



**CENTER FOR GLOBAL  
HEALTH DELIVERY–DUBAI**  
HARVARD MEDICAL SCHOOL

# PROCEEDINGS

## The Emerging Role of Municipalities in the Fight Against Tuberculosis





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# **The Emerging Role of Municipalities in the Fight Against Tuberculosis**

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**Harvard Medical School Center for Global Health Delivery Dubai  
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# 1.0 Introduction

On April 14, 2015, over 64 public health practitioners, social entrepreneurs, researchers, clinicians, and policy-makers met for The Emerging Role of Municipalities in the Fight Against Tuberculosis workshop. The meeting was hosted by the newly established Harvard Medical School Center for Global Health Delivery–Dubai, in Dubai, United Arab Emirates. The workshop's aim was to convene practitioners, policy makers, thought leaders and funders to frame and discuss the role of municipalities in the fight against tuberculosis (TB). The group supported an action plan for coordinating innovative municipal TB control projects around the world.

Participants from five continents and 16 countries represented hospitals, social businesses, pharmaceutical businesses, non-profit organizations, academic research institutions, national and global health organizations. Represented organizations included The Global Fund, New York City Department of Health, Partners In Health, Clinton Health Access

Initiative, TB Reach, Interactive Research and Development, King Dinuzulu Hospital, Indus Hospital, Operation ASHA, Baylor College of Medicine, Stellenbosch University, Stop TB Partnership, Eli Lilly &Co., and Janssen Pharmaceuticals, among many others.

The workshop started with a review of ongoing city-wide projects that are tentatively looking at aligning with the new Zero TB Cities Project, and also past city experiences that took place before the initiative. There were detailed presentations as well as rigorous discussions on the strengths and limitations of such a municipal focus through clinical, programmatic, and advocacy lenses. Case study presentations were shared on innovative TB detection and treatment programs in urban and peri-urban settings, including experiences from New York City, United States; Karachi, Pakistan; Chennai, India; Vladimir, Russia; and Ho Chi Minh City, Vietnam.

## Box 1-1 Tuberculosis and drug-resistant tuberculosis basics<sup>1</sup>

### What is tuberculosis (TB)?

Tuberculosis (TB) is a disease caused by bacteria that are spread from person to person through the air. TB usually affects the lungs, but it can also affect other parts of the body, such as the brain, the kidneys, or the spine. TB is treatable and curable; however, individuals with TB can die if they do not get the correct treatment in a timely fashion.

### What is multidrug-resistant tuberculosis (MDR-TB)?

When TB bacteria are resistant to an anti-TB medication, it means that that medication can no longer kill the bacteria. Multidrug-resistant TB (MDR-TB) is caused by bacteria that are resistant to both isoniazid and rifampin, the two most potent anti-TB drugs. Without the ability to use these two drugs, TB treatment regimens are longer, more toxic, and can be less effective.

### What is extensively drug-resistant tuberculosis (XDR-TB)?

Extensively drug-resistant TB (XDR-TB) is a type of MDR-TB that is resistant to both isoniazid and rifampin, plus the backbone of the second-line anti-TB regimen: fluoroquinolones and at least one of three injectable second-line drugs (i.e., amikacin, kanamycin, or capreomycin).

Because XDR-TB is resistant to the most potent TB drugs, patients are left with treatment options that are much less effective.

TB is of special concern for persons with HIV infection or other conditions that can weaken the immune system. These individuals are more likely to develop TB disease once they are infected, and also have a higher risk of death once they develop TB.

<sup>1</sup> Source: <http://www.cdc.gov/tb/publications/factsheets/drtb/mdrtb.htm>

# 1.1 Leveraging the emerging power of cities against TB<sup>2</sup>

## 1.1.1 URBANIZATION: A GLOBAL TREND

Tom Nicholson unpacked the idea of leveraging the emerging power of cities against TB, particularly in high-burden, so-called “emerging” markets. Almost 4 billion people representing more than half of the global population currently live in cities. That number is expected to increase by a further billion over the next 15 years, with 90% of that growth in Sub-Saharan Africa and South Asia. Of course, massive urbanization is a global trend buttressed by complicated dynamics—populations travel both to and from cities in the hundreds of millions each year.

Despite their inherent complexities, cities of all sizes are well situated to house innovative, efficient health-delivery arrangements for several reasons. Concentrations of independent private institutions spanning a range of sizes and functions compete for talent and resources on a national level. Public sector institutions are typically close to the affairs of large populations and are thus likely to be responsive. Cities also stand in close proximity to the starkest inequalities driven by global economic forces and migration.

## 1.1.2 HEALTH SERVICE INCLUSION AS A DRIVER OF SOCIAL CHANGE

Nicholson advocated for the use of health service inclusion to drive social change. To affect this change, he called for a push for more inclusive services and the implementation of proven TB interventions to interrupt the cycle of poverty and disease, given TB’s intrinsic link to social and political marginalization. To work toward these objectives, he suggested the launch of a supportive interface entity as a way to drive citywide efforts against the disease.

Despite good reason for excitement surrounding cities and the attention garnered by city-based approaches, he cautioned that there is equally good reason for skepticism. For a complex disease like TB, efforts must be

intense, detail-oriented, and politically viable over time if they are to drive real change.

## 1.1.3 STEMMING THE TUBERCULOSIS EPIDEMIC: THE ZERO TB CITIES PROJECT

The Zero TB Cities Project was started to help cities implement comprehensive, ambitious, municipality-based TB initiatives. A non-governmental organization, Advance Access & Delivery (AA&D) was formed to raise public and private resources for this effort. AA&D draws on academic input from Harvard University and Duke University in the United States, as well as program experience from Partners In Health sites worldwide. It is informed by the standards of resource-blind, evidence-based TB care delivery.

## 1.1.4 THE ZERO TB CITIES PROJECT: CORE PRINCIPLES

Nicholson explored three core principles underpinning the Zero TB Cities Project’s platform for community-based care delivery for TB and DR-TB (Fig. 1).

### ***Principle 1: Target municipalities as the sustaining agent***

In general, cities are the political and civil units that are closest to individuals suffering from disease and are thus well placed to sustain and monitor successful programs over time. Cities have their own resource bases in addition to national funds; city governments have a wealth of practical experience linking the public and private sectors, which can facilitate harmonization and create helpful policy environments.

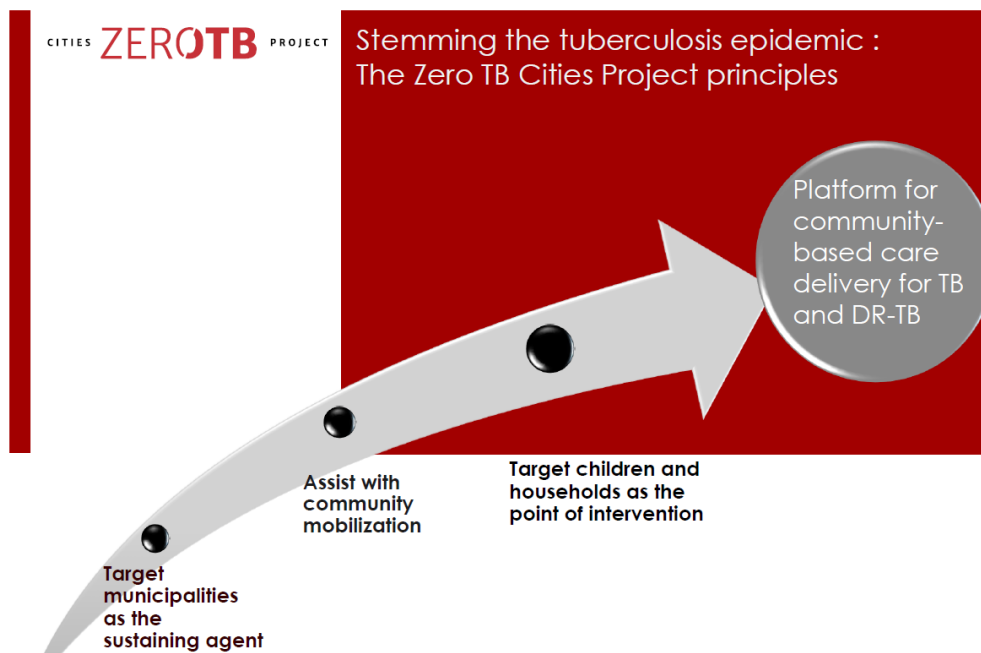
### ***Principle 2: Assist with community mobilization***

Community mobilization has been a necessary component of the notable public health successes against infectious diseases that have been carried out over the last decades. It can help to improve and promote health literacy, an important factor for achieving

<sup>2</sup>The section is based on the presentation of Tom Nicholson, Executive Director, Advance Access & Delivery; Associate In Research, Duke University, Sanford School of Public Policy Duke Center for International Development



Figure 1. Zero TB Cities Project principles



Source: Nicholson presentation at April 2015 TB Innovation Workshop hosted by HMS Center for Global Health Delivery-Dubai.

better health outcomes. Communities and organizations calling for expanded TB care need their voices to be amplified, but tools and exposure are tricky and politically mediated.

### **Principle 3: Target children and households as the point of intervention**

Children are highly vulnerable to preventable TB disease and death, which is exacerbated by the particular challenges that TB poses for diagnosis and treatment among children. Thus, children and households were selected as the point of intervention for the Zero TB Cities Project. Infection and active disease are often detected among the household contacts of TB cases, and the provision of earlier treatment initiation offers the most “bang for the buck.”

### **1.1.5 THE ZERO TB CITIES PROJECT: OVERVIEW OF CARE DELIVERY PLATFORM**

Nicholson identified the following priorities of the Zero TB Cities Project's care delivery platform:

- Delivering immediate, appropriate treatment at a convenient location for the patient
- Screening for both infection and disease

- Treating both latent infection and active disease
- Emphasizing the linkage from diagnosis to treatment
- Providing programmatic and social supports

### **1.1.6 THE ZERO TB CITIES PROJECT: CHENNAI**

After careful consideration, Chennai in India was selected as the first site to be supported by the Zero TB Cities Project, which works in close conjunction with the Clinton Health Access Initiative (CHAI) in India. The city has a strong core of research and delivery institutions, as well as committed local municipal authorities. They have identified areas where they can benefit from strategic assistance in clinical, diagnostic, and programmatic support.

Moving forward, the objective is to generate interest in the idea of an association of municipal governments that shares information and tries to push a global TB agenda forward in terms of access and quality care delivery. Partner sites and future participant sites are present at this event precisely to move this discussion forward.

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## 2.0 Experience in Cities

### ***Organizer's note:***

The following section outlines efforts in eight cities, six of which are in high-burden countries and two of which are in the United States, to combat TB in a comprehensive way. Included in this section is a side session on modeling tuberculosis disease dynamics in an Asian megacity after specific programmatic interventions.

The collective experience of these cities during this day's proceedings shows both the promise and the challenge of a municipally focused TB initiative like the Zero TB Cities Project. Variations in approach, local context, and resources drive divergences across the board. However, the importance of proven biomedical interventions and social support is clear, regardless of economic, demographic, and institutional variation.

## 2.1 Tuberculosis control in New York City, United States<sup>3</sup>

### 2.1.1 OVERVIEW: NEW YORK CITY TB EPIDEMIC IN THE 1990S

New York City is the most densely populated city in the United States, with a diverse population of over 8 million that is 37% foreign-born as of 2015. Dr. Joseph Burzynski described<sup>4</sup> how the city faced an epidemic of TB that gained momentum in the late 1980s and peaked in 1992, when case rates reached 51 cases per 100,000 population (around 3,800 cases overall). In some neighborhoods, the rate climbed upwards of 150 cases per 100,000 population. Less than half of the patients in New York City were completing treatment, and around 20% of the cases were multi-drug resistant TB (MDR-TB).

Due to efforts to pinpoint the causes of the epidemic and to implement measures specifically targeting those causal factors, by 2014

the number of confirmed TB cases in New York City had dropped to 585 (7.2 per 100,000 population), the lowest number on record.

### 2.1.2 CAUSES OF RESURGENCE AND PROGRAMMATIC MEASURES USED TO CONTROL THE TB EPIDEMIC IN NEW YORK CITY

Burzynski explained that the resurgence of TB in New York City was multifactorial, pointing to several specific catalysts and outlining the programmatic measures that were instituted to address each cause.

#### *Decline of public health infrastructure*

By the time the TB epidemic was gaining momentum, New York City no longer had a TB control infrastructure; the former TB control program was reduced to a surveillance program



<sup>3</sup> This section is drawn from the presentation of Joseph Burzynski, Director, Bureau of Tuberculosis Control, New York City Department of Health and Mental Hygiene, U.S.

<sup>4</sup> Frieden et al. N Engl J Med 1993; Frieden et al. N Engl J Med 1995; Burzynski & Schluger Semin Respir Crit Care Med 2008

when TB was believed to be no longer a significant presence in the city. Addressing this problem required obtaining political support and resources from federal, state, and local agencies to expand TB staff, clinics, and operational plans. The extensive media coverage of the epidemic was instrumental in raising public awareness about the problem and increasing resources for TB control. It also enabled the institution of policies within the health code to more effectively track and manage patients with TB.

### ***HIV/AIDS epidemic***

The HIV epidemic was concomitantly reaching its peak in the early 1990s, and around 40% of TB patients were also infected with HIV. However, insufficient attention was paid to preventing the spread of TB among this population. For example, all HIV-positive patients were placed in the same ward, regardless of whether or not they also had TB. Measures put in place to rectify this included:

- Coordinating with HIV care programs to test for TB
- Increasing HIV testing of TB cases
- Isolating any patients that entered the hospital with TB
- Providing anti-retroviral treatment for HIV
- Increasing awareness of HIV providers about TB
- Poverty, homelessness, and substance abuse

At the time, transmission of TB was rampant in settings such as hospitals, prisons, and homeless facilities. Addressing this issue involved integrating social services into the TB control program, including dedicated housing and shelters where patients could receive directly observed therapy (DOT), incentive programs, and drug-treatment referrals. Screening programs were put in place at homeless shelters and drug treatment centers.

### ***Poor treatment and infection control practices***

TB treatment practice was hampered by lack of standardization. Therefore, guidelines were developed to institute a general standard of care, which included DOT, mandatory drug-susceptibility testing, and systematic case-management for all TB patients, and empiric treatment regimens.

A similar strategy was employed to improve infection control. Infection control guidelines were developed, and staff were trained in hospitals, prisons, and other congregate settings.

### ***Immigration from high TB-prevalence countries***

New York City has always been a city of immigrants, and many of the city's TB patients are individuals coming from countries with high TB burdens. While it is not feasible to screen all of the visitors who arrive in New York City for TB, everyone who applies for permanent residence or refugee status is screened for TB via chest X-ray and medical examination. Outreach programs for high-risk immigrant communities have also been productive.

