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ENHANCING TUBERCULOSIS CONTROL THROUGH EARLY DETECTION AND TREATMENT IMPLEMENTATION

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Abstract: Tuberculosis (TB) remains a major global public health challenge, particularly in low- and middle-income countries. Early diagnosis and timely initiation of appropriate treatment represent key pillars in breaking the chain of transmission and improving patient outcomes. This article reviews the current state of early detection of TB, outlines effective treatment strategies and offers practical guidance on implementing measures in clinical and public-health practice. The first part emphasises early diagnosis, including symptom screening, contact tracing, radiological and molecular diagnostics, and newer approaches such as artificial-intelligence-assisted imaging and biomarkers. Evidence shows that systematic contact investigation and active case finding significantly increase case detection rates before advanced disease develops. The second part discusses treatment: first-line regimens for drug-susceptible TB, emerging shortened regimens, and the management of drug-resistant TB (DR-TB) with recent advancements in all-oral, shorter-duration regimens. Guidelines from the World Health Organization (WHO) and other authorities are summarised, including monitoring and support measures. The third part addresses operational implementation: how to translate early-diagnosis and treatment protocols into practice — including strengthening laboratory capacity, training healthcare workers, ensuring drug supply and patient adherence, and integrating contact screening into health services. The article also discusses barriers such as limited access to diagnostics in resource-constrained settings, stigma, and patient-level factors affecting adherence. A methodology section explains how relevant literature was identified and reviewed, and the results section summarises key findings. The conclusion offers recommendations for healthcare systems and practitioners to implement early diagnosis and effective treatment in order to reduce TB morbidity, mortality and transmission. Key words are provided to facilitate indexing and searching. By bridging the diagnostic, therapeutic and implementation dimensions of TB care, the article aims to support clinicians, public-health practitioners and programme managers in translating evidence into action to curb the burden of TB.

Keywords: Tuberculosis, early diagnosis, treatment implementation, contact tracing, molecular diagnostics, drug-resistant TB, shortened regimen, adherence, public health, active case finding.

Introduction

Tuberculosis (TB), caused by Tuberculosis (Mycobacterium tuberculosis), continues to pose a serious threat worldwide. Although many countries have made progress, TB remains among the top infectious-disease killers globally. Early diagnosis and prompt treatment are crucial for controlling the disease, improving individual outcomes and reducing transmission. The challenge is twofold: first, identifying TB early in its course — ideally before extensive lung damage or

wider dissemination occurs; and second, ensuring that once diagnosed, patients receive timely and appropriate treatment, adhering to therapy until completion. Early detection allows interruption of the transmission cycle, and treatment prevents progression to severe disease, morbidity, and death. From a public-health perspective, implementing systematic screening of contacts and at-risk populations, combined with modern diagnostics, offers the opportunity to detect cases earlier than traditional passive case-finding alone. Treatment implementation has evolved: the long-standing standard 6-month regimen for drug-susceptible TB is now being complemented by studies of shortened regimens, while drug-resistant TB has witnessed revolutionary all-oral, shorter-duration options. Yet moving from guideline to practice remains a global challenge. Implementation requires infrastructure, human resources, diagnostic capacity, supply chains, patient support systems, and monitoring frameworks. In many settings, delays in diagnosis and gaps in treatment initiation undermine the potential benefits. This article aims to integrate the evidence on early diagnosis and treatment implementation of TB. We will first review diagnostic strategies and tools for early detection; second, discuss therapeutic regimens and guideline-based approaches; and third, explore how health systems can operationalise these measures in practice — including contact investigation, adherence support, and monitoring. We also reflect on barriers and propose strategies to overcome them. Understanding how to apply early diagnosis and effective treatment in real-world settings is central to achieving the global targets for TB elimination.

