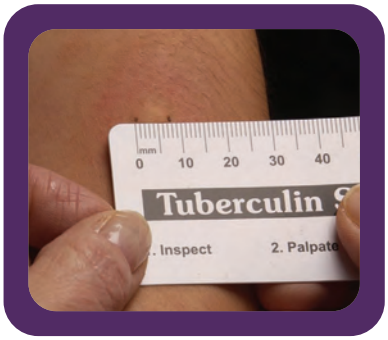
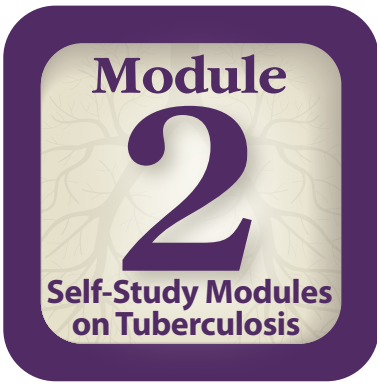
Self-Study Modules on Tuberculosis



Module 2

Epidemiology of Tuberculosis

National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention
Division of Tuberculosis Elimination



Epidemiology of Tuberculosis

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention
Division of Tuberculosis Elimination

Atlanta, Georgia
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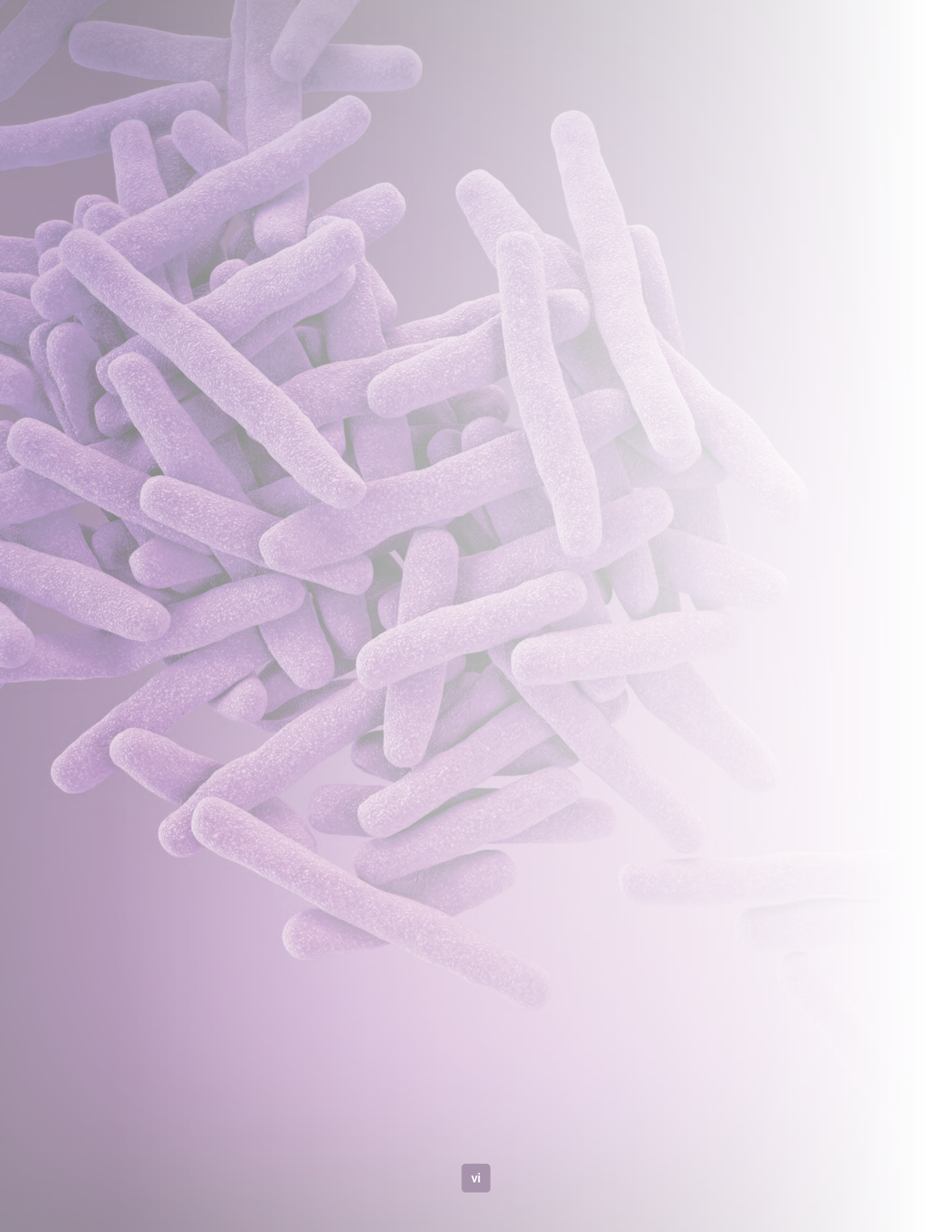
Module 2 Self-Study Modules on Tuberculosis

