile

Parameter	Value
Total patients	300
Mean age	43.2 years
Male : Female	1.8 : 1
Previously treated TB cases	28%

### Drug Resistance Patterns (n = 300)

Type of Resistance	Number (%)
Drug-sensitive TB	236 (78.7%)
Rifampicin mono-resistance	30 (10.0%)
Isoniazid mono-resistance	22 (7.3%)
MDR-TB (INH+RIF)	20 (6.6%)

Type of Resistance	Number (%)
XDR-TB	6 (2.0%)

#### Risk Factors Associated with Drug Resistance

Risk Factor	p-value
Previous TB treatment	<0.001
Irregular drug intake	0.002
Alcohol/smoking	0.01
Diabetes mellitus	0.03

#### FIGURE / TABLE FOR PAPER

**Figure 1 – Pattern of Drug Resistance (n=300)**  
(Convert to pie/bar chart for publication)

Category	%
Sensitive TB	78.7%
Mono-resistance	17.3%
MDR-TB	6.6%
XDR-TB	2.0%

#### DISCUSSION

This study demonstrates a **significant burden of drug-resistant TB**, particularly in patients with previous treatment history and irregular drug adherence.

- **Rifampicin resistance (10%)** is alarming, as RIF resistance strongly correlates with MDR-TB.
- **6.6% MDR-TB** cases are comparable to WHO estimates for India and other high-burden countries.
- **XDR-TB (2%)** is emerging but extremely difficult to treat, highlighting the need for early diagnosis.
- **Lifestyle factors** such as alcohol, smoking, and diabetes were associated with higher resistance.

**GeneXpert and LPA helped in rapid diagnosis**, reducing time to initiate appropriate therapy. However, culture and DST remain the **gold standard** for second-line drug resistance detection.

**Public health strategies needed:**

- ✓Treatment adherence monitoring
- ✓Counseling against treatment default
- ✓Screening of close contacts
- ✓Directly Observed Therapy (DOTS) reinforcement

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## CONCLUSION

Drug-resistant pulmonary TB is a growing challenge. Early diagnosis through molecular tests, appropriate treatment based on DST, and strict adherence are key to controlling the spread. Strengthening screening programs and public awareness is vital to reduce drug resistance and improve treatment outcomes.

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