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RESEARCH ARTICLE

National Tuberculosis Elimination Program Guidelines and its Relevance to the Indian Population in the Post-COVID-19 Pandemic Era

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ABSTRACT

Introduction: Though tuberculosis was declared a public health emergency in 1993 and the revised national tuberculosis control programme gained momentum soon after, south Asian countries were left with a daunting task in the effective implementation of the control measures. The decades of progress achieved in tuberculosis control and elimination measures were almost wiped off in the last 12 to 18 months of the COVID-19 pandemic, clearly indicating that these measures need to be more structured and resilient. This manuscript focuses on the impact of the COVID-19 pandemic on TB control and also on the measures taken by the Government of India in effectively combating this syndemic.

Tuberculosis and COVID – a synergistic syndemic: The positive trends in tuberculosis elimination strategies observed till 2019 showed a dramatic reversal after the onset of the COVID-19 pandemic. The sharp decline observed in the TB notification rates in 2020 and 2021 showed signs of improvement in the first two quarters of 2022. Biological interactions between tuberculosis and COVID-19 agents, lung parenchymal damage occurring in both diseases, multiple lockdowns, the reduced workforce at tuberculosis notification centres and reallocation of funds to control the new-onset pandemic were some of the reasons for the decline in overall notifications across the globe.

Government goals (post-syndemic) and measures: The National Tuberculosis Elimination Programme initiated a holistic approach to eliminate TB from South Asia by 2030. Innovative strategies like digitalization of service delivery systems, telemedicine consultations and a four-tier hierarchy system resulted in a rise in the number of tuberculosis notifications. Making this campaign a public movement, creating Public Support Groups and propagating an online Nikshay portal for tuberculous notification greatly facilitated efforts to create a tuberculosis-free world.

Conclusions: Despite the COVID-19 pandemic causing a temporary slowdown in the measures to eliminate tuberculosis by 2030, digitalization processes and various innovative strategies have kept disease elimination hopes still alive. The government alone may not be able to accomplish this goal. Combined efforts and collective responsibility from the public, medical and para-medical support staff are imperative in making this dream of a tuberculosis free society, soon a reality.

Keywords: RNTCP, tuberculosis, COVID-19, pandemic, syndemic.

INTRODUCTION

The global Covid-19 pandemic has posed innumerable challenges to all of us. The consistent and sustained reduction in the overall number of tuberculosis (TB) related deaths during the pre-Covid period made us all strongly believe that the TB pandemic might face its very end soon[1]. The first-ever United Nations High-Level Meeting (UNHLM) passed a resolution in 2018 prioritising the TB pandemic, taking measures to bring it to an end soon[2]. The global health community had expected a reduction in the overall incidence by 55% and mortality by 72% by 2025[3]. The United Nations' Sustainable Development Goals (SDG) predicted the ending of the TB pandemic by the year 2030. All of them were optimistic that an appreciable reduction in TB burden appeared a distinct possibility with the current diagnostic innovations and interventional approaches. Though the target set was a bit pushy, the global health communities hailed such an ambitious move. However, the onset of Covid-19 pandemic created a huge dent in the progress of TB control measures as the worldwide lockdown significantly hampered resource allocation and accessibility for the diagnosis, treatment and preventive measures[4].

The Revised National Control Programme (RNTCP) of India, with assistance from the Government of India (GOI), developed an e-platform for a single portal online notification of TB cases, through Nikshay.

Year	Private sector (aimed at)	Public sector (aimed at)	Target (aimed at)	Target achieved	Percentage (%)
2017	896256	1429046	2325302	1525059	66
2018	1426882	1456647	2883529	1998301	69
2019	988375	1883380	2871755	2391838	83
2020	1075910	1923120	2999030	1810908	60
2021	1041580	1952750	2994330	2146557	72
2022 (till Sept 2022)	951740	1828260	2780000	1937493	70

Table 1 - Nikshay Dashboard showing TB notification. (Source: www.nikshay.in, a GOI portal)

The above table, taken from the Nikshay portal illustrates that the pre-Covid period (from 2018 to 2019) observed a sharp rise (14%) in the percentage of targets achieved while a significant (23%) drop was observed in the year 2020. The numbers are yet to catch up with the pre-Covid values. According to a survey conducted in Southern India on the awareness and clinical utility of this web-based TB notification portal, though there were initial barriers observed by the treating physicians, the overall case notification rates and patient load significantly improved with increased utilization of this online portal[5]. Though the case notification numbers are on the rise in 2022, there is still a daunting task ahead for the RNTCP to reach and surpass the pre-pandemic numbers.

