Government of the People's Republic of Bangladesh

Strategic Roadmap for Zero TB Cities Bangladesh (ZTBCB) 2018-2025

A Comprehensive and Expanded Approach for Urban TB Management in Bangladesh

June 2018

National TB Control Program
Directorate General of Health Services
Ministry of Health and Family Welfare

স্বাস্থ্য ও পরিবার কল্যাণ মন্ত্রণালয়

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Mohammed Nasim, MP
Minister
Ministry of Health and Family Welfare
Govt. of the People's Republic of Bangladesh

Message

Over the last few decades, Bangladesh has made significant progress in health and human development, which have been well appreciated by the global community. Despite the success in health, tuberculosis (TB) is a major public health threat for years and remains a top killer in Bangladesh. We still face challenges in achieving universal access to TB prevention and care services particularly in urban areas. Our cities have high rates of TB with complex population dynamics. This demands innovative solutions from our National TB Control Program. The World Health Organization declared the END TB STRATEGY for reducing TB incidence and death rates further and eliminating catastrophic health costs for TB-affected families by 2030. Aligned with global strategy, ending the TB epidemic by 2030 in Bangladesh is one of the key health targets of the newly adopted Sustainable Development Goals.

It is inspiring to note here that the Ministry of Health and Family Welfare (MoHFW) along with its development partners have developed a National Strategic Plan 2018- 2022 for TB Control, with the goal of ensuring universal access to early diagnosis through new diagnostics and effective treatment. We are committed to achieving universal health coverage, thus, Zero TB Cities approach is important for urban TB management in Bangladesh. For as long as TB confronts us, we will fight back. We will fight in ways that are tailored to different settings and circumstances like urban slums, factories and other hard to reach areas.

This Strategic Roadmap for Zero TB Cities Bangladesh (ZTBCB) is a way forward to our fight against TB. Following the approach outlined in this roadmap we will "Search, Treat and Prevent" TB effectively in big cities. I hope this comprehensive approach will guide us to ending TB in Bangladesh. ZTBCB strategic roadmap has set clear vision and pathway for urban TB management, which will surely accelerate the progress towards a TB free Bangladesh. Our endeavor should now be to effectively implement the strategic actions under ZTBCB through a consorted public-private partnership approach.

I want to congratulate the National TB Control Program, Directorate General of Health Services and all stakeholders for developing this Strategic Roadmap for Zero TB Cities Bangladesh 2018-2025 and I hope that all strategic issues will be addressed in the next sector program of the MoHFW.

Joy Bangla, Joy Bangabondhu
Long Live Bangladesh.

Mohammed Nasim

Mosharraf Hossain Khandker, MP
Minister
Ministry of Local Government, Rural Development, and Co-operatives
Govt. of the People's Republic of Bangladesh

Message

Bangladesh has made remarkable progress in combating TB. However, urban TB has long been identified as an area that will require additional efforts and strategies. Making real progress against the TB epidemic in Bangladesh will require a paradigm shift as incorporated in the newly adopted SDGs targets. It will require new strategies to search for and diagnose everyone who is sick with TB diseases, to treat them promptly and effectively, and to prevent future TB cases by stopping the transmission of TB infection in settings.

The comprehensive and expanded approach for urban TB management offers new hope to the millions of people living in cities and suffering from TB each year. This strategic roadmap is a comprehensive approach that creates an opportunity to work collaboratively to eliminate TB in our cities. Efforts must begin now to ensure effective rollout of the Strategic Roadmap for Zero TB Cities Bangladesh 2018-2025 where strategic partnerships are the key to success of the initiative. To end TB in urban areas, active engagement of the Ministry of Health and the Ministry of Local Government, City Corporations development partners, NGOs, civil society and the private is essential. This will help to achieve our goal of Zero TB Cities Bangladesh.

I would like to congratulate the National TB Control Program (NTP) along with the development and implementing partners, MoHFW, Ministry Local Government and City Corporations for developing timely approach for urban TB management.

I believe this Strategic Roadmap for Zero TB Cities in Bangladesh will guide us to implement effective actions for combating TB in urban areas in Bangladesh. I hope this roadmap will provide an opportunity for all relevant ministries and stakeholders to adopt a coordinated approach to accelerate real progress at country level.

Joy Bangla, Joy Bangabondhu
Long Live Bangladesh.

Mosharraf Hossain Khandker

Md. Serajul Huq Khan
Secretary
Health Services Division
Ministry of Health & Family Welfare
Govt. of the People's Republic of Bangladesh

Message

Bangladesh has been acknowledged by the global community for significant achievement in poverty reduction, health and social development. As we work to reduce poverty rates further we need to consider other health and development issues which are linked together. TB and poverty are closely interlinked. Once someone has active TB disease and is too ill to work, we start to see a drop-in family income, and life for the family become even more precarious. Bangladesh is committed to achieve the targets of the vision 2021 and ensure the need of basic health to all the citizens.

TB is still a serious public health concern for the country. Moreover, urban TB has long been identified as one of the areas that will require additional efforts and strategies to resolve the challenges. The urbanization has led to an increasing number of slums in cities, which has emerged as a risk factor for TB. The End TB Strategy offers new hope to the millions of people suffering and losing their lives to TB each year. However, eliminating TB requires a well-coordinated and innovative response. We must ensure increased and sustained political attention, effective tools and innovative solutions to support the scaling up of TB prevention, diagnosis and treatment for urban population.

Public policy and investments make a dramatic difference in the battle against the epidemic. With efficient and effective health policy, and more investment in best practices, new strategies and technologies, we will be able to achieve our end TB goal. The 'Strategic Roadmap for Zero TB Cities Bangladesh 2018-2025' will create a platform for the government, country programs, donors civil society, communities, technical partners, international organizations and the private sector to work together to reach the people with TB in urban areas, including key and vulnerable populations and place them on appropriate treatment.

I would like to thank the National TB Control Program (NTP), Directorate General of Health Services, development and implementing partners for formulating the Strategic Roadmap for urban focused TB programming, which will guide the NTP to achieve end TB targets by 2035.

Md. Serajul Huq Khan

Professor Dr. Abul Kalam Azad
Director General
Directorate General of Health Services

Message

Bangladesh has made significant improvements in the health and family planning sector over the last few decades. Government of Bangladesh is committed to ensuring universal access to quality health care services for the people. We have seen improvements in many health indicators, which are globally acknowledged. Rapid progress in the most important health indicators; for example infant and child mortality, maternal mortality, fertility and contraceptive prevalence; are remarkable.

Bangladesh is one of the high TB burden countries in the world. Although Bangladesh has made good progress in TB control, significant reduction in TB incidence is needed in order to achieve the global targets of End TB Strategy. The Directorate General of Health Services (DGHS) is persistently working to reach the target through the national TB Control Program. However, many challenges need to be addressed. About 33% of all estimated TB cases in our country remain undetected. It is also true that Bangladesh's urban areas are overcrowded with huge number of poor, transient and homeless population; making it difficult to track each person with TB and increasing risk of spreading TB.

The National Strategic Plan 2018- 2022 for TB, WHO led Joint monitoring mission and the recent national TB prevalence survey all recommend to focus TB services towards urban population. Considering the situation, the 'Strategic Roadmap for Zero TB Cities Bangladesh 2018-2025' offers a comprehensive 'Search, Treat and Prevent' approach that will help us tackle urban TB. The DGHS will continue to follow this evidence-based approach to eliminate TB in urban areas. I believe that the Strategic Roadmap will guide us to deliver expanded package of services to ensure universal access to quality TB care for all people affected with TB. We will work together with the local governments especially city corporations/municipalities and Urban Primary Health Care Service Delivery Project and NGOs, civil society to build dynamic and flexible partnership. This will help to achieve our goal of Zero TB Cities Bangladesh.

I would like to congratulate the National TB Control Program for taking this timely initiative to develop this Strategic Roadmap for Zero TB Cities Bangladesh 2018-2025. I would like to thank our Development partners for supporting us. I also would like to thank colleagues from other ministries, and experts who supported the development of this Strategic Roadmap.

Professor Dr. Abul Kalam Azad

Prof. (Dr.) Md. Shamiul Islam
Director MBDC & Line Director TB-LEP & ASP
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Acknowledgement

Although Bangladesh has made significant progress in different aspects of health, urban TB has not been prioritized, as it should be. Each year, the National TB Control Program (NTP) fails to detect and treat about 33% of total TB cases. The NTP seeks to achieve a 75% reduction in deaths and a 50% reduction in incidence by 2025, relative to 2015, as part of our efforts towards achieving the health SDG targets by 2030 and the target of the End TB Strategy by 2035. However, making real progress against the TB epidemic in Bangladesh will require a paradigm shift. It will require new approaches and new ways of working to identify each undetected TB case remaining in the community. In Bangladesh, we are fortunate to have very good collaboration with partners to implement TB activities and made good progress in TB control though challenges still remain.

The rapid urbanization of Bangladesh over the last decades symbolizes the economic development and growth of our country. At the same time this urbanization has created huge risk for the health sector, and tuberculosis is one of them. Our cities have high rates of TB with complex population dynamics; large number of poor, migrant and homeless population; and overcrowding and poorly ventilated living and working conditions; all of which allow TB to spread. An urban approach is therefore needed to address these challenges. Following the declaration of Zero TB Cities Initiative by the Minister of Health in October 2018, the NTP carried out rigorous exercise and engaged with national and international TB experts to develop an appropriate and effective urban TB management model. Being motivated by the success of International Zero TB City Initiative in other countries and recommendations of global experts, the NTP has adopted a comprehensive “Search, Treat and Prevent” approach to tackle urban TB in Bangladesh. Thus, the NTP has formulated this ‘Strategic Roadmap for Zero TB Cities Bangladesh 2018-2025’ with the support of development and implementing partners and local government especially city corporations. The Strategic Roadmap is a ‘Comprehensive and Expanded Approach for Urban TB Management’ to detect, treat, and prevent TB to eliminate the disease from urban areas, and will reduce the national TB burden.

A group of experts worked relentlessly through several meetings and workshops involving different stakeholders, organizations and professional bodies. I want to express my sincere gratitude to these experts and also to the organizations involved in the development process of the Strategic Roadmap for Zero TB Cities Bangladesh 2018-2025. I also want to express my heartfelt thanks to the MoHFW for their continuous supports for arranging inter-ministerial meeting involving MOLGRDC and for their kind approval of the draft of the document. I would also like to express my gratitude to our development and implementing partners and stakeholders for their continuous support in the process of developing this Strategic Roadmap.

I believe ZTBCB Strategic Roadmap will guide our actions to address the needs of underserved TB patients in urban Bangladesh and that we will be able to work collaboratively to combat TB more effectively and will help us to make our cities TB free and achieve the End TB targets of a TB free country.

