State of the Globe: Computed Tomography and Bronchoscopy for Improved Diagnosis of Tuberculosis in India

The Central Tuberculosis Division (CTD) of India released its “National Strategic Plan (NSP) for Tuberculosis (TB) Elimination 2017–2025” in March 2017.[1] The goal of this NSP is to achieve a rapid decline in the burden of TB morbidity and mortality while working toward the elimination of TB by 2025.[1]

The approach of NSP revolves around four pillars Detect–Treat–Prevent–Build.[1] Out of these, the most important pillar is the early detection of TB cases and their drug sensitivity status. This can be achieved by scaling up diagnostic tests and algorithms that have high sensitivity and are freely available to the public. In addition, universal testing for drug-resistant TB is an integral component of the “Detect” pillar.[1] In 2021, out of all new TB patients, 23% were diagnosed using smear microscopy, 21% using molecular diagnostic methods, 35% using chest X-rays, and 20% using other methods.[2]

In the current issue of this journal, an article by Yadav et al. has estimated the costs per test for Ziehl–Neelsen microscopy, fluorescent microscopy, line probe assay (LPA), cartridge-based nucleic acid amplification test (CBNAAT) assay, solid culture plus drug sensitivity testing (DST), liquid culture plus DST to be $2.5 (INR 156.8), $2.0 (INR 128.9), $18.6 (INR 1210), $13.8 (INR 895.2), $21.5 (INR 1396.6), and $29.1 (INR 1888.2), respectively.[3] The NSP already has in place the algorithms that take into account the costing analysis of various tests and judicious use of microscopy, molecular diagnostics, and culture-based methods.[1]

For diagnosing TB, CBNAAT has the highest positivity rate at 29.5%, followed by TRUNAT at 20.5%, but these two are costlier than smear microscopy and are available at limited sites in India. The smear microscopy still remains the backbone of TB diagnostics in India with a positivity rate of 6.8% [Table 1]. Detection of resistance for anti-tubercular drugs was highest with LPA (17.4%), followed by CBNAAT (10%) and TRUNAT (4.8%). LPA is undoubtedly the best test to diagnose drug resistance but it is also costlier than NAAT.[3]

NSP has recommended diagnostic algorithms keeping in mind the availability, accessibility, and costing of various tests for diagnosis and drug-resistance testing of TB samples. Most algorithms start with sputum microscopy, followed by either CBNAAT or TRUNAT for smear microscopy negative samples. For smear microscopy positive samples, LPA is a better option to diagnose drug resistance looking at its higher yield compared to CBNAAT or TRUNAT [Table 1].

To strengthen the “Detect” pillar, the National TB Elimination Program has expanded its free of cost TB diagnostic facilities tremendously in the past decade and it now has six national reference laboratories, 34 intermediate reference laboratories (state level), 58 culture and drug sensitivity laboratories (medical college level), 3760 nucleic acid amplification test laboratories, and 21,820 designated microscopy centers in India.[2]

The NSP target for estimated mortality due to TB per 100,000 population was 15 and 6 for 2020 and 2023, respectively.[1] As per the annual TB report released by the CTD in 2022, the actual numbers for estimated mortality due to TB in 2020 were 37 per 100,000 in India, which is even higher than 32 per 100,000 in 2015.[2] The prevalence of TB in India in 2021 was at 312 per 100,000 population against a target of 32 per 100,000 in 2015.[2] Unfortunately, despite the best efforts, the numbers are not very encouraging at the moment for the TB elimination program in India.

There is no doubt that the TB program in India is working at its best with enough funding and workforce. Having said that, despite the availability of free of cost smear microscopy, molecular diagnostics, culture-based diagnostics, anti-TB drugs, treatment adherence support mechanisms, monetary incentives to patients for nutrition, monetary incentives for private sector TB care providers, active case finding attempts, and TB preventive therapy, the NSP targets have still been elusive for the parameters such as TB prevalence and estimated mortality due to TB in India in 2021.[2]

COVID-19-related disruptions in the TB services can be cited as one of the reasons why NSP was unable to achieve intended targets. The health system has been stressed with

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**Table 1: Performance statistics of various tests used for diagnosis of tuberculosis and drug resistance in India in 2021**[2]

| Diagnostic test         | Numbers tested | Positive (%) |
|-------------------------|----------------|--------------|
| Smear microscopy        | 8,279,066      | 564,097 (6.8)|
| CBNAAT                  | 1,434,124      | 423,421 (29.5)|
| TRUNAT                  | 2,197,757      | 450,304 (20.5)|

| Resistance test         | Numbers tested | Resistant (%) |
|-------------------------|----------------|---------------|
| CBNAAT                  | 423,421        | 43,493 (10)   |
| TRUNAT                  | 450,304        | 21,927 (4.8)  |
| LPA                     | 311,399        | 53,403 (17.14)|

CBNAAT: Cartridge-based nucleic acid amplification test, LPA: Line probe assay
COVID-19-related activities over the past 2 years and this may have generated some fatigue among the workers involved in TB care. We believe that the TB program of India is at a crucial juncture where a lot of funding has been vested in TB elimination-related activities including infrastructural advancements and therefore any possibility of physician and health-care worker fatigue and complacency can be a real danger to the program.

It is also noteworthy that 55% of all TB patients in 2021 were diagnosed clinically, without a microbiological confirmation proving thereby, that investment alone will not help achieve targets envisioned in the NSP.\(^1\) In view of this evidence, and at a time when we are aiming to eliminate TB from the country, NSP not finding mention words such as computed tomography (CT) and bronchoscopy (in relation to X-ray) in the armamentarium of diagnosis (Detect) appears to be the missing link.\(^1\)

In the current situation of the COVID-19 pandemic, there is a high likelihood of COVID-19 patients being misdiagnosed as TB patients based on chest X-rays. Although there is a long list of other differentials for chest X-ray findings such as cavitary lesions, pleural disease, mediastinal lymphadenopathy, and even miliary shadows, NSP does not include in its algorithms the need for CT scan and bronchoscopic lavage to confirm TB in patients with suspicious lesions on chest X-ray needs attention.\(^1,4\) A more comprehensive, open, and all-inclusive approach may help. The fact that 746,913 (35%) patients were diagnosed with TB based on chest X-rays alone accounting for one-third of all new TB patients, emphasizes this further.\(^2\) Facilities of bronchoscopy and CT scan are available in all medical colleges in India as they are essential requirements per the National Medical Commission.

Correct identification of TB cases can surely prevent a lot of resources from being wasted on wrongly diagnosed TB. We believe that the NSP needs to map and integrate all the available bronchoscopy and CT scan centers in India and judiciously utilize them to achieve a correct diagnosis for clinically diagnosed cases, especially in the setting of the ongoing COVID-19 pandemic.

To conclude, NSP needs to be commended for the strengthening of microbiological diagnostics all over India and further efforts are ongoing. Simultaneously, the magnitude of patients diagnosed on chest X-rays alone (35% of all TB) makes it imperative to adopt better radiological diagnostic criteria for TB. All 600+ Medical Colleges of India, roughly one per district, should be entrusted with the responsibility of using their CT scans and Bronchoscopy services for this purpose.

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