



Epidemiological Trends and Multidrug-Resistant Tuberculosis Burden in Vikarabad District: A Cross-Sectional Observational Study.

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Abstract

Background:

Multidrug-resistant tuberculosis (MDR-TB) remains a public health concern, particularly in resource-constrained settings. Limited data exist on the regional burden and epidemiological patterns of MDR-TB in Vikarabad district, Telangana, India. This study was conducted to evaluate the clinical characteristics, prevalence of drug resistance, and treatment outcomes among patients diagnosed with tuberculosis.

Methods:

A cross-sectional observational study was conducted from October 2023 to January 2025 across DOTS centers in Vikarabad district. A total of 300 bacteriologically confirmed TB patients were enrolled. Demographic and clinical data were collected using structured case records. Drug susceptibility testing (DST) for rifampicin and isoniazid was performed using GeneXpert and line probe assays. Treatment outcomes were evaluated per national TB program guidelines.

Results:

The mean age of participants was 38.4 ± 14.7 years, with 66% being male and 59% residing in rural areas. Pulmonary TB accounted for 81% of cases. Of the total sample, 24% were previously treated TB cases. Rifampicin resistance was detected in 6% of participants; MDR-TB was confirmed in 4%. Notably, 13.9% of previously treated cases were MDR-TB, compared to 0.9% in new cases. Treatment success was achieved in 80% of patients overall, but only 58.3% among MDR-TB cases. Drug-sensitive TB patients had a significantly higher success rate of 82.2%.

Conclusion:

MDR-TB remains a considerable burden in Vikarabad, particularly among previously treated TB cases. Targeted DST, robust follow-up, and community-based adherence strategies are essential to improve outcomes and reduce transmission.

Recommendations:

Enhance early DST access, strengthen treatment adherence monitoring, integrate TB counseling at primary care, and ensure continuous drug supply and follow-up systems to effectively manage MDR-TB in high-risk rural populations.

Keywords: Multidrug-resistant tuberculosis, Vikarabad, Drug resistance, GeneXpert, Treatment outcomes, Cross-sectional study, Tuberculosis control

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Introduction:

Tuberculosis (TB) continues to be a major global health challenge and remains one of the top ten causes of mortality, especially in low- and middle-income countries. According to the World Health Organization Global TB Report 2023, approximately 10.6 million individuals developed TB in

2022, resulting in 1.3 million deaths among HIV-negative individuals. India bears a disproportionate share of the global TB burden, consistently reporting the highest number of cases each year [1].

The global rise in multidrug-resistant tuberculosis (MDR-TB)—defined as resistance to at least isoniazid and rifampicin—has further complicated TB control strategies.



The increasing burden of MDR-TB has been linked to factors such as delayed diagnosis, inadequate treatment regimens, poor adherence, and irregular drug supply [2,3]. Studies indicate that the prevalence of MDR-TB is not only persistent but also increasing in several regions, despite intensified control efforts [4,5]. In India, the India TB Report 2023 estimates that 2.84% of new TB cases and up to 11.6% of previously treated cases may develop MDR-TB, reflecting a significant public health concern.

Globally, MDR-TB has emerged as a critical threat to TB elimination goals, with its burden increasing in both high-incidence and low-resource settings [1,4,5]. Despite progress in diagnostics and treatment protocols, epidemiological surveillance at the district level remains limited in many parts of India. Vikarabad district, located in Telangana state, represents one such region where reliable local data on MDR-TB prevalence, associated risk factors, and treatment outcomes are sparse. This lack of localized evidence impedes the design of targeted interventions and delays timely programmatic responses [6].

This study was designed to bridge this gap by evaluating the clinical spectrum, epidemiological trends, and treatment outcomes of TB patients, with a focus on the prevalence and burden of MDR-TB in Vikarabad. By identifying resistance patterns and outcome disparities between drug-sensitive and drug-resistant TB, the study aims to inform more effective regional TB control strategies.

Methodology

Study Design and Duration:

This was a hospital-based cross-sectional observational study conducted over a period of 16 months, from October 2023 to January 2025.

Study Setting:

The study was carried out at the Government General Hospital, Vikarabad, a tertiary care facility and designated nodal center for tuberculosis diagnosis and treatment under the National Tuberculosis Elimination Programme (NTEP). The hospital serves both urban and rural populations from the Vikarabad district and surrounding areas.

Study Population:

The study included bacteriologically confirmed TB patients attending the outpatient and inpatient departments of the hospital during the study period. Both newly diagnosed and previously treated pulmonary and extrapulmonary TB patients were considered for inclusion.

