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THE TUBERCULOSIS CRISIS IN PAKISTAN: CURRENT TRENDS, MAJOR CHALLENGES, AND THE NEED FOR AN INTEGRATED APPROACH: A NARRATIVE REVIEW

Narrative Review

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ABSTRACT

Background: Tuberculosis (TB) remains a major public health challenge in Pakistan, ranking fifth globally in terms of incidence and contributing significantly to morbidity and mortality. Despite advances in global TB control, Pakistan continues to face a rising burden, with reported cases increasing from 323,255 in 2015 to 475,761 in 2023, representing a 67.95% escalation. The disease's persistence reflects a combination of socioeconomic inequities, healthcare system limitations, and the growing threat of drug-resistant tuberculosis (DR-TB).

Objective: This narrative review aims to analyze the factors contributing to Pakistan's high TB prevalence, evaluate the effectiveness of the National Tuberculosis Control Program (NTP), and propose evidence-based recommendations for improved control and prevention strategies.

Main Discussion Points: The review highlights major determinants influencing TB prevalence, including poverty, malnutrition, overcrowded housing, and limited access to diagnostic and treatment facilities. Healthcare system challenges—such as insufficient laboratory capacity, inadequate human resources, and poor coordination between public and private sectors—further hinder TB management. The increasing incidence of DR-TB, along with co-morbidities such as diabetes and smoking, exacerbates disease control efforts. Stigma, lack of awareness, and underreporting continue to delay timely diagnosis and adherence to treatment.

Conclusion: Effective TB control in Pakistan requires a comprehensive, multi-sectoral approach that strengthens primary healthcare infrastructure, enhances drug-resistance management, and integrates social and economic interventions. Sustained political commitment, domestic funding, and operational research are essential to achieving WHO's End TB targets.

Keywords: Tuberculosis, Drug-Resistant Tuberculosis, Public Health, National Tuberculosis Control Program, Pakistan, Narrative Review.

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INTRODUCTION

Tuberculosis (TB) continues to represent one of the most serious public health threats globally, causing extensive morbidity and mortality across both developed and developing nations. It is an infectious disease caused by *Mycobacterium tuberculosis*, a gram-positive bacterium that primarily attacks the lungs but can also affect other vital organs, including the brain, bones, kidneys, and lymph nodes. The incubation period of the disease generally ranges between two and ten weeks, reflecting the slow-growing nature of the pathogen and its ability to persist in latent form for years before reactivation (1). Despite decades of global control efforts, TB remains endemic in many low- and middle-income countries, including Pakistan, where socio-economic conditions, population density, and gaps in healthcare infrastructure perpetuate its spread. In recent years, Pakistan's population has shown steady growth, placing increasing strain on healthcare resources. Between 2015 and 2024, the population's annual rise has led to significant challenges in healthcare delivery, urban planning, and disease control (2-4). According to the National TB Control Programme (NTP), Islamabad, 323,255 TB cases were reported nationwide in 2015, escalating to 475,761 by 2023 — an alarming 67.95% increase over eight years. Punjab remains the most severely affected province, with 275,752 TB cases among a population of 123 million in 2022, while Gilgit-Baltistan reports the lowest burden, with only 4,347 cases out of a 1.7 million population (5,6). These figures indicate persistent transmission and insufficient containment measures, particularly in densely populated and low-income communities. The situation is further compounded by the rise of drug-resistant TB strains. Pakistan ranks fifth globally in total TB burden and fourth in multidrug-resistant TB (MDR-TB) prevalence, contributing to 61% of all TB cases in the WHO Eastern Mediterranean Region (7,8).