STUDY DESIGN, AIMS AND OBJECTIVES

In this manuscript, we review the impact of the COVID-19 pandemic on the morbidity associated with tuberculosis. The study design includes the initiatives taken by the GOI to overcome the hurdles and obstacles faced due to the new-onset COVID-19 pandemic and also summarizes the efforts taken by the Government to accomplish its goal of making this society, tuberculosis free. The aim of this manuscript is to summarize the magnitude of tuberculous burden faced by the Asian countries, especially the Indian sub-continent and also make the readers realize and appreciate the innovative strategies adopted by the GOI. This article is a presentation of the GOI policy programmes and summarizes the efforts taken by the GOI in realizing their goal of a TB-free world by 2030.

TUBERCULOSIS AND COVID-19 – A SYNERGISTIC EPIDEMIC (SYNDEMIC)

The year 2019 witnessed a staggering 10 million individuals developing active tuberculosis. The single most common cause of death was tuberculosis, until when Covid-19 took the centre stage in the latter half of 2020[6]. More than one-fourth of all tuberculosis cases are seen in India. Also, India witnessed more than 44 million Covid-19 cases and recorded more than 500,000 deaths related to the viral illness[7]. This unexpected pandemic further adversely affected those with pre-existing co-morbid illnesses[8, 9]. Over the past two years, tuberculosis and Covid-19 pandemics together (Syndemic) had caused death in more than 5 million people all over the world[10]. The strict regulations including multiple lockdowns, quarantines and social distancing approaches further interrupted and disrupted healthcare services. A community health survey conducted in Western Africa reported a significant drop in the number of cases of

presumptive and confirmed cases of TB after the lockdown was imposed[11]. Also, a major allocation of funding was diverted by various governments to stop the spread of Covid virus transmission, that further added to the misery faced by various TB control organizations. TB notifications were negatively impacted by this syndemic, with the reduced case-finding likely to significantly increase TB-related deaths in the coming years.

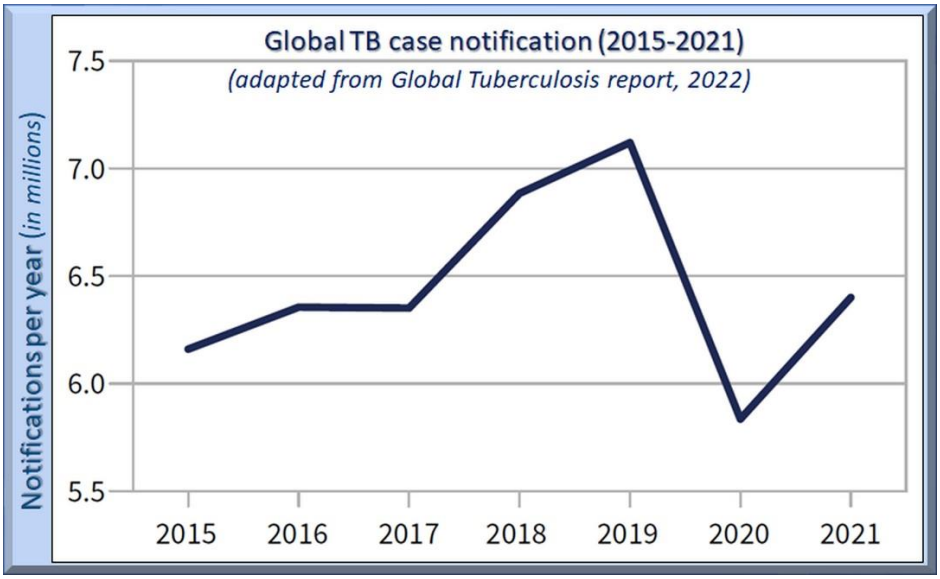

Fig 1. TB notifications per year, before and after the onset of the Covid-19 pandemic (adapted from Global Tuberculosis report, 2022).