Literature Review

A growing body of literature addresses early-detection strategies for TB. A recent systematic review emphasised that early detection—which includes latent infection screening and diagnosis at initial symptomatic stages—is critical for TB control. Traditional diagnostics such as sputum smear microscopy and culture remain foundations, but their sensitivity and time-to-result pose limitations. Advances in molecular diagnostics (nucleic acid amplification tests, line-probe assays) and radiological modalities (e.g., FDG-PET/CT) have improved early diagnosis. Studies also show that systematic contact investigation among household members of TB index cases significantly improves case finding — for instance, an operational research project in Indonesia found an 8.1 % additional case detection contribution through early detection in contact investigation. On the treatment side, the WHO's 2022 consolidated guidelines for drug-resistant TB recommend a 6-month BPaLM regimen (bedaquiline-pretomanid-linezolid-moxifloxacin) and a 9-month all-oral regimen for MDR/RR-TB. More recent clinical practice guidelines by ATS/CDC/ERS/IDSA support a 4-month regimen for drug-susceptible TB in eligible patients, representing a shift toward shorter therapy. Overall, the literature underscores the dual importance of improving diagnostic speed and expanding treatment options — but also highlights implementation challenges, particularly in resource-limited settings where access to advanced diagnostics and new drugs may be limited.

Main Part

Early diagnostics and screening strategies

Early diagnosis of TB is critical both for the individual patient and for public-health impact. Traditional diagnostic methods include sputum smear microscopy, culture on solid or liquid media, and chest radiography. However, sputum microscopy has low and variable sensitivity, and culture takes weeks. Therefore, modern approaches emphasise molecular diagnostics such as

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nucleic acid amplification tests (NAATs), line-probe assays for drug resistance, and advanced imaging. Contact screening — actively investigating those who have lived with or been exposed to an index case — is a key component of early detection. A study from Indonesia found that among household contacts of known TB cases, systematic screening found additional cases especially in children (positivity rates up to ~46 % in children) and thus enhanced case finding. Emerging technologies offer even earlier detection: for example, FDG-PET/CT has shown sensitivity around 82.6 % in detecting TB lesions before outputs of conventional diagnostics. Artificial-intelligence tools analysing chest-X-rays and sputum microscopy images are under development and may help overcome shortages of trained personnel in resource-limited settings. To implement early detection, programmes must (a) define target populations (contacts, high-risk individuals such as HIV, diabetes, malnutrition), (b) select appropriate screening tools for resource context (symptom screening + chest X-ray + NAAT), (c) ensure linkage to diagnostic confirmation and treatment initiation, and (d) monitor performance (time to diagnosis, proportion of contacts screened, yield per contact). Barriers include limited laboratory access, cost of advanced diagnostics, patient non-attendance for screening, stigma and limited awareness. Addressing these via health-education, mobile screening units, outreach and integrating screening into primary care are essential steps.

Treatment regimens and therapy implementation

Once TB is diagnosed, timely initiation of effective therapy is vital. For drug-susceptible TB (DS-TB), the standard regimen historically has been a 6-month combination of isoniazid, rifampin, pyrazinamide (2 months) plus extension (4 months) of isoniazid and rifampin. Recent guideline updates now support shorter regimens: for example, in eligible adults a 4-month regimen of isoniazid, rifapentine, moxifloxacin and pyrazinamide followed by isoniazid, rifapentine and moxifloxacin has been conditionally recommended. For drug-resistant TB (DR-TB) including MDR and RR-TB, the 2022 WHO consolidated guidelines introduced the 6-month BPaLM regimen (bedaquiline, pretomanid, linezolid, moxifloxacin) and a 9-month all-oral regimen for patients without fluoroquinolone resistance. These shorter, all-oral regimens reduce treatment duration, avoid injections, enhance patient adherence and reduce complications. Implementation of treatment also involves directly observed therapy (DOT) or other adherence support, monitoring of drug adverse effects, drug-susceptibility testing to tailor therapy, and integration with HIV care where relevant. Key issues include ensuring uninterrupted drug supply, monitoring for resistance emergence, managing side-effects and ensuring completion of therapy to prevent relapse and transmission. In many settings, delays in treatment initiation or incomplete therapy undermine outcomes and facilitate resistance. Effective therapy implementation must be underpinned by patient-centred care, counselling, nutritional support, side-effect monitoring and programme tracking.

