

# Tuberculosis

- TB was once the leading cause of death in the United States.
- With the introduction of effective antibiotics in the 1940's, however, rates of TB declined significantly.
- In spite of this decline, certain statistics remain troubling:
- Worldwide, two billion people are infected with TB. In 2005, 1.6 million people died. Cases of TB are still rising in many regions of the world.
- In the United States, 13,767 cases of TB disease were reported in 2006.
- Although nationwide TB rates have declined steadily since 1992, rates have, in fact, increased in certain states, and among certain populations.
- All of these statistics suggest the ongoing need for vigilance and TB prevention efforts. This course has been designed to help you do your part in preventing the spread of TB.

## Cause and Transmission

- Tuberculosis is caused by *Mycobacterium tuberculosis*.
- This pathogenic bacterium is transmitted by the airborne route.
- Bacteria transmitted by the airborne route are carried by tiny droplets or dust particles. These tiny carriers can remain airborne for long periods and can travel long distances. Infection results when a susceptible host inhales the bacteria-containing carrier.

## Latent TB Infection

In most people who are exposed to TB and become infected, the immune system responds to the infection within two to eight weeks, by isolating TB-infected cells.

The TB bacteria remain alive, but inactive. The infected individual does not feel sick, has no symptoms, and cannot spread TB to others. This is latent TB infection.

Most people undergo complete healing of this initial infection. Eventually, the bacteria die off, and the only remaining signs of a previous infection are:

- A positive TB skin test
- Old scars on a chest X-ray

## Infection: Likelihood

- Infection usually occurs only after lengthy contact with a contagious individual.
- A susceptible host has a 50% chance of becoming infected after spending either:
- Eight hours a day for six months with an infectious TB patient
- Twenty-four hours a day for two months with an infectious TB patient

## Infection: Risk Factors

Certain groups are at increased risk for TB exposure and infection.

These include:

- Healthcare workers
- Residents of long-term care facilities
- Homeless people
- Residents of correctional facilities
- People from countries where TB is common
- HIV/AIDS
- Alcoholics and IV drug users
- Medically underserved low income populations
- People with household contact with suspected or confirmed active TB
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## Active TB Disease

- One in ten people infected with the TB bacterium will develop active TB disease at some point in their lives.
- This happens when the immune system is weakened, and can no longer contain the TB bacterium.
- Active TB disease may develop:
- Immediately or soon after infection, if the immune system is not able to contain the TB bacteria
- Many years later, when the immune system is weakened and the bacteria are able to break out and become active

### Disease: Early Course and Symptoms

- Early symptoms of active TB disease may include:
- Loss of appetite
- Weight loss
- Weakness
- Fatigue
- Fever
- Night sweats
- Chills

Symptomatic patients can spread TB to others.

### Disease: Later Course and Symptoms

One in three patients will die within weeks to months if treatment is not started during the early stage of active disease.

For untreated patients who survive the initial phase of active TB, the disease may enter remission.

Alternatively, TB may become chronic and debilitating, with symptoms such as:

- Cough
- Chest pain
- Bloody sputum

*Note: The symptoms described are for pulmonary TB. TB most often infects the lungs. However, TB can infect other parts of the body, as well. Symptoms differ for TB disease in the kidneys, spine, brain, or other parts of the body. Non-pulmonary TB disease is usually not infectious.*

### Disease: Risk

Immunocompromised individuals are at increased risk for progression of TB infection to TB disease.

Populations with weak or compromised immune systems include:

- Babies and young children
- The elderly
- Patients with HIV/AIDS
- Alcoholics
- Injection-drug users
- Diabetics
- Patients with silicosis
- Cancer patients, especially patients with:
  - Head or neck cancers
  - Leukemia
  - Hodgkin's disease
- Severe kidney disease
- Low body weight
- Certain medical treatments

HIV is a major contributor to the worldwide TB pandemic.

### Epidemiology: Populations at Risk

Within the United States, certain racial and ethnic populations are at greatly elevated risk for TB infection and disease.

According to CDC statistics:

- TB rates in Hispanics are almost eight times those of non-Hispanic whites. For the third consecutive year, more TB cases were reported among Hispanics than any other racial/ethnic population.
- TB rates in non-Hispanic blacks are over eight times those of non-Hispanic whites.
- TB rates in Asians are over twenty times those of non-Hispanic whites.
- TB rates declined for all racial/ethnic minorities except American Indians/Alaska Natives and native Hawaiians or other Pacific Islanders.
- The TB rate was the lowest recorded since national reporting began in 1953, but the rate of decline has slowed since 2000.

