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COVID-19 pandemic has affected TB case detection and continuity of care globally. Kerala, the southern Indian state has experienced a reduction in TB notification during second and third quarter of 2020. Through (1) causal analysis (2) meticulous planning and establishment of systems (3) locally customised guidelines (4) better management of resources (5) integration with other programs and (6) good partnership with private sector, Kerala was able to catch up the TB notification and ensure that TB services remain intact even during the COVID-19 pandemic. Approach to catch up TB diagnosis included (1) Field based active case finding among the vulnerable individuals, (2) bilateral screening for TB and COVID-19, (3) enhancement of biosafety in laboratories, (4) strengthening of specimen collection and transportation systems, (5) targeted advocacy and communication to find out missed cases and (6) effective partnership with the private sector.

Current experiences also show that TB case finding could be improved and delay in diagnosis could be averted by integrating TB case finding into the screening and testing systems established for COVID-19. The experiences of ensuring TB services during pandemic in Kerala also affirms the importance of maintaining an integrated and strong TB control component in the public health sector and vesting ownership of the TB control programme with the primary health care team. Community-based and community-led responses that take diagnosis, care, and support to the doors of those affected have much potential in delivering TB services in the subsequent years of pandemic.

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1. Introduction

COVID-19 has challenged health systems and restricted essential health service delivery. Health system infrastructure, from diagnostic tools to the workforce, has pivoted towards COVID-19 and away from competing priorities, including tuberculosis. Health-care access has been constrained due to many reasons including lockdowns, redeployment of health staff, polyvalent molecular diagnostic platforms, health program management processes and fear to access health. Nine of the countries with the most tuberculosis (TB) cases—representing 60% of the global TB burden—saw a drastic decline in diagnosis and treatment of TB infections in 2020, ranging from 16% to 41%.1

2. Local setting

Kerala, the southern Indian state has made remarkable progress in improving the people’s health as evidenced by a higher life expectancy and a lower infant mortality rate.2 Primary health care delivery system is well established with a primary health centre manned by a modern medicine practitioner for every 25,000 population. For every 5000 population, there are two multi-purpose health workers and for every 1000 population there is a community health volunteer (ASHA). TB Program is well integrated with the primary health care delivery. Experiencing a 7.5% annual decline in the incidence TB, state has notified 72 TB cases per 100,000 population in 2019.3

To flatten the Covid-19 incidence curve, India has locked down the country from 25th of March 2020 to 31st of May 2020. Kerala state which reported the first COVID-19 case in India, had 22,314 cumulative confirmed cases per million population by Dec 31, 2020. Peak of COVID-19 pandemic in the state was in October 2020 (260 cases per million per day).4

Government of Kerala has issued advisory, which was a locally customised version of advisory by NTEP (National TB Elimination Program), as early as on April 2020 and established system to ensure that all services to the TB patients remains uninterrupted during and after the lockdown.5 All TB laboratory staff were provided with adequate additional personal protective equipment. Extra efforts were taken by the health system to deliver the services for TB patients at their door steps including medicines for TB and co-morbidity management, providing proactive fortnightly clinical reviews through tele consultations and ensuring public health actions including offering Rifampicin sensitive testing at baseline, TB Preventive Therapy to the eligible household, contact investigations, Direct Benefit Transfer of INR 500 (7USD). All TB related activities were monitored daily through NIKSHAY- a case-based patient management system through the e-platform.6

3. Problem

While all services to the diagnosed TB patients were ensured, Kerala experienced a reduction in TB notification during lock down period (82% of estimated cases notified in second quarter Vs 99% of estimated cases notified in the first quarter). A more severe reduction in TB notification was observed during the period when the COVID-19 cases started increasing rapidly (76% of estimated cases notified in third quarter). An unusual delay in diagnosis of TB was reported by clinicians as some of the cases presented to the health facilities with haemoptysis and chest x-rays revealing cavity.

4. Approach

Causal analysis was done for non-improvement in TB notifications through 10 key informant interviews with primary health care providers and middle level program managers. Identified problems and suggested solutions were listed in Table 1. Based on the potential solutions, an action plan was prepared to catch up the TB notification in Kerala. The approach included.