## **2.1.3 NEW YORK CITY TB CONTROL: CURRENT PRACTICES (2015)**

The specific measures that were used to quell the TB epidemic in the 1990s are largely still in practice today, noted Burzynski. Key activities are mandated through local and state legislation, and the provision of direct patient care is coordinated with providers across the city. About 50% of TB patients in New York City avail themselves of four city-funded clinics where they receive free care. The other 50% of patients receive their care from hospitals and private providers.

Burzynski outlined eight key activities of the New York City Bureau of TB Control (BTBC):

### Reporting and surveillance

The health code in New York City mandates that all cases of active TB and positive sputum laboratory results be reported; all instances of delayed or missed case reporting are reviewed. The city maintains a centralized TB registry of suspected and confirmed TB cases and their contacts, as well as managing cases and contacts who move in and out of New York City. Burzynski expressed confidence that due to these efforts, the BTBC is aware of all TB cases in the city.

### Case management

Each person with TB has a dedicated case manager who is responsible for educating patients about the disease, collecting standardized patient information, and working with providers to ensure treatment adherence. These case managers take part in weekly case reviews with Health Department clinicians. The program utilizes a community-based approach whereby case managers are trained public health advisors (but not medical professionals) who are familiar with and knowledgeable about the communities in which they work.

Providers are required to report regularly on treatment plans and outcomes. In exceptional cases of recalcitrant patients, legal interventions may include involuntary detention for testing or treatment.

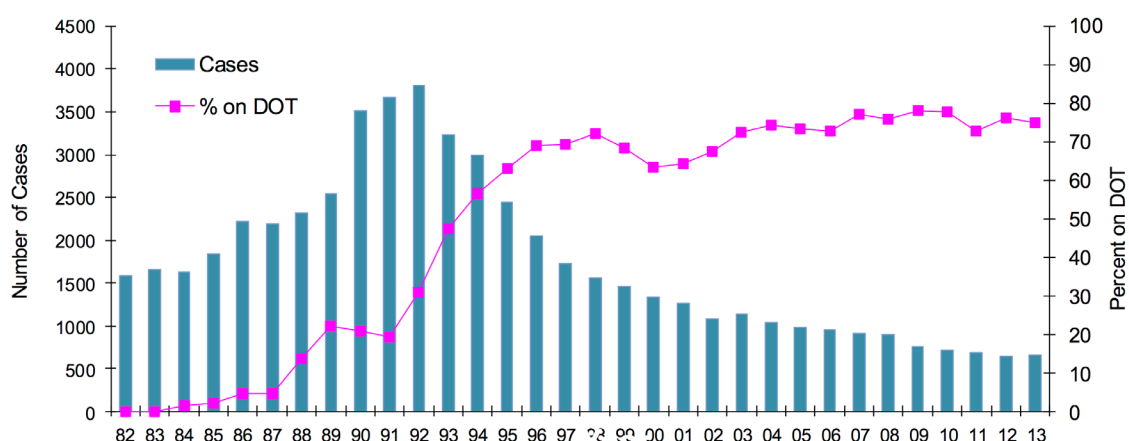
### Medical care and consultation

The BTBC sets the standards and guidelines for healthcare providers on all aspects of TB control. Medical consultations review provider discharge and treatment plans, with enhanced case management of drug-resistant cases. Free TB chest centers operate throughout the city.

### Directly Observed Therapy (DOT)

DOT is available for all TB patients in New York City, and its provision is made as convenient as possible for the patient. A healthcare worker observes the patient swallowing each dose of medication, either in person or over video. DOT is mandated for non-adherent patients. Burzynski posited that there could well be a correlation between the decrease in the number of TB cases and the increase in DOT provision that began in the 1990s (Fig. 2).

**Figure 2. Number of cases and percent\* on DOT, New York City, 1982–2013**



\* Of those diagnosed who received outpatient treatment with two or more TB drugs

Source: Burzynski presentation at April 2015 TB Innovation Workshop hosted by HMS Center for Global Health Delivery-Dubai.



## BOX 2-1 Hallmarks of TB control: persistence and forgetfulness

*In his closing remarks, Burzynski pointed out that the keys to TB control are good case management, DOT, and contact investigations, but the hallmark of TB is persistence.<sup>5</sup> Just as TB persists in the body even after treatment initiation, TB control efforts must also be persistent in efforts such as ensuring treatment adherence and finding cases who have defaulted. The crucial challenge in TB control is forgetfulness: people forget to take their medications when they feel better; public health leaders forget that when TB rates decline and TB control programs are eliminated, TB will come back. He urged the participants to be persistent and not to forget.*

### Contact investigations

Contact investigation is an integral component of the program. BTBC staff promptly interview patients to identify contacts and exposure sites, and prioritize testing close contacts and those at high risk for developing active disease. Exposures in congregate settings are investigated based on the likelihood of transmission. Treatment is offered people with TB infection and steps are taken to ensure treatment completion.

### Outbreak detection and control

The BTBC is able to monitor disease trends by mandating that culture-positive TB isolates be genotyped. Identifying and investigating clusters of matching genotypes has been an effective way for them to pinpoint specific social networks where transmission is occurring and intervene effectively.

### Monitoring and evaluation

A cohort review process is in place to ensure accountability at all levels of TB control. The Bureau Director reviews every TB case to identify and address any case-management issues, from DOT to contact investigation. The chain of responsibility ensures that everyone with TB receives proper management.

Specific standards are set for key performance measures and targets:

- Treatment completion (93%)
- Sputum culture conversion within 60 days (62%)
- Drug susceptibility testing (100%)
- Proportion of cases tested for HIV (89%)
- Proportion of eligible cases with contacts identified (100%)
- Proportion of contacts who complete treatment for TB infection (73%)
- Collaboration with partners

Collaboration is an important component of delivering a TB control program; partnerships include healthcare providers, laboratories, and community outreach to carry out targeted testing in high-risk TB populations. Research collaborations in partnership with academic institutions involve participating in and publishing results of clinical trials and studies.

<sup>5</sup>He referred to a relevant article that explores this idea: Frieden JAMA 2014

### 2.1.4 KEY POINTS FROM DISCUSSION

In the context of cost implications for successful programs, Aamir Khan<sup>6</sup> asked for specifics about the level of investment that is annually spent to control TB in New York City. Burzynski replied that while a very large investment had to be made to address the TB epidemic in the 1990s, the current budget is \$14 million per year, which he considered reasonable for a city the size of New York. He noted that public health advisors with moderate salaries currently do a majority of the work. He emphasized that the BTBC budget is relatively trim compared to other expenditures in US healthcare and they no longer run on huge resources, but rather an efficient model. He reiterated that so many constituents of the program are in place now because of that initial expenditure, so they do not have to keep doing it every year: “The cost of not doing things was huge, and we paid a price for that trying to turn it around.”

Several points related to the involuntary isolation component of the New York City TB control program. Grigory Volchenkov<sup>7</sup> questioned how often it occurs, what criteria are used to assess infectiousness, and when patients are released. Burzynski explained that the only way they can isolate someone is if they have a respiratory specimen that is positive for TB, and in general, they have to have smear-positive pulmonary TB. He stressed that it is really used as a last resort, with only four patients receiving involuntary isolation last year. The process for doing so is very step-wise. Patients are educated about the importance of treatment and protecting public health. Noncompliant patients are given a warning letter and informed that they will be required to take their medication under DOT. They are given multiple chances, but if they do not follow the recommendations, the BTBC has the authority to detain them in a locked ward at Bellevue Hospital to take their medications

at least until they are not infectious. Everybody who undergoes this process receives social services and a psychiatric evaluation, as well as the rights to a lawyer and due legal process. He stressed that the majority of the people who fall into this category have some kind of mental health or substance-abuse issue. Replying to a follow-up question about how helpful involuntary isolation was during the epidemic in the 1990s, Burzynski said that they are making efforts to model the impact but that there is not a clear answer yet. He pointed out that at that time in New York City, there was also a crack cocaine epidemic going on, more homeless people, and generally more chaos. This resulted in more people who were unable to follow a structured life acquiring and continuing to spread TB. Forced isolation was thus an important part of the program, but he reiterated that they took (and continue to take) all measures possible to avoid it.

Paula Akugizibwe<sup>8</sup> questioned how treatment is monitored, regulated, and standardized among clinics and private hospitals across the city, today and particularly during the epidemic. Burzynski explained that they provide clear guidance about treatment to physicians. Private providers and community doctors are required to report on their treatment plans monthly to public health advisors, who follow up if anything is amiss. Rare instances of extreme cases of poor treatment practices can be reported to the medical licensing board.

Volchenkov asked whether they use DOT for preventive therapy, to which Burzynski responded that they use a successful new regimen, thus far delivered to about 1,000 patients, called 3HP—once-weekly isoniazid and rifapentine for 12 weeks—for which they recommend DOT. However, he said that they generally do not use DOT for preventative therapy.

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<sup>6</sup> Aamir Khan, Interactive Research and Development, Karachi, Pakistan

<sup>7</sup> Grigory Volchenkov, Vladimir TB Control Center, Vladimir, Russia

## Q&A Highlight: TB, immigration and economic booms in New York

*Jacob Creswell<sup>9</sup> noted that New York City experienced an incredible economic boom in the 1990s that roughly coincided with the decline of TB. While acknowledging that it would be very difficult to measure the impact of an economic boom on a city, he questioned whether the proportions of case notification rates have changed among populations such as the homeless and foreign-born.*

*Burzynski agreed that economic booms have been helpful for TB rates; however, he noted a converse phenomenon whereby TB rates declined markedly in 2009 after the economic turmoil. He posited that this could be because young men from countries such as Mexico and Ecuador, who had come to New York City for service industry jobs, typically had higher than average TB rates; their leaving during the economic downturn therefore may have contributed to a decrease in TB rates in the city. That said, he concurred that the improved economic status of the city has helped. Currently, almost 90% of TB cases in New York City are foreign-born, indicating that there is very little transmission going on. People born in China account for 130 of the city's roughly 650 cases—these people were probably infected years ago and recently reactivated. Burzynski emphasized that the bulk of their work today comes from people who have migrated from areas of the world that still have a high TB burden. The homeless population accounts for only about 5% of cases, although there was a mini-outbreak several years ago among the “street” homeless, who are homeless individuals who choose not to use shelters and are very difficult to track.*

Jeffrey Starke<sup>10</sup> sought Burzynski's opinion about the most significant factors that have contributed to the fall of MDR-TB rates in New York City—from 20% in the 1990s to 2% (10 cases) today, all of which have been “imported” into the city. He responded that they are no longer creating MDR-TB because they use drug-susceptibility testing to determine susceptibility patterns and appropriate regimens, and they administer treatment by DOT. Improved infection control protocols require that identified cases of MDR-TB are strictly contained at home or isolated in the hospital. Starke followed up by asking where the latent MDR-TB cases are, given previous MDR prevalence of 20%, to which Burzynski replied that the epidemic at that time was concentrated in people with HIV,

many of whom may have died because it was the pre-antiretroviral era. In the present day, MDR-TB cases are quickly identified and isolated, so a new vulnerable population of recently infected people is not being created.

Salmaan Keshavjee<sup>11</sup> characterized the fall of TB in New York City as astounding and unprecedented. Granting that there was a fall of TB in Western countries during the 1950s that many have attributed to economic development, he emphasized that in a city like New York marked increases and declines in TB rates have both happened in the presence of wealth—demonstrating that there is a definite place for biomedical interventions. TB is a social disease, but it also requires that certain programmatic interventions take

<sup>8</sup> Paula Akugizibwe, Clinton Health Access Initiative, Kigali, Rwanda

<sup>9</sup> Jacob Creswell, Stop TB Partnership, Geneva, Switzerland

<sup>10</sup> Jeffrey Starke, Baylor College of Medicine, Houston, TX, U.S.

<sup>11</sup> Salmaan Keshavjee, Harvard Medical School, Boston, MA, USA



place. In contrast to TB programs in poorer countries that typically assign all responsibilities to national TB programs, Keshavjee commended the New York City program for working with private labs and private providers that are already in place. Rather than recreating a system, the program connects dots and provides glue for the existing system. Keshavjee asked Burzynski to expand further regarding the interactions between the public and private health sectors with the view to informing this kind of approach in other cities. Burzynski recommended that TB control programs should serve as a resource for education, help, management, and oversight. Community outreach and a TB hotline help to educate doctors and hospitals about TB care.

Keshavjee questioned whether there is a tension, as there is in many countries, between the city's TB control program and guidelines set at the national level. Burzynski responded that while the US Centers for Disease Control (CDC) sets national guidelines, provides funding to the city, and requires annual reporting, New York City does have some autonomy to establish their own procedures, which may not yet be codified in the CDC guidelines (e.g., outreach efforts and video DOT). The city has a relationship with the CDC, but it is not an authoritarian one.

## 2.2 Advocacy and community-building activities in Chennai: experience from REACH<sup>12</sup>



### 2.2.1 OVERVIEW: TB IN CHENNAI, INDIA

Ramya Ananthakrishnan described REACH's advocacy and community-building efforts for treating TB in Chennai, India. There are approximately 7,000 TB patients who initiate treatment in Chennai each year.

In July 2014, Chennai's population grew from around 4.7 million to 7.2 million when the city limits were expanded to encompass zones in greater Chennai.<sup>13</sup> This necessitated increasing the number of TB units from 10 to 24 (with an additional 12 planned units)

and moving toward a more decentralized model of care, with each unit serving about 200,000 residents instead of 500,000.

A major challenge faced by Municipal Corporation of Chennai's efforts to manage TB is the fact that more than 50% of the TB patients first seek care in India's vast private sector.<sup>14</sup> Ananthakrishnan emphasized that this trend is a direct contributor to the more than 3,000 "missing" TB cases in Chennai.

<sup>12</sup> This section is based on the presentation by Ramya Ananthakrishnan, Resource Group for Education and Advocacy for Community Health (REACH), India.

<sup>13</sup> About a third of the population of Chennai reside in slums.

<sup>14</sup> Comprising an estimated 10,000 private practitioners, nearly 1,000 private hospitals, and nearly 2,000 private pharmacies.

