Epidemiology of TB: Global, National, Regional

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Epidemiology is an Important Part of TB Control

The information on patterns of infection and disease can assist in:
– Assessing current and evolving trends in TB morbidity
– Identifying people or groups of people at risk for TB
– Understanding how the disease is transmitted
– Prioritizing cases
– Planning appropriate use of staff and resources

History of TB

• 17th-18th centuries: TB took 1 in 5 adult lives
• 1700-1900: 1 billion died of TB
• 1882: Robert Koch discovered the TB bacillus (7 million deaths)
• 1873-1945: Sanatorium treatment
• 1944: Development of streptomycin
• 1952: Development of isoniazid
Why do we need to care about TB in the rest of the world?

The Global Burden of TB, 2009

- Estimated 9.4 million new cases (range 8.9-9.9 million)
  - 137/100,000 population
  - 7.9 million (86%) in Asia and sub-Saharan Africa
  - 12% of new TB cases are HIV-infected (1.0-1.2 million new cases) 79% of these HIV-positive cases were in the African Region and 11% were in the South-East Asia Region.
  - 38% of new TB cases in Africa are HIV-infected
  - In 2004, just 4% of TB patients in the region were tested for HIV; in 2007 that number rose to 37%, with several countries testing more than 75% of TB patients for their HIV status

Why do we need to care about TB in the rest of the world?


- 1.7 million people died of TB (98% of deaths in developing world)
  - 2010 global TB control report also reveals that one out of four TB deaths is HIV-related, twice as many as previously recognized. The 400,000 deaths among HIV-positive incident TB cases equate to 33% of HIV-positive incident cases of TB and 23% of the estimated 1.7 million deaths in 2010.

1/3 of the world is infected with M. Tb (2 billion people)
Estimated TB Incidence Rates, 2009 (per 100,000)

Estimated TB Burden, 2010
22 high burden countries*

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>New Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>India</td>
<td>1,982,628</td>
</tr>
<tr>
<td>2</td>
<td>China</td>
<td>1,301,322</td>
</tr>
<tr>
<td>3</td>
<td>South Africa</td>
<td>476,732</td>
</tr>
<tr>
<td>4</td>
<td>Nigeria</td>
<td>457,675</td>
</tr>
<tr>
<td>5</td>
<td>Indonesia</td>
<td>429,730</td>
</tr>
<tr>
<td>6</td>
<td>Pakistan</td>
<td>409,392</td>
</tr>
<tr>
<td>7</td>
<td>Bangladesh</td>
<td>359,671</td>
</tr>
<tr>
<td>8</td>
<td>Ethiopia</td>
<td>297,337</td>
</tr>
<tr>
<td>9</td>
<td>Philippines</td>
<td>257,317</td>
</tr>
<tr>
<td>10</td>
<td>DR Congo</td>
<td>245,162</td>
</tr>
<tr>
<td>11</td>
<td>Myanmar</td>
<td>200,060</td>
</tr>
</tbody>
</table>

*Ranks based on numbers of smear-positive cases

WHO Update, 2010

Global TB Control: Background
International TB Control Strategy

Stop TB Strategy: 2006 - current
1. Pursue high-quality DOTS expansion and enhancement
2. Address TB/HIV, MDR-TB and other challenges
3. Contribute to health system strengthening
4. Engage all care providers
5. Empower people with TB, and communities
6. Enable and promote research

Emergence of “Worst-Case” TB Scenarios

- Co-infection between TB and HIV
- Multidrug-resistant TB (MDR-TB)
  - Resistance to isoniazid and rifampin – the 2 most powerful anti-TB drugs
- Extensively-drug resistant TB (XDR-TB)
  - MDR-TB plus resistance to any fluoroquinolone and at least 1 second-line injectable (aminoglycosides, capreomycin)

The Global Burden of TB/HIV

- 1/3 of 33 million people living with HIV/AIDS co-infected with TB (>10 million people)
- Without treatment, 90% will die within months
  - HIV and TB form a lethal combination, each speeding the other's progress
- TB is the leading cause of death among HIV-positive people (up to 50% of all patients worldwide)
Estimated HIV Prevalence in New TB Cases, 2009 (per 100,000)

