The Epidemiology of Tuberculosis in Minnesota, 2005-2009

Minnesota Department of Health
Tuberculosis Prevention and Control Program
(651) 201-5414
Tuberculosis surveillance data for Minnesota are available on the Web at:
www.health.state.mn.us/tb

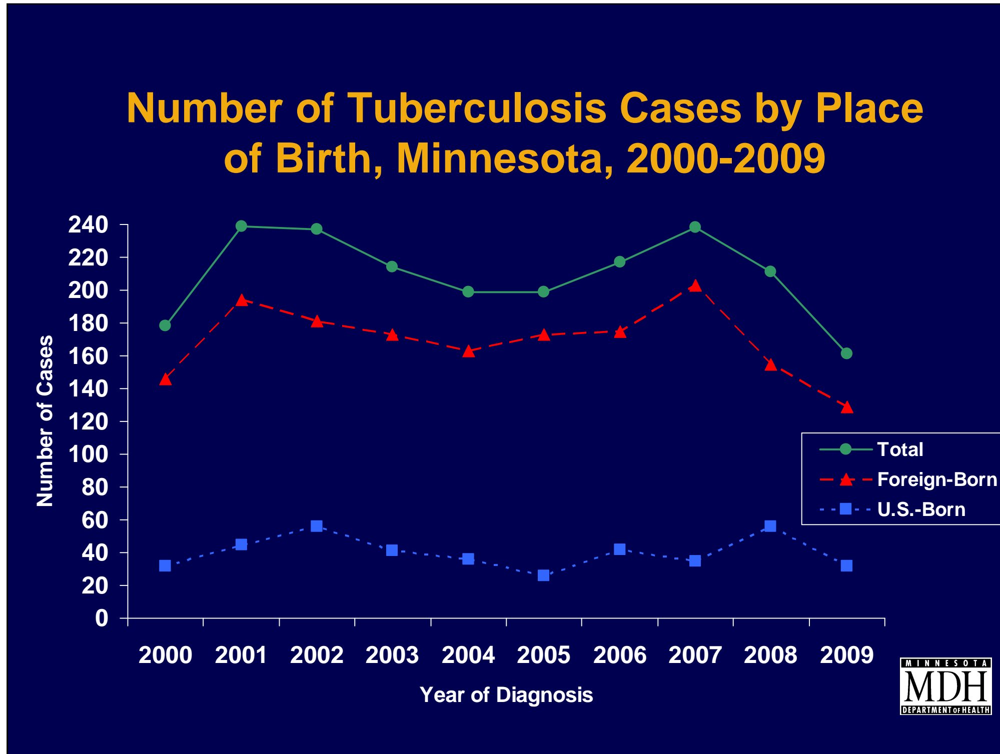
The purpose of this slide set is to characterize the epidemiology of tuberculosis (TB) disease in Minnesota. The slides present data in tabular and graphic format that describe both demographic and clinical characteristics of TB statewide. The data in these slides pertain to cases of active TB disease reported from 2005 through 2009. In accordance with the Minnesota Communicable Disease Reporting Rule, physicians, laboratories, and other health care providers are required to report all confirmed and suspected cases of TB disease among persons residing in Minnesota to the Minnesota Department of Health; such reports serve as the source of information for the data presented in these slides.

Tuberculosis Morbidity, Minnesota, 2005-2009

Year	No. Cases	Rate*
2005	199	3.9
2006	217	4.2
2007	238	4.6
2008	211	4.0
2009	161	3.1

* Cases per 100,000 population. Rates were calculated using state population estimates from the U.S. Census Bureau.

In 2009, 161 new cases of active TB disease among residents of Minnesota were reported to the Minnesota Department of Health. This number corresponds to an incidence rate of 3.1 cases per 100,000 population. In comparison, 11,540 new cases of TB disease (3.8 cases per 100,000 population) were reported in the United States during 2009; the median TB incidence rate among 51 states and reporting areas nationally was 2.7 cases per 100,000 population. While the incidence rate of TB in Minnesota during 2009 declined 23% from 2008 and was less than the national rate, the statewide rate was above both the median rate among states and reporting areas in the U.S. and the national "Healthy People 2010" objective of reducing the annual TB incidence rate in the U.S. to no more than 1 case per 100,000 population.