The Fig 1 illustrates the TB case notifications that were at their peak in 2019. However, the onset of the COVID-19 pandemic severely dented the notification rates, as evident by a sharp decline in the number of cases notified in 2020. However, as the lockdowns eased a bit, the numbers showed a mild increase in 2021.

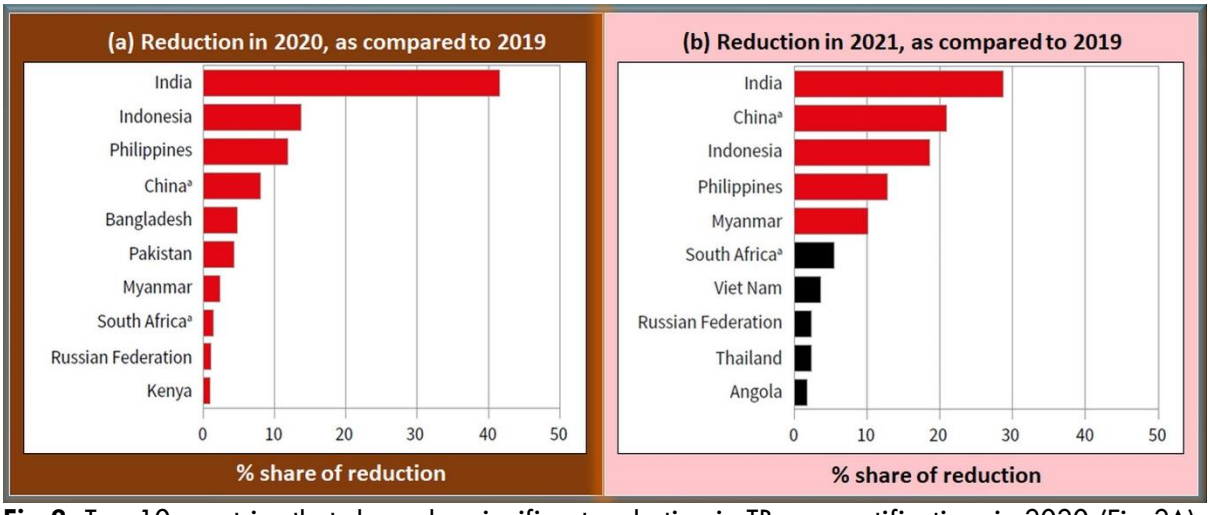

Fig 2. Top 10 countries that showed a significant reduction in TB case notifications in 2020 (Fig 2A) and 2021 (Fig 2B). (adapted from Global Tuberculosis report, 2022).

The Fig 2a summarizes the list of the top 10 countries that accounted for a global reduction in case notifications of people newly diagnosed with tuberculosis in the post-pandemic period. The five countries shown in red in Fig 2b alone account for more than 90% of the reduction in case notifications in 2021.

Biological interaction between the agents causing synchronous and synergistic epidemics, lung parenchymal damage caused by both organisms and service disruption (public fear of reporting to

the health-care facility, reduced workforce at health centres, reallocation of the existing workforce) further added on to the mortality. Prioritization (towards Covid-19) of diagnostic facilities, treatment and support systems also caused more TB-related mortality in this syndemic[12, 13]. However, the learning curve, positive experiences reported in some countries and aggressive approach adopted by a few countries in keeping transmission under control have infused faith and conviction that this syndemic-related impediment could be soon reversed.

GOALS, PRIORITIES AND CHALLENGES OF RNTCP (POST-SYNDEMIC)

Tuberculosis was declared a public health emergency in 1993[14]. Though the National TB control program in India had taken stringent measures to control the spread of TB, the programme gained momentum only after various innovative strategies (categorization of treatment regimens and directly observed treatment) were encouraged by the RNTCP. The emergency declared in 1993 appeared a non-urgent one for the next 15 years, as the targets aimed at did not fully match with the targets achieved. The newer pandemic was declared by the WHO as a Public Health Emergency of International concern in January 2020[15]. The call for "Double down" and "Be more aggressive" campaigns helped the health authorities across the globe contain the virus spread[16]. However, more than 18 months from the start of a global call for control of the COVID-19 pandemic, the time has now come for us to look back, introspect, self-analyse and audit the measures taken by the global COVID-19 control committee and see if those measures can be extrapolated to control the spread of TB pandemic. The RNTCP India had proposed an ambitious plan to end TB by the year, 2025. This deadline is at least 5 years ahead of the proposed global target. The aims of this strategy were not just to reduce the morbidity and mortality associated with TB, but also to ensure that none of the affected families is fraught with catastrophic expenditures due to this disease. With this primary objective in mind, in March 2017, the RNTCP India proposed a National Strategic Plan (NSP) 2017-2025. The NSP has gained further momentum after NTEP joined hands with WHO and carried out the Joint Monitoring Mission (JMM).