Contributing factors include delayed diagnosis, inconsistent adherence to treatment protocols, unsupervised medication use, and inadequate patient follow-up systems. Moreover, the social stigma surrounding TB, coupled with limited community-based awareness programs, continues to hinder early detection and effective management, particularly among marginalized populations. To address this escalating crisis, the NTP has adopted the WHO End TB Strategy and introduced the National Strategic Plan (2017–2020), focusing on integrated care, multi-sector collaboration, and innovation in diagnostic and treatment approaches (9-11). These efforts are bolstered by substantial international support, including a US$154 million grant from the Global Fund, which strengthens public–private partnerships and enhances service delivery through organizations such as Indus Hospital and Mercy Corps. Additionally, global partners including WHO and the Stop TB Partnership provide essential technical assistance in surveillance, diagnostics, and research capacity building. Despite these efforts, Pakistan continues to face formidable barriers, underscoring the urgent need for comprehensive policy reform, community-based engagement, and improved diagnostic and treatment infrastructure. Therefore, the present study aims to assess the current trends and challenges in tuberculosis control in Pakistan, analyze the contributing factors driving its persistence, and highlight the need for an integrated, evidence-based national strategy to curb the disease burden effectively. The objective is to identify systemic gaps and propose sustainable, multidisciplinary solutions to accelerate progress toward the End TB targets.

THEMATIC DISCUSSION

Factors Contributing to High TB Prevalence

Tuberculosis (TB) continues to thrive as a complex public health issue in Pakistan, shaped by an intricate interplay of socioeconomic, structural, biological, and systemic determinants. The persistence of the disease is not solely a result of microbial virulence but rather a reflection of social inequities, under-resourced healthcare systems, and gaps in public awareness and control strategies. The following sections synthesize key thematic factors that contribute to the continued high prevalence and transmission of TB in Pakistan, drawing from current epidemiological evidence and national health reports.

Socioeconomic Determinants

Socioeconomic disparities lie at the heart of TB transmission and persistence in Pakistan (5). Poverty, unemployment, and food insecurity act as fundamental determinants by perpetuating malnutrition and weakening immune resilience, thereby increasing susceptibility to infection and disease reactivation (6). Studies have shown that malnourished individuals are significantly more likely to develop active TB than those with adequate nutrition, emphasizing the strong bidirectional link between poverty and disease burden. Overcrowding—especially in urban slums and densely populated rural settlements—further compounds the issue, as poorly ventilated homes facilitate

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the airborne transmission of *Mycobacterium tuberculosis* (7). These living conditions are often intergenerational, trapping families within a vicious cycle of disease and poverty. TB disproportionately affects economically productive adults, resulting in loss of income, job insecurity, and additional social stigma (8). The interplay of these factors creates a self-reinforcing loop where social deprivation enhances disease risk, and the disease itself exacerbates economic hardship, undermining national productivity and public health stability.

Healthcare System Challenges

A central impediment to TB control in Pakistan is the inadequacy of the healthcare delivery system in ensuring equitable access to diagnosis, treatment, and follow-up (5). Diagnostic delays remain a critical problem, driven by both systemic inefficiencies and patient-level barriers such as low health literacy and stigma (9). Despite the presence of the National TB Control Programme (NTP), the reach of diagnostic tools like GeneXpert and drug susceptibility testing (DST) remains uneven, especially in peripheral regions (10).Health infrastructure deficits are compounded by a shortage of trained healthcare personnel and uneven distribution of laboratories capable of performing rapid molecular diagnostics. The fragmented nature of the health system, marked by a large private sector operating independently of national guidelines, complicates standardized reporting and treatment monitoring (11). Although the Public–Private Mix (PPM) initiative aims to bridge this gap, inconsistencies in data sharing and quality assurance persist. Logistical challenges—such as irregular drug supply chains and weak monitoring systems—often disrupt patient adherence to long-term therapy (12). Financial constraints and dependence on donor-driven funding further limit the scalability and sustainability of TB interventions (10).

Lack of Awareness and Social Stigma

Low awareness and deep-rooted stigma significantly impede early diagnosis and treatment adherence. Many individuals in Pakistan remain unaware of TB's transmission mechanisms, symptoms, and preventive measures (9). Misconceptions, such as associating TB with curses or moral failings, persist in several communities, leading to fear, social isolation, and reluctance to seek medical help (7). Stigma exerts a profound psychological and social toll, discouraging disclosure even within families. Patients often conceal their illness to avoid discrimination in workplaces or marriage prospects. This concealment contributes to ongoing community transmission, as infectious individuals delay treatment. Research indicates that stigma-driven delays in care-seeking can extend the infectious period by several months, undermining public health efforts and increasing disease spread. Therefore, tackling TB in Pakistan demands not only biomedical solutions but also culturally sensitive educational campaigns and community engagement to normalize testing and treatment adherence.