### 2.2.2 REACH'S ROLE IN TB CONTROL IN CHENNAI, INDIA

Ananthakrishnan described the ethos of the Resource Group for Education and Advocacy for Community Health (REACH), which recognizes that civil society is the key to the fight against TB. They work primarily through partnerships and networks to grasp the impact of TB on the patient, family, community and society fully. REACH strives to provide a continuum of care, which encompasses:

- Providing patient care and support: nutrition, family support, transport, and screening
- Focusing on the poor and vulnerable, e.g., homeless populations, migrant workers, and daily wage earners
- Engaging all care providers: private practitioners, hospitals, pharmacists, and community volunteers
- Advocating with decision makers and garnering corporate support
- Establishing community networks and increasing awareness about TB

### 2.2.3 OVERVIEW OF REACH'S KEY INTERVENTIONS

REACH started in 1999, around the same time as the Revised National TB Control Program (RNTCP) was being rolled out and there was an urgent need to engage with the private sector. At the outset, a network of public-private mix (PPM) centers was put in place to take referrals from private practitioners and to provide DOT and treatment monitoring. REACH has been able to implement a range of interventions in subsequent years, such as engaging with pharmacists, community volunteer mobilization, and intensified outreach activities.<sup>15</sup> Their objective is to encourage TB patients to seek care at the PPM centers in Chennai, rather than seeking out private practitioners.

Ananthakrishnan summarized REACH's efforts to target groups for interventions (Fig. 3).

Specific activities under the PPM initiative have also included community mobilization, patient empowerment and education, and a TB helpline that has already received over 1,500 calls. With support from allies such as the Lilly MDR-TB Partnership and through Project Axshya (Global Fund Round 9 project), activities such as engagement of community

#### BOX 2-2 Where are the “missing” TB cases in India?

*India is home to a high proportion—1 million—of the estimated 3 million “missing” TB cases worldwide.<sup>15</sup> These missing cases are cases that are either not diagnosed or that are diagnosed but not reported to the national TB program. Ananthakrishnan suggested that the million missing TB patients in India remain unaccounted for three main reasons:*

- The patient is diagnosed and treated adequately in the private sector, and not reported to the TB program.
- The patient is diagnosed and treated inadequately in the private sector, and not reported to the TB program.
- The patient is not diagnosed and is not seeking treatment.

<sup>15</sup> WHO 2013 Global Tuberculosis Report

<sup>16</sup> Outreach to engage and survey informal practitioners in both urban and rural settings has been a key focus.

pharmacists, AYUSH practitioners, non-qualified practitioners and intensified outreach activities are also being undertaken.

A contact-tracing program in the public health system and GeneXpert-based rapid testing for TB<sup>17</sup> using an innovative algorithm is also being implemented.

## 2.2.4 CHALLENGES AND OPPORTUNITIES IN CHENNAI

Notification of TB cases by the private sector represents a major challenge. It was mandated by the Indian government in 2012, but this has had limited success and many cases of TB are still not notified.

Key challenges in the private sector are how to best select patients for referral to PPM centers and how best to deal with the subset of patients who are receiving intermittent treatment. Resolving these issues will require sustained engagement with key partners and establishing public-private management arrangements.

Challenges with respect to patients and their communities include low levels of awareness about TB coupled with stigmatization and discrimination against TB patients. Socioeconomic factors compound the issue despite the availability of good quality medicines.

Ananthakrishnan identified a set of opportunities that could address these barriers:

- Using a multi-stakeholders approach
- Using a patient-centric approach involving counseling and choice of DOT provider
- Identifying and mitigating risk factors at the beginning of treatment (e.g., smoking, alcoholism)
- Strengthening patients' social environment
- Establishing a community-based monitoring program and TB forum comprising cured patients and community members
- Securing a strong administrative commitment in the current leadership

## 2.2.5 KEY POINTS FROM DISCUSSION

Citing a study by Project Axshya,<sup>18</sup> which found that only 19% of TB patients in India are actually aware that DOT is available, Vadim Kogan questioned why the RNTCP appears to have been hesitant to expand the successful program in Chennai to other places in India. Ananthakrishnan explained that many people think that TB is not a problem, and because TB symptoms are similar to other common illnesses, they are often not associated with TB. She noted that interest in diseases changes in India; the current focus is on different diseases and health concerns, and unfortunately, TB is a lower priority than others are.

As an example of how the private sector can contribute to the public sector, Giorgio Roscigno<sup>20</sup> suggested using a pay-for-performance model, e.g., a network of private nurses providing home-based care who are paid for properly supervised patients. He cautioned that the government cannot be solely responsible. Aamir Khan agreed that there are limits to what the government can do, but noted that a balance needs to be maintained, perhaps by containing the profit so it is reinvested in a similar program and by incentivizing government health workers as well as private-sector workers. He stressed that performance-based incentives can effectively drive changes in healthcare workers' behavior. Ananthakrishnan remarked that the government seems to be open to some kind of pay-for-performance model to engage the private sector on a limited scale, though a challenge is that private providers are often reluctant to get involved in DOT provision because it is time that could be spent seeing other patients.

Burzynski related that in New York, they make it clear to private providers that the BTBC functions as a partner, providing DOT and other treatment support services, but doctors remain TB patients' primary providers. He called for caution in treading the line between offering patients incentives and being coercive; the BTBC incentive program includes breakfast offered at clinics and travel vouchers. Ananthakrishnan remarked that the

<sup>17</sup> Funded by a grant from wave 4 StopTB partnership.

<sup>18</sup> International Union Against Tuberculosis and Lung Disease South-East Asia Office 2011

<sup>19</sup> Vadim Kogan, Harvard Medical School, Boston, MA, U.S.

<sup>20</sup> Giorgio Roscigno, NEXT, South Africa

**Figure 3. REACH target groups, interventions, and impacts**

<b>Private Practitioners &amp; Pharmacies</b>	
Intervention	<ul style="list-style-type: none"> <li>• Promote identification and sensitization of target group</li> <li>• Provide communication materials and tools</li> <li>• Provide support to TB patients for treatment adherence</li> <li>• Facilitate free drugs from the program for patients</li> <li>• Establish PPM centers</li> <li>• Facilitation through helpline, linkage to PPM /government centers</li> </ul>
Impact	<ul style="list-style-type: none"> <li>• Promote patient access to high-quality free standardized treatment</li> <li>• Increase case detection and improve adherence</li> <li>• Create a pool of trained providers</li> </ul> <p>For pharmacies:</p> <ul style="list-style-type: none"> <li>• Direct patients to point of care; link to services</li> <li>• Serve as vehicles for information</li> <li>• Act as DOT providers</li> </ul>
<b>Patient Care and Support (“patient-centric” approach)</b>	
Intervention	<ul style="list-style-type: none"> <li>• Individual and family counseling</li> <li>• Nutritional support</li> <li>• Problem-solving approach to improve adherence</li> </ul>
Impact	<ul style="list-style-type: none"> <li>• Improve treatment adherence</li> <li>• Mitigate socio-economic impact of TB on patients and their families</li> </ul>
<b>Community Volunteers</b>	
Intervention	<ul style="list-style-type: none"> <li>• Identification, training, and monitoring</li> </ul>
Impact	<ul style="list-style-type: none"> <li>• Establish base of volunteers to intensify outreach activities and DOT</li> </ul>
<b>Health System (RNTCP)</b>	
Intervention	<ul style="list-style-type: none"> <li>• Encourage advocacy efforts; Use of patient charter</li> <li>• State-level networks and TB forum</li> <li>• Provide volunteers to the system</li> <li>• Soft-skills training</li> </ul>
Impact	<ul style="list-style-type: none"> <li>• Strengthen health system</li> </ul>
<b>Media and Communication</b>	
Intervention	<ul style="list-style-type: none"> <li>• Campaigns and celebrity engagement</li> <li>• Campaigns addressing stigma due to TB (awareness and hygiene campaigns)</li> <li>• Engaging journalists for improved and increased reporting on TB</li> </ul>
Impact	<ul style="list-style-type: none"> <li>• Improve awareness in the general community</li> </ul>

Source: Ananthakrishnan presentation at April 2015 TB Innovation Workshop hosted by HMS Center for Global Health Delivery-Dubai.

public health corporation in Chennai recently began a similar program of providing meals at TB clinics where daily DOT is provided.

Roscigno proposed a vertical approach for the Zero TB Cities project, in the sense of having guidelines that are adhered to, and transitioning to a horizontal approach moving downward. Care at the level of the slums should encompass not only TB but also other conditions, which is where the private sector could be involved. He maintained that the city-level approach cannot be completely different from the country-level one. Ananthakrishnan replied that existing healthcare centers are being scaled up and their capacities augmented and strengthened.

Keshavjee asked about the gaps that are keeping the great programs in Chennai from achieving results similar to New York City. Ananthakrishnan clarified that the programmatic successes she described are happening in isolated pockets, i.e., there is a good health system and available resources, but activities have not coalesced in a sustained manner. The strategy should be to incorporate all players and to augment these over a long period of time. All the elements are in place, but they need to be integrated and expanded: this is what the Zero TB Cities initiative is trying to accomplish.

#### **BOX 2-3 Data anecdote showing value of active management**

**“A word of caution: in a meeting of the U.S. CDC, data from California shows that the mortality from drug-susceptible TB was higher than the mortality rate for drug-resistant TB. And the major difference was probably to active management of experts for drug-resistant TB rather than the decentralized treatment for drug-susceptible TB. I think what is lacking in TB is a quality approach. *If you decentralize things, quality standards become essential.*”**

*- Jeffrey Starke*



## 2.3 Avoiding the pitfalls of one-size-fits all: engaging the private sector against TB in three Asian mega-cities<sup>21</sup>



### 2.3.1 LEVERAGING DONOR FUNDS TO STRENGTHEN THE PRIVATE HEALTHCARE SECTOR

Aamir Khan explored the ideas of constructing cities as pillars of interventions for TB control and seeking ways to harness existing capacities in the private sector. He underlined an erroneous assumption that in many cities, TB control programs are paid for by donors. Citing data from Pakistan<sup>22</sup> as an example, he noted that of the gross annual health expenditure for interventions, only 2% (about \$3.5 billion) comes from donors.<sup>23</sup>

According to Khan, this underscores the need to find ways to leverage that 2% and turn it into more effective healthcare. Because so many patients prefer to seek private sector healthcare, rather than travelling to national

TB treatment sites, he maintained that efforts should thus be focused on working with private sector providers to develop sustainable models of healthcare delivery in the private sector to can improve TB control.

### 2.3.2 EXPERIENCE FROM PRIVATE SECTOR TB REACH PROJECTS: DHAKA, JAKARTA, AND KARACHI

Khan described a series of TB REACH initiatives<sup>24</sup> that have been implemented in Karachi (Pakistan), Dhaka (Bangladesh), and Jakarta (Indonesia) since 2011 in collaboration with his organization, Interactive Research and Development (IRD).

The first intervention, in Karachi, focused on verbal symptom screening for patients in private clinics and hospitals, and offered performance-based incentives for screeners. The

<sup>21</sup> This section is based on the presentation by Aamir Khan, Interactive Research and Development (IRD), Pakistan.

<sup>22</sup> Bajwa 2014 Pakistan National Health Accounts 2011-12

<sup>23</sup> Comprising almost 40% from public expenditure, around 7% from the private sector for their employees, and more than half of patients paying for their healthcare out of pocket.

<sup>24</sup> Funded by the STOP TB Partnership and UNITAID.

second project expanded to include Dhaka, and targeted verbal screening at private-sector laboratories and diagnostic centers, coupled with rapid TB testing using GeneXpert. Jakarta was included in the third phase (still in progress), which employs a social business delivery model to scale up GeneXpert testing in the public and private sectors.

Some of the process and technology innovations featured in the initiatives included:

- Mass screening algorithms, such as automated detection of TB using computers to read chest X-rays
- Community engagement through low-cost television advertisements
- Video instructions to improve sputum collection techniques
- Electronic medical record systems
- Performance incentives for community health workers and patient lottery prizes

### 2.3.3 IRD TB REACH PROJECTS: OUTCOMES

Khan reported that more than 50% of the bacteriologically positive TB cases in Karachi are yielded from IRD TB REACH projects and Indus Hospital, a major implementation partner.

During the project, the number of cases notified from project areas doubled compared to case notifications in other areas of Karachi (Fig. 4).<sup>25,26</sup>

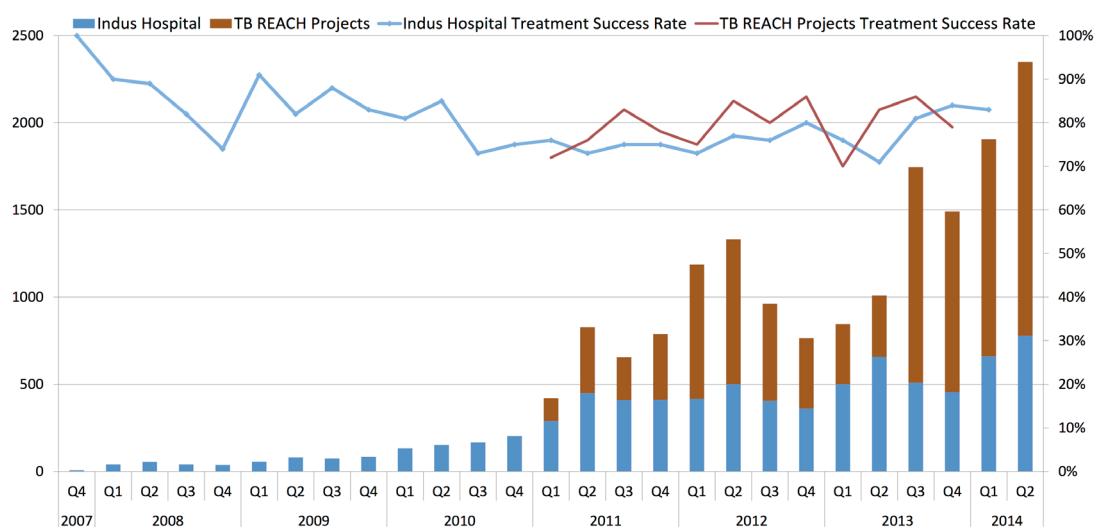
Using a simple model to assess impact, Khan maintained that it would be feasible for a sustained intervention like the one implemented in Karachi to effect a 25% reduction in the incidence of TB and a potential 50% reduction in TB mortality.

### 2.3.4 TBXPERT PPM: SOCIAL BUSINESS PROJECT

The most recent segment of the TB REACH program is the TBXpert PPM social business project.<sup>24</sup> Approximately \$6 million (USD) worth of rapid diagnostics for TB were acquired, comprising 75 GeneXpert machines and up to 450,000 cartridges. Khan described how the project then invested \$3 million USD in the establishment of independent social businesses for providing testing in Karachi, Dhaka, and Jakarta; oversight protects the businesses' mission from profiteering and maintains focus on the poorest of the community.

Using Karachi as an example, Khan explained that GeneXpert testing sites were created in strategic areas of Karachi that would

**Figure 4. Susceptible TB (all forms) case notification and treatment success rate (Indus Hospital and IRD TB REACH projects, Karachi, 2007–2014)**



Source: Khan presentation at April 2015 TB Innovation Workshop hosted by HMS Center for Global Health Delivery-Dubai.