Prof. (Dr.) Md. Shamiul Islam

Acronyms

BNTPS	Bangladesh National TB Prevalence Survey
CI	confidence interval
DHIS	District Health Information System
DM	diabetes mellitus
DOT	directly observed treatment
DOTS	directly observed treatment, short course
DR-TB	drug-resistant tuberculosis
DST	drug susceptibility testing
FAST	Find cases Actively, Separate safely and Treat effectively
GOB	Government of Bangladesh
HIV	human immunodeficiency virus
ICT	information and communications technology
IPT	isoniazid preventive therapy
JMM	Joint Monitoring Mission
MDR-TB	multidrug resistant tuberculosis
MDR/RR-TB	multidrug-resistant/rifampicin-resistant tuberculosis
MOHFW	Ministry of Health and Family Welfare
MOLGRDC	Ministry of Local Government, Rural Development & Cooperatives
NGO	nongovernmental organization
NSP	National Strategic Plan
NTP	National Tuberculosis Control Program
P:N	prevalence to notification
PLHIV	people living with HIV
PWID	people who inject drugs
STP	Search, Treat, and Prevent
TB	tuberculosis
UHC	universal health coverage
USAID	United States Agency for International Development
WHO	World Health Organization
XDR-TB	extensively drug-resistant tuberculosis
ZTBCB	Zero TB Cities Bangladesh
ZTBCI	Zero TB Cities Initiative

Executive Summary

Zero TB Cities Bangladesh (ZTBCB) is the urban tuberculosis (TB) management program of the Government of Bangladesh (GOB), and it is specifically organized to deliver TB services under the multi-actor urban health structure. This Strategic Roadmap for Zero TB Cities Bangladesh, 2018-2025, is a seven-year plan that sets as its objective the target that was defined by the 2018-2022 National Strategic Plan for TB for 2025: a 50% reduction in the incidence rate from a 2015 baseline. It describes the interventions under a "Search, Treat, and Prevent (STP)" strategic approach needed to reach the objective. The four most important documents used to develop the Roadmap were the (1) 2018-2022 Government of Bangladesh National Strategic Plan (NSP) for TB, (2) 2015-2016 Bangladesh National TB Prevalence Survey, (3) October 2015 *Lancet* series on eliminating TB, and (4) 2015 World Health Organization (WHO) Implementing the End TB Strategy: The Essentials.

The Strategic Roadmap falls under the umbrella of the 2018-2022 NSP for TB approved in January 2017 and addresses the recommendations from the November 2016 Joint Monitoring Mission (JMM). It aligns with the policies and recommendations of all national TB guidelines approved by the National Tuberculosis Control Program (NTP), and it also aligns with current internationally endorsed scientific practices for TB management. By recognizing that existing programs are insufficient to drive down stubbornly high TB incidence rates, it echoes the recent observation that "business as usual can no longer be an option in the fight against tuberculosis."[1]

Drawing on the experience of the international Zero TB Initiative, ZTBCB offers a comprehensive, empirically based program of care that targets geographic areas of highest TB transmission (cities) and populations at greatest TB risk. Its interventions follow a ***"Search, Treat, and Prevent"*** approach in which people with TB are actively sought and found at an early stage of the disease, rapidly diagnosed, placed on appropriate treatment regimens, and successfully treated and cured of the disease. In addition, the approach prevents TB by identifying and treating people infected with TB or at high risk of infection. To support the STP approach, its services and care include raising public and private health care provider's awareness, developing capacity, linkage and retention in care, and social support.

Bangladesh is the first country in the world to develop a documented strategic roadmap to end TB in its urban areas. The rationale for the initiative is clear. As the 10th leading cause of death in Bangladesh, TB continues to represent a serious public health threat. According to WHO recent estimates, Bangladesh is one of the high burden countries in the world both for TB and MDR-TB. The country ranks 4th highest in the world for HIV-negative TB mortality.

[1] Das P and Horton R. Tuberculosis: getting to zero. *Lancet* series: Tuberculosis elimination. October 2015. 386 (10010): 2231-32.

These numbers are in part caused by Bangladesh's population size, the 8th largest in the world. When calculated in rates per unit of population rather than total number, they indeed compare well with countries at a similar economic level and health profile. Despite challenges, the NTP has made significant progress in increasing its TB treatment coverage and lowering TB mortality over time. However, reflecting the global experience of insufficient declines in annual incidence rates, the national incidence rate (between 221-225/100,000), almost unchanged over the last several years, calls for a new programmatic approach.

On October 28, 2017, the GOB committed itself to this new strategic approach based on STP interventions by formally adopting the Zero TB Cities Initiative (ZTBCI). During a ceremony attended by national and international dignitaries and stakeholders, the Honorable Minister of Health and Family Welfare, Mohammed Nasim, signed an official ZTBCI declaration under the slogan of "Let Us Unite Together to Make Our Cities TB Free".

This declaration includes four key strategic activities that international experience suggests will be most effective in drastically lowering TB incidence and mortality rates: ***(1) actively finding, diagnosing, and treating people with TB disease;*** (***2) identifying and treating people with latent TB infection; (3) replacing conventional sputum smear microscopy with rapid molecular testing as the initial test; and (4) focusing on high-transmission geographic areas (cities) and people at high risk of TB infection and disease.*** By embracing these four ZTBCB elements, the GOB will expand the existing approach of passive case finding, reliance on microscopy, active disease treatment, and undifferentiated geographic inclusion. The national program will still continue the existing approach, as it is necessary for effective TB management, but it will augment it by adding the ZTBCB strategic elements. The goal of Zero TB Cities Bangladesh is to halve the national incidence rate of 225/100,000 in 2015 to 112/100,000 in 2025 in Bangladesh's cities. Reaching this goal will necessitate delivery of services along a rigorously measured continuum of care.

In June 2017, the Task Force for the Urban TB Initiative under NTP's leadership identified eight strategic STP activities to achieve the incidence reduction goal. ***Search activities included provider engagement, active screening, and rapid and accurate diagnostics in public and private sectors. Treat activities included a continuum of public and private providers, integrated care of TB patients, and treatment support; and prevent activities included airborne infection control and treatment of latent TB infection.*** These eight activities were accompanied by 25 sub-activities and nine cross-cutting health systems interventions. This Strategic Roadmap describes these activities in greater detail in the context of Bangladesh's TB profile and the structure of its urban health services.

The formal launch of ZTBCB in October 2017 underscored the commitment of the NTP and Ministry of Health and Family Welfare (MOHFW) to support the program. In addition to the MOHFW and NTP, achievement of the ZTBCB goal will require strong collaboration with multisectoral stakeholders, including the Ministry of Local Government, Rural Development, and Cooperatives (MOLGRDC); city corporations; NGOs; development partners and their

implementing agencies; professional medical associations; public and private health sector facilities and practitioners; civil society members; and urban communities and social groups.

As a dedicated urban health program, ZTBCB will pioneer a multisectoral, results-oriented urban health model. It will galvanize the support of all relevant urban governmental structures, stakeholders and donor agencies; and build referral chains along a continuum of service delivery to measurably reduce the incidence of TB as a disease of major public health significance. This roadmap will complement the 2017-2022 Fourth Health, Population, and Nutrition Sector Plan, which focuses on reducing the burden of health service costs and expanding access to essential services for urban dwellers. ZTBCB will benefit from the experiences of other cities in the international ZTBCI and, in turn, share valuable experiences with them to improve the visibility of the initiative. Other health programs in urban Bangladesh might learn from this model and apply its knowledge and practices for their own improvement and impact.

I. Justification for Zero TB Cities Bangladesh

A. An Approach Based on National TB Strategies and Recommendations

2016 Joint Monitoring Mission (JMM) to Bangladesh: A JMM with international and national TB specialists occurred in November 2016 as a prelude to the development of the 2018-2022 National Strategic Plan for TB and the new funding request for the 2018-2020 Global Fund TB grant. It noted NTP achievements in increasing case notifications and continuing high treatment success rates for both drug-sensitive TB and drug-resistant TB (DR-TB); expanding new diagnostic technologies; supporting a public-private mix through private practitioner networks, hospitals, and professional associations; and nurturing NGO capacity for screening, referrals, and treatment. The JMM also noted critical areas for improvement including the need for better identifying the two-fifths of TB cases that remained undetected and untreated; accelerating private-sector participation and community-based services; expanding use of new diagnostic technologies and electronic recording and reporting systems; bolstering childhood TB detection and management; and improving the TB response in urban areas.

The 2018-2022 National Strategic Plan (NSP) for TB control: Drawing from the 2015-2016 National Prevalence Survey findings and the JMM recommendations, the NTP developed a five-year National Strategic Plan for TB and approved it in January 2017. The NSP included the following objectives to achieve program targets: increasing the annual case detection of all forms of TB; increasing treatment success rates and ensuring quality-controlled treatment services at all implementation sites; increasing the annual case detection of MDR-TB and improving MDR management through implementation of the shorter MDR-TB treatment regimen; and ensuring (1) social support for TB-affected families to mitigate catastrophic costs, (2) adequate staff training, (3) long-term availability of funding through effective planning and partner coordination, and (4) adequate support for operational research.

The four major programmatic elements of ZTBCB—***active and early case finding, roll-out of rapid molecular testing, expanded contact investigation and TB preventive treatment, and focus on high-transmission areas and populations at risk***—all fall under the NSP and are aligned with the JMM recommendations. This comprehensive approach that prioritizes formation of sustainable public and private sector, and community service delivery networks will also entail the strengthening of key health systems components such as monitoring and evaluation; multisectoral stakeholder engagement; quality management; advocacy; information technology; communications; development of a business model; implementation research; and comprehensive patient service delivery.

B. A Strategic Approach Based on Epidemiological Evidence

Globally, absolute numbers of TB deaths[2] and annual new cases (incidence) have fallen since 2000.[3] The global rate of decline in TB incidence rates has been a negligible 1.6% annually

[2] Excludes TB deaths among HIV-positive people.

during the past 25 years; at this pace of decline, another two centuries will elapse before the disease is eliminated.[4] The WHO's best estimate of TB total incidence for Bangladesh was 360,000 annual new cases in 2016, the 8th highest among countries in the world,[5] up from approximately 324,000 cases in 2005. The country's MDR/RR-TB estimated incidence of 8,800 cases ranks 12th among countries in the world. WHO's estimate of HIV-negative TB mortality for Bangladesh was 66,000 deaths in 2016, the 4th highest estimated number of deaths in the world; however, this decline represents progress from the approximately 89,280 annual number of similar deaths in 2005.

Large absolute numbers of incident cases and deaths reflect the large population size of Bangladesh, an estimated 162.9 million[6] in 2016; its estimated rate of population growth, 2010-2015, was 1.2% per year. Bangladesh's population is the eighth largest in the world. At 1,251 people per square kilometer, it is also the most densely populated country among all countries in the world, with at least 10 million in population. Slightly more than one-third of Bangladesh's population (34.3%) lives in urban areas, and the average urban annual population growth rate, 2010-2015, was 3.6%, three times the national rate.

Although absolute numbers of incident cases and deaths remain high in Bangladesh, rates per 100,000 population reveal a more nuanced situation; the country's best-estimate TB incidence rate of 221/100,000 population ranks 21st and its best-estimate HIV-negative mortality rate of 40/100,000 ranks 17th among countries in the world. Certain trends over time also appear positive for Bangladesh. TB treatment coverage (notified/estimated incidence) rose from 27% in 2002 to 62% in 2016, and deaths from TB among HIV-negative people fell from 72/100,000 in 2002 to 40/100,000 in 2016.

Case notifications stood at 223,921 in 2017 and the high treatment success rate of above 90% of diagnosed cases was maintained from 2005 to 2016.[7] The TB incidence rate, by contrast, has remained flat between 225/100,000 and 221/100,000 from 2001 to 2016; therefore, despite progress, the NTP continues to miss 38% of drug-sensitive TB cases (all forms) and only an estimated 20% of DR-TB cases are enrolled in the national program.

