



Self-Study Modules on Tuberculosis

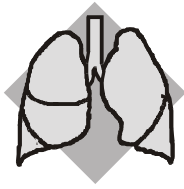
Epidemiology of Tuberculosis

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Division of Tuberculosis Elimination



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Epidemiology of Tuberculosis

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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 people who are at risk.

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.

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 50 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

Look for the following new terms in this module and in the glossary.

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

case reporting – informing the state or local health department when a new case (an occurrence) of TB disease has been diagnosed or is suspected

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

close contacts – people who spend time with someone who has infectious TB disease

congregate setting – a setting in which a group of usually unrelated persons reside in close physical proximity. These settings may include hospitals, long term care facilities, assisted living facilities, correctional facilities, or homeless shelters (see residential facilities)

contact investigation – a procedure for interviewing a person who has TB disease to determine who may have been exposed to TB. People who have been exposed to TB are tested for LTBI and TB disease

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*

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

infection control procedures – measures to prevent the spread of TB

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

residential facilities – institutions where people live, such as nursing homes, assisted living facilities, correctional facilities, or homeless shelters (see congregate setting)



READING MATERIAL

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

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 2 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 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 latent TB infection (LTBI) and TB disease.

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). Each year CDC compiles and reports the number of TB cases that occur in the United States.

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)

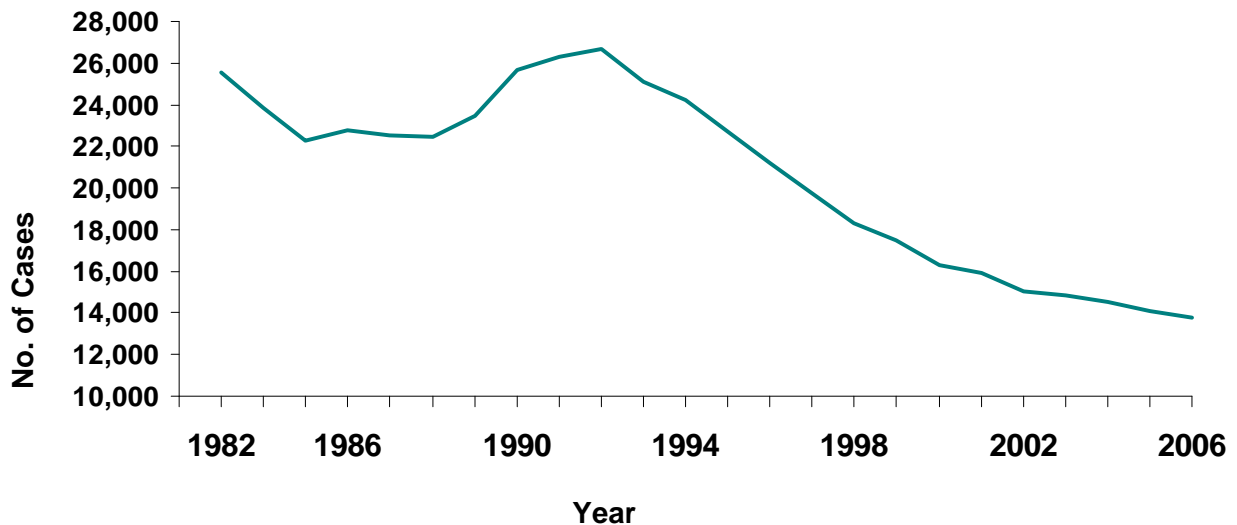


Figure 2.1 Reported TB Cases, United States, 1982 – 2006.



