

Transmission and Pathogenesis of Tuberculosis

Tuberculosis 101
Web-based Workshop

SESSION 1
May 9, 2007



Objectives

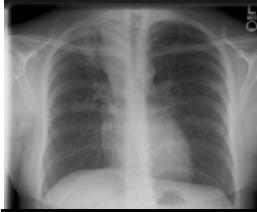
- Describe how TB is spread and how it affects the body
- Describe how other medical conditions, like HIV, can affect the development of TB disease
- Explain the difference between TB infection and disease
- Define "MDR" and "XDR" TB
- Describe two ways a person can acquire drug-resistant TB (MDR/XDR)

Overview

- A real example of TB and transmission
- Brief review of global and domestic TB epidemiology
 - TB transmission
 - TB pathogenesis

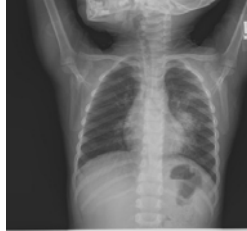
TB is a Primary Care Issue!

Reactivation



28 year old mom coughing for 3 months. Failed to follow-up for latent TB infection (LTBI) treatment 2.5 years ago

Primary



3 year old son: +PPD asymptomatic

Global TB: How Bad is It?

- ~8 million new cases of active TB/year
- 2-3 million deaths worldwide/year
- 1 in 3 persons infected with *Mycobacterium tuberculosis* (*M. tb*) [2 billion people!]
- 22 high TB burden countries; hot spots for multidrug-resistant (MDR) with drug resistance as high as 14%
- HIV fuels TB cases globally



Key Terms

- Mono-drug resistant TB – TB that is resistant to one of the first line drugs
- Multidrug-resistant TB (MDR-TB) – TB that is resistant to isoniazid and rifampin
- Extensively-drug resistant TB (XDR-TB) – MDR-TB that is also resistant to fluoroquinolones and at least one of three injectable drugs (*i.e.*, amikacin, kanamycin, or capreomycin)

How Does Drug Resistance Develop?

Patient related

- Non-adherence, default

Provider/program related

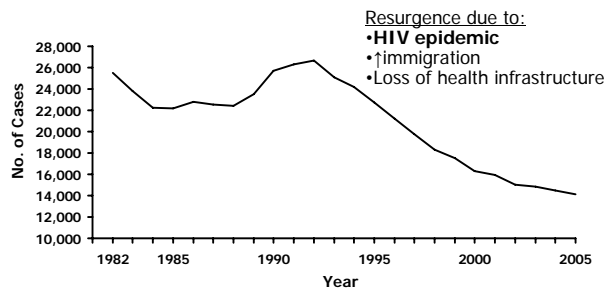
- Inadequate treatment regimen (*e.g.*, virtual single drug)
- Poor case management—adding a single drug to a failing regimen
- Treatment “in the dark”: no drug susceptibility testing or results are delayed
- Lack of suspicion delays appropriate therapy



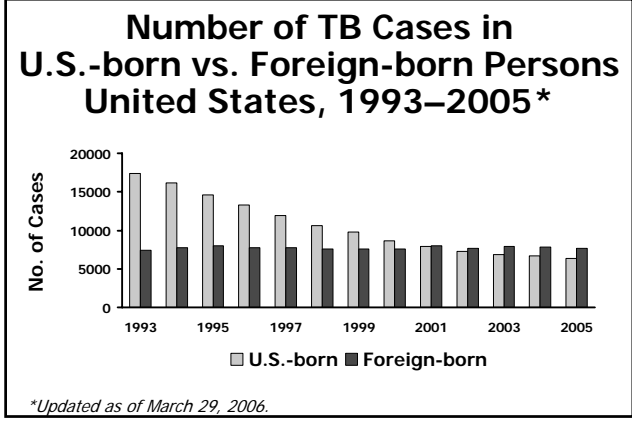
U.S.A.

