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What is TB?
OBJECTIVES

Become familiar with the cause of TB
Become familiar with how TB is spread
Become familiar with TB facts/statistics
Become familiar with latent TB infection (LTBI)
Become familiar with TB Infection
Become familiar with the diagnostic tests for TB
Become familiar with the sites of TB disease
Become familiar with progression of TB disease
Become familiar with MDR-TB
Become familiar with XDR-TB
Become familiar with TB worldwide statistics
What is TB?

• Caused by *Mycobacterium tuberculosis*, leading to:
  – Latent infection
  – Disease
• Primarily involving the lungs
• Spread by airborne transmission
• Coughing, sneezing, singing
• Droplets containing bacilli remain suspended for hours
Respiratory transmission by airborne droplet nuclei aerosolized with coughs and sneezes
TB FACTS

• 10.4 million new TB cases worldwide in 2015

• 2 Billion people or 1/3 of the world’s population are infected with the TB bacilli

• Every second a new person is infected with TB

• Tuberculosis (TB) is one of the top 10 causes of death worldwide
TB FACTS

• TB is a pandemic

• 1 in 10 people infected with TB will become sick with active TB

• In 2015, 1.8 million died from the disease (including 0.4 million among people with HIV)

• TB is a leading killer of HIV-positive people: in 2015, 35% of HIV deaths were due to TB
TB FACTS

• In 2015, an estimated 1 million children became ill with TB and 170,000 children died of TB (excluding children with HIV)

• Globally in 2015, an estimated 480,000 people developed multidrug-resistant TB (MDR-TB)
TB FACTS

• In 2016, a total of 9,287 new tuberculosis (TB) cases were reported in the United States; this provisional* count represents the lowest number of U.S. TB cases on record and a 2.7% decrease from 2015 (1)

• The U. S. 2016 TB incidence of 2.9 cases per 100,000 persons
<table>
<thead>
<tr>
<th>Latent TB Infection</th>
<th>Pulmonary TB Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inactive tubercle bacilli in the body</td>
<td>Active tubercle bacilli in the body</td>
</tr>
<tr>
<td>Results of tuberculin skin test (TST) or IGRA are usually positive</td>
<td>Results of TST or IGRA are usually positive</td>
</tr>
<tr>
<td>Findings on chest radiograph are generally normal</td>
<td>Findings on chest radiograph are generally abnormal</td>
</tr>
<tr>
<td>If sputum is collected:</td>
<td></td>
</tr>
<tr>
<td>Smear and sputum results are negative</td>
<td>Results of sputum smear and culture are positive</td>
</tr>
<tr>
<td>Lack of symptoms</td>
<td>Symptoms such as cough, fever and weight loss</td>
</tr>
<tr>
<td>Not infectious</td>
<td>Often infectious before treatment</td>
</tr>
</tbody>
</table>
TB is caused by *Mycobacterium tuberculosis*
M. tuberculosis seen as acid-fast bacilli (AFB) in sputum of TB patient
The TB skin test (PPD) detects delayed type hypersensitivity reactions to TB antigens.
TB causes disease primarily in the lungs, but can affect other body systems.
Common Sites of TB Disease

- Lungs
- Pleura
- Central nervous system
- Lymphatic system
- Genitourinary systems
- Bones and joints
- Disseminated (miliary TB)
• Aerosolized *M. tb*. may be inhaled by anyone sharing the same air

• Risk of infection depends on closeness and duration of contact, infectiousness of source, volume of air space, ventilation

• 20-50% of close household contacts infected
Multiplication of Bacilli

- Multiplication in alveolar space
- Establishment of TB infection dependent on
  - Number of organisms
  - Host factors
Dissemination of Infection

• Some bacilli break into blood stream and disseminate throughout the body
Immune Reaction to Infection

- Specialized immune cells (lymphocytes and macrophages) invade the sites of infection, surround and engulf the bacteria
Progression to Disease

• If bacteria escape body’s defenses, **TB disease** develops
• 10% lifetime risk of developing active TB disease
• Risk highest within 1st 2 years after infection
• 90% of infected people will not develop active TB
Sick Patients

Symptoms

• Pulmonary: cough more than 2-3 weeks, chest pain, difficulty breathing, coughing blood
• Systemic: fever, night sweats, weight loss, weakness,
• Extrapulmonary: depends upon site
Treatment is > 95% effective