However, the Covid-19 pandemic hampered the effective implementation and execution of the strategies. In January 2020, after the Covid-19 pandemic was declared a new health Emergency, to offer additional thrust to the proposed strategies, RNTCP was renamed as National Tuberculosis Elimination Programme (NTEP). The NSP 2017-25 was renamed as NSP 2020-25.

The recommended actions of the NSP 2020-2025 include the following: (i) initiating a TB elimination campaign; (ii) reinforcement of the existing workforce; (iii) stimulating effective community participation and (iv) newer diagnostic facilities for targeted case finding and identification of high-risk group individuals. The online Nikshay dashboard is considered a key step towards TB elimination. Various modelling analyses have projected an additional 6 million new cases of TB would emerge by 2025 and an additional 1.4 million deaths by 2025[17]. Measures and welfare activities were prioritized to get the nation back on track, to the pre-COVID levels. Stop-TB Partnership committee with its partner organizations urged the high endemic nations to adopt provocative initiatives and protect the affected individuals from economic destitution and differentiation.

TUBERCULOSIS ELIMINATION PROGRAMME – the GOI MEASURES

The National Tuberculosis Elimination Programme (NTEP), earlier termed as Revised National Tuberculosis Control Programme (RNTCP), functions intending to tactically diminish the TB burden in India by the year 2025, five years in advance of the SDGs. The RNTCP was renamed the National TB Elimination Program (NTEP) in 2020 by the GOI to eliminate TB in India by 2025. The principal goal of NTEP is to enhance the availability of advanced tools for early diagnosis, with an increased focus on educating the common man and forming effective policies and campaign strategies[18]. According to the WHO report on Global Tuberculosis, released on 27th October 2022, India ranked among the top eight countries that accounted for over 60% of total TB patients[19]. India is also conducting its National Prevalence Survey to assess the true TB burden. The India TB Report, 2022 claimed that India is the only country to have such a survey, mainly through their innovative, 'Coming Together to End TB Altogether' campaigns.

The core theme of World TB Day, 2022 has been "*Invest to End Tuberculosis and save lives*"[20]. The NTEP, a GOI initiative, stresses the need to focus on areas of investment to End TB, thereby saving lives. Reiterating its commitment to end tuberculosis, the GOI initiated a 360-degree holistic approach to eliminate TB by the year 2030. It is therefore imperative to understand that even the slightest degree of distraction in TB case finding could leave a lasting impact in accomplishing their goal of TB elimination by 2030[21]. The GOI also stressed the

need for a collaborative effort from non-governmental organizations and civil society groups to achieve a TB-free world. The healthcare delivery system has undergone a paradigm shift after the onset of the COVID-19 pandemic. Digital technologies are being increasingly used in healthcare delivery systems globally. Electronic medical records and patient consultation using telemedicine and teleradiology for the interpretation of X-rays and axial images have revolutionized the effective management of this syndemic. Lee et al suggested an increasing need for use of digital technology for the effective treatment and elimination of tuberculosis[22]. Digital facilities including service delivery systems, e-pharmacies, telemedicine and artificial intelligence were incorporated into the NTEP.

The Fig 3 illustrates the four-tier system involved in eliminating TB by 2025. The NTEP is accomplished through a four-level hierarchy programme from national to sub-district levels (TB units). The topmost in the hierarchy is the national level, where the programme is coordinated by the Central TB division (CTD) which comes under the Ministry of Health and Family Welfare. The CTD is headed by a Deputy Director General - TB and is the National Program Manager.

