

Prevalence of Pulmonary Tuberculosis through Gene-Xpert in patients with history of cough lasting more than three weeks in Infectious Disease Hospital Bilal Gunj Lahore

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Abstract: Tuberculosis (TB), caused by *Mycobacterium tuberculosis*, remains a major public health concern, especially in low-income and resource-limited settings. This study aimed to assess the prevalence of TB among individuals with a persistent cough lasting more than three weeks and to evaluate the diagnostic accuracy of the Gene-Xpert test compared to conventional methods.

Material and Methods: A cross-sectional study was conducted at the Infectious Disease Hospital, Bilal Ganj, Lahore, over a three-month period. Fifty participants were selected using a convenient sampling technique. Each participant provided a sputum sample for Gene-Xpert testing, and chest X-rays were performed to support diagnosis. Demographic details and clinical histories were collected to assess associations with TB positivity.

Results: Gene-Xpert detected TB in 46% of participants. A significant correlation was found between TB prevalence and variables such as family structure, family history of TB, and gender. Chest X-rays showed abnormalities in several patients, including miliary shadows in 22% and upper lobe infiltrates in 12%. These findings suggest that TB remains highly prevalent among symptomatic individuals in the studied setting.

Conclusion: The study highlights the usefulness of Gene-Xpert as a rapid and accurate diagnostic tool for tuberculosis. It also emphasizes the importance of screening high-risk groups, especially individuals with a family history of TB and those living in joint family systems. Early detection and targeted interventions are critical for effective TB control in resource-limited environments.

Keywords: Tuberculosis, Gene-Xpert, Persistent Cough, Diagnostic Accuracy, Public Health.

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Introduction

Tuberculosis (TB), caused by *Mycobacterium tuberculosis*, is a lung infection spread through respiratory droplets. Despite advances, it remains a global health threat, especially in poor and overcrowded areas. TB is closely linked to HIV, with many cases involving co-infection.¹

Tuberculosis (TB) remains a major global health challenge, causing around 10 million new cases and 1.2 million deaths among HIV-negative individuals in 2019, with an additional 208,000 deaths among those with HIV. Although incidence rates have slightly declined, progress is too slow to meet WHO's goal of ending TB by 2030. The disease disproportionately affects low socio-demographic index (SDI) countries, especially in regions like Sub-Saharan Africa, where incidence and mortality rates are significantly higher. Drug resistance, HIV co-infection, and poor treatment follow-up continue to hinder control efforts. Advancements in diagnostics, treatment, and equitable healthcare access are essential to eliminate TB globally.²

Tuberculosis (TB) spreads through the air when an infected person coughs, sneezes, talks, or sings, releasing *Mycobacterium tuberculosis* into the environment. These airborne droplet nuclei can stay suspended and infect others, especially in crowded or poorly ventilated spaces. Transmission risk depends on exposure time and the immune status of individuals. While latent TB is not contagious, active pulmonary TB is the main source of spread, highlighting the importance of early diagnosis, isolation, and timely treatment.³

Pulmonary tuberculosis (TB) presents with a range of symptoms that evolve over time. Respiratory symptoms include a persistent cough lasting over three weeks, often with sputum, hemoptysis, chest pain, and shortness of breath. Systemic signs—such as fever, night sweats, fatigue, weight loss, and poor appetite—are common in advanced stages. Complications like pleural effusion, bronchiectasis, and cavitation can worsen respiratory distress. Symptoms may vary based on immune status, co-infections, and drug resistance, making early diagnosis and treatment essential to reduce disease severity and transmission.⁴

GeneXpert is a highly advanced diagnostic tool for tuberculosis (TB), providing rapid and accurate results by detecting *Mycobacterium tuberculosis* DNA and rifampicin resistance within two hours. Unlike traditional methods such as Ziehl-Neelsen or fluorescent staining, which lack sensitivity and take longer, GeneXpert offers superior performance with a sensitivity of 98.4% and specificity of 100%. It is especially effective in detecting TB in smear-negative and extrapulmonary cases, where conventional methods often fail. While its cost is higher, GeneXpert's speed and accuracy make it crucial for early diagnosis, timely treatment, and effective TB control in high-burden areas.⁵

Preventing TB requires strong infection control and public health measures. Key steps include good ventilation, mask use, and cough triage, but challenges like poor infrastructure and training limit success. The Umoya omuhle project shows that tailoring solutions to each facility improves results.