Drug-Resistant Tuberculosis (DR-TB)

The emergence of multidrug-resistant (MDR) and extensively drug-resistant (XDR) TB presents one of the gravest threats to TB control in Pakistan (8). Resistance to first-line drugs such as isoniazid and rifampicin stems largely from incomplete or improper treatment, self-medication, and the circulation of substandard drugs. Patients frequently discontinue therapy once symptoms subside, unaware that incomplete treatment fosters resistant strains. Furthermore, the transmission of resistant *M. tuberculosis* strains from untreated patients has become an increasingly recognized driver of new MDR-TB cases. Managing DR-TB is markedly more complex and resource-intensive, requiring prolonged therapy with second-line drugs that are often more toxic and expensive (13). Delayed resistance detection and insufficient laboratory capacity further hinder timely intervention. While the expansion of GeneXpert and culture-based DST has improved case identification, national coverage remains suboptimal. According to recent estimates, Pakistan accounts for one of the highest global burdens of MDR-TB, yet less than half of these patients receive appropriate treatment (14). This persistent gap underscores the urgent need for improved diagnostic accessibility, patient adherence support, and robust pharmacovigilance.

Co-morbidities

TB frequently coexists with other chronic conditions that complicate its management and prognosis. Diabetes mellitus, which has reached epidemic proportions in Pakistan, significantly increases the risk of developing active TB due to immune dysregulation and reduced macrophage function. Diabetic patients with TB often experience delayed sputum conversion, higher relapse rates, and poorer treatment outcomes. Smoking, another widespread habit, impairs pulmonary defense mechanisms, exacerbating susceptibility to TB infection (7). Although HIV prevalence in the general population is relatively low, co-infection rates among high-risk groups—such as injection drug users—remain concerning (9). TB/HIV co-infection not only accelerates disease progression but also complicates diagnosis due to overlapping clinical presentations. The convergence of these co-morbidities amplifies Pakistan's TB challenge, necessitating integrated screening and management programs within primary care frameworks.

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National Tuberculosis Control Program (NTP): Efforts and Hurdles

The National Tuberculosis Control Program (NTP), restructured in 2001 after TB's declaration as a national emergency, serves as the backbone of Pakistan's anti-TB efforts (15). Built upon the Directly Observed Treatment, Short-course (DOTS) strategy, it has successfully expanded diagnostic networks and treatment coverage nationwide. The introduction of GeneXpert testing, digital surveillance tools, and PPM collaborations has improved detection and treatment outcomes, with reported success rates exceeding 90% for drug-susceptible TB (10). However, the program continues to face persistent challenges. Case detection remains below the global target, suggesting potential underreporting or hidden disease reservoirs. Coordination between federal and provincial levels has become more complex since health sector devolution, leading to administrative and funding disparities (14). The program also remains heavily reliant on international donors, raising concerns about sustainability should external support wane. Furthermore, despite progress, integrating TB services within Pakistan's broader primary healthcare system remains incomplete, limiting accessibility for rural populations and marginalized groups.