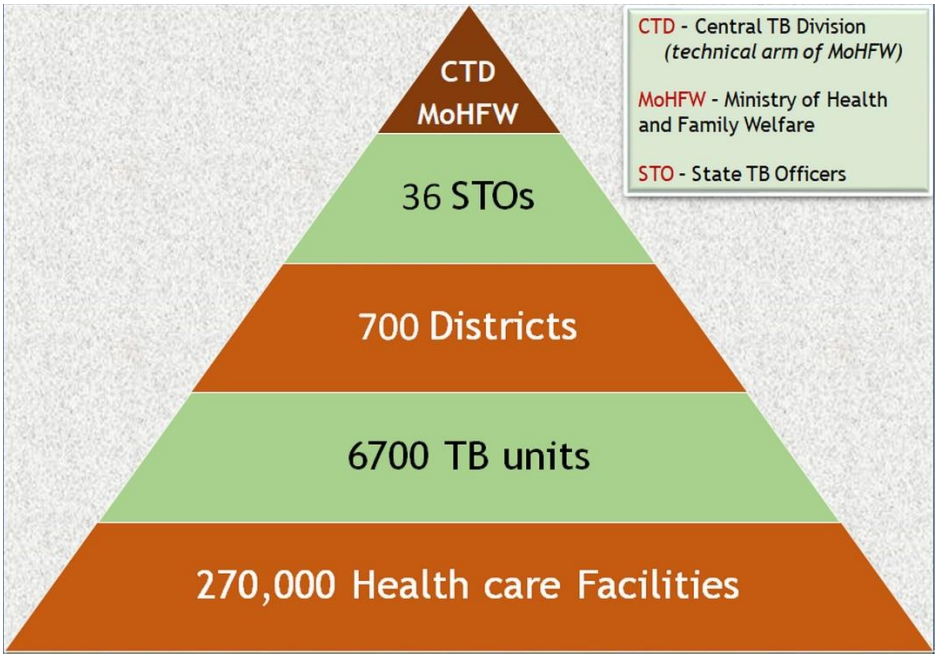

Fig 3: The four-tier hierarchy system of NTEP

Under the CTD, the National Level Expert Committees and National Institutes for Tuberculosis coordinate all TB control measures. The second and third levels in the hierarchy are the state and district level TB officers who oversee and administer the activities of NTEP at the state and district levels respectively. The fourth and last are the sub-district or block-level activities organized by the Tuberculous units.

The NTEP also focused on the need for improving nutritional status for all (thereby enhancing their immunity), organizing various awareness campaign programmes and alleviating fear and social stigma associated with the disease. Enhanced and aggressive screening of children in schools and anganwadis and encouraging the parents to get their children screened for tuberculosis were also integral core components of NTEP, enabling a prompt diagnosis and appropriate treatment[23]. The Ministry of Science and Technology allocated more funds to the fields of disease biology, vaccine development and drug discovery to facilitate the goals of NTEP.

In India, multiple initiatives have been initiated in the last 5 years to guarantee TB elimination. The Ministry of Health and Family Welfare announced that the TB incidence in India in 2021 was 210 per 100,000 population. This is much higher than the baseline year of 2015, where the incidence was 256 per lakh of the population. The year 2021 observed a massive 220 million citizens being screened for TB in India. The Ministry claims that the aim is to detect and diagnose more cases, solely intending to halt further transmission of tuberculosis in the community. This measure was very successful in contributing to the decline in overall incidence. Also, even during the pandemic period, these innovative measures resulted in the NTEP notifying

more than 2 million TB cases[24]. The 'TB Mukth Bharat Abhiyan' campaign was launched by the Honourable President of India, with the sole aim to make it a public initiative (Jan Andolan). This brings more people together for this highly ambitious project. The movement aims to creation of Patient Support Groups (PSGs) that enable easy conversations between patients, caregivers and treating physicians to address various common issues in the diagnosis and treatment of this disease. The Nikshay 2.0 online portal for TB notification and Nikshay Mitra initiative (a patient-centric health system) greatly facilitate the Government's initiatives towards TB elimination by 2030[25].

A revised National Strategic Plan (NSP) was proposed and initiated by India with a plan to end TB by 2025. The NSP urges an intensive collaboration across various ministries of the government to facilitate and endorse a multisectoral approach to eliminate TB by 2025. Through NSP, the NTEP has undertaken various procedural and structural changes, ensuring an agile and healthy response to protect the interests of TB victims and healthcare providers during certain unexpected emergencies[26].

