# Tuberculosis

Definition: Tuberculosis (TB) is an infectious disease caused by the bacteria *Mycobacterium tuberculosis*. TB disease most commonly attacks the lungs, though it can also occur in other parts of the body. TB takes one of two forms—active TB disease or latent TB infection. People with active TB disease are in advanced stages of infection, most often show specific clinical signs and symptoms, and can transmit TB to others. People with latent TB infection do not show signs or symptoms and cannot transmit TB. Incidence rate estimates for TB disease are reported as the number of new cases per 100,000 population and use the Centers for Disease Control and Prevention case definition.[1]

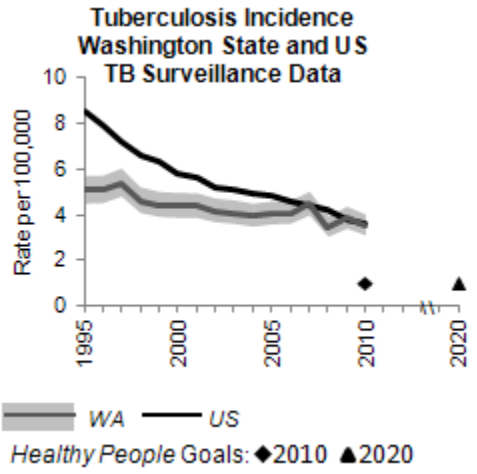

## Summary

**In 2010, Washington State reported 236 new cases of tuberculosis (TB) disease, ranking 14th highest among states in the number of new cases for that year. The incidence rate for Washington in 2010 was 3.5 cases per 100,000 residents. This was similar to the national rate of 3.6 per 100,000. Older adults tend to have higher rates of TB disease than younger adults. Higher disease rates are also seen among Washington residents of Hispanic origin and those in minority racial groups as compared to whites. A portion of these racial and ethnic differences is related to being born in countries with high rates of TB. People born in foreign countries where TB is widespread are more likely to become infected with TB. Overall, this greater risk of infection is the main factor contributing to higher rates of TB disease seen among foreign-born Washington residents. About 76% of Washington residents diagnosed with TB in 2010 were foreign-born. Those at greater risk of developing TB disease if infected include children under five years of age, older adults, people with chronic disease and those with weakened immune systems.**

**Healthcare providers are required to report all new and suspect cases of TB disease to their local health jurisdiction. Early detection and initiation of treatment help to control the spread of TB in the community. Local health jurisdictions also work to prevent the spread of TB by identifying and treating those who have come into contact with people having active TB disease. New technologies are helping to identify people with TB and improve treatment. These include more accurate blood-based tests for infection, and rapid tests for active TB disease that use molecular methods.**


## Time Trends

Since 1995 incidence rates of TB disease in Washington have shown moderate decline. The rate of new TB cases in the United States also decreased during this period.




## 2010 and 2020 Goals

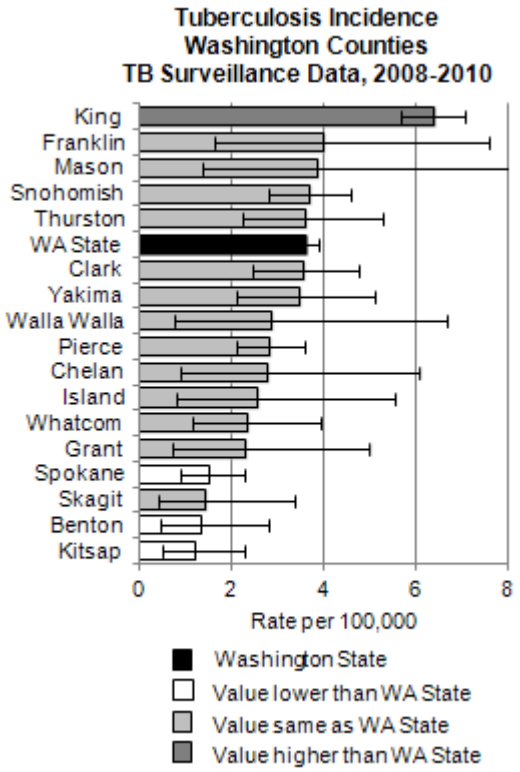
The *Healthy People 2010* and *Healthy People 2020* targets for new TB cases are 1.0 case per 100,000. Washington has made progress toward this goal but has not yet reached it. The large numbers of foreign-born Washington residents who are more likely to be infected with TB than those born in the United States present a challenge to meeting the *Healthy People* goal. Preventing TB disease among people with chronic illnesses such as diabetes mellitus[2] also presents a challenge. Washington's success with reducing the number of TB cases shows that sustained efforts in TB prevention and control can help us make continued progress towards this goal.

