Chapter

1

What is the Current Epidemiology of Tuberculosis?

Sriram Selvaraju • C Padmapriyadarsini

1. How are estimates of TB burden measured by WHO or any country?

The common measures of TB burden used by WHO or any country are TB incidence, and TB mortality.[1]

- There are four main methods used to derive TB incidence: (i) Results from TB prevalence surveys, (ii) notifications in high-income countries adjusted by a standard factor to account for under-reporting and underdiagnosis, and (iii) national inventory studies, (iv) case notification data combined with expert opinion about case detection gaps.
- Mortality is obtained from national vital registration systems of mortality surveys, where available. In other countries, mortality is derived indirectly from multiplying estimates of TB incidence by estimates of the case fatality rate (CFR).
  (*Ref:* Methods used by WHO to estimate the global burden of TB disease, 2022)

2. What is the estimated burden of TB in India?[2]

- The prevalence of microbiologically confirmed TB in India for all forms of TB was 312 (286–337) in 2021.
- The TB incidence in India was 196 (95% CI 171–228) per 1,00,000 in the year 2022 resulting in a total of 27.7(24.2–32.3) lakhs TB patients (Mandal et al.).
- The TB mortality in India was 23 (95% CI 16–33) per 1,00,000 in the year 2022 resulting in a total of 3,20,000 (95% CI 230,000–4,70,000) TB deaths.

3. Explain briefly about the last National TB Prevalence Survey in India.

- The National TB Prevalence Survey in India was conducted from 2019 to 2021[3] to know the actual disease burden of TB at a national level. The survey estimated the point prevalence of microbiologically confirmed pulmonary tuberculosis (MCPTB) among persons ≥15 years of age in India. It was a population-based cross-sectional study, done across India except Andaman and Nicobar islands and Lakshadweep islands. In this survey, the prevalence of MCPTB ≥15 years of age was 316 per lakh population (95% CI: 290–342) in the country and varied from 151 per lakh (Kerala) to 534 per lakh (Delhi). The prevalence of all forms of TB for all ages in India was 312 per lakh population (286–337) for the year 2021.

4. What is the prevalence to notification ratio (P : N)? What is P : N ratio in India?[4]

- The P : N ratio is a critical parameter to evaluate how effective a state or nation is at detecting and notifying TB cases. The ratio informs about for each case notified, how many TB cases go undetected, and quantify the extent of underreporting of people diagnosed with TB to national authorities The higher the ratio, the more the number of cases that are being missed out. P : N ratio can help to inform the development or improvement of TB case findings, diagnosis, and treatment interventions.
- The P : N ratio for India is 2.84 (2.61–3.07) for 2021.

5. What is the prevalence of TB infection in India?

The prevalence of TB infection among the population ≥15 years of age is 22.6% (95% CI:19.4 –25.8).

6. What are the 5 most important risk factors for TB in India?

As per the recently completed National TB Prevalence Survey, the most important risk factors for TB in India are:

- Undernutrition
- Elderly
- Past history of TB
- Smokers
- Diabetics

7. What is differentiated care for TB in India? How can it reduce mortality?

- Differentiated care for TB is a strategy, where triaging of TB patients happens at diagnosis based on the severity of the TB disease.[5] This identifies patients with very severe undernutrition, respiratory insufficiency, or poor performance status or those with a high-risk of severe illness at the time of TB diagnosis and prioritizes comprehensive assessment and inpatient care.
- As most TB deaths occur within 2 months (early deaths) and half of early deaths happen within the first 2 weeks of diagnosis, assessment mandates a quick decision at diagnosis. This strategy reduces TB mortality by providing an opportunity for (i) reducing the delay in referral, and (ii) increasing the chances of survival by offering interventions for severe disease during inpatient care.

8. What is a TB care cascade?

The cascade of care is a model for evaluating patient retention across sequential stages of care required to achieve a successful treatment outcome.[6] In the model shown below, for the TB care cascade, each cascade stage contains a step (i.e. the absolute number of individuals achieving a point in care) and a gap (i.e. the difference between steps, representing individuals with suboptimal outcomes).