Inclusion Criteria:

Patients aged ≥ 18 years with a confirmed diagnosis of TB by GeneXpert MTB/RIF.

Patients are willing to give informed consent.

Both new and previously treated TB cases.

Exclusion Criteria:

Patients diagnosed with non-tuberculous mycobacterial infections.

Patients who were critically ill or unwilling to participate.

Patients with incomplete diagnostic records.

Sample Size and Sampling Method:

The sample size was calculated using the formula:

$$n = Z^2 \times p(1-p) / d^2$$

Where $Z = 1.96$ for a 95% confidence level, p = anticipated prevalence of MDR-TB (assumed at 4% based on national estimates), and $d = 0.022$ (margin of error).

$$n = (1.96)^2 \times 0.04(1-0.04) / (0.022)^2 \approx 271$$

After adjusting for a 10% non-response rate, the final sample size was rounded to 300.

Participants were selected using consecutive sampling from among bacteriologically confirmed TB patients who met the eligibility criteria during the study period.

Data Collection:

Data were collected using a structured proforma, which included:

Socio-demographic details (age, gender, residence)

Clinical features (type of TB, treatment history)

Laboratory results (GeneXpert results, rifampicin resistance)

Treatment outcomes, as per NTEP definitions (cure, treatment completion, failure, death, lost to follow-up)

Drug susceptibility testing (DST) was performed using GeneXpert MTB/RIF and line probe assay (LPA) for confirmation of MDR-TB.

Statistical Analysis:

Collected data were entered into Microsoft Excel and analyzed using SPSS version 25. Descriptive statistics were used to summarize socio-demographic and clinical characteristics. Categorical variables were expressed as frequencies and percentages, and comparisons were made using the Chi-square test. A p -value < 0.05 was considered statistically significant.

Bias Control Measures:

To minimize selection bias, all eligible TB patients attending the hospital during the study period were enrolled using consecutive sampling, ensuring inclusivity. Information bias was reduced by employing standardized data collection tools and trained personnel for documentation. Diagnostic bias was minimized through the use of validated molecular diagnostic methods (GeneXpert and LPA). Additionally, all outcome definitions strictly adhered to NTEP guidelines to maintain uniformity and comparability.

Ethical Considerations:

Ethical approval was obtained from the Institutional Ethics Committee of Government General Hospital, Vikarabad.

Informed consent was obtained from all participants. Confidentiality and anonymity were strictly maintained throughout the study.

Results

Participant Flow:

During the study period, a total of 328 bacteriologically confirmed TB patients were approached across outpatient and inpatient departments. Of these, 310 patients met the eligibility criteria and were examined for participation. Ten individuals were excluded due to incomplete diagnostic records or critical illness. Among the 310 eligible patients, 10 declined to provide informed consent. Thus, a total of 300 TB patients were enrolled and included in the final analysis.

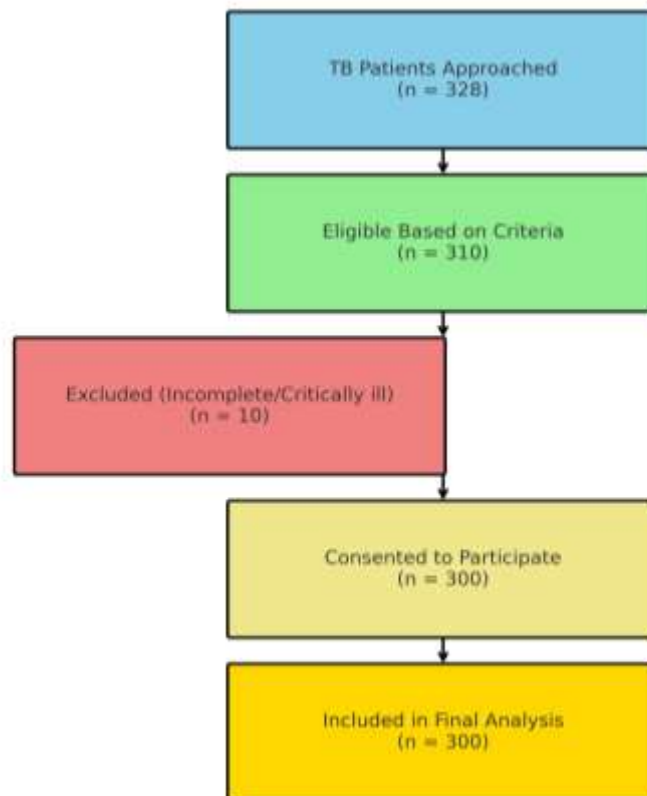


Figure 1: Flow Diagram of Participant Recruitment and Inclusion

A total of 300 tuberculosis (TB) patients were enrolled in this cross-sectional observational study conducted in Vikarabad District. The analysis focused on demographic

profiles, clinical characteristics, drug resistance patterns, and treatment outcomes.