4.1. A field-based active/intensified TB case finding

a) Active Case Finding among Individuals with high vulnerability to TB & COVID: Individuals who are vulnerable to develop TB (Contacts of TB, Past history of TB, Diabetes Mellitus, Chronic Smoker, Chronic alcoholic, Elderly, Bed ridden, Chronic Renal Diseases, those on immunosuppressive drugs) were mapped earlier through a door-to-door survey. List of individuals with high vulnerability to develop TB in their field area were maintained at every primary health centre. Individuals with high vulnerability to develop TB were contacted directly/over telephone by the community health volunteer and screened for TB using the 4-symptom complex (4S = cough >2 weeks, fever >2 weeks, weight loss, night sweats). Since such individuals were also vulnerability for severe COVID-19, TB active case finding happened along with ensuring reverse quarantine for COVID-19. Reverse quarantine was ensured by the primary health care team by provide proactive care to the vulnerable individuals including counselling, education and delivering their essential medicines at door steps. All inmates of elderly homes and persons receiving palliative care were also screened for TB with the help of elderly care program and palliative care program.

b) Bidirectional screening for COVID-19 and TB - State had developed a COVID-19 surveillance system — universe being all individuals at risk for developing COVID-19. All such individuals have been contacted by the primary health care team daily for symptom surveillance. In addition to that, individuals presenting directly to a health facility with Influenza Like Illness/Severe Acute Respiratory Infection (ILI/SARI) symptoms were tested for COVID-19. Details of the tests were entered in a real time e-platform based management information system.

In the universe eligible for COVID-19 testing, the following actions for screening and testing for TB were taken7

a) ILI in a person with any vulnerability to develop TB were tested for TB.
b) Covid negative ILI were followed up after 10 days over telephone/direct visit to screen for 4S by the primary health care team. If the symptoms persisted for >14 days, TB test was done.

c) Individuals with SARI were screened for 4S. Those requiring hospital admissions were screened using Chest X ray.

d) Confirmed COVID-19 patients were screened for 4S and COVID-19 patients requiring hospital admissions were screened using Chest X rays.

All those screened positive with any one criterion in 4S or any abnormality in Chest Xray were tested for TB with an upfront molecular test with GeneXpert (Cephid, US)/Truenat (Molbio Diagnostics, Verna, India) closed nucleic acid amplification platforms.

4.2 Biosafety enhancement of laboratories

In addition to 43 molecular Nucleic Acid Amplification testing (GeneXpert/Truenat) machines provided by NTEP, 32 new machines were purchased. All molecular test machines were installed in laboratories equipped with Biosafety Class II A2/B2 cabinets. Seventy-five such public laboratories (1 per 400,000 population) were set up for performing bilateral tests for TB and COVID-19. Referral linkages were revised to improve testing turnaround times and result reporting. Human Resources were redistributed to run all the machines for an average of 12 hours a day.

4.3 Strengthening specimen collection and transportation system

Specimen collection and transportation system was established in a hub and spoke model from every village. The transportation mechanisms were locally customised to each setting-by human carriers or dedicated vehicles transporting to concerned hubs. Through the system, samples for COVID-19 and TB testing flowed to concerned hubs.

Standard operating procedure for collecting the sputum samples from home was prepared. 2-hour online training module was prepared with interactive videos and presentations. All category of staff including community health volunteers were trained.

Equipment for collection, packing and transporting were also locally developed with a prototype prepared at state level.

4.4 Targeted advocacy and communication to find out missed cases

A strong communication strategy was implemented focussing on all health providers and a separate one on general public. Successful advocacy was done with the managements of private hospitals, leaders of professional medical associations, doctors of other systems of medicines which resulted in bringing TB back to the minds of all health care providers. Innovative social media campaign, short messages by celebrities and opinion leaders, awards to local self-governments, non-financial incentives to health care providers, advocacy by the TB survivors forum were the other key strategies deployed. Non-financial incentives including awards were declared to all category of staff for exceptional work.

4.5 Ensuring partnership with private sector

Through STEPS (System for TB Elimination in Private Sector), the NTEP program was already in partnership with 380 major private hospitals in the state. The policies and ideas were disseminated timely to private sector also. Need for more molecular testing platforms in private sector was advocated for integrated testing of TB and COVID-19. This resulted in an enhanced capacity of molecular testing platforms in private sector with 62 additional GeneXpert/Truenat machines. While some of the major public hospitals were converted to exclusive COVID hospitals, majority of the private sector hospitals remained to provide exclusive non-COVID services. In some areas where public hospitals were offering COVID services, presumptive TB patients requiring detailed evaluation were referred to private hospitals by the field team where free X ray, free NAAT, free specimen collection transportation and free medicines were already being provided by the NTEP.

5. Implementation

Field based case finding efforts started in October 2020. Regular weekly review was done with program mangers at all level facilitating cross learning.