Integrating these efforts into national health systems is essential for lasting TB control.⁶

Tuberculosis (TB) remains a major public health issue in Pakistan, ranking it among the top five high-burden countries globally. In 2016, 510,000 cases were reported, with 20% being extrapulmonary TB (EPTB), up from 17.4% in 2011. EPTB is more common in young adults (15–24 years) and females, with higher rates in Khyber Pakhtunkhwa and Balochistan than in Punjab and Sindh. Contributing factors include malnutrition, poverty, and limited healthcare access. While tools like GeneXpert and expanded DOTS coverage have improved TB detection, gaps remain in managing EPTB and addressing regional disparities.⁷

Material and Methods

Tuberculosis (TB) remains a global health threat and a leading cause of morbidity and mortality, especially in low-resource settings. Despite advancements in treatment and vaccination, the disease continues to affect millions, with persistent transmission and delayed diagnoses contributing to poor outcomes. According to the World Health Organization (WHO), early detection and timely intervention are crucial for effective TB control. This study was designed to evaluate the prevalence of TB among individuals presenting with a persistent cough lasting more than three weeks, assess the diagnostic accuracy of GeneXpert and chest X-ray findings, and explore the relationship between chronic cough and other clinical features of TB.

A cross-sectional study was conducted over a three-month period at the Infectious Disease Hospital (IDH), Bilal Ganj, Lahore. The study population comprised outpatients aged 18 to 55 years with a cough persisting for more than three weeks. Participants were selected using a convenient sampling technique. The minimum required sample size was calculated using the formula $n = z^2P(1-P)/d^2$, yielding 35.19, with an estimated prevalence of 10.18%, a 95% confidence level ($z = 1.96$), and a 5% margin of error. Exclusion criteria included individuals previously diagnosed with TB, those

undergoing treatment, patients with acute respiratory infections, and those unable to consent.

After obtaining informed consent, demographic and clinical information was recorded. Sputum samples were collected and tested using Acid-Fast Bacilli (AFB) staining and the Gene-Xpert test—a cartridge-based nucleic acid amplification technique with high sensitivity for *Mycobacterium tuberculosis*. Chest X-rays were also conducted. Trained personnel handled all samples following strict biosafety protocols. Data were analyzed using IBM SPSS, applying chi-square tests to identify associations between TB diagnosis and factors such as gender, family history, and clinical symptoms. Ethical approval was obtained from the Ethical Review Board, and permission was granted by the Institute of Public Health, Lahore.

Results

Out of the 50 participants, 27 (54%) tested negative for tuberculosis using the Gene-Xpert test, while 23 (46%) were positive. This result highlights a significant proportion of tuberculosis positive cases among the collected samples. (See Table 1)

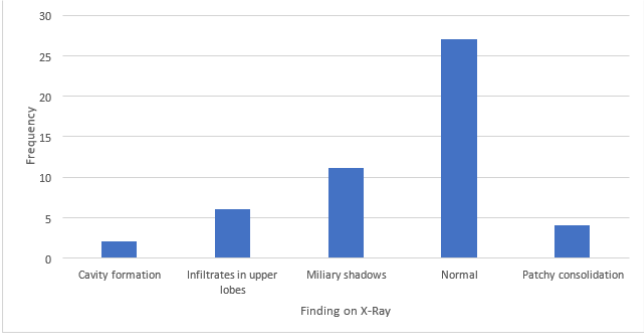
Table 1: Prevalence of Tuberculosis Based on Gene-Xpert Test Results