Contents



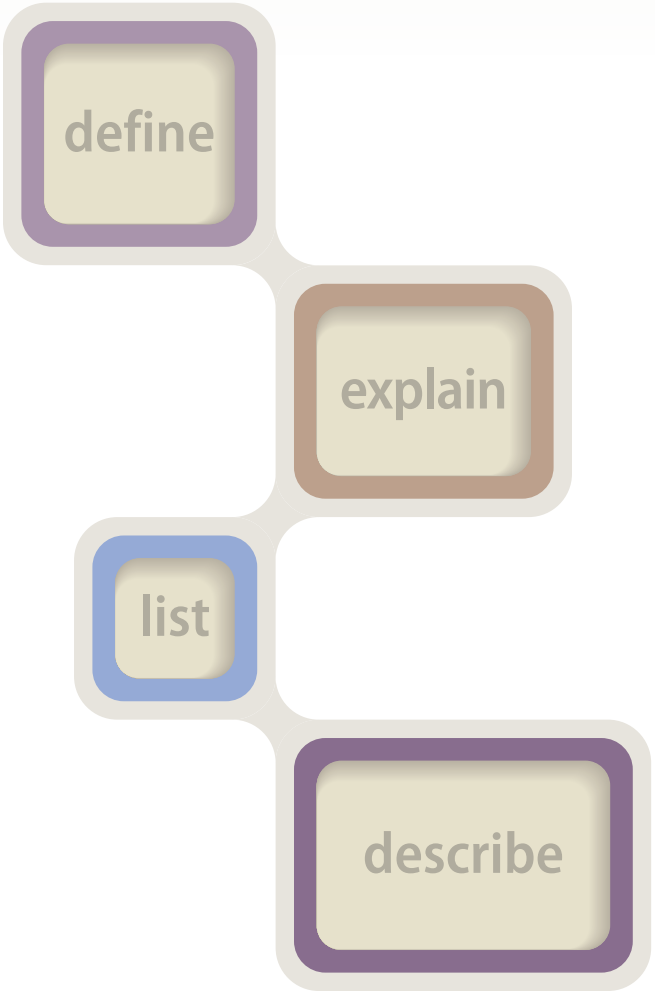
Background

Epidemiology is the study of diseases and other health problems in groups of people. Epidemiologists determine the frequency and pattern (the distribution) of health problems in different communities. In other words, they find out who has a specific health problem, how often the problem occurs, and where the problem occurs. Using this information about who, when, and where, epidemiologists try to determine why the health problem is occurring.

Public health officials use epidemiologic information to design ways to prevent and control the diseases in the community. By finding out who is at risk for a specific health problem, they can target their prevention and control strategies at this group.

This module examines recent trends in TB in the United States and describes groups of people who are at higher risk for latent TB infection (LTBI) and TB disease. Groups of people who are at higher risk for TB vary from area to area; state and local health departments are responsible for determining specifically who is at risk in their area.

Note: The *Self-Study Modules on Tuberculosis* are a series of educational modules designed to provide information about TB in a self-study format. The target audiences include outreach workers, nurses, physicians, administrators, health educators, and students from a variety of settings. The Modules should not be used as a substitute for guidelines and should not be used for patient care decisions.



Objectives

After working through this module, you will be able to

1. Describe how the number of TB cases reported in the United States has changed over the last 60 years.
2. List five factors that contributed to the increase in the number of TB cases between 1985 and 1992.
3. List three improvements TB programs were able to make with increased federal, state, and other funds and resources that have contributed to a decrease in TB cases since 1993.
4. List the groups of people who are more likely to be exposed to or infected with *M. tuberculosis*.
5. List the groups of people who are more likely to develop TB disease once infected with *M. tuberculosis*.

New Terms

New terms introduced in this module are included below. These terms appear in **bold** in the module text.

case rate—the number of cases that occur during a certain time period, divided by the size of the population during that time period; the case rate is often expressed in terms of a population size of 100,000 persons

civil surgeons—domestic health care providers who screen immigrants living in the United States and applying for a permanent residence visa or citizenship

congregate setting—a setting in which a group of persons reside, meet, or gather either for a limited or extended period of time in close physical proximity. Examples include prisons, nursing homes, schools, and homeless shelters.

contacts—persons exposed to someone with infectious TB disease; can include family members, roommates or housemates, close friends, coworkers, classmates, and others

epidemiology—the study of the distribution and causes of disease and other health problems in different groups of people

foreign-born persons—people born outside of the United States; foreign-born persons from areas of the world where TB is common (for example, Asia, Africa, Latin America, Eastern Europe, Russia, and the Caribbean) are more likely to be infected with *M. tuberculosis*

gastrectomy—a partial or full surgical removal of the stomach

health care facilities—places where people receive health care, such as hospitals or clinics

infection control procedures—measures to prevent the spread of TB

jejunoileal bypass—surgical operation performed to reduce absorption in the small intestine

panel physicians—overseas health care providers who screen U.S. immigration applicants for TB disease

Introduction to TB Epidemiology

It is estimated that 2 billion people are infected with M. tuberculosis *worldwide.*

TB infection is one of the most common infections in the world. It is estimated that globally 2 billion people (about one third of the world's population) are infected with *M. tuberculosis*. Every year, about 9 million people develop TB disease and 1.5 million people die of it. In fact, among those older than 5 years of age, TB disease is one of the leading causes of death due to infectious disease in the world.

Physicians and other health care providers are required by law to report TB cases to their state or local health department.

In the United States, physicians and other health care providers are required by law to report TB cases to their state or local health department. Reporting is very important for TB control. When the health department learns about a new case of TB, it should take steps to ensure that the person receives appropriate care and treatment. The health department should also start a contact investigation. This means first interviewing a person who has TB disease to determine who else may have been exposed to TB. The people who have been exposed to TB are then tested for TB infection and TB disease. For more information on contact investigations, refer to *Module 8, Contact Investigations for Tuberculosis*.

The 50 states, the District of Columbia, New York City, Puerto Rico, and seven other jurisdictions in the Pacific and Caribbean report TB cases to the federal Centers for Disease Control and Prevention (CDC) using a standard case report form called the Report of Verified Case of Tuberculosis (RVCT). Each reported TB case is checked to make sure that it meets certain criteria. All cases that meet the criteria, called verified TB cases, are counted each year. These data are used by CDC to monitor national TB trends, identify priority needs, and create the Annual Surveillance Report. For more information on criteria for reporting TB cases, refer to *Module 3, Targeted Testing and the Diagnosis of Latent Tuberculosis Infection and Tuberculosis Disease*. For more information on the RVCT, refer to CDC's *Tuberculosis Surveillance Data Training—Report of Verified Case of Tuberculosis Instruction Manual*, available from the CDC website (www.cdc.gov/tb).

