Retrospective Microbiological Analysis of Pulmonary Tuberculosis Diagnosed by Smear Microscopy and Molecular Assays in Garhwa District, Jharkhand (2022–2024)

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Abstract

Background & Objectives: Tuberculosis (TB) remains a major public health challenge in India, particularly in rural districts with limited diagnostic access. Molecular assays, including Truenat and cartridge-based nucleic acid amplification tests (CBNAAT), have been implemented under the National Tuberculosis Elimination Programme (NTEP) to improve detection and enable early identification of rifampicin resistance. This study aimed to evaluate trends in pulmonary TB diagnosis using smear microscopy, Truenat, and CBNAAT at Sadar Hospital, Garhwa district, Jharkhand, between 2022 and 2024.
Methods: This retrospective laboratory-based analysis was conducted using routine programmatic data for all presumptive pulmonary TB cases tested from January 2022 to December 2024. Data were obtained from Designated Microscopy Centre registers, Truenat and CBNAAT laboratory records, and the NIKSHAY portal. Positivity rates for each diagnostic modality were calculated, and rifampicin-resistant cases were documented. Descriptive statistics were used to summarise findings.
Results: A total of 118,573 presumptive pulmonary TB cases were evaluated. Smear microscopy detected 10,281 cases in 2022 (53.7%), declining to 897 (1.9%) in 2023 and 1,126 (2.16%) in 2024. Truenat positivity increased from 338 of 7,071 tests (4.8%) in 2022 to 848 of 3,340 tests (25.4%) in 2024. CBNAAT identified 7 of 24 cases (1 rifampicin-resistant) in 2022, 544 of 1,957 (28 rifampicin-resistant) in 2023, and 501 of 2,018 (33 rifampicin-resistant) in 2024. Males constituted the majority of confirmed cases each year, with fewer female and paediatric cases.
Conclusions: There is a clear shift from smear microscopy to molecular diagnostics for pulmonary TB in Garhwa district. CBNAAT consistently yielded higher detection rates and enabled early rifampicin resistance detection. Expansion and optimal use of molecular diagnostic platforms are critical to improving TB case detection and drug-resistance surveillance in high-burden, resource-limited settings.

Keywords: Pulmonary tuberculosis; Smear microscopy; Truenat; CBNAAT; Rifampicin resistance

INTRODUCTION

Tuberculosis (TB) remains a major public health challenge worldwide, with India accounting for the largest share of the global TB burden. Despite ongoing control efforts, TB continues to affect populations living in rural and socioeconomically disadvantaged areas, where access to healthcare services is often limited. The National Tuberculosis Elimination Programme (NTEP) aims to eliminate TB by 2025 through early diagnosis and prompt initiation of treatment.

For decades, sputum smear microscopy has been the mainstay of TB diagnosis due to its low cost and simplicity. However, it has limited sensitivity, particularly among patients with low bacillary load, children, and those with smear-negative disease. To overcome these limitations, molecular diagnostic assays such as Truenat and cartridge-based nucleic acid amplification tests

(CBNAAT/GeneXpert) have been introduced under NTEP. These assays provide higher sensitivity and specificity and allow rapid detection of rifampicin resistance, a surrogate marker for multidrug-resistant TB.

Garhwa district, Jharkhand, is predominantly rural and faces challenges in healthcare access and infrastructure. Although molecular diagnostic facilities are now available under NTEP, there is limited published evidence describing their real-world performance at the district level. The present retrospective study was undertaken to evaluate trends in pulmonary TB detection using smear microscopy, Truenat, and CBNAAT at Sadar Hospital, Garhwa, over three years (2022–2024).

MATERIALS AND METHODS

Study Design and Setting

This retrospective laboratory-based study was conducted at Sadar Hospital, Garhwa district, Jharkhand, India. Routine diagnostic data generated under the National Tuberculosis Elimination Programme between January 2022 and December 2024 were analysed. Sadar Hospital serves as a district-level centre providing smear microscopy, Truenat, and CBNAAT services through designated diagnostic facilities.

Study Population

All individuals identified as presumptive pulmonary tuberculosis (PTB) cases and referred for microbiological testing during the study period were included. Both adult and paediatric populations were analysed. Cases suspected of extrapulmonary TB were excluded.

Data Sources

Data were retrieved from routinely maintained programmatic records, including:

- Designated Microscopy Centre (DMC) registers
- Truenat laboratory records
- CBNAAT laboratory records
- NIKSHAY portal entries

These sources provided information on the number of samples tested and microbiological outcomes for pulmonary TB.

Data Analysis

Descriptive statistical analyses were performed. Positivity rates for smear microscopy, Truenat, and CBNAAT were calculated as the proportion of positive results among the total tests conducted for each diagnostic modality. Results are presented as frequencies and percentages.

