

# MULTIDRUG-RESISTANT TUBERCULOSIS IN INDIA:

Solving the Problem by Reconstructing the Public Health Infrastructure

**Student:** Maribel Gamon, Biomedical Sciences '14  
**Mentor:** Dr. Linda J. Laatsch, Ph.D., MT(ASCP)SM,  
Department of Clinical Laboratory Sciences

## GLOBAL HEALTH AGENDA

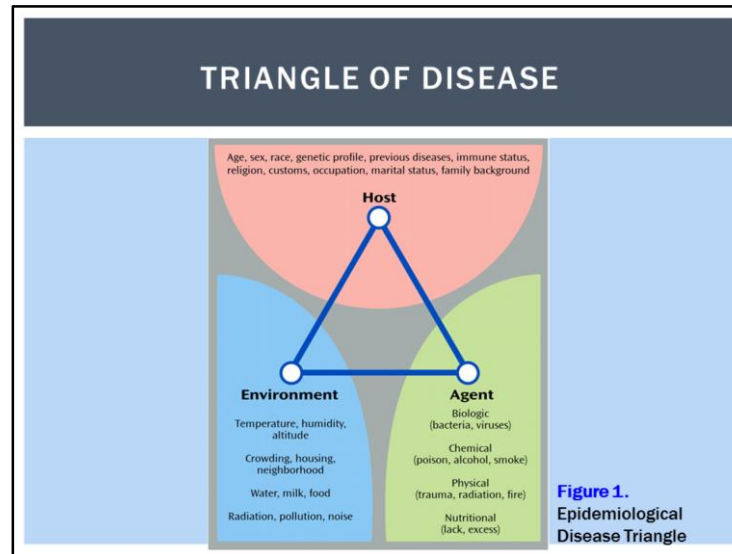
- Inception of antibiotic resistant pathogens
  - 2013 Emerging diseases: Avian Influenza (H5N1), cholera, wild poliovirus, enterovirus-71, and extensively **drug-resistant tuberculosis** (Christian et al., 2013)
- Outbreaks are difficult to control in developing and underdeveloped countries
- Globalization- travel/tourism, migration, etc.
  - **Pathogen translocation**

*“When the world is collectively at risk, defense becomes a shared responsibility of all nations” (World Health Day, 2007).*

- The infectious diseases were identified according to the following factors: “high transmissibility, disease burden and severity; established or pandemic potential; disease eradication; and lack of available preventative or treatment interventions.”
- Goal of surveillance, diagnosis, and treatment programs is to contain disease at their local origin, with the purpose of preventing a global threat of disease
- 2010 U.S. TB Report: 60% of all TB cases were found in foreign-born persons

## PURPOSE

- Identify the underlying factors causing high TB rates in India
- Evaluate previous research studies to identify effective TB programs in countries with similar risk factors to that of India
- Assess if intervention strategies from other communities may support India in bridging the gap among the TB-infected populations



## PURPOSE

Identify the risk factors causing the rapid transmission multidrug-resistant tuberculosis (MDR-TB)

Assess the underlying social factors that are causing high MDR-TB rates in India

Evaluate TB intervention strategies from other countries that may help India develop an appropriate solution for decreasing the prevalence of MDR-TB incubation

## **PATHOGEN: TUBERCULOSIS (TB)**

- Caused by bacterium *Mycobacterium tuberculosis*
- **Transmission:**
  - Airborne means→ Infected nuclei
- **Symptoms:**
  - 3-week prolonged cough having sputum discharge, possibly with blood
  - Chest pain with shortness of breath
- **Diagnosis:** Acid-fast bacteria staining and culture
  - Biohazard-containment environment in equipped labs
- **Treatment:**
  - First-line TB drugs-isoniazid and rifampicin
  - Second-line TB drugs-injectable drugs such as capreomycin, kanamycin and amikacin are used for MDR-TB patients when first-line drugs fail
    - Roughly 18-24 months combination of multiple drugs

- Airborne means: coughing, sneezing, etc.
- Transmits nuclei infected droplets→ can remain airborne for several hours
- ACTIVE: infects the human host in a progression of weeks or months, depending on the person, and presents itself as an infectious tubercle
- LATENT: can remain hidden for decades, ready to resume reproduction when immune system becomes infected (compromised)
- LATENT:

