Multidrug-resistant Tuberculosis in India:

Solving the problem by reconstructing the public health infrastructure

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Introduction

Infectious diseases are at a dawn of a new era where strains are becoming resistant to medications that have been used for decades. However, emerging strains with resistance to medications may be prevented through public health measures. Multidrug resistant tuberculosis (MDR-TB) is of particular concern to public health officials throughout the world. As reported by the CDC, there is an estimated 3 million prevalent TB cases worldwide of which 75, 000 are MDR-TB.

The adverse effects of TB are exacerbated most when the wrong treatment is given. If an inappropriate course of treatment is given, that is either too short or missing an active ingredient, the strain of bacterium develops resistance, and this form is MDR-TB. At the point of antibiotic resistance, there are limited agents for treatment. In addition, "accumulation of additional resistance mutations leads to extensively resistant TB (XDR-TB)" (Drilca, 2011, p. 11), which is rendered almost untreatable. Unquestionably, high prevalence rates of TB and MDR-TB in developing countries must be addressed with the goal of avoiding a high percentage of their population being resistant to any type of treatment.

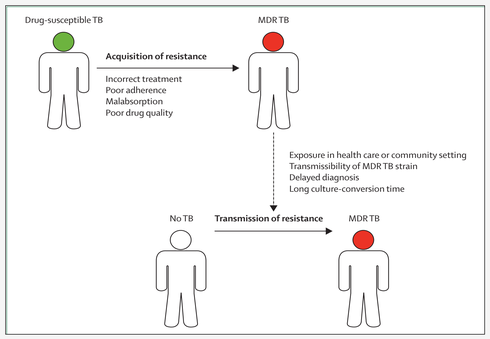


Figure 1. Transmission and development of MDR-TB (TB=tuberculosis. MDR= multidrug resistant. Adapted from Gandhi et al., (2010)

M.tuberculosis Background

Transmission:
- Airborne means: coughing, sneezing, etc.
- Nuclei infected droplets infect human host
- Infection may be latent or active
- Risk factors allowing for more rapid transmission result from socio-environmental triggers such as overpopulation

Symptoms: (Tille, 2014)
- 3-week prolonged cough having
- Sputum discharge, possibly with blood
- Chest pain with shortness of breathe

Diagnosis: The only definitive diagnosis for TB is done in labs equipped for the microbiologic procedure of acid-fast bacteria staining and culture (Chiang, Weezenbeek, Mori, and Enarson, 2013).

Treatment:
- Delays in treatment can result multidrug-resistant TB
- One MDR-TB case left untreated or inadequately treated creates roughly 10-15 new cases of MDR-TB in a period of 1-year (Maurya, Kant, Nag, Kushwaha, & Dhole, 2012)
- As seen in Figure 1. MDR strains are directly transferred from infected to healthy hosts

First-line TB drugs: Commonly the antibiotics isoniazid and rifampicin are used to treat TB (Tille, 2014).

Second-line TB injectable drugs: Namely, capreomycin, kanamycin, and amikacin are used for MDR-TB patients when first-line drugs fail. These drugs must be administered for roughly 2-years and are more toxic, expensive, and less effective in curing the patient (Dyer, 2010).

Figure 2. Overpopulated conditions of India. Conducive environment for transmission of the MDR-TB bacteria. (*Telegraph*)

Problem

- 2011: World Health Organization (WHO) estimated 12 million prevalent cases worldwide, with 40% of TB cases being from India and China
- India is affected by high TB rates because of a disconnectedness in their public health infrastructure
- India's underlying socio-environmental risk factors such as poverty and overpopulation are making their populations more susceptible to TB infections
- As seen in Figure 2. overpopulation allows for the rapid transmission of an aggressive TB bacteria
- Poor socioeconomic status results in lack of access to healthcare, malnutrition, unhealthy living conditions, and overcrowded residing districts

Purpose

- The focus of the evaluated research was to identify effective TB treatment programs in countries with similar risk factors to that of India
- Using intervention strategies from other communities may help India develop an appropriate solution for decreasing the prevalence of MDR-TB and bridging the gap in disparities among their TB-infected populations

Research Design/Methods

- A review of literature was conducted to identify the underlying reasons of India's TB epidemic
- The study then used qualitative and comparative methods to examine the current treatment programs being used in locations with high prevalence of TB and MDR-TB
  - Bangladesh, Peru, Russia, and Thailand were chosen as the locations of interest
- It was also necessary to assess TB programs in the United States, since the country reports record low-rates of TB
- The research conducted was based on primary and secondary sources, using both articles and a few books
- Databases like ProQuest were used to identify scientific journals such as *Lancet's Infectious Diseases*, PLoS ONE and reports from WHO as well as Centers for Disease Control and Prevention (CDC)