- Standardized
- ≥ 6 months duration
- Multiple drugs
- Most patients become noninfectious in 2+ weeks
- Treatment is prevention
- 49 million prevented through effective diagnosis and treatment between 2000 and 2015
TB

HIV
Introduction of Anti-TB Drugs

Streptomycin (S) 1944
Para-aminosalicylic acid (PAS) 1946
Isoniazid (H) 1952
Pyrazinamide (Z) 1956
Rifampin (R) 1965
Ethambutol (E) 1968
TB in the United States
Reported Tuberculosis (TB) Cases
United States, 1982–2015*

*As of June 9, 2016.
Reported TB Cases by Origin and Race/Ethnicity,* United States, 2008

* All races are non-Hispanic. Persons reporting two or more races accounted for less than 1% of all cases.

**American Indian or Alaska Native accounted for less than 1% of foreign-born cases and are not shown.
Countries of Birth of Foreign-born Persons Reported with TB
United States, 2008

- Mexico (23%)
- Philippines (11%)
- Viet Nam (8%)
- India (8%)
- China (5%)
- Haiti (3%)
- Guatemala (3%)
- Other Countries (38%)
TB in the USAPI

* Cases per 100,000 population; as of June 9, 2016.
TB RATES

Case rate per 100,000

• U. S. – 2.9/per 100,000 (2016)
• Hawaii – 8.9/100,000
• Guam – 47.0/100,000 (57.2 in 2009; 34.8 2014)
• Marshalls – 189/100,000
TB GLOBALLY
Estimated TB incidence rates, 2015

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Reasons for Creating and Transmitting Drug Resistant TB

- Poor adherence / DOT practices
- Inadequate treatment regimens
- Poor drug quality or erratic supply
- Delayed recognition by clinics and laboratories
- Absence of administrative infection control measures
Estimated incidence of MDR/RR-TB in 2015, for countries with at least 1000 incident cases

- **Russia**: 60,000
- **China**: 70,000
- **India**: 130,000

* MDR = multidrug-resistant; RR = rifampicin-resistant

MDR/RR-TB = RR-TB cases including MDR-TB cases


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XDR TB
World TB Day — March 24, 2006

World TB Day is March 24. This annual event commemorates the date in 1882 when Robert Koch announced his discovery of *Mycobacterium tuberculosis*, the bacterium that causes tuberculosis (TB). Worldwide, TB remains one of the leading causes of death from infectious disease. Approximately 8 million people in the United States are infected with TB and 5,000 die of it annually. March 24 is a day to remember those who have died from TB and to honor those who have lived with the disease. It is a day of action, of unity, and of hope.


During the 1990s, multidrug-resistant (MDR) tuberculosis (TB), defined as resistance to at least isoniazid and rifampin, emerged as a threat to TB control, both in the United States and internationally. MDR-TB cases were first reported in 1992 in South Africa and rapidly became an important global public health concern. Multidrug-resistant TB greatly complicates treatment and is associated with additional clinical and public health consequences. To address the emergence of MDR-TB, the World Health Organization (WHO) established the Global Plan to Stop TB in 1993. The plan set targets for disease control and prevention and included strategies to strengthen national tuberculosis programs and reduce the number of TB cases with MDR-TB. The targets were reviewed in 1998, and the Global Plan to Stop TB was updated in 2003. The new plan included strategies to reduce the incidence of MDR-TB and to improve the outcomes of patients with MDR-TB.
What is XDR TB?

• A subgroup of MDR TB even more highly drug-resistant than MDR TB itself

• **Conceptually:** MDR TB that is also resistant to the most important 2nd-line drugs used to treat MDR TB

• **Specifically:** MDR TB that is also resistant to:
  – any one of the fluoroquinolones
  – at least one of the 2nd-line injectable drugs
XDR TB is a subgroup of MDR TB

Culture confirmed TB cases with adequate DST Results

Cases with any drug resistance

MDR TB

XDR TB
### TB Medical Consultation 2003

- CDC regional epidemiologist
- Trippler Army Medical Center
- University of Hawaii
- Hawaii TB Control Program

### TB Medical Consultation 2009

Regional Training and Medical Consultation Center (RTMCC) in San Francisco provides expert medical consultation for the region. USAPI program completes request form with notes and faxes or emails to Curry.
Patient Education Challenges

- Use of copied materials
- Not translated into 6 local languages
- Written vs. Video (oral or visual based)
HIV, MDR TB, and Diabetes Epidemic – The Perfect Storm?
MDR and XDR TB Disease

Latent MDR XDR TB Infection