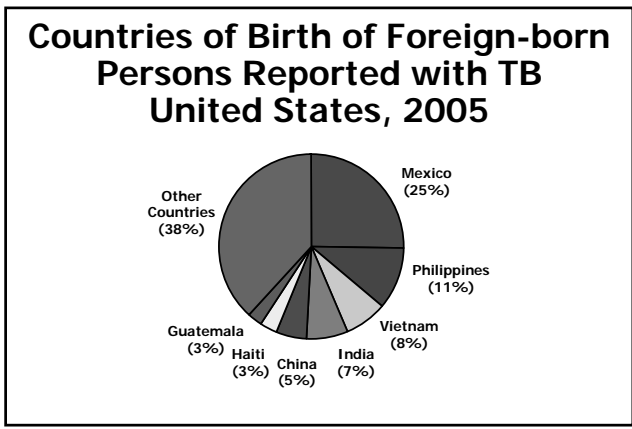
- 10-20 million infected individuals
- Pool of infected individuals grows by 400,000 per year due to legal immigration
- 2004: 81% of 14,511 TB cases among racial and ethnic minorities

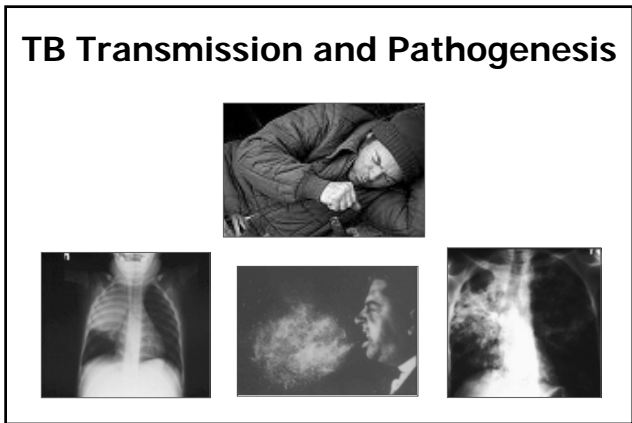
Reported TB Cases* United States, 1982–2005



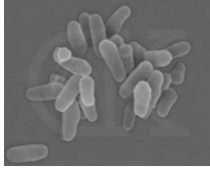
*Updated as of March 29, 2006







Tuberculosis



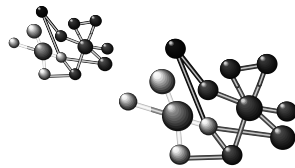
Tuberculosis complex

The etiology

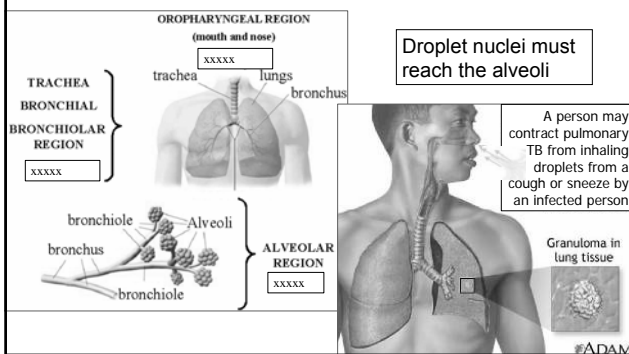
- M. tuberculosis*
- M. bovis*
- M. africanum*
- M. microti*

Transmission of TB

TB is contracted by inhalation of aerosolized infected particles in the range of 1–5 microns (μ)



How TB Enters and Infects the Body



Generation of TB Droplet Nuclei

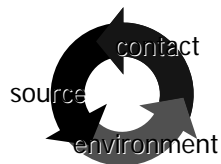
- One cough produces 500 droplets
- The average TB patient generates 75,000 droplets per day before therapy
- This drops to 25 infectious droplets per day within 2 weeks of effective therapy

Fate of *M. tb* Aerosols

- Large droplets settle to the ground quickly
- Smaller droplets form “droplet nuclei” of 1–5 μ in diameter
- Droplet nuclei can remain airborne indefinitely

Factors Affecting TB Transmission

- Characteristics of the source case
- Environment
- Factors increasing risk for contacts



TB Germs Can Be Spread When a Contagious Person:

