Epidemiology of Tuberculosis

Deborah Sodt, RN, PHN, MPH
Minnesota Department of Health
Mayo TB Intensive Course
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Disclosure

Relevant Financial Relationships
None

Off-Label/Investigational Uses
None
Learning Objectives

1. Describe risk factors for tuberculosis in the United States and Minnesota.

2. Identify ways in which tuberculosis raises unique public health issues.

3. Identify TB-related diagnoses that are reportable to the Minnesota Department of Health.
TB is Unique

- Airborne spread
- Long latency period
- Risk of drug resistance if improperly treated
- Treatment is resource intensive
- The medical care and public health systems share responsibility for ensuring that TB patients complete adequate treatment
“TB is a social disease with medical consequences”

American Thoracic Society
(and many others)
Persons at Risk for TB Infection

• Close contacts of persons with active TB
• Foreign-born persons from areas where TB is common
• Persons who visit TB-prevalent countries
• Residents/employees of high-risk settings
• HCWs who serve high-risk clients
• Locally defined populations

Adapted from CDC
Persons at Higher Risk for Progression to Active TB, if Infected (1)

- HIV-infected
- Recent contacts
- Fibrotic changes on CXR
- Immunosuppression
- Foreign-born from high-prevalence countries

Adapted from CDC
Persons at Higher Risk for Progression to Active TB, if Infected (2)

• Injection drug users
• Residents and employees of certain congregate settings
• Persons with certain medical conditions
• Cigarette smokers
• Children under age 4

Adapted from CDC
Medical Conditions that Increase Risk of Progression from LTBI to Active TB

- Silicosis
- Diabetes
- Chronic renal failure
- Certain types of cancers
- Gastrectomy/jejunoileal bypass
- Underweight (>10% below ideal)

Adapted from CDC
TB Burden, Worldwide, 2010

Source: WHO: Global Tuberculosis Control Report, 2010
Tuberculosis: Major Cause of Illness and Death

- 8.6 million new cases of TB disease (2012)
  - # of new cases has decreased annually since 2003

- 1.3 million deaths (2012)
  - 3,500/day, 95% in developing world

Source: WHO, 2013
Estimated tuberculosis (TB) incidence rates, 2011

The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

22 Countries Account for 80% of the TB Cases in the World

[Map showing countries with high TB cases]

World Health Organization
HIV and TB: A Lethal Combination

- TB is a leading killer of people living with HIV (1/4 of deaths)
- Estimated 1.1 million new HIV-positive TB cases (2012)
- People living with HIV and infected with TB are 20-30 times more likely to develop active TB disease than people without HIV.

Source: WHO, 2013
Global Tuberculosis: Drug Resistance

- Drug-resistant TB strains spreading globally and threaten to make TB incurable
- Multi-drug resistant TB present in virtually all countries surveyed by WHO
- Est. 450,000 MDR-TB cases (2012)

Source: WHO, 2013
Percentage of new tuberculosis cases with MDR-TB*

* MDR-TB: multidrug-resistant tuberculosis (resistance to, at least, isoniazid and rifampicin)

Note: Figures are based on the most recent year for which data have been reported, which varies among countries.

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Countries that had reported at least one XDR-TB case by end 2011

Argentina, Armenia, Australia, Austria, Azerbaijan, Bangladesh, Belarus, Belgium, Benin, Botswana, Brazil, Burkina Faso, Chile, China, Colombia, Czech Republic, Dominican Republic, Ecuador, Egypt, Estonia, France, Georgia, Germany, Greece, India, Indonesia, Iran (Islamic Rep. of), Ireland, Israel, Italy, Japan, Kazakhstan, Kenya, Kyrgyzstan, Latvia, Lesotho, Lithuania, Luxembourg, Malaysia, Mexico, Mongolia, Mozambique, Myanmar, Namibia, Nepal, Netherlands, New Zealand, Niger, Norway, Pakistan, Peru, Philippines, Poland, Portugal, Qatar, Republic of Korea, Republic of Moldova, Romania, Russian Federation, Slovenia, South Africa, Spain, Sweden, Swaziland, Tajikistan, Thailand, The Former Yugoslav Republic of Macedonia, Togo, Tunisia, Turkey, Ukraine, United Arab Emirates, United Kingdom, United Republic of Tanzania, United States of America, Uzbekistan, Viet Nam.
Tuberculosis in the United States