## TB STATISTICS

### TB PREVALENCE WORLDWIDE

- Top reasons of **worldwide mortality** from infectious diseases: **HIV and TB**, respectively
  - Outside the U.S. TB is the number one opportunistic infection for patients who are HIV positive
- Eliminating TB as a public health problem would require current incidence rates to **fall at a rate of 16% per year** for the length of at least **40 years** (Lawn et al., 2013)
  - Progress reports are not representative of African and European regions
- In 2011, **1.4 million people died from TB** (WHO TB Report 2012)
  - 31%: HIV co-infection
  - 36% Women
  - 64,000 children younger than 15 years
- Only 1/5 of multidrug-resistant tuberculosis (MDR-TB) cases are being reported to WHO

## ENVIRONMENT: INDIA

- Ranked the 5<sup>th</sup> largest economy in the 21<sup>st</sup> century (John et al., 2011)
  - BRIC
- 2011 WHO Report: **40%** of all reported TB cases worldwide were from India and China
- MDR-TB prevalence rates were not reported to WHO
  - **Estimated burden of 50%** in combination with China
- **Disconnectedness in public health system**
  - Private and public sectors
  - Disintegrated laboratory surveillance & monitoring
- **Over-the-counter medications**
- **Overpopulation: Figure 2.**
  - 2<sup>nd</sup> Largest population in the world- 1.2 billion inhabitants

### INDIA'S LAB CAPACITY- WHO TB REPORT 2012

#### Smear microscopy labs

13, 026

**1 per 100,00 population**

% using LED microscopes 2

#### CULTURE LABS + DRUG SUSCEPTIBILITY TESTING (DST)

37

**0.1 per 5 million population**

#### LINE PROBE ASSAY

17

<0.1 per 5 million population

#### XPRT MTB/RIF

18 sites

“In India, drugs available by prescription elsewhere are available over the counter in any pharmacy, which complicates the management of MDR-TB. For example, **fluoroquinolones** are available over the counter and are

commonly used in households for fevers and infections (CITE).”

“In 2006, prior to the implementation of the DOTS-Plus program in India, based on the total amount of money available for anti-TB drugs sold in India, 75% of first-line drugs and 100 percent of second-line drugs were being used outside the RNTCP (CITE).”



## CONDUCTIVE ENVIRONMENT



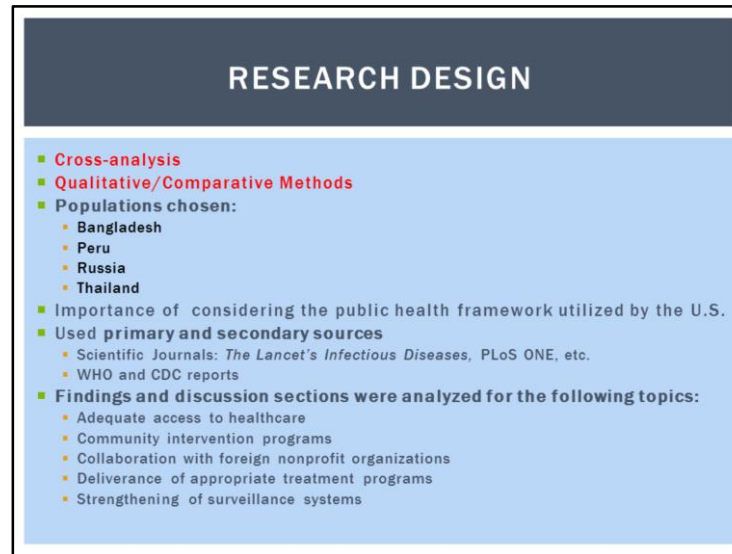
**Figure 2.** Overpopulated conditions of India. Incubating environment allows for rapid TB and MDR-TB transmission. (*Telegraph*, 2010)

## HOST: INDIAN POPULATION

### ■ Risk Factors:

- **Poverty**-the "poor [are] 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*, 2010)
- **Unhealthy living conditions**
  - Poor ventilation
- **Rural population**-disproportionately affected by distribution of funds to healthcare facilities
- **Poor health literacy**
  - "stigma"
- **Malnutrition**
- **Co-infected**

1999 poorest country



- All of the countries are part of the 22 high-burden countries, 1990- 2011 (WHO TB Report 2012) [EXCEPT FOR PERU]
- Bangladesh has kept their rates stagnant
- Russian Federation has seen a steadily decrease in TB incidence rates but an increase in HIV-positive incidence rates
- Thailand has also see a decrease