*Healthy People* also includes goals for increasing the rate of treatment completion among patients whose treatment course is 12 months or less. For 2010 this goal was 90%, and for 2020 it is 93%. Washington performed better than the national

average from 2006–2009. Washington met the goal in 2008, with 90% of patients completing treatment in 12 months. Washington's gradual improvement over the last five years suggests we may meet the *Healthy People 2020* goal.

Completion of treatment for latent TB infection is an essential part of TB prevention and control. In *Healthy People 2020*, this goal focuses on latent TB infection treatment completion among contacts to the most infectious TB cases, with the target set at 79%. In each year for 2006–2008, Washington exceeded the national average on this measure, reaching a peak of 73% in 2008 after sustained progress. With this rate falling to 68% in 2009, and fewer public health resources available to ensure treatment of latent TB infection, achieving this goal by 2020 will be a challenge for Washington.

## Geographic Variation

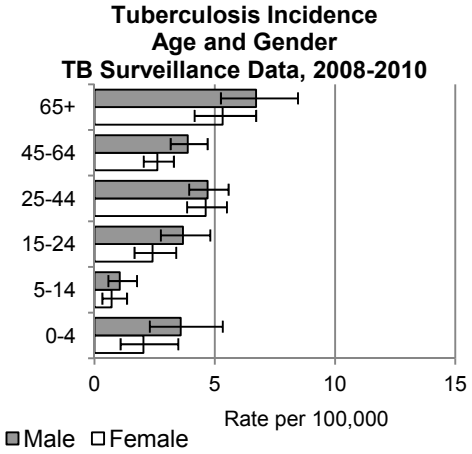



From 2008–2010 combined, Washington's TB incidence rate was 3.6 cases per 100,000. During this period, 10 Washington counties had no TB cases and 11 had fewer than five. Rates are reported here for the 18 remaining counties having five or more cases. King County had 51% of the state's cases, with a rate higher than the state average. The most important factor contributing to King County's TB rate is its large number of foreign-born residents. Three other counties (Spokane, Benton and Kitsap) had rates below the state average for this period.

## Age and Gender

From 2008–2010 combined, TB rates were highest among Washington residents ages 65 and older. The high rates of TB disease in this group may be related to a greater risk of past exposure when TB was more widespread in the United States, along with a greater present risk of chronic disease.

Public health closely monitors the incidence of TB among young children. New cases of TB disease among children under five years old indicate recent TB transmission in a community.[3] In 2008–2010 combined, there were about three new cases of TB per 100,000 children under five years old in Washington. Washington's rate among children under five years old has exceeded the national rate in each year for 2007–2010, when the national rate ranged from 1.7 to 2.3 per 100,000.




For 2008–2010 combined, males accounted for 55% of all Washington's TB cases, and had a higher incidence rate of TB compared to females (4.0 and 3.2 cases per 100,000, respectively). Higher overall incidence of TB among males has also been observed in other countries,[4] nationally[5] and in U.S. urban centers.[6] One reason suggested for the greater risk of TB disease often seen among males is their being more likely to be in places or groups in which risk of exposure to TB is heightened. Another is that males more often practice health behaviors that increase the risk of developing active TB disease if infected.[7,8] Each of these may help explain the higher incidence of TB among male Washington residents. Among all Washington residents diagnosed with TB for 2009–2010, males

