

Tuberculosis in India: Overview, Challenges, and Way Forward in the Post-COVID-19 Era

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Tuberculosis (TB) remains one of India's most pressing and challenging problems. Globally, India remains the highest TB burden country, infecting people of all age groups, mainly affecting the younger population. The bacterium Mycobacterium tuberculosis is highly infectious and spreads through droplet infection. Millions of people die due to TB annually, and India alone accounts for a significant portion of these fatalities. TB is a major barrier to social and economic development, and each day hundreds of workdays are lost because of the illness. TB mortality over the years has reduced, and India currently has revised its mission under the new program, that is, National Tuberculosis Elimination Program (NTEP). The NTEP has a goal to end TB by 2025 under an ambitious "Detect-Treat-Prevent-Build" model. Tackling TB during the COVID-19 pandemic became more challenging, and the global community was compelled to rethink its operation and implementation. The present article recommends the feasibility and scope of telemedicine and the integration of social development approaches in policy planning to ensure social and health equity.

Keywords: tuberculosis, global health, public health, COVID-19, pandemic, India

Problem Overview

Tuberculosis (TB) is a disease caused by the bacterium *Mycobacterium tuberculosis*. The bacterium affects the lungs but can attack any part of the body if left untreated, and leads to death.

According to the Global Tuberculosis Report 2018 (World Health Organization [WHO], 2020a), there are an estimated 10 million incident TB cases, which

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corresponds to 133 cases per 100,000 people. India alone accounts for 27 percent of all estimated incident TB cases worldwide. Every year, about 2 million people are diagnosed with TB, and 0.87 million of these cases are infectious; in India, 3,30,000 people die due to TB annually (WHO, 2009).

The Annual Rate of Tuberculosis Infection (ARTI) is used as a significant indicator for the prevalence of TB in a community. It has demonstrated high figures of TB cases in almost all the four zones of India (Vashishtha, 2010). A survey conducted in three districts of Maharashtra to estimate the Annual Risk of Infection (ARI) revealed high rate of transmission of TB infection in all the three studied areas (both urban and rural; Chadha et al., 2003a). Similarly, a study conducted in the districts of Uttar Pradesh has found a high rate of TB transmission in northern India (Chadha, Jagannatha, Vaidyanathan, Singh, & Lakshminarayana, 2003b). TB usually affects young adults, but almost all age groups are at risk of contracting this disease. TB spreads from person to person and is highly infectious; therefore, anyone coming in close contact with the infected person can inhale the germ. The clinical manifestations of TB include cough with sputum and blood (in extreme cases), chest pain, weakness, fever, weight loss, and night sweats.

Since TB spreads very easily, immune system in TB patients is weakened when it can no longer fight the bacteria. Moreover, those having human immunodeficiency virus (HIV) infection are more at a risk of becoming infected with TB than those without HIV infection or having a normal immune system. About 5–10 percent of infected people who do not receive treatment for latent TB infection develop the disease at some point (Center for Disease Control and Prevention [CDC], 2010). In a study conducted in South India, authors found that TB was associated with low level of education, urbanization, having no separate kitchen, changing economic climate, and chronic diseases such as diabetes (Shetty, Shemko, Vaz, & Dsouza, 2010). TB also spreads rapidly in congested areas and conditions favorable to malnutrition and poverty, usually typical of developing countries (Pereira et al., 2005).

According to Aggarwal (2010): “In addition to clinical symptoms, a tuberculosis patient needs to deal with several physiological, financial, and psychological problems.” These factors, along with the clinical manifestations of TB, extend beyond the usual duration of treatment and add to social development issues. In India, TB carries a social stigma because of the nature of the disease and its outcomes with various adverse effects (Aggarwal, 2010). A study conducted on newly detected sputum-positive pulmonary TB patients revealed that the socioeconomic impact of the disease was high, and affected the normal daily functioning of patients (Rajeswari et al., 1999). This included children dropping out of school, direct and indirect expenditures on drugs, diagnosis, and travel, loss of wages, and female patients being rejected by their families (Rajeswari et al., 1999). Families had to use all their savings for the treatment; in some cases, children were made to work in place of their parents, when detected with TB could no longer go to work (Aggarwal, 2010).

A person's daily social interaction revolves around people at home, work, and the society. Owing to the disease, many patients lose an average of 4–10 weeks of work because of the required treatment (Rajeswari et al., 1999). The impact of the disease is also related to marital spectrum. It is challenging to arrange matrimony for boys and girls suffering from the disease, and in some cases, patients face divorce when the partner comes to know of the disease (Aggarwal, 2010). Even after a patient is cured, transition into everyday life is difficult as the patient continues to feel discriminated, isolated, and abandoned (Aggarwal, 2010). According to WHO, "health" is defined as the state of complete physical, mental, and social well-being and not a mere absence of disease or infirmity. According to Aggarwal (2010), "The impact of any disease, especially a chronic illness like tuberculosis, on an individual patient is therefore often all-encompassing, affecting his physical health and his psychological, economic, and social well-being."