Socio-Demographic Profile:

The study included 300 tuberculosis patients, with a mean age of 38.4 ± 14.7 years (range: 18–76 years), indicating that TB predominantly affected adults in their economically productive age group. A higher proportion of participants

were male (66%), suggesting a gender disparity that may be attributed to occupational exposure and health-seeking behaviors. Additionally, 59% of the patients resided in rural areas, highlighting the continued burden of TB in underserved and resource-limited settings of the district (Table 1).

Table 1. Socio-Demographic Profile of Study Participants (n = 300)

Variable	Category	Frequency (n)	Percentage (%)
Age (in years)	Mean \pm SD	38.4 ± 14.7	—
Gender	Male	198	66.0
	Female	102	34.0
Residence	Urban	123	41.0
	Rural	177	59.0

Clinical Characteristics:

Out of the 300 patients, 243 (81%) had pulmonary TB, while 57 (19%) presented with extrapulmonary TB. A majority of

the participants (76%) were newly diagnosed cases, and the remaining 24% were previously treated for TB, indicating a substantial subgroup with treatment history who may be at risk of drug resistance (Table 2).

Table 2. Clinical Characteristics of TB Patients

Variable	Category	Frequency (n)	Percentage (%)
Type of TB	Pulmonary TB	243	81.0
	Extrapulmonary TB	57	19.0
Treatment History	New TB cases	228	76.0
	Previously treated	72	24.0

Drug Susceptibility Testing and MDR-TB Burden:

Rifampicin resistance, detected via GeneXpert MTB/RIF, was found in 6% (18/300) of the total sample. Among these, 14 patients had a history of previous TB treatment, accounting for 19.4% of all previously treated cases,

compared to only 1.8% in newly diagnosed cases. Furthermore, 12 participants (4%) were identified with multidrug-resistant TB (MDR-TB), defined as resistance to both rifampicin and isoniazid. Of these, 10 (13.9%) were from the previously treated group, whereas only 2 (0.9%) were from the new case group (Table 3).

Table 3. Drug Susceptibility Testing (DST) and MDR-TB Prevalence

Drug Resistance Category	Group	Frequency (n)	Percentage (%)
Rifampicin-resistant TB (RR-TB)	All patients	18	6.0
	New cases	4	1.8
	Previously treated	14	19.4
Confirmed MDR-TB (RR + INH)	All patients	12	4.0
	New cases	2	0.9
	Previously treated	10	13.9

Treatment Outcomes:

Treatment success, defined as cure or completion of therapy, was achieved in 80% (240/300) of the cases. However, 24



patients (8%) were lost to follow-up, and 18 (6%) succumbed to the disease. Treatment failure was recorded in 9 patients (3%), while 9 others (3%) were either transferred

out or not evaluated due to various logistical reasons (Table 4).

Table 4. Treatment Outcomes Among Study Participants

Outcome Category	Total (n = 300)	Percentage (%)
Treatment Success	240	80.0
Lost to Follow-up	24	8.0
Deaths	18	6.0
Treatment Failure	9	3.0
Not Evaluated/Transferred Out	9	3.0

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MDR-TB vs. Drug-Sensitive TB: Outcome Comparison:

A comparative assessment revealed a significant disparity in treatment success between MDR-TB and drug-sensitive TB

cases. Among the 12 MDR-TB patients, only 7 (58.3%) achieved treatment success, whereas 82.2% of drug-sensitive TB patients (237/288) successfully completed their therapy. This highlights the challenge posed by drug resistance in TB management (Table 5).

Table 5. Treatment Success Comparison Between MDR-TB and Drug-Sensitive TB

TB Type	Patients (n)	Treatment Success (n)	Success Rate (%)
Drug-sensitive TB	288	237	82.2
MDR-TB	12	7	58.3

Discussion:

This study assessed the epidemiological and clinical characteristics of tuberculosis (TB) patients and the burden of multidrug-resistant TB (MDR-TB) at Government General Hospital, Vikarabad, over 16 months. Among 300 bacteriologically confirmed TB patients, the study revealed critical insights into the regional patterns of drug resistance in a semi-urban Indian setting.