Recent TIME modelling[8] shows that a continuation of baseline conditions will increase incidence cases from an estimated 357,039 in 2015 to 419,865 in 2025. In order to achieve a 50% reduction in incidence by 2025 in Bangladesh, incidence cases would need to decline to

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[3] WHO. *Global Tuberculosis Report, 2017.* Geneva: WHO, 2017.
[4] Keshavjee S, Dowdy D, and Swaminathan S. Stopping the body count: a comprehensive approach to move towards zero tuberculosis deaths. *Lancet* series: Tuberculosis elimination. October 2015. 386 (10010):e46-7.
[5] References to "the world" refer to the 30 highest TB disease burden countries.
[6] World Bank Group. World Bank Open Data: Bangladesh [webpage]. http:// https://data.worldbank.org/country/bangladesh. Accessed April 29, 2018.
[7] WHO. *Global Tuberculosis Report, 2017.*
[8] TIME Impact is an epidemiological transmission model that reflects key aspects of the natural history of TB, drug resistance, treatment history, and age. TIME Impact enables national TB programs and policymakers to better understand the TB epidemic, plan responses, apply for funding, and evaluate the implementation of the response.

158,974, which would entail growth in the case detection rate to more than 90% from its current 60% and stability in treatment success rates at over 90%.[9]

Reflecting the global WHO End TB Strategy, the 2018-2022 NSP identified ambitious epidemiological milestones and targets for the country from a 2015 baseline: a 75% reduction in TB deaths and a 50% reduction in the TB incidence rate by 2025, and a 95% reduction in TB deaths and a 90% reduction in the TB incidence rate by 2035.

Bangladesh's current TB epidemiological status and trends suggest, therefore, that programming under the ZTBCB Strategic Roadmap is crucially needed to increase TB treatment and prophylaxis coverage through expanded and enhanced contact investigation, active case finding, and maintenance of high treatment success rates. Large population size and density suggest significant reservoirs of infection, representing challenges for reducing incidence and mortality rates over time. Without expanded management and treatment of latent TB infection, achieving national mortality and incidence rate milestones and targets will remain daunting.

Results of the 2015-2016 Bangladesh National Tuberculosis Prevalence Survey[10] (BNTPS) also provide evidence for the ZTBCB strategic approach. In this nationally representative survey among adults (≥ 15 years) living in both urban and rural areas, the prevalence of bacteriologically confirmed positive TB was reported at 287 per 100,000 populations.

Table 1 shows bacteriologically confirmed TB prevalence rates by sex and age and prevalence to notification (P:N) ratios. The national P:N ratio was 2.8, which suggests that Bangladesh is officially reporting 36% of the total estimated prevalent TB cases. Because only 28% of males and 23% of elderly people were currently being notified, these two demographic groups merit special attention.

Table 1: Estimated Prevalence of Bacteriologically-Confirmed TB Cases (per 100,000), Notification of TB Cases (per 100,000), and Prevalence to Notification Ratios, National and Disaggregated by Sex and Age, Bangladesh, 2015-2016

	Prevalence (per 100,000)	Notification (per 100,000)	Prevalence to Notification Ratios
National (15+)	287	102	2.8
Sex			
Male	452	127	3.6
Female	143	76	1.9
Age Groups (in years)			
15-24	103	52	2.0
25-34	183	73	2.5
35-44	302	88	3.4
45-54	338	137	2.5
55-64	462	241	1.9
65+	954	223	4.3

Prevalence -- bacteriologically confirmed cases from the survey. Notifications -- pulmonary TB (new bacteriologically and clinically diagnosed) from NTP 2015

Source: National Tuberculosis Prevalence Survey, Bangladesh, 2015-2016.

[9] Draft GOB National TB Program Funding Request to the Global Fund Application. December 15, 2016.
[10] National Tuberculosis Prevalence Survey, Bangladesh, 2015-2016. Draft Report. August 2017.

The BNTPS also found that the urban TB prevalence rate was 316/100,000 compared to the rural TB prevalence rate of 270/100,000. The survey did not calculate P:N ratios by residence.[11]

In the spirit of maximizing impact, the 2015-2016 BNTPS findings point to the clear need for ZTBCB to develop special interventions in urban areas with particular focus on males and elderly populations. Under-five children will merit special consideration because of the greater susceptibility of young children to disseminated TB;their relatively low case identification and high morbidity and mortality; and the ability by the MOHFW and NGOs to serve them through maternal and child health and nutrition fixed-site and outreach platforms. Pregnant women likewise will remain a focal population because of their TB risks and the number and capacity of existing antenatal care centers and NGO platforms that serve them.

The BNTPS found that of the 278/100,000 bacteriologically confirmed TB cases, if X-ray alone were used as a screening tool, 251 (90.3%) the TB cases could be diagnosed as TB. However, if symptoms alone were used as a screening tool, only 108 (38.8%) could have been captured. Therefore, chest X-ray screening is a highly sensitive procedure to identify TB that, along with rapid molecular testing, should be widely available and accessible.

The BNTPS also reported that only a minority (29.9%) of urban residents with bacteriologically confirmed TB sought care for their symptoms. Of those individuals, 49.3% were seen by pharmacists/drug sellers followed by government hospitals (13.8%), graduate medical practitioners (13.6%), private hospitals/clinics (7.9%), and non-graduate providers (5.6%); an additional 7.5% treated themselves. These data indicate that qualified practitioners from hospitals and clinics or with private practice managed only a minority (35.3%) of urban residents with bacteriologically confirmed TB. A marked need therefore exists to raise public awareness and develop effective community-based screening and referral networks between informal providers and qualified medical practitioners in urban areas.

C. An Urban Strategic Approach

Urbanization is occurring rapidly in Bangladesh. By 2050, the urban population is projected to account for more than half of Bangladesh's total population. Slum settlements have proliferated as part of this trend, with a recent census counting approximately 15,000 slum settlements across the country. Because TB typically is more prevalent in areas with high levels of poverty, deprived populations, compact and crowded neighborhoods, and residences with poor ventilation,[12] ***ZTBCB will pay special attention to urban slums, high-density workplaces/factories, and locales identified with large numbers of floating migrants.*** The Bangladesh Census of Slums and Floating Populations 2014[13] defined a slum as a cluster of compact settlements of five or more households that has developed in an unplanned manner

[11] Urban TB prevalence is likely underestimated in the survey because the sample did not include slum areas and high-risk congregate settings, such as prisons and garments factories.

[12] Lonnröth K, Jaramillo E, Williams BG, et al. Drivers of tuberculosis epidemics: the role of risk factors and social determinants. *Social Science and Medicine.* 2009; 68 (12): 2240-46.

[13] Bangladesh Bureau of Statistics. Census of Slum Areas and Floating Populations. September 2014.

and exhibits unhealthy conditions. Slum dwellers are characterized by low socio-economic status; their major occupations include rickshaw/van pulling, garment and other factory work, service work, and construction and day labor. Slum housing structures are densely clustered, dilapidated, and built of cheap materials; rooms are crowded, with all household members typically living in one room. The 2014 Census found that 51.2% of slum dwellers were male and that 33.2% of those aged seven or older were literate.

The Census defined a floating population as a mobile and vagrant category of rootless people who had no permanent dwelling and were economically deprived. This population is exposed to disease and suffers from severe detection, outreach, and treatment challenges because of their residential dislocation. The Census found that a full 75.2% of floating migrants were male and that only 18.8% of those aged seven or older were literate.

As a government initiative, ***ZTBCB will foster a close partnership between the MOLGRDC, MOHFW, city corporations, and the NTP for eliminating TB in big cities.*** Operationally, the cities with 1 million or more population will be considered for ZTBCB interventions in phases**.** The MOHFW is the lead ministry to establish national health policy, formulate guidelines, and deliver secondary and tertiary level health services to urban residents. The MOLGRDC is responsible for overseeing primary health care in urban areas, although actual service delivery is often conducted by NGOs. This governance and implementation structure has led to inadequate coordination between various levels of government and nongovernmental authorities and management. Supported by development partners, NGOs deliver nonprofit urban health services at the primary health care level, but they too remain insufficiently coordinated with government structures and administration and are suboptimally regulated by them. In addition to coordination deficiencies, understaffing, low staff competency, and low staff effort contribute to an unsatisfactory quality of service delivery. Thus, ***ZTBCB will strengthen coordination mechanisms between the MOLGRDC, MOHFW, city corporations, and the NTP to improve health service delivery in urban settings.***

The private sector is robust in urban areas but it is also poorly linked to government authorities. It is fee-based and for-profit, and includes hospitals, clinics, diagnostic centers, pharmacies, and private practices operated by medical doctors and informal or traditional health practitioners. Private facilities are more accessible than public ones because of their widespread service coverage and longer, more convenient service hours. Many private providers offer services at low fees, making them affordable to the poor, especially after accounting for the monetary and nonmonetary costs of traveling to less accessible public and NGO facilities. Evidence from the 2015-2016 BNTPS suggests that Bangladeshis with TB symptoms generally first seek care from pharmacists, drug sellers, and informal providers and then, if they fail to recover, from qualified government and private health service providers. Slum residents in Dhaka prefer to seek health services from pharmacies and informal or traditional health service practitioners. Two key issues affecting private sector services include lack of quality control standards and enforcement and insufficient notification of diagnosed cases to the NTP. Taking these gaps and crucial needs for urban strategic approach into account, ***ZTBCB will involve the private sector with the urban TB care delivery system, which will help combating TB in Bangladesh.***

D. A Strategic Approach Based on Co-Morbid Conditions and High-Risk Populations

TB is a disease that is unequally distributed across populations. Not only is it generally higher in urban rather than rural areas, it is also more common among certain population groups. Considering that the goal of ZTBCB is to halve the TB incidence rate in cities within seven years, a recommended approach would maximize measurable impact and efficient use of resources. For this reason, ***ZTBCB will spotlight those populations that scientific evidence indicates run the greatest risk of developing TB infection and disease.*** They include people with co-morbid conditions and behaviors and those with demographic characteristics that place them at risk of developing TB. ***ZTBCB will target its interventions at people with three conditions—HIV, diabetes, and undernutrition—that put them at heightened risk of acquiring TB.*** The relationships are bidirectional, so that people suffering from TB also experience a higher risk of developing HIV, diabetes, and undernutrition.

HIV: Globally, people living with HIV (PLHIV) run a 20-to-40-fold higher risk of developing active TB than HIV-negative people, and TB incidence is 5-fold higher even in HIV co-infected people on effective antiretroviral therapy. The AIDS epidemic to date has largely been contained in Bangladesh. HIV prevalence remains low among the general population and stands at <1% among key populations. The estimated number of PLHIV in Bangladesh was 12,000[14] in 2016, up from approximately 9,600 in 2015. Of the 578 new HIV cases reported in 2016, 110 were people who inject drugs (PWID) and 189 were migrants.

Although HIV prevalence has remained low in Bangladesh, new evidence suggests that the future might be different. In 2016, weighted estimated HIV prevalence among male PWID in Dhaka stood at around 22%, compared to 5.3% in 2011; any increase of prevalence of this magnitude would likely result in a concomitant increase in TB prevalence. Although all PLHIV were screened for TB, only 0.55% of TB patients were tested for HIV in 2017. A scant 10 DOTS centers of Bangladesh's estimated 1,100 DOTS sites screened for HIV; of the 1,100 TB cases tested, 45 (4%) of TB cases tested positive. The national co-infection guidelines support the international recommendation of HIV screening for all TB patients unless the patient declines the procedure.