Rising Trend in Pakistan

Epidemiological data from 2015 to 2023 illustrate fluctuating but concerning trends in TB notifications. Between 2015 and 2018, reported cases among both genders remained relatively stable, with males consistently exhibiting higher notification rates. A sharp decline occurred in 2020, corresponding with the COVID-19 pandemic, which disrupted health services, delayed diagnoses, and reduced reporting capacity. However, this decline was followed by a rebound from 2021 onward, as diagnostic services resumed and community screening efforts intensified. By 2023, Pakistan reported approximately 480,000 TB cases, marking the highest national figure to date. This resurgence indicates both improved detection and an underlying increase in transmission (15-17). The gender gap, with males bearing a higher disease burden, reflects occupational exposure patterns and behavioral factors such as smoking and delayed health-seeking. The trend underscores the urgent need for strengthening surveillance systems, ensuring uninterrupted diagnostic capacity, and enhancing resilience of TB services against future disruptions. In summary, the persistently high TB prevalence in Pakistan is multifactorial—rooted in socioeconomic disparities, systemic healthcare challenges, and emerging biological threats such as drug resistance and co-morbidities. While national programs have made tangible progress, bridging the remaining gaps will require an integrated, patient-centered approach that combines biomedical, social, and policy interventions supported by sustainable funding and community engagement.

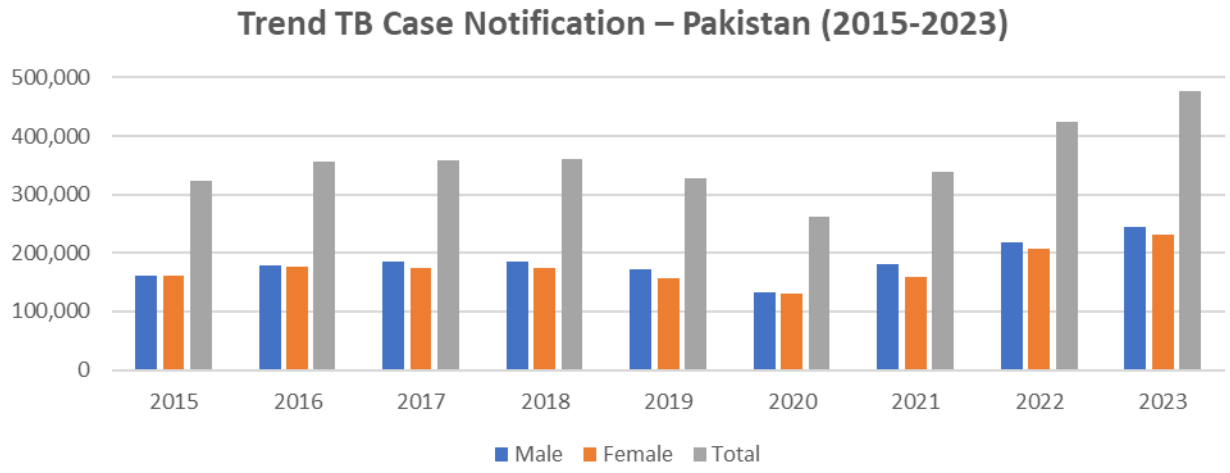


Figure 1 Trend TB Cases Notification- Pakistan (2015-2023)

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CRITICAL ANALYSIS AND LIMITATIONS

The current body of literature on tuberculosis (TB) in Pakistan offers valuable insights into epidemiology, service delivery, and program performance; however, several recurring limitations constrain the certainty and applicability of its conclusions. Many studies rely on cross-sectional designs with modest sample sizes from single districts or facilities, which undermines statistical power and limits causal inference (12,15). Even in evaluations of drug-resistant TB (DR-TB) and public–private mix (PPM) initiatives, quasi-experimental or before-and-after approaches predominate, with short observation windows and insufficient adjustment for secular trends—particularly the disruptive effects of COVID-19 on care-seeking and notifications (14,16). Longitudinal cohorts and randomized implementation trials remain rare, and follow-up is often truncated at treatment completion, leaving relapse, post-TB lung disease, and longer-term socioeconomic outcomes under-documented (12,15). These design constraints are especially consequential for comorbidity questions—most notably diabetes–TB interaction—where heterogeneity in confounder control and limited glycemic monitoring data make it difficult to quantify effect sizes on failure, relapse, and mortality across care levels (8,13). Methodological bias is a persistent concern. Selection bias arises when studies sample from tertiary centers, urban clinics, or high-performing PPM sites, thereby over-representing milder cases or better-resourced settings while under-capturing mobile, rural, or stigmatized populations (17). Performance and detection bias frequently follow from absent or partial blinding of outcome assessment and from uneven availability of rapid molecular diagnostics (GeneXpert) and drug-susceptibility testing (DST), which can misclassify disease severity and resistance patterns (12,18). Information bias also appears where routine data are used without standardized data quality audits; under-notification during the pandemic and rebound surges thereafter complicate trend attribution (19). For stigma and patient-experience research, qualitative studies provide crucial context but can be vulnerable to social desirability and interviewer effects, especially when participants fear discrimination or service repercussions (18).