The mean age of patients was 38.4 years, with a predominance of males (66%) and rural residents (59%). This demographic profile mirrors national and international trends, where TB disproportionately affects economically productive males in resource-constrained rural areas due to occupational exposure, undernutrition, and delayed health-seeking behavior [9, 12].

Pulmonary TB was the most prevalent form (81%) in this cohort, consistent with existing literature that identifies pulmonary TB as the most common and transmissible form globally [9]. A significant proportion of participants (24%) had a prior history of TB treatment, a known risk factor for developing drug resistance [10, 11].

The prevalence of rifampicin resistance (6%) and confirmed MDR-TB (4%) observed in this study is within the range reported by the India TB Report and corroborated by regional surveillance data from other parts of India, including Delhi and Uttar Pradesh [10, 12]. Notably, 13.9% of previously treated cases in this study had MDR-TB compared to just 0.9%

among new cases, reinforcing the critical need for routine drug susceptibility testing (DST) at the time of diagnosis, especially in retreatment cases [7, 11].

Treatment success in the overall cohort was 80%, comparable to national programmatic targets. However, the markedly lower treatment success rate among MDR-TB patients (58.3%) reflects the ongoing challenges associated with drug-resistant TB management, including longer treatment regimens, increased toxicity, poor adherence, and socioeconomic constraints [8, 10]. These findings align with surveillance data from Brazil and China that also emphasize the burden and treatment complexity of MDR-TB and TB/HIV coinfection [7, 8].

This study's prospective design enhanced data completeness and allowed real-time documentation of clinical interventions and outcomes, thus improving the reliability of findings and supporting evidence-based recommendations for district-level TB control planning.

Generalizability:

Although this study was conducted at a single tertiary care center in Vikarabad, its findings may be generalizable to similar semi-urban and rural settings across India with comparable TB epidemiology and healthcare infrastructure. The use of standardized NTEP protocols, inclusion of both new and previously treated cases, and consistent diagnostic methods enhance external validity. However, findings should



be cautiously extrapolated to metropolitan populations or regions with differing health system dynamics and MDR-TB control measures.

Conclusion:

This study highlights a significant burden of multidrug-resistant tuberculosis (MDR-TB) in Vikarabad district, particularly among previously treated patients. The overall treatment success rate of 80% aligns with national TB control targets, but the markedly lower success rate in MDR-TB cases (58.3%) underscores the urgent need for early drug susceptibility testing, effective follow-up, and patient-centered care models. The predominance of TB among males and rural residents suggests targeted interventions are needed for high-risk populations. Strengthening adherence support, ensuring uninterrupted drug supply, and enhancing health education are critical to improving outcomes. These findings can inform district-level TB program planning and MDR-TB control strategies.

Limitations:

This study had several limitations. First, it was conducted at a single tertiary care center, which limited the generalizability of findings to the broader district or state level. Second, the use of consecutive sampling introduced selection bias, as patients presenting to the hospital differed from those managed at peripheral health centers or those who did not seek care. Third, although GeneXpert and Line Probe Assays were used, second-line drug resistance testing was not performed, thus restricting full resistance profiling. Lastly, socio-behavioral factors influencing treatment adherence were not assessed, which could have provided deeper insights into treatment outcomes.

Recommendations:

To address the burden of MDR-TB in Vikarabad, we recommend: (1) universal drug susceptibility testing (DST) for all diagnosed TB cases, especially retreatment cases; (2) strengthening community-based adherence support and nutritional counseling; (3) improving follow-up mechanisms through digital health tools; (4) capacity building of healthcare providers in MDR-TB management; and (5) enhancing public awareness campaigns in rural areas. Integrating these strategies can improve treatment outcomes and reduce transmission of drug-resistant TB strains.

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Abbreviations:

TB – Tuberculosis

MDR-TB – Multidrug-Resistant Tuberculosis

RR-TB – Rifampicin-Resistant Tuberculosis

DST – Drug Susceptibility Testing

DOTS – Directly Observed Treatment Short-course

NTEP – National Tuberculosis Elimination Programme

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The study had no funding.

Conflict of interest:

The authors declare no conflict of interest.

Author contributions:

GP-Concept and design of the study, results interpretation, review of literature, and preparation of the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript. SN-Concept and design of the study, results interpretation, review of literature, preparing the first draft of the manuscript, and revision of the manuscript. BS-Review of literature and preparing the first draft of the manuscript. Statistical analysis and interpretation. STB-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript.

Data availability:

Data available on request

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