TB Epidemiology
TB around the World (2009)

- There were 9.4 million new TB cases, including 1.1 million cases among people with HIV.
- 1.7 million people died from TB, including 380,000 people with HIV, equal to 4700 deaths a day.

* Source: WHO
TB around the World

- The estimated global incidence rate fell to 137 cases per 100,000 population in 2009, after peaking in 2004 at 142 cases per 100,000.
- Globally, the percentage of people successfully treated reached the highest level at 86% in 2008.
High Burden Countries (WHO)

- Afghanistan
- Bangladesh
- Brazil
- Cambodia
- China
- Democratic Republic of the Congo
- Ethiopia
- India
- Indonesia
- Kenya
- Mozambique
- Myanmar
- Nigeria
- Pakistan
- Philippines
- Russian Federation
- South Africa
- Thailand
- Uganda
- United Republic of Tanzania
- Viet Nam
- Zimbabwe
TB Epidemiology
Reported TB Cases*
United States, 1982–2009

*Updated as of July 1, 2010. Source: CDC
TB Morbidity  
United States, 2003–2009

<table>
<thead>
<tr>
<th>Year</th>
<th>No.</th>
<th>Rate*</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>14,836</td>
<td>5.1</td>
</tr>
<tr>
<td>2004</td>
<td>14,499</td>
<td>4.9</td>
</tr>
<tr>
<td>2005</td>
<td>14,064</td>
<td>4.8</td>
</tr>
<tr>
<td>2006</td>
<td>13,734</td>
<td>4.6</td>
</tr>
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<td>2007</td>
<td>13,280</td>
<td>4.4</td>
</tr>
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<td>2008</td>
<td>12,906</td>
<td>4.2</td>
</tr>
<tr>
<td>2009</td>
<td>11,545</td>
<td>3.8</td>
</tr>
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</table>

*Cases per 100,000, updated as of July 1, 2010. Source: CDC
TB Case Rates,* United States, 2009

*Cases per 100,000. Source: CDC
**TB Case Rates by Race/Ethnicity***
United States, 1993–2009**

*All races are non-Hispanic. In 2003, Asian/Pacific Islander category includes persons who reported race as Asian only and/or Native Hawaiian or Other Pacific Islander only.

**Updated as of July 1, 2010. Source CDC**
Number of TB Cases in U.S.-born vs. Foreign-born Persons
United States, 1993–2009*

*Updated as of July 1, 2010
Source: CDC
Countries of Birth of Foreign-born Persons Reported with TB
United States, 2009

- Mexico (23%)
- Philippines (12%)
- India (8%)
- Vietnam (8%)
- China (5%)
- Guatemala (3%)
- Haiti (3%)
- Other Countries (38%)

Source: CDC
Estimated HIV Co-infection in Persons Reported with TB, United States, 1993–2009*

*Updated as of July 1, 2010. Source: CDC

Note: Minimum estimates based on reported HIV-positive status among all TB cases in the age group.
TB Epidemiology
Tuberculosis in Michigan - 2010

- 184 cases reported → rate of 1.8/100,000
  - 27.8% increase from 2009
- Foreign-born cases increased to 58.3% from 50% in 2009
- 58.2% of cases are located in Metro Detroit (Wayne, Oakland and Macomb)
- 8.2% were homeless within the last year
- 18.5% abused alcohol, injection or non-injection drugs within the last year
2010 Michigan Tuberculosis Cases

TB Cases
1 Dot = 1 Case

The map shown here is a dot density map showing TB cases by county in Michigan. The dots shown are visual representations of aggregated county data and do not represent any individual patient’s location.
### 5 year summary on TB cases and incidence rates* for the State of Michigan (2006-2010)

<table>
<thead>
<tr>
<th>Year</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>5 year average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of cases</td>
<td>221</td>
<td>226</td>
<td>188</td>
<td>144</td>
<td>184</td>
<td>193</td>
</tr>
<tr>
<td>Incident rates</td>
<td>2.2</td>
<td>2.3</td>
<td>1.9</td>
<td>1.4</td>
<td>1.9</td>
<td>1.9</td>
</tr>
</tbody>
</table>

*Rate per 100,000 population
Incidence of TB in High-Burden Areas, Michigan, 2006-2010

Year

Number of Cases


Detroit Wayne Oakland Kent Washtenaw Macomb Ingham Genesee Ottawa
## TB in Children

<table>
<thead>
<tr>
<th>Age</th>
<th>2009</th>
<th>2010</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5 years</td>
<td>3</td>
<td>9</td>
<td>200%</td>
</tr>
<tr>
<td>5-14 years</td>
<td>0</td>
<td>2</td>
<td>200%</td>
</tr>
<tr>
<td>15-19 years</td>
<td>11</td>
<td>5</td>
<td>-54.50%</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>
Racial and Ethnic Disparities, TB patients in MI, 2010 *

