

## Review Article

# Barriers to effective management of drug-resistant tuberculosis in India, insights into patient & health system challenges: An exploratory review

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The emergence of drug-resistant tuberculosis (DR-TB), especially multi drug resistant tuberculosis (MDR-TB), is increasingly threatening the effectiveness of India's National TB Elimination Program (NTEP). This review seeks to analyse the patient and health system challenges concerning the management of DR-TB and seeks to find appropriate solutions to maximize the programmatic impact. A systematic literature search was carried out on PubMed, Embase, Scopus and Google Scholar for articles published between 2015 and 2024 focusing on the treatment challenges in India's MDR or extensive drug resistant (XDR) TB. Factors regarding care access, adherence to treatment, and systemic barriers were prioritised. We accepted qualitative, retrospective, and cross-sectional designs; clinical trials and non-English publications were excluded. We included 15 eligible studies thematically. The socioeconomic factors, barriers to access to care were paired with a stigma, low disease awareness and care responsibility at home. This was alongside a high pill burden and adverse drug effects. Alcoholism and psychosocial depression comorbidities with poorly supportive social environments further worsened adherence. Gaps in the health system included insufficient drug resistance testing, delay in diagnostics, a lack of healthcare personnel, inadequate referral chains, and inconsistent treatment regimens. Lack of streamlined referral pathways and non-standardised treatment regimens posed problematic operational challenges. Weak involvement from the private sector and lack of training and supervision of frontline workers also contributed to operational gaps. Policy gaps included limited program scope, inadequate funding, or lack of universal health coverage. While urban areas faced coordination issues with the private sector, rural areas contended with further delays in diagnostics. A comprehensive strategy is essential when dealing with patients with DR-TB in India. Aligning psychosocial support, enhanced funding, and multisector coordination with infrastructure and better access to conflicting diagnostics can improve local contexts and targets NTEP's TB elimination goals.

**Key words** Challenges - drug-resistant tuberculosis - healthcare access - India - patient compliance - tuberculosis management

Multidrug-resistant TB (MDR-TB) has emerged as a particularly formidable obstacle to global TB control efforts. The global incidence of MDR-TB has remained

relatively stable in recent years, with ~400,000 cases reported annually between 2020 and 2023<sup>1,2</sup>. However, the treatment success rates for MDR-TB remain

alarming low, with high mortality rates further underscoring the urgent need for innovative solutions<sup>1</sup>. India bears a disproportionate share of this global health crisis, accounting for an estimated 27 per cent of all new TB cases in 2023<sup>2</sup>. The National TB Elimination Program (NTEP) has led significant efforts to reduce TB incidence and mortality, achieving a 16 per cent decline in incidence and an 18 per cent reduction in mortality since 2015. However, the emergence and prevalence of drug-resistant TB, particularly MDR-TB, present an urgent and complex challenge<sup>2,3</sup>. In 2023, India reported approximately 147,000 MDR-TB cases, representing nearly one-fourth of the global burden. This includes 3.2 per cent of new TB cases and 16 per cent of previously treated cases<sup>3</sup>. Treatment outcomes for MDR-TB in India highlight the scale of the problem. The treatment success rate is around 46 per cent, significantly below the global average of 52 per cent, while the death rate among people with MDR-TB in India is 20 per cent, exceeding the global rate of 17 per cent<sup>3,4</sup>.

Several interconnected factors drive the persistence of TB globally and in India. On a global scale, funding shortfalls, catastrophic financial burdens for patients, climate change, conflict, migration, and the rise of drug-resistant TB significantly challenge TB care and management<sup>5</sup>. In India, additional challenges include resistance to fluoroquinolones, poor adherence to treatment regimens, limited access to quality healthcare, and a substantial gap between diagnosis and treatment enrolment. These barriers collectively hinder progress in controlling the disease and achieving effective treatment outcomes<sup>6,7</sup>.