<sup>25</sup> Dowdy DW et al. 2013 PLoS ONE

<sup>26</sup> Khan AJ et al. 2012 Lancet Infect Dis

<sup>27</sup> Supported by UNITAID and WHO.



facilitate transfer of patients from TB clinics to a central site for examination. A mass verbal screening program for TB and diabetes takes place at private clinics or public hospitals; further testing (chest X-ray, spirometry, GeneXpert) is carried out at screening sites, and TB patients receive treatment at private clinics or public hospitals. All cases are notified to the National TB Program.

### 2.3.5 COMPONENTS OF A FULLY INTEGRATED DIGITAL RADIOLOGY AND COMPUTER AIDED DETECTION FOR TB (CAD4T) SYSTEM

Khan provided an overview of the components of a mobile, fully integrated digital radiology and computer-aided detection for TB (CAD4T) system, a diagnostic tool that includes an X-ray generator (Delft EasyDR System), integrated detector (Canon) and automated reader (CAD4TB) that employs multiple algorithms to detect likely abnormalities and assist healthcare providers in deciding whether GeneXpert testing is warranted. A separate phone-based platform (also funded by TB REACH) for lung health and child screening has already been used to screen more than 2 million people in Karachi.

### 2.3.6 TBXPERT: SUMMARY OF PROGRAM RESULTS

As of January 2015, nearly 2 million people have been screened through the TBXpert programs in Dhaka, Jakarta, and Karachi; almost 13,000 cases of MDR-TB have been detected in those three cities using the programs' GeneXpert testing. Khan noted that the majority of those people were found in the public sector, but the preponderance is shifting toward the private sector over time.








Turning to treatment rates for the MDR-TB cases detected in the programs, Khan reported the following outcomes<sup>28</sup> (Table 1).

According to Khan, the mass screening through TBXpert in Karachi is directly responsible for meeting the national target for MDR-TB case-finding set by the Global Fund (Fig. 5).

### 2.3.7 LESSONS FROM IMPLEMENTATION OF PRIVATE-SECTOR TB REACH PROJECTS

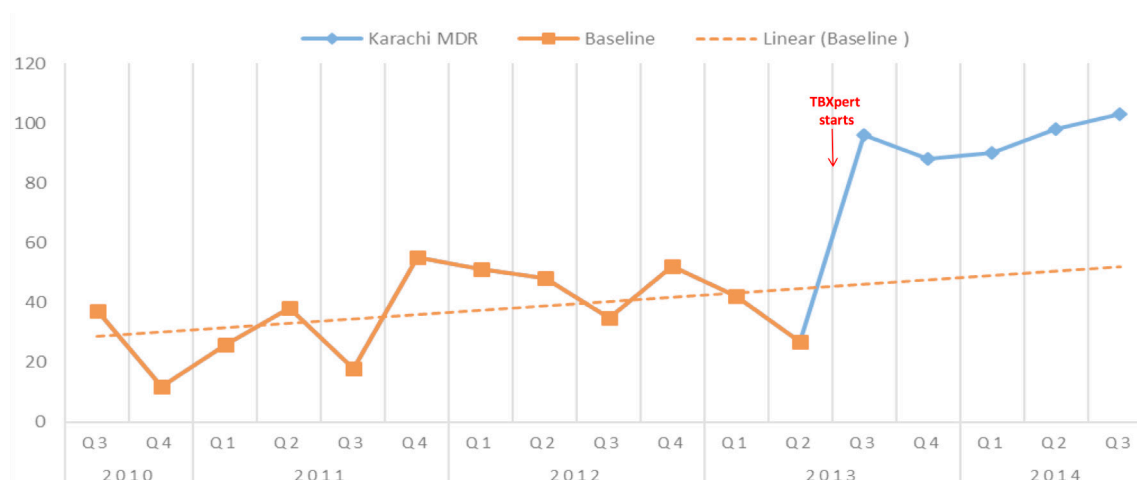
Khan emphasized that scaling and sustaining a TB program in the private sector requires fundamentally new approaches, including social business models—"engaging with the

**Table 1: Source: Khan Presentation at April 2015 TB Innovation Workshop hosted by HMS Center for Global Health Delivery-Dubai.**

TBXpert PPM Summary for Treatment					
Up to January 31, 2015					
	Tests Performed	MTB+ Cases Detected	MTB+/Rif+ Cases Detected	% On treatment MTB+/Rif-	% On treatment MTB+/Rif+
Dhaka 	33,714	2,327	130	90%	86%
Jakarta 	28,357	4,600	363	47%	15%
Karachi 	33,794	5,969	432	86%	90%
   					

<sup>28</sup> Khan attributed the lower rates of MDR-TB patients on treatment in Jakarta, in part, to problems with the team that was assembled.

**Figure 5. Quarterly MDR-TB enrollment, Karachi (2010–2014)**



Source: Khan presentation at April 2015 TB Innovation Workshop hosted by HMS Center for Global Health Delivery-Dubai.

private sector requires private sector expertise.” He advocated for the integration of TB care with consumer services for public health priorities that poor patients access routinely, noting that there is a 10%–20% prevalence of diabetes among adult TB patients. Further, he strongly recommended that mass chest X-ray screening for TB needs to be made free for patients, along with GeneXpert testing and TB treatment. He stressed that going forward, public and private resources need to converge in new ways, pointing to the possibility of rolling out new drugs in the private sector.

### 2.3.8 KEY POINTS FROM DISCUSSION

Starke raised the question of how the TBXpert programs handle household contact investigation after a case is found. Khan responded that they do attempt to investigate MDR-TB contacts, but do not yet have the tools to conduct routine contact investigations in households to identify other TB contacts. They are simultaneously building new models to engage with the private sector and find this mass of patients to treat; he acknowledged the need to bring it together into a comprehensive program that includes components such as contact investigation. While the current priority is to figure out how to sustain what they are already doing, they would like to do more. He reported that small pilot programs for investigating contacts

have had high yields, but require large amounts of resources as well as better methods.

Roscigno posed the challenge of establishing a sustainable model whereby the private sector makes money and the government pays, not the patients. He questioned the best way to make a powerful case to convince the government that paying for performance is cheaper. Mercedes Becerra<sup>29</sup> stressed that payment can go beyond the government, especially when they are unable or unwilling to pay. In those cases, philanthropists or alternative mechanisms should be used.

Khan highlighted the difference between urban areas and rural areas, noting that in many countries more than half of the populations live in cities. He held that urban areas are often rightly considered lower hanging fruit, because the speed and magnitude of these models’ impact is greater in urban centers. He remarked that the models would likely not work at all in a rural setting due to cost. Acknowledging that models would of course need to be adapted for different settings, he maintained that urban centers offer the most “bang for the buck” in pursuing the goal of zero TB deaths, which will not be achieved under the current system of funding and NTPs. In TBXpert cities, an investment of \$3–4 million per year for five years could potentially serve to reduce mortality by half and incidence by a quarter, he projected.

<sup>29</sup> Mercedes Becerra, Harvard Medical School, Boston, MA, U.S.

Responding to questions from Gail Cassell<sup>31</sup> about the use of their X-ray methodology to capture pediatric cases, Khan responded that the X-ray technology for children has not yet been developed sufficiently. Starke advised against mass X-ray testing of all children<sup>32</sup>, but strongly recommended the use of mass X-ray testing for children who are household contacts of TB cases.

Creswell interpreted Khan's data as indicating huge increases in MDR-TB detection. He commented that their work is responsible for finding a very significant proportion of general TB, and pointed to the key program feature of using GeneXpert to provide drug susceptibility test results for all patients with TB. Attributing the slow rate of scaling up MDR-TB treatment in most countries to the narrow focus on very high-risk groups, he argued that the data show that using GeneXpert to generally diagnose people with TB, rather than just using it on a very restrictive group, will enable huge numbers of cases to be found. In the context of the Zero TB Cities Project, he agreed that chest X-ray plus GeneXpert for screening is the best diagnostic that could reasonably be expected to bear fruit in terms of sensitivity and early detection.

Luan Nguyen Quang Vo<sup>33</sup> raised the issue of how to equitably determine which patients can and cannot afford to pay. Khan replied by

emphasizing that there must always be an alternative available for patients who cannot pay. In the three TBXpert cities, patients who pay can decide whether to go to a private or a public hospital. Patients who cannot pay receive free, high-quality care, but they face a longer wait at the government hospital. In Karachi, they identified 30,000 TB suspects, but only 9,000 came to their center for screening while the remaining 20,000 sought care at the public Indus Hospital.

Ananthakrishnan questioned what happens to patients who are diagnosed but not started on treatment, and what kinds of incentives they use. Khan replied that many patients diagnosed in the private sector tend to want to be treated in the private sector, where they pay out of pocket; there is also the element of "transfer out" due to migration or other reasons. Khan and colleagues work with The Abdul Latif Jameel Poverty Action Lab (J-PAL) at the Massachusetts Institute of Technology, which studies the use of incentives in global development delivery and is interested in understanding better what will keep patients on treatment. Burzynski asked how screening itself was incentivized. Khan described how screeners at small general practitioner clinics would "tag" TB suspects by giving them a card that alerts the general practitioner, who then makes a decision about referring them for further testing at TBXpert sites.

#### BOX 2-4 Situating social business in the public-private dichotomy

*Dan Collins<sup>30</sup> requested clarification about where social business fits between the private and public sectors, and Khan offered the TBXpert program as an example. When it was rolled out five years prior, patients were found in the community at general practitioner clinics and then referred to private or public hospitals within the NTP for testing and treatment as needed. TBXpert developed a social business model to set up a screening center with superior diagnostic technology. Per the model, patients would pay for their chest X-rays to help sustain the center, which also became an NTP reporting partner. Khan explained that social business models such as these are set up with a double bottom line: both profit and a mission. To curtail profiteering, there are no dividends for shareholders and all profit is reinvested back into the company. He characterized the social business model as essentially a hybrid of an NGO and a purely commercial company.*

<sup>30</sup> Dan Collins, Global Health Programs, Eli Lilly and Company, U.S.

<sup>31</sup> Gail Cassell, Harvard Medical School / Infectious Disease Research Institute, U.S.

<sup>32</sup> Creswell commented, and Starke agreed, that "mass screening" is a misnomer; targeted, systematic X-ray screening is more precise.

<sup>33</sup> Internationale Tuberkulosehilfe (FIT), Vietnam

## 2.4 Modeling scale-up across a city<sup>34</sup>



### 2.4.1 IMPLICATIONS OF MODELING THE IMPACT OF CITYWIDE SCALE-UP OF TB CASE-FINDING INTERVENTIONS

From the perspective of David Dowdy, TB transmission occurs on the scale of cities and their constituent neighborhoods—not on the scale of countries. His presentation focused on understanding the implications for modeling the impact of city-wide scale-up of TB case-finding interventions and seeking ways to move forward with designing and improving city-based approaches to TB case-finding.

He presented a model for discussion based upon a 2011 case-finding initiative in Karachi, Pakistan,<sup>35</sup> which employed mass communications, local residents as TB screeners in private clinics, and small conditional cash transfers as performance-based incentives. By the end of the initiative, the number of cases started on treatment had doubled, with notification rates continuing to increase since the intervention. However,

Dowdy noted that questions remain as to:

- Whether these notified cases are people who are long-term “chronic” patients who have been sick for a long time
- Whether they are people who recently developed TB who would otherwise die or get better without treatment
- Whether they are people who would otherwise have been treated in the informal private sector but not necessarily notified

### 2.4.2 MODELING APPROACH

To construct the model, a simplified compartmental approach was adopted to estimate the epidemiological impact of the intervention.<sup>36</sup> They estimated the size of the informal sector, i.e., cases being treated but not notified.<sup>37</sup> Then they conservatively assumed that the active case-finding intervention results in the formal notification of all those cases that were already being treated in the informal sector but had not

<sup>34</sup> This section is based on the presentation by David Dowdy, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, U.S.

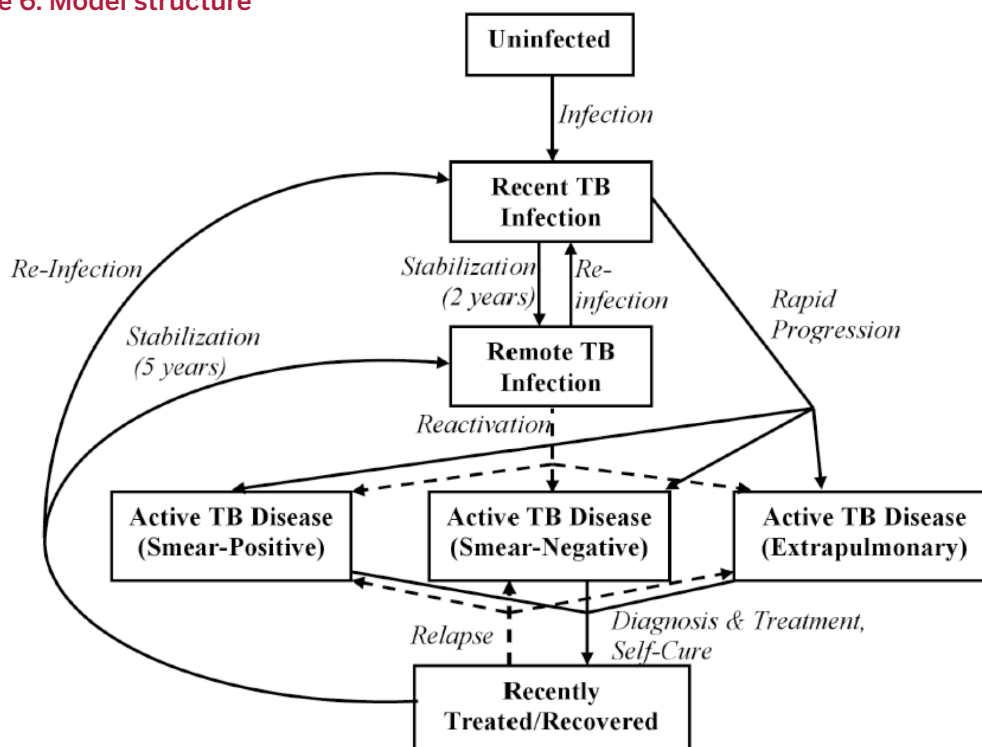
<sup>35</sup> Dowdy et al. 2013 PLoS ONE

<sup>36</sup> Population-level data would be needed to inform a more detailed approach.

<sup>37</sup> He noted that 45% of all treatments were made in private sector, but only 20% of notifications.