In 1953, when nationwide TB reporting first began, there were more than 84,000 TB cases in the United States (the 50 states and District of Columbia). From 1953 through 1984, the number of TB cases decreased by an average of 6% each year. In 1985, the number of TB cases reached a low of 22,201.

From 1985 through 1992, the number of new TB cases in the United States increased by about 20%.

In 1986, however, there was an increase in TB cases, the first significant rise since 1953. Between 1985 and 1992 there was a resurgence of TB, with the number of new cases increasing from 22,201 in 1985 to 26,673 in 1992, an increase of about 20% (Figure 2.1).

The resurgence in TB cases between 1985 and 1992 can be attributed to at least five factors:

- Inadequate funding for TB control and other public health efforts
- The HIV epidemic
- Increased immigration from countries where TB is common
- The spread of TB in certain settings (for example, correctional facilities and homeless shelters)
- The spread of multidrug-resistant TB (MDR TB)

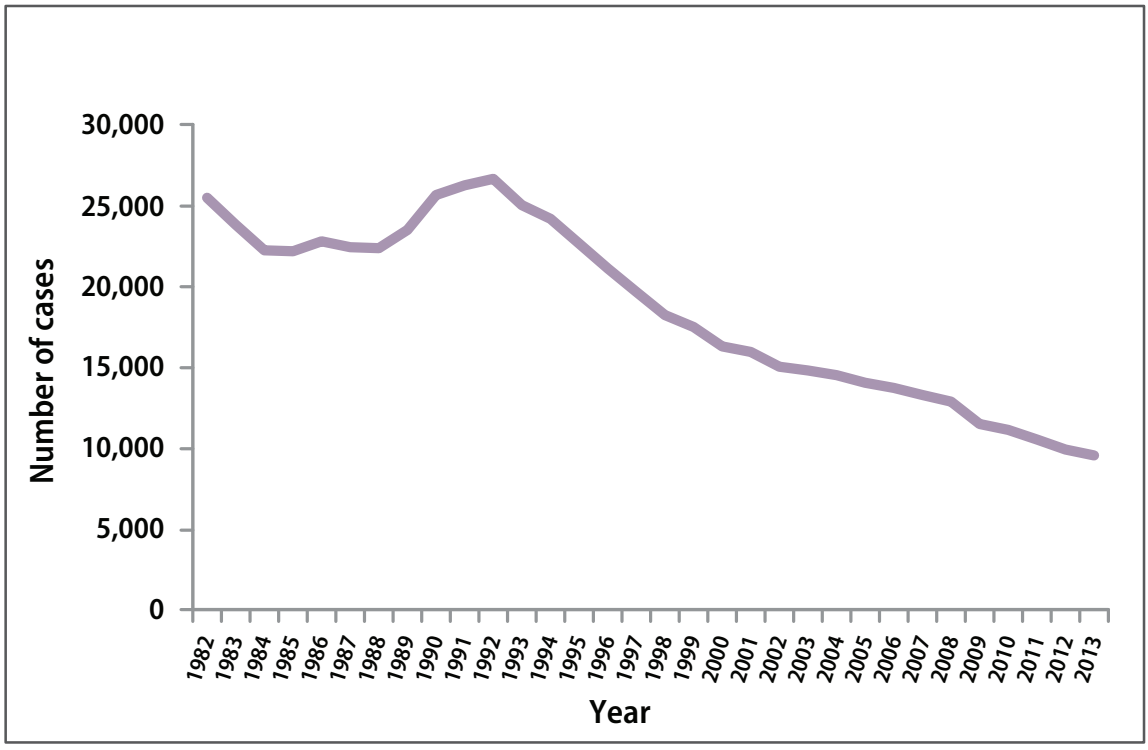


Figure 2.1 Reported TB cases, United States, 1982–2013.

From 1993 through 2013, there was a steady decline in the number of TB cases reported annually in the United States.

In 1993, the upward trend of new TB cases reversed. From 1993 through 2013, the number of TB cases reported annually in the United States steadily declined (Figure 2.1). In 2013, there were a total of 9,582 new cases of TB, resulting in the lowest number of reported TB cases since national reporting began in 1953.

The continued decline in reported TB cases since 1993 may be attributed to the increase in resources used to strengthen TB control efforts. The increase in federal, state, and other funds and resources allowed TB programs to improve their control efforts to

- Promptly identify persons with TB
- Start appropriate initial treatment for TB cases
- Ensure patients complete treatment
- Conduct contact investigations