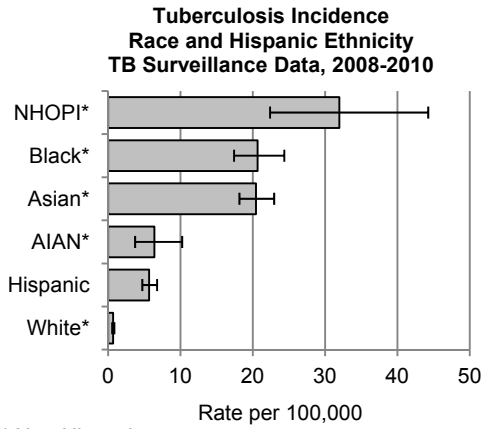
were more likely to have experienced recent homelessness, and to have been incarcerated at the time of diagnosis. Males were also more likely to have abused alcohol or used illegal drugs in the 12 months prior to their diagnosis.

## Economic Factors and Education

The Washington State Department of Health has not recently explored the relationship between income and education and the incidence of TB in Washington. Earlier work showed increasing TB rates with increasing proportions of residents living in poverty.[9] Researchers have shown that globally[10] and in the United States,[11] low income and low levels of education are associated with higher rates of TB.

## Race, Ethnicity and Foreign-born Origin

For 2008–2010 combined, Washington residents reporting their race as white had lower rates of TB than those reporting other racial groups or Hispanic ethnicity. Black and Asian residents (rates of 21 and 20 cases per 100,000, respectively) had higher rates of TB compared to American Indian or Alaska Natives and Hispanics (both 6 cases per 100,000). Of all race or ethnic groups, Native Hawaiians and other Pacific Islanders experienced the greatest burden of TB disease relative to population size. However, the small size of this population results in a rate with large random variation that cannot with certainty be interpreted as higher than rates among blacks or Asians.




* Non-Hispanic
AIAN: American Indian/Alaska Native
NHOPI: Native Hawaiian/Other Pacific Islander

Foreign-born origin is a persistent risk factor for TB at the national level[5,12] and in Washington State. For 2008–2010 combined, 77% of all Washington residents diagnosed with TB were born outside the United States. Higher rates of TB seen among some of Washington's racial and ethnic communities are partly due to origins from foreign countries where TB is more common. For example, during this same time period, 94% of Washington's TB cases among Asians, 83% among blacks and 82% among Hispanics were foreign-born.

## Other Measures of Impact and Burden

***Drug resistance.*** As TB bacteria multiply, genetic changes can randomly occur that cause resistance to certain drugs used in treating TB. Proper treatment of TB requires the use of several drugs to make sure all bacteria are killed, including those that have changed genetically. Inappropriate treatment may leave some bacteria to survive and further multiply. This can result in strains of TB that are resistant to some TB drugs. A strain's resistance to TB drugs can have serious implications in a patient's treatment. One result can be the need for an extended treatment course using drugs that are more toxic to the patient. Longer treatment with stronger drugs is also much more expensive. Drug resistance is categorized by the number and classes of TB drugs to which a strain is resistant. First-line drugs are preferred as an initial treatment option due to their relative effectiveness, lesser side effects and lower costs. Second-line drugs are used when resistance to first-line drugs is found. One principal category of drug resistance is multi-drug resistance (MDR-TB). It is defined as resistance to the key first-line drugs Isoniazid and Rifampin. Another type of resistance is extensive drug-resistance (XDR-TB). It is defined as resistance to Isoniazid and Rifampin, plus one or more drugs in each of two key classes of second-line drugs.

TB specimens in Washington that grow in culture are routinely tested for how they respond to different TB drugs. This testing is referred to as drug susceptibility testing. From all 720 TB cases diagnosed in 2008–2010, 585 specimens were submitted for drug susceptibility testing. Of these, 48 (8.2%) were resistant to one or more of four first-line TB drugs but were not MDR-TB. Another eight (1.4%) were categorized as MDR-TB. One other specimen showed resistance to Isoniazid, Rifampin and one or more drugs from one key class of second-line drugs. This one specimen is of particular note as its level of resistance approaches that of XDR-TB, which is very difficult and costly to treat.

## Risk Factors

When TB is in the lungs or airways, people with active disease can transmit TB to others while

coughing, sneezing, talking or singing, when TB is spread into the air in the form of invisible droplets. The chance that a person exposed to someone with active TB will become infected depends on four main factors. These include: 1) how infectious the person with active TB disease is; 2) the environment in which exposure occurs; 3) the duration of exposure; and 4) the immune status of the exposed individual.[13] About 90% of all those who become infected never develop active TB disease, while about 10% develop TB disease at some point during their lives.