Figure 6. Model structure



Source: Dowdy presentation at April 2015 TB Innovation Workshop hosted by HMS Center for Global Health Delivery-Dubai.

previously been notified; the corresponding increase in notifications thus corresponds to no new identification of cases. When this assumption is made, the impact observed in the model represents the minimal impact of the active case-finding intervention since the estimated number of new cases identified is minimized. Finally, the incidence trajectory was projected under two assumptions about TB incidence in Karachi: the WHO estimate for TB incidence in Pakistan, and an estimate 50% higher.

Reiterating the simplicity of this particular modeling approach, Dowdy explained that everyone in the catchment area of the intervention in Karachi could be represented as being in one of the following categories: uninfected; recently infected with TB; remotely infected with TB (i.e., infected a long time ago); having active TB disease which is either smear-positive or smear-negative; or recently treated/recovered (with an increased risk of relapse) (Fig. 6). The population in the intervention's

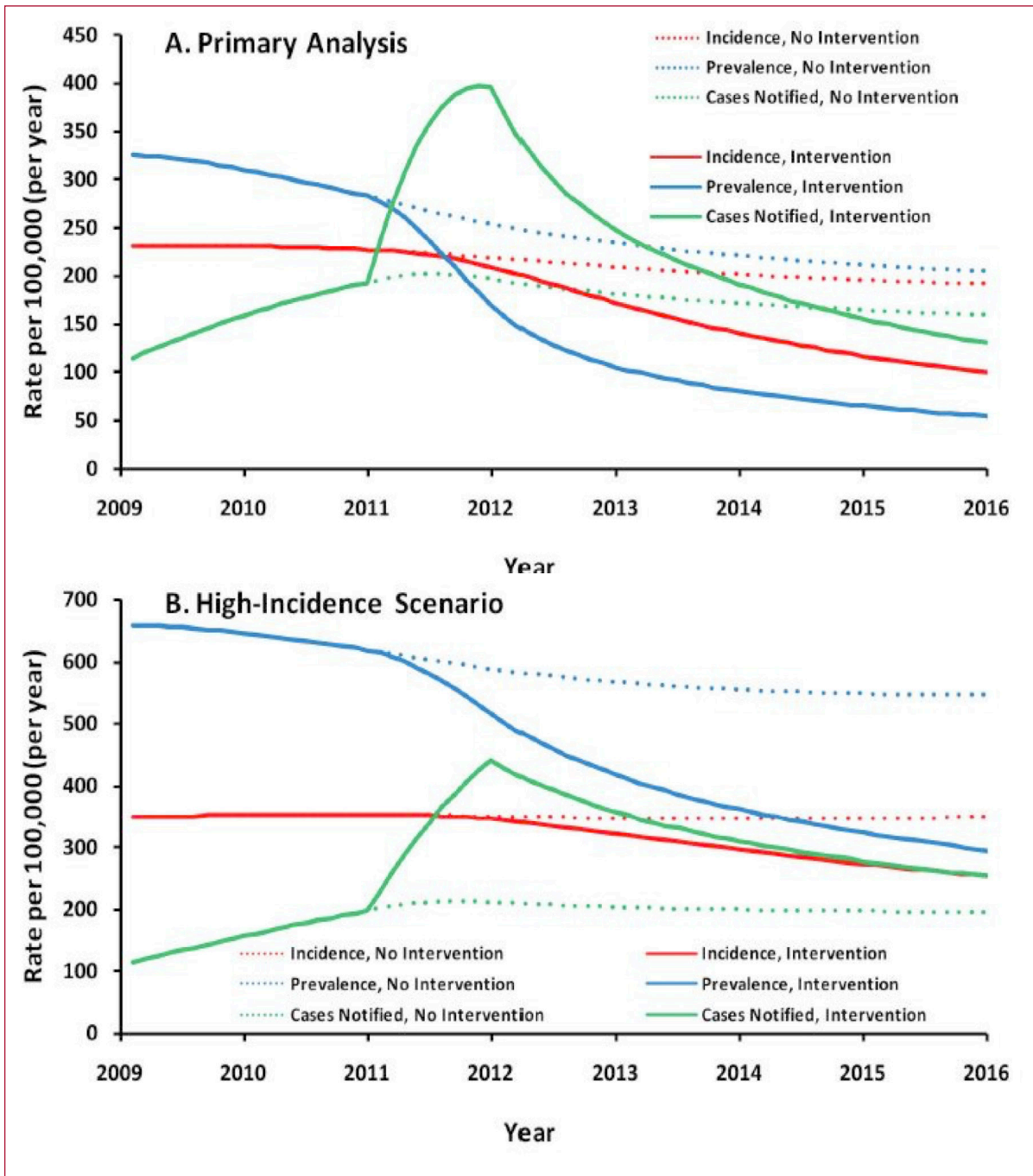
catchment area was represented as homogeneous and distributed among these categories.

The question being asked was what the impact on the TB epidemiology in the intervention area would be given the following conditions:

- The number of people started on treatment is doubled by the intervention (corresponding to the observed impact of the intervention)
- Of these people being notified as starting on treatment, the maximum number possible are assumed to be people moved from the informal sector to the formal sector, and thus not newly identified cases
- Each person has the same probability of being diagnosed and treated each year (even though the number of cases diagnosed and treated each year will decline as total TB cases decline)

The intervention was essentially modeled as an increase in the arrow at the bottom of the model labeled "diagnosis and

Figure 7. Primary analysis and high-incidence scenario



Source: Dowdy presentation at April 2015 TB Innovation Workshop hosted by HMS Center for Global Health Delivery-Dubai.

treatment.” That is, the rate at which people go from having active disease to being treated was increased by enough to generate the observed change in TB notifications.

### 2.4.3 MODELING RESULTS: PRIMARY ANALYSIS AND HIGH-INCIDENCE SCENARIO

The top panel of Fig. 7 shows the results of the primary analysis, carried out under the assumption that TB incidence in Karachi is the same as the WHO estimate for underlying TB incidence in Pakistan (2011). The bottom panel assumes that the underlying incidence in Karachi is actually 1.5 times higher than the WHO estimate for Pakistan.

Dowdy pointed out how in the primary analysis, the case-finding intervention precipitates a bump in the notified cases curve and a relatively quick decline in prevalence, but that the incidence curve takes longer to fall. The model predicts that after five years, sustained case-finding could reduce TB incidence by 45% and mortality by 72%.<sup>38</sup> In the high-incidence model, the percentages are smaller but the absolute numbers are larger.

Sensitivity analyses investigating the impact of various parameters in the model found that case-finding and treatment have more impact when a greater proportion of TB is caused by recent transmission rather than remote reactivation.

### 2.4.4 CHALLENGES IN MODELING CITY-LEVEL INTERVENTIONS

Dowdy used the modeling exercise as a springboard to motivate discussion about some specific challenges of modeling city-level interventions. The first issue he raised is the dearth of city-level data, e.g., the actual underlying incidence of TB in Karachi is unknown. The second issue is that understanding heterogeneities is critical to successful interventions; for instance, targeting “hotspots” of transmission or high-risk types of people is possible with a city-level approach. However, without data on local heterogeneities (e.g., geographic differences in TB incidence or

prevalence), it is difficult to model the impact of these targeted interventions, which may in fact be the most effective interventions. Finally, he noted that the generalizability of a model from one city to another is not guaranteed.

Dowdy concluded by offering several points for further discussion about modeling city-level interventions:

- What is the role of modeling in evaluating citywide scale-up? That is, what questions are better answered by models than by actual data?
- How do we balance the need for complex models of cities with sparse data?
- How do we generalize across cities and use models to advocate for a local-level approach?

### 2.4.5 KEY POINTS FROM DISCUSSION

In response to Starke’s question about the amount of minimal data needed to begin constructing a model for a given location, Dowdy noted that the output of any model depends upon what is put into it. Simple models can be constructed with just incidence or notifications. More detailed data, like genotypes for transmission mapping, can populate more complex models, with the caveat that these models may be less generalizable to other cities. Baseline requirements depend on the question being answered, e.g., looking at the impact of a risk factor requires knowing the relative risk associated with it and its prevalence in the population.

Keshavjee asked if adding more types of active case-finding to the model Dowdy presented would result in an even more significant drop in cases. Dowdy agreed that it is possible, but reiterated that the model is a simplification of reality that does not take into account factors such as whether everyone who was notified actually had TB. While the model is a good attempt at reality, it may overestimate or underestimate the actual impact.

Creswell raised the issue of migration and immigration, and how the model might control for or measure them. Dowdy replied that it is a challenge and, in this case, they assumed

<sup>38</sup> Assuming the same intensity of case-finding and even if the number of cases found drops off.

a simplified model of no migration. Further, he noted that it is not clear whether including migration would actually augment or diminish the impact of the intervention on an overall population level. However, he believes that it is an answerable question if additional models could be constructed to characterize migration.

Luke Disney<sup>39</sup> queried whether the focus should be on a whole-population-based approach. Dowdy agreed that it is important to focus on populations who are at the highest risk. A key feature of TB is its airborne transmission, which sets it apart from other major diseases. He recommended focusing on the level at which TB transmission occurs (e.g., neighborhood-level approach, public transport system approach, etc.), but in the context of delivering interventions administratively, the city-level approach is most effective.

Regarding non-intervention uses of data, Shelly Batra<sup>40</sup> asked about the minimal amount of data that could be used for advocacy to governments and donor agencies to step up funding. Dowdy recommended advocating based on simple models constructed from the best available data, even if it is currently sparse, rather than waiting for perfect data. He called for finding a

balance between collecting the data needed to deepen our understanding, while at the same time advocating for resources using simple models with the data currently available.

Starke distinguished between defining disease prevalence at the outset of the model, which represents transmission in the past, but moving forward with the model and defining disease incidence, which might be a better indicator of current transmission (which is where factors such as migration may come into play). Dowdy agreed that incidence is a marker of current transmission, whereas prevalence is both the current pool of future infection and the reflection of past transmission. There is a lag between prevalent cases as the source of transmission, and incidence in the future when those transmission events result in active disease.

<sup>39</sup> Luke Disney, North Star Alliance, The Netherlands

<sup>40</sup> Shelly Batra, Operation ASHA, India



## 2.5 Minding the gaps: cities as a path to TB elimination<sup>41</sup>



### 2.5.1 OVERVIEW: TB CONTROL PROGRAM IN VLADIMIR REGION, RUSSIA

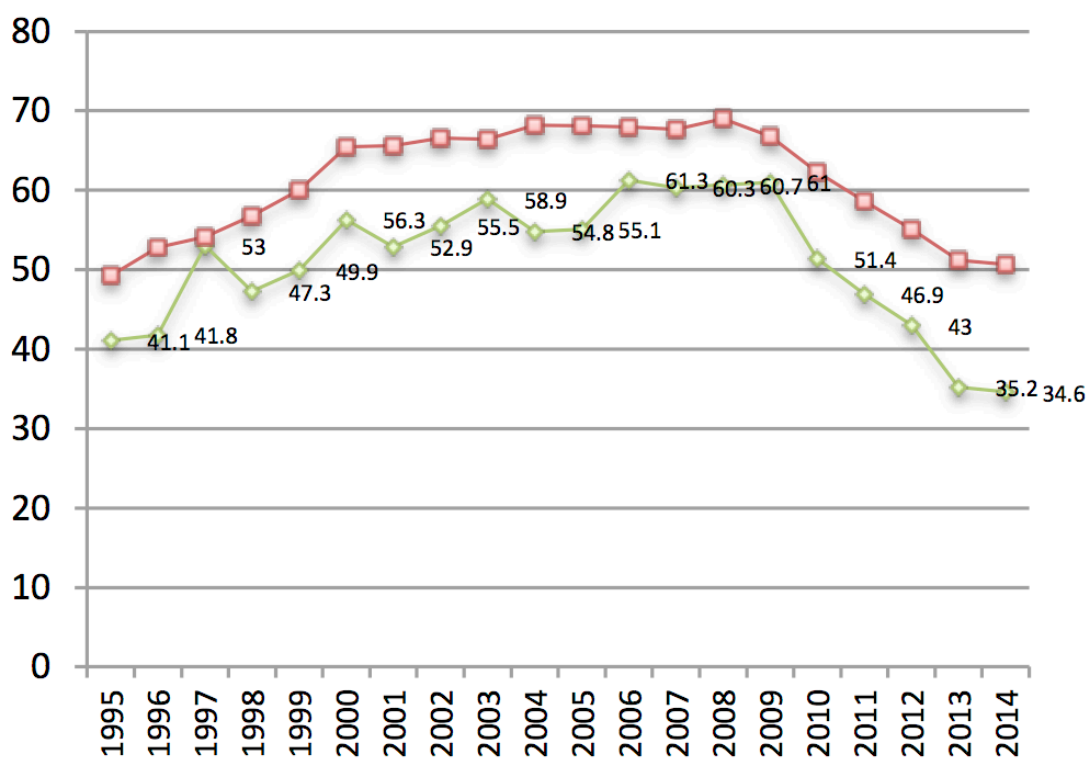
Vladimir Region, located east of Moscow in Russia, has a population of about 1.5 million people. A WHO-supported DOT pilot project was launched in the region in 1999, followed by an intensive TB infection control program in 2002, and the establishment of a TB Infection Control Center for Excellence in 2008.

Volchenkov described the success of the TB Control Program in sharply reducing incidence and prevalence of TB since 2000, though this has been juxtaposed with a sharp rise in HIV prevalence. TB mortality has dropped from 20.6 per 100,000 population in 2004 to 5.5 per 100,000 population in 2014 (Fig. 8):

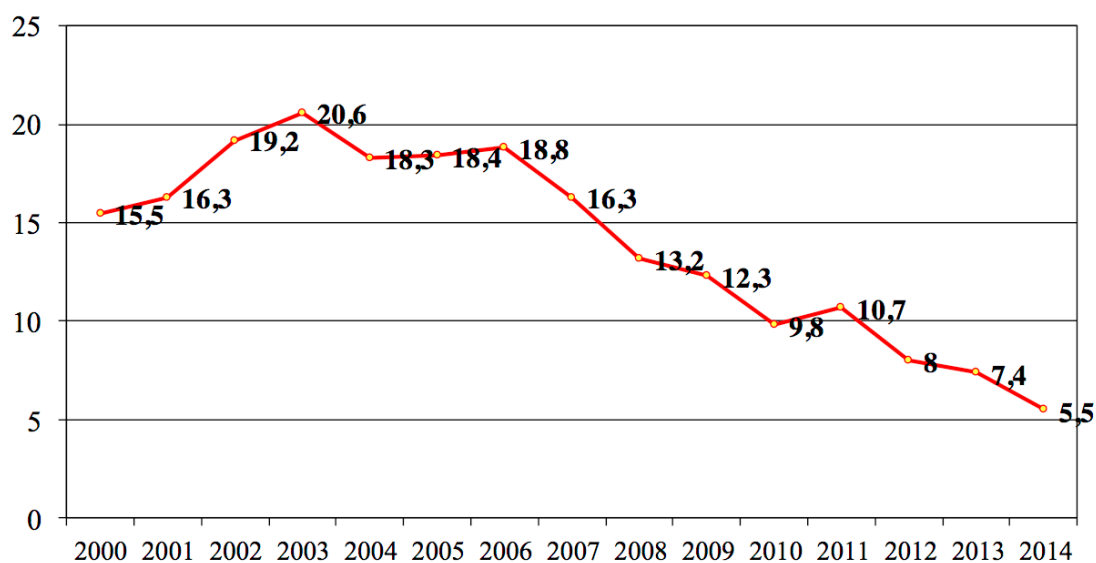
<sup>41</sup> This section is based on the presentation by Grigory Volchenkov, Vladimir Regional TB Dispensary, Russia.