* Based on 2010 Census Data.
Number of TB Cases in US-Born vs. Foreign-Born Persons, Michigan, 1993-2010

No. of Cases

U.S.-born Persons
Foreign-born Persons
Countries of Birth of foreign-born persons with reported TB in Michigan, 2010

- India: 21%
- Philippines: 9%
- Mexico: 8%
- Ethiopia: 6%
- China: 5%
- Vietnam: 4%
- Myanmar: 4%
- Yemen: 4%
- Other: 38%
Substance Abuse and Homelessness Among Reported TB Cases, Michigan, 2005 – 2010

- Alcohol
- Non-Injection
- Injection
- Homelessness
TB Drug Resistant Trends, Michigan, 2000 – 2010

Year Reported

# of TB Cases

>=1 Drug
INH/RIF
Trends in HIV-TB Coinfection, Michigan, 1993-2010
History of *M. tuberculosis*

- Phthisis known since ancient times
- 1839 all forms designated as TB
- 1859 first sanatorium
- 1882 Koch demonstrated relationship between germ and disease
- 1896 Roentgen discovery of diagnostic x-ray
- 1940’s-1950’s chemotherapy
Transmission and Pathogenesis
Transmission

- Spread via droplet nuclei
- Organism (bacteria)- *Mycobacterium tuberculosis*
- Transmission factors:
  - Infectiousness of case
  - Environment of exposure
  - Duration of exposure
  - Virulence of the organism
- Latent TB infection (LTBI)-NOT INFECTIOUS
- TB disease-IS INFECTIOUS
Pathogenesis

- Inhale droplet nuclei
- Bacteria multiplies in alveoli
- Macrophages consume bacteria, then die
- Travel through the bloodstream, lymph system
- It may take 2-10 weeks to develop + reaction to TST
- Containment-infection (LTBI)
- Multiplication-disease
Pathogenesis

- 10% of infected persons with normal immune systems develop TB at some point in life
- HIV is strongest risk factor for development of TB if infected
  - Risk of developing TB disease 7% to 10% each yr
- Certain other medical conditions increase risk that TB infection will progress to TB disease
Pathogenesis

- Common sites of TB Disease
  - Lungs
  - Pleura
  - Central nervous system
  - Lymphatic system
  - Genitourinary systems
  - Bones and joints
  - Disseminated (miliary TB)
Drug-Resistant TB

- Drug-resistant TB transmitted same way as drug susceptible TB

- Drug resistance is divided into two types:
  - Primary resistance develops in persons initially infected with resistant organisms
  - Secondary resistance (acquired resistance) develops during TB therapy

- Terms
  - MDR-TB: Multidrug Resistant TB
  - XDR-TB: Extensively Drug Resistant TB
Evaluation for TB

- Medical history
- Physical examination
- Test for TB Infection
  - Mantoux tuberculin skin test
  - IGRA (interferon-gamma release assay)
- Chest radiograph
- Bacteriologic or histologic exam
<table>
<thead>
<tr>
<th>TB Infection</th>
<th>TB Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>CXR: Normal</td>
<td>CXR: Abnormal</td>
</tr>
<tr>
<td>No Symptoms</td>
<td>Symptoms</td>
</tr>
<tr>
<td>Negative Sputum Culture</td>
<td>Positive Sputum Culture</td>
</tr>
<tr>
<td>Not a Case of TB</td>
<td>Case of TB</td>
</tr>
<tr>
<td>NOT INFECTIOUS</td>
<td>INFECTIONOUS</td>
</tr>
</tbody>
</table>
TB Disease-Signs/Symptoms

- Productive, prolonged cough (> 2 weeks)
- Shortness of breath
- Chest pain
- Hemoptysis
- Fever / chills
- Appetite loss / Unexplained weight loss
- Night sweats
- Fatigue
TB Disease Identification

- History
  - S/S
  - Potential for exposure
  - Past TB treatment
  - Demographic risk factors
  - Medical conditions that increase risk of TB
  - HIV status is critical

- IGRA or Mantoux skin test
  - Positive result indicates TB infection; must be interpreted with overall medical evaluation
  - May be neg if:
    - Too soon after exposure
    - Severe illness
    - <6 months old
  - Useful when S/S present
  - Useful to determine how many people infected
TB Disease Identification

- CXR
  - Abnormalities often seen in apical or posterior segments of upper lobe or superior segments of lower lobe
  - HIV: may be unusual
  - Cannot confirm dx of TB