National Tuberculosis Surveillance System Highlights from 2012
Reported TB Cases
United States, 1982–2012*

*Updated as of June 10, 2013.
Factors Contributing to the Increase in TB Morbidity: 1985-1992

- Emerging HIV/AIDS epidemic
- Immigration from countries where TB was common
- Transmission of TB in congregate settings
- Development of multidrug-resistant (MDR) TB

Decades of funding cuts had impaired effectiveness of TB control programs

Source: CDC
TB Case Rates,* United States, 2012

*Cases per 100,000.

- ≤ 3.2 (2012 national average)
- >3.2

*Cases per 100,000.
TB Case Rates by Age Group and Sex, United States, 2012

Cases per 100,000

Under 5 5 - 14 15 - 24 25 - 44 45 - 64 ≥65

Male Female
Estimated HIV Coinfection in Persons Reported with TB, United States, 1993 – 2012*

*Updated as of June 10, 2013

Note: Minimum estimates based on reported HIV-positive status among all TB cases in the age group
Number of TB Cases in U.S.-born vs. Foreign-born Persons, United States, 1993–2012*

*Updated as of June 10, 2013
Countries of Birth of Foreign-born Persons Reported with TB, United States, 2012

- Mexico (21%)
- Philippines (12%)
- India (8%)
- Vietnam (7%)
- China (6%)
- Guatemala (3%)
- Haiti (3%)
- Other Countries 39%
Primary Anti-TB Drug Resistance, United States, 1993 – 2012*

*Updated as of June 10, 2013.

Note: Based on initial isolates from persons with no prior history of TB. Multidrug resistant TB (MDR TB) is defined as resistance to at least isoniazid and rifampin.
Updated as of June 10, 2013.

Note: Based on initial isolates from persons with no prior history of TB. MDR TB defined as resistance to at least isoniazid and rifampin.
Extensively Drug-Resistant (XDR) TB

- XDR TB is a rare type of MDR TB
  - Resistant to INH, RIF, fluoroquinolones, and ≥1 of 3 injectable 2nd-line drugs
- No apparent trend for XDR TB in the U.S.

†Drug susceptibility test.
*Reported incident cases as of July 1, 2010.
Extensively drug-resistant TB (XDR TB) is defined as resistance to isoniazid and rifampin, plus resistance to any fluoroquinolone and at least one of three injectable second-line anti-TB drugs.
Areas of Concern Remain

- U.S. TB cases occur largely in high-risk populations
- In these populations, TB is difficult to detect, diagnose, and treat
- Global TB epidemic persists
- Current TB control measures are limited; new tests, vaccines, drugs needed

Source: CDC
The Epidemiology of Tuberculosis in Minnesota, 2008-2012

Minnesota Department of Health
Tuberculosis Prevention and Control Program
(651) 201-5414
Tuberculosis surveillance data for Minnesota are available on the Web at:
www.health.state.mn.us.tb
Tuberculosis Disease: Minnesota, 2008-2012

Hennepin: 355
Ramsey: 189
Suburban metro: 104
Greater MN: 158
Total: 806
Tuberculosis Incidence Rates per 100,000 Population, United States and Minnesota, 1998-2012

Healthy People 2010 and 2020 objectives

Year of Diagnosis

United States

Minnesota
Reported Cases of Tuberculosis, Minnesota, 1918-2012

Number of Cases vs. Year graph showing a decline in reported cases from 1918 to 2012.
<table>
<thead>
<tr>
<th>Year</th>
<th>No. Cases</th>
<th>No. Deaths* (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>211</td>
<td>3 (1%)</td>
</tr>
<tr>
<td>2009</td>
<td>161</td>
<td>1 (1%)</td>
</tr>
<tr>
<td>2010</td>
<td>135</td>
<td>3 (2%)</td>
</tr>
<tr>
<td>2011</td>
<td>137</td>
<td>9 (7%)</td>
</tr>
<tr>
<td>2012</td>
<td>162</td>
<td>4 (2%)</td>
</tr>
</tbody>
</table>

*Represents only deaths due to TB disease or TB drug-induced toxicity
# Tuberculosis Morbidity, 2012
Selected Midwest States