System-level measures for implementation and monitoring

Putting early detection and treatment into practice requires system-level adaptations. First, health systems must strengthen laboratory and diagnostic networks: ensure access to NAATs, quality chest-X-rays, culture and drug-susceptibility testing, and reporting systems. Training and capacity building of healthcare workers are essential. Second, programme managers must integrate active case-finding strategies (contact investigation, community outreach), screening of high-risk groups (HIV, diabetics, malnourished, smokers) and referral mechanisms to ensure seamless linkages from detection to treatment initiation. Third, monitoring and evaluation systems must capture key indicators: screening yield, time from suspect to diagnosis, time from diagnosis to treatment start, treatment completion rates, relapse rates and drug-resistance emergence. Fourth, supply-chain management is critical to ensure availability of first-line and

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second-line TB drugs, and to avoid stock-outs that disrupt therapy. Fifth, adherence support and patient-centred care: provide education, counselling, incentives/enablers, nutritional and psychosocial support to improve completion and outcomes. Finally, addressing barriers such as stigma, socio-economic constraints, health-system delays and financing is vital. Cost-effectiveness studies suggest that early detection and shortened regimens can yield better outcomes with lower overall cost to health systems. Implementation research remains needed to adapt global guidelines to local contexts.

Methodology

This article is based on a narrative review of English-language peer-reviewed literature, guideline documents and operational research reports published up to mid-2025. Key databases including PubMed, PMC, Embase and Google Scholar were searched using combinations of terms such as “early detection tuberculosis”, “tuberculosis diagnostics”, “tuberculosis treatment guidelines”, “MDR-TB treatment”, “shrinking TB regimen”. Eligible sources included systematic reviews, guideline documents (e.g., WHO), original operational research studies on contact investigation and treatment implementation, and recent clinical practice guideline updates. Exclusion criteria included single-case reports, non-English articles, studies not involving humans, or those focusing solely on non-tuberculous mycobacteria. Data extraction focused on diagnostic and treatment methods, their performance characteristics (sensitivity, specificity, duration, adherence), implementation strategies, and barriers. Findings were synthesised thematically under diagnostic strategies, treatment regimens, and implementation measures. Where possible, empirical evidence (e.g., from operational studies) was referenced to support discussions of implementation outcomes. Limitations of this methodology include potential publication bias, heterogeneity of settings (diagnostics or treatment regimens may differ by region), and the narrative rather than systematic nature of the review, which may limit exhaustive coverage of all emerging technologies.

Results

The review indicates that early detection strategies significantly improve TB case finding and allow interventions before advanced disease. For example, contact investigation with early screening in Indonesia yielded an additional case detection contribution of 8.1 %, with higher positivity among children and symptomatic contacts. Advances in diagnostics — such as NAATs, line-probe assays, AI-assisted imaging and PET/CT imaging — provide improved sensitivity and speed compared to traditional methods. On the treatment front, new shorter and all-oral regimens have been endorsed by major guideline bodies, notably the 4-month DS-TB regimen and the 6-month/9-month regimens for DR-TB. Implementation research suggests that when diagnostic and treatment programmes are integrated with screening, contact tracing and patient support, better outcomes are achieved. Nevertheless, persistent gaps remain: in many high-burden settings access to advanced diagnostics and newer drug regimens is limited; delays between diagnosis and treatment initiation persist; adherence remains a challenge; and monitoring and reporting systems are often weak. The combination of technical advances plus system-level measures appears promising for reducing TB burden, but requires strong health-system investment, training, and adaptation to local context.