6. Relevant changes

TB notification figures started rising up reaching the estimated target in the month of December 2020. Approximately 87.4% of
the estimated cases were notified in 2020. Trend of month wise TB notifications against the estimated target is shown in Fig. 1. Private sector diagnosed 5795 TB cases in 2020 (4927 in 2019).

A total of 661,470 individuals were screened for TB as part of field-based case finding during October to December 2020, 37,685 presumptive TB cases were identified, 29,166 samples were tested and 802 individuals were diagnosed as TB. This constituted 15% of notified TB in last quarter 2020. Details of field-based case finding were shown in Table 2.

Other public health actions relevant to the diagnosed TB patients remain intact as evidenced by proportion of TB cases who knew their rifampicin resistance status at baseline (63% Vs 58%), proportion of TB patients with known HIV status (91% Vs 87%), household contact tracing visits (85% Vs 61%) and Lost to Follow Up rates (stable at 2%) during 2020 and 2019 respectively.

7. Discussion

Through (1) causal analysis (2) meticulous planning and establishment of systems (3) locally customised guidelines (4) better management of resources (5) integration with other programs and (6) good partnership with private sector, Kerala was able to catch up the TB notification to some extent and ensure that TB services remain intact even during the COVID-19 pandemic.

Screening for TB among those with COVID-19 symptoms and implementing integrated testing for TB and COVID-19 was a bold decision. High political and administrative commitment was the key to take such a bold decision and setting up the necessary systems. Effective leadership also tried to mobilise and coordinate all available resources.

NIKSHAY the case based real time surveillance system of NTEP ensured smooth flow of information without which it would have been difficult to detect the Problem and monitor the impact so meticulously. The experience reiterates the need to have a strong surveillance system for every public health programs to pick up early warning signals and facilitate monitoring during a disaster.

Having not ensured the biosafety of laboratories and infection control systems, the health staff would not have gained confidence to collect and transport specimen and perform tests. Robust specimen collection and transportation system helped in preventing leaks in the cascade. Though the clinicians were apprehensive about the bilateral screening algorithm in the beginning, strong behaviour change communication with involvement of leaders of professional associations, celebrities, owners of private hospitals and social media campaign with clinical experiences by peers gained their trust.

Well-motivated and supported staff took on extra burdens. Such commitments have been witnessed previously also during the time of Kerala Floods. However, current one was a long fight and it was difficult to maintain the motivation due to ‘fatigue’. Building team spirit, highlighting health care

| Category                          | Mapped for Screening (Universe) | Actually screened | Presumptive TB identified | Tested for TB | Diagnosed as TB | Test Positivity Rate |
|-----------------------------------|---------------------------------|-------------------|---------------------------|---------------|-----------------|---------------------|
| Individuals with High Vulnerability to develop TB | 976147                          | 537371            | 30900                     | 23585         | 610             | 2.6                 |
| Palliative Care/Bedridden         | 132800                          | 66156             | 1753                      | 1066          | 37              | 3.5                 |
| Elderly at old age homes          | 19494                           | 15350             | 1743                      | 1226          | 25              | 2                   |
| Influenza Like Illness            | 34417                           | 34417             | 2437                      | 2437          | 69              | 2.8                 |
| Severe Acute Respiratory Illness  | 6176                            | 6176              | 852                       | 852           | 61              | 7.2                 |
workers and volunteers as heroes, non-financial incentives including appreciations and awards, payment of financial incentives on time, effective communication and supportive supervision were attempted. Integration of activities is another solution to minimise effort duplication by the health care staff.

Test positivity was unusually high among SARI. People with SARI are the most likely to seek care from a hospital and have a high probability to get a chest X-ray done. This could be the reason for a higher positivity.

Experiences also show that bilateral screening for TB and COVID-19 is feasible in routine program setting. TB case finding could be improved and delay in diagnosis could be averted by integrating TB case finding into the screening and testing systems established for COVID-19. Process of bidirectional screening for COVID-19 and TB were documented in paper-based systems. Deliberate decision was made to collect only minimal reports to prevent system being overburdened. Incorporating integrated testing details to COVID-19 management information system can facilitate real time monitoring. Analysis of the cost would be essential to make further recommendations.

The experiences of ensuring TB services during pandemic in Kerala also affirms the importance of maintaining an integrated and strong TB control component in the public health sector and vesting ownership of the TB control programme with the primary health care team. Community-based and community-led responses that take diagnosis, care, and support to the doors of those affected have much potential in delivering TB services in the subsequent years of pandemic.

**Conflicts of interest**

The authors have none to declare.

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