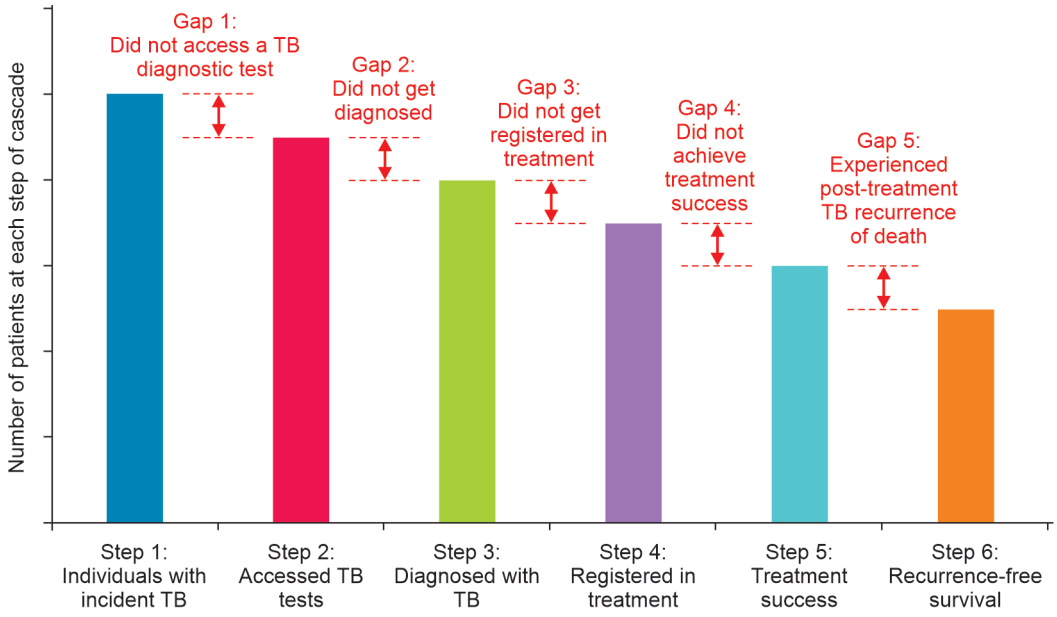

Fig. 1.1: TB care cascade

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Chapter

2

What is meant by TB Elimination?

Sanjeev Nair

Until recently, the global TB community was discussing TB control, which is breaking the chain of transmission by detecting infectious cases of TB early, and treating them successfully, so as to prevent new infections from occurring in the community.

Now the Global TB Community has also started discussing TB elimination.

Generally, in the case of infectious diseases, the hierarchy of potential public health efforts is as follows:[1]

- *Control:* "The reduction of disease incidence, prevalence, morbidity or mortality to a locally acceptable level as a result of deliberate efforts".
- *Elimination of disease:* "Reduction to zero of the incidence of a specified disease in a defined geographical area as a result of deliberate efforts".
- *Elimination of infections:* "Reduction to zero of the incidence of infection caused by a specific agent in a defined geographical area as a result of deliberate efforts".
- *Eradication:* "Permanent reduction to zero of the worldwide incidence of infection caused by a specific agent as a result of deliberate efforts".
- *Extinction:* "The specific infectious agent no longer exists in nature or in the laboratory."

In the context of TB, WHO has also come out with a document, "Framework for the Elimination of TB in low burden countries". As per this framework, countries with an incidence of <100 cases/million should progress towards "pre-elimination" (defined as <10 cases of TB per million) and once pre-elimination is achieved, move towards TB elimination (defined as <1 TB case per million population).

The End TB targets for 2035 for the world are to reduce the incidence by 90%, which would reduce the incidence from a projected baseline of 110/100,000 to <10/100,000 by 2035. Often, this "target" is mistaken to mean "TB elimination", which is wide off the mark, as TB elimination is <1/1,000,000.

India currently has a notification rate of 172 TB cases/lakh population (1720 cases/million) in 2022 (WHO estimates for incidence in India was 210 cases per lakh population for 2021), hence the "framework for the elimination of TB in low burden countries" does not apply for a country like India. Even if India reduces its incidence by 90%, it will only reach a level of about 20/100,000, which is 200 per million, quite far from "TB elimination" (as defined by WHO, <1/million).

Chapter

3

What are the Goals of End TB Strategy?

Sanjeev Nair

Global TB strategies have been evolving. In the 1990s we had the DOTS strategy; and from 2006 to 2015, we had the Stop TB strategy. The current strategy, which started in 2016, is called the End TB strategy. This has been adopted by our country too.

The End TB strategy has a vision of a world free of TB with zero deaths, disease and suffering due to TB. The goal of this strategy is to end the global TB epidemic. For achieving the goal, there are various components to the strategy, listed under three "pillars".

Pillar 1. Integrated, patient-centered care and prevention

- Early diagnosis of tuberculosis including universal drug-susceptibility testing, and systematic screening of contacts and high-risk groups
- Treatment of all people with tuberculosis including drug-resistant tuberculosis, and patient support
- Collaborative tuberculosis/HIV activities, and management of co-morbidities
- Preventive treatment of persons at high-risk, and vaccination against tuberculosis.

Pillar 2. Bold policies and supportive systems

- Political commitment with adequate resources for tuberculosis care and prevention
- Engagement of communities, civil society organizations, and public and private care providers
- Universal health coverage policy, and regulatory frameworks for case notification, vital registration, quality and rational use of medicines, and infection control
- Social protection, poverty alleviation, and actions on other determinants of tuberculosis.

Pillar 3. Intensified research and innovation

- Discovery, development, and rapid uptake of new tools, interventions, and strategies
- Research to optimize implementation and impact, and promote innovations.

To ensure that the goals are met, the strategy has set milestones and targets, as follows.

	Milestones			*Targets*
Indicator comparing with baseline of 2015	2020	2025	2030	2035
Reduction in deaths due to TB	35%	75%	90%	95%
Reduction in TB incidence	20%	50%	80%	90%
Proportion of families facing catastrophic costs	Zero	Zero	Zero	Zero

Chapter

4

What is the Holistic Approach towards End TB Strategy followed in India?