Figure 8. TB notification and mortality rates, Vladimir Region (green line) and Russian Federation (red lines)

a) TB notification rates per 100,000 population (1995–2014)



b) TB mortality rates per 100,000 population (2000–2014)



Source: Volchenkov presentation at April 2015 TB Innovation Workshop hosted by HMS Center for Global Health Delivery-Dubai.

### 2.5.2 KEY COMPONENTS OF TB CONTROL PROGRAM IN VLADIMIR REGION

Volchenkov summarized the critical interventions that have been implemented as part of the TB control program in Vladimir:

- Maintaining a centralized, uninterrupted supply of first- and second-line TB drugs
- Implementing evidence-based treatment protocols based on drug susceptibility testing and recommended by WHO and the Russian Society of TB Specialists
- Using centralized, quality-assured microbiological laboratory results as the basis for effective treatment regimens
- Delivering DOT at patients' areas of residence
- Providing incentive programs for adherent TB patients (e.g., free meals, monthly food and sanitary supply packages, and transport reimbursement)
- Developing and implementing a protocol for isoniazid preventive therapy for people living with HIV
- Restructuring the TB control service to increase its effectiveness and to reduce nosocomial TB transmission risk

To facilitate case-finding and diagnosis, the program uses laboratory diagnostic algorithms; Volchenkov emphasized that rapid molecular testing is used for all suspected cases of TB.

### 2.5.3 CHALLENGES AND WAYS FORWARD IN VLADIMIR REGION

Volchenkov highlighted several challenges the program faces, despite the availability of resources. The state funds an active case-finding system that screens all citizens annually with chest X-rays, but he noted that the highest risk populations (e.g., homeless, unemployed, and substance abusers) are not adequately covered by the program. Ensuring treatment adherence and compliance are problematic, especially among patients co-infected with HIV and substance abusers.

Despite the success of the TB control program in reducing TB prevalence and mortality, the levels of nosocomial drug-resistant TB transmission remain high. Strategies used to address this include advocacy and media campaigns, community engagement, NGO involvement, and outcome-oriented funding and incentives for the TB control program.

### 2.5.4 CASE STUDY: DEFINING AN OPTIMAL MODEL OF TB CARE

TB control in Russia was traditionally based on intensive hospitalization of all cases. Volchenkov cautioned that in actuality, such vertical TB control structures ultimately tend to be self-sustaining rather than geared toward treating patients effectively. A pervasive problem is that concentrating TB patients in hospitals fosters high rates of TB transmission. The TB control program has been working toward defining an optimal model of TB care; one of its key components is transitioning from a policy of extensive hospitalization toward one that limits centralized hospitalization to regional TB hospitals with effective infection control programs in place to reduce nosocomial TB transmission.<sup>42</sup>

To demonstrate how restructuring TB-control approaches can affect the outcomes of an intervention, Volchenkov offered an instructive comparison of the experiences in two smaller-sized cities in the region, Murom and Kovrov. Both cities previously had small TB inpatient departments with high rates of transmission. The inpatient department in Murom was closed, with

<sup>42</sup> As well as the elimination of all district-level inpatient TB departments/beds.

a DOT delivery location and day-care TB department launched in a new building. In Kovrov, inpatient hospitalization continued as before with no improvements in infection-control protocol.

Six years after this intervention, outcomes improved across the board in Murom, where they reduced hospitalization, provided better outpatient services, and restricted the potential for nosocomial transmission. TB prevalence and mortality declined in both cities, but less so in Kovrov. Volchenkov stressed that while patients in both cities received the same treatment protocol, drugs, and services, MDR-TB transmission rates declined in Murom but actually increased in Kovrov (Table 2).

Preventing MDR-TB transmission is a high priority in Russia, where 2% of new TB cases are MDR-TB and 10% of MDR-TB cases are XDR-TB.

Volchenkov underscored how the experiences in Murom and Kovrov provide support for implementing a model of care that reduces transmission by limiting hospitalization to highly contagious cases in safer facilities that are compliant with TB infection-control protocol. He advocated for rapid molecular testing for all TB suspects and immediate initiation of effective DOT in outpatient settings,<sup>43</sup> with an incentivized, patient-centered approach to improve treatment compliance.

## 2.5.5 KEY POINTS FROM DISCUSSION

Nicholson asked Volchenkov about the extent to which he has shared his data with the relevant ministries and the regional Federal Tuberculosis Research Institute, and what the response has been thus far. Volchenkov mentioned that he had shared this material, and that this type of intervention package is a high priority for them. He said it was met with interest but fits as a small piece within what they are looking at in terms of reduction of hospitalization in general, diagnosis algorithms, high-quality treatment, evidence-based protocols, and outpatient services.

Keshavjee questioned what kind of restructuring of delivery capacity was necessitated and prioritized in the shift from a hospital-based system to a more ambulatory-based system. Volchenkov reported that they try to maintain and reinforce their existing outpatient services with transportation support, IT supplies, mobile communication, food packages, and general care delivery.

Khan inquired about the extent of the private or NGO sector that engages in treatment, the challenges or absence of linkages between the public systems and those private sectors,

**Table 2. Epidemiological effectiveness of TB care models in Murom and Kovrov**

Indicator	Average annual change (%)		
	Murom	Kovrov	Region
TB notification rate (2005–2012)	- 12.5	- 0.6	- 5.3
TB mortality	- 15.6	- 9.6	- 9.9
TB prevalence	- 9.1	- 5.0	- 5.1
MDR-TB notification rate (2010–2012)	- 34.4	+ 94.0	+ 0.6
Proportion of MDR-TB among new TB cases	- 24.9	+ 37.3	+ 10.3

Source: Volchenkov presentation at April 2015 TB Innovation Workshop hosted by HMS Center for Global Health Delivery-Dubai.

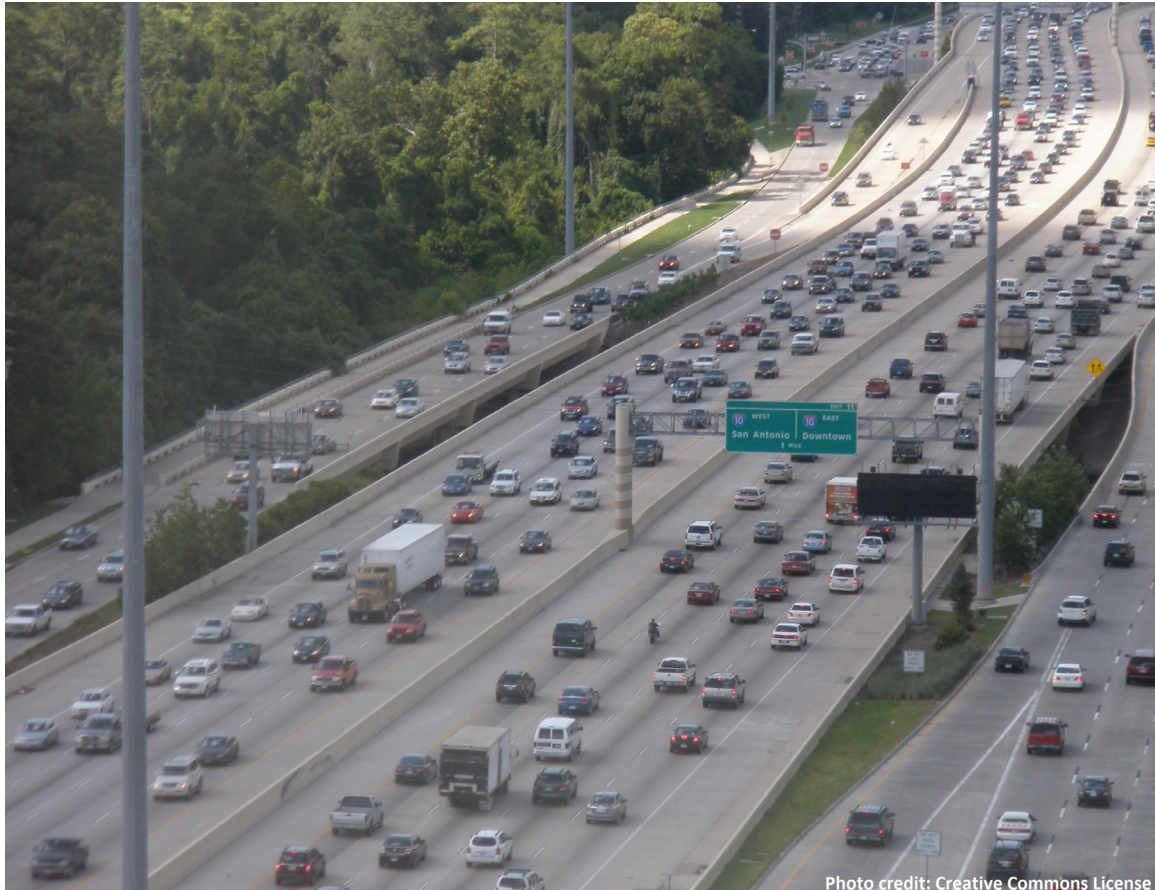
<sup>43</sup>Based on quality-assured liquid media drug susceptibility testing throughout all treatment courses.

and what steps have been taken to engage NGOs in the provision of care for the hardest patients to reach. Volchenkov explained that non-governmental healthcare services that did not exist in the Soviet Union are expanding at the same time that state-owned structures are deteriorating in some areas. The public sector is trying to establish cooperation among private partners, but Volchenkov expressed hope that the vertical structure would be maintained; it is not as efficient as the private sector, but funding is assured. Private sector partnerships are involved in providing chest X-rays for active case-finding; DOT is provided by the TB-control structures and primary healthcare. NGO partnerships are involved in outreach to marginalized populations such as individuals suffering from alcoholism and members of the Roma community.

Khan followed up by questioning whether the existing technology and state-based approach would allow for a targeted chest X-ray screening program for TB suspects, similar to the program under the Soviet Union. Volchenkov clarified that the targeted system in fact still exists, but its ambitions are too high in terms of population-level screening given the resources it has available at this time.



## 2.6 Household-centered approach: Houston, Texas USA<sup>44</sup>



Jeffrey Starke's presentation centered on the household-centered approach to TB contact investigation that is used in Houston, Texas and throughout the United States to investigate patterns of TB transmission and prevent transmission among family members. He explained that because children tend to develop TB quickly, pediatric TB trends offer a window into the real state of TB transmission in the population at large. In the area where he works, half of childhood TB cases are actively diagnosed on the basis of family and household contact-tracing efforts, particularly in high-risk households. These children tend to have less severe disease than when childhood TB is discovered passively by evaluation of a sick child.

The household-centered approach seeks to identify people who have been exposed recently<sup>45</sup> and/or infected

with TB in high-risk households.

### 2.6.1 ADVANTAGES OF HOUSEHOLD-CENTERED APPROACH TO CONTACT TRACING

The household-centered approach offers a host of advantages, chief among them being the opportunities to:

- Prevent the establishment of TB infection
- Prevent progression to disease
- Detect disease in its early stages, when it is easier to treat and cure
- Reduce hospitalization rates
- Prevent transmission of the organism

<sup>44</sup> This section is based on the presentation by Jeffrey Starke, Professor, Baylor College of Medicine, U.S.

<sup>45</sup> He remarked that recently infected people are likely to become the next incident TB cases.

Starke emphasized that the household-centered approach represents the only opportunity to determine drug susceptibility for 50% to 70% of children with TB disease, because it is only possible to isolate the TB bacteria from a child 30%-40% of the time. In cases where no bacteria can be isolated, the only way to deduce if a child has drug-resistant TB is to determine with reasonable probability the person who transmitted TB to the child.<sup>46</sup> For 100% of children with TB infection, contact tracing is the only opportunity to know if the strain is drug-resistant.

Most children who develop TB disease do so soon after being infected; as a result, their source case may not yet be discovered. In Texas Children's Hospital, adults who accompany children with suspected TB are immediately sent for a chest X-ray at the hospital's expense. Around 15% of these adults are diagnosed with TB disease, with most having infectious pulmonary TB.<sup>47</sup> This is a case rate of 15,000 per 100,000, probably the highest yield from any TB screening program yet described. This procedure reduces transmission of the organism within the hospital and helps to support the correct diagnosis in the child.

### **2.6.2 TB CONTROL IN HOUSTON TX: 1985 - 2015**

In 1985, the TB case rate in Houston was about 30 per 100,000 population, with rates being highest among African-American children from poor families. Starke described how analysis revealed that up to 40% of those childhood TB cases would have been prevented had the principles of TB control been applied. In the private sector, adult cases were not being reported and children were receiving non-standard care. Lack of funding led to 6–9 month delays in initiation of contact investigations.

The picture in 2015 is a starkly different: the case rate has dropped to eight per 100,000 population. Services have been consolidated into a single clinic comprising public and private partners including a private children's hospital, physicians from academia, a commercial laboratory, and state contracts.

An essential component of the program, according to Starke, is a universal DOT program

that has achieved a cure rate of 98% and no children lost to follow up in 30 years. The program provides a package of services including enablers, health assessments, social services, and financial counseling to support the children and their families. Establishing and monitoring standards of care instills accountability among doctors in the community. Given that childhood TB is itself a quality indicator, every case of childhood TB is reviewed to determine whether it could have been prevented.

### **2.6.3 KEY POINTS FROM DISCUSSION**

Khan remarked that given the significantly high yield of the screening program for parents of child TB cases, it should be more commonly implemented. Starke agreed, adding that it is evidence-based and widely adopted in US children's hospitals, due to the potential for high rates of transmission in those facilities.

Responding to the question of why the yield for adult household contacts (averaging 2%–4% in the United States) tends to be lower than the yield for child household contacts, Starke characterized it as an epiphenomenon in some ways. Children get sick rapidly, often before their source case is diagnosed, so developing disease is actually the marker for recent infection in children. In low-prevalence areas, the signal-to-noise ratio is such that the source case is in the household most of the time.