While prior reviews have addressed TB epidemiology or clinical outcomes in India, few have systematically synthesized patient and health system barriers specific to MDR-TB management, particularly in the pre- and post-COVID-19 era. This review synthesizes patient-specific and health system barriers to managing drug-resistant TB in India, aiming to identify evidence-based strategies for overcoming these challenges. Exploring the intersection of trends and national realities aims to highlight the systemic, social, and clinical barriers hindering TB control and propose evidence-based strategies for overcoming these challenges, aligning with the goals of the NTEP and the World Health Organization (WHO's) end TB strategy.

## Materials & Methods

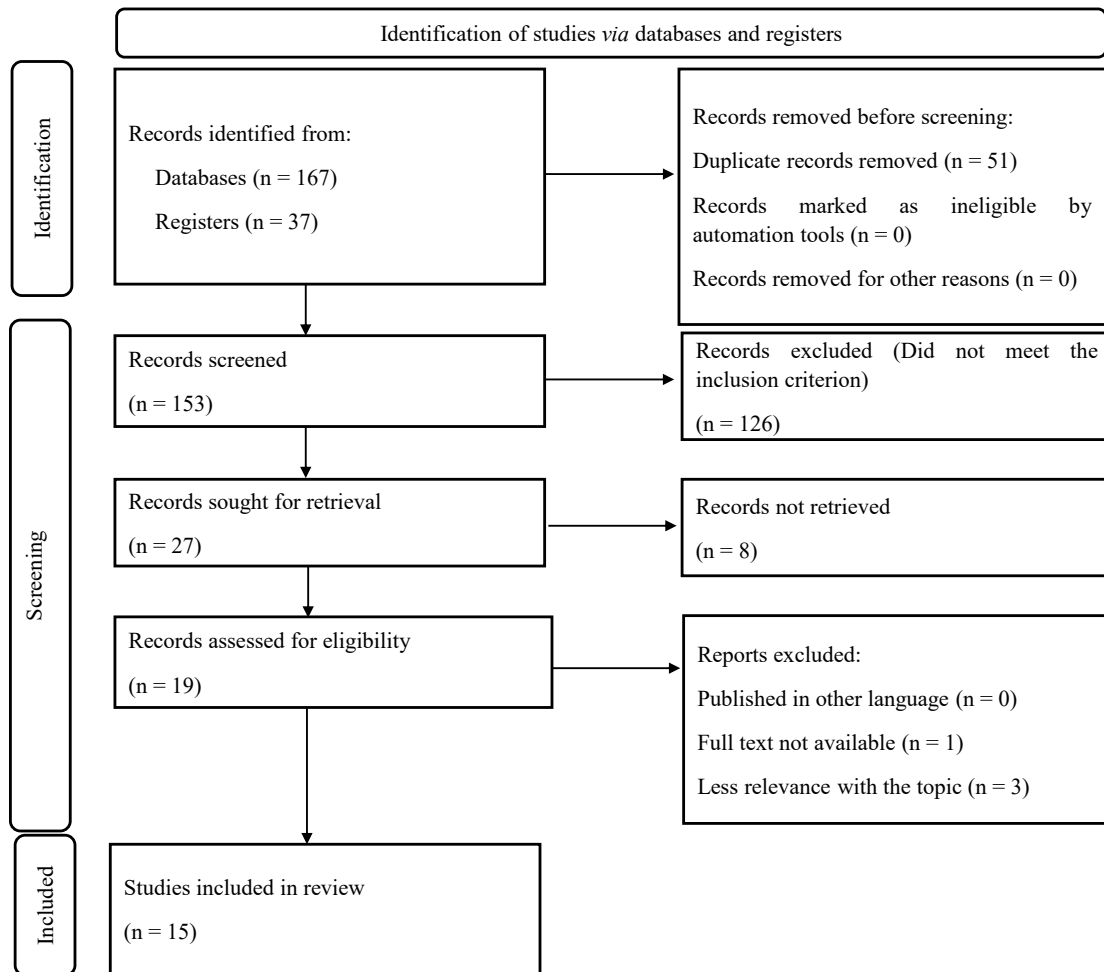
This review aimed to comprehensively examine the interplay between key challenges, specifically drug resistance status, patient compliance, healthcare access, and the barriers of the health system, addressing the management of DR-TB in India. The review sought to identify research gaps, synthesize existing evidence, and inform future research directions and policy development related to DR-TB management in the Indian context.

