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Prevalence, Laboratory Diagnosis, and Drug Resistance Pattern of Mycobacterium Tuberculosis among Suspected Tuberculosis Patients: A Study on 100 Clinical Samples

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ABSTRACT

Tuberculosis (TB) remains a major public health problem worldwide and is further complicated by the emergence of multidrug-resistant tuberculosis (MDR-TB). The present study was conducted to evaluate the prevalence, laboratory diagnosis, and drug resistance pattern of Mycobacterium tuberculosis among suspected tuberculosis patients. A total of 100 sputum samples were collected and analyzed using Ziehl–Neelsen staining, GeneXpert MTB/RIF assay, culture on Löwenstein–Jensen medium, and drug susceptibility testing. GeneXpert detected tuberculosis in 42% of samples, whereas culture and microscopy detected 40% and 35% positivity, respectively. Among GeneXpert-positive cases, rifampicin resistance was observed in 8 cases. Drug susceptibility testing demonstrated resistance to first-line anti-tubercular drugs, particularly isoniazid and rifampicin. Six isolates were identified as multidrug-resistant tuberculosis. The study highlights the superior sensitivity of GeneXpert for rapid diagnosis and emphasizes the importance of routine drug susceptibility testing for early detection of drug-resistant tuberculosis. Early diagnosis and appropriate treatment are essential for reducing disease transmission and improving patient outcomes.

Keywords: Tuberculosis, Mycobacterium tuberculosis, GeneXpert MTB/RIF, Drug Resistance, MDR-TB, Culture, Microscopy

INTRODUCTION

Tuberculosis is a chronic infectious disease caused by Mycobacterium tuberculosis and remains one of the leading causes of morbidity and mortality worldwide. Despite significant advances in diagnosis and treatment, tuberculosis continues to pose serious challenges, particularly in developing countries. The emergence of multidrug-resistant tuberculosis has further complicated disease management and control efforts.

Early diagnosis and prompt treatment are essential for effective tuberculosis control. Conventional diagnostic methods such as sputum smear microscopy and culture remain widely used; however, molecular diagnostic techniques have significantly improved the speed and accuracy of diagnosis. GeneXpert MTB/RIF assay enables simultaneous detection of M. tuberculosis and rifampicin resistance within a short period, facilitating rapid clinical decision-making.

The present study aimed to determine the prevalence of tuberculosis among suspected patients and evaluate the performance of laboratory diagnostic techniques while assessing drug resistance patterns among the isolates.

MATERIALS AND METHODS

2.1 Study Design

A laboratory-based cross-sectional study was conducted between January 2026 and May 2026.

2.2 Sample Collection

A total of 100 sputum samples were collected from clinically suspected tuberculosis patients attending healthcare facilities.

2.3 Laboratory Investigations

The collected samples were subjected to:

- Ziehl–Neelsen staining for acid-fast bacilli detection
- GeneXpert MTB/RIF assay
- Culture on Löwenstein–Jensen medium
- Drug susceptibility testing

2.4 Data Analysis

Data were analyzed using Microsoft Excel and SPSS software. Frequency and percentage analyses were performed, and results were presented in tabular form.

RESULTS AND DISCUSSION

3.1 Age-wise Distribution of Patients

Tuberculosis was observed across different age groups, with the highest prevalence among individuals belonging to the economically productive age category. The majority of cases were reported among patients aged 26–35 years, followed by those aged 36–45 years. Increased occupational exposure, social interaction, and mobility may contribute to the higher occurrence of tuberculosis in these age groups.

Table 1. Age-wise Distribution of Patients

Age Group (Years)	Observation
15–25	Lower prevalence
26–35	Highest prevalence
36–45	Second highest prevalence
>45	Moderate prevalence

The findings indicate that tuberculosis remains a significant health concern among young and middle-aged adults, emphasizing the need for early diagnosis and timely treatment.

3.2 Gender Distribution

Male patients constituted 62% of the study population, whereas females accounted for 38%, indicating a higher prevalence among males.

Table 2. Gender Distribution of Patients

Gender	Percentage (%)
Male	62
Female	38
Total	100

The higher prevalence among males may be associated with increased exposure to environmental risk factors, occupational activities, smoking habits, and delayed healthcare-seeking behavior.