<table>
<thead>
<tr>
<th>State</th>
<th>No. Cases</th>
<th>TB Rate*</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA</td>
<td>46</td>
<td>1.5</td>
</tr>
<tr>
<td>IL</td>
<td>347</td>
<td>2.7</td>
</tr>
<tr>
<td>MI</td>
<td>149</td>
<td>1.5</td>
</tr>
<tr>
<td>MN</td>
<td>162</td>
<td>3.0</td>
</tr>
<tr>
<td>ND</td>
<td>26</td>
<td>3.7</td>
</tr>
<tr>
<td>SD</td>
<td>19</td>
<td>2.3</td>
</tr>
<tr>
<td>WI</td>
<td>71</td>
<td>1.2</td>
</tr>
</tbody>
</table>

* # TB cases per 100,000 population

Source: CDC
Tuberculosis Cases by Method of Case Identification, Minnesota, 2009-2012

N = 595

TB symptoms 81%

Other 19%

- TB contact investigations 5%
- Incidental chest x-ray 4%
- Other targeted testing 3%
- Refugee health exam (domestic) 2%
- Incidental lab result 2%
- Other* 3%

* “Other” includes: pre-immigration exam (overseas) – 1.5%, other immigration exam – 1%, and employment screening – 1%
Tuberculosis Cases by Risk Category*, Minnesota, 2008-2012

* Risk categories are not mutually exclusive.
† Alcohol abuse and/or illicit drug use
** Conditions or therapies that increase risk for progression from latent TB infection to active TB disease
Foreign-Born Tuberculosis Cases by Country of Birth, Minnesota, 2008-2012

- Somalia: 33%
- Other: 28%
- Kenya: 4%
- Vietnam: 5%
- India: 6%
- Mexico: 6%
- Laos: 8%
- Ethiopia: 10%

N = 646
Tuberculosis Cases by Gender and Place of Birth, Minnesota, 2008-2012

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign-Born</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>U.S.-Born</td>
<td>65</td>
<td>35</td>
</tr>
<tr>
<td>Total</td>
<td>53</td>
<td>47</td>
</tr>
</tbody>
</table>
Tuberculosis Cases by Age Group and Place of Birth, Minnesota, 2008-2012
# Tuberculosis Cases by Race/Ethnicity and Place of Birth, Minnesota, 2008-2012

<table>
<thead>
<tr>
<th>Race/Ethnicity*</th>
<th>Foreign-Born Cases</th>
<th>U.S.-Born Cases†</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>16 (2)</td>
<td>55 (34)</td>
</tr>
<tr>
<td>Black</td>
<td>358 (55)</td>
<td>56 (35)</td>
</tr>
<tr>
<td>Asian</td>
<td>200 (31)</td>
<td>14 (9)</td>
</tr>
<tr>
<td>American Indian</td>
<td>0 (0)</td>
<td>15 (9)</td>
</tr>
<tr>
<td>Multi-racial</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Hispanic/Latino</td>
<td>72 (11)</td>
<td>20 (13)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>646 (100)</strong></td>
<td><strong>160 (100)</strong></td>
</tr>
</tbody>
</table>

*Race categories do not include persons of Hispanic/Latino origin.
†Includes U.S.-born children of foreign-born parents.
## Tuberculosis Cases With Other Medical Conditions, by Type of Condition, Minnesota, 2008-2012

<table>
<thead>
<tr>
<th>Medical conditions*</th>
<th>Cases (N=806)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes</td>
<td>65 (8)</td>
</tr>
<tr>
<td>Other Immunosuppressive Therapy</td>
<td>41 (5)</td>
</tr>
<tr>
<td>End Stage Renal Disease</td>
<td>13 (2)</td>
</tr>
<tr>
<td>Prolonged Corticosteroid Therapy</td>
<td>2 (&lt;1)</td>
</tr>
<tr>
<td>Weight loss/Undernutrition</td>
<td>6 (1)</td>
</tr>
<tr>
<td>Hematologic/Reticuloendothelial Disease</td>
<td>1 (&lt;1)</td>
</tr>
</tbody>
</table>

*Patients could have > 1 medical condition.
Tuberculosis Cases by Site of Disease, Minnesota, 2008-2012

