Challenges and Research Priorities in Achieving Tuberculosis Elimination in India: A Narrative Review

### Abstract

India bears nearly one-quarter of global TB cases, and the 2025 elimination target under the NTEP remains elusive. Major obstacles include diagnostic delays, substantial economic burden, lagging private sector engagement, MDR-TB, and gaps in technological integration. This review presents the current evidence, quantifies critical issues, and outlines research priorities to drive elimination efforts forward.

**Keywords**: Tuberculosis, India, elimination, diagnostic delay, catastrophic costs, MDR-TB, AI diagnostics, private sector.

### 1. Introduction

India accounts for approximately **28% of global TB cases**, with over **2.8 million estimated incident cases** in 2022 . Despite enhanced interventions—like digital notification (Nikshay), nutritional support, and new shorter regimens such as BPaLM—the country is projected to fall short of the 2025 elimination goal .

### 2. Methods

We reviewed literature (2020–mid-2025) from PubMed, India TB Reports, and recent reports in The Hindu, Times of India, and WHO. Search terms included “TB elimination India,” “diagnostic delay TB India,” “AI CXR India,” “catastrophic cost TB India,” and “BPaLM rollout India.”

### 3. Critical Challenges

#### 3.1 Diagnostic delays & pre-treatment burden

A multicentre study (n=1,482) across four states (2019–22) reported **delays of 7–9 weeks** from symptom onset to treatment, about **double the acceptable 4 weeks**, leading to **30–61%** of patients experiencing **catastrophic costs** ( >20% of annual income) before even starting treatment .  
A factor analysis highlighted that **44–59%** of totals costs were pre-treatment, due to repeated provider visits and testing .

#### 3.2 Private-sector notification gaps

While private sector notification rose from **21% in 2017 to 33% in 2023**, it still lags behind NSP 2022–25 targets (35–56%) . With **50–70%** of patients initially seeking private care, this under-reporting continues to undermine surveillance .

#### 3.3 MDR-TB burden & new regimens

India has the highest DR-TB burden globally, with an estimated **110,000 new MDR-TB cases annually**; 10–15% may progress to XDR-TB . In September 2024, the Ministry approved the **BPaLM** (6-month) regimen under NTEP, expected to benefit ~75,000 DR-TB patients with better efficacy and tolerability . In Mumbai, over 1,000 patients have received BPaLM, seeing faster clearance though with mild adverse events (e.g. hepatitis, neuropathy) .

#### 3.4 Economic burden persists

Even under NTEP “free care,” costs accumulate. One ICMR-supported study (n ~1,400) found **median patient expenditure of ₹32,000**, with **45% experiencing catastrophic costs**, largely due to lost productivity and indirect costs .

#### 3.5 Diagnostic innovation: AI-CXR & mobile screening

* Mumbai hospitals and mobile vans using qXR AI detected a **13% rise in additional TB cases**, and GeneXpert positivity improved by 18–27%.
* A PPP model using mobile digital CXR in van settings yielded a **19.6% diagnostic yield** among presumptive TB cases (161 microbiologically confirmed + 106 clinically diagnosed out of 2,973 screened) .
* In remote Chennai, the Genki AI tool deployed in mobile units achieved **98% sensitivity** and **~97% specificity** in detecting TB among 25,598 screened individuals .

#### 3.6 Case-finding in urban slums

In Delhi’s slum screening campaign using AI-enabled portable X-rays (21 units), 37 TB cases were detected from 9,200 individuals screened, highlighting the utility of targeted screening among high-risk, underserved populations .

### 4. Research Priorities

| **Area** | **Priority Topics** |
| --- | --- |
| **Diagnostics** | Mobile AI-CXR platforms, TB biomarker panels, pediatric non-sputum diagnostics |
| **Treatment** | BPaLM safety/monitoring, resistance surveillance (e.g., targeted sequencing) |
| **Health systems** | Private sector notification strategies, DBT efficiency, adherence technologies |
| **Economic interventions** | Cash transfers, pre-treatment cost mitigation, social protection evaluations |
| **Community approaches** | Awareness campaigns, peer support in slums/prisons/migrant settings |

### 5. Conclusion

India’s progress against TB has improved, but elimination by 2025 remains unlikely. It must urgently tackle **diagnostic delays**, **financial hardship**, **MDR-TB**, and **under-leveraged AI tools and private sector**. A reinforced research agenda, aligned with pragmatic interventions, is essential to recalibrate the TB elimination drive beyond 2025.

### References (Vancouver style)

1. Study on catastrophic costs before treatment initiation. Chatterjee S et al. PLOS Global Public Health. 2024.
2. Delay and cost breakdown. Chatterjee S et al. (PMC) 2025.
3. Private sector notification stats. The Hindu. 2024.
4. MDR-TB case load and BPaLM approval. Lung India; Ministry of Health, 2024.
5. BPaLM rollout data. Times of India. 2025.
6. Financial burden on patients. Times of India. 2024.
7. AI-CXR in Mumbai. The Hindu. 2023.
8. Mobile CXR PPP model. PubMed. 2020.
9. Genki AI in Chennai. PMC. 2022.
10. Delhi urban screening outcomes. Times of India. 2025.