Sanjeev Nair

India is committed to achieving the End TB strategy targets, if feasible, earlier than the current periods set for the targets by WHO. The country has planned a multipronged, holistic approach towards achieving the goals. The strategy is planned under four headings:

1. Build, strengthen and sustain
2. Detect
3. Treat
4. Prevent

The sub-components planned for each of these strategic arms are as follows.

Build

1. Adequate funding support for NTEP—the program is being helped by strong political and administrative commitment and adequate funding is being made available
2. Multi-sectorial collaboration—collaboration with other programs as below is being strengthened. This is mainly to address the determinants of TB disease
   a. National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke
   b. National Tobacco Control Programme
   c. National AIDS Control Programme
   d. Ayushman Bharat—with special focus on the health and wellness centres
   e. Rashtriya Bal Swasthya Karyakram and Rashtriya Kishor Swasthya Karyakram to give special attention to children
   f. POSHAN abhiyaan—to improve nutrition, malnutrition being the biggest driver of the TB epidemic in India
3. Private sector involvement: Particular focus is being placed on involving all healthcare providers, with special emphasis on involving the private sector
4. Corporates to be involved to support the efforts to End TB
5. Incentives for informants, treatment supporters and patients
6. System for surveillance, monitoring and evaluation—strengthening the digital information system—NIKSHAY
7. Endowering and engaging communities—focus on human rights and gender
8. Strengthening procurement and supply chain management

9. Technical support networks
10. Promoting research

Detect

1. Improved diagnosis through a revised diagnostic algorithm, which suggests upfront nucleic acid amplification tests (NAAT) testing and improved coverage of diagnostic centres
   a. A network of laboratories has been established and more labs are being added—about 5000 NAAT labs have been established in the country with plans to increase the number to one per block (about 8000 NAAT labs)
2. Improved access to chest X-rays for diagnosis of TB
   a. AI for chest X-ray reading
   b. Mobile/portable chest X-rays
3. Active case finding
   a. Focus on vulnerable population—vulnerability mapping of population and regular follow-up of vulnerable population and preventive therapy
   b. Intensive case finding in health facilities
4. Strengthening case finding in private sector
   a. Mandatory notification of TB
   b. Implementation of schedule H1
   c. Patient provider support agencies for improving program implementation in private sector (e.g., TB JEET)
   d. Partnership schemes to involve private sector.

Treat

1. Fixed dose combination (FDC) based treatment for drugs suspectable TB
2. Access to newer drugs and newer regimes: Shorter regimes for drug resistant (DR TB)—bedaquiline containing oral regimes
3. Improve access to treatment, particularly for DR TB, in private sector

Prevent

1. Implementation and strengthening of TB preventive therapy (TPT)
2. Fast tracking implementation of new vaccination strategies for TB
3. Reduction of vulnerabilities for TB in community
   a. Malnutrition
   b. Alcohol/tobacco abuse
   c. Non-communicable diseases—diabetes, COPD, chronic kidney disease, etc.

Chapter

5

What are the Reasons for Mortality in TB?

Sridhar Ratinam • V Vinod Kumar

Study of mortality data is an indicator of the effectiveness of healthcare delivery systems. It is also needed for long term planning to cut down the mortality.

The United Nations sustainable development goals include ending the TB epidemic by 2030 and targets reduction in TB deaths by 90% in 2030.[1] Understanding of mortality data due to tuberculosis will aid us to achieve this target.

According to WHO, globally 1.6 million lives were lost to TB in 2021, with 36% of these deaths from India alone.[1]

Studies were done at the Government Hospital of Thoracic Medicine, Tambaram Sanatorium, Chennai[2,3] which is a centre of excellence for the treatment of all forms of tuberculosis including drug-resistant TB, and also for HIV treatment on mortality due to tuberculosis.

The majority of deaths due to tuberculosis was in males (87%) in the productive age group of 20 to 60 years (89%) leading to socioeconomic loss to the community. Also, our studies revealed that mortality was higher in pulmonary tuberculosis (91%) and in sputum-positive patients (75%) and the majority of deaths were in drug-sensitive patients (92%). Studies also reveal that mortality is higher in seriously ill forms of tuberculosis like meningitis and in association with immunosuppressive illnesses like diabetes and HIV coinfection.

Our studies revealed higher mortality in newly diagnosed patients (48%) and within the first week of admission (59%) reflecting the late referrals and delayed diagnosis in such patients. The higher mortality among patients with lower saturation and the predominant cause of death being respiratory failure reflects the destruction of pulmonary parenchyma due to tuberculosis. Other pulmonary causes of death included haemoptysis and ARDS.

Among HIV patients both pulmonary and extrapulmonary tuberculosis equally contribute to the mortality.

Our studies show that timely detection of tuberculosis and initiation of ATT would have prevented 48% of tuberculosis deaths and elimination of HIV could have prevented 25% of TB deaths. Adequate control of diabetes mellitus could have prevented another 28% of TB-associated deaths.

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