WHO's new screening guidelines recommend that "people living with HIV should be systematically screened for active TB at each visit to a health facility." Considering the high percentage of Bangladeshis likely exposed to TB, regular and active screening for the disease among PLHIV and high-risk contacts of PLHIV is imperative. Conversely, TB patients with clinically or bacteriologically confirmed TB disease are at high risk of acquiring HIV or in close contact with a PLHIV should also be screened for the disease. The National Guidelines on TB/HIV Management Program Collaboration and Implementation Manual recommend that HIV

[14] UNAIDS. Country Fact Sheet Bangladesh 2016 [webpage]. www.unaids.org/en/regionscountries/countries/bangladesh. Accessed May 2, 2018.

testing should be offered to TB patients at high risk of developing HIV and to those with clinical signs and symptoms of HIV.[15]

Diabetes: People with diabetes mellitus (DM) are three times more likely to develop active TB than people without diabetes.[16] Evidence suggests that diabetes constitutes a risk factor for TB presentation and treatment and that TB might aggravate glucose intolerance and glycemic control in people with diabetes.[17] As of 2016, diabetes was the fifth leading cause of death in Bangladesh, accounting for 3% of all mortality.[18] The 2011 Bangladesh Demographic Survey found that 11% of men and women are diabetic and an additional 25% of men and women are pre-diabetic.[19]

The 2018-2022 NSP identified diabetes as a high-risk condition and called for a "comprehensive multi-component approach to increase access to TB services for DM patients by improving prevention, early case detection, and quality of care for persons with diabetes and TB. . . ." The National Guidelines for the Management of Tuberculosis and Diabetes Mellitus Co-Morbidity state that "bi-directional screening of tuberculosis patients for diabetes and diabetes patients for tuberculosis is imperative in routine health care settings."[20]

Undernutrition: Globally, people who are undernourished or underweight run a 12-fold higher risk of developing active TB than people who are adequately nourished. Malnutrition and micronutrient deficiencies heighten the risk of active TB, which in turn worsens malnutrition.[21] The number of malnourished people in Bangladesh remains high. Malnutrition rates are relatively severe in urban slums, where 49.6% of under-five children living in City Corporation slums are stunted and 18.5% are wasted.[22] Only 26% of children 6-23 months in slums are fed with proper infant and young child feeding practices, compared with 40% for non-slum children. Micronutrient challenges remain a public health concern, with 20% and 44% of pre-school-aged children suffering from vitamin A and zinc deficiencies, respectively. The 2018-2022 NSP calls for clinic and outreach service providers to screen for malnutrition and TB; referral and monitoring mechanisms should also be in place for both conditions.

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[15] Bangladesh TB Control Program, National AIDS/STD Program, and WHO Country Office for Bangladesh. *National Guidelines on TB/HIV Management Program Collaboration and Implementation Program.* 2nd Ed. 2016.
[16] van Crevel R, Dockrell HM, TANDEM Consortium. TANDEM: understanding diabetes and tuberculosis. *Lancet Diabetes & Endocrinology.* April 2014; 2 (4): 270-72.
[17] Dooley KE and Chaisson RE. Tuberculosis and diabetes mellitus: convergence of two epidemics. *Lancet Infectious Diseases.* December 2009; 9 (12): 737-46.
[18] Institute for Health Metrics and Evaluation. Country profile: Bangladesh. http://www.healthdata.org/bangladesh. Accessed June 12, 2018.
[19] National Institute of Population Research and Training (NIPORT), Mitra and Associates, and ICF International. *Bangladesh Demographic and Health Survey 2011.* Dhaka, Bangladesh, and Calverton, MD, US: NIPORT, Mitra and Associates, and ICF International, 2013.
[20] GOB. National Guidelines for the Management of Tuberculosis (TB)-Diabetes Mellitus (DM) Co-Morbidity. 1st Ed. November 2014.
[21] Ortblad KF, Salomon JA, Bärnighausen T, and Atun R. Stopping tuberculosis: a biosocial model for sustainable development. *Lancet* series: Tuberculosis elimination. October 2015. 386 (10010): 2354-62.
[22] National Institute of Population Research and Training (NIPORT). Bangladesh Urban Health Survey 2013.

Populations at high risk of developing TB in Bangladesh include close contacts of people with TB, children under the age of five, adults aged 65 or older, men, pregnant women, slum dwellers and street populations, people living or working in congregate settings (prisons, factories etc.) and smokers. ***ZTBCB will carry out targeted interventions among all high-risk population in urban areas.***

Close contacts: Close contact with persons known or suspected to have TB disease is a significant risk factor for developing TB infection,[23] and the risk of a contact becoming infected is related to the infectiousness of the TB patient and the duration, proximity, and susceptibility of the contact.[24] Household contact investigation yields 1-5% of the expected prevalence of newly diagnosed TB.[25] Recent WHO guidelines now recommend that "in countries with a high TB incidence, children aged ≥ 5 years, adolescents and adults who are household contacts of people with bacteriologically confirmed pulmonary TB who are found not to have active TB by an appropriate clinical evaluation or according to national guidelines may be given TB preventive treatment."[26]

The National Guidelines and Operational Manual for Tuberculosis Control currently recommend that health providers actively ask TB patients about chronic coughing by household members. ZTBCB will target people with chronic cough and encourage them to visit a health facility for sputum examination. All household contacts under age 15 of TB patients and household contacts of identified DR-TB patients will be examined for signs of TB. If household contacts are unable to visit the health facility, health workers or community workers involved with TB management will visit the patient's house and ask them to identify people with symptoms suggestive of TB.

Children less than five years of age: Under-five children are identified as a group of concern for TB infection and disease. The most common age of children who present with the disease is between one and four years.[27] Children are especially vulnerable to extrapulmonary disease; children, especially those under the age of two, run a relatively high risk of developing severe, disseminated TB associated with high morbidity and mortality. Diagnosis with smear microscopy presents special challenges for children because it is difficult for them to expectorate sputum. Therefore, the latest WHO guidelines recommend use of Xpert MTB/RIF for children in preference to conventional microscopy. WHO also recommends clinical

[23] US Centers for Disease Control and Prevention (CDC). *Core Curriculum on Tuberculosis: What the Clinician Should Know.* 6th Ed. Atlanta, GA: CDC, 2013.
[24] Fox GJ, Barry SE, Britton WJ, and Marks GB. Contact investigation for tuberculosis: a systematic review and meta-analysis. *European Respiratory Journal.* 2013; 41: 140-56.
[25] Yuen CM, Amanullah, F, Dharmadhikari A et al. Turning off the tap: stopping tuberculosis transmission through active case-finding and prompt effective treatment. *Lancet* series: Tuberculosis elimination. October 2015; 386 (10010): 2334-43.
[26] WHO. *Latent Tuberculosis Infection: Updated and Consolidated Guidelines for Programmatic Management.* Geneva: WHO, 2018.
[27] WHO. *Guidance for National Tuberculosis Programmes on the Management of Tuberculosis in Children.* 2nd Ed. Geneva: WHO, 2014.

investigation of child contacts with symptoms suggestive of TB; children under the age of five; and children with known or suspected immunocompromising conditions (particularly HIV); and child contacts of index cases with MDR-TB or XDR-TB***. ZTBCB will follow recommended procedures of TB preventive treatment for under-five children who are household or close contacts of people with TB.***

Severe malnutrition is identified as a risk factor for children with TB[28] in the National Guidelines and Operations Manual for Tuberculosis Control. The NTP reported that childhood TB cases accounted for only 4% of all TB cases detected in 2015, well below the 8% of all cases described by the national target for 2022. The 2018-2022 NSP called for an expansion of child TB training, including training for health workers to undertake contact investigation using tuberculin skin tests; provision of isoniazid preventive treatment (IPT) for child contacts of active cases; expanded use of chest radiography and gastric lavage for small children; and the development of systems to support active case finding of child TB cases through contact investigation. It is also important for the NTP to record and report all children treated for TB. The current National Guidelines and Operational Manual for Tuberculosis Control recommend that all children less than five years, whose household contacts are under treatment for smear-positive TB, should be given chemoprophylaxis with isoniazid for six months if they are free of active TB disease.

Adults 65 years of age and over: The number of people aged 65 and over in Bangladesh grew from 6,079,086 (4.3% of the total) in 2005 to 8,007,209 (5.0%) in 2015. This population runs an elevated risk of developing and dying from TB. The 2015-2016 National TB Prevalence Survey showed notification of only 23.4% of bacteriologically confirmed cases of TB in elderly people, the lowest notification rate of any demographic group. The reasons for this under-notification are unclear and not well described in the literature. Elderly people generally have not been targeted for awareness-raising or active case detection in Bangladesh. In addition, they might have weakened immune systems; conditions such as DM that increase their risk of TB; chronic renal failure or certain types of cancers; exposure to pollution; malnutrition; economic and social disempowerment; or poor health seeking behaviors. Certain elderly populations, such as widows, might be at heightened riskBecause elderly people commonly act as caregivers in Bangladesh, failure to adequately detect and treat this population likely increases the risk to young children or other household members needing care. In consistent with the recommendations of the 2018-2022 NSP, ***ZTBCB will reach out to the elderly through contact investigation, FAST[29] activities in hospital outpatient departments and high-risk congregate settings, and expanded X-ray screening in places accessible by the elderly.***

Men: Globally, males have a two-fold higher risk of developing active TB than females. The results of a recent systematic review and meta-analysis of TB prevalence for smear-positive TB by sex demonstrated that TB prevalence is significantly higher among men than women in low-

[28] GOB. *National Guidelines and Operations Manual for Tuberculosis Control.* 5th Ed. Dhaka: NTP, June 2015.
[29] Finding TB cases actively, separating safely, and treating effectively. FAST is an active case finding approach that is used to screen symptomatic individuals and separate and treat them in large congregate settings such as outpatient departments in tertiary hospitals.

and middle-income countries; the study attributes much of this discrepancy to different health seeking behaviors among men and women.[30] The authors state that "men have a higher prevalence of TB and, in many settings, remain infectious in the community for a longer period of time than women. Men are therefore likely to generate a greater number of secondary infections than women, and social mixing patterns have suggested that, as a result, men are responsible for the majority of infections in men, women, and children." Sex differences in Bangladesh are particularly stark,[31] with the estimated bacteriologically confirmed prevalence being 452/100,000 (CI: 379-526) for males and 143 (CI: 109-178) for females. Prevalence-to-notification ratios[32] are 3.6 for men and 1.9 for women, indicating that only 28.1% of TB cases among men are notified, compared to 53.1% for women. Following the 2018-2022 NSP recommends, ZTBCB will develop [policies and approaches that provide better access to services for men and encourages TB clinics to remain open during hours convenient to them.

Pregnant women: Globally, TB is one of the top five killers of adult women in the 20-59 age range, and TB among mothers is associated with a six-fold increase in perinatal deaths and a two-fold higher risk of premature birth and low birth weight. Pregnant women infected with TB are more likely to progress to active TB disease than men.[33] TB in pregnant women living with HIV increases maternal and infant mortality by almost 300%. Although antenatal care facilities might not have the trained staff to diagnose TB appropriately,[34] antenatal care visits offer an excellent opportunity to perform symptom and risk screening for pregnant women and to refer possible cases for appropriate diagnostic and treatment services.

Smokers: Scientific evidence suggests that tobacco smoking is positively associated with TB. Smokers have a relatively high risk of developing TB infection and active disease and dying from TB. The risk of TB is also elevated for people exposed to passive smoking and is especially high for children who are not normally at high risk of active disease.[35] Smokers appear to have a prolonged period of contagiousness and might transmit the infection to their contacts for a longer period than nonsmokers.[36] Cure rates in patients newly diagnosed with pulmonary TB are also lower in smokers than in nonsmokers and quitters at two months.[37]

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[30] Horton KC, MacPherson P, Houben RM, et al. Sex differences in tuberculosis burden and notifications in low- and middle-income countries: a systematic review and meta-analysis. *PLoS Medicine.* 2015; 13 (9): e1002119.

