The Public Health Issue Of Tuberculosis in India

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I sincerely thank Mr. Manoj Kumar, the CEO of India Health Fund (IHF), for providing me with this internship opportunity at the India Health Fund in Mumbai.

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The role of health and the delivery of healthcare in an economy has great bearing on the well-being of the economy. Empirical evidence has bridged a link between the health of the occupants in an economy and economic development. The economics of health is a well-established feature of an economy—developed countries have successfully eradicated communicable diseases whereas lower-middle-income countries like India are still grappling with health challenges. One such disease, tuberculosis, claiming many lives in India, is still in the nascent stage of extinction, however, there is a silver lining with the efforts being undertaken to reduce its prevalence.

RATIONALE

Tuberculosis (TB) is an ancient communicable disease which has been dealt with in the developed world but is still a major health problem in India. TB is a disease caused by a bacillus called Mycobacterium tuberculosis which poses negative externalities (a patient becomes the source for others to get infected) and thus imposes social costs (contributing to the high financial burden of tuberculosis). Approximately 2.7 million people in India are affected by TB annually, of which 0.12 million are children. There are 0.42 million deaths caused by TB in India annually. (Floyd et al., 2018)

As cited by a scholarly article, “TB elimination provides perhaps one of the strongest cases for public intervention from an economic point of view.” (Coarasa & Pai, 2017) According to the Stop TB Partnership, ending TB on a global basis could yield US$ 1.2 trillion overall economic return on investment. (Coarasa & Pai, 2017) Experimental research has established a strong positive correlation between economic growth and health of the workforce; deteriorating health as a result of contracting tuberculosis results in minimal economic growth prospects. The cost to the economy due to patients’ lowered productivity can be quantified in the form of lost earnings in the workforce. Data for average income is multiplied by time lost in the labour force due to morbidity or mortality to arrive at a tangible cost of TB. The global burden of tuberculosis can be represented according to recent World Health Organisation (WHO) estimates, given 8.4 million sick, and with the majority of them willing and able to work, the cost amounts to $1 billion yearly (with the assumption of a 30% decline in productivity). Two million deaths yearly, along with an average loss of 15 years income, adds an additional deficit of $11 billion. Tuberculosis imposes a significant cost on the global economy of US$12 billion annually. (Yong Kim, Shakow, Castro, Vande & Farmer, n.d.) Moreover, the funds required to combat TB worldwide until 2020 sum up to US$65 Billion. (“Stop TB Partnership | The Global Plan to End TB | The Global Plan to Stop TB 2016 - 2020”, 2019)

Investment in TB control has been a global concern for a long period of time. Despite being an age-old disease in comparison to diseases such as the recent Ebola, TB control has suffered from low investment on both a local and global scale until the last 2 years. There has been minimal research and development that has taken place in devising TB solutions. “India’s strength in research and development needs to be leveraged.”(Khetrapal, 2018) Overall, there has been fairly poor development of new diagnostic TB solutions or medicinal drugs; a longer pipeline of research and development is desirable. TB control can be viewed as a global public good as it is non-rivalrous and non-excludable. TB control suffers from the ‘prisoner’s dilemma’ issue wherein countries must consider whether or not to spend in TB control while being unaware of whether other countries will spend or not. As a result, countries who do not invest in TB control could become ‘free-riders’ by not paying heed to their own TB problems and instead forcing patients to seek help from the private sector or other countries, who offer high-quality healthcare services. (Yong Kim, Shakow, Castro, Vande & Farmer, n.d.)

Whilst there has been a multitude of public health policies designed to tackle the tuberculosis endemic in India, it is imperative to explore the core of this issue by considering the underlying factors (especially socio-economic determinants) which...
are increasing susceptibility to tuberculosis, in light of the Indian context. The impoverished in urban slums, indigenous populations, migrant workers, refugees, children and those residing in congregate settings (such as prison cells, mental asylums, old age homes and orphanages) are considered to be the most vulnerable stakeholder groups in light of this health endemic. TB control is high on the global public health issues agenda due to its significant economic, psychological and social impacts. The consequent discrimination of TB patients has been found to be associated with increased anxiety, lowered self-esteem, and depression, as well as with higher unemployment and lowered income (as mentioned above in the rationale). The social stigma associated with TB, especially in India, has provoked social problems like desertion and social exclusion of women.