Tuberculosis and HIV co-infection add to the already burdened health system and pose additional challenges to their diagnoses and treatment (Pawlowski et al., 2012). Risk of latent TB infection increases by 20 times when an HIV positive patient is exposed to TB infection (Pawlowski et al., 2012). The spread of HIV/AIDS increased global TB cases by more than 6 percent each year (Sharma, Mohan, & Kadiravan, 2005). Both TB and HIV are interrelated with exact causes and consequences—malnutrition, homelessness, unemployment, substance abuse, and poverty (Sharma et al., 2005). Approximately 5 percent of incident TB cases in India have comorbidity with HIV. In 2016, an estimated 87,000 HIV-associated TB cases were reported, with death of 12,000 patients (Government of India, Director General Health Services, 2017).

Another study conducted in southern India found the prevalence of both HIV and diabetes mellitus in pulmonary TB patients (Gupta, Shenoy, Bairy, Srinivasa, & Mukhopadhyay, 2011). The study revealed that although HIV–TB co-infection was more common and prioritized in terms of research and study, diabetes mellitus was also observed in the same population, which added a challenge to work toward TB control in developing countries (Gupta et al., 2011). Another study established that diabetes mellitus was associated with a three-fold incident risk of contracting TB (Restrepo, 2016).

According to WHO, serious association is established between tobacco smoking and TB. According to WHO, lung damage caused by tobacco smoking creates favorable conditions for contracting TB infection. In 2020, globally, 0.74 million new TB cases were attributed to alcohol use disorder and 0.73 million were ascribed to tobacco smoking.

According to a meta-analysis, tobacco smoking is related to TB morbidity and mortality and is a great risk factor for TB infection (Bates et al., 2007). Apart from active smoking, passive smoking also contributes toward developing TB (Leung et al., 2010). A case-control study conducted in India revealed that men from the lower socioeconomic strata who smoked *bidi* were at a greater risk of acquiring pulmonary TB (Prasad et al., 2009). The study demonstrated that low combustible

leaves of *tendu*, which are used to make *bidis*, are highly porous and smokers take deep puffs to keep them lighting, which thus accounts for more harmful outcomes in case of active smokers than passive smokers (Prasad et al., 2009).

According to Global Tuberculosis Report 2020, TB infection has become the leading cause of human mortality (WHO, 2020a). However, the milestones created by the UN Sustainable Development Goals and the WHO End TB Strategy have made substantial improvement in decreasing the mortality rate by one-third over the years. However, this development was severely altered by the COVID-19 pandemic in many countries, resulting in reduced TB testing and access to TB health services (WHO, 2020b). WHO's Global Tuberculosis Report 2020 indicated an 18 percent reduction in TB cases in 2020 compared to 2019. In 2020, the Government of India announced a strict lockdown to combat the COVID-19 pandemic. This negatively affected healthcare provisions and severely restricted access to TB diagnosis and treatment, as healthcare workers from TB programs and facilities were directed toward the COVID-19 interventions (Shrinivasan, Rane, & Pai, 2020).

Programs and Policies

In India, the National Tuberculosis Program (NTP) was started in 1962 to identify and treat TB patients and reduce the magnitude of TB as an infectious disease and public health problem. Besides NTP, both National Tuberculosis Institute in Bangalore and Tuberculosis Research Centre in Chennai were established with the same objectives and activities of case detection, case treatment, health education, and Bacillus of Calmette and Guérin (BCG) vaccination. However, NTP suffered from inadequate program funding, irregular drug supply, and weak administration (Tuberculosis Program Review, India, 1992). Low rate of case detection, incomplete treatment, high default rate, and mortality added to the problem (Tuberculosis Program Review, India, 1992). To overcome the problem, several clinical trials were conducted from 1993 to 1996 and Direct Observed Therapy, Shortcourse (DOTS/TB-DOTS) was launched in India in 1997 as a Revised NTCP (RNTCP), which demonstrated decreased TB death rates.