[31] National Tuberculosis Prevalence Survey, Bangladesh, 2015-16: Preliminary Results.

[32] Prevalence: bacteriologically confirmed cases from the National Prevalence Survey. Notifications: pulmonary TB (new bacteriologically and clinically diagnosed) from the National TB Program 2015. Note that notifications for women (76/100,000) are lower than for men (143/100,000).

[33] Bates M, Ahmed Y, Kapata N, et al. Perspectives on tuberculosis in pregnancy. *International Journal of Infectious Diseases.* 2015; 32: 124-27.

[34] University Research Corporation. *Tuberculosis in Pregnancy: Situational Analysis of Screening and Treatment of TB in Pregnant Women.* Bethesda, MD: University Research Corporation. 2017.

[35] Lin H, Ezzati M, and Murray M. Tobacco smoke, indoor air pollution and tuberculosis: a systematic review and meta-analysis. *PLOS Medicine.* 2007; 4 (1): e20.

[36] Zellweger JP, Cattamanchi A, and Sotgiu G. Tobacco and tuberculosis: could we improve tuberculosis outcomes by helping patients to stop smoking? *European Respiratory Journal.* 2015; 45 (3): 583-85.

[37] Masjedi MR, Hosseini M, Aryanpur M, et al. The effects of smoking on treatment outcomes in patients newly diagnosed with pulmonary disease. *International Journal of Tuberculosis and Lung Disease.* 2017; 21 (3): 351-56.

The WHO age-standardized prevalence estimate for daily tobacco smoking in Bangladesh was 20.4% of the population in 2015, with a significant sex differential of 39.8% for males and 0.9% for females.[38] The most recent survey statistics of adult cigarette smoking from the 2009-2010 Non-Communicable Risk Factor Survey in Bangladesh showed that 26.2% of the population was currently smoking tobacco—54.8% of males and 1.3% of females. The 2015-2016 Bangladesh National TB Prevalence Survey showed that 20.6% of the urban survey participants were current smokers: 43.7% of urban males and 1.3% of urban females.

II. The International Zero TB Cities Initiative

Bangladesh is an important, innovative member of the international Zero TB Cities Initiative community. As such, it will draw on the experiences of other member cities and countries and share its experiences with them. Bangladesh under ZTBCB will receive and provide technical assistance, attend international forums and conferences to exchange lessons learned, and donate to a common storehouse of knowledge about urban TB management. The successes of ZTBCB will place the Bangladesh as pioneer in the international platform for urban TB programming. Its impact should attract investment not only for itself but also for the entire international ZTBCI movement.

The international ZTBCI is a novel, holistic approach that creates ''islands of elimination" by implementing a comprehensive TB "Search, Treat, and Prevent" package in cities through the active participation of national and city governments and other stakeholders. The rationale for a comprehensive approach to eliminate TB has been described in a series of *Lancet* articles entitled Tuberculosis Elimination. It possesses three interlinked components of Search, Treat, and Prevent[39] as the means to accelerate the reduction of TB incidence rates and thereby contain the disease in a sustainable fashion. The approach directly addresses the two principal explanations for the lack of rapid decline in incidence: missed or late diagnosis of active TB disease and untreated TB infection.[40]

SEARCH means to actively find and screen people who have TB disease. It recognizes that delays in diagnosis result in increased illness, risk of death, and TB transmission. Targeted active case finding involves finding, screening, and diagnosing people who are at high risk of falling ill with TB[41] at an early stage of the disease.

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[38] WHO. *WHO Report on the Global Tobacco Epidemic 2017: Monitoring Tobacco Use and Prevention Policies.* http://apps.who.int/iris/bitstream/handle/10665/255874/9789241512824-eng.pdf;jsessionid=0DA2ACE4108EC17E334A5008A993EEE4?sequence=1. Accessed on May 1, 2018.

[39] Advance Access & Delivery, Search-Treat-Prevent: A Comprehensive Strategy [webpage]. http://www.advanceaccessanddelivery.org/tb-activist-toolkit/. Accessed on May 18, 2018.

[40] Lonnröth, K, Corbett E, Golub J et al. Systematic screening for active tuberculosis: rationale, definitions and key considerations. *International Journal of Tuberculosis and Lung Disease.* 2013; 17 (3):289-98.

[41] Advance Access & Delivery, Harvard Medical School Health Delivery–Dubai, Interactive Research and Development, and Partners for Health. *Getting to Zero: A Guide to the Search, Treat, Prevent Comprehensive Approach for TB.* Durham, NC: Zero TB Initiative, March 2017. https://static1.squarespace.com/static/54e39cb6e4b096d5269be282/t/58eba0b53a0411706a599aff/1491837111138/Getting+to+Zero+STP+Pamphlet+-+March+2017.pdf.

TREAT means to deliver prompt and appropriate treatment to people who are sick with TB to reduce their contagiousness. Minimizing the delay between diagnosis and treatment is critical for stopping transmission and ensuring that patients experience a good treatment outcome. Using molecular diagnostics such as Xpert MTB/RIF or Xpert Ultra ensures that the initial screening or diagnosis is accompanied by a rifampicin susceptibility test, which allows rifampicin-resistant patients to immediately initiate an appropriate regimen and undergo further testing to exclude MDR- or XDR-TB. Throughout treatment, patients should be empowered and linked to appropriate social support interventions. Approaches that address economic and social barriers to treatment adherence and completion are important for the success of a comprehensive TB program.

PREVENT means to protect people from exposure, which in turn will reduce wider disease transmission. People who have been exposed to individuals with active disease have increased probability of themselves becoming infected. Studies in low- and middle-income countries have found that exposure to pulmonary TB disease amplified risk of illness and infection and transmission of the disease to the community. More than 3% of contacts had active TB disease, and more than 50% were infected after exposure to people ill with the disease.[42] All health care facilities offering TB services should therefore take appropriate infection control measures to prevent the spread of the disease.

Individuals infected with TB but free from TB disease or other contraindications should receive TB preventive treatment to stop progression from infection to disease.[43] People infected with TB constitute a reservoir of potential future active disease cases. Estimates suggest that roughly 10% of immunocompetent people infected with TB will eventually fall ill with active disease. Without treatment, approximately 5% of people with normal immune systems who have been infected with TB will develop disease in the first year or two after infection, and another 5% will develop disease sometime later in life.[44] Even if health systems could find and instantly treat every new TB patient, the epidemic would remain unchecked. Drastically shrinking that reservoir of people who are infected with TB is the only way to eliminate the disease. This will require reducing the burden of infectious TB through early and active case finding, protecting people from exposure to the TB bacteria, and treating people who have been exposed to TB with preventive treatment, preferably with shorter regimens.

The ZTBCI is based on persuasive scientific evidence that suggests that a comprehensive approach that includes active case finding and TB infection treatment leads to epidemic

[42] Morrison J, Pai M, and Hopewell PC. Tuberculosis and latent tuberculosis infection in close contacts of people with pulmonary tuberculosis in low-income and middle-income countries: a systematic review and meta-analysis. *Lancet Infectious Diseases.* 2008; 8 (6): 359-68.
[43] Rangaka MX, Cavalcante SC, Marais BJ, et al. Controlling seedbeds of tuberculosis: diagnosis and treatment of tuberculosis infection. Lancet series: Tuberculosis elimination. October 2015; 386(10010): 2344-53.
[44] US Centers for Disease Control and Prevention. Core Curriculum on Tuberculosis. 2013.

control. One study conducted in Alaska in the 1950s demonstrated that households whose contacts were treated with isoniazid preventive therapy had 60% lower new cases of TB than in households whose contacts were not treated; this reduced risk of developing TB was sustained for 20 years. Another study in Tomsk, Russia, showed that an intensive TB control program resulted in a dramatic decrease in deaths in prisons between 1999 and 2006. The impact of this localized comprehensive intervention impacted TB notification rates throughout the Tomsk Oblast (region), resulting in a reduction of TB prevalence from 108/100,000 to 75/100,000 in the same period. Similarly, New York City achieved a decline in TB prevalence from 52/100,000 in 1992 to 12/100,000 in 2009 using a comprehensive approach.

Recent studies in Brazil have investigated the effect of active case finding combined with preventive treatment for household contacts of TB patients. After five years, the number of new TB cases was 10% lower in those communities compared with a 5% increase of new TB cases in communities whose household contacts were not screened. Another study screened patients enrolled in HIV clinics in Brazil and treated those who had TB infection with preventive treatment, which reduced the number of new TB cases in the patient population by between 25% and 30%.

Mathematical models predict that using preventive treatment in low- and high-income countries would be cost effective and would have a large population-level impact. In India, for example, models predict that scaling up mass preventive treatment from 2025 onward would reduce the incidence of TB to one case per million people by 2050. By 2035, the number of deaths caused by TB in India could drop from 190 people per million to fewer than 10 per million.[45] Mathematical modeling indicated that significant share of the disease burden in India could be attributed to smoking (40%) and diabetes (15%).[46]

Search, Treat, and Prevent interventions must be undertaken comprehensively and at the same time; they will not be as effective if implemented piecemeal. The scientific studies and mathematical models cited above suggest that deploying these interventions in combination with one another will rapidly lower TB cases and deaths. Creating systems to implementing the STP strategy will require resources, reorganization, and integration of activities with other programs and commitment by governments, the public and private health sectors, and communities. If optimally implemented, the STP approach will move the NTP toward eliminating TB; the systems developed can be used as a model for other diseases as well.

The ZTBCI is now being implemented in cities as diverse as Chennai (India), Karachi and Peshawar (Pakistan), Kisumu (Kenya), Lima (Peru), Odessa (Ukraine), Ho Chi Minh City (Vietnam), Ulaanbaatar (Mongolia), and Chisinau (Moldova). Other potential sites are under consideration throughout Asia, Europe, and the Middle East.

[45] Dye C, Glaziou P, Floyd K, and Raviglione M. Prospects for tuberculosis elimination. *Annual Review of Public Health.* 2013; 34: 271–86.

[46] Lonnröth K, Castro KG, Chakaya JM, et al. Tuberculosis control and elimination 2010-50: cure, care, and social development. *Lancet.* 2010; 375 (9728): 1814-29.

III. Zero TB Cities Bangladesh

Starting in January 2017, the NTP and key stakeholders expressed an interest in developing a dedicated urban initiative for TB management in Bangladesh based on the recommendations of the Joint Monitoring Mission and the National Strategic Plan for TB. The Government organized a conference in May 2017 for government and nongovernmental stakeholders, international and national TB experts, development partners, physicians, and researchers to discuss key challenges in developing and implementing this initiative. Conference objectives included: (1) presenting evidence on effective urban TB health approaches; (2) identifying lessons learned, successes, and failures in urban TB health programming; and (3) recommending strategic approaches to address urban TB management in Bangladesh.

The conference highlighted the importance of implementing active case finding and TB preventive therapy to lower TB incidence rates and suggested adopting a "Search, Treat, and Prevent" approach in Bangladesh. Following the conference, the GOB officially launched the Zero TB Cities Initiative in Bangladesh (later changed to Zero TB Cities Bangladesh) on October 28, 2017, in a ceremony that garnered national and international attention. At the event, the Honorable Mohammed Nasim, Minister of Health and Family Welfare, expressed the government's commitment to end TB and signed a declaration calling for "uniting to make our cities TB free." The seven points of the declaration are as follows:

1. Actively search for people with TB in every city in the country and, once found, put them under mandatory notification and treatment.
2. Provide equitable access to quality diagnostic services for all presumed TB patients.
3. Provide quality treatment to all diagnosed TB patients free of cost.
4. Support an active program to prevent TB infection and disease.
5. Serve urban people with special attention to the poor and underserved populations and those at highest risk of developing TB.
6. Support public-sector, NGO, and private sector platforms and services for universal access.
7. Work with partners with full enthusiasm for urban TB control.