*Inclusion criteria:* This review included published studies in English language from 2015 onwards that examined the management of multidrug-resistant tuberculosis (MDR-TB), extensively drug-resistant tuberculosis (XDR-TB) or of drug resistant tuberculosis (DR-TB) in India, with a focus on patient compliance and related challenges, barriers to treatment, healthcare access, or health system challenges; eligible study designs comprised qualitative studies, retrospective cohort studies, cross-sectional studies, and only full text article.

*Exclusion criteria:* Studies were excluded if they were clinical trials, review articles, or scoping reviews, as these designs did not align with the objectives of the systematic review. Articles were also excluded if they focused primarily on tuberculosis as a secondary or comorbid condition alongside other chronic diseases without specifically addressing TB management challenges. In addition, alongside other chronic diseases, without specifically addressing TB management challenges. In addition, studies that did not evaluate treatment adherence, barriers, healthcare access, or health system challenges were excluded.

*Search strategy to identify articles:* Two reviewers conducted a systematic search of PubMed®, Embase, Google Scholar, and Scopus for peer-reviewed articles on November 10–15, 2024, covering 2015–2024 using keywords and medical subject headings (MeSH) terms. Supplementary searches included checking the reference lists of included studies. Authors were contacted for missing full texts, with non-responses noted (Figure).

Keywords and MeSH terms were carefully identified based on the review's objectives and scope. Core terms such as “drug-resistant tuberculosis,” “MDR-TB,” and extensively drug-resistant



**Figure.** PRISMA Flow Diagram for challenges in drug-resistant tuberculosis management.

tuberculosis (XDR-TB) “XDR-TB” were selected to align with the primary focus of the review. MeSH terms like “Tuberculosis, Multi-Drug-Resistant” and “Drug Resistance” ensured consistency and precision in retrieving relevant studies. Additional terms, including “Patient challenges,” “Treatment Barriers,” “Treatment adherence,” and “Healthcare access,” were chosen to capture the multifaceted barriers affecting TB management. The geographic filter “India” was applied to ensure contextual relevance, and the keyword list was iteratively refined through preliminary searches to maximize the quality and breadth of results.

This search string utilized Boolean operators (AND, OR) to combine relevant terms and focus the search on studies specific to India. The search was limited to articles published between January 1, 2015, and November 30, 2024, to ensure the inclusion of recent and relevant findings, and restricted to English-language studies with full-text availability.

*Study selection and data extraction:* The retrieved studies were screened in two stages using Rayaan software: an initial review of titles and abstracts, followed by full-text assessment against the predefined inclusion criteria (Figure). To enhance reliability, ~20 per cent of the studies were independently cross-checked. Data extraction was performed manually using a standardized Microsoft Excel form that captured study characteristics, including study design, location, year of publication, and key findings. To reduce the potential bias, data extraction was independently verified, and the discrepancies were resolved with discussion and consensus.

*Data synthesis:* Narrative synthesis integrated findings from heterogeneous study designs (qualitative, cohort, cross-sectional). Two reviewers performed open coding in Excel; codes were inductively grouped through iterative discussions into two overarching

themes—patient-related (sub-themes: socioeconomic, e.g., financial constraints; clinical, e.g., side effects; psychosocial, e.g., stigma) and system-related (sub-themes: infrastructural, e.g., diagnostic delays; operational, e.g., workforce shortages; policy, e.g., inadequate funding).