PROBLEM STATEMENT

India leads the world in the burden of tuberculosis according to the latest report of WHO on the disease. (Floyd et al., 2018) India’s share of tuberculosis cases in the global tuberculosis burden is 27% and India’s share of drug-resistant TB patients globally is 24%. (Floyd et al., 2018) There is slow progress on research and development in TB diagnostics, treatment and prevention. There has been low investment on TB over decades, however, that scenario is changing now. India has not given the needed priority to invest in health in the past years. For decades, the Government of India expenditure on health has been one of the lowest in the world-only 1.5% of GDP. The budget for India’s Revised National TB Control Plan (RNTCP) needs to see an increase. In the 2017 Union Budget, there was some indication that TB mitigation will get a higher allocation, however, a recent analysis suggests that, after adjusting for inflation, the funds available for TB mitigation were much lower than the anticipated funds. (Pai, Bhaumik & Bhuyan, 2017)

The WHO has identified the need for a holistic approach to alleviating tuberculosis, including the fundamental socio-economic, environmental and political factors contributing toward its prevalence in India. Food insecurity and poor general nutritional status in the Indian population are key contributors to the TB burden. In another light, the burden of TB is also increasing due to the prolonged HIV/AIDS spread. A pressing element of this Indian public health issue of TB stems from addressing inequities which are causing increased susceptibility to TB. TB control requires the approach of first mitigating the factors directly contributing to its susceptibility and prevalence. As identified by a Guardian article, “Poverty reduction could be just as effective in tackling the disease as drugs and vaccines.” A report published cited that, “eradicating extreme poverty would lead to an 84% reduction in TB cases by 2035.” (Summers, 2018) To further compound the detrimental consequences of this health issue, there is the presence of the “missing millions” - the healthcare sector not reporting the cases of TB which gives an unclear image of the issue as a whole. “Fewer than 10% of all cases reported to the national TB control program are from the private sector, (despite 60% of TB patients in India seeking care from the private sector).”

The Sustainable Development Goals (SDGs) set by the UN in 2015 are a widespread and widely reputed representation of global targets in hope for a sustainable future for the world and striving to eliminate prevailing humanitarian and environmental issues in today’s contemporary world. The desired aim is that there will be mitigation of tuberculosis public health problem by 2025 in India as part of SDG 3. This is ahead of the overall SDGs completion target- 2030.

**Research question:** What are the underlying factors contributing to the prevalence of the pressing tuberculosis public health issue in India?
A significant proportion of this research paper has been written on the basis of secondary research, and there is an element of primary research with the first-hand inputs from the Program Director at India Health Fund used to substantiate findings from the secondary research. The research strategy for this paper encompassed using the search engines PubMed, Google Scholar and Oxford Academic to access pertinent academic journals, WHO yearly reports, Survivors against TB, World Bank, UN, and media reports. Search terms included the following: 'socio-economic determinants contributing to TB in India', 'TB risk factors', 'influential environmental factors that give rise to TB', 'underlying causes of TB' and 'most vulnerable groups in the TB public health issue in India'.

This literature review framework materialised as a result of conversing with the Program Director, Jayeeta Chowdhury, at India Health Fund (IHF) which is an initiative supported by Tata Trusts in collaboration with The Global Fund against AIDS, Tuberculosis and Malaria and the Government of India. I engaged in an internship at IHF in Mumbai, India and I was informed about their role as ‘a platform for pooled financing towards validation, implementation and scale-up innovations targeted at combating infectious diseases’. IHF aims at fostering innovations related to TB prevention, diagnosis, like developing point of care devices for early TB screening, adherence to treatment regimen, surveillance, supply and logistics. As a means for delving deeper into understanding tuberculosis as a public health issue (prior to exploring solutions and innovations for TB control), understanding the underlying factors contributing to this urgent public health issue proved to be pivotal.