Direct Observed Therapy Shortcourse is WHO's initiative to treat TB patients having positive results of sputum-smear, which is enough to spread TB infection in community. DOTS program has been the most effective intervention to stop the spread of TB in communities, and targets to achieve 70 percent rate of case detection and 85 percent rate of cure. It is a cost-effective, internationally recommended strategy, based on the following five core components:

- Sustained political and financial commitment
- Diagnosis by quality ensured sputum-smear microscopy
- Standardized shortcourse anti-TB treatment (SCC) given under direct and supportive observation (DOT)

- Regular, uninterrupted supply of high-quality anti-TB drugs
- Standardized recording and reporting

Since the initiation of RNTCP, it has established impressive results in cure rate (>80 percent in new infectious cases) and a decrease in death rate (Bhargava, Pinto, & Pai, 2011). DOTS strategy focuses on patients who report the disease on their own. However, research on mathematical models has suggested that active case determining (which requires additional effort by health professionals to find out cases) can serve as a beneficial method of reducing TB (Borgdorff, Floyd, & Broekmans, 2002). Other helpful interventions for TB control include BCG immunization, community-based treatment, and preventive therapy for HIV–TB infection. BCG immunization does not provide 100 percent protection but is effective to prevent infection for initial few years, and hence recommended to be given to children at the time of birth (Borgdorff et al., 2002).

Studies have established that ambulatory treatment is effective for the initial 2 months of hospitalization because of its cost-effectiveness and uncompromising cure rate (Murray & Salmon, 1998). Hence, this type of variation in the program can help people save money, time, and resources. As discussed earlier, patients infected with HIV are at a higher risk of acquiring TB infection; hence, programs such as anti-retroviral therapy (ART) help the immune system to repair itself and prevent further damage in HIV-infected patient, and thus delay the onset of TB (Kirk et al., 2000).

Under RNTCP, an innovative online recording and reporting system called Nikshay was stated across the country in 2012 (Government of India, Director General Health Services, 2017). About 98 percent of reporting units send case-based reports of TB patients, including reports from private service providers (Government of India, Director General Health Services, 2017). Universal Drug Sensitivity Testing (DST) has been offered since 2014 to assess the presence of Rifampicin resistance at the time of TB diagnosis among patients. However, the COVID-19 pandemic drastically brought down notifications of TB patients.

India intends to end TB by 2025, 5 years ahead of the Sustainable Development Goals (Government of India, Director General Health Services, 2017). The goal is to reduce TB deaths by 95 percent, decrease new cases by 90 percent, and ensure that families are stress-free from huge expenses incurred to treat TB. The set goal also considers that no TB-affected household incurs high costs of TB diagnosis and treatment, a serious factor that creates barriers to access and achieve the End TB strategy (Muniyandi et al., 2020). A National Strategic Plan (NSP) 2017–2025 was developed to achieve these goals, and in January 2020, RNTCP was renamed as the National Tuberculosis Elimination Program (NTEP), which has devised four strategic pillars of Detect-Treat-Prevent-Build (DTPB) (see Table 1).

The goal of ending TB by 2025 received prompt attention from WHO, endorsing the India-made TrueNat MTB. WHO has recommended using molecular nucleic acid amplification tests (NAATs) for detection of TB instead of smear

Table 1 The “Detect-Treat-Prevent-Build” (DTPB) model of the National Strategic Plan 2017–2025

NTEP approach	Technique adopted
<p>1. DETECT: Find all DS-TB and DRTB cases with an emphasis on reaching TB patients seeking care from private providers and undiagnosed TB in high-risk populations.</p>	<ul style="list-style-type: none"> • Scale up free, high-sensitivity diagnostic tests and algorithms. • Scale up effective private provider engagement approaches. • Universal testing for drug-resistant TB. • Systematic screening of high-risk populations.
<p>2. TREAT: Initiate and sustain all patients on appropriate anti-TB treatment wherever they seek care, with patient-friendly systems and social support.</p>	<ul style="list-style-type: none"> • Prevent the loss of TB cases in the cascade of care with support systems. • Free TB drugs for all TB cases. • Universal daily regimen for TB cases and rapid scale up of short-course regimens for drug-resistant TB and DST-guided treatment approaches. • Patient-friendly adherence monitoring and social support to sustain TB treatment. • Elimination of catastrophic costs by linkages of eligible TB patients with social welfare schemes, including nutritional support.
<p>3. PREVENT: Prevent the emergence of TB in susceptible populations.</p>	<ul style="list-style-type: none"> • Scale up air-borne infection control measures at health care facilities • Treatment for latent TB infection in contacts of bacteriologically-confirmed cases
<p>4. BUILD: Build and strengthen-enabling policies, empowered institutions, and human resources with enhanced capacities.</p>	<ul style="list-style-type: none"> • Address social determinants of TB through intersectoral approach • Translate high-level political commitment to action through supportive policy and institutional structures. • National TB Elimination Board with four divisions instead of the current administrative set-up at the national level—TB elimination efforts to be implemented in a “Mission mode.” • National TB Policy and Act • Restructure RNTCP management structure and institutional arrangement. • HR reforms to include unified state-level contractual supervisory cadre (merger of STS/STLS) and dedicated staff for TB surveillance network in the country. • Build supportive structures for surveillance, research, and innovations, and a cafeteria approach of interventions based on local epidemiological situation. • Reforming STDCs and expand the role of medical colleges to include surveillance and function as centers of excellence (COEs). • Redefining the role of National institutes (NTI, NRTI, etc.) to encompass the burgeoning requirement for evidence to support policy advice. • Scale up technical assistance at national and state levels. • Align and harmonize partners’ activities with program requirements to prevent duplication.