- Africa: 46
- Americas: 12
- Eastern Mediterranean: 3.6
- Europe: 4.9
- South-East Asia: 14
- Western Pacific: 11
- Global: 12

Global Multidrug-Resistant TB

- Estimated 390,000 – 510,000 MDR-TB cases in 2008 (best estimate, 440,000 cases – 3.6%)
- Global prevalence: could be as high as 1 million
- China, India, the Russian Federation and South Africa had largest number of MDR-TB cases
- “Hot spots” for MDR-TB: countries of the former Soviet Union

Global Extensively Drug-Resistant TB

- 2010 Global Report: % of XDR-TB among MDR-TB
  - Japan: 30.9%
  - Tajikistan: 21.0%
  - Ukraine: 15.0%
- United States: from 1993-2010, 57 cases of XDR-TB
- As of July 2010, 58 countries and territories reported at least 1 case of XDR-TB
TB Remains a Global Killer

Why does TB infect one-third of the world’s population and still remain a global health threat despite the fact that highly cost-effective drugs are available to eradicate it?

Challenges in TB Control

- Insufficient financial and human resources
- Inadequate healthcare infrastructure
- Weak laboratory capacity and lack of new rapid diagnostic tools
  - Smear negative and drug susceptibility testing
- Lack of new drugs that would cure TB in a shorter time
- Lack of effective vaccine that would prevent spread of infection
- Minimal social mobilization for TB control and minimal population awareness → stigma
- HIV and MDR/XDR threats

Burden of Tuberculosis:

National
TB Morbidity United States, 2002–2010

<table>
<thead>
<tr>
<th>Year</th>
<th>No.</th>
<th>Rate*</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>15,056</td>
<td>5.2</td>
</tr>
<tr>
<td>2003</td>
<td>14,837</td>
<td>5.1</td>
</tr>
<tr>
<td>2004</td>
<td>14,501</td>
<td>4.9</td>
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<tr>
<td>2005</td>
<td>14,065</td>
<td>4.7</td>
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<tr>
<td>2006</td>
<td>13,754</td>
<td>4.6</td>
</tr>
<tr>
<td>2007</td>
<td>13,299</td>
<td>4.4</td>
</tr>
<tr>
<td>2008</td>
<td>12,898</td>
<td>4.2</td>
</tr>
<tr>
<td>2009</td>
<td>11,540</td>
<td>3.8</td>
</tr>
<tr>
<td>2010</td>
<td>11,181</td>
<td>3.6</td>
</tr>
</tbody>
</table>

*Cases per 100,000, updated as of March 25, 2011.

Lowest since 1953

TB Case Rates,* United States, 2010

- TB rate ranged from 0.6 (Maine) to 8.8 (Hawaii)
- 32 states had lower rates in 2010 than in 2009
  - 18 and DC had higher rates
- 4 states (California, Florida, New York, Texas) each reported more than 500 cases
  - Combined, these 4 states accounted for nearly half (49.2%) of all TB cases in the US

TB Rate Trends in the U.S.

- 2010 TB case rate (3.6) represent a 3.9% decline from 2009 and lowest recorded since national reporting began in 1953
- BUT progress has slowed in recent years
  - Average annual percentage decline in TB rate slowed from 7.3% per year during 1993-2000 to 3.8% during 2000-2008
- Groups with disproportionate burden of TB disease in the US in 2009:
  - Hispanics: 7 times higher than non-Hispanic whites
  - Blacks: 8 times higher
  - Asian: 25 times higher
  - Non-US born: 11 times higher than US-born

Number & Rate of TB Cases in U.S.-born vs. Non-U.S.-born Persons United States, 1993–2010*

*Updated March 2011 with provisional 2010 data
Globalization of Economy = Globalization of Health Risks

- Increasing percentage of cases in the US observed among non-US-born (60.5%: 2010)
  - In 2009, 35% of non-US-born TB cases developed the disease within 4 years of immigrating to US