- Specimens
  - Sputum: 3 consecutive days
    - Spontaneous
    - Induced
    - Bronchoscopy
    - Gastric aspiration

- Laboratory
  - Smear
  - Culture
  - Susceptibilities
  - Genotyping
TB Disease Treatment

- Provide safest, most effective therapy in shortest time
- Multiple drugs to which the organisms are susceptible
- Never add a single drug to a failing regimen
- Ensure adherence to therapy
TB Disease Treatment

- Monitoring
  - Case management
  - Client side effects
  - Lab testing
    - Adverse reactions
    - Disease clearance

- Compliance
  - Without guidance or assistance, 25% do not complete therapy within one year
  - DOT-directly observed therapy
  - Incentives/enablers
  - Accommodations for barriers
TB Disease Treatment

- Usually 6 months, some cases 9 months
  - Four drugs for two months
    - INH-RIF-PZA-EMB
  - Two drugs for four or seven months
    - INH-RIF
  - Intermittent therapy: option after 2 weeks of daily therapy
  - Adjust regimen when susceptibility results are known
  - Always maintain at least two effective drugs in regimen

- Extrapulmonary TB
  - Surgery may be an option
  - May require longer therapy
TB Disease Treatment

- **Children**
  - Prompt and aggressive
  - EMB not recommended

- **Pregnancy and lactation**
  - Nine month therapy of INH, RIF, and EMB
  - PZA and SM are contraindicated
  - No toxic effect on breast milk

- **Monitoring for adverse reactions**
  - Baseline measurements
  - At least monthly
  - Must be individualized
  - Instruct patients to immediately report adverse reactions
Infectiousness

Patients should be considered infectious if they

- Are coughing
- Are undergoing cough-inducing or aerosol-generating procedures, or
- Have sputum smears positive for acid-fast bacilli and they
  - Are not receiving therapy (or)
  - Have just started therapy (or)
  - Have poor clinical response to therapy
Infection Control

- **Administrative**
  - Alert to S/S of *M. tb*
  - Early isolation of suspect cases
  - Prompt therapy with suspect cases
  - Alert for undiagnosed pulmonary illness with HIV

- **Engineering**
  - Neg. pressure isolation rooms
  - Enhanced air exchanges
  - UV lights
  - Hepa filtration systems

- **Personal protection**
  - Client: surgical mask
  - HCW: N-95 respirator
Latent TB Infection-LTBI

● Positive skin test and no disease
  ● Reactor: No history of skin test or negative skin test >2 yrs ago
  ● Converter: History of negative skin test within past 2 yrs
LTBI Treatment

- TB Disease must be ruled out
- If you test-you treat
- Pregnant women: treat if high risk for the progression of LTBI to active disease
- Adults and children
  - INH for 9 months (daily or intermittent)
  - RIF for 4 months (daily)
LTBI-Therapy Monitoring

- Determine hx of tx for LTBI or disease
- Assessment for contraindications
- Obtain hx of current medications
- Concurrent medical conditions
- Recommend HIV testing
LTBI-Therapy Monitoring

Establish rapport and emphasize

- Benefits of treatment
- Possible side effects: n/v, anorexia, malaise, hepatitis, neurotoxicity, elev T. >3 days
- Importance of adherence to regimen
- Establishment of optimal follow-up plan
BCG (bacille Calmette-Guérin)

- Vaccine used in many countries outside the USA
- Controversial efficacy
- Response wanes with time
- NOT a contraindication for skin testing
Other Mycobacteria

- **Terms**
  - NTM: nontuberculous mycobacteria
  - MOTT: mycobacteria other than tuberculosis
  - Atypical: mycobacteria other than tuberculosis

- **MAC: Mycobacterium avium complex**
  - Found in water and soil
  - Seen with HIV
  - Treatment: surgery or chemotherapy, can be difficult to treat
Questions?
Number of TB cases in MI 1993-2010

- 1993: 477 cases (↓ 8.4%)
- 1994: 462 cases (↓ 17%)
- 1995: 423 cases (↓ 17%)
- 1996: 444 cases (↓ 23%)
- 1997: 368 cases (↓ 23%)
- 1998: 383 cases
- 1999: 349 cases
- 2000: 287 cases
- 2001: 329 cases
- 2002: 315 cases
- 2003: 243 cases
- 2004: 272 cases
- 2005: 245 cases
- 2006: 221 cases
- 2007: 225 cases
- 2008: 188 cases
- 2009: 144 cases
- 2010: 184 cases
Trends in TB Cases in Foreign-born Persons, United States, 1989–2009*

*Updated as of July 1, 2010. Source: CDC