.....
From 1993 through 2006,
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 2006, the number of TB cases reported annually in the United States steadily declined (Figure 2.1). In 2006, there were a total of 13,779 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

Despite national trends reflecting a steady decline in the number of TB cases reported annually in the United States between 1993 and 2006, there are still several areas of ongoing concern:

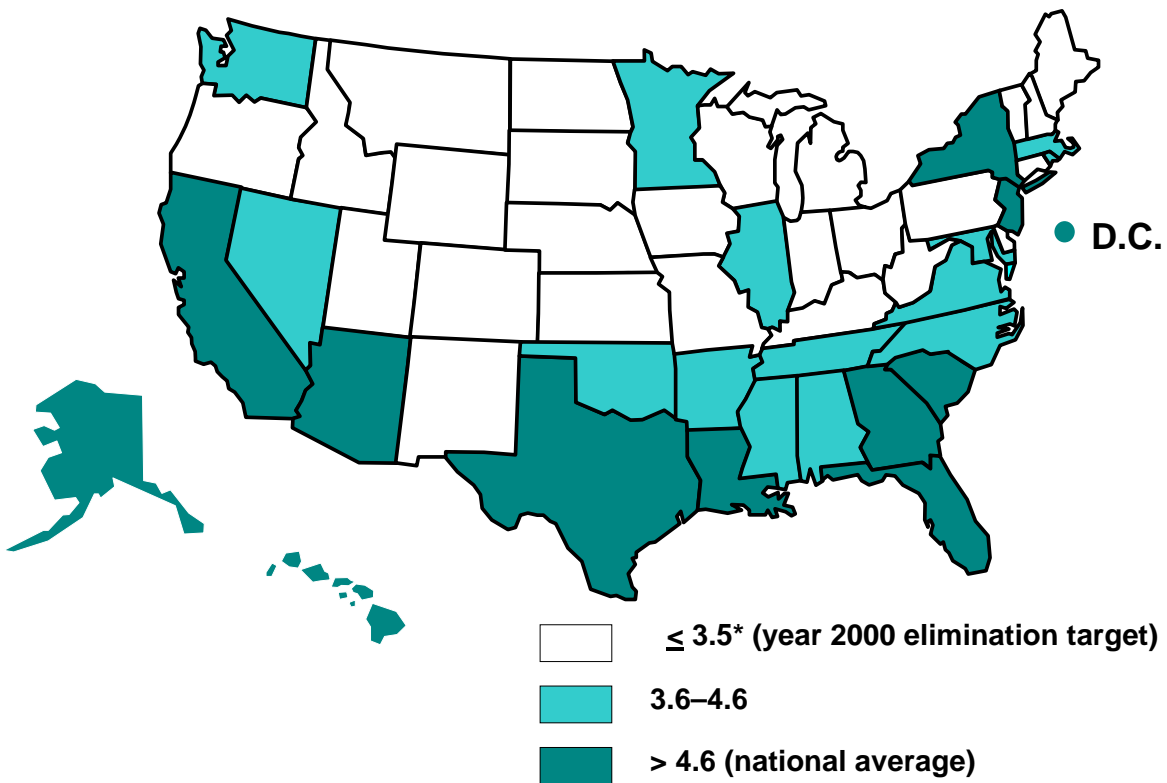
.....
Despite trends reflecting a
steady decline in TB cases in
the U.S. between 1993 and
2006, there are still several
areas of ongoing concern.
.....

- 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 therapy can develop and spread strains of TB that are resistant to available drugs.



.....
 In 2006, the TB case rate in the United States was 4.6 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 2006, there were 13,779 new TB cases in a population of approximately 299,398,484 people. In other words, the TB case rate was 4.6 TB cases per 100,000 persons. The TB case ranges for each state and the District of Columbia (D.C.) in 2006 are shown in Figure 2.2.



*Cases per 100,000.

Figure 2.2 TB case rates by state, United States, 2006.



.....
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 2.1):

- **People at high risk for becoming infected with *Mycobacteria tuberculosis***
- **People at high risk for developing TB disease after infection with *Mycobacteria tuberculosis***