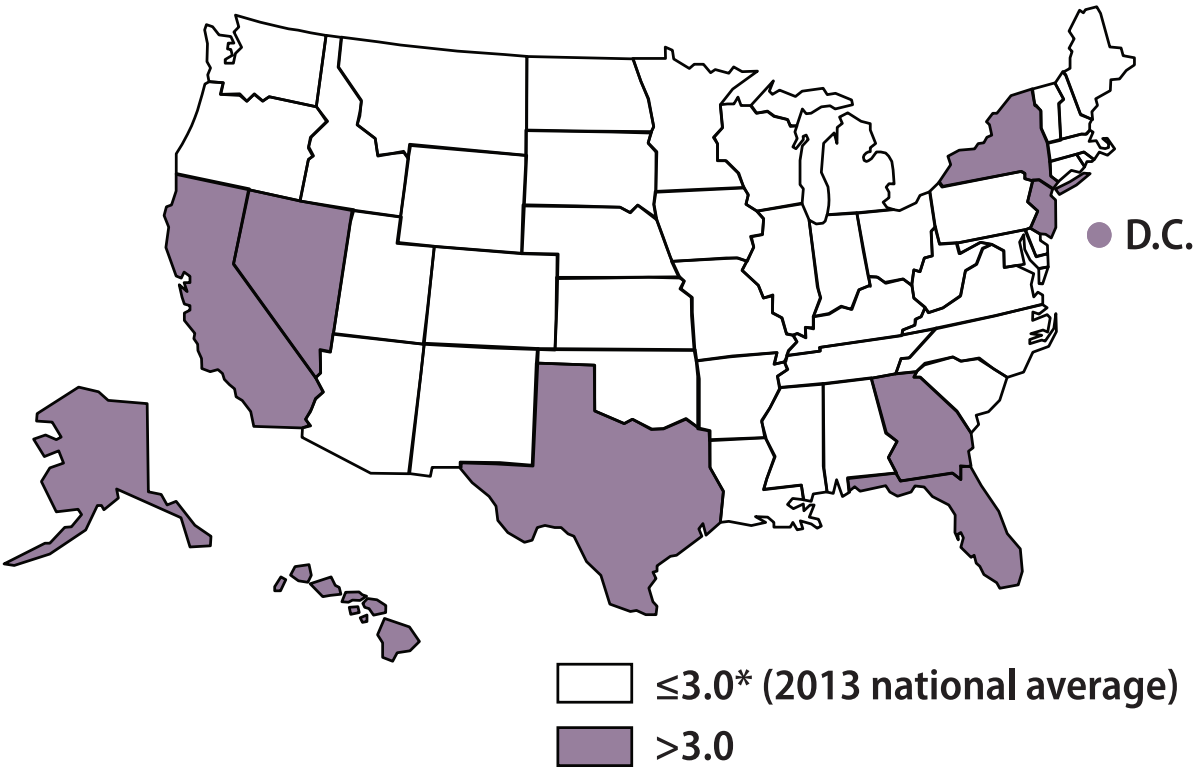
Despite trends reflecting a steady decline in TB cases in the United States between 1993 and 2013, there are still several areas of ongoing concern.

Despite national trends reflecting a steady decline in the number of TB cases reported annually in the United States between 1993 and 2013, there are still several areas of ongoing concern:

- While TB cases declined nationally, TB cases continue to be reported in almost every state and actually increased in some areas.
- More than half of all TB cases in the United States are among residents born outside of the United States (foreign-born).
- TB affects racial/ethnic minorities disproportionately. Hispanics, non-Hispanic blacks or African Americans, and Asians continue to have TB at higher rates than white, non-Hispanics.
- Drug-resistant TB (MDR TB and extensively drug-resistant TB [XDR TB]) remains a serious public health concern. Patients who do not complete treatment or do not take anti-TB drugs as directed can develop and spread strains of TB that are resistant to available drugs.

In 2013, the TB case rate in the United States was 3.0 TB cases per 100,000 persons.

The number of TB cases at a certain place and time is often expressed as a case rate. A **case rate** is the number of cases that occur during a certain time period, divided by the size of the population during that time period. (The case rate is often expressed in terms of a population size of 100,000 persons.) For example, in the United States in 2013, there were 9,582 new TB cases in a population of approximately 316,128,839 people. In other words, the TB case rate was 3.0 TB cases per 100,000 persons. Figure 2.2 depicts the states that reported a case rate above the national average in 2013 (3.0/100,000 population) in purple.



*Cases per 100,000.

Figure 2.2 TB case rates by state, United States, 2013.

Study Question 2.1–2.5

2.1 What happened to the number of TB cases in the United States between 1953 and 1984?

2.2 What happened to the number of TB cases in the United States between 1985 and 1992?

2.3 Name five factors that may have contributed to the increase in the number of TB cases between 1985 and 1992.

2.4 What has been happening to the number of TB cases in the United States since 1993?

2.5 Name three improvements TB programs were able to make with increased federal, state, and other funds and resources that contributed to the decrease in TB cases since 1993.

Answers to study questions are on pages 22–25

Race and Ethnicity

In 2013, 85% of all TB cases occurred among persons who were Asian, black or African American, Hispanic, American Indian or Alaska Native, or Native Hawaiian.

Information about the race and ethnicity of people who are reported to have TB shows that TB affects certain racial and ethnic minorities disproportionately. Of all the TB cases reported in the United States in 2013, 85% occurred among persons who were Asian, black or African American, Hispanic, American Indian or Alaska Native, or Native Hawaiian. (Hispanic is an ethnicity, not a race. People of Hispanic origin may be of any race.)

In 2013, about 28% of the TB cases were in Hispanics, a group which made up about 17% of the total United States population. Similarly, 22% of the reported TB cases in the United States were in non-Hispanic blacks or African Americans, even though this group made up only about 12% of the total population. Furthermore, 31% of the TB cases were in Asians who made up 5% of the population; 1% in American Indian or Alaska Natives who made up 1% of the population; and less than 1% in Native Hawaiian or Other Pacific Islanders, who were less than 1% of the United States population.

The percentage of TB cases that occur in Hispanics, blacks or African Americans, and Asians is higher than expected based on the percentage of these minorities in the U.S. population.

In other words, the percentage of TB cases that occur in Hispanics, blacks or African Americans, and Asians is higher than expected based on the percentage of these minorities in the U.S. population (Figures 2.3 and 2.4).

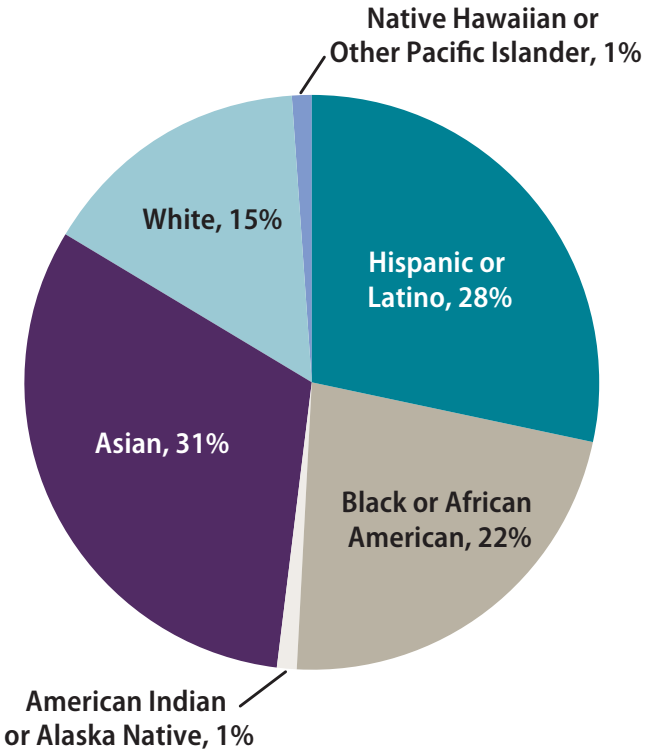


Figure 2.3 Reported TB cases by race and ethnicity*, United States, 2013.