Source: Government of India, Director General Health Services (2017).

Notes: DS-TB: Drug Sensitive Tuberculosis; DRTB: Drug Resistant Tuberculosis; STDC: State TB Training and Demonstration Centre; STS: Senior TB Treatment Supervisor; STLS: Senior TB Laboratory Supervisor; RNTCP: Revised National Tuberculosis Control Programme

microscopy, as NAAT can detect TB more accurately (Kohli, MacLean, Pai, & Denking, 2021). TrueNat MTB is a battery-operated diagnostic tool that detects pulmonary TB, extra-pulmonary TB, and rifampicin-resistant TB, and helps to reduce delay in diagnosis and having early treatment.

Future Directions

Tuberculosis remains one of the most disreputable infectious diseases in spite of being preventable and curable. According to WHO, more than 4100 people die every day because of TB. The Global Tuberculosis Report 2021 indicates that with almost 26 lakh TB patients, India accounts for 26 percent of global and multi-drug resistant TB cases. Crucial interventions are required to minimize impact of the COVID-19 pandemic on TB and steer the goal toward achieving laid targets. It is essential to ensure the continuity of TB diagnostic services, notification, treatment, and prevention services during COVID-19. Protection against economic upheavals, isolation, stigma, and discrimination is also required to be a part of solid advocacy. NTEP is also required to secure human and financial resources commanded to prioritize the continuation of TB services during the COVID-19 disruptions.

The recently conducted national TB survey in India (2019–2021) reports that more than three persons per 1000 had active TB infection (Government of India, MOHFW, (2021), which is much higher than WHO's 2020 estimate of 1.8 persons per 1000 active infection cases. Delhi recorded the highest number of TB patients in India, with over 5 patients per 1000 persons. In India, the highest thrust of TB is carried by people aged 15–45 years. Keeping its youth healthy is crucial for a country with a population that has substantial potential to contribute immensely to its social and economic stock. This wide age group is highly connected through social media, accounting for more than 50 percent user base in India. By effective usage of the Internet, social media platforms can be used as advocacy instruments to prevent, track, and treat TB among the youth and other population groups.

Technology and online medicine practice have been in use in India for some time now. Telemedicine in India has come a long way in establishing programs such as Integrated Disease Surveillance Project (IDSP), National Rural Telemedicine Network connecting to about 45 remote and rural hospitals, and Village Resource Centres (VRCs) providing space-based services in the rural areas. These interventions provide tele-education, online decision support, and telemedicine (Chellaiyan, Nirupama, & Taneja, 2019). Artificial Intelligence (AI)-based testing tools and telemedicine have reduced travel costs and increased access to healthcare. The Ayushman Bharat Digital Health Mission (ABDM) has enabled a digital infrastructure through exchange of health information, open standards, and a national health information network. The Nikshay portal monitors and transfers funds for nutrition to patients and other stakeholders, including

healthcare workers, to encourage screening, treatment, and notifications to eradicate TB. COVID-19 has forced us to rethink our priorities and the way of working. Using technology to combat TB could be the one way of tackling the disease.

The global health community has now, more than ever, recognized the social determinants of health, that is, the factors apart from medical management that influence social and economic development. WHO defines social determinants of health (SDH) as “the conditions in which people are born, grow, live, work and age and the wider set of forces and systems shaping the conditions of daily life.” Research demonstrates a strong relationship between socioeconomic factors and health outcomes. Poverty reduction and social protection are major components of the End TB Strategy. A modeling investigation has revealed that enrolling individuals in social protection schemes and reducing poverty could help lower incidence of TB by 84.3 percent (Carter et al., 2018). However, the COVID-19 pandemic has disrupted the social determinants, leading to worsened health inequalities. The pandemic has pushed disadvantaged populations further into poverty, compromised food security, interrupted education, increased gender inequality, and overwhelmed health systems (WHO, 2021). Distorted social determinants of health could have generational effects even after a pandemic has subsided. Integrating social development factors into pandemic and disaster preparedness and response should be essential in policy planning and development that ensures social justice at its core.

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