Being motivated by the success of the International Zero TB Cities Initiative, ***ZTBCB will adopt the "Search, Treat, and Prevent" approach as its strategic roadmap*** in order to make significant progress towards the above declaration points.

IV. Vision, Goal, and Objectives of the Zero TB Cities Bangladesh Strategic Roadmap

Vision: Zero TB Cities Bangladesh will end TB in cities through a comprehensive approach implemented by national and local governments; public sector, NGO, and private sector providers; and communities.

Goal: By implementing the ZTBCB approach, the National TB Control Program will reduce the TB incidence rate by 50% in big cities by 2025 compared to the base incidence rate in 2015.

Objectives:

1. Develop a comprehensive, targeted "Search, Treat, and Prevent" continuum of services that actively and at an early stage of TB finds most people with the disease and successfully tests and treats them. The approach prevents TB in people with close and prolonged exposure to the disease.
2. Establish networks of public sector, NGO, private sector, and community health providers that form referral chains for formal screening, diagnosis, and treatment processes.
3. Prioritize an approach for cities and people at greatest risk of developing the disease.
4. Integrate TB into an essential service package of urban health services under the principles of universal health coverage that promotes equitable and affordable access to quality TB diagnostic and treatment services for urban residents.
5. Develop a monitoring and evaluation system that generates rigorous measurement of interventions along a continuum of STP services and enables an evaluation of the impact of the ZTBCB approach.

V. The Zero TB Cities Bangladesh Strategic Roadmap

In June 2017, the Task Force for the Urban TB Initiative, under the NTP's leadership, developed a ZTBCB roadmap that identified eight strategic "Search, Treat, and Prevent" components to achieve drastic reduction in the incidence rate. The Chakra below is a visual representation of the roadmap. It indicates that the Search, Treat, and Prevent components are part of a continuous and synergistic process. Search components include active case finding (ACF), provider engagement, and rapid and accurate diagnostics in the public and private sectors. Treat components include engagement by a network of public and private providers, integrated care of TB patients, and treatment support; and prevent components include airborne infection control and TB preventive treatment. These eight components are accompanied by 25 sub-components and nine cross-cutting health systems interventions.

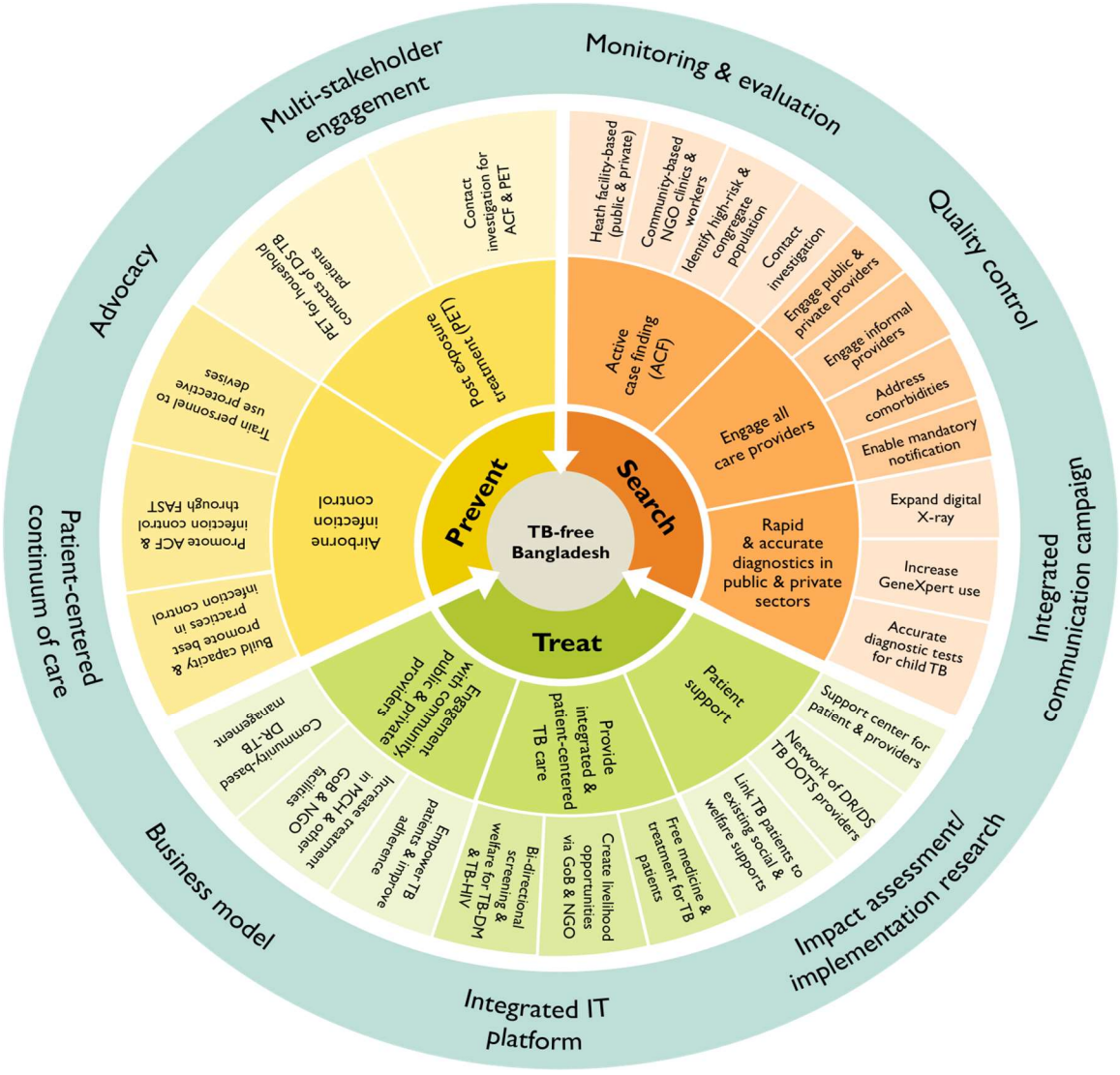
A. Search

ZTBCB will undertake early and active case finding (ACF) by formal and informal health providers to identify people with TB. Screening, however, will have an impact only if it is linked to good diagnostic services. ZTBCB will develop active referral networks and the accurate diagnosis of people with TB through use of rapid and sensitive diagnostic technologies in public and private sector health facilities.

Active case finding: ACF will occur in facilities and communities. Types of facilities will include hospital inpatient and outpatient departments, private and NGO clinics, and congregate sites such as prisons, factories, and dormitories. The FAST approach has the potential to yield a substantial number of patients in these kinds of settings. It is effective in finding new cases of

TB among patients visiting health care facilities. The FAST approach might also be adapted for congregated settings and community-based active case finding and diagnosis.

The Chakra: Visual Representation of ZTBCB Strategic Roadmap



People with possible TB will be identified through community-based approaches in high-transmission urban areas like slums. These approaches will include outreach by community health providers, mobilization of schoolchildren to act as change makers in their communities, and the possible use of mobile vans equipped with digital chest X-ray with computer-aided detection and Xpert machines. ZTBCB will develop special interventions to identify and screen all major high-risk groups. NTP and its partners will support extended opening hours for clinics delivering services to underserved populations such as working men and women, floating migrants, and street populations. It will advocate for NGO clinics to be open at times that are convenient for all members of the community.

ZTBCB will develop linkages between DOT centers and NGO clinics and outreach workers to undertake contact investigation, and it will explore using diagnostic clinics and the private sector in the same capacity. All household members and close contacts (as per the NTP definition of a close contact) of index patients will be screened for TB symptoms and provided with appropriate treatment (see below). Because an accurate definition of a close contact might result only from program experience, ZTBCB will gather baseline evidence before finalizing it.

Pharmacists, drug sellers, and informal health providers are common entry points for people with TB symptoms. ZTBCB will therefore develop a network of these community providers to identify and refer possible TB patients to qualified health practitioners and appropriately equipped diagnostic centers (centers with access to X-ray machines and Xpert machines). It will develop methodologies to track and record people with TB through a continuum of screening, referral, diagnosis, and treatment procedures.

Screening and testing provider engagement: ZTBCB will establish a coordination mechanism between the public and private sectors to standardize procedures for TB screening and diagnosis. Once a TB patient is diagnosed, all public and private health providers should notify their patients to the NTP according to the official mandatory Bangladesh government policy.

ZTBCB will address co-morbid conditions such as HIV, diabetes, and undernutrition (although other conditions, such as chronic pulmonary diseases and mental health, might also be considered). Coordination mechanisms with the National AIDS and STI Program will be developed to encourage bidirectional screening between TB facilities and HIV/AIDS treatment centers. Similar coordination mechanisms will be established to encourage TB and diabetes and TB and nutrition reciprocal screening at the primary health care level.

Rapid and accurate diagnostics: ACF activities are effective only if appropriate diagnostics exist and are fully operational in the public and private sectors. Countries with the highest TB burdens still rely heavily on conventional sputum smear microscopy, which is a test of low sensitivity. The 2015-2016 National TB Prevalence Survey found that 61.2% of cases were smear negative among those bacteriologically confirmed by Xpert MTB/RIF or culture. Recognizing the challenges associated with conventional sputum smear microscopy, the NTP's new algorithm recommends chest X-ray screening that, if indicated by the findings, is followed by Xpert testing. The NTP is rapidly expanding its network of Xpert machines in the country, including in urban areas. Bangladesh already has sufficient numbers of X-ray machines in the public and private sectors that can be deployed for TB screening, but ZTBCB will effectively link them with the Xpert technologies and clinical diagnosis. In addition, ZTBCB will monitor this linkage and the use of the recently approved national algorithm for TB screening and testing. The NTP algorithm for clinical and laboratory diagnosis will continue to play an essential role in diagnosing TB in children and people living with HIV.

B. Treat

Treatment provider engagement: Under ZTBCB, appropriate treatment will begin immediately after a patient is diagnosed and notified to the NTP. Stopping the TB epidemic requires treating people with the right medications in the right dosages for the recommended duration. In Bangladesh, adherence support can occur in the community or at public sector and private sector facilities. ZTBCB will strengthen the treatment support network by investing in a call center that provides patients and their caregivers with information and monitors their treatment adherence. It will also support the use of applications by public and private sector providers to track community-based interventions such as active case finding, contact investigation, and adherence monitoring. It will encourage TB patients to be aware that they are eligible to receive free Xpert testing and TB medications from all providers and that these services and drugs are conveniently accessible and available to them.

Integrated and patient-centered TB care: ZTBCB directly addresses the first pillar of the End TB Strategy: integrated patient-centered TB care and prevention. Integrated care reduces the expenditure of time and effort that TB-related activities can impose upon patients, making them more likely to complete proper treatment. ZTBCB will work with major stakeholders (MOHFW, MOLGRDC, city corporations, NGOs, civil society organizations, and the private sector) to integrate TB into general health services (particularly primary health care) and into relevant specialized HIV, diabetes, maternal and child health, and nutrition services. To address HIV/TB co-infection, TB and HIV programs will coordinate by providing TB screening during every HIV clinic visit and offering high-risk TB patients an HIV test. HIV-positive patients without TB or other contraindications will receive TB infection treatment according to national guidelines. ZTBCB will encourage use of rapid molecular testing and other relevant and updated technologies that can be deployed for both diseases.