*All races are non-Hispanic. Persons reporting two or more races accounted for 2% of all cases.

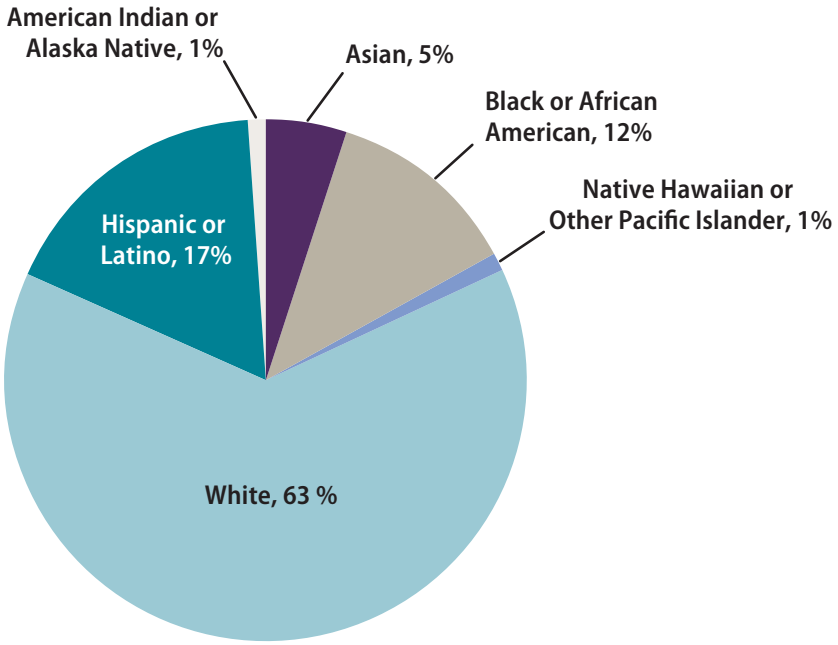


Figure 2.4 Racial and ethnic groups by percentage of U.S. population annual estimates, 2013.

TB case rates also show that certain racial and ethnic minorities are disproportionately affected by TB.

TB case rates also show that certain racial and ethnic minorities are disproportionately affected by TB. In 2013, the TB case rate for non-Hispanic whites was 0.7, which means there were 0.7 TB cases in non-Hispanic whites for every 100,000 non-Hispanic whites in the general population. The case rate for Asians was 18.7 cases per 100,000 persons, about 27 times higher. This means that Asians were about 27 times more likely than non-Hispanic whites to have TB. Similarly, the case rate for Native Hawaiians or Other Pacific Islanders was about 16 times higher than the case rate for non-Hispanic whites; for non-Hispanic blacks, about 8 times higher; for Hispanics, about 7 times higher; and for American Indians or Alaska Natives, about 8 times higher (Table 2.1).

TB rates are higher for some racial and ethnic groups, probably because a greater proportion of people in these groups have other risk factors for TB.

TB case rates are higher for some racial and ethnic groups, probably because a greater proportion of people in these groups have other risk factors for TB. These risk factors include birth in a country where TB is common, HIV infection, low socioeconomic status (for example, low level of employment or income), and exposure to TB in high-risk settings (for example, correctional facilities, homeless shelters, and some health care facilities).

Table 2.1 Relative Risk* for TB by Race and Ethnicity, 2013.

Race/Ethnicity	TB Case Rate (number of TB cases for every 100,000 persons in this race/ethnicity)	Relative Risk***
Asian	18.7	27
Native Hawaiian or Other Pacific Islander	11.3	16
Black or African American	5.4	8
American Indian or Alaska Native	5.4	8
Hispanic or Latino	5.0	7
Multiple Race**	2.4	3
Non-Hispanic White	0.7	1

*The relative risk is a comparison of case rates between two groups. In this table, all case rates are compared to the case rate for non-Hispanic whites because non-Hispanic whites have the lowest case rate for one race reported for a person. For example, the relative risk for Asians is 27, because the case rate for this group is about 27 times higher than the case rate for non-Hispanic whites.

** Indicates two or more races reported for a person. Persons reporting two or more races accounted for 2% of cases.

*** Relative risk numbers rounded to nearest whole number.

Study Question 2.6

2.6 Which racial and ethnic groups are disproportionately affected by TB?

Answers to study questions are on pages 22–25

People at High Risk for TB Infection and TB Disease

In certain groups, the rates of TB are higher than in others.

Health departments, CDC, and others can compare the occurrence of TB cases in different places, time periods, and groups of people by using case rates. They have found that the rates of TB are higher in certain groups than in others. These high-risk groups can be divided into two categories (Table 2.2):

- People at high risk for exposure to or infection with *M. tuberculosis*
- People at high risk for developing TB disease after infection with *M. tuberculosis*

Detailed information regarding some of these high-risk groups is presented on the following pages.

Table 2.2 Groups at High Risk for TB Infection and TB Disease.