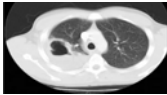


Coughs
Sneezes
Shouts
Sings

- You can get TB infection if you spend a lot of time indoors with this person

Risk Factors for Transmission of TB

- The source
- Cough, cough inducing procedures
- Duration of symptoms
- Cavitory disease
- Sputum smear positive for AFB



Risk Factors for Transmission of TB (2)

- The contact
- Proximity to source
 - Duration of exposure
 - Ventilation
 - Air entrainment, recirculation



Risk Factors for Inhaling TB From a Person with Infectious TB Disease

- The length of time you spend near the person
- The distance between you and the person



Risk Factors for Inhaling TB From a Person with Infectious TB Disease (2)

- The amount of clean air moving through the spaces
 - Size and openness of space
 - Effectiveness of ventilation

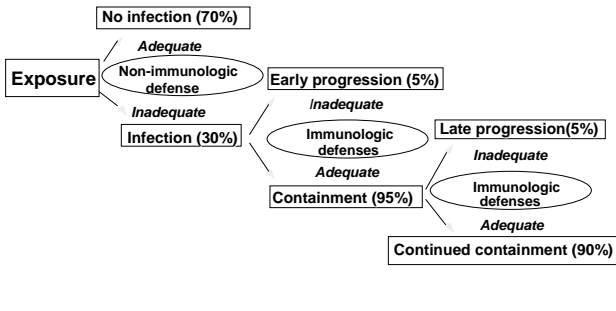


TB Germs Cannot be Spread By:

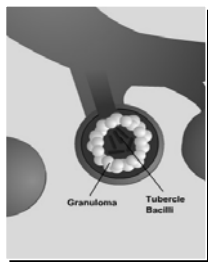
- Brief contact
- Sharing dishes and utensils
- Using towels and linens
- Handling food



Transmission and Pathogenesis of TB

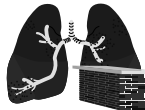


Latent TB Infection (LTBI)



Person:

- Not ill
- Not contagious
- Normal chest x-ray



Germs:

- Sleeping but still alive
- Surrounded (walled off) by body's defense system
- Usually positive skin test

TB Infection

- The person has **no symptoms** and is not sick
- Yes, the person is infected with TB but **not infectious** to others
- This person is not a case of TB
- If no preventive medicine, 10% chance of developing active TB (**higher if medical problems exists!**)

What Causes TB Infection to Become TB Disease?



Wall breaks down due to a weakened immune system

Active TB Disease



Germs:

- Awake and multiplying
- Cause damage

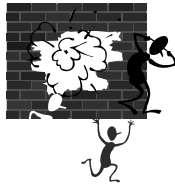
Person:

- Most often feels sick
- Contagious (before treatment)
- Usually positive skin test
- Considered an active "case" of TB

Granuloma breaks down and tubercle escape and multiply

Active TB

- TB germs growing and causing damage
- The TB skin test is usually **positive** (over 10 mm)
- Chest x-ray = **abnormal**
- Sputum culture = **positive**



Active TB (2)

- The person has *symptoms*

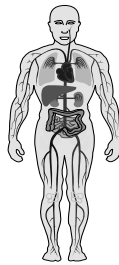
- Has a chronic cough
- Weight loss
- May have fever
- Sputum



- **Note:** Up to 20% have no symptoms at all

Common Sites of TB Disease

- Lungs (85% of all cases)
- Pleura
- Central nervous system
- Lymphatic system
- Genitourinary system
- Bones and joints
- Disseminated (miliary TB)

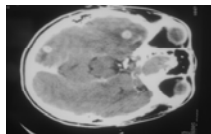


Note: TB can affect any part of your body!

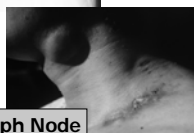
TB Can Affect Any Part of Your Body: Extrapulmonary TB



Pleura



Brain



Lymph Node



Spine

Summary

- TB is the most common bacterial infection globally
- It is an airborne disease spread by an untreated person with TB disease of the lung or larynx
- TB can be prevented and cured but drug resistant TB is a big threat to current control strategies

Thank You!