## Results

This exploratory review synthesized findings from 15 studies (Table<sup>5,7-10,12-14,17-21,23,30</sup>) that collectively highlighted a complex interplay of patient- and health system-related challenges in management of MDR-TB in India. The studies, spanning diverse geographies and designs such as qualitative, cohort, and cross-sectional, revealed both recurring challenges and context-specific variations, underscoring the need for tailored interventions. Barriers were thematically organised into patient-side (socioeconomic, clinical, psychosocial) and system-side (infrastructural, operational, policy) categories, with key patterns and discrepancies analysed below.

*Patient-related challenges:* Patient-side challenges were prominent across all the studies, reflecting socioeconomic, clinical, and psychosocial dimensions. Socioeconomically, financial constraints emerged as a critical challenge in several studies, often forcing patients to prioritise basic needs like food over treatment<sup>5,8-16</sup>. Family responsibilities disproportionately affected women, who faced caregiving pressures, while men reported work-related disruptions<sup>11,13-15,17,18</sup>. Studies also emphasized that patients often misunderstood the disease, treatment protocols, or government entitlements, which negatively influenced adherence<sup>9,19</sup>.

Clinically, poor treatment adherence, linked to side effects of second-line drugs such as gastrointestinal distress, hearing loss, was reported in a majority of the studies<sup>8-10,12,14,15,17,20</sup>. The pill burden and extended length of the DRTB treatment regimen were also emphasized as contributing factors. Comorbidities further complicated adherence, with alcohol addiction and silicosis identified as regional drivers, the latter notably prevalent in Gujarat's mining communities, with limited programmatic focus on addressing these issues<sup>18,21</sup>. Psychosocially, stigma was a pervasive barrier, with studies emphasizing its isolating effect, while inadequate social support and psychological burdens like depression were also observed in a few studies<sup>6,9,12,18</sup>.

The studies by Bhattacharya *et al*<sup>8</sup> and Rupani<sup>21</sup> highlighted distinct regional and gender-specific

variations in barriers and clinical factors that influenced TB care. Silicosis emerged as a critical clinical determinant in Gujarat, whereas stigma was identified as the dominant barrier in West Bengal, underscoring the need for tailored, context-specific strategies to improve outcomes.

*Health system-related challenges:* System-side challenges, identified across all the studies, encompassed infrastructural, operational, and policy-related issues. Inadequate healthcare infrastructure, particularly in rural areas, was a recurring theme in a majority of the studies, along with limited access and referral insufficiency to drug-resistance testing (e.g., GeneXpert), delaying diagnosis<sup>19,22</sup>. Poor quality control of diagnostics and medications, noted in a few studies, compounded these delays, increasing transmission risks<sup>9</sup>.

Operationally, overburdened healthcare providers and gaps in training hindered case detection and management<sup>5,10</sup>. Inconsistent treatment protocols and insufficient resources were cited in some studies<sup>14,20</sup>. Policy-wise, a lack of integration between private healthcare and NTEP emerged in several studies, while inadequate budgetary allocations and the absence of universal health coverage were flagged as structural impediments<sup>5,15,19</sup>.

Qualitative findings from a few studies emphasized the health system's inability to provide flexible, empathetic, and supportive environments. Programmes often focused on compliance rather than engagement<sup>13,17</sup>. Notably, diagnostic delays were more pronounced in Jharkhand and Gujarat, while private sector disconnects dominated urban settings, suggesting geographic disparities in systemic weaknesses<sup>19,22</sup>.

*Positive deviance and resilience:* A few studies uniquely explored positive deviance, identifying self-driven behaviours and caregiver strategies that enabled patients to complete treatment despite system and social constraints<sup>17,23</sup>. This emerging area suggests potential for cognitive-behavioural interventions and family-based support models to complement clinical approaches.