**FACTOR ANALYSIS**

![Figure 1: Determinants of tuberculosis disease and intervention entry points ("Addressing the social determinants of TB", n.d.)](image-url)
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**METHODOLOGY**

**FACTOR ANALYSIS**

Figure 1: Determinants of tuberculosis disease and intervention entry points

"(Addressing the social determinants of TB", n.d.)

- **Social and Economic factors**
  - Lack of awareness
  - The perception that public sector healthcare services are poorly functioning.
  - Accelerating urbanisation
  - Delay in tuberculosis diagnosis
  - Malnutrition, alcohol or tobacco abuse
  - Income constraints limit the use of healthcare services
  - Lack of education
  - Poor access to healthcare in some areas
  - The socio-cultural factor of the stigma associated with TB and consequent desertion

- **Political factors**
  - Diagnosis and treatment are very costly and not operationally feasible for the TB programme. (Engel, 2012)
  - Trade-offs between alternative pressing issues for the Government of India
  - Attention given by the Indian government - there was a lack of investment and a dire need for funding; now they have picked up momentum with the end TB campaign initiated by Narendra Modi
  - Investment in the public health system has been weak over the years
  - Not able to do a 100% detection- “missing millions” - estimates convey that there are more than a million missing cases of TB in India.

- **Environmental factors**
  - Living or working in a high incident setting, overcrowding, and poor ventilation

**FINDINGS AND DISCUSSION**

**SOCIAL EPIDEMIOLOGY**

“Social epidemiology emphasises how health behaviours are shaped and constrained by the social context.” (Berkman, Kawachi & Glymour, n.d.) Poverty is a major socio-economic determinant of tuberculosis as high population density settings and poorly ventilated residential or work areas are risk factors contributing to the transmission of this airborne disease. Studies reinforce that socioeconomic status can influence all stages of TB pathogenesis. (Duarte et al., 2018) A groundbreaking study conducted by leading academia in this field has established that through primary data collection encompassing the alteration of TB risk factors including indoor air pollution, poor ventilation and socio-economic status of one’s household directly influence TB disease spread. (Furin, Cox & Pai, 2019) Whilst this primary research was not conducted in India, its findings are highly applicable in the Indian context.

Figure 2, (Floyd et al., 2018)
Poverty in India is strongly correlated with poor basic health knowledge and not acting upon health knowledge practically. Poor general health knowledge leads to the risk of exposure to several factors such as HIV, smoking and alcohol abuse, aggravating TB prevalence. ("Addressing the social determinants of TB", n.d.) Comorbidities also make individuals susceptible to TB including HIV/AIDS which is prevalent in poverty. The poorest of the poor in India (those faced with absolute poverty) have minimal financial resources. Scarcity of time due to demands of their lowly work is another challenge. As time is scarce and finances are minimal, individuals have no choice but to seek the most convenient and cheap food options available respectively, which may not be high in nutritional value.

**NUTRITIONAL SCIENCE APPROACH**

A key component of poverty entails undernutrition or the lack of a balanced diet. Vitamin A was reported to have restricted multiplication of bacteria in cultured human macrophages and has a critical role in the growth of lymphocytes; there is reported Vitamin A deficiency among adults with tuberculosis. (Gupta, Gupta, Atreja, Verma & Vishvkarma, 2009) This could suggest that a lack of Vitamin A in one’s diet is a TB risk factor. Vitamin D is important in preventing the activation of tuberculosis as it plays a critical part in the function of macrophages, which provokes resistance of TB causing bacterium. Additionally, Vitamin D may have beneficial effects in reducing morbidity through its role in supporting immune function. Sources of Vitamin D primarily include meat, fish or eggs which are mostly unaffordable for the poor in India. Alternatively, another consideration is that the poor due to their illiteracy, may be unaware of the importance of Vitamin D consumption. Empirical evidence has shown that patients with active TB symptoms are Vitamin D deficient. (Campbell Sadler, 2019) Alongside vitamin deficiencies, lack of protein in one’s diet is a TB risk factor contributing towards ‘predisposition to intracellular infection’ as deduced by a study based on tuberculosis and nutrition. (Gupta, Gupta, Atreja, Verma & Vishvkarma, 2009)