The United States Agency for International Development (USAID), in collaboration with the National Tuberculosis (TB) Elimination Programme set up a joint effort team to facilitate the GOI's initiatives to achieve the goal of a TB-free India by 2025[27].

TUBERCULOSIS FREE WORLD – SOON A REALITY?

Tuberculosis continues to be a relentless menace for many centuries, especially in Asian countries. This mother earth can no longer discount the massive damage already caused by this dreaded disease. India stands as the epicentre of tuberculosis amongst Asian countries, carrying the highest slice of the global TB burden[28]. The World Health Organization (WHO) TB statistics for India for 2021 estimated the overall incidence as 2,590,000 cases, which accounts for 188 cases per 100,000 population. The rising numbers of HIV make it even more difficult to control the spread of tuberculosis. Latent TB is another entity that further adds to the difficulties in diagnosis. About 40% of the Indian population is estimated to be infected with TB bacteria, with a vast majority of them having latent disease without any clinical manifestations[29].

Despite herculean measures taken by the GOI, the Covid-19 pandemic has had an eternal bearing on the transmission of tuberculosis. A significant rise in the number of TB-related deaths is expected in the forthcoming years and a major setback is to be seen in TB control measures[30]. Lancet commission, in 2019, identified five priority areas of investment that must be focused upon, to realise the goals of WHO's Ent TB campaign[31]. These include (i) making available high-quality rapid diagnostic facilities and initiation of prompt treatment wherever needed; (ii) reaching out to populations at higher risk of getting affected by TB and bringing them to care; (iii) increasing the areas of research and therapeutic strategies; (iv) increasing the development assistance for tuberculosis according to the financial needs of the individual patients and making it a shared responsibility and (v) holding all the countries, their administrators and other major stakeholders accountable for the progress made towards eliminating tuberculosis. These five areas of investment were aimed at fulfilling the recommendations of the United Nations High-Level Meeting (UNHLM) on tuberculosis.

The WHO's End TB strategy and the United Nation's SDGs united all their member states to commit themselves to ending this TB pandemic that has been haunting our community for many centuries. The milestones for 2025 and targets for 2030 were formulated[32].

Table 2 illustrates the End TB strategy goals for 2025, 2030 and 2035 [Global TB report, 2022]

MISSION/VISION	TB FREE SOCIETY		
GOAL	End TB Strategy goals		
INDICATORS (compared to 2015 data available)	Milestones	Targets	
	2025	2030	2035
Reduction in overall TB incidence	50%	80%	90%
Reduction in TB-related mortality	75%	90%	95%

The WHO aims at a 95% reduction in overall mortality by 2035 (Table 2). To achieve this goal of a TB-free society by 2035, the annual reduction in overall TB incidence should be aimed at 10% per year by 2025 and increase further by 17% per year from 2025 till 2035. This needs proper planning, effective strategy and appropriate implementation of these strategic measures.

By increasing the Government's responsibility and accountability, facilitating an effective coalition with communities and civil societies, protecting human rights, promoting ethics in treatment,

enhancing the equity of distribution of effective treatment across the community and by calling for global collaboration in setting up strategic goals/targets at national level, the world could witness a TB-free by 2035.

CONCLUSIONS

The last two years have witnessed a slowing down of TB diagnostic service, active TB case detection and TB control measures, emphasizing the growing need for structured planning and effective implementation. Immediate and prompt measures are needed to control and minimize the negative impact of the COVID-19 pandemic on TB elimination measures. For a nation to reach its pre-pandemic statistics and to save the lives of millions of affected individuals, aggressive and proactive measures need to be taken. RNTCP or NTEP alone may not be able to achieve a TB-free India by 2035. Collective responsibility and involvement from various NGOs, and medical and para-medical support teams is the need of the hour, which would greatly facilitate achieving a TB-Free world by 2035.