Ethical considerations

This study involved retrospective analysis of anonymized routine programmatic data collected under the National Tuberculosis Elimination Programme. As no patient identifiers were used, Formal institutional ethical approval was not required as anonymized secondary programmatic data were used.

RESULTS

1.Presumptive Pulmonary Tuberculosis

Between January 2022 and December 2024, a total of 118,573 presumptive pulmonary TB cases were evaluated. The number of individuals tested increased steadily over the study period, from 19,137 in 2022 to 52,085 in 2024, reflecting expanded TB screening under NTEP.

Table 1. Presumptive pulmonary tuberculosis cases evaluated during 2022–2024

Year	Presumptive TB Cases
2022	19,137
2023	47,351
2024	52,085
Total	118,573

2.Smear microscopy results

Smear microscopy detected 10,281 positive cases in 2022 (53.7%). A marked decline was observed in subsequent years, with 897 cases (1.9%) in 2023 and 1,126 cases (2.16%) in 2024. The high positivity observed in 2022 reflects testing predominantly among clinically high-suspicion cases prior to large-scale implementation of molecular diagnostic services.

Table 2. Smear microscopy positivity for pulmonary tuberculosis (2022–2024)

Year	Smear-Positive Cases	Positivity Rate
2022	10,281	53.7%
2023	897	1.9%
2024	1,126	2.16%

3.Truenat testing outcomes

Truenat positivity increased over the study period. In 2022, 338 of 7,071 tests were positive (4.8%). In 2023, 101 of 987 tests (10.2%) were positive, and in 2024, 848 of 3,340 tests (25.4%) were positive.

Table 3. Truenat testing outcomes for pulmonary tuberculosis (2022–2024)

Year	Male	Female	Children
2022	817	211	10
2023	716	177	4
2024	906	209	11

4.CBNAAT Results with Rifampicin Resistance

CBNAAT consistently identified a high proportion of pulmonary TB cases and allowed detection of rifampicin resistance. In 2022, 7 of 24 tests were positive, including 1 rifampicin-resistant case. In 2023, 544 of 1,957 tests were positive, with 28 rifampicin-resistant cases. In 2024, 501 of 2,018 tests were positive, with 33 rifampicin-resistant cases.

Table 4. CBNAAT results and rifampicin resistance among pulmonary cases (2022–2024)

Year	Total CBNAAT Tests	CBNAAT-Positive Cases	Rif-Resistant Cases
2022	24	7	1
2023	1,957	544	28
2024	2,018	501	33
Total	**3,999**	**1,052**	**62**

5.Demographic Profile

Across all years, males formed the majority of confirmed pulmonary TB cases, with females and children representing smaller proportions.

Table 5. Demographic Profile

Year	Total Truenat Tests	Positive Cases	Positivity Rate
2022	**7,071**	**338**	**4.8%**
2023	**987**	**101**	**10.2%**
2024	**3,340**	**848**	**25.4%**

DISCUSSION

This study provides insight into evolving diagnostic trends for pulmonary TB at Sadar Hospital, Garhwa district, between 2022 and 2024. The steady increase in presumptive TB cases reflects expanded screening and improved access to diagnostic services under NTEP. Over the three-year period, there was a noticeable shift from reliance on smear microscopy towards molecular diagnostic platforms for pulmonary tuberculosis diagnosis.

The decline in smear microscopy positivity in later years may be explained by the increased use of more sensitive molecular assays, which can detect TB even among patients with low bacillary load or prior antibiotic exposure. Both Truenat and CBNAAT demonstrated higher diagnostic yield, with CBNAAT also enabling early detection of rifampicin resistance. Similar trends have been reported in other programmatic settings in India, highlighting the value of molecular diagnostics for routine TB control.

The rising number of rifampicin-resistant cases detected by CBNAAT underscores the importance of universal drug-resistance testing at diagnosis. Early identification enables timely initiation of appropriate treatment and may improve programmatic outcomes in resource-limited settings.

Overall, the study emphasizes that molecular diagnostics complement smear microscopy and are vital for enhancing TB case detection and drug-resistance surveillance in high-burden districts.These findings support continued decentralization of molecular diagnostics at district hospitals to strengthen early case detection and drug-resistance surveillance.

CONCLUSION

This retrospective study demonstrates a clear transition from smear microscopy to molecular diagnostic methods for pulmonary TB in Garhwa district between 2022 and 2024. Molecular assays, particularly CBNAAT, consistently showed higher diagnostic yield and enabled early detection of rifampicin resistance under routine programmatic conditions. Continued expansion and optimal utilisation of these diagnostic platforms are essential for strengthening TB diagnosis and surveillance of drug-resistant cases in high-burden, resource-limited districts.

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