Gene-Xpert Test Findings Status	Frequency	Percent
Negative	27	54
Positive	23	46

The chest X-ray analysis revealed various patterns among the participants. Normal findings were observed in 27 (54%) participants, indicating the absence of visible abnormalities in a little over half of the study group. However, a significant portion exhibited abnormal X-ray patterns indicative of tuberculosis, including miliary shadows in 11 (22%) participants and infiltrates in the upper lobes in 6 (12%). Additionally, patchy consolidation was noted in 4 (8%) participants, while cavity formation, a hallmark of advanced tuberculosis, was found in 2 (4%). These results

highlight the diverse manifestations of tuberculosis on chest X-rays and emphasize the importance of radiological evaluation in diagnosing the disease. (Fig 1)

Figure 1: Bar chart of Chest Xray Finding



The study found a significant relationship between family structure and tuberculosis prevalence. Among participants from joint families, 23 (74.2%) tested positive, whereas all 19 (100%) participants from individual families tested negative. The p-value for this relationship was statistically significant ($p < 0.001$), emphasizing the influence of family structure on disease prevalence. A strong correlation was observed between a family history of tuberculosis and disease prevalence. Among participants with a family history of tuberculosis, 18 (75%) tested positive, whereas only 5 (19.3%) without a family history tested positive. The p-value ($p = 0.0002$) confirms this association as statistically significant. (See Table 3)

Table 3: Association Between Family Type and TB Prevalence and Pervious Family History

Variable		Negative		Positive		Remarks
		n	%	n	%	
Types Of Family	Individual	19	100	0	0	0.001* Significant
	Joint	8	25.8	23	74.2	
Family History Of Tb in Past	Yes	06	25	18	75	0.0002* Significant
	No	21	80.7	05	19.3	

Discussion

The Gene-Xpert test results indicated that 46% of participants with a cough lasting more than three weeks tested positive for tuberculosis (TB), reflecting a substantial disease burden in symptomatic individuals. Similarly, Mehmood et al. (2022) found that TB prevalence was significantly higher among individuals with prolonged cough symptoms, with Gene-Xpert proving critical in early detection.⁸ These findings emphasize the strong association between chronic cough and TB in high-burden populations and underscore the importance of Gene-Xpert as a diagnostic tool to enable timely treatment and reduce transmission.

The study found that males constituted a higher proportion of participants (58%) and exhibited a greater tendency for tuberculosis (TB) infection compared to females. This finding aligns with studies indicating that males are often at higher risk due to biological, behavioral, and occupational factors that may increase exposure to TB. For example, Mehmood et al. (2022) also reported a higher TB prevalence among males in similar high-risk settings.⁹

The study found a significant relationship between family structure and tuberculosis prevalence. Among participants from joint families, 23

(74.2%) tested positive, whereas all 19 (100%) participants from individual families tested negative. This finding is supported by studies that link overcrowded living conditions with increased TB risk due to prolonged close contact. Mohammed et al. (2022) similarly identified higher TB prevalence in densely populated households, highlighting the importance of improving housing conditions to mitigate disease spread.⁹

Conclusion

This study highlights a significant burden of tuberculosis (TB) among participants at the Infectious Disease Hospital, Bilal Ganj, Lahore, with a prevalence of 46% as determined by the Gene-Xpert test. The findings demonstrate critical associations between TB prevalence and factors such as family structure, gender, and a history of TB in the family, emphasizing the role of close living conditions and familial exposure in disease transmission. Additionally, chest X-ray patterns revealed diverse presentations, including miliary shadows and infiltrates, underscoring the importance of radiological evaluations in TB diagnosis. These results emphasize the need for targeted interventions, including enhanced screening protocols and public health strategies to reduce TB transmission in high-risk populations.

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