People at High Risk for Exposure to or Infection with *M. tuberculosis*	People at High Risk for Developing TB Disease after Infection with *M. tuberculosis*
■ **Contacts** of people known or suspected to have TB disease ■ People who have come to the United States within the last 5 years from areas of the world where TB is common (for example, Asia, Africa, Russia, Eastern Europe, or Latin America) ■ People who visit areas with a high prevalence of TB disease, especially if visits are frequent or prolonged ■ People who live or work in high-risk **congregate settings** (for example, nursing homes, homeless shelters, or correctional facilities) ■ Health care workers who serve patients who are at increased risk for TB disease ■ Populations defined locally as having an increased incidence of LTBI or TB disease, possibly including medically underserved, low-income populations, or persons who abuse drugs or alcohol ■ Infants, children, and adolescents exposed to adults who are at increased risk for LTBI or TB disease	■ People living with HIV ■ Children younger than 5 years of age ■ People recently infected with *M. tuberculosis* (within the past 2 years) ■ People with a history of untreated or inadequately treated TB disease ■ Persons who are receiving immunosuppressive therapy such as tumor necrosis factor-alpha (TNF) antagonists, systemic corticosteroids equivalent to/greater than 15 mg of prednisone per day, or immunosuppressive drug therapy following organ transplantation ■ Persons with silicosis, diabetes mellitus, chronic renal failure, leukemia, or cancer of the head, neck, or lung ■ Persons who have had a **gastrectomy** or **jejunoileal bypass** ■ Low body weight ■ Cigarette smokers and persons who abuse drugs or alcohol ■ Populations defined locally as having an increased incidence of disease due to *M. tuberculosis*, including medically underserved, low-income populations

Contacts

Contacts are at high risk of being infected with M. tuberculosis.

Contacts are persons who have spent time with someone who has infectious TB disease. They are at high risk of being infected with *M. tuberculosis*. Contacts may include family members, coworkers, friends, or others who have been in contact with the TB patient.

Foreign-Born Persons/Immigrants

Of all TB cases reported to CDC in 2013, 65% were in foreign-born persons.

In the United States, TB infection and TB disease occur often among people born in areas of the world where TB is common, such as Asia, Africa, Russia, Eastern Europe, and Latin America. Most of these **foreign-born persons** become exposed to and infected with *M. tuberculosis* in their country of birth. Of all TB cases reported to CDC in 2013, more than half (65%) were in foreign-born persons. This is more than twice the percentage compared to 1992, when 27% of reported TB cases were in foreign-born persons.

To address the high rate of TB in foreign-born persons, CDC and other national and international public health organizations are working to

- Improve the overseas and domestic screening process of immigrants and refugees
- Strengthen the current notification system that alerts health departments about the arrival of immigrants or refugees with suspected TB
- Test recent arrivals from countries where TB is common for TB infection and ensure completion of treatment

People who apply for immigration are screened for TB overseas by panel physicians before entering the United States.

People who apply for immigration and refugee status are screened for TB disease before coming to the United States by health care providers known as **panel physicians**. Immigrants with TB disease are required to receive treatment before they enter the United States. Also, many immigrants have latent TB infection, but not TB disease, at the time of screening. These immigrants may develop TB disease months or years after they come to the United States. Health departments are notified of immigrants who were suspected of having latent TB infection or TB disease on their overseas examination. This notification system allows health departments to ensure patients receive a medical evaluation and TB treatment if necessary.

Immigrants living in the United States who apply for permanent residence or citizenship are required to be tested for TB infection and evaluated for TB disease by U.S.-based health care providers known as **civil surgeons**.

Congregate Settings

The risk of being exposed to TB is higher in certain settings because many people in these facilities are at risk for TB disease.

In certain **congregate settings**, such as correctional facilities, homeless shelters, nursing homes, or **health care facilities**, the risk of being exposed to TB is higher than in other places. This is because many people in these facilities are at risk for TB disease. The risk of transmission and exposure to TB is even higher if the facility is crowded.

For example, the risk of TB disease is higher in correctional facilities because the incarcerated population contains a high proportion of people at greater risk for TB than the overall population. These risk factors include, but are not limited to, HIV-infection and a history of homelessness or drug use. The physical structure of correctional facilities can include close living quarters, overcrowding, and the potential for inadequate ventilation. Finally, the movement of inmates into and out of facilities and inmates returning to the community can lead to interruption of therapy.

Other settings where people are at risk for TB are homeless shelters and drug treatment centers. People who live or work in these settings are at higher risk of being exposed to TB.

TB can also be a problem in nursing homes and other assisted living facilities. TB case rates increase with age for all racial/ethnic groups. In 2013, 23% of TB cases were in people 65 years or older, even though this age group made up only about 14% of the population. This may be because many elderly people may have been exposed to and infected with *M. tuberculosis* when they were younger, at a time when TB was more common than it is today. A nursing home with a concentration of elderly persons, who may have weak immune systems, creates a high-risk setting for TB transmission.

Health Care Workers

People who work in health care facilities may be exposed to TB on the job.

People who work in health care facilities, such as clinics and hospitals, may be exposed to TB on the job. The risk of exposure depends on the number of persons with TB in the facility, the employee's duties, and the effectiveness of the **infection control procedures** in the facility.

Each facility where there is a high risk of TB transmission should ensure that appropriate TB prevention and control measures are in effect to protect residents and staff. Infection control procedures, or measures to prevent the spread of TB, are discussed in more detail in *Module 5, Infectiousness and Infection Control*.

Populations Defined Locally as Having an Increased Incidence of Latent TB Infection or TB Disease

Populations that may have an increased incidence of latent TB infection or TB disease include persons experiencing homelessness, medically underserved, low-income populations, or persons who abuse drugs or alcohol.

TB rates are 10 times higher for people experiencing homelessness.

For example, TB rates are 10 times higher for people experiencing homelessness than for people who have stable housing. Homeless people may be at higher risk of developing TB disease once infected because of malnutrition, medical conditions such as HIV infection or diabetes, and poor access to health care. Congregation in crowded shelters can also increase the risk of TB transmission.