## Discussion

The present study illuminates the multifaceted barriers to managing MDR-TB in India, revealing a dual burden of patient-specific and health-system challenges. Synthesizing findings from 15 studies, it underscores the need for integrated strategies that

**Table.** Characteristics of studies that assessed the challenges in TB care and management

Study (author & yr)	Study design	Participants of the study	Health system-related challenges	Patient-side challenges
Pillai <i>et al</i> <sup>30</sup> , 2015	Retrospective + interview study	145 initial defaulters identified; 38 interviewed in Puducherry	Poor diagnosis-to-DOTS linkage; inadequate lab follow up	Stigma, disbelief in diagnosis, substance use, and financial issues
Shringarpure <i>et al</i> <sup>12</sup> , 2015	Retrospective cohort study	796 MDR-TB patients from Gujarat	High LFU early in treatment; provider inconsistency	Treatment side effects, poor socioeconomic conditions
Tripathi <i>et al</i> <sup>10</sup> , 2015	Mixed methods	64 MDR-TB patients; patients + RNTCP staff from Uttar Pradesh	Lack of culture follow-up, lab gaps, poor logistics	Limited awareness, geographical access barriers
Deshmukh <i>et al</i> <sup>13</sup> , 2018	Qualitative (grounded theory)	20 MDR-TB patients + 10 providers from Maharashtra	Lack of patient-centred approaches, poor counselling	Low self-motivation, poor support, and nutritional constraints
Velavan <i>et al</i> <sup>18</sup> , 2018	Mixed methods	392 retreatment TB cases; HCPs in Puducherry	Weak referral, lack of trained staff, poor LFU management	Alcoholism, job pressure, inadequate support, and low BMI
Dzeyic <i>et al</i> <sup>9</sup> , 2018	Cross-sectional Interview + Record Review	250 DR-TB patients at the Delhi tertiary centre	No early intervention despite behavioural risk flags	High-risk behaviours: smoking, substance use, delays in seeking care
Bhattacharya <i>et al</i> <sup>8</sup> , 2018	Qualitative Study	A total of 14 IDI of defaulter TB patients, 4 FGD with 30 DOTS provider, & 4 key informant interviews with staffs of TU	Inadequate facility engagement post-diagnosis	Stigma, cultural beliefs, & economic stressors
Thakur <i>et al</i> <sup>5</sup> , 2021	Stakeholder Survey	46 TB stakeholders: clinicians, researchers, policymakers	Underfunded infrastructure, drug resistance tracking gaps	Low public awareness, stigma, and misinformation
Yasobant <i>et al</i> <sup>19</sup> , 2023	Cross-sectional (Mixed methods)	990 TB patients in Gujarat and Jharkhand	Gaps in ADR follow up, case finding, and poor diagnostics	Comorbidities, addiction, and low awareness of the benefits
Linda <i>et al</i> <sup>23</sup> , 2024	Qualitative study	20 DR-TB patients, 20 caregivers from Hyderabad & Bengaluru	The system is not equipped for personalized support	Psychological fatigue, home remedies, caregiver-dependent coping
Arifunhera <i>et al</i> <sup>20</sup> , 2024	Mixed methods	180 Hr-TB patients + 35 interviews (patients/HCWs)	Drug shortage, staff shortage, & delayed LPA-based diagnosis	Low adherence due to pill burden & early fatigue
Kumar <i>et al</i> <sup>14</sup> , 2024	Prospective observational	171 PTB patients (135 DS, 36 DR) in South Delhi	DOTS management gaps, inadequate ADR response	Adverse effects, treatment fatigue, and social barriers
Rupani <i>et al</i> <sup>21</sup> , 2024	Retrospective analysis	138 silico-TB + 2610 TB patients (2006–2022), Gujarat	No tailored treatment for silico-TB; diagnostic lag	High recurrence & retreatment, linked with silicosis
Nagarajan <i>et al</i> <sup>17</sup> , 2024	Qualitative study	DR-TB patients in Gujarat	The health system is unable to support long-term behavioural change	Loss of hope, refusal of treatment, psychological trauma
Hiremath <i>et al</i> <sup>7</sup> , 2023	Cross-sectional study	Key implementers of the NTEP at 14 selected medical colleges.	Work overload, manpower shortages, funding issues, infrastructure deficits, lack of trained staff, irregular TB-HIV coordination, limited training.	Inadequate patient education, referral to inappropriate institutions, and incorrect patient addresses.

extend beyond clinical management to address social, psychological, and structural dimensions. Below, these challenges are critically examined, compared

to existing literature, and paired with actionable implications tailored to India's context. MDR-TB management is hindered by patient-side barriers that

transcend mere adherence, driven by the interplay of clinical, psychosocial, and socioeconomic factors.

