

Childhood Tuberculosis Detection Gaps within Primary Healthcare Facilities in Punjab, Pakistan

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Abstract

Background: Pakistan is among the top five highest TB burden countries, contributing 6.3% of global TB cases. Childhood tuberculosis (CHTB) in Pakistan, defined as tuberculosis occurring in children aged 0–14 years, makes 14% of the total TB cases in the country and 8% in the Punjab. Nevertheless, CHTB remains substantially under-diagnosed and under-reported in high TB-burden rural settings. Punjab accounts for the largest proportion, 60% of national's TB notifications; however, primary health care facility-level patterns of CHTB diagnosis and treatment initiation are disproportionately low relative to the overall patients and TB caseload, indicating significant detection and service delivery gaps within the healthcare system.

Objective: To assess detection gaps of childhood TB across primary, secondary, and tertiary healthcare facilities in Punjab from January 2024 to June 2025.

Methods: Retrospective cross-sectional study conducted in Punjab province, Pakistan for the period of 18 months from January 2024 to June 2025. Secondary analysis of routine surveillance data from the Punjab Tuberculosis Control Program was conducted. Facility-level contributions to total TB notifications and childhood TB proportions were compared across primary (BHUs, RHCs), secondary (THQs, DHQs), and tertiary healthcare facilities. Data validation was done by the district and provincial DHIS -2 data coordinators, descriptive statistics were applied.

Results: Primary healthcare facilities detected only 4% of TB cases among children despite managing high patient volumes. Secondary facilities reported the highest absolute number of childhood TB cases, while tertiary hospitals showed the highest proportion (10%) of childhood TB among total TB notifications.

Conclusion: Primary healthcare facilities in Punjab represent a major missed opportunity for early childhood TB detection. Strengthening decentralized diagnostic capacity, doctors training, and systematic contact screening is essential to improve pediatric TB outcomes.

Keywords: Childhood tuberculosis, Primary healthcare, TB detection, Punjab, Pakistan, Pediatric TB, Public health

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Introduction

Tuberculosis remains one of the leading infectious causes of morbidity and mortality worldwide. Children aged 0–14 years' account for approximately 12% of global TB cases and are at higher risk of severe disease and death if diagnosis is delayed.¹ Pakistan ranks among the highest TB-burden countries

globally contributing 6.3% of total cases, with Punjab contributing nearly 60% of national TB notifications.²

Childhood TB presents unique diagnostic challenges due to non-specific clinical features, paucibacillary disease, difficulty in

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obtaining microbiological confirmation, and limited access to pediatric diagnostic tools like Gene pert testing at primary healthcare facilities.³ Delayed diagnosis increases the risk of severe complications and ongoing transmission within households.

The National TB Case Management Guidelines Pakistan 2024 emphasize decentralization of services, routine household contact screening, and expanded access to rapid molecular diagnostics such as Gene pert Ultra to improve pediatric TB detection.⁴ Globally, evidence suggests that strengthening primary healthcare systems plays a critical role in early TB diagnosis among children. Community-based interventions, nutritional support, and family-centered approaches have shown effectiveness in improving case detection and treatment outcomes in high-burden settings.^{5,6,7,8,9,10,11,12}

This study evaluates facility-level differences in childhood TB detection across Punjab’s public healthcare system and compares findings with global experiences.

Methodology

Study Design

Retrospective cross-sectional secondary data analysis.

Study Setting

Public sector healthcare facilities across Punjab province, Pakistan.

Study Period

Level of Care	Facility Types	Total Childhood TB Cases	Childhood TB Proportion/Cases	TB Services (Diagnostic and Treatment Facility)
Primary	Basic Health Units (BHUs), Rural Health Centers (RHCs)	High: (72,961 cases)	4% (2,518)	No TB diagnosis and treatment facilities available at 2590 BHUs. TB diagnostic and treatment facility existing at the 325 RHCs in the form of microscopy and free medicines without Gene pert facilities.
Secondary	Tehsil Headquarters Hospitals (THQs), District Headquarters Hospitals (DHQs)	Highest (111,001 cases)	7% (7,321)	TB diagnosis, Gene pert testing, and treatment facilities available.
Tertiary	Teaching hospitals and specialized institutes including children's hospital Lahore, Multan, and Faisalabad	Low: (43,843 cases)	10% (4,389)	TB diagnosis, Gene pert testing, and treatment facilities available.

January 2024 to June 2025.

Study Population

All notified TB cases among children aged 0–14 years.

Data Source and Analysis.

Routine quarterly surveillance data obtained from the Punjab Tuberculosis Control Program.

Data were analyzed using descriptive statistics including frequencies and proportions. Facility-level comparisons were performed across quarters. Inferential statistical testing was not conducted due to the aggregated nature of programmatic data.