Becerra emphasized that because children get sicker sooner than adults infected at the same time, they should be considered the most sensitive indicators at the system level. Childhood cases of TB indicate that recent transmission has occurred, and that preventative therapy has not been provided in time. Cassell questioned whether this increased rapidity of progression occurs in children of all ages and, if so, why there is not more focus on understanding why this happens. Starke agreed that this is not well understood, but it has been established that children <2 years of age are the most sensitive. Children aged <1 year have a 40% chance of developing active disease if they are infected, typically progress within 6–9 months, and develop worse forms of TB.

<sup>46</sup> Starke noted that this is less straightforward in high-prevalence areas.

<sup>47</sup> During the discussion, Starke clarified that all but one of the 15% have been culture positive in the last 10 years.



## 2.7 Project PROPER CARE: Ho Chi Minh City, Vietnam<sup>48</sup>



### 2.7.1 VIETNAM'S TB BURDEN

Vo described his organization's efforts to implement Project PROPER CARE, a TB intervention in Ho Chi Minh City, Vietnam. While Vietnam's National TB Program (NTP) has made steady progress in reducing TB incidence, prevalence, and mortality over the past 25 years, there are still 130,000 new TB cases annually—about 5,000 of which are drug-resistant—and there are about 17,000 deaths due to TB every year.

Vo reported that the NTP's goal is to reduce TB prevalence by more than 30% by 2020 (Fig. 9). A key obstacle faced is poor health-seeking behavior that has led to 44% of cases being missed.<sup>49</sup> This is exacerbated by poor treatment outcomes, especially in the private sector: around two-thirds of smear-positive patients treated by private providers in Ho Chi Minh City default from treatment.

### 2.7.2 PROJECT PROPER CARE: OVERVIEW

To help address these hurdles, four different PPM models providing increasing levels of service and responsibility<sup>50</sup> were introduced with pilots across various sectors, but mainly focusing on the referral-only model. The NTP reports that PPM scale-up remains slow and has not yet extended to private facilities to the extent desired.

Vo explained that Project PROPER CARE was devised to provide PPM-driven reinforcement of patient enrollment and retrieval as well as community advocacy and engagement, with two primary goals: to increase the number of cases detected and to lower loss to follow up rates. More specifically, the model was designed to be holistic and provide a comprehensive care model, together with economic and social support for urban poverty pockets, facilitated by active linkage between public and

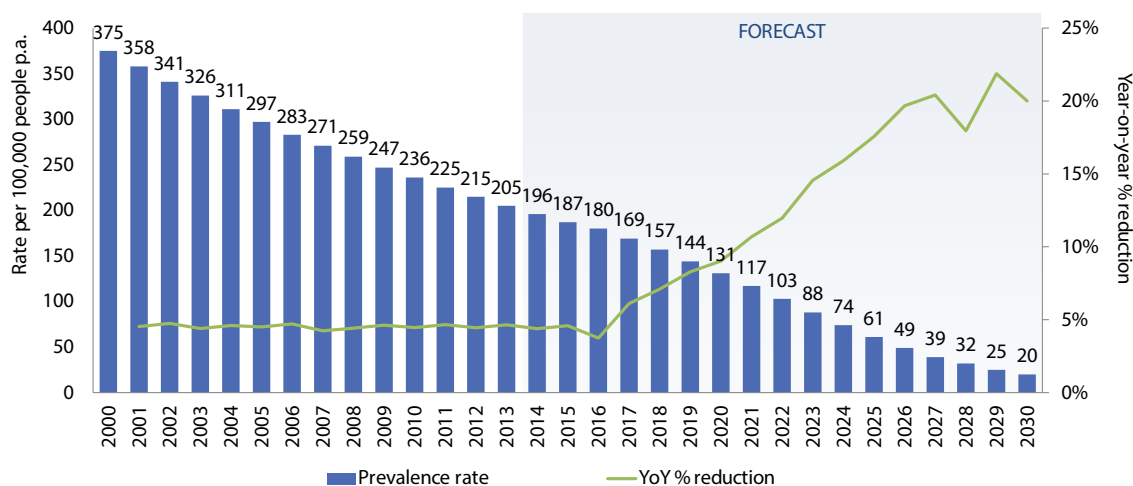
<sup>48</sup> This section is based on the presentation by Luan Nguyen Quang Vo, Freundeskreis für Internationale Tuberkulosehilfe (FIT), Vietnam.

<sup>49</sup> WHO, National Situational Assessment for PPM DOTS. 2007; (2) Quy et al. *Int J Tuberc Lung Dis* 2003; 2011-2015 Vietnam NTP National Strategic Plan

<sup>50</sup> Model 1: Referral; Model 2: Diagnosis (symptom screening and chest X-ray) and referral to TB facilities; Model 3: treat (DOTS), record and report to NTP; Model 4: Full package service functioning as district TB unit

**Figure 9. Vietnam's TB prevalence rate and year-on-year % reduction, 2000-2030**

Prevalence rate &amp; year-on-year % reduction, 2000-2030



Source: Vo presentation at April 2015 TB Innovation Workshop hosted by HMS Center for Global Health Delivery-Dubai.

private providers. To do so, gaps in the existing model were augmented with best practices concerning active case-finding, patient contact tracing, follow-up of missed doses, and patient tracking both within and beyond the NTP.

Ultimately, Project PROPER CARE proposed a new comprehensive PPM model (Fig. 10).

The model features greater vertical integration across a broad spectrum of stakeholders from the municipal, public health, and private sectors, with roles spanning treatment, oversight, technical support, management, reporting, and referrals.

### 2.7.3 PROJECT PROPER CARE: GO VAP DISTRICT PILOT SITE

Go Vap district in Ho Chi Minh City was selected as the pilot project site. Ho Chi Minh City accounts for about 1 in 6 TB notifications in the country—around 15,000 each year. Go Vap district has a high population density with up to 47% migrants, and many residents live in slums, boarding houses, and poverty pockets. Go Vap has an estimated annual TB incidence of 950 per year with an increasing proportion of missed cases and a high rate of loss to follow up.

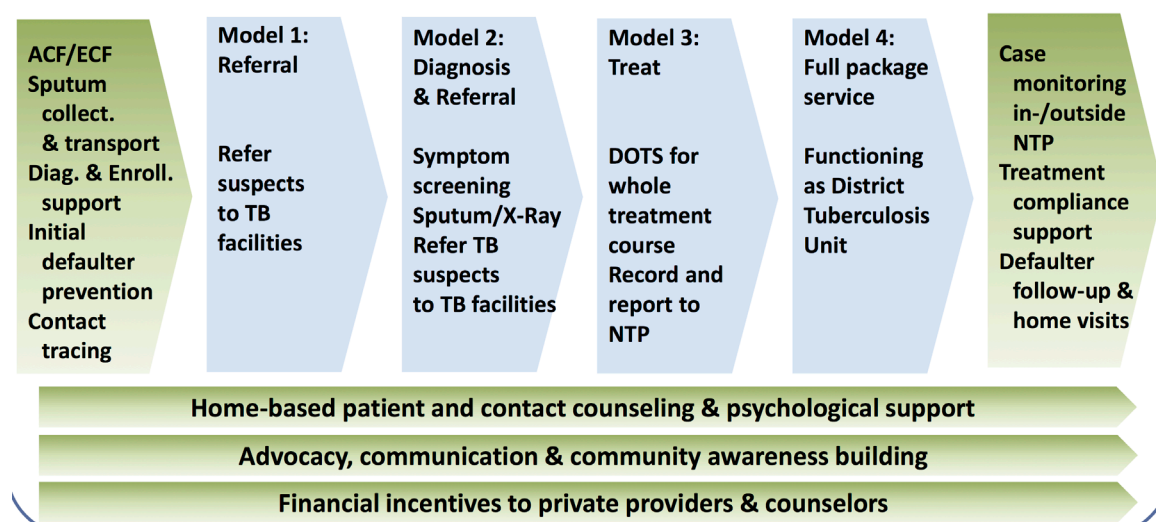
The pilot project built upon the existing infrastructure of a single District TB Unit (part of the official NTP network) by adding a basic healthcare unit in each of the district's 16 wards. There is a loose referral network with a limited number of private providers. Vo highlighted the crucial role of project counselors, a team of 18 local, trained, and incentivized counselors who are responsible for community outreach<sup>51</sup> and liaising among private providers and the official TB-care infrastructure (Fig. 11).

### 2.7.4 PROJECT PROPER CARE: INITIAL RESULTS

Vo reported that since the project's launch in April 2014, annual new case enrollments have increased noticeably, reversing a multi-year declining trend (though more data points are needed for a statistically significant analysis). Default rates improved significantly from 11% in 2012 to 1% in 2014; Vo posited that this trend may be attributable to the value that people in Vietnam place on relationships, and the role that their counselors play in providing personal and treatment support to patients.

<sup>51</sup> For instance, assisting migrants in establishing the proof of residency that is required for NTP enrollment.

**Figure 10. Project PROPER CARE comprehensive PPM model**



Source: Vo presentation at April 2015 TB Innovation Workshop hosted by HMS Center for Global Health Delivery-Dubai.

## 2.7.5 PROJECT PROPER CARE: POTENTIAL ARGUMENT FOR COST EFFECTIVENESS

Citing a meta-analysis<sup>52</sup> (challenged by Cre-swell of the Stop TB Partnership, below) performed on 19 TB REACH first-wave projects that included a contact-tracing component, Vo sketched a potential argument for the relative cost effectiveness of Project PROPER CARE. The TB REACH meta-analysis found that 139,000 contacts of 30,000 index cases were traced, yielding around 2,500 sputum-smear-positive patients with a pool yield of 1.5%, at an estimated cost of 10 million USD (~\$72 per person; ~\$333 per household; ~\$4,000 per sputum-smear-positive patient).

After 9.5 months, Project PROPER CARE had spent approximately \$71,250 USD to reach more than 42,000 households and contact over 195,000 household members. Vo conceded that the yield was much lower (163 sputum-smear-positive TB; 0.1% yield) but offered the following cost estimates: ~\$0.37 per person; ~\$1.68 per household; and ~\$437 per sputum-smear-positive patient.

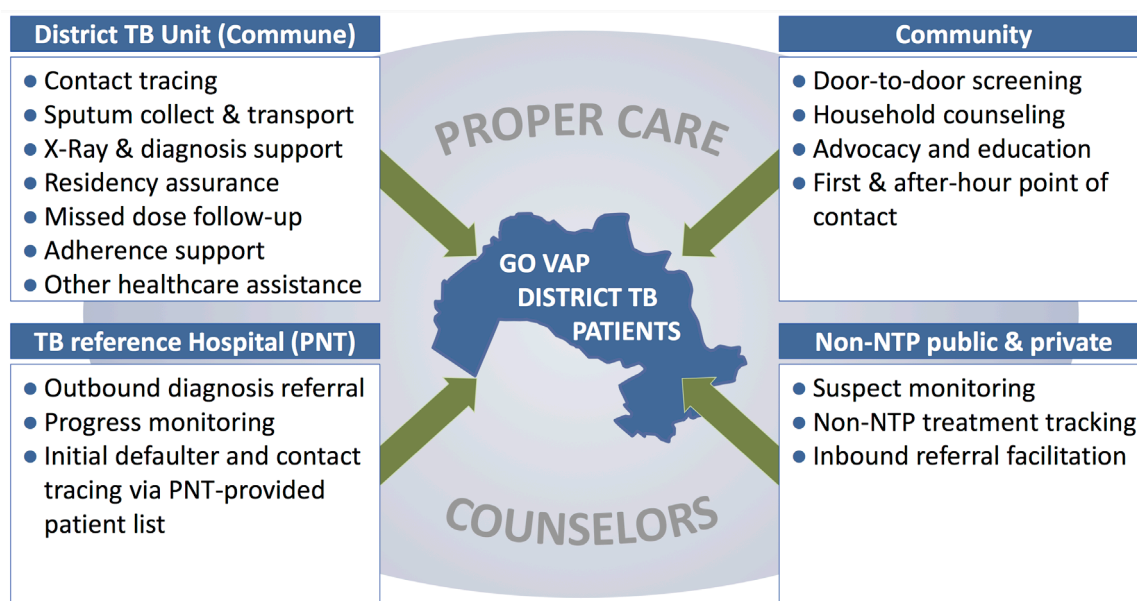
## 2.7.6 MUNICIPAL AND PUBLIC HEALTH LINKAGES

Vo noted that one of the potential levers that substantiates cost effectiveness was the ability to leverage some subsidies from close collaboration with the municipality. TB projects in Vietnam are typically top-down (from central to district level) for ease of implementation, but Project PROPER CARE adopted a grassroots focus from the district and ward levels upward.

Six key areas were identified to drive value through comprehensive municipal collaboration and integration:

- Recruiting and training staff with applicable skillsets and relationships
- Fostering sustainable collaborations with relevant private providers
- Creating a favorable sociopolitical environment for case detection and enrollment
- Using health system enablers to improve patient management vis-à-vis adherence and follow up
- Recording and reporting data for accurate and transparent impact assessment
- Improving financial management with synergies for optimized, transparent cost profiles

<sup>52</sup> Blok et al. 2015 PLoS ONE

**Figure 11. Comprehensive care within and outside NTP (Project PROPER CARE)**

Source: Vo presentation at April 2015 TB Innovation Workshop hosted by HMS Center for Global Health Delivery-Dubai.

## 2.7.7 PROJECT PROPER CARE: NEXT STEPS FOR MUNICIPAL COLLABORATIONS

To conclude, Vo outlined the next steps planned for the project in terms of municipal collaborations. Operational plans include expanding and strengthening collaboration with non-NTP public health facilities and the District Health Office, optimizing public-private collaboration with a particular focus on private practices of NTP doctors, initiating two-way patient referrals and treatment monitoring with PPMs, and structured involvement of pharmacies and socio-political organizations.

In terms of advocacy and sustainability, the plan is to intensify involvement with the Ho Chi Minh City Department of Health, with the view to securing a commitment to early detection and treatment of TB such as the Department has made for HIV. Further plans include provision for TB services in the social health insurance scheme and access to a special NTP fund for extremely poor patients to cover user fees.

## 2.7.8 KEY POINTS FROM DISCUSSION

Vo clarified that the case-finding data he presented show all of the cases found in the intervention area, both by Project PROPER CARE's intervention and through passive case-finding. Creswell asked what proportion of the total cases notified in the district were found through the project's intervention. Vo replied that the presumption was that counselors would find cases who would eventually have made their way to the NTP, so there is no overlap.