The prolonged treatment duration (often >18 months) and severe side effects of second-line drugs, such as gastrointestinal distress and hearing loss, impose significant physical and psychological burdens, discouraging adherence. Unlike global reviews emphasizing clinical resistance, this review highlights India-specific psychosocial drivers like stigma, which amplify isolation and undermine care-seeking. Gender dynamics further complicate this: women face caregiving pressures, while men grapple with occupational disruptions, reflecting cultural and economic realities unique to India<sup>8,15,17,24</sup>. Comorbidities like alcohol addiction and silicosis exacerbate outcomes, diverging from global foci on HIV/AIDS<sup>18,20,21,25</sup>. Nutritional deficiencies, prevalent in lower socioeconomic groups, intensify side effects, yet conditional cash transfers, showing promise, offer a feasible mitigation strategy<sup>12</sup>. These findings suggest that patient-centric interventions must integrate mental health support, nutritional programmes, and gender-sensitive approaches to improve adherence and outcomes. Systemic challenges, identified across the included studies, reveal deep infrastructural and operational gaps. Diagnostic delays, driven by limited access to GeneXpert and drug susceptibility testing, contrast with global reviews prioritising treatment resistance<sup>19,22,26</sup>. In India, rural infrastructure deficits and poor drug supply chains disproportionately affect marginalized populations, amplifying transmission risks<sup>27</sup>. Workforce shortages and inadequate training further strain care delivery, a challenge less emphasized in high-income settings<sup>5,19</sup>. Unlike global literature, this review uniquely highlights India's private sector disconnect, reflecting NTEP's limited reach. These systemic weaknesses demand reforms like decentralizing DST to district-level facilities and task-shifting to community health workers—practical steps to bridge rural-urban gaps. Effective MDR-TB management requires a holistic approach addressing the interplay of physical, psychosocial, and cultural barriers. Cultural misunderstandings erode trust, necessitating care tailored to local languages and beliefs<sup>24</sup>. Psychological challenges like depression call for counselling and peer support, while stigma's isolating effect demands public awareness campaigns—aligning with WHO's End TB Strategy<sup>28,29</sup>. Financial insecurity, compounded by prolonged treatment timelines, reinforces the necessity of scaling up direct benefit transfers and nutritional support schemes under NTEP.<sup>16</sup>

Unlike in high-income countries, where these innovations have seen swifter integration, Indian implementation requires coordinated funding, streamlined procurement, and policy reform. Sustainable progress will depend on cross-sectoral investments and global partnerships that prioritize community-based care and equitable access for high-burden, low-resource populations.

Although this review provides valuable insights into the barriers to DR-TB management in India, certain limitations warrant consideration. The heterogeneity of study designs—spanning qualitative interviews to retrospective analyses—restricted direct comparability, while the absence of randomized controlled trials limited the robustness of causal inferences. Furthermore, as many of the included studies were conducted in specific regions or tertiary care settings, the findings may not be fully generalizable across India's diverse sociocultural and health system contexts. Despite these constraints, the findings highlight a clear message: that when a patient with MDR-TB discontinues treatment or struggles with adherence, it should not be viewed simply as non-compliance but rather as a signal of underlying psychosocial distress, socioeconomic hardship, or systemic barriers; addressing these factors through integrated patient support and health system strengthening is essential to improving individual outcomes and advancing the goals of TB elimination in India.

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