Publication bias likely shapes the evidence landscape. Programmatic and operational studies that demonstrate gains in case-finding or treatment success are more visible than null or negative results, particularly in donor-funded environments where successful models are prioritized for scale-up (7,16). This asymmetry may inflate perceived effect sizes of PPM, digital adherence technologies, and active case-finding while under-reporting implementation failures, cost overruns, or equity gaps. Similarly, DR-TB reports often highlight cohorts managed at specialized centers, where outcomes may surpass those achievable in routine peripheral settings (19). Without prospective registries of implementation studies and stronger incentives to publish inconclusive findings, decision-makers risk optimistic bias when allocating resources. Variability in measurement outcomes further complicates synthesis and comparison. Studies use diverse definitions for "treatment success," "loss to follow-up," and "catastrophic cost," and they differ in whether outcomes are measured per WHO standards, per-protocol, or intent-to-treat (20). In diabetes–TB research, exposure definitions range from self-reported diabetes to HbA1c-confirmed dysglycemia, with inconsistent thresholds and timing of measurement; these differences materially affect associations with sputum conversion, failure, and mortality (8,13). Stigma research similarly spans distinct constructs—anticipated stigma, enacted stigma, internalized stigma—measured with non-uniform tools, hindering pooled estimation and the identification of intervention-sensitive domains (18,20). For health-system performance, indicators such as "PPM contribution to notifications" may not be standardized for catchment population, private market share, or diagnostic intensity, limiting comparability across provinces and years (21).

Questions of generalizability remain. Evidence is disproportionately concentrated in major urban centers and among facility-attending populations, with less representation from conflict-affected districts, remote mountainous regions, and informal settlements where risk, mobility, and health-system access differ markedly (12,15). Key populations—including people who inject drugs, incarcerated individuals, miners, and transgender communities—are under-studied, despite emerging reports that they face substantial barriers and distinct risk profiles (10,22). Extrapolating outcomes from high-performing pilots or academic centers to routine primary care may therefore overstate effectiveness and understate implementation complexity. Likewise, global burden signals from WHO reports are indispensable but may not reflect sub-provincial heterogeneity in Pakistan's pluralistic health system (5,20). In aggregate, the literature supports several policy-relevant conclusions—rising or rebounding notifications, persistent case-detection gaps, the salience of DR-TB, and the promise of private-sector engagement—yet confidence in effect estimates is tempered by design limitations, biases, outcome variability, and external validity concerns (16,20). Future work would benefit from adequately powered, multi-site prospective cohorts that integrate standardized diagnostics (including universal DST), harmonized outcome frameworks, and longer follow-up for relapse and post-TB morbidity. Pragmatic cluster randomized or stepped-wedge trials could more credibly test PPM, digital adherence, and

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community stigma-reduction packages at scale. Finally, routine program data should be strengthened through data quality audits, pre-registration of implementation evaluations, and systematic reporting of equity-stratified outcomes to ensure that gains are both real and fairly distributed (7,12).