Author declarations: Authors declare no conflicts of interest

REFERENCES

1. McQuaid CF, Vassall A, Cohen T, Fiekert K, White RG. The impact of COVID-19 on TB: a review of the data. *Int J Tuberc Lung Dis*. 2021 Jun 1;25(6):436-446. doi: 10.5588/ijtld.21.0148.
2. Sahu S, Ditiu L, Sachdeva KS, Zumla A. Recovering from the Impact of the Covid-19 Pandemic and Accelerating to Achieving the United Nations General Assembly Tuberculosis Targets. *Int J Infect Dis*. 2021 Dec;113 Suppl 1:S100-S103. doi: 10.1016/j.ijid.2021.02.078.
3. Houben RMGJ, Menzies NA, Sumner T et al. Feasibility of achieving the 2025 WHO global tuberculosis targets in South Africa, China, and India: a combined analysis of 11 mathematical models. *Lancet Glob Health*. 2016 Nov;4(11):e806-e815. doi: 10.1016/S2214-109X(16)30199-1.
4. Migliori GB, Thong PM, Akkerman O et al. Worldwide effects of coronavirus disease pandemic on tuberculosis services, January-April 2020. *Emerg Infect Dis*. 2020;26(11):2709–12. doi: 10.3201/eid2611.203163.
5. Dey S, Rao AP, Kumar A, Narayanan P. Awareness & utilization of NIKSHAY and perceived barriers for tuberculosis case notification among the private practitioners in Udupi district, Karnataka. *Indian J Tuberc*. 2020 Jan;67(1):15-19. doi: 10.1016/j.ijtb.2020.01.004.
6. Trajman A, Felker I, Alves LC et al. The COVID-19 and TB syndemic: the way forward. *Int J Tuberc Lung Dis*. 2022 Aug 1;26(8):710-719. doi: 10.5588/ijtld.22.0006.
7. Yasobant S, Bhavsar P, Kalpana P, Memon F, Trivedi P, Saxena D. Contributing Factors in the Tuberculosis Care Cascade in India: A Systematic Literature Review. *Risk Manag Healthc Policy*. 2021 Aug 10;14:3275-3286. doi: 10.2147/RMHP.S322143.
8. Guan WJ, Liang WH, Zhao Y et al. Comorbidity and its impact on 1590 patients with COVID-19 in China: A nationwide analysis. *Eur Respir J* 2020; *55*: 2000547. doi: 10.1183/13993003.00547-2020.
9. Huddart S, Svadzian A, Nafade V, Satyanarayana S, Pai M. Tuberculosis case fatality in India: A systematic review and meta-analysis. *BMJ Glob Health* 2020; *5*: e002080. doi: 10.1136/bmjgh-2019-002080.
10. Trajman A, Felker I, Alves LC et al. The COVID-19 and TB syndemic: the way forward. *Int J Tuberc Lung Dis*. 2022 Aug 1;26(8):710-719. doi: 10.5588/ijtld.22.0006.
11. Buonsenso D, Iodice F, Sorba Biala J, Goletti D. COVID-19 effects on tuberculosis care in Sierra Leone. *Pulmonology*. 2021 Jan-Feb;27(1):67-69. doi: 10.1016/j.pulmoe.2020.05.013.
12. Hogan AB, Jewell BL, Sherrard-Smith E et al. Potential impact of the COVID-19 pandemic on HIV, tuberculosis, and malaria in low-income and middle-income countries: a modelling study. *Lancet Glob Health* 2020;8(9): e1132–1141. doi: 10.1016/S2214-109X(20)30288-6.
13. Migliori GB, Thong PM, Alffenaar JW et al. Gauging the impact of the COVID-19 pandemic on tuberculosis services: a global study. *Eur Respir J* 2021;58(5):2101786. doi: 10.1183/13993003.01786-2021.
14. Grange JM, Zumla A. The global emergency of tuberculosis: what is the cause? *J R Soc Promot Health* 2002; 122: 78–81. doi: 10.1177/146642400212200206.
15. Dikid T, Chaudhary S, Goel K et al. Responding to COVID-19 pandemic: Why a strong health system is required. *Indian J Med Res*. 2020 Feb & Mar;151(2 & 3):140-145. doi: 10.4103/ijmr.IJMR_761_20.
16. Cucinotta D, Vanelli M. WHO Declares COVID-19 a Pandemic. *Acta Biomed*. 2020 Mar 19;91(1):157-160. doi: 10.23750/abm.v91i1.9397.
17. Soko RN, Burke RM, Feasey HRA et al. Effects of Coronavirus Disease Pandemic on Tuberculosis Notifications, Malawi. *Emerg Infect Dis*. 2021 Jul;27(7):1831-1839. doi: 10.3201/eid2707.210557.
18. Vashi K, Pathak YV, Patel J. Understanding the gaps in elimination of tuberculosis in India. *Indian J Tuberc*. 2021 Jan;68(1):114-118. doi: 10.1016/j.ijtb.2020.08.012.
19. Thakur G, Thakur S, Thakur H. Status and challenges for tuberculosis control in India - Stakeholders' perspective. *Indian J Tuberc*. 2021 Jul;68(3):334-339. doi: 10.1016/j.ijtb.2020.10.001.
20. Ruwanpura, A.I., 2022. Invest to end TB. Save lives"- World TB Day 2022. *Journal of the College of Community Physicians of Sri Lanka*, 28(1), pp.518–519. doi.org/10.4038/jccpsl.v28i1.8479
21. Saini V, Garg K. Case finding strategies under National Tuberculosis Elimination Programme (NTEP). *Indian J Tuberc*. 2020 Dec;67(4S):S101-S106. doi: 10.1016/j.ijtb.2020.09.029.