- More than half (50.3%) of non-US-born TB cases were reported in persons from 4 countries
  - Mexico (23.0%)
  - Philippines (11.0%)
  - India (8.6%)
  - Vietnam (7.7%)

Trends in TB Cases in Non-U.S.-born Persons, United States, 1987–2010*

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Cases</th>
<th>Percentage of Total Cases</th>
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<tbody>
<tr>
<td>1987</td>
<td>6,000</td>
<td>0</td>
</tr>
<tr>
<td>1990</td>
<td>4,000</td>
<td>10</td>
</tr>
<tr>
<td>1992</td>
<td>3,000</td>
<td>20</td>
</tr>
<tr>
<td>1994</td>
<td>2,000</td>
<td>30</td>
</tr>
<tr>
<td>1996</td>
<td>1,000</td>
<td>40</td>
</tr>
<tr>
<td>1998</td>
<td>800</td>
<td>50</td>
</tr>
<tr>
<td>2000</td>
<td>600</td>
<td>60</td>
</tr>
<tr>
<td>2002</td>
<td>400</td>
<td>70</td>
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<tr>
<td>2004</td>
<td>300</td>
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<tr>
<td>2006</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

*Updated March 2011 with provisional 2010 data


<table>
<thead>
<tr>
<th>Year</th>
<th>No. of MDR-TB Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>500</td>
</tr>
<tr>
<td>1995</td>
<td>300</td>
</tr>
<tr>
<td>1997</td>
<td>200</td>
</tr>
<tr>
<td>1999</td>
<td>100</td>
</tr>
<tr>
<td>2001</td>
<td>80</td>
</tr>
<tr>
<td>2003</td>
<td>60</td>
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<tr>
<td>2005</td>
<td>40</td>
</tr>
<tr>
<td>2007</td>
<td>20</td>
</tr>
<tr>
<td>2009</td>
<td>10</td>
</tr>
</tbody>
</table>

*Most recent year for which complete drug susceptibility data are available

Trends in MDR-TB Cases in the U.S. 1997-2010

- Proportion of MDR-TB cases among persons without a previous history of TB has remained stable at 1% since 1997
  - BUT is 4-5 times higher for persons with a previous history of TB

- MDR-TB disproportionately impacts non-US-born persons
  - Account for 84.5% of MDR-TB cases in 2009

- One new XDR-TB case reported in 2010
Estimated HIV Co-infection in Persons Reported with TB United States, 1993–2009*

*Data for all years updated through July 1, 2010
Note: Minimum estimates based on reported HIV-positive status among all TB cases in the age group.

Burden of Tuberculosis

Regional

Number of TB Cases and Case Rate, Northeast Region US, 2009

DO NOT
FLUSH
PAPER TOWELS,
NEWSPAPER,
WRAPPING PAPER
RAGS, DISPOSABLE
DIAPERS, SANITARY
NAPKINS,
TAMPONS
PLASTIC, STICKS,
ETC., DOWN
TOILET.
Trends in TB Cases and Case Rate, Northeast Region US, 2008 vs. 2009

- 2 reporting areas had an increased TB case rate in 2009 compared to 2008
  - Indiana and Vermont
- 18 reporting areas had a decreased TB case rate in 2009 compared to 2008
  - New York, New Jersey, Massachusetts, Pennsylvania, Maryland, Ohio, Michigan, Connecticut, District of Columbia, Rhode Island, Delaware, West Virginia, New Hampshire and Maine


### MDR-TB in Northeast Region, US, 2009

- Initial drug-susceptibility testing performed
  - With the exception of VT (50%), all reporting areas had at least 75% culture positive cases tested
- 9 reporting areas reported MDR-TB cases
- 8 reported no MDR-TB cases (CT, DE, DC, ME, NH, RI, WV)
- Data not available for VT