Review of Literature: Risk Factors Affecting India's Population

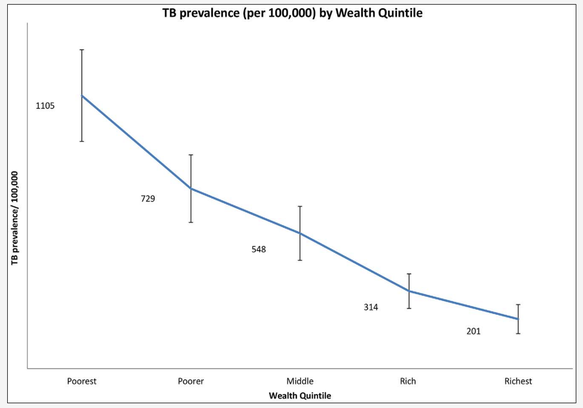
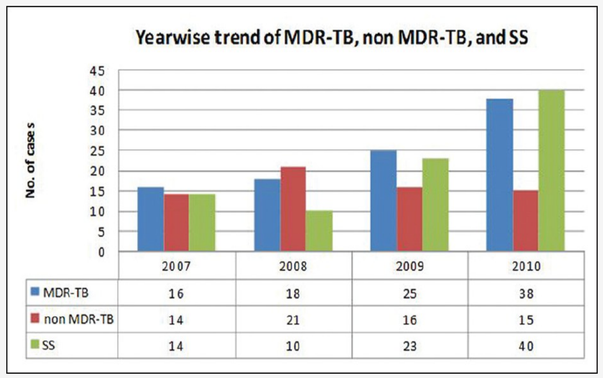


Figure 3. Prevalence of TB (per 100,000) in relation to wealth. Adapted from Oxlade & Murray (2012)

Poverty:
- India ranks 119 out of 169 countries based on human development and 41.8% of their population is living below the international poverty line (Kamineni et al., 2012)
- Consequently, a recent survey done in Delhi, revealed that the "poor were two times more likely to have TB, three times less likely to access TB care, four times less likely to complete treatment and many times more likely to incur impoverishing payments for TB care" (The Union, 2011).
- Figure 3. shows the grave effect that income has on health outcomes. The study sought to determine the reason for the disproportionate care received by the poor. As the wealth quintile increased the prevalence of reported TB cases decreased.



	2007	2008	2009	2010
MDR-TB	16	18	25	38
non MDR-TB	14	21	16	15
SS	14	10	23	40

Figure 4. Year-wise distribution of MDR-TB, non-MDR-TB and susceptible (SS) from 2007 to 2010. Adapted from Maurya et al., (2013)

Lack of Rapid Diagnostic Susceptibility Testing (DST):
- Low-quality diagnostic and treatment services are burdened by the rapidly increasing TB rates
- MDR-TB cases detection decreases due to inadequate laboratory DST equipment
- Figure 4. shows the results from a study done in a Northern India clinic, regarding the increase in MDR-TB, where MDR-TB and TB susceptible strains increased from 36.4% in 2007 to 40.8% in 2010
- Increasing surveillance and laboratory technology in developing countries is imperative to implementing change

Results/Cross-Analysis

Bangladesh's TB Campaigns
- Collaboration effort between a nongovernmental organization (NGO) and Bangladesh's NTP, known as Fund for Innovative DOTS Expansion through Local Initiatives to Stop TB (FIDELIS) (Rifat et al., 2008)
- Mobilization campaign increased TB case detection by 36% compared to 29% from other districts that did not implement the same measures (Rifat et al., 2008)

Lima, Peru's New Database
- Most TB burdened country of South America (Fraser et al., 2011)
- OpenMRS database was launched in September 2009 (Fraser et al., 2011) with the objective of monitoring epidemiological patterns for disease outbreaks

Tomsk, Russia's 'Sputnik' TB Program
- Collaboration with Partners in Health (PIH) nonprofit organization
- Home-based treatment delivered patients at high risk for non-adherence, such as drug-addicts (Gelmanova et al., 2011)

Thailand's Surveillance Network
- Another example of how surveillance systems are able to increase communication between the private-public health sectors

United States Public Health Infrastructure
- Reported record low TB rates in 2011 (CDC, 2012)
- Intensive healthcare measures are the reason U.S. TB rates are better managed
- Also, much political involvement and government funding allowed for the implementation of surveillance and monitoring systems with the intent of actively tracking disease patterns
- Current CDC provides the U.S. public health organizations with infection control guidelines that include surveillance, response, applied research, training, prevention, and control (Schneider, 2004)

Conclusion/Implications

Principally, studies of other countries suggested the following guidelines: 1) Establishment of a surveillance system, 2) engaging the community with TB awareness campaigns, and 3) Strengthen NTPs with collaborations from foreign establishments such as PIH. In addition, evaluation of the U.S. public health initiative for infection control offers India a guideline for the integration of many departments working towards a single objective.

Intervention strategies for combating TB must include collaborations between NTPs like RNTCP and foreign nonprofits or NGOs. Funding must be sought both from the national government as well as partnering programs interested in eliminating infectious diseases like MDR-TB. As of 2009, the treatment success for MDR-TB failed to reach the global target of 75% success rate (Chiang et al., 2013). The reported success rate was 48% (Chiang et al., 2013). Therefore, the next decade should seek to unite nations, foreign organizations, and nonprofits in an alliance towards establishing strong public health structures for all countries.

Also, more research must be done for further evidence that community engagement may drastically decrease TB incidence rates. Most of the studies evaluated in this paper involve communicating knowledge to certain regions about their TB diagnosis and treatment. Aside from NTPs and NGOs that are more likely to include community engagement activities, combating the MDR-TB epidemic will also require the support from the general public health infrastructure and regulations for ensuring qualified physicians and authenticate treatment TB drugs.