Table 2.1 Groups at High Risk for TB Infection and TB Disease

| People at High Risk for Becoming Infected with <i>M. tuberculosis</i> | People at High Risk for Developing TB Disease after Infection with <i>M. tuberculosis</i> |
|---|--|
| <ul style="list-style-type: none"> ▪ Close contacts of people known or suspected to have TB ▪ People, including children, 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) ▪ Low-income groups with poor access to health care, including homeless people ▪ People who live or work in high-risk residential settings (for example, nursing homes, homeless shelters, or correctional facilities) ▪ People who inject illegal drugs ▪ Health care workers who serve high-risk clients ▪ High-risk racial or ethnic minority populations, as locally defined ▪ Infants, children, and adolescents exposed to adults in high-risk groups | <ul style="list-style-type: none"> ▪ People living with HIV ▪ People recently infected with <i>M. tuberculosis</i> (within the past 2 years) ▪ People with medical conditions known to increase the risk for TB <ul style="list-style-type: none"> - silicosis - diabetes mellitus - severe kidney disease - certain types of cancer - certain intestinal conditions - organ transplant - immunosuppressive therapy (including prolonged use of corticosteroids and tumor necrosis factor-alpha [TNF-α] antagonists) - low body weight ▪ People who inject illegal drugs ▪ Infants and children younger than 4 years |



People at High Risk for Becoming Infected with *Mycobacterium Tuberculosis*

.....
 Close contacts are at high risk of being infected with *M. tuberculosis*.

Close Contacts

Close contacts are people who have spent time with someone who has infectious TB disease. They are at high risk of being infected with *M. tuberculosis*. Close contacts may include family members, coworkers, or friends.

.....
 Of all TB cases reported to CDC in 2006, 57% were in foreign-born persons.

Foreign-Born/Immigrants

In the United States, LTBI 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 2006, more than half (57%) were in foreign-born persons. This is twice the percentage as 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 LTBI 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 who are infectious are required to receive treatment before they enter the United States. Some immigrants have TB disease but are not infectious at the time of screening. Sometimes these immigrants become infectious after they enter the United States. Also, many immigrants have LTBI, 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 are suspected of having TB. This notification system allows health departments to assist patients to 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 LTBI and evaluated for TB disease by U.S.-based health care providers known as **civil surgeons**.

Low-Income Groups and Homeless Persons

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.

.....
In 2006, about 6% of TB patients were homeless.
.....

TB is also more common among **homeless people**. In 2006, about 6% of TB patients were reported as homeless. Homeless people may be at higher risk of developing TB disease once infected because of malnutrition and poor access to health care. Moreover, in some areas they may be more likely than the general population to be infected with HIV.



Special Settings

In certain **congregate** or **residential settings**, such as nursing homes, correctional facilities, health care facilities, and homeless shelters, 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.

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

For example, TB is a problem in **nursing homes**. TB case rates increase with age for all racial/ethnic groups. Of all TB cases reported in 2006, 19% were in people 65 years or older, even though this age group made up only about 12% of the population. This may be because many elderly people may have been exposed to and infected with *M. tuberculosis* when they were younger, which was in a time when TB was more common than it is today. A nursing home with such a concentration of elderly persons, who may have weak immune systems, creates a high-risk situation for TB transmission.

TB is also a problem in **correctional facilities**. There are several reasons why the risk of TB disease is higher in correctional facilities. First, many inmates already have LTBI and therefore are already at high risk of developing TB disease. Second, an increasing number of inmates are infected with HIV, which means that they are more likely to develop TB disease if they are or become infected with *M. tuberculosis*. Finally, some correctional facilities are crowded, which promotes the spread of TB.

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

People who Inject Illegal Drugs

People who inject illegal drugs are 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 inject illegal drugs 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 inject illegal drugs are also at high risk of developing TB disease once infected, perhaps because they are more likely to be HIV infected. Also, it is possible that injecting illegal drugs weakens the immune system.

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 undertaken 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*.

Race and Ethnicity

.....
In 2006, 83% of the TB cases reported in the United States were in racial and ethnic minorities.
.....

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 2006, about 83% were in racial and ethnic minorities. This includes Hispanics, non-Hispanic blacks, Asians, Native Hawaiian and other Pacific Islanders, American Indians, and Alaska Natives. (Hispanic is an ethnicity, not a race. People of Hispanic origin may be of any race.)

.....
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 2006, about 30% of the TB cases were in Hispanics, a group which made up about 15% of the total United States population. Similarly, 27% of the reported TB cases in the United States were in non-Hispanic blacks or African Americans, even though this group made up only 12% of the total population. Furthermore, 24% of the TB cases were in Asians who made up 4% of the population; 1% in American Indian or Alaska Natives who made up less than 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.