Conclusion

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Tuberculosis remains a formidable public-health adversary. However, progress in diagnostics, therapeutics and programme implementation offers real opportunities to reduce disease burden, transmission and mortality. Early detection — via symptom screening, contact investigation, chest radiography, molecular diagnostics and emerging imaging/AI tools — enables identification of TB cases at an earlier stage, before extensive lung damage or wider spread. The literature demonstrates that systematic application of early-detection strategies improves case-finding yield and supports control efforts. On the therapeutic side, the evolution of treatment regimens — especially the introduction of shorter, all-oral regimens for drug-susceptible and drug-resistant TB — marks a major advance in patient care, allowing higher adherence, lower burden of therapy, fewer side-effects and potentially lower cost. Implementation is the bridge between evidence and impact. Health systems must ensure that diagnostic capacity is available, that screening programmes reach target populations, that treatment initiation is prompt, that drug supply chains and adherence support are reliable, and that monitoring systems capture performance indicators and patient outcomes. Barriers such as limited access to diagnostics or drugs, patient non-attendance, stigma, comorbidities (HIV, diabetes), and resource constraints must be actively addressed. For countries and programmes, key recommendations include: integrating contact tracing and screening into routine TB services; strengthening laboratory networks for molecular diagnostics and drug resistance testing; adopting guideline-recommended shorter and all-oral regimens where eligible; ensuring uninterrupted and timely drug supply; providing patient-centred support (education, counselling, nutrition, psychosocial support); and implementing robust monitoring and evaluation frameworks to track time-to-diagnosis, time-to-treatment, treatment completion, relapse and resistance outcomes. Ultimately, achieving TB elimination will depend on coordinated action across detection, treatment and systems implementation. Early diagnosis alone is insufficient unless followed by effective treatment and adherence. Likewise, the best drug regimen will only fulfil its promise if operational challenges are surmounted. As global targets call for substantial reductions in TB incidence and mortality, concerted efforts to apply early-detection strategies and effective treatment implementation are indispensable. In summary, by advancing both the “when” (early diagnosis) and the “how” (effective treatment implementation) of TB care, health systems can markedly improve outcomes for patients and communities, reducing transmission, preventing complications and moving closer to TB elimination goals.

References

1. Yayan J, Franke K-J, Berger M, Windisch W, Rasche K. Early detection of tuberculosis: a systematic review. *Pneumonia*. 2024;?
2. Suh et al. Review and updates on the diagnosis of tuberculosis. PMC. 2023.
3. “Diagnosis of Pulmonary Tuberculosis: Recent Advances and Challenges.” PMC. 2014.
4. The Implementation of Early Detection in Tuberculosis Contact Investigation to Improve Case Finding. PMC. 2020.
5. WHO. Early detection of tuberculosis: an overview of approaches, guidelines and tools. Geneva: WHO; 2011.
6. Advances in the detection and diagnosis of tuberculosis using novel technologies. ScienceDirect. 2023.
7. Innovative laboratory methods for improved tuberculosis diagnosis. Frontiers. 2023.
8. Recent progress in tuberculosis diagnosis: insights into blood-based biomarkers. Frontiers in Cellular and Infection Microbiology. 2025.

9. WHO Consolidated Guidelines on Tuberculosis. Module 4: Treatment – Drug-Resistant Tuberculosis Treatment (2022 update). Geneva: WHO; 2022.
10. Lopes SR et al. Update in tuberculosis treatment: a scoping review. PMC. 2025.
11. McFadden R, et al. Treatment of Drug-Resistant and Drug-Susceptible TB: Clinical Practice Guideline. ATS/CDC/ERS/IDSA. 2024.
12. Sahra S, Bronze MS. Tuberculosis (TB) Treatment & Management. eMedicine/Medscape. October 2024.
13. US Pharmacist. A Comprehensive Review of Tuberculosis Management. 2024.
14. InfectiousDiseaseAdvisor. Tuberculosis Treatment Guidelines Updated. February 2025.
15. J Miller et al. Diagnostic Performance of Artificial Intelligence–Based Methods for Tuberculosis Detection. J Med Internet Res. 2025;?
16. Spandidos Publications. Recent advances in nanomaterials for the detection of tuberculosis. Int J Mol Med. 2024;?