***Risks for TB infection.*** People who have close contact with or spend significant periods of time with a person who has active TB disease are at highest risk of becoming infected. These can include housemates, relatives, friends and sometimes coworkers. This is particularly true for infants and children. Another risk for infection includes origins from or residence in countries where TB is common.

People may also be at risk when they work or live in group settings where TB is more common. These settings include prisons or homeless shelters and certain healthcare environments such as long-term care facilities.

***Risks for developing TB disease.*** Many conditions increase the chance that TB infection will progress to active disease. Infants and children under five are at greater risk of developing TB disease due to immature immune systems. HIV-positive people with weakened immune systems are also at risk. While HIV contributes to increased TB incidence in many parts of the world and the United States, in Washington the influence of HIV on TB incidence remains slight. During 2008–2010, only 3.5% of TB cases in Washington were among people with HIV.

Other risk factors for developing active TB disease include: 1) recent TB infection; 2) having a history of inadequately treated TB disease; 3) chest x-ray results that indicate prior TB disease; and 4) abuse of alcohol or use of illegal drugs. People with certain medical conditions are also at risk of developing active disease if they are infected with TB. These include certain types of cancer, poorly-managed diabetes mellitus, silicosis, or medical procedures that compromise the immune system. Public health professionals and medical providers use these risk factors to prioritize screening for infection, evaluating for disease and initiating preventive treatment.

## Intervention Strategies

***Preventive vaccines.*** The bacilli Calmette-Guerin (or BCG) vaccine against TB was developed in the 1920s. Other parts of the world use it to prevent TB's more severe forms in children. However, the BCG vaccine's limited usefulness has never justified its routine use in the United States. In the absence of broadly effective vaccines, TB prevention and control efforts focus on rapid diagnosis and effective treatment of TB disease and completion of treatment for latent TB infection.

***Detection and treatment***. Healthcare providers must report all new and suspect cases of TB disease to their local health jurisdiction. Early detection and early initiation of treatment help to keep the disease from spreading in the community. After a person with active TB begins effective treatment, the risk of infecting others usually declines in a few weeks.

After local and state health authorities learn that a person has confirmed or suspect TB, they facilitate full evaluation of the patient to ensure appropriate treatment is prescribed. During the initial stage of treatment, patients with infectious TB may be isolated to prevent further exposure to others. Local and state health authorities also coordinate in a process of contact investigation, to determine the extent of exposure and prevent further spread. Contacts at greatest risk of exposure are screened for infection, evaluated for active disease, and prescribed appropriate treatment for infection or disease as needed. Throughout the course of treatment health authorities make every possible effort to ensure treatment adherence and completion.

***Preventive treatment for latent TB infection.*** Treatment for latent TB infection greatly reduces the risk that infection will progress to disease. However, treatment for latent infection is not a substitute for treatment of TB disease. Medical providers should only consider it after they have ruled out active disease. People testing positive for TB infection are candidates for preventive treatment, if they have not previously received it, regardless of when they were first infected. Children under five are at high risk of developing TB disease when they are exposed to TB. Because of this, they should initiate treatment for latent TB infection as soon as possible following exposure, after active disease is ruled out. Also, treatment for latent TB is routinely recommended for HIV-positive persons following exposure, due to their greater risk of developing TB disease if infected.

***Treatment adherence***. Treatment adherence occurs when patients correctly complete their TB treatment. Adherence is an important part of TB control. Incomplete adherence can lead to treatment failure or the development of drug resistance. In 2007–2009 combined, 89% of TB patients in Washington completed their 12-month treatment plan on time. For this same period, the national average was 79%.

Directly observed therapy (DOT) occurs when a healthcare worker observes the patient swallow each dose of TB medicine. DOT is an effective way to ensure adherence. The U.S. Centers for Disease Control and Prevention and other leading TB prevention and control organizations recommend it.[14] From 2009–2010 combined, approximately 79% of Washington's TB cases were on DOT or a combination of DOT and self-administered treatment.

