PERSPECTIVE

Tuberculosis Elimination in India: Where the Country Stands

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ABSTRACT

Tuberculosis (TB) remains a significant public health challenge in India, with the country bearing the highest burden of TB cases globally. This article provides an overview of India's ongoing efforts towards TB elimination, highlighting both progress and persistent challenges.

India's Revised National Tuberculosis Control Program (RNTCP), launched in 1997, has made remarkable strides in TB control. The introduction of the RNTCP and later its expansion as the National Tuberculosis Elimination Program (NTEP) in 2017, aimed to strengthen diagnostic and treatment services, with a focus on achieving universal access to TB care. DOTS (Directly Observed Treatment, Short-course) therapy has been a cornerstone of treatment, contributing to significant reductions in TB mortality. In recent years, India has made strides in adopting new technologies, including molecular diagnostics and telemedicine, to enhance TB case detection and patient care. The introduction of Bedaquiline and Delamanid, novel drugs for drug-resistant TB, has offered hope for patients with more resistant forms of the disease. However, the road to TB elimination in India is not without challenges. There is a pressing need for improved healthcare infrastructure, reduced stigma, and increased awareness among both the public and healthcare providers. The emergence of drug-resistant TB and the impact of the COVID-19 pandemic on TB services have posed additional hurdles. India's journey toward TB elimination is marked by significant progress and continued challenges. To achieve the ambitious goal of eliminating TB by 2025, concerted efforts are required to strengthen healthcare systems, improve diagnostic capabilities, and address social determinants of the disease.

Keywords: India, tuberculosis, progress, challenges, strategies

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INTRODUCTION

Tuberculosis (TB), caused by Mycobacterium tuberculosis, continues to be a formidable public health challenge in India, where it ranks among the top infectious diseases.[1] Despite significant progress in the healthcare sector, the country bears a disproportionate share of the global TB burden, with millions of new cases and thousands of deaths annually. One of the primary reasons for the high TB burden in India is its vast population, which exceeds 1.3 billion people.[2] The sheer size of the population contributes to the disease's prevalence, as crowded living conditions and limited access to healthcare services in certain areas create ideal conditions for TB transmission. In the year 2021, 21.4 lakh cases were notified from India, which was 20% more when compared to the year 2020. Additionally, India's socioeconomic diversity further complicates efforts to control TB, as the disease is more prevalent among marginalized communities with limited access to healthcare and nutrition.[3,4]

Multidrug-resistant TB (MDR-TB) and extensively drug-resistant TB (XDR-TB) pose a particularly challenging aspect of the TB burden in India. The emergence of drug-resistant strains, often due to inadequate treatment adherence and misuse of antibiotics, requires specialized care and significantly increases the cost and complexity of TB management.[5,6] Addressing drug-resistant TB is a critical aspect of TB control efforts in the country. The impact of the COVID-19 pandemic has further exacerbated the TB burden in India. Lockdowns, disrupted healthcare services, and diverted resources have hindered TB diagnosis and treatment, leading to a potential increase in undiagnosed and untreated cases.[7] It is imperative that health systems prioritize TB services and adapt to the evolving healthcare landscape to mitigate the collateral damage caused by the pandemic.[8]

India has made strides in tackling TB through its National Tuberculosis Elimination Program (NTEP). However, to reduce the TB burden significantly, there is a need for sustained investment in healthcare infrastructure, increased access to quality diagnostic services, and improved social support systems.[9] Moreover, addressing the social determinants of TB, such as poverty and malnutrition, is essential to curbing the disease's prevalence.[2] The objectives of this comprehensive review are to provide a historical perspective on TB in India, analyze the current epidemiological situation and identify the challenges hindering TB elimination efforts.

Historical Overview

TB has a long history in India, with evidence of its presence dating back to ancient times. The disease was initially associated with supernatural causes and superstitions. However, with advancements in medical science, particularly the discoveries by Robert Koch in the late 19th century, the microbial origin of TB became clear.[10] In the early 20th century, India established sanatoriums and TB treatment centers to isolate and treat TB patients. This approach aimed to prevent the spread of the disease but did little to address the root causes of TB or to control its transmission.[11] The globally recognized Directly Observed Treatment, Short-course (DOTS) strategy was introduced in India in 1997 as the Revised National Tuberculosis Control Program (RNTCP). This marked a significant shift in TB control efforts, emphasizing early case detection, standardized treatment regimens, and community involvement.[12,13]

Epidemiology of TB in India

India has consistently ranked among the countries with the highest TB burden globally. Our Country accounts for approximately one-quarter of the global TB incidence. Furthermore, India also has a high prevalence of drug-resistant TB, with a substantial number of multidrug-resistant TB (MDR-TB) cases.[4] The epidemiological landscape is complex, with variations across regions, urban-rural divides, and demographic factors influencing the prevalence and incidence of TB. The country's large and diverse population, characterized by varying levels of socioeconomic development, contributes to the persistence of TB. Vulnerable populations, such as those living in crowded urban slums and tribal areas with limited access to healthcare, remain at high risk.[14,15] Gender disparities in TB incidence are also notable. In India, TB incidence is higher among men than women, which can be attributed to various cultural, social, and healthcare-seeking behaviour differences.[16] The factors contributing to gender disparities in incidence of TB are shown in Table 1.