Nutritional science supports the argument that malnourished individuals are at severe risk of an infectious disease due to inadequate immune response; empirical evidence suggests that undernourishment can lead to secondary immunodeficiency that increases the host's susceptibility to TB. (Gupta, Gupta, Atreja, Verma & Vishvkarma, 2009) “The branch of the immune system that produces antibodies is depressed in malnutrition, with a decreased number of circulating B-cells and antibody response.” (Campbell Sadler, 2019) Being underweight is a significant contributor to increased susceptibility to disease which is compounded by the consistent correlation between BMI and the risk of catching the disease once infected; having a low BMI increases the risk of TB.

**URBANISATION**

Urbanisation and cramped living conditions, a consequence of rampant industrialisation are favourable conditions for the bacillus, Mycobacterium tuberculosis, to spread. India has had a prolonged wave of urbanisation which intensifies the likelihood of TB spread. Urban slums are prevalent in the metropolitan cities of India and contribute towards the exacerbation of tuberculosis endemic as poor environmental conditions within urban slums is a critical TB risk factor. These conditions in which individuals live are also responsible for causing health inequities. This cause can be attributed to India’s context wherein health systems fail to keep pace with the growing urban population. Although there is an expectation that as India undergoes urbanisation, in the long run, individuals will have access to better infrastructure and services to be resilient in facing the poverty cycle and infectious diseases, a large proportion of Indians live in overcrowded slums, worsening the TB burden. (Prasad, Ross, Rosenberg & Dye, 2016) These populations are highly likely to be vulnerable to TB disease due to weakened host defence against the disease. Urban settlements must be resilient so as to not cause pathogen spread. This can be viewed...
in conjunction with SDG 3 (good health and well-being). (Prasad, Ross, Rosenberg & Dye, 2016) Whilst those in urban slums have physical access to healthcare services, they may not have the financial means to receive the appropriate healthcare services.

**HEALTHCARE PROVISION BY THE PUBLIC AND PRIVATE SECTOR**

There is tuberculosis disease healthcare provision as part of the Indian public sector provision (by the government’s RNTCP). Government of India provisions free TB treatment to its citizens. However, amongst the general Indian population, there appears to be more trust in the private sector. A study has found that about 60% of patients with TB in India are seeking care in the private sector as opposed to the public healthcare sector. (Chin & Hanson, 2017) The private sector healthcare in India is characterised by excessive promotion to the extent that individuals go by brand names, and eventually, due to brand recognition, they blindly believe the private sector will provide the best healthcare services. This assertion is further mentioned in a recent academic study conducted on political psychology wherein citizen’s evaluations of public sector services are incomplete representations of service quality and performance (Jilke & Baekgaard, 2019) Nonetheless, the Government of India has made it mandatory for the private sector to notify all TB cases on an electronic platform named Nikshay.

Despite that there are many patients turning to the private sector, eventually some patients are forced to turn to the public sector when they cannot afford treatment in the private sector. Suspected TB cases are missed out by the public health system due to weak outreach services related to screening and diagnosis. Even those who enrol often drop out because of their socio-economic compulsions or adverse drug reactions. TB patients also require adequate quality counselling services, which are currently not reaching out to all.