IMPLICATIONS AND FUTURE DIRECTIONS

The findings of this review hold substantial implications for clinical practice, public health policy, and future research concerning tuberculosis (TB) control in Pakistan. Clinically, the synthesis of current evidence underscores the need to enhance patient-centered approaches within primary healthcare systems. Strengthening diagnostic accessibility through decentralized GeneXpert testing, improving case management via digital adherence monitoring, and integrating comorbidity screening—particularly for diabetes mellitus and smoking-related lung disease—should be prioritized to improve outcomes (23). Clinicians must also recognize the growing challenge of drug-resistant TB (DR-TB), which demands rapid diagnostic confirmation and strict adherence to individualized treatment regimens with quality-assured second-line drugs (8,13). Incorporating psychosocial support, nutritional counseling, and stigma reduction interventions into TB care could significantly enhance adherence and recovery rates. At the policy level, this review emphasizes that TB control cannot be achieved through biomedical interventions alone; it requires sustained multi-sectoral collaboration. Policymakers should integrate TB programs into broader health system strengthening and social protection frameworks (24). Updating national TB guidelines to align with the WHO's End TB Strategy (2023–2030) is essential, ensuring that the private sector operates under uniform standards of diagnosis, treatment, and reporting (10,25). Political commitment must translate into sustained domestic financing and accountability mechanisms rather than overreliance on donor funding. Additionally, incorporating TB surveillance into universal health coverage (UHC) agendas can ensure equity in access, especially for marginalized populations such as urban poor, migrants, and conflict-affected communities (26).

From a research perspective, significant gaps remain in understanding the evolving epidemiology, social determinants, and post-treatment sequelae of TB in Pakistan. Few studies employ longitudinal or randomized designs capable of identifying causal relationships between interventions and outcomes (12,15). There is a pressing need for operational research on the implementation of Public–Private Mix (PPM) models, cost-effectiveness of digital adherence technologies, and the long-term socioeconomic impact of TB illness (7,16). Furthermore, data on pediatric TB, gender-specific barriers, and TB in high-risk groups—such as people who inject drugs or those with HIV co-infection—remain scarce (10,19). Addressing these research gaps would facilitate the design of evidence-informed, context-sensitive interventions that can reduce disease burden and mortality. Future investigations should adopt robust, multi-center prospective designs with standardized diagnostic criteria and harmonized outcome measures to enhance comparability and reproducibility (12,20). Pragmatic randomized controlled trials or stepped-wedge cluster studies could test real-world effectiveness of integrated care models, stigma-reduction interventions, and socioeconomic support packages. Additionally, leveraging digital health innovations such as mobile treatment monitoring, artificial intelligence-assisted radiology, and genomic surveillance for DR-TB could transform early detection and treatment optimization (27). Expanding national TB prevalence surveys and strengthening routine data quality through electronic case-based reporting systems would also provide more accurate estimates of true disease burden and treatment outcomes. In conclusion, the implications of this review extend beyond TB management to the broader public health framework of Pakistan. Combating TB effectively demands the convergence of clinical excellence, policy coherence, and rigorous research innovation. Future efforts should focus on bridging the gap between evidence and implementation—ensuring that scientific advances translate into equitable, sustainable, and patient-centered TB control strategies across the nation.

CONCLUSION

The persistent high prevalence of tuberculosis in Pakistan reflects a multifaceted public health challenge shaped by deep-rooted socioeconomic disparities, gaps in healthcare infrastructure, and the growing threat of drug-resistant strains. Despite notable progress achieved through the National TB Control Program in expanding diagnostic networks and improving treatment success rates for drug-susceptible cases, the overall disease burden remains unacceptably high. The current body of evidence, while informative, is limited by methodological variability and insufficient longitudinal data, reducing the strength of generalizable conclusions. Strengthening the reliability of TB research in Pakistan requires larger, well-designed, multi-center studies that capture the complex interaction between biological, social, and systemic determinants. Clinicians and policymakers must integrate patient-centered care with socioeconomic interventions, ensuring equitable access to diagnosis, effective management of drug resistance, and sustained community engagement.

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Future research should focus on implementation science, evaluating innovative diagnostic technologies, community-based interventions, and long-term health outcomes to advance Pakistan's progress toward achieving the WHO End TB targets.

AUTHOR CONTRIBUTION

Author	Contribution
Hafiz Muhammad Saqib*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Syed Ali Shah	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Wasif Irfan	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Muhammad Tayyab Akhtar	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Muhammad Awais Ali Akram	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published

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