### Populations at Risk

Foreign-born persons in the United States also are at greatly elevated risk.

In 2007:

- TB rates in foreign-born persons were 9.5 times those of persons born in the United States.

- Foreign-born persons accounted for approximately 50% of reported cases of TB disease

#### Screening: TST Test

- The standard screening test for TB infection is the tuberculin skin test (TST), previously called the tuberculin purified protein derivative (PPD) skin test or the Mantoux test.
- In this test, a small amount of purified protein from the TB bacterium is injected just under the skin of the forearm.
- If the patient has TB infection (latent or active), the immune system will mount a response against the injected material, and a welt will form.

#### TST Test Results

With the TST test, 48 to 72 hours after injection, the size of the welt is measured.

Size is categorized, and results are interpreted, as follows:

Less than 5 mm

5 mm or greater

10 mm or greater

15 mm or greater

#### Who Should Be Screened?

Healthcare workers who care for patients with infectious TB should be tested on a regular basis. Screening for healthcare workers will be discussed in greater detail in lesson 5.

The following high-risk groups also should be tested, if they do not know their TB-infection status:

- Anyone who has spent time with a person with known or suspected active TB disease
- Patients with HIV infection or other high-risk conditions
- Foreign-born persons, especially persons from countries where TB is common (Africa, Bangladesh, China, India, Indonesia, Pakistan, the Philippines)
- Injection-drug users
- Persons who live in places where TB is relatively common (e.g., homeless shelters, migrant farm camps, prisons/jails, long-term care facilities)
- Homeless patients (CDC recommends a chest x-ray and possible sputum smear to determine current disease)

#### Diagnosis

After a positive screening test, further tests must be performed to determine whether the patient has active TB disease.

These include:

- Acid-fast bacilli (AFB) stain
- Culture
- Chest x-ray

#### Diagnosis: Chest X-Ray

A chest x-ray should be performed on all patients with clinical signs or symptoms of pulmonary TB (including a positive PPD test).

The chest x-ray may or may not appear abnormal, depending on the extent and severity of TB disease.

#### Treatment of TB Infection

Treatment of latent TB infection is recommended for all high-risk patients.

The antibiotic isoniazid (isonicotinic acid hydrazide, INH) is the normal treatment, taken daily for at least six to nine months.

When taken properly over the recommended time period, INH is bactericidal (it kills all TB bacteria present, ensuring that infection will not progress to disease).

- **INH is the most common treatment for latent TB**

#### Treating Close Contacts

- The immune system may take up to 12 weeks to develop a reactive response to tuberculin. For this reason, INH treatment should be recommended to individuals who have been in close contact with a TB patient, even if tuberculin testing is negative.

- This recommendation is especially important for those at high risk of developing serious TB disease soon after infection.
- These high-risk groups include: Infants, Young children, HIV-positive patients
- INH treatment should be given for three months. After three months, the screening test should be repeated, to evaluate the need for further treatment.

#### **Potential Side Effects of INH**

Although INH treatment is relatively safe, serious side effects can occur.

Be sure to inform your patients that the following should be reported and evaluated:

- Loss of appetite
- Nausea
- Vomiting
- Hepatitis; Jaundice
- Fever for three or more days
- Abdominal pain
- Peripheral neuropathy (tingling in extremities)
- Thrombocytopenia
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#### **Course of Treatment**

After a few weeks of full compliance with treatment, patients with active TB disease should:

- Experience clinical improvement
- No longer be infectious

**It is critical to stress the importance of continued drug treatment.**

Although symptoms may improve within a few weeks of starting treatment, TB bacteria are still alive.

If the patient stops taking his or her medication, the bacteria will re-grow.

The development of resistance is likely, in which case the patient will need to take second-line drugs that are more toxic and/or less effective.

#### **Preventing the Spread of TB**

A highly effective TB vaccine is not available.

The BCG vaccine is widely used in countries with a high incidence of TB. The vaccine is not widely used in the U.S. because risk of infection is low and the vaccine:

- Has limited success
- Interferes with TB skin test results

The CDC recommends that the BCG vaccine be considered for select persons and in consultation with a TB expert including certain groups of children and health care workers. The vaccine is contraindicated for pregnant women and people with HIV/AIDS.