**POVERTY AND HEALTH AS A POSITIVE FEEDBACK LOOP**

It is important to consider that TB treatment requires 6-9 months which brings to mind the concept of poverty not only causing TB, but TB further exacerbating the situation as it causes increased poverty. This can be supported through the case study of Manasi Khade in 'The TB Survivor’s Manifesto' named 'TB and Poverty: A mutual relationship' which is edited by Chapal Mehra and introduced by Dr Soumya Swaminathan (WHO Deputy Director General). Hailing from a middle class background, Manasi’s family faced economic hardship in gaining access to the appropriate testing and medications, exhausted their household income, initiated a chain of financial debts, and eventually concluded that “we cannot address TB unless we address the poverty that precedes it, and comes with it.” (Mehra & Swaminathan, 2018) There is significant empirical literature on the effects of health on poverty. (Bonds, Keenan, Rohani & Sachs, 2010) Work in the labour force requires human resources- expertise in the chosen field with cognitive function and physical development- which are compromised by TB. The combined repercussions of poverty on health and health and poverty initiate a positive feedback loop. “Feedback between economics and the ecology of infectious diseases forms a poverty trap.” (Bonds, Keenan, Rohani & Sachs, 2010)
ENVIRONMENTAL CONDITIONS

It has been shown that the areas with the highest TB incidence are also those with a high incidence of HIV infection, incarceration, overcrowding, unemployment and immigrants. (Prasad et al., 2017) Prisons are characterised by overcrowding and poor ventilation, hygiene, and nutrition. “Prisons are also a locus of HIV infection, a significant risk factor for acquiring and developing TB.” (Hannum & Larson, 2001) Prisoners remain infectious given their harsh living conditions and the existing situation is worsened by prisoners developing drug-resistant TB. The particular vulnerability faced by Indian prisoners can be attributed to the fact that prisoners are already at high risk of TB as people who inject drugs, the homeless, mentally ill and immigrants (potentially from areas of high TB incidence) are concentrated in the prison setting. (Dara, Chorgoliangi & Colombani, n.d.)

VULNERABLE COMMUNITIES

Social causes for the TB endemic can be identified by the consideration of vulnerable stakeholder groups in India. This is in conjunction with SDG 10 (reduced inequalities). Smoking prevalence and tobacco consumption (TB risk factors) were commonly higher in indigenous groups than in non-indigenous groups. Food insecurity was prevalent in most indigenous communities evaluated. This evidence highlights some of the health disparities affecting indigenous people worldwide. (Van Steelandt, Hurtado, Rolón, Rojas de Arias & Jara, 2015) The increased prevalence of these social, behavioural, and medical determinants might partly explain the disproportionate burden of tuberculosis in indigenous populations. The tribal populations in India are one of the marginalised sections in Indian society who are constrained by structural and cultural barriers in being able to access healthcare services. There is a lack of appropriate awareness-building measures within tribal groups and in most cases, indigenous populations are more prone to developing tuberculosis than the general Indian population. The prevalence of TB is significantly higher among Indian tribal populations- 703 per 100,000 as compared to the national average of 256 per 100,000. (Thomas BE, Adinarayanan S, Manogaran C, Swaminathan S., 2015)

The Saharia Tribe in Central Madhya Pradesh is a manifestation of a particularly vulnerable Indian indigenous group. The Saharia Tribe is based in a geographically isolated location and is prone to low socio-economic living conditions. Indian tribal groups are unable to access healthcare, and if they are able to, it is limited to informal healthcare providers who tend to be unqualified professionals. Findings from a prevalence survey highlight high TB burden among the Saharia Tribe as compared to the general Indian population. There is an exceedingly stark difference with the prevalence rate of TB for the Saharins and that of the general Indian population and average tribal group- it is 1518 per 100,000. (Thomas BE, Adinarayanan S, Manogaran C, Swaminathan S., 2015)