Table 1: Factors that may contribute to Gender disparities in incidence of TB[17]

• Perceived lower risk of tuberculosis
• Prioritizing Household chores and neglecting self-care
• Fear of TB related stigma
• Difficulty in accessing healthcare facilities
• Lack of financial resources
• Cultural barriers
• Lack of confidentiality and privacy

The emergence of drug-resistant TB strains, particularly MDR-TB and extensively drug-resistant TB (XDR-TB), poses a serious challenge to TB control efforts in India. In recent years, efforts have been made to strengthen drug susceptibility testing and provide access to new and more effective drugs, such as Bedaquiline and Delamanid.[6] However, the burden of drug-resistant TB remains a concern, requiring improved treatment regimens, better adherence support, and infection control measures.[5]

Challenges to TB Elimination

The sheer number of TB cases in India poses a significant challenge to elimination efforts. Despite progress, the burden remains immense. The emergence of drug-resistant TB strains, which require specialized and costly treatment, is a critical obstacle to TB control and elimination. India's healthcare system, while extensive, faces challenges related to quality and accessibility.[6] Rural areas often lack adequate healthcare facilities and trained personnel, making it difficult to diagnose and treat TB promptly. Stigma surrounding TB persists in many parts of India, leading to delayed diagnosis and treatment. Raising public awareness and reducing social stigma are crucial for early detection and adherence to treatment.[18] Socioeconomic factors, including poverty and malnutrition, contribute to vulnerability to TB. Poor living conditions and inadequate nutrition weaken the immune system, increasing the risk of TB infection and progression.[14] The challenges in eliminating TB from our community are highlighted in figure 1.

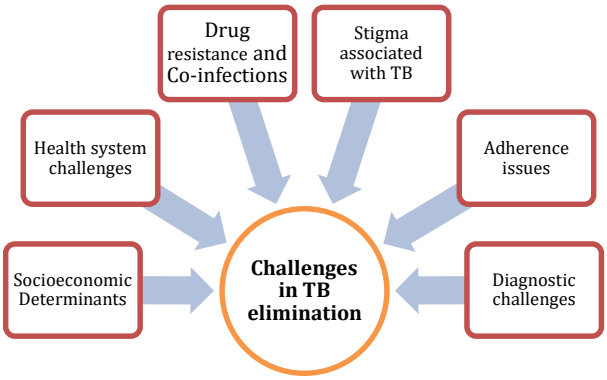

Figure 1: Challenges that could impact TB elimination efforts in India

Strategies for TB Elimination

The National Tuberculosis Elimination Program (NTEP), formerly known as the RNTCP, forms the cornerstone of India's TB elimination strategy. It focuses on early case detection, standardized treatment regimens, and improved patient care. India has scaled up efforts to provide universal drug sensitivity testing (DST) to all diagnosed TB patients. This allows for tailored treatment plans based on specific drug resistance patterns.[19] The introduction of shorter, more effective treatment regimens for drug-resistant TB has improved patient compliance and outcomes, reducing the risk of transmission. India has embraced digital technologies like telemedicine and mobile applications to enhance TB diagnosis and treatment adherence.[20] Mobile apps have been used to track patients' progress, improving their adherence to medication.[21]

Given the significant proportion of TB patients seeking care in the private sector, the government has worked to engage and regulate private healthcare providers to ensure that TB cases are diagnosed and treated correctly.[22] Recognizing the impact of malnutrition on TB outcomes, India has integrated nutritional support into TB care, providing patients with essential nutrients to strengthen their immune systems.[23] Engaging communities in TB awareness campaigns, education, and active case finding has been crucial in reaching vulnerable populations and reducing stigma.[24]

Progress Towards Elimination

Through intensified efforts and the use of molecular diagnostics like GeneXpert, India has significantly increased the detection of TB cases, including drug-resistant forms.[25] The country has achieved a steady improvement in TB treatment success rates, ensuring that more patients complete their treatment and are cured. India has witnessed a decline in TB incidence, albeit gradual.[26] This trend is a positive sign and demonstrates the effectiveness of elimination strategies. India's efforts have not gone unnoticed on the global stage. The country has played a pivotal role in advocating for TB elimination and has actively participated in international initiatives.[27]

India has been actively involved in the development of TB vaccines, with several promising candidates in various stages of clinical trials.[28] Efforts are underway to discover new drugs for TB treatment, particularly those effective against drug-resistant strains.[29,30] India has contributed to the development of improved TB diagnostics, including point-of-care tests that can rapidly detect TB and drug resistance.[6] Research studies are being conducted to assess the impact of various interventions and strategies on TB control and elimination in India. India collaborates with international organizations such as the World Health Organization (WHO), the Global Fund, and the Stop TB Partnership to access resources, expertise, and funding for TB elimination.[31] Numerous non-governmental organizations (NGOs) work in partnership with the government to implement TB control and awareness programs at the community level.[32] Civil society organizations play a crucial role in advocacy, awareness campaigns, and support for TB patients, helping reduce stigma and improve access to care.[33]