<table>
<thead>
<tr>
<th>Area</th>
<th># MDR</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN</td>
<td>3</td>
<td>3.1</td>
</tr>
<tr>
<td>MD</td>
<td>2</td>
<td>1.2</td>
</tr>
<tr>
<td>MA</td>
<td>3</td>
<td>1.7</td>
</tr>
<tr>
<td>MI</td>
<td>1</td>
<td>0.9</td>
</tr>
<tr>
<td>NJ</td>
<td>9</td>
<td>3.0</td>
</tr>
<tr>
<td>NYS</td>
<td>4</td>
<td>2.2</td>
</tr>
<tr>
<td>NYC</td>
<td>8</td>
<td>1.5</td>
</tr>
<tr>
<td>OH</td>
<td>2</td>
<td>1.3</td>
</tr>
<tr>
<td>PA</td>
<td>2</td>
<td>1.5</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Area</th>
<th>% of cases w/ HIV status</th>
<th>No. HIV-positive (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT</td>
<td>76.3</td>
<td>N/A</td>
</tr>
<tr>
<td>DE</td>
<td>100.0</td>
<td>1 (11.1)</td>
</tr>
<tr>
<td>DC</td>
<td>77.4</td>
<td>N/A</td>
</tr>
<tr>
<td>IN</td>
<td>97.2</td>
<td>5 (14.3)</td>
</tr>
<tr>
<td>ME</td>
<td>0</td>
<td>0 (0)</td>
</tr>
<tr>
<td>MD</td>
<td>95.7</td>
<td>11 (12.5)</td>
</tr>
<tr>
<td>MA</td>
<td>72.6</td>
<td>N/A</td>
</tr>
<tr>
<td>MI</td>
<td>80.4</td>
<td>4 (9.8)</td>
</tr>
<tr>
<td>NH</td>
<td>100.0</td>
<td>1 (50.0)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Area</th>
<th>% of cases w/ HIV status</th>
<th>No. HIV-positive (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NJ</td>
<td>85.1</td>
<td>18 (12.6)</td>
</tr>
<tr>
<td>NYS</td>
<td>89.4</td>
<td>6 (7.9)</td>
</tr>
<tr>
<td>NYC</td>
<td>89.8</td>
<td>37 (14.5)</td>
</tr>
<tr>
<td>OH</td>
<td>83.3</td>
<td>7 (12.7)</td>
</tr>
<tr>
<td>PA</td>
<td>83.8</td>
<td>4 (7.0)</td>
</tr>
<tr>
<td>RI</td>
<td>100.0</td>
<td>2 (22.2)</td>
</tr>
<tr>
<td>VT</td>
<td>0.0</td>
<td>N/A</td>
</tr>
<tr>
<td>WV</td>
<td>63.3</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

N/A: data not available
Why do we need to care about TB in the rest of the world?

“Diseases don’t need visas”

Have germs, will travel…
Migrating populations in the 1990s

Source: Population Action International 1994

Immigration

Immigration has played an important role in American history, and the US continues to have the most open immigration policy in the world

- Immigrants account for 1 in 8 US residents
- 2009 census—307,006,556 US pop 38,452,822 FB (12.5%)

States in the NE Region with the highest percent non-US born (2009)

#2 New York (21.3%)
#3 New Jersey (20.2%)
#9 Massachusetts (14.4%)
#12 Maryland (12.9%)
#30 Pennsylvania (5.3%)

Applicants for U.S. immigration being screened according to the 2007 Technical Instructions for TB screening and treatment