Therefore, the primary method for preventing TB is reduction of person-to-person transmission.

With this goal in mind, two authorities have established guidelines and requirements for TB safety in the healthcare setting:

- The Centers for Disease Control and Prevention (CDC)
- The Occupational Safety and Health Administration (OSHA)

#### **Identification and Evaluation of Patients with TB**

All patients should be screened for signs and symptoms of active TB, either:

Upon initial encounter in the emergency room or ambulatory care setting

Before or at the time of admission

Any patients showing signs and symptoms suggestive of active TB should be further evaluated with a:

- Chest x-ray
- AFB stain

**If TB is suspected or confirmed, promptly initiate Airborne Precautions.**

#### **Management of Outpatients with Possible Infectious TB**

If an outpatient presents with clinical signs and symptoms suggestive of TB:

- Place the patient in a separate waiting room or TB isolation room (see the section on engineering controls for more information on TB isolation)
- Give the patient a surgical mask and a box of tissues. Instruct the patient on the use of both

### Management of Inpatients with Possible Infectious TB: Isolation and Treatment

Inpatients with known or suspected TB (based on clinical signs and symptoms, as well as test results) should immediately be placed in a TB isolation room.

- Isolated patients must be educated regarding TB and the need for isolation. Adherence to isolation measures should be encouraged through the use of incentives (e.g., special dietary requests) or other means.
- Isolated patients should remain in their rooms, with the door closed.
- Treatment should be initiated as necessary, and response to treatment should be monitored.

### Engineering Controls

Inpatients with known or suspected infectious TB disease should be placed in isolation rooms that meet the criteria for Airborne Precautions:

- Monitored negative air pressure
- At least six air changes per hour in existing facilities
- At least 12 air changes per hour in new or renovated facilities
- Room air exhausted directly to the outside, or, if absolutely necessary, HEPA [glossary] filtration of room air before recirculation back into the facility-wide ventilation system

A person with expertise in ventilation engineering should be consulted when designing local exhaust and general ventilation systems.

### Respiratory Protection

Certified respirators must be used by the following people:

- Anyone entering an isolation room housing a patient with known or suspected TB
- Any person present during a cough-inducing or aerosol-generating procedure (see next screen) on a patient with known or suspected TB
- Any person in any other setting in which administrative and engineering controls are not likely to provide full protection against airborne transmission (for example, when transporting a patient with known or suspected TB in an ambulance)

All healthcare facilities that use personal respirators must have a formal respirator program.

### Healthcare Worker Counseling and Screening

All healthcare workers should receive counseling regarding TB and TB infection.

This should include information on the increased risk of developing active TB disease among the immunocompromised.

Tuberculin tests should be performed on all employees:

At the beginning of employment

At periodic intervals throughout employment

Symptomatic staff members should be evaluated for active TB disease.

The importance of healthcare worker testing is illustrated in the case presented on the right.

### OSHA Policy

**In keeping with the CDC guidelines just described, OSHA requires that workers in the healthcare setting be protected from TB exposure.**

OSHA Policy: Respiratory Protection Standard

Respirator usage for TB is regulated under OSHA's *General Industry Standard for Respiratory Protection*.

This standard requires healthcare facilities to develop, implement, and evaluate a respiratory-protection program.

The respiratory-protection program must include:

- Assignment of responsibility
- Training
- Fit testing

In addition:

- Respirators must meet certain minimum standards.
- Fit-testing and fit-checking for respirators are **required**.

- Respiratory Protection Standard
- Respirators must meet certain minimum standards.
- Any respirator used for TB must be selected from those approved by the CDC/NIOSH. N95 respirators are the minimum acceptable level of respiratory protection.
- Disposable respirators are considered acceptable, if structural and functional integrity is maintained.
- Fit-testing and fit-checking procedures for respirators are required.
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#### **Which Respirators Are Acceptable?**

- The National Institute of Occupational Safety and Health (NIOSH) certifies respirators that meet certain performance criteria (e.g., the ability to filter out air particles with efficiency).
- OSHA requires the use of certified respirators, for tasks that warrant personal respiratory protection.
- Certified respirators are labeled (on the filter, container, or instruction sheet) with a NIOSH approval statement.