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).

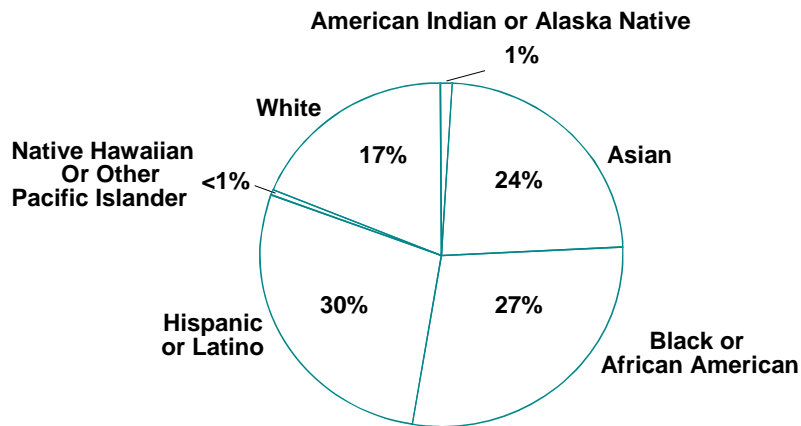


Figure 2.3 Reported TB cases by race and ethnicity*, United States, 2006.
 *All races are non-Hispanic. Persons reporting two or more races totaled less than 1% of all cases.

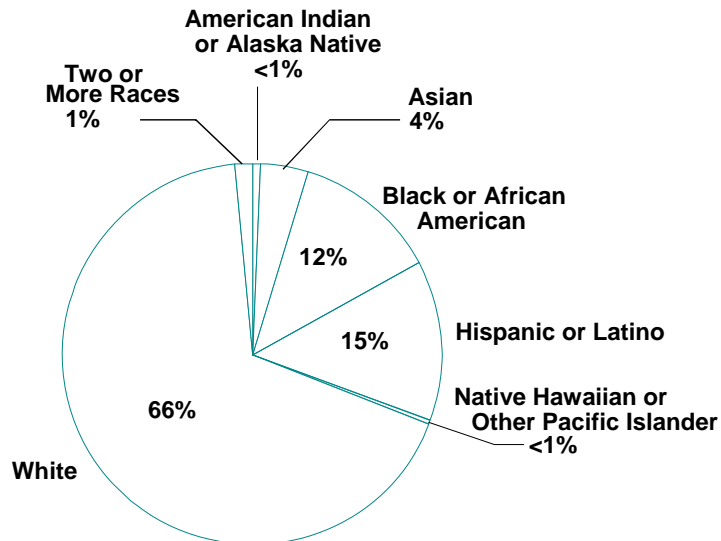


Figure 2.4 Racial and ethnic groups by percentage of U.S. population annual estimates, 2006.



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The idea that certain racial and ethnic minorities are disproportionately affected by TB can also be shown in terms of case rates.
.....

The idea that certain racial and ethnic minorities are disproportionately affected by TB can also be shown in terms of case rates. In 2006, the TB case rate for non-Hispanic whites was 1.2, which means there were 1.2 TB cases in non-Hispanic whites for every 100,000 non-Hispanic whites in the general population. The case rate for Asians was 25.6 cases per 100,000 persons, about 21 times higher. This means that Asians were about 21 times more likely than non-Hispanic whites to have TB. Similarly, the case rate for Native Hawaiians or Other Pacific Islanders was about 11 times higher than the case rate for non-Hispanic whites; for non-Hispanics blacks, about 9 times higher; for Hispanics, about 8 times higher; and for American Indians or Alaska Natives, about 6 times higher (Table 2.2).

Table 2.2
Relative Risk* for TB by Race and Ethnicity, 2006

| Race/Ethnicity | TB Case Rate (number of TB cases for every 100,000 persons in this race/ethnicity) | Relative Risk |
|--|--|----------------------|
| Asians | 25.6 | 21 |
| Native Hawaiian or Other Pacific Islanders | 13.6 | 11 |
| Non-Hispanic blacks | 10.2 | 9 |
| Hispanics | 9.2 | 8 |
| American Indians or Alaska Natives | 7.4 | 6 |
| Non-Hispanic whites | 1.2 | 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 20, because the case rate for this group is about 20 times higher than the case rate for non-Hispanic whites.