Beyond being considered as ethnic minorities in India (due to being tribal groups), the low socio-economic status of the tribal groups could also be attributed to the fact that they live in a food desert area. Qualitative studies indicate that residents in food deserts cited a preference to eat healthily as strong as those of higher socio-economic standing but are resource-deprived. (Berkman, Kawachi & Glymour, n.d.) Tuberculosis is met with culturally discriminatory attitudes, especially towards women. “Policymakers, in consultation with all the stakeholders, should consider developing specific intervention strategies for TB management in this population group.” Nonetheless, deducing the extent to which indigenous Indian communities are vulnerable is subject to limitations as conducting primary research in geographically remote communities is challenging. Hence, it is difficult to track evidence-based health policy marking to observe the altered impact on the tribal communities.
Children are a vulnerable group in the facet of tuberculosis as diagnosis and treatment are most challenging. Children are less likely to produce adequate specimens for microscopy and cultural accessing. (Caulfield & Wengenack, 2016) Moreover, for children hailing from a poorer background, they have a susceptibility to HIV, amplifying the existing health issue. Refugees are a vulnerable stakeholder group in the face of tuberculosis in India, as can be exemplified by the prevalence of TB in Tibetan schools in India. The historical context is that during the invasion of Tibet in the 1950s by China, many Tibetans sought refuge in Dharamshala, India. An empirical study on TB prevalence amongst child refugees in Tibetan schools in Himachal Pradesh, India, revealed that TB prevalence is alarmingly high amongst Tibetan child refugees. (Dorjee et al., 2018) Exposure to the change of environment, living in congregate settings such as boarding schools and weather discouraging ventilation increases the likelihood of contracting TB. (Johns Hopkins Medicine, 2018)

CONSIDERING SOLUTIONS:

Broad medicinal literature, as well as TB epidemiology, assert the importance of employing strategies that recognise the socio-economic epidemiological interaction in communicable disease control. The focus on mitigation strategies should consider relevant socio-economic and environmental determinants as important to address. (Hargreaves et al., 2011) Raising the nutritional status of the poor population could be a beneficial TB mitigation strategy. (Gupta, Gupta, Atreja, Verma & Vishvkarma, 2009) Although a commendable venture in terms of nutritional assistance, Nikshay Poshan Yojana is a scheme which provides nutritional support to TB patients whilst undergoing their treatment, it does not aid in reducing a key TB risk factor in the first place- malnutrition caused by poverty. Increased awareness prospects through youth and adult educational initiatives for those of lower socio-economic standing could also be considered as a strategy to address an underlying contributor to TB. After the literature review conducted, an informed consensus can be reached that intervention strategies require interdisciplinary collaboration beyond the health sector. In India’s endeavour to tackle the underlying determinants of TB, intersectoral collaboration between multiple ministries, agencies, and civil society is required. (Pai, Bhaumik & Bhuyan, 2017) TB control strategies in India should be targeted to the poor population (who are most at risk), vulnerable stakeholder groups. “In high-burden settings, more human and material resources are required to promote tuberculosis case finding initiatives, reduce tuberculosis associated stigma and address the determinants underlying diagnostic delay.”(Bonadonna et al., 2017) Notably, without addressing the concern of development disparities between the megacities of India and those of the tribal groups spread across the country, there will be a major hindrance in fulfilling the goal of reducing inequalities (SDG 10) and thereby good health and wellbeing(SDG 3) in the national setting of India. In a similar light, it is highly recommended that for prisoners(another vulnerable stakeholder group), the Government of India integrates TB services in prisons alongside National TB mitigation programs. (Prasad et al., 2017) Whilst suggested solutions have entailed a political commitment to an increase in funding and prototyping of molecular diagnostics, interventions have undermined the significance of the factors contributing to TB burden in India in the first place. “Urbanisation offers the chance to offset the epidemiological risks of high-density living (if used appropriately)” and hence measures need to be taken to develop urban settlements that counter the spread of TB. (Prasad, Ross, Rosenberg & Dye, 2016) However, there is a significant time lag present in urban regeneration to the extent that a large proportion of the Indian population is benefited - this needs to be addressed. To concurrently address the issue of minimal nutritional assistance, urban organic farming could be considered; slum dwellers in India could rely upon this method both for their sustenance as well as a form of income. To ensure social protection, a potential solution that could be considered is increasing microfinance opportunities to support business development amongst the poor in India. (Hargreaves et al., 2011)
The perception of the private sector being more credible than the public sector should be addressed by the government - as the public sector healthcare is comparatively characterised by a lack of promotion. Government of India healthcare should focus on the increased promotion of the public sector healthcare. This will also help with addressing the poverty situation as the public sector provision is more affordable as compared to the private sector. The government's financial resources are scarce and therefore the Government of India is faced by the problem of choice-which gives rise to an opportunity cost. Nonetheless, this could be mitigated by considering the lateral approach solution( explored further in the paper).