Smoking cessation programs that raise awareness and provide joint counseling about TB and smoking will be considered in primary health care facilities and communities. ZTBCB will establish partnerships with community leaders and health providers to bolster TB detection and treatment; the establishment of a nexus of pharmacists and drug sellers to detect and refer TB cases actively and promptly will be important. ZTBCB will also create one network with linkages between public sector hospitals and diagnostic/treatment centers; private sector diagnostic and treatment facilities and practitioners; and community screening, referral, and treatment agents.

Treatment support: Social support contributes to and improves the quality of life patients and their families. In Bangladesh, this support has included psychosocial counseling for DR-TB patients; direct cash support for nutrition and baseline/follow-up diagnostic testing; and free access to drugs, diagnostic services, and nutritional support for all DR-TB patients enrolled in a study for new drugs. Provision of support has increased DR-TB cure rates from 64% to 70% (2011 versus 2014, NTP) and reduced loss to follow-up from 27% to 10% (2011 versus 2014, NTP). Treatment support will include provision of free drugs and Xpert testing, counseling for

treatment initiation and adherence, referral for services related to co-morbid conditions, and referral to existing government welfare and NGO social safety net programs.

C. Prevent

Airborne infection control: In Bangladesh, the FAST approach has been found to rapidly detect, diagnose, and treat people with TB in hospitals.[47] ZTBCB will encourage health facilities to adapt and institutionalize FAST as well as to implement other recommended airborne infection control measures such as good ventilation. Further, ZTBCB will include prevention activities for airborne infection management at health facilities, and build the capacity of health service providers to develop and deploy administrative and environmental control measures according to internationally recommended standards.

TB preventive treatment: Contact screening and treatment of TB infection are important elements of an effective prevent approach, although incorrect perceptions, inadequate training, insufficient financial support, and workforce constraints can limit their effectiveness. Identifying and treating people infected with TB are essential to achieve TB treatment targets.[48] ZTBCB will therefore undertake contact investigation to reach close contacts of index patients, diagnose and treat all those with active disease, and provide TB preventive treatment for all those without active disease or other contraindications. Contact investigation under ZTBCB will follow recommendations in the revised national TB guidelines.

According to the current guidelines, only children under the age of five and PLHIV are eligible for isoniazid preventive treatment. Based on the availability of resources, ZTBCB will increase provision of preventive treatment to all contacts in a phased manner starting with household members and then, if feasible, expanding to contacts residing in densely populated slums and other congregate settings. The recommended preventive therapy now is isoniazid given daily for at least six months. However, completion rates of preventive treatment are often low because of the long duration of treatment.[49] Recent WHO guidelines recommend shorter regimens that ease the burden on both patients and health systems. These regimens include three to four months of treatment with rifampicin once daily; three to four months of treatment with rifampicin plus isoniazid once daily; or three months of treatment with rifapentine plus isoniazid once weekly. ZTBCB will serve as a laboratory to investigate the implications of implementation of these different regimens for adults and children but will settle on the shortest regimen that achieves the highest rates of adherence, least severe side effects, and acceptable cost.

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[47] Nathavitharana RR, Daru P, Barrera AE, et al. FAST implementation in Bangladesh: high frequency of unsuspected tuberculosis justifies challenges of scale-up. *International Journal of Tuberculosis and Lung Disease.* 2017; 21 (9): 1020-25.

[48] Zenner D, Beer N, Harris RJ et al. Treatment of latent TB infection: an updated network meta-analysis. *Annals of Internal Medicine.* 2017; 167 (4): 248-55.

[49] Stuurman AL, Vonk Noordegraaf-Schouten M, van Kessel F, et al. Interventions for improving adherence to treatment for latent tuberculosis infection: a systematic review. *BMC Infectious Diseases.* 2016; 16: 257.

D. Cross-Cutting Health Systems Strengthening Elements

ZTBCB focuses on the second pillar of WHO's End TB Strategy: bold policies and supportive systems. It aligns with the GOB's universal health coverage (UHC) principles. UHC has two interrelated components: (1) the full spectrum of good quality essential health services according to need and (2) protection from financial hardship, including possible impoverishment, because of out-of-pocket payments for health services. The 2018-2022 NSP calls for reducing the number of TB-affected families facing TB-induced catastrophic costs to zero. ZTBCB will implement a comprehensive package of integrated, patient-centered TB health services by all providers using modern technologies in urban areas and among at-risk populations, while linking TB-affected families who encounter severe economic difficulties to existing welfare and social support services of GOB and NGOs.

ZTBCB will strengthen urban health systems for TB management following WHO recommendations on raising capacity and effectiveness for leadership and governance, financing, supply chain, information, health workforce, and integrated service delivery. Systematically and comprehensively strengthening the health system for urban TB management could serve as a model for the rural TB program and for other health programs in Bangladesh.

The ZTBCB Strategic Roadmap includes nine cross-cutting health systems strengthening elements that will enable the institutionalization and sustainability of the approach. Shown in the outer ring of the Chakra, they include (1) advocacy; (2) multi-stakeholder engagement; (3) monitoring and evaluation; (4) quality control; (5) integrated communications campaigns; (6) impact assessment/implementation research; (7) integrated information technology (IT) platform; (8) business model; and (9) patient-centered continuum of care. The section below that describes these elements is informed both by the Bangladesh TB experience and recommendations in WHO's End TB Strategy.[50]

Advocacy: The NTP demonstrated its commitment to urban TB management through the formal launch of the Zero TB Cities Initiative in October 2017. As ZTBCB moves into its implementation stage and expands geographically, the NTP and its partners will continue to exert this robust leadership by advocating that the MOHFW visibly support the initiative at all levels of the urban health system. This will also establish a coordination mechanism to secure support of the MOLGRDC, Ministry of Finance, Ministry of Planning, city corporations, and other governmental bodies of importance to the TB programming. Since ZTBCB supports the UHC strategy endorsed by the GOB, the NTP and its partners will lobby for the initiative with major development partners and potential contributors. Because mandatory notification has not yet been firmly established with the private sector, they should advocate with professional medical bodies/associations to encourage notification among private sector providers. ZTBCB will build a screening, referral, diagnosis, and treatment network among public sector, NGO, private sector, and community providers, and the NTP and its partners will play a critical leadership and

[50] WHO. *Implementing the End TB Strategy: The Essentials.* Geneva: WHO, 2015.

advocacy role in encouraging all network actors to follow national TB policies, regulations, and guidelines.

Multi-stakeholder engagement: ZTBCB engages multiple stakeholders at the international, national, and programmatic levels. As ZTBCB's leader, the NTP will directly involve the MOHFW (particularly the Directorate General of Health Services), MOLGRDC, drug regulatory authorities, city corporations and communities, NGOs, and private medical associations in defining and implementing policies, programs, and, if needed, specific interventions. Creation of a national high-level ZTBCB Steering Committee will be encouraged to endorse important policy and programmatic issues; and when appropriate, ZTBCB issues related to donor supported programming might also be discussed with the Bangladesh Country Coordinating Mechanism. ZTBCB will funnel programmatic and budget information to the MOHFW and MOLGRDC to enable proper levels of inter-ministerial funding and administrative support from the Ministry of Planning, Ministry of Finance, and other relevant government ministries. NTP will coordinate ZTBCB activities with HIV, diabetes, nutrition, maternal and child health, pulmonary disease, mental health, and smoking cessation public health programs.

ZTBCB will serve as an example of professional urban health implementation for the Fourth Health, Population, and Nutrition Sector Plan collaborating agencies and deliver appropriate TB services in other urban health programs funded by development partners. Its inclusion under any donor supported new urban primary health care project would be of interest.

Current United States Agency for International Development (USAID) projects that receive TB funding already support urban TB management and future ones are likely to continue this interest. Global Fund principal recipients and several of subrecipients are already engaged in urban TB management, and their activities might be coordinated under the aegis of ZTBCB according to the terms and conditions of their existing grants.

Monitoring and evaluation: Monitoring and evaluation will be systematic and routine processes under ZTBCB, and all partners will subscribe to using common indicators, standardized forms, and recording and reporting procedures, as developed and endorsed by the NTP and its partners. Monitoring and evaluation will be informed by the monitoring and evaluation framework established by the international Zero TB Cities Initiative, which describes three sets of process indicators corresponding to searching, treatment, and prevention. NTP and its partners will be responsible for establishing regular monitoring visits that assess and provide formal feedback on performance using standardized tools and procedures. Data should feed into the District Health Information System (DHIS 2) and should be periodically validated through independent data quality assessments. Data can also be collected through e-TB Manager if available at health facilities. ZTBCB will use both quantitative and qualitative data to assess performance.

ZTBCB will measure STP processes and outcomes and will develop a detailed performance framework that describes a cascade of steps with indicators measuring the proportion of people moving from one step to the next. These tracking mechanisms across the continuum will

help the NTP and its partners to empirically determine performance and impact. ZTBCB will develop digital tools for use at points along the spectrum, including the critical first entry, ACF and contact investigation/TB preventive treatment stages. These digital technologies will enable efficient, real-time reporting and feedback of data.

Effective monitoring and evaluation will require investment by the NTP and its partners for training and routine costs such as transportation; accommodations; data collection equipment such as phones and data storage servers; and printing and processing materials. Costs should be determined at an early point in the initiative and factored into sustainability considerations.

Quality control: ZTBCB will implement activities that assure and improve screening, diagnosis, and treatment quality. It will develop policies, regulations, and guidelines for the NTP and its partners that will encourage all providers to meet national TB management standards. Assistance will be given to identify and define TB components for inclusion in a package of essential health services, and, when appropriate, design costing and cost reimbursement mechanisms for their delivery. ZTBCB will work with the MOHFW and NTP to develop certification and accreditation criteria that will enable government specification of quality standards for TB facilities and providers.

ZTBCB will design and implement training programs for TB health care workers, particularly in the important areas of quality assurance. It will identify and budget human workforce requirements at all levels of the urban health system and assist NTP and its partners to promote full staffing of appropriately skilled health providers at relevant facilities for offering high-quality diagnostic and treatment services. It will promote the quality assurance and rational use of drugs, a well-functioning TB commodity supply chain, and an effective adverse drug event monitoring system. Also of importance will be assistance for the convenient location and implementation of high-quality and timely sputum referral mechanisms.

The initiative will support the design and implementation of standardized diagnostic and treatment algorithms and undertake frequent clinical audits and regular data review. ZTBCB will help establish expert clinical committees to manage patients with complicated disease.

The operation and utilization of laboratories using comprehensive and rigorous quality standards is essential to achieving the ZTBCB goal and objectives. Technical assistance will be given to improve access to and use of affordable radiographic screening and free-of-charge Xpert and drug sensitivity testing (DST). The initiative will develop the capacity of national and regional TB reference laboratories to perform quality-assured DST for first- and second-line drugs using phenotypic and genotypic methods. It will support the development and use of laboratory information management systems. It will work with private sector diagnostic centers to perform high-quality tests while reducing perverse incentives for unnecessary tests.

A significant number of urban Bangladeshis elect to use private sector health services. An essential component of ZTBCB will therefore be to encourage private sector providers to comply with the government's mandatory notification regulations and to deliver high-quality

diagnostic and therapeutic services. Because inappropriate screening and delayed referral at the community level remain major sources of delayed diagnosis and treatment, the initiative will train pharmacists, drug sellers, and informal providers to recognize TB symptoms, provide them with appropriate tools and applications, and link them to high-quality service providers.