** Persons reporting two or more races comprised less than 1% of all cases and had a case rate of 0.9.

*** Relative risk numbers rounded to nearest whole number



.....
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 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 a high-risk settings (see Special Settings, page 11).

TB in Children

.....
TB cases in children have been decreasing since 1993.
.....

In 2006, about 6% 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.

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

The occurrence of LTBI 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



Study Questions 2.6 – 2.9

- 2.6 Name eight groups of people who are more likely to be exposed to or infected with *M. tuberculosis*.
- 2.7 What are public health agencies doing to address the high rate of TB in foreign-born persons?
- 2.8 Why is the risk of being exposed to TB higher in certain settings, such as nursing homes or correctional facilities?
- 2.9 What are some reasons why rates of TB disease are higher in correctional facilities?

Answers to study questions are on pages 26 – 28.



Study Questions 2.10 – 2.11

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

2.11 When a child has TB infection or 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 26 – 28.



Case Study 2.1

For each of the following people, choose the factor or factors 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. LeFevre:** works at a nursing home
rides the subway every day
immigrated 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 study questions are on pages 29 – 30.



People at High Risk for Developing TB Disease

.....
 People living with HIV are at very high risk of developing TB disease.

Anyone who has LTBI can develop TB disease, but some people are at higher risk than others (see *Module 1, Transmission and Pathogenesis of Tuberculosis*). **HIV-infected people are at highest risk.** High-risk groups include

- People living with HIV infection
- People with medical conditions that are known to increase the risk for TB (patients on prolonged therapy with corticosteroids and other immunosuppressive therapy, silicosis, diabetes mellitus, severe kidney disease, certain types of cancer, and certain intestinal conditions)
- People recently infected with *M. tuberculosis* (within the past 2 years)
- Infants and children younger than 4 years
- People who inject illegal drugs

TB and 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 TB infection.

Worldwide TB is responsible for the deaths of one in three people living with HIV/AIDS, thus making it a leading cause of death among people infected with HIV.

.....
 Worldwide, TB is responsible for the deaths of one in three 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. 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*).



In the United States, national data on HIV status of TB cases is incomplete and should be interpreted with caution. 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 reported with TB decreased from 15% to 7% overall and from 29% to 13% in persons aged 25 to 44 years during 1993 to 2005.



Study Questions 2.12 – 2.14

2.12 Name five 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 26 – 28.



Case Study 2.2

For each of the following people, circle the factor or factors 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. Sims:** **injects heroin**
 is HIV infected
- 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 obese**
 became infected with *M. tuberculosis* 6 months ago

Answers to case study questions are on pages 29 – 30.



SUMMARY

From 1953 through 1984, the number of TB cases reported in the United States decreased by an average of 6% each year. Between 1985 and 1992 there was a resurgence of TB with the number of new cases increasing by about 20% — from 22,201 in 1985 to 26,673 in 1992. The increase 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; immigration from countries where TB is common; the spread of TB in certain settings; and the transmission of multidrug-resistant (MDR) TB strains.

In 1993, after funding was increased and TB control programs were strengthened, the upward trend in TB cases reversed. Since 1993, there has been a steady decline in the number of TB cases reported annually in the United States. This decrease is attributed to the increased resources for TB control that improved TB programs' abilities to promptly identify persons with TB; start appropriate initial treatment for TB cases; and to ensure that patients complete treatment.

Despite national trends reflecting a steady decline in the number of TB cases, there are still several concerns: TB cases are increasing in some areas; TB continues to affect racial and ethnic minorities disproportionately; multidrug-resistant TB still remains a problem; and over half of all TB cases (57%) in 2006 in the United States are among persons born outside of the United States (foreign-born).