In 2019, the Government of India increased the healthcare budget by about 15% from the previous year, Government budget outlay on healthcare continues to be inadequate however in this light there is not much that can be done considering that India is a budget deficit country and the government is the largest social sector. Nevertheless, the Government of India has put into play certain programmes which contribute towards reducing TB risk factors. As cited by Pradeep Venkatesh in a study of The Lancet, “In addition to the health budget for fighting tuberculosis, parallel programmes (devised and run) by the Government of India including Swachh Bharat Abhiyan, Housing for All by 2022( an attempt to provide housing facilities to the urban poor), and the development of Smart Cities would help mitigate the burden of tuberculosis in India.” (Venkatesh, 2017) The Smart Cities Mission will particularly help in eliminating environmental risk factors contributing to the incidence of TB. These large-scale governmental initiatives need to completely come into fruition to resolve this pressing health issue. In conversation with Jayeeta Chowdhury, “Instead of stand-alone programs, convergence across sectors and ministries becomes critical.”(Chowdhury, 2019) For instance, within the Swachh Bharat Abhiyan framework, there must be a disease prevention goal embedded in its framework to initiate a direct impact on lowering the TB burden. As Jayeeta Chowdhury mentioned, “Why do stand-alone programs when the lateral approach is more effective?” (Chowdhury, 2019) A solution which could yield fruitful results in reducing TB prevalence is establishing lateral connections between multiple programs run by the Government of India as it will aid in countering the fundamental economic problem of opportunity cost- trade-offs between multiple programs. This will also help in saving the government’s financial resources as with the horizontal approach, multiple problems related to the SDGs will be resolved.

CONCLUSION
The research undertaken in this literature review paper has highlighted significant underlying factors contributing to the prevalence of tuberculosis in India in the socio-economic, environmental and political domains; the socio-economic determinants contributing towards TB burden appear to be the most critical. To reiterate, malnutrition, poor access to healthcare services, overcrowding, poor air circulation and sanitation-factors associated with poverty- increase both the probability of becoming infected and the probability of developing clinical disease.

In addition to addressing the underlying contributing factors explored in this research paper, undeniably, scaling up of molecular diagnostics, development of vaccines and ensuring widespread availability of drug susceptibility testing need to be considered; this requires investment in research and development over a long-term basis. Innovations- the product- need to be injected and integrated into the public and private healthcare systems. Along with innovation, the TB testing and treatment services must reach the larger population more effectively through the public and private health systems. Finally, TB advocacy and patient groups need to be more active and empowered. This needs much more investment by the government and the private sector.

In reference to literature studies, whole-genome sequencing is a feasible tool for detection of drug resistance in Mycobacterium tuberculosis and will enable understanding of TB transmission. (Furin, Cox & Pai, 2019) The problem of unreported
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Large-scale governmental initiatives need to completely come into fruition to resolve in eliminating environmental risk factors contributing to the incidence of TB. These tuberculosis in India." (Venkatesh, 2017) The Smart Cities Mission will particularly help understanding of TB transmission. (Furin, Cox & Pai, 2019) The problem of unreported urban poor), and the development of Smart Cities would help mitigate the burden of detecting drug resistance in Mycobacterium tuberculosis and will enable detection of TB. For general health check-ups, there must be an emphasis on screening for TB to decrease days of suffering from TB and thereby a reduction in the probability of disease spread across the Indian population. The fight to eliminate TB is not just a single disease treatment but also needs to be integrated with overall human development strategies which include human needs in the areas of sanitation, housing and nutrition.

Indian nutritional assistance programs need to link to TB mitigation programs and maternal and child health programs need to include screening for TB to enable early detection of TB. For general health check-ups, there must be an emphasis on screening for TB to decrease days of suffering from TB and thereby a reduction in the probability of disease spread across the Indian population. The fight to eliminate TB is not just a single disease treatment but also needs to be integrated with overall human development strategies which include human needs in the areas of sanitation, housing and nutrition.
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