Low income has been linked to a higher risk of exposure to TB. Possible reasons include factors that are often associated with low income such as crowding, inadequate living conditions, malnutrition, and poor access to health care.

People who abuse drugs or alcohol are more likely to be exposed to or infected with M. tuberculosis. *They are also at high risk of developing TB disease once infected.*

People who abuse drugs or alcohol are also more likely to be exposed to or infected with *M. tuberculosis*. This may be because a large proportion of people in this risk group have other risk factors for exposure to TB, such as being in correctional facilities, drug treatment centers, or having poor access to health care.

People who abuse drugs are also at high risk of developing TB disease once infected, perhaps because they are more likely to be HIV infected. They may also have other medical conditions that weaken the immune system.

Children

Children younger than 5 years of age are at a particularly high risk for rapidly developing TB disease after infection with *M. tuberculosis*. In 2013, about 5% of all reported TB cases were in children younger than 15 years of age. Between 1985 and 1992, the number of reported TB cases in children 0–14 steadily increased. Since 1993, however, TB cases in children have been decreasing.

TB cases in children have been decreasing since 1993.

The occurrence of TB infection and disease in children provides important information about the spread of TB in homes and communities.

The occurrence of latent TB infection and TB disease in children provides important information about the spread of TB in homes and communities. When a child has TB infection or disease, it means that

- TB was transmitted relatively recently
- The person who transmitted TB to the child may still be infectious
- Other adults and children in the household or community have probably been exposed to TB; if they are infected, they may develop TB disease in the future

Persons Living with HIV

HIV infection is the strongest known risk factor for the development of TB disease.

HIV infection is the strongest known risk factor for the development of TB disease in people with latent TB infection. **Worldwide TB is responsible for the deaths of one in four people living with HIV/AIDS, thus making it a leading cause of death among people living with HIV.**

Worldwide, TB is responsible for the deaths of one in four people living with HIV/AIDS.

Because HIV weakens the immune system, people with TB infection and HIV infection are at **very high risk** of developing active TB disease. In fact, the risk of developing TB disease is about 7% to 10% **each year** for people who are infected with both *M. tuberculosis* and HIV (if the HIV is not treated). In contrast, the risk of developing TB disease is 10% **over a lifetime** for people infected only with *M. tuberculosis* (see *Module 1, Transmission and Pathogenesis of Tuberculosis*).

Because of concerns about confidentiality, a few states have laws and regulations that do not allow HIV/AIDS programs to share HIV status data on TB patients with TB programs. Many state health departments compare TB and AIDS registries to estimate the proportion of reported TB patients with HIV coinfection. For all ages, the estimated percentage of HIV coinfection in persons with TB who reported HIV testing (positive, negative, or indeterminate test results) decreased from 48% to 7% from 1993 to 2013, and from 63% to 9% among persons aged 25 to 44 years during this period.

Study Questions 2.7–2.9

2.7 Name seven groups of people who are more likely to be exposed to or infected with *M. tuberculosis*.

2.8 What are public health agencies doing to address the high rate of TB in foreign-born persons?

2.9 Why is the risk of being exposed to TB higher in certain settings, such as nursing homes or correctional facilities?

Answers to study questions are on pages 22–25

Study Questions 2.10–2.11

2.10 What are some reasons why rates of TB disease are higher in correctional facilities?

2.11 When a child has latent TB infection or TB disease, what does it tell us about the spread of TB in the child's home or community? Name three things.

Answers to study questions are on pages 22–25

Case Study 2.1

For each of the following people, choose the factor(s) known to increase the risk of being exposed to or infected with* M. tuberculosis. *Each person may have more than one risk factor.

a) Mr. Petrov:

- ☐ works at a nursing home
- ☐ rides the subway every day
- ☐ emigrated from Russia

b) Ms. Montoya:

- ☐ was born in Latin America
- ☐ has a father who had pulmonary TB disease

c) Ms. Parker:

- ☐ volunteers in the emergency room of an inner-city hospital
- ☐ works in a day care center

d) Mr. Dudley:

- ☐ was released from prison last year
- ☐ sleeps in a homeless shelter

Answers to case studies are on pages 26–27

Study Questions 2.12–2.14

2.12 Name at least eight groups of people who are more likely to develop TB disease once infected.

2.13 What is the strongest known risk factor for the development of TB disease?

2.14 If a person is infected with both *M. tuberculosis* and HIV, what are his or her chances of developing TB disease? How does this compare to the risk for people who are infected only with *M. tuberculosis*?

Answers to study questions are on pages 22–25

Case Study 2.2

For each of the following people, choose the factor(s) known to increase the risk of developing TB disease once infected. Each person may have more than one risk factor.

a) Mr. Sims:

- ☐ injects heroin
- ☐ has HIV

b) Mr. Allen:

- ☐ has diabetes
- ☐ has high blood pressure

c) Ms. Li:

- ☐ has chest x-ray findings suggestive of previous TB disease
- ☐ has heart problems

d) Mr. Vinson:

- ☐ is overweight
- ☐ became infected with *M. tuberculosis* 6 months ago

Answers to case studies are on pages 26–27

Additional Resources

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8. U.S. Census Bureau. USA QuickFacts from the US Census Bureau. Washington, DC: US Census Bureau; 2014. http://quickfacts.census.gov/qfd/states/00000.html.

Answers to Study Questions

2.1 What happened to the number of TB cases in the United States between 1953 and 1984?

From 1953 through 1984, the number of TB cases reported in the United States decreased by an average of 6% each year.

2.2 What happened to the number of TB cases in the United States between 1985 and 1992?

From 1985 through 1992, the number of new TB cases increased by 20%.

2.3 Name five factors that contributed to the increase in the number of TB cases between 1985 and 1992.

- Inadequate funding for TB control and other public health efforts
- The HIV epidemic
- Immigration from countries where TB is common
- The spread of TB in certain settings (for example, correctional facilities and homeless shelters)
- The spread of multidrug-resistant TB (MDR TB)

2.4 What has been happening to the number of TB cases in the United States since 1993?

Since 1993 there has been a steady decline in the number of TB cases reported annually in the United States.