- Pulmonary: 49%
- Extrapulmonary: 39%
- Both: 12%

N = 806
Extrapulmonary* Tuberculosis Cases by Site of Disease, Minnesota, 2008-2012

<table>
<thead>
<tr>
<th>Sites of Disease</th>
<th>Cases (N=491)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. ( %)</td>
</tr>
<tr>
<td>Lymphatic</td>
<td>243 (49)</td>
</tr>
<tr>
<td>Bone/joint</td>
<td>45 (9)</td>
</tr>
<tr>
<td>Pleural</td>
<td>41 (8)</td>
</tr>
<tr>
<td>Peritoneal</td>
<td>27 (5)</td>
</tr>
<tr>
<td>Genitourinary</td>
<td>19 (4)</td>
</tr>
<tr>
<td>Meningeal</td>
<td>16 (3)</td>
</tr>
<tr>
<td>Other</td>
<td>58 (12)</td>
</tr>
</tbody>
</table>

* Includes TB cases with or without concurrent pulmonary disease; patients may have multiple extrapulmonary sites of disease.
Tuberculosis Cases by Mycobacterial Culture Result, Minnesota, 2008-2012

- Positive: 75%
- Negative: 21%
- Not done/unknown: 4%

N = 806
Tuberculosis Cases by Drug Susceptibility Patterns and Place of Birth, Minnesota, 2008-2012

<table>
<thead>
<tr>
<th>Place of Birth</th>
<th>Cases With Susceptibility Results*</th>
<th>Any Drug Resistance†</th>
<th>INH-Resistant **</th>
<th>MDR-TB ‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign-Born Cases</td>
<td>495</td>
<td>94 (19)</td>
<td>54 (11)</td>
<td>7 (1)</td>
</tr>
<tr>
<td>U.S.-Born Cases</td>
<td>108</td>
<td>9 (8)</td>
<td>5 (5)</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Total</td>
<td>603</td>
<td>103 (17)</td>
<td>59 (10)</td>
<td>8 (1) §</td>
</tr>
</tbody>
</table>

* Culture-confirmed cases with drug susceptibility results available

† Resistance to at least one first-line anti-TB drug [i.e., isoniazid (INH), rifampin, pyrazinamide (PZA), or ethambutol]

** INH-resistant cases may also be resistant to other drugs.

‡ Multi-drug resistant TB, defined as resistance to at least INH and rifampin

§ One of these cases was resistant to INH, rifampin, PZA, and ethambutol.
Communicable Disease Reporting

- Report confirmed or suspected cases of TB disease to MDH within 1 working day of identification.

- Mycobacterium tuberculosis complex
  - pulmonary or extrapulmonary sites of disease
  - includes laboratory confirmed or clinically diagnosed disease
  - Latent tuberculosis infection is not reportable

Minnesota Rules, Chapter 4605, revised 2005
TB Case Surveillance Definition: Laboratory Confirmed

- Isolation of *M. tuberculosis* complex from a clinical specimen,*  OR
- Demonstration of *M. tuberculosis* complex from a clinical specimen by nucleic acid amplification test,**  OR
- Demonstration of acid-fast bacilli in a clinical specimen when a culture has not been or cannot be obtained or is falsely negative or contaminated.
TB Case Surveillance Definition: Clinical Case

- A positive TST or IGRA, AND
- Other signs and symptoms compatible with TB (e.g., abnormal chest radiograph or other chest imaging study, or clinical evidence of current disease), AND
- Treatment with two or more anti-TB medications, AND
- A completed diagnostic evaluation
Key Points

• From a public health perspective, TB is unique
• TB is a health disparities issue
• TB is decreasing but increasingly occurs in population subgroups where it can be hard to detect and treat
• TB incidence in the U.S. and Minnesota increasingly reflects global TB trends
• Current TB control measures are limited; new tests, vaccines, and drugs are needed
Questions?
References

• CDC. Controlling tuberculosis in the United States: recommendations from the American Thoracic Society, CDC and the Infectious Diseases Society of America. MMWR 2005;54(No. RR-12)

• World Health Organization http://www.who.int/topics/tuberculosis

• CDC http://www.cdc.gov/tb/

• MDH www.health.state.mn.us/tb