Some groups of people are at higher risk for exposure to or infection with *M. tuberculosis*. This category includes close contacts of people with infectious TB disease; people born in areas of the world where TB is common (foreign-born); low-income groups with poor access to health care; people who inject illegal drugs; infants, children, and adolescents exposed to adults in high-risk categories; and high-risk racial or ethnic minority populations, as locally defined. It also includes people who live or work in certain settings such as nursing homes, correctional facilities, homeless shelters, and drug treatment centers and other people who may be exposed to TB on the job, such as health care workers.

The United States is collaborating with other national and international public health organizations to address the high rate of TB in foreign-born persons. About 83% of TB cases reported in the United States in 2006 were in racial and ethnic minorities. This is probably because a greater proportion of people in these groups have other risk factors for TB.



In 2006, about 6% of all reported TB cases were in children younger than 15 years of age. The occurrence of TB disease and TB infection in children provides important information about the spread of TB in homes and communities. For example, when a child has TB disease or LTBI, it means that *M. tuberculosis* was transmitted relatively recently and the person who transmitted it to the child may still be infectious. This also means that other adults and children in the household or community have probably been exposed to the organism that causes TB. If they are infected, they may develop TB disease in the future.

Groups of people who are at higher risk for developing TB disease once infected include people with HIV infection, people who were recently infected with *M. tuberculosis*, people with certain medical conditions, people who inject illegal drugs, and people with a history of inadequately treated TB. HIV is the strongest known risk factor for the development of TB disease in people with TB infection. For people infected with both *M. tuberculosis* and HIV, the risk of developing TB disease is about 7% to 10% **each year**. In contrast, for people infected only with *M. tuberculosis*, the risk of developing TB disease is 10% **over a lifetime**.



Additional Reading

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ANSWERS TO STUDY QUESTIONS

2.1 What happened to the number of TB cases in the United States between 1953 and 1984? (page 3)

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? (page 4)

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. (page 4)

- 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? (page 5)

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. (page 5)

The increase in funds allowed TB programs to

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



2.6 Name eight groups of people who are more likely to be exposed to or infected with *M. tuberculosis*. (page 8) (Table 2.1)

- Close contacts of people known or suspected to have TB
- People, including children, 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)
- Low-income groups with poor access to health care, including homeless people
- People who live or work in residential facilities such as nursing homes, homeless shelters, or correctional facilities
- People who inject illegal drugs
- Health care workers who serve high-risk clients
- High-risk racial or ethnic minority populations, as locally defined
- Infants, children, and adolescents exposed to adults in high-risk groups

2.7 What are public health agencies doing to address the high rate of TB in foreign-born persons? (page 9)

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 LTBI and to ensure completion of treatment

2.8 Why is the risk of being exposed to TB higher in certain settings, such as nursing homes or correctional facilities? (page 11)

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.

2.9 What are some reasons why rates of TB disease are higher in correctional facilities? (page 11)

First, many inmates already have TB infection and therefore are at higher risk of developing TB disease. 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*. Finally, some correctional facilities are crowded, which promotes the spread of TB.

2.10 Which racial and ethnic groups are disproportionately affected by TB? (pages 12-13)
Asians, Native Hawaiians or Other Pacific Islanders, non-Hispanic blacks, Hispanics, and



American Indians or Alaska Natives are disproportionately affected by TB.

2.11 When a child has 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. (page 15)

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 five groups of people who are more likely to develop TB disease once infected. (page 19)

- People with HIV infection
- People with other medical conditions that appear to increase the risk for TB
- People recently infected with *M. tuberculosis* (within the past 2 years), especially
- Infants and children younger than 4 years
- People who inject illegal drugs

2.13 What is the strongest known risk factor for the development of TB disease? (page 19)

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*? (page 19)

The risk of developing TB disease is about 7% to 10% each year for people who are infected with both *M. tuberculosis* and HIV. In contrast, the risk of developing TB disease is 10% over a lifetime for people infected only with *M. tuberculosis*.



ANSWERS TO CASE STUDIES

2.1 For each of the following people, choose the factor or factors 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. LeFevre

- ✓ works at a nursing home
- ✓ immigrated from Russia
- rides the subway every day

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



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

a) Mr. Sims

- ✓ injects heroin
- ✓ is HIV infected

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 obese
- ✓ became infected with *M. tuberculosis* 6 months ago