2.5 Name three improvements TB programs were able to make with increased federal, state and other funds and resources that contributed to the decrease in TB cases since 1993.

The increase in funds allowed TB programs to

- Promptly identify persons with TB
- Start appropriate initial treatment for TB cases
- Ensure patients complete treatment
- Conduct contact investigations

2.6 Which racial and ethnic groups are disproportionately affected by TB?

Asians, Native Hawaiians or Other Pacific Islanders, non-Hispanic blacks, Hispanics, and American Indians or Alaska Natives are disproportionately affected by TB.

Answers to Study Questions, Continued

2.7 Name seven groups of people who are more likely to be exposed to or infected with *M. tuberculosis*.

- Contacts of people known or suspected to have infectious TB
- People who have come to the United States within the last 5 years from areas of the world where TB is common (for example, Asia, Africa, Russia, Eastern Europe, or Latin America)
- People who visit areas with a high prevalence of TB disease, especially if visits are frequent or prolonged
- People who live or work in high-risk congregate settings (for example, nursing homes, homeless shelters, or correctional facilities)
- Health care workers who serve patients who are at increased risk for TB disease
- Populations defined locally as having an increased incidence of TB infection or TB disease, possibly including medically underserved, low-income populations, or persons who abuse drugs or alcohol
- Infants, children, and adolescents exposed to adults who are at increased risk for TB infection or TB disease

2.8 What are public health agencies doing to address the high rate of TB in foreign-born persons?

To address the high rate of TB in foreign-born persons, CDC and other national and international public health organizations are working to

- Improve the overseas and domestic screening process of immigrants and refugees
- Strengthen the current notification system that alerts health departments about the arrival of immigrants or refugees with suspected TB
- Test recent arrivals from countries where TB is common for TB infection and to ensure completion of treatment

2.9 Why is the risk of being exposed to TB higher in certain settings, such as nursing homes or correctional facilities?

The risk of being exposed to TB is higher in certain settings because many people in these facilities are at risk for TB. The risk of exposure to TB is even higher if the facility is crowded.

Answers to Study Questions, Continued

2.10 What are some reasons why rates of TB disease are higher in correctional facilities?

First, the incarcerated population contains a higher proportion of people at greater risk for TB than the general population. Second, an increasing number of inmates are infected with HIV, which means that they are more likely to develop TB disease if they become infected with *M. tuberculosis*. Also, some correctional facilities are crowded and may have inadequate ventilation, which promotes the spread of TB. Finally, therapy can be interrupted when inmates are moved into and out of facilities.

2.11 When a child has latent TB infection or TB disease, what does it tell us about the spread of TB in the child's home or community? Name three things.

When a child has TB infection or TB disease, it indicates that

- TB was transmitted relatively recently
- The person who transmitted TB to the child may still be infectious
- Other adults and children in the household or community have probably been exposed to TB; if they are infected, they may develop TB disease in the future

2.12 Name at least eight groups of people who are more likely to develop TB disease once infected.

- People living with HIV
- Children younger than 5 years of age
- People recently infected with *M. tuberculosis* (within the past 2 years)
- People with a history of untreated or inadequately treated TB disease
- Persons who are receiving immunosuppressive therapy such as tumor necrosis factor-alpha (TNF) antagonists, systemic corticosteroids equivalent to/greater than 15 mg of prednisone per day, or immunosuppressive drug therapy following organ transplantation
- Persons with silicosis, diabetes mellitus, chronic renal failure, leukemia, or cancer of the head, neck, or lung
- Persons who have had a gastrectomy or jejunoileal bypass
- Low body weight
- Cigarette smokers and persons who abuse drugs or alcohol
- Populations defined locally as having an increased incidence of disease due to *M. tuberculosis*, including medically underserved, low-income populations

Answers to Study Questions, Continued

2.13 What is the strongest known risk factor for the development of TB disease?

HIV infection is the strongest known risk factor for the development of TB disease in people with TB infection. HIV infection weakens the body's immune system, making it more likely that a person who has TB infection will develop TB disease.

2.14 If a person is infected with both *M. tuberculosis* and HIV, what are his or her chances of developing TB disease? How does this compare to the risk for people who are infected only with *M. tuberculosis*?

The risk of developing TB disease is about 7% to 10% each year for people who are infected with both *M. tuberculosis* and HIV who are not being treated for HIV. In contrast, the risk of developing TB disease is 10% over a lifetime for people infected only with *M. tuberculosis*.

Case Study Answers

2.1 For each of the following people, choose the factor(s) known to increase the risk of being exposed to or infected with* M. tuberculosis. *Each person may have more than one risk factor. (☒ indicates correct answer)

a) Mr. Petrov:

- ☒ works at a nursing home
- ☐ rides the subway every day
- ☒ emigrated from Russia

b) Ms. Montoya:

- ☒ was born in Latin America
- ☒ has a father who had pulmonary TB disease

c) Ms. Parker:

- ☒ volunteers in the emergency room of an inner-city hospital
- ☐ works in a day care center

d) Mr. Dudley:

- ☒ was released from prison last year
- ☒ sleeps in a homeless shelter

Case Study Answers, Continued

For each of the following people, choose the factor(s) known to increase the risk of developing TB disease once infected. Each person may have more than one risk factor. (☒ indicates correct answer)

a) Mr. Sims:

- ☒ injects heroin
- ☒ has HIV

b) Mr. Allen:

- ☒ has diabetes
- ☐ has high blood pressure

c) Ms. Li:

- ☒ has chest x-ray findings suggestive of previous TB disease
- ☐ has heart problems

d) Mr. Vinson:

- ☐ is overweight
- ☒ became infected with *M. tuberculosis* 6 months ago

Notes

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