Integrated communication campaign: According to 2015-2016 National TB Prevalence Survey, 70.1% of urban respondents diagnosed with bacteriologically confirmed pulmonary TB had not sought care for their symptoms. Because integrated campaigns targeting geographic high-transmission areas and high-risk populations are found effective to raise awareness about TB symptoms, this intervention will be a central ZTBCB activity. ZTBCB will determine communications modes and messaging best suited for specific geographic areas and demographic groups; considering their comparatively high prevalence rates, men and the elderly will merit special attention.

Communications activities will also occur in settings such as hospitals, fixed-site clinics, satellite clinics, schools, places of worship, prisons, and households. ZTBCB will map these sites in its focal geographic areas and design communications approaches for each type and population; the initiative will highlight raising awareness and addressing stigma and discrimination. If warranted, approaches will be customized by sex and age. Communications activities will be developed for different types of facility- and community-based providers. Digital communications, including social media, are rapidly expanding in Bangladesh, even among slum dwellers, and transmitting TB messages through these channels will be an innovative way to reach target populations.

TB communications will be integrated with messaging for related health conditions, such as diabetes and nutrition. One area that warrants consideration is alerting people about the twin dangers of passive smoke inhalation and TB transmission to children living in closed, poorly ventilated spaces.

Impact assessment/implementation research: Research addresses the third pillar of the WHO End TB Strategy: intensified research and innovation. Consideration should be given to the impact of the four key ZTBCB interventions: early and active case finding; rapid molecular testing; TB infection treatment; and high-transmission geographic areas and high-risk populations.

Impact assessment and implementation research will be critical components of ZTBCB as an innovative urban TB management platform that is new to Bangladesh. An independent research organization will conduct baseline and end-line evaluations that include intervention and control areas and standardized milestones and indicators. Importantly, impact assessment will enable analysis of a counterfactual situation that would have occurred had it not been for the ZTBCB interventions. Results from the impact assessment will be used to inform expansion and investment decisions. The National TB Prevalence Surveys might be designed to collect quantitative data on the effect of ZTBCB; likewise, periodic Joint Monitoring Missions might collect qualitative data for the same purpose.

The NTP and its partners will develop a research agenda for ZTBCB that includes a mapping of qualified research centers and researchers, the content and types of research, and linkages to international organizations and initiatives, such as ZTBCI, that could provide resources for collaboration, technical assistance, and capacity building. The NTP and its partners involved in ZTBCI will analyze both National TB Prevalence Survey data and routine service statistics to determine urban/rural differentials and trends on key indicators. Research that takes place in ZTBCI cities in multiple countries using standardized protocols and data analysis could greatly advance the science of urban TB management. ZTBCB will employ mathematical modeling in innovative ways that include estimating the impact of early disease detection and high-transmission geographic focus on TB epidemiological patterns. Mathematical modeling will also be used to determine combinations of interventions that most cost-effectively reduce the urban TB incidence rate.

ZTBCI is a comprehensive approach, so that data collection and analysis should occur at each stage of the continuum from screening and referral to diagnosis, treatment, and cure, with precise measurement of the points of greatest attrition. Because ZTBCB will address health conditions co-morbid with TB, collaborative research might be undertaken jointly with other national programs, such as HIV, diabetes, nutrition, maternal and child health, and smoking cessation.

ZTBCB will feature operations research on multiple topics but priority should be given to ones that concern the four main elements of active case finding, rapid molecular testing, TB infection treatment, and geographic and at-risk populations; research on health seeking behavior, community health provider incentives, and public awareness and communication activities might all be areas of research interest. Research will be essential to understand the effect of ZTBCB's interventions under the GOB's UHC Strategy, including access to patient-centered, integrated services and social support schemes.

Integrated information and communications technology platforms: Information and communications technologies (ICT) facilitate efficient TB patient care, surveillance, program management, and electronic learning,[51] and ZTBCB will adapt them to the Bangladeshi urban context. ZTBCB will support the development of electronic health systems (e-Health) to support a wide range of activities: supply chain management and logistics management information systems; laboratory information management systems; adverse drug event reporting systems; and patient recording and reporting systems. These systems should integrate and become interoperable with the MOHFW's DHIS 2, if not formally incorporated into it. m-Health applications will be used for purposes such as diagnostic and treatment appointments; collection and transmission of screening, referral, diagnosis, and treatment information; treatment adherence tracking; and case notification. Attention will be paid to designing simple

[51] Falzon D, Timimi H, Kurosinski P, et al. Digital health for the End TB Strategy: developing priority products and making them work. *European Respiratory Journal.* 2016; 48 (1): 29-45.

m-Health applications that will be used by community health providers, especially for the early identification and referral of persons with TB symptoms.

Digital electronic tools will be developed for patient and provider e-Learning as well as for surveillance, monitoring and evaluation, and research. Patient data collected through electronic systems will be disaggregated by sex and age. Systems might be designed that link TB data with data on co-morbid conditions. ICT applications will be developed that link patients with social protection schemes and possibly to transfer social support credits.

Business model: Although ZTBCB is a GOB initiative, it welcomes support from its development partners for start-up funding and specialized assistance such as for informal provider early detection and referral networks, public awareness and mass communications, and community-based NGO facility and outreach services. ZTBCB will be governed by one strategy and have a standard design[52] so that the NTP should request other interested contributors to buy into a basic platform that includes early and active case finding, rapid molecular testing, TB infection treatment, and geographic and at-risk population focus. Key to ZTBCB's successful implementation will be development of referral chains among public sector, NGO, private sector, and community health providers. The ZTBCB network of providers will offer a high standard of quality and provide accessible and affordable services to all TB patients; the initiative will link people with TB to social protection services. All facilities and providers offering TB services in the ZTBCB network will report to the NTP; all of them should receive official certification that recognizes a standard of quality of care once the appropriate systems are developed and actualized.

Because ZTBCB will contribute to the GOB's UHC strategy, it will examine programmatic costs and payment of services. According to government policy, all TB services and products will be provided free of charge, which is appropriate considering that TB is typically a disease of poverty. However, patients are sometimes charged for diagnostic services in the public sector and generally charged for consultation and diagnostic services in the private sector. Most TB patients receive free drugs; nevertheless, some pharmacies sell them, and some patients buy them. ZTBCB will follow official government policies, but subsidization of TB services from patient payments for non-TB conditions might be a feasible way of generating revenue and recouping costs. Means testing for payment of TB services might be considered after receiving government authorization.

ZTBCB will tackle the important issue of providing incentives to community health workers, including informal providers, pharmacists, and drug sellers, to appropriately screen and refer for TB. Although these incentives may be in cash or kind, concern for long-term sustainability demands consideration of giving monetary benefits through an established system.

[52] Having a standard design will not preclude customization by geographic area, interest by a particular city government or funding agency, or other similar consideration.

ZTBCB will conduct periodic studies of costs to determine possible programmatic efficiencies and develop investment and sustainability plans to transfer activities currently shouldered by development partners to the government and private sectors. All administrative, management, and procurement costs should be incorporated into routine budgets as soon as ZTBCB is fully operational and produces empirical evidence demonstrating reductions in urban TB incidence rates.

Patient-centered continuum of care: ZTBCB will develop a systematic approach to service delivery that addresses and measures each stage of patient care from first point of contact to completed treatment and cure. The matrix of TB facilities and services in Bangladesh is complex. Examples of entry points include hospitals, clinics, prisons, pharmacies, graduate medical practitioners, informal health providers, and drug sellers. Public sector, NGO, and private sector facilities as well as community-based programs deliver screening, diagnostic, and treatment services; contact investigation will include interventions delivered in households and locales of close contacts. People with TB are lost at all points along the pathway and identifying and measuring the points of greatest attrition is critical for developing interventions that will have the greatest effect on lowering urban incidence rates. Understanding the reasons why people with TB drop off the pathway are also critical. Possibilities include lack of knowledge or erroneous information; stigma; perceived or actual poor service quality; losses during referral; distance; travel and service costs; loss of wages; erroneous testing results; delays in providing results and treatment; and drug stock-outs.[53]

VI. Illustrative Indicators

The monitoring and evaluation framework of the Zero TB Cities Initiative describes three sets of process indicators that correspond to the strategic elements of "Search, Treat, and Prevent." Each is presented as a cascade of steps with indicators measuring the proportion of people moving from one step to the next. The Search indicators measure the continuum of steps from verbal symptom screening to diagnosis; the Treat indicators measure the continuum of steps from treatment initiation to treatment cure; and the Prevent indicators measure the steps from the identification of index patients to the successful preventive treatment of contacts.

ZTBCB can either collect data on cohorts of individuals as they move through the cascade (individual-level cohort data) or on numbers of people who complete each cascade step during a certain time (aggregate data). Collecting cohort data necessitates having a data recording and reporting system in place that tracks individuals over time. Both registers and electronic health records can be used to track individual patients. Records held by patients themselves (e.g., paper treatment cards or mobile applications that do the same thing) represent another option. If it is not possible to track individuals, aggregate data can be collected that fills in the missing steps. If large numbers of patients are assessed, then the indicators calculated using aggregated cross-sectional data can be comparable to those developed using individual-level data.

[53] Blok, L, Cresswell J, Stevens R, et al. A pragmatic approach to measuring, monitoring, and evaluating interventions for improved tuberculosis case detection. *International Health.* 2014; 6 (3):181-88.

Table 2: Illustrative Indicators for ZTBCB		
Search	# of the estimated target population	
	# of people verbally screened for symptoms	
	# of presumptive cases identified	
	# of presumptive cases evaluated and investigated	
	# of cases diagnosed with TB	
	Bacteriologically confirmed	
	Clinically diagnosed	
	Extrapulmonary	
Treat	# of TB cases started treatment	
	Treatment outcomes	
	Completed successfully	
	Failure	
	Died	
	Lost	
	TB-free 1 year after treatment completion	
Prevent	# of index TB cases eligible for contact investigation (CI)	
	# of index cases who received CI	
	# of contacts of index cases identified	
	Adults	
	Children	
	# of contacts screened verbally	
	# of contacts referred for further evaluation	
	# of contacts clinically evaluated	
	# of contacts investigated	
	# of contacts with TB disease (adults/children)	
	# of contacts eligible for preventive therapy (adults/children)	
	# of contacts prescribed for preventive therapy (adults/children)	
	# of contacts who started preventive treatment (adults/children)	
	# of contacts who completed preventive treatment (adults/children)	
	# of contacts who did not complete preventive treatment (adults/children)	
	# of contacts who rejected preventive treatment (adults/children)	

VII. Conclusions

The Zero TB Cities Bangladesh Strategic Roadmap describes the "Search, Treat, and Prevent" interventions required to reach the goal of halving the TB incidence rate in urban Bangladesh by 2025. ZTBCB will target cities, as the geographic areas of highest TB transmission, and people who are at highest risk of developing TB and other co-morbid health conditions. The initiative will actively find and test people with possible TB and treat them at an early stage of the

disease. Individuals in close contact with TB patients will also be found and initiated on preventive treatment. To be successful, ZTBCB will require political and financial commitment from multiple stakeholders and a National TB Control Program that operates with improved capacity. ZTBCB's impact will be rigorously measured at all stages along a continuum from screening to treatment completion.

ZTBCB is a Government of Bangladesh program. Although it welcomes support from development partners, government authorities are responsible for implementing the strategy. Led by the NTP, ZTBCB will coordinate multisector national and urban actors to achieve the goal and activities of the initiative.

Because ZTBCB is part of the international Zero TB Cities Initiative, it will inform the urban TB management programs of other countries, and, in turn, be informed by them. Its experiences will therefore extend beyond the boundaries of Bangladesh to provide global impact and benefit.