Facility Classification, TB Services and Caseload

Ethical Considerations

The study utilized routine DHIS-2 program data as a part of the research team, confidentiality was maintained. Formal ethical review was not required for secondary program analysis.

Results

Childhood TB detection varied substantially across levels of healthcare.

Primary Healthcare Facilities (BHUs & RHCs)

Primary care facilities showed the lowest proportion of childhood TB detection at approximately **4%** of total TB notifications. Although these 2,823 health facilities serve large populations and represent the first point of contact for most patients, childhood TB cases remained relatively low (416–469 cases per quarter). Total TB notifications declined from 14,065 to 9,427 during the study period.

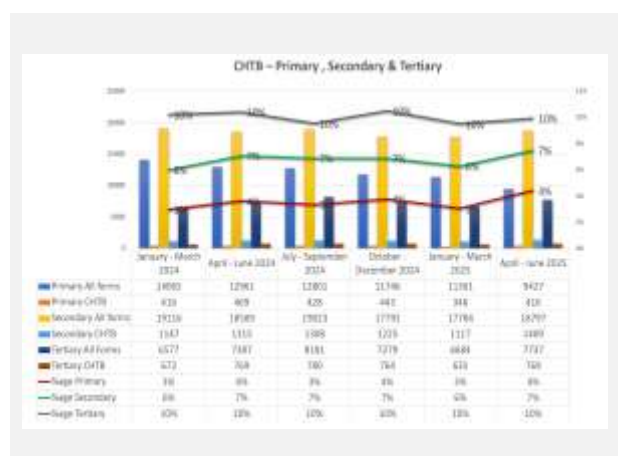
Secondary Healthcare Facilities (THQs & DHQs)

Secondary facilities reported the highest absolute number of childhood TB cases, accounting for approximately 7% of total TB notifications. The overall TB caseload remained stable, ranging from 17,700 to 19,100 cases per quarter.

Tertiary Healthcare Facilities

Tertiary hospitals showed the highest proportion of childhood TB cases in reference to total TB at approximately 10%, despite managing fewer overall TB cases (6,500–8,100 per quarter). This likely reflects referral of complicated pediatric cases requiring specialized diagnostic services.

Summary of Facility-Level Detection



Discussion

The findings demonstrate a clear gradient in childhood TB detection, increasing from primary to tertiary healthcare levels. This pattern suggests substantial under-diagnosis at primary healthcare facilities despite their accessibility and central role in service delivery.

Similar patterns have been reported in other high-burden countries, where pediatric TB diagnosis is concentrated in higher-level hospitals due to limited diagnostic capacity at primary level.^{5,6} Provider knowledge gaps,

inadequate child-friendly diagnostic tools, and weak referral systems contribute to missed opportunities for early detection.

In contrast, low-incidence countries detect most childhood TB cases at the primary care level through strong surveillance systems, systematic contact tracing, and accessible diagnostics.⁷

Evidence from several countries demonstrates that community-based approaches can significantly improve pediatric TB outcomes. Studies from China and Indonesia have shown that family-centered care models and preventive therapy programs increase treatment initiation and completion rates among children.^{8,9,11} Similarly, integration of TB services into child health programs in the Philippines has improved uptake of preventive therapy and case detection.¹⁰

In India, community-based interventions combining nutritional support and contact tracing have also been shown to enhance early detection of childhood TB.¹²

Conclusion

Childhood TB detection in Punjab is heavily concentrated in secondary and tertiary healthcare facilities, indicating missed opportunities at primary care level. Strengthening decentralized diagnostic capacity by Gene pert testing, doctors training, community awareness, and systematic contact screening at the community level is essential to improve early detection and reduce pediatric TB morbidity and mortality.

Key barriers at primary healthcare level identified in Punjab during meetings with the healthcare providers include:

- Low confidence and limited clinical suspicion among primary level doctors for CHTB

- Lack of pediatric diagnostic tools – GeneXpert stool sampling at the primary level
- Insufficient CHTB training of medical officers at the primary health facilities
- Weak referral and feedback mechanisms
- Inadequate implementation of household contact screening by community health workers

Strengthening these areas is essential to achieve provincial and national TB control targets of detection and treatment.

Strengths of the Study

- Province-wide programmatic dataset covering a large population
- Real-world evidence reflecting health system performance
- Policy-relevant findings aligned with provincial and national TB strategy
- Comparison across all levels of healthcare

Limitations

- Use of aggregated data limits individual-level analysis
- Possible underreporting from private sector facilities
- Lack of information on diagnostic methods and outcomes
- Inability to assess delays in diagnosis or treatment

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Conflict of Interest

The author declares no conflict of interest.

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