<table>
<thead>
<tr>
<th>Country</th>
<th>Procedure</th>
<th>Start Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mexico</td>
<td>All applicants</td>
<td>October 1, 2005</td>
</tr>
<tr>
<td>Canada</td>
<td>All applicants</td>
<td>September 3, 2008</td>
</tr>
<tr>
<td>China</td>
<td>All applicants</td>
<td>November 19, 2008</td>
</tr>
<tr>
<td>India</td>
<td>All applicants</td>
<td>October 1, 2005</td>
</tr>
<tr>
<td>Philippines</td>
<td>All applicants</td>
<td>September 3, 2008</td>
</tr>
<tr>
<td>Vietnam</td>
<td>TB-positive</td>
<td>October 1, 2005</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>All applicants</td>
<td>September 3, 2008</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>All applicants</td>
<td>September 3, 2008</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>All applicants</td>
<td>September 3, 2008</td>
</tr>
<tr>
<td>Pakistan</td>
<td>All applicants</td>
<td>September 3, 2008</td>
</tr>
<tr>
<td>Yemen</td>
<td>All applicants</td>
<td>September 3, 2008</td>
</tr>
<tr>
<td>Egypt</td>
<td>All applicants</td>
<td>September 3, 2008</td>
</tr>
<tr>
<td>Nigeria</td>
<td>All applicants</td>
<td>September 3, 2008</td>
</tr>
<tr>
<td>Rwanda</td>
<td>All applicants</td>
<td>September 3, 2008</td>
</tr>
<tr>
<td>Senegal</td>
<td>All applicants</td>
<td>September 3, 2008</td>
</tr>
<tr>
<td>South Africa</td>
<td>All applicants</td>
<td>September 3, 2008</td>
</tr>
<tr>
<td>Malaysia</td>
<td>All applicants</td>
<td>September 3, 2008</td>
</tr>
<tr>
<td>Thailand</td>
<td>All applicants</td>
<td>September 3, 2008</td>
</tr>
<tr>
<td>Indonesia</td>
<td>All applicants</td>
<td>September 3, 2008</td>
</tr>
<tr>
<td>Burma</td>
<td>All applicants</td>
<td>September 3, 2008</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>All applicants</td>
<td>September 3, 2008</td>
</tr>
<tr>
<td>Korea (North)</td>
<td>All applicants</td>
<td>December 26, 2006</td>
</tr>
<tr>
<td>Korea (South)</td>
<td>All applicants</td>
<td>December 26, 2006</td>
</tr>
<tr>
<td>Taiwan</td>
<td>All applicants</td>
<td>December 26, 2006</td>
</tr>
<tr>
<td>Iraq</td>
<td>TB-positive</td>
<td>December 26, 2006</td>
</tr>
<tr>
<td>Afghanistan</td>
<td>All applicants</td>
<td>December 26, 2006</td>
</tr>
<tr>
<td>Pakistan (visa)</td>
<td>All applicants</td>
<td>December 26, 2006</td>
</tr>
<tr>
<td>Philippines (visa)</td>
<td>All applicants</td>
<td>December 26, 2006</td>
</tr>
<tr>
<td>Egypt (visa)</td>
<td>All applicants</td>
<td>December 26, 2006</td>
</tr>
<tr>
<td>Bangladesh (visa)</td>
<td>All applicants</td>
<td>December 26, 2006</td>
</tr>
</tbody>
</table>
Medical Examinations

Who is required to have a medical examination for migration to the United States?

<table>
<thead>
<tr>
<th>Category</th>
<th>Medical Examinations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immigrants</td>
<td>Medical history</td>
</tr>
<tr>
<td>Non-immigrants</td>
<td>Medical history, physical examination</td>
</tr>
</tbody>
</table>

TB Screening Medical Examination

- For applicants 2-35 years of age
- Medical history
- Physical examination
- TST (IFN-gamma)
- Chest radiograph
- Medical history, presentation of clinical correlation or negative skin test and interferon-gamma release assay
- Chest x-ray

CDC Immigration Requirements: 2007 Technical Instructions for TB Screening & Treatment

TB Classifications

- No TB classification – normal TB screening exam
- Class A – TB disease, smear and/or culture positive
- Class B1 TB – Pulmonary
  - No treatment: abnormal CXR, smear & culture negative
  - Completed TB treatment
- Class B1 TB – Extrapulmonary
- Class B2 TB – LTBI evaluation
  - TST < 10mm or positive IGRA
- Class B3 TB – Contact evaluation

International Travel

- 51.1 million international visitors in 2006
- 9% anticipated increase in next 5 years
- Travelers from China increased 24%
- Expected visitors from India to increase 50% and visitors from China to increase 64% by 2013
- 35.2 million US citizens traveled overseas in 2008

Office of Travel and Tourism Industries
1. Failure to develop measures to prevent and treat TB everywhere threatens our ability to control the disease anywhere.


TB ANYWHERE IS TB EVERYWHERE!

TUBERCULOSIS

Contact:

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