Future Prospects

The COVID-19 pandemic has posed significant challenges to TB control efforts in India, leading to disruptions in diagnosis and treatment. However, it has also highlighted the importance of strong healthcare systems and research capacity. The integration of digital health technologies can further improve TB diagnosis, treatment adherence, and monitoring, especially in remote and underserved areas.[7] Continued efforts are needed to address drug-resistant TB, including research into new drugs and treatment regimens, as well as better infection control

measures. Investments in healthcare infrastructure, particularly in rural areas, are essential to ensure timely diagnosis and treatment of TB.[2] India can continue to contribute to TB research and innovation, not only for its own population but also as a global leader in the fight against TB. One of the most promising developments in the fight against TB is the emergence of innovative diagnostic tools and treatments.[25] Molecular diagnostics, such as GeneXpert and line probe assays, have improved the accuracy and speed of TB diagnosis. Additionally, the introduction of new drugs like Bedaquiline and Delamanid, along with shorter treatment regimens, holds great potential for improving treatment outcomes and reducing the risk of drug resistance.[19]

India's commitment to improving TB prevention includes the exploration of new vaccination strategies. The Bacille Calmette-Guérin (BCG) vaccine has been a mainstay for TB prevention, but its effectiveness in adults is limited. Research into newer vaccines, such as the candidate vaccine M72/AS01E, offers hope for more effective TB prevention in the future.[28] India recognizes the need for targeted interventions to address the TB burden among vulnerable populations. Initiatives like the Nikshay Poshan Yojana, which provides financial support for nutrition to TB patients, aim to reduce malnutrition-related TB cases. Enhanced outreach programs in urban slums and tribal areas are essential to reach marginalized communities with limited access to healthcare.[9]

The integration of digital health technologies has the potential to revolutionize TB care and management in India. Mobile apps for symptom tracking, telemedicine for remote consultations, and digital adherence technologies help ensure patients receive the care and support they need throughout their treatment journey.[34,35] Improving TB surveillance and data analytics is critical for understanding disease trends, identifying hotspots, and tailoring interventions. India has been investing in strengthening its health information systems to capture real-time data, enabling rapid response to outbreaks and better resource allocation.[36] A significant proportion of TB patients in India seek care in the private sector. Collaborative efforts between the public and private sectors are essential for early diagnosis, standardizing treatment, and ensuring quality care delivery. Public-private partnerships have the potential to greatly impact TB control efforts.[32] Empowering communities and increasing awareness about TB are fundamental to its elimination. Grassroots initiatives, community health workers, and educational campaigns can reduce stigma, improve early case detection, and promote treatment adherence.[24,37] The strategies to work for TB elimination in India are summarised in Table 2.

Table 2: Strategies and recommendations to achieve TB elimination in India

Strategy	Recommendation
Research and development	• Continued investment in research and development for new diagnostics, drugs, and vaccines • Collaboration between public and private sectors for accelerated innovation
Integrated Healthcare Systems	• Integration of TB care into broader healthcare systems for improved access and sustainability. • Strengthening the linkages between TB care and other relevant healthcare services
Digital Health Technologies	• Leveraging digital health technologies for improved surveillance, monitoring, and patient management. • Telemedicine and mHealth interventions for remote consultations and support
International Collaboration	• Collaborative efforts with global health organizations and research institutions. • Sharing of best practices and lessons learned from successful TB control programs worldwide
Advocacy and Policy Reforms	• Advocacy for increased political commitment and resource allocation for TB control • Policy reforms to address social determinants and ensure equitable access to healthcare

CONCLUSION

Tuberculosis in India remains a formidable challenge, necessitating a multidimensional and research-driven approach. The current landscape is marked by both persistent challenges and promising interventions. India has made remarkable progress in its fight against TB, and the future holds promise for its elimination. Through innovative diagnostics, targeted interventions, digital health solutions, research, and community engagement, India is poised to make significant strides in reducing TB incidence and mortality. However, it is crucial to address challenges such as drug resistance, healthcare infrastructure, and social determinants to achieve the ambitious goal of TB elimination. A concerted effort from the government, healthcare providers, civil society, and international partners is essential to make TB a disease of the past in India. With continued dedication and innovation, the future of TB elimination in India looks brighter than ever.

Tuberculosis elimination in India is a complex and ongoing endeavour that requires sustained commitment, innovation, and collaboration. Despite chal-

lenges such as high TB burden, drug resistance, and healthcare infrastructure limitations, India has made significant progress in reducing TB incidence and improving treatment outcomes. The country's efforts serve as a testament to the potential for TB elimination, both within India and globally. As research and innovation continue to advance, and partnerships strengthen, India stands on the precipice of achieving its goal of a TB-free nation, making a substantial contribution to the global effort to end TB by 2030. By addressing diagnostic gaps, improving treatment regimens, strengthening health systems, and considering social determinants, there is potential to significantly reduce the burden of TB in India. Continued research, collaboration, and advocacy are essential for paving the way towards a TB-free future.

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