***Screening and treatment of foreign-born residents.*** TB has declined nationally over the last 15 years. This decline has not been equal between U.S.-born and foreign-born groups. The decline in TB incidence among U.S.-born residents has been much greater than the decline among foreign-born residents. The balance in overall disease burden between the U.S.-born and foreign-born has also changed over time. In 1993, foreign-born residents accounted for 29% of all TB cases in the United States. By 2010, their share increased to 60%.[5] This imbalance in the number of cases also occurs in Washington State, where foreign-born residents accounted for 77% of all TB cases diagnosed from 2008–2010.

Research suggests that much of the TB incidence among foreign-born residents occurs when the disease progresses from latent infection that is present at entry to the United States.[15,16] Leading authorities, including the Centers for Disease Control and Prevention and American Thoracic Society, view improved screening and treatment for latent TB infection among foreign-born residents as essential in efforts to eliminate TB in the United States.[12,17] Detection of TB disease among U.S.-bound immigrants and refugees is also a vital step for reducing incidence of TB among foreign-born residents. However, research has suggested that screening prior to U.S. entry of immigrants and refugees originating from some countries may fail to detect TB disease.[18]

Technical instructions directing overseas physicians in pre-immigration medical screening have recently been updated as one key measure to improve detection and treatment of TB among foreign-born people bound for the United States.[19] The use of these enhanced protocols has shown improved pre-entry detection resulting in decreased importation of active TB into the United States.[20] Further success of these protocols will benefit from expanding their use to all countries of origin, and continuing investments to ensure adequate overseas capacities in screening, diagnosis and treatment.

While pre-immigration screening and post-arrival follow-up among immigrants and refugees is important for controlling TB in the United States, such protocols do not currently apply to the majority of foreign-born people entering the United States. Findings suggest that non-immigrant foreign-born people—for example students, exchange visitors, and diplomats—are responsible for a substantial proportion of TB diagnosed among foreign-born people within 12 months of arrival.[21]
The lack of current protocols, along with evidence of risk, point to expanding pre-entry evaluation and post-arrival follow-up among non-immigrants as an opportunity to improve detection and treatment of TB disease among foreign-born people.

***Advancements in technology.*** To eliminate TB, we need better preventive, diagnostic and treatment methods. One important advance has been the development of a more specific test for detecting TB infection. The traditional test, the tuberculin skin test, requires two in-person provider visits and is not always accurate. Newer blood-based tests (e.g., QuantiFERON-TB Gold[22], T-Spot[23]) require one in-person provider visit and are more accurate. The use and further evaluation of these newer testing methods is continuing.[24]

Another promising advance involves the use of nucleic acid amplification testing (NAAT) for the rapid diagnosis of TB disease.[25] Molecular approaches such as NAAT offer an enhanced capacity to detect TB disease faster and with greater accuracy. This will help providers quickly initiate treatment and more effectively prevent the spread of TB.

### *Data Sources*

Tuberculosis surveillance data for years 2009-2010: Washington State Department of Health; Public Health Issues Management System (PHIMS-TB).

Tuberculosis surveillance data for years 1993-2008: U.S. Centers for Disease Control and Prevention; Tuberculosis Information Management System (TIMS).

National tuberculosis data: U.S. Centers for Disease Control and Prevention.

Population estimates data for state, county, age and sex: Washington State Office of Financial Management; Intercensal and Postcensal Estimates of April 1 County Population by Age and Sex: 1990 to present; Release date, December 12, 2011.

Population estimates data for race and ethnicity: US Census Bureau; Intercensal Estimates of the Resident Population by Sex, Race, and Hispanic Origin for Washington; April 1, 2000 to July 1, 2000; Release date September 2011.

### *For More Information*

Washington State Department of Health, Tuberculosis Control Program, (360) 236-3443

### *Technical Notes*

Foreign-born: The term foreign-born refers to any person born outside of the United States or its territories (e.g., Puerto Rico) and protectorates (e.g., Guam and American Samoa), to non-U.S. citizen parents. Regardless of parental citizenship, the TB case report records the month and year of U.S. entry for any person born in a foreign country.

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### *Endnotes*

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