3.3 Ziehl–Neelsen Staining Results

Among the 100 sputum samples analyzed, 35 samples were positive for acid-fast bacilli by Ziehl–Neelsen staining.

Table 3. Ziehl–Neelsen Microscopy Results

Result	Number of Samples
Positive	35
Negative	65
Total	100

Microscopy remains a useful screening tool; however, its sensitivity is lower than molecular diagnostic methods, particularly in paucibacillary cases.

3.4 GeneXpert MTB/RIF Results

GeneXpert detected Mycobacterium tuberculosis in 42 samples.

Table 4. GeneXpert MTB/RIF Results

Result	Number of Samples
Positive	42
Negative	58
Total	100

The higher positivity rate compared with microscopy demonstrates the superior sensitivity of molecular diagnostic techniques.

3.5 Culture Results

Culture on Löwenstein–Jensen medium confirmed tuberculosis in 40 samples.

Table 5. Culture Positivity Results

Result	Number of Samples
Positive	40
Negative	60
Total	100

Although culture remains the gold standard for tuberculosis diagnosis, the prolonged incubation period limits its utility for rapid clinical decision-making.

3.6 Rifampicin Resistance Pattern

Among the 42 GeneXpert-positive samples, rifampicin resistance was detected in 8 cases.

Table 6. Rifampicin Resistance Pattern

Category	Number
Resistant	8
Sensitive	34
Total	42

The presence of rifampicin resistance indicates a growing burden of drug-resistant tuberculosis and highlights the importance of routine molecular screening.

3.7 Drug Susceptibility Testing

Drug susceptibility testing demonstrated that isoniazid resistance was highest, followed by rifampicin resistance. Resistance to ethambutol and pyrazinamide was comparatively lower.

Table 7. Relative Drug Resistance Pattern among Tuberculosis Isolates

Drug	Relative Resistance Level
Isoniazid	Highest
Rifampicin	High
Ethambutol	Moderate
Pyrazinamide	Lower

Resistance to first-line anti-tubercular drugs was observed among several isolates, with isoniazid and rifampicin demonstrating the highest resistance patterns.

3.8 Prevalence of Multidrug-Resistant Tuberculosis

Six isolates were identified as multidrug-resistant tuberculosis (MDR-TB), representing a significant challenge to tuberculosis control and treatment outcomes.

Table 8. Distribution of MDR-TB Cases

Category	Number
MDR-TB	6
Non-MDR-TB	36
Total Positive Cases	42

The occurrence of MDR-TB highlights the importance of routine molecular diagnosis, drug susceptibility testing, and strict adherence to treatment protocols.

3.9 Comparison of Diagnostic Techniques

Table 9. Comparison of Diagnostic Methods

Diagnostic Method	Positive Cases
Ziehl–Neelsen Microscopy	35
Culture	40
GeneXpert MTB/RIF	42

GeneXpert MTB/RIF demonstrated the highest detection rate among all diagnostic methods evaluated in the study, confirming its value as a rapid and sensitive diagnostic tool for tuberculosis detection and rifampicin resistance screening.

The findings of the present study demonstrate the superiority of molecular diagnostic techniques over conventional methods for early tuberculosis detection. While microscopy remains a useful screening tool and culture continues to serve as the gold standard for confirmation, GeneXpert MTB/RIF provides rapid and reliable diagnosis with simultaneous detection of rifampicin resistance. Early identification of drug-resistant tuberculosis is essential for appropriate treatment selection, prevention of disease transmission, and improvement of patient outcomes. The results emphasize the need for wider implementation of molecular diagnostic technologies in routine tuberculosis control programs.

CONCLUSIONS

The present study demonstrated that tuberculosis remains prevalent among suspected patients, particularly among males and individuals belonging to the economically productive age group. GeneXpert MTB/RIF assay exhibited superior sensitivity compared with conventional microscopy and provided rapid detection of rifampicin resistance. Culture remained the gold standard for confirmation of infection, although its prolonged turnaround time limits immediate clinical utility.

Drug resistance, particularly against isoniazid and rifampicin, was observed among several isolates, and six cases of multidrug-resistant tuberculosis were identified. These findings emphasize the need for routine molecular diagnosis, drug susceptibility testing, and early treatment intervention for effective tuberculosis control.

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