Imran Zafar<sup>53</sup> questioned why case-finding through contact tracing yielded lower numbers than general population screening in this case. In that context, Becerra emphasized that household contact tracing is far more efficient and cost-effective than general population screening. Vo answered that there were assumptions that when counselors find cases, they find cases that probably would have found their way to the NTP sooner or later. He suggested that there was a combination of effects in addition to household or contact screening, such as X-ray subsidies, at play.

<sup>53</sup>Imran Zafar, Interactive Research and Development, Karachi, Pakistan

Starke questioned why Vietnam presents almost no data on childhood TB. Vo remarked that, in his experience, they have very little guidance as to how to diagnose children and often send them to the district TB reference hospital for treatment. He posited that this might be further compounded by lack of experience and knowledge regarding pediatric TB diagnosis in the field.

Asad Zaidi<sup>54</sup> requested details about the performance management and appraisal system used to keep counselors motivated beyond

compensation. Vo described the reporting system, wherein counselors submit the number of suspects they have referred, the number of people who were tested, and the number of new patients that they have counseled. They use three primary measures: number of suspects tested or sputum samples, number of cases enrolled, and number of patients lost to follow up. “Soft” metrics include accurate reporting and timely attendance at weekly meetings.

#### **Q&A Highlight: A Note on the TB REACH Data**

*Creswell clarified that a cost-effectiveness comparison that Vo presented, situating Proper Care against other TB REACH projects, was misleading in terms of cost per patient. The TB REACH-funded programs had very little contact investigation work as part of the operations covered specifically by TB REACH funding, and were heavy on clinic-based activities. There is only one TB REACH project that did contact investigation, and they had almost the exact same case-finding results as Vo’s team.*

<sup>54</sup>Asad Zaidi, Interactive Research and Development, Karachi, Pakistan

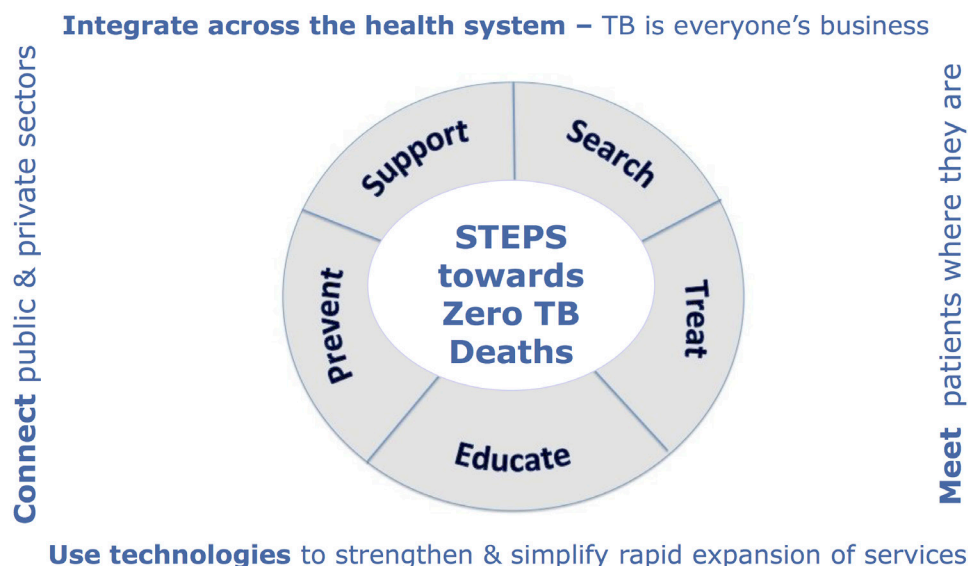


## 3.0 STEPS: Towards Zero TB Deaths in Chennai<sup>55</sup>

Rigveda Kadam introduced STEPS (now referred to as S-T-P), a comprehensive push for all the ingredients of successful TB care, underpinned by crosscutting principles for maximum effectiveness and efficiency. The measures are already being implemented to various degrees in Chennai, founded on the need to build on systems, not build new systems (Fig. 12):

**Figure 12. Overview of STEPS initiative**

**STEPS: a comprehensive push for all the ingredients of successful TB care, underpinned by cross-cutting principles for maximum effectiveness and efficiency.**



Source: Kadam presentation at April 2015 TB Innovation Workshop hosted by HMS Center for Global Health Delivery-Dubai.

### 3.1 SEARCH

The SEARCH component seeks to find all “missing cases” in the public and private sectors, and to detect drug resistance earlier. Efforts are already in place to expand designated microscopy centers, introduce radiography (X-ray) for first-line diagnosis, and use GeneXpert for diagnosing sputum smear-negative patients. A contact-tracing pilot has been rolled out, along with routine screening in schools and antiretroviral therapy clinics by the government. Current challenges are drug resistance, the need for more active case-finding, and the limited insight into diagnosis in the private sector.

Proposed SEARCH interventions include:

- Investigating all contacts of index TB cases, and conducting routine screening of high-risk groups
- Introducing computer-aided radiography to improve efficiency of rapid scale-up
- Expanding the use of GeneXpert to cover all new sputum smear-positive patients to ensure early detection of drug resistance in this population
- Exploring diagnostic public-private partnerships and strengthening notification from private sector

<sup>55</sup> This section is based on the presentation by Rigveda Kadam, Clinton Health Access Initiative, India.

### 3.2 TREAT

TREAT objectives are to expand access to uninterrupted treatment, improve adherence, and manage side effects. Treatment is currently available in DOTS centers, but challenges included limited engagement of the private sector, lack of systems for adherence monitoring and follow-up, and limited community-based treatment.

Proposed TREAT interventions include:

- Strengthening supply chain management to avert potential interruptions to supply of TB treatment
- Establishing Private Provider Interface Agencies to strengthen the role of the private sector (doctors and pharmacies) in treatment
- Improving the quality of clinical care, especially with respect to side effects
- Designing interventions to improve patient monitoring and adherence, improve treatment outcomes, and uncover the potential for more efficient models of treatment delivery

### 3.3 EDUCATE

The EDUCATE component serves to improve understanding of patient knowledge and behavior, design interventions to address challenges, and build community-education platforms. REACH currently trains community-based providers, but there is a lack of

systemic outreach at the community level and limited understanding of TB among the public.

Proposed EDUCATE interventions include:

- Conducting a study to understand patient behavior and inform the development of targeted, context-appropriate education interventions
- Training a cadre of community TB workers to do patient education, treatment monitoring, and case-finding
- Expanding the capacity for community-driven, patient-centered care
- Carrying out innovative mass education activities and leveraging the existing TB patient helpline to build community awareness of TB and patients' ownership of diagnosis and treatment efforts

### 3.4 PREVENT

PREVENT objectives are to prevent new cases of TB in HIV-positive people and child contacts, as well as reducing transmission in facility and community settings. Isoniazid preventive therapy (IPT) is currently provided for child contacts and HIV-positive patients, but it is hampered by inconsistent implementation. Infection control is also lacking in health facilities and congregate settings.

Proposed PREVENT interventions include:

- Strengthening IPT implementation in children and conducting operational research on IPT in adults,<sup>56</sup> working towards universal access to TB prophylaxis
- Improving transmission control in facilities and communities by identifying and reducing hotspots of transmission

<sup>56</sup> Current WHO guidelines that have been adopted by India do not recommend treatment of TB infection in adults in low-income countries or countries with rates of TB greater than 100 per 100,000 population.



### 3.5 SUPPORT

The SUPPORT component strives to provide socio-economic support to patients to improve clinical outcomes. Canteens are currently available for citizens, with plans to expand the number of meals per day for TB patients. However, patient access to services is still a challenge.

Proposed SUPPORT interventions include:

- Supporting the expansion of canteens to meet patient volume and ensure uninterrupted access to nutritional support
- Exploring the need for, and feasibility of, transport support for patients to ensure that distance does not present barrier to patients' accessing services

### 3.6 KEY POINTS FROM DISCUSSION

Responding to a question from Khan about how the STEPS intervention is related to the existing REACH intervention in Chennai, Kadam explained that REACH has a wealth of experience and has been a key partner in all aspects, particularly with regard to fostering community engagement and providing nutritional support to patients. She also noted that computer-aided software will augment X-ray-based diagnosis.

Creswell commented that while contact investigation is clearly a high-yield intervention, if current WHO estimations of 7,000 missing cases in Chennai are presumed, then neither contact investigation nor a more sensitive test will be sufficient. There is a huge prevalent population that is either going to private care providers or is not being identified. Keshavjee countered that the rationale for using households as the unit of analysis for contact investigations is to find contacts who either have active disease or are infected with TB (without active disease at the time of infection; roughly 10% will go on to get active disease). Creswell responded that the data suggest that systematic, well-done contact investigations yield 10%–15% of

total notifications. In addition, he maintained that even if contact investigations yield a large number or proportion of cases, it does not mean the number of notifications is increasing; it may mean that case are just being found earlier (something Keshavjee noted as valuable in itself). Creswell cited prevalence survey data showing that in 40% of cases of prevalent TB, patients do not complain about chest symptoms, and detection is dependent on X-ray and on a diagnostic tool better than smear. He argued that finding cases that are currently being missed would require using chest X-ray earlier in the screening process, expanding GeneXpert, and utilizing targeted active screening. Kadam remarked that active case-finding efforts in Chennai are currently concentrated in the slums where there is high TB prevalence.

Akugizibwe noted that platforms already exist in Chennai that could facilitate aggressive case-finding strategies to find cases in unexpected places, but they are underutilized. Taking advantage of these platforms would not require huge amounts of resources, but does require thinking creatively and forming effective partnerships beyond TB programs. Starke agreed, but cautioned against assuming that "one size fits all" within and across cities. He called for an initial focus on clearing out the prevalence to focus on incidence—a process that will change over time—and adopting a dynamic approach that is both strategic and sequential.

Liesl Page-Shipp<sup>57</sup> remarked that reaching the goals of the Zero TB Cities Project will require proper implementation of all strategies with known efficacy, such as IPT in all infected adults, not just those who are HIV-positive. Keshavjee referred to the limitations imposed by the legacy of older policies, which pose a challenge to efforts such as expanding IPT to cover adults as well as children; this may mean that progress in those areas will have to happen in stages.

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<sup>57</sup> Liesl Page-Shipp, Aurum Institute, South Africa

To address the risk factor of malnourishment, Cassell suggested that aggressively pursuing potential partnerships (e.g., with food producers) for the nutritional component of TB interventions should be considered. Keshavjee noted that Chennai Corporation already recognizes that nutrition should be a key part of this effort, and Nicholson shared that there is already interest from a large food producer and distributor. Akugizibwe added that there is a women's development group in Chennai that produces food at low cost with high nutritional value, so there are possible social enterprise models to start distribution to TB patients and families.

Kadam described further efforts to engage doctors and pharmacists in Chennai, building on REACH's extensive partnership with pharmacies. A planned IT- and mobile-based infrastructure will allow healthcare workers to use their mobile phones to track cases, patients, and contacts, provide education, and identify hotspots.

Because Eli Lilly is supporting work done by REACH as well as funding private sector

initiatives in Chennai, Collins questioned how the information that is gathered will be communicated clearly so that Lilly can strive to be as effective as possible there. Kadam replied that they are mapping the existing work with partners in order to build rather than duplicate and relevant findings will be disseminated among stakeholders.

Kadam and Ananthakrishnan were asked to outline the key components and core assumptions that underlie the Chennai project moving forward:

- Commitment to the STEPS strategy
- Political will
- Readiness to employ innovative approaches and partner with the private sector
- Open-mindedness towards collaboration
- Commitment to funding and building a sustainable infrastructure

### BOX 3-1 Notifications

*Kadam further described efforts to expand notification in the private sector. The national TB program currently mandates notification, but it is not enforced. Efforts are being made to work with doctors, pharmacists, and laboratories to increase notification rates. To ensure sustainability moving forward, incentives for notification are not offered. Ananthakrishnan added that based on feedback from private practitioners, they need to offer a range of ways to notify cases (e.g., mobile-, paper-, and web-based approaches). Oommen George<sup>58</sup> concurred that the issue of notification in India is complicated, citing a study of private practitioners that revealed that they are willing to notify, but either they do not know how or the notification system is not conducive to their doing so.*

*Nicholson noted separately that this dynamic stems from:*

- Weak incentives
- Lack of standardized reporting mechanisms
- Limited sanctions for poor reporting
- High patient load (and inadequate staff for task shifting)
- Potential audits from government due to full reporting of case load

<sup>58</sup> Oommen George, Abt Associates, India

## 4.0 Summary and Synthesis

The legal, regulatory, administrative, epidemiological, and programmatic differences between these projects are clearly significant. These differences suggest that a one-size-fits-all approach against TB in municipalities is unreasonable. However, emphasis on the key program components of searching, preventing, and treating the disease comprehensively were present across the board, either in practice at the more experienced sites, or in planning at the newer, high-burden sites.

Throughout, there was a clear emphasis on adequate social supports and biosocial interventions to complement the above components in innovative ways. Utilization of social business models, new organizational partnerships, and targeted institutional arrangements against TB were shown to be key components of effective TB control in multiple settings.

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## APPENDIX A. AGENDAS



**CENTER FOR GLOBAL  
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### MEETING AGENDA

#### The Emerging Role of Municipalities; Applications for the Fight Against Tuberculosis

14 April 2015

8:30	Shuttle bus will pick up participants at Hyatt lobby	
8:45 – 9:00	Registration	
9:00 – 9:10	Welcome, Overview and goals for the day	Salmaan Keshavjee
9:10 – 9:30	The Zero TB Cities project: A brief overview and rationale	Thomas Nicholson
9:30 – 10:00	The New York City experience in tackling TB: The essential building blocks of a successful program	Joseph Burzynski
10:00 – 10:30	Discussion: The role of advocacy and community building against TB in Chennai	Ramya Ananthakrishnan
10:30 – 11:00	Coffee Break	
11:00-11:30	Avoiding the pitfalls of one-size-fits-all: Engaging the private sector against three Asian mega-cities	Aamir Khan
11:30-12:00	Minding the gaps: Cities as a path to TB elimination	Grigori Volchenkov
12:00-12:30	Learning from cities: The experience of Ho Chi Minh City	Luan Nguyen Quang Vo
12:30-13:30	Lunch Break	
13:30-13:45	Modeling scale-up across a city	David Dowdy
13:45-14:00	Overcoming institutional overlap to deliver family-centered care in Houston	Jeffrey Starke
14:00 – 14:30	Discussion: Can we identify any design principles that emerge through these various city initiatives? How can levers in these settings become levers for national scale up of TB treatment?	
14:30-14:45	Closing remarks	Salmaan Keshavjee
14:45 – 15:15	Coffee Break	
15:15 – 15:45	Side meeting: Chennai details (all welcome)	
15:45	Shuttle back to the Hyatt	



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