CASES FOR MDR-TB have been reported in all countries but the top 27 MDR-TB burdened country list does not include Peru or Thailand

Peru has an expanding LABORATORY PREPAREDNESS PLAN

## RESULTS: DEVELOPING COUNTRIES

### ■ **Bangladesh's TB Campaigns**

- Collaboration: Nonprofit & local NTP (FIDELIS)
- Information delivered to roughly 28 million people in 10 rural districts
  - Case detection
- Information was reported through theater performances, in classroom settings, mosques, at small group meetings, and through television messages (Rifat et al., 2008)

### ■ **Lima, Peru's Database**

- Collaboration: Partners in Health (PIH) & Socios en Salud (SES)
- National Institute of Health (NIH): Provided fund for establishing an electronic medical record system
- OpenMRS- launched in September of 2009

- Bangladesh
  - NTP is called FIDELIS (Fund for Innovative DOTS Expansion through Local Initiatives to Stop TB)
  - Case detection increased from 29%(districts who didn't implement anything) to 36% (health awareness campaigns)
  - Programs were structured in a culturally-sensitive manner
    - Structured to fit identified population
  - Healthy literacy increase
- PERU
  - Collaboration delivered home-based treatment to diseased community

## RESULTS: DEVELOPING COUNTRIES

### ■ *Tomsk, Russia 'Sputnik' TB Program*

- Collaboration: PIH & Russia's Health Ministry
- Recent 'Sputnik' is modeled as a DOTS-plus home-based MDR-TB treatment program
- Cure rate of the program overall has been reported to be **68%**, according to Gelmanova et al., 2011
- Cost of treating a Sputnik patient
  - U.S. \$6.50 per day
  - Alternative: In-patient care for the duration of treatment ranges from U.S. \$9.30-\$35.00 per day (Gelmanova et al., 2011)

### ■ *Thailand's Surveillance Network*

- **2006**: ranked 8<sup>th</sup> most burdened country in the world
  - Exacerbated by HIV/TB co-infection
- TB Active Surveillance Network established October 2004
  - **Public-private mix (PPM)**
- Demonstrates importance of collecting epidemiologic data

- RUSSIA
  - Sputnik was established in 2006
  - For patients who are at high risk for non-adherence

## RESULTS: DEVELOPED COUNTRY

### ■ ***United States Public Health System***

- 2011: Recorded lowest TB rates since the 1990s
- Milestone in combating TB
  - 17<sup>th</sup> century and again in 1985
    - TB accounted for a large percentage of mortality in U.S.
- 1990: New York MDR-TB outbreak
  - Immediate political involvement
- Active surveillance and monitoring systems
- Intrinsic system with many stakeholders, systems, and organizations all working towards maintaining a healthy population
- CDC annual report for infection control guidelines

## U.S. 10 ESSENTIAL ELEMENTS OF PH



*"You can't have public health without a public health system. We just don't want to be part of a mindless competition for resources. We want to build back capacity in the system." – Paul Farmer*

2002

## SUGGESTED GUIDELINES FOR INDIA

- Reshaping the public health system:
  - 1) Establish a national active surveillance system
    - Identify outbreaks as they are happening and not days or months later
    - Increase laboratory technology
  - 2) Engage the community with TB awareness campaigns
    - Increase health literacy
  - 3) Strengthen NTPs with collaborations from foreign establishments such as PIH
  - 4) Integrate public-private sectors through regulations
    - Increase communication
    - Decrease the risk of patients receiving inadequate treatments
  - 5) Evaluate the strong public health structures of countries such as the U.S. and create infection control guideline for all healthcare stakeholders
  - 6) Motivate government intervention
    - Establishment of national regulations

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CDC definition of community engagement: “the process of working collaboratively with a through groups of people affiliated by geographical proximity, special interest, or similar situations to address issues affecting the wellbeing of those people” (Boulanger et al., 2013).



## SUGGESTIONS FOR FUTURE STUDIES

- Research the cost-effectiveness of TB programs
- Quantify funding labs
  - Smear microscopy
  - Culture labs + Drugs Susceptibility Testing (DST)
  - XPERT MTB/RIF
- Conduct trials for **XPERT MTB/RIF**
- Collect data on the effect of community based treatments
  - Culturally appropriate programs
- Further research for developing a TB vaccine

Currently they have 1 lab per 100,000 population

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QUESTIONS?