22. Lee Y, Raviglione MC, Flahault A. Use of Digital Technology to Enhance Tuberculosis Control: Scoping Review. *J Med Internet Res*. 2020 Feb 13;22(2):e15727. doi: 10.2196/15727.
23. Kumar AM, Harries AD, Satyanarayana S, Thekkur P, Shewade HD, Zachariah R. What is operational research and how can national tuberculosis programmes in low- and middle-income countries use it to end TB? *Indian J Tuberc*. 2020 Dec;67(4S):S23-S32. doi: 10.1016/j.ijtb.2020.11.009.
24. Rieder HL. Air pollution, COVID-19, and tuberculosis interrelationship. *Indian J Tuberc*. 2020 Jul;67(3):281-283. doi: 10.1016/j.ijtb.2020.07.033.
25. Pai M, Bhaumik S, Bhuyan SS. India's plan to eliminate tuberculosis by 2025: converting rhetoric into reality. *BMJ Glob Health*. 2017 Mar 20;2(2):e000326. doi: 10.1136/bmjgh-2017-000326.
26. Purty AJ. Detect-Treat-Prevent-Build: Strategy for TB Elimination in India by 2025. *Indian J Community Med*. 2018 Jan-Mar;43(1):1-4. doi: 10.4103/ijcm.IJCM_321_17.
27. Potty RS, Kumarasamy K, Adepu R et al. Community health workers augment the cascade of TB detection to care in urban slums of two metro cities in *India*. *J Glob Health*. 2021 Jul 17;11:04042. doi: 10.7189/jogh.11.04042.
28. Arentz, M., Ma, J., Zheng, P. et al. The impact of the COVID-19 pandemic and associated suppression measures on the burden of tuberculosis in India. *BMC Infect Dis* 22, 92 (2022). doi: 10.1186/s12879-022-07078-y.
29. Pattnaik S. Analysis of tuberculosis case report in Hyderabad district of Telangana state. *J Family Med Prim Care*. 2018 May-Jun;7(3):561-564. doi: 10.4103/jfmpc.jfmpc_110_18.
30. Cilloni L, Fu H, Vesga JF et al. The potential impact of the COVID-19 pandemic on the tuberculosis epidemic a modelling analysis. *E Clinical Medicine*. 2020 Oct 24;28:100603. doi: 10.1016/j.eclinm.2020.100603.
31. Bhatia V, Srivastava R, Reddy KS et al. Ending TB in Southeast Asia: current resources are not enough. *BMJ Glob Health*. 2020 Mar 5;5(3):e002073. doi: 10.1136/bmjgh-2019-002073.
32. Ntoumi F, Nachega JB, Aklillu E et al. World Tuberculosis Day 2022: aligning COVID-19 and tuberculosis innovations to save lives and to end tuberculosis. *Lancet Infect Dis*. 2022 Apr;22(4):442-444. doi: 10.1016/S1473-3099(22) 00142-6.