After increasing throughout much of the 1990s, the incidence of TB disease in Minnesota fluctuated during the past decade, with peaks in 2001 (239 cases) and 2007 (238 cases). In 2009, 161 new cases of TB disease (3.1 cases per 100,000 population) were reported statewide, which represents a 24% decline from the 211 TB cases reported in 2008. In particular, from 2008 to 2009 in Minnesota, the number of TB cases reported among U.S.–born persons decreased 43%, while that among foreign-born persons decreased 23%.

Tuberculosis Morbidity and Mortality, Minnesota, 2005-2009

Year	No. Cases	No. Deaths* (%)
2005	199	1 (1%)
2006	217	2 (1%)
2007	238	4 (2%)
2008	211	3 (1%)
2009	161	1 (1%)

*Represents only deaths due to TB disease or TB drug-induced toxicity

This slide depicts the number of deaths attributed to TB in Minnesota between 2005 and 2009. The number of incident TB cases is listed, along with the number and percentage of those case-patients who subsequently died as a result of TB. The number and percentage of TB case-patients with TB-related deaths ranged from 1 to 2 percent annually. Overall, 1% of TB case-patients died as a result of TB during this 5-year period. (These data do not include individuals who died from causes other than TB while on TB treatment.)

Number of Cases and Incidence of Tuberculosis by Location of Residence, Minnesota, 2005-2009

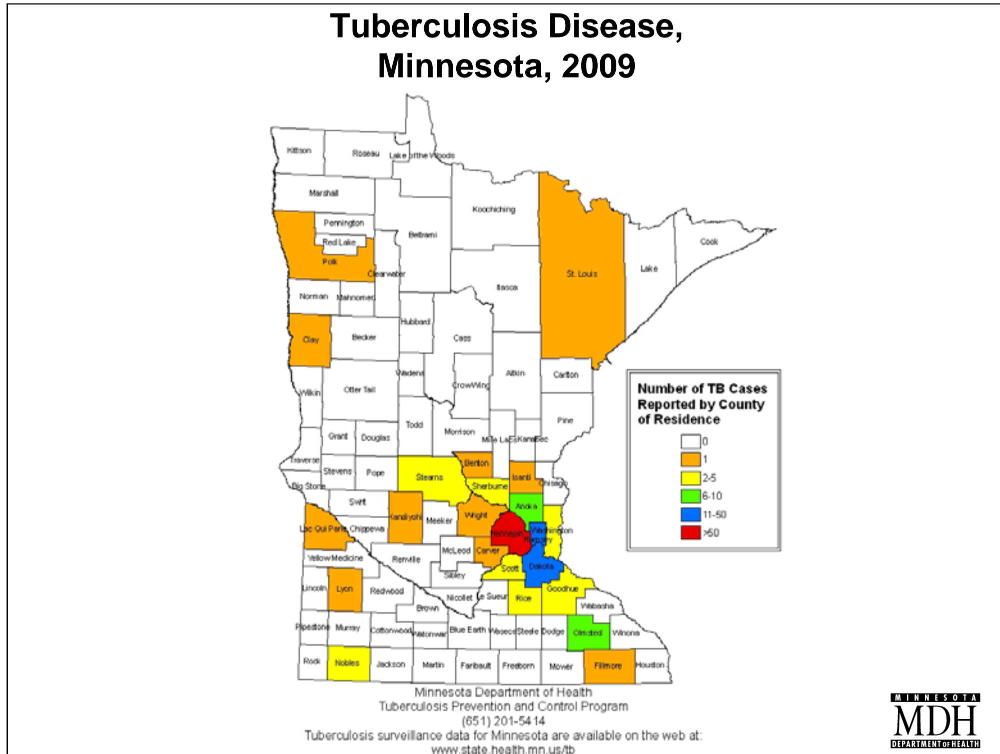
Location of Residence	2005 No. (rate)*	2006 No. (rate)*	2007 No. (rate)*	2008 No. (rate)*	2009 No. (rate)*
Hennepin County	99 (8.8)	95 (8.4)	114 (10.0)	97 (8.5)	61 (5.3)
Ramsey County	36 (7.2)	44 (8.8)	47 (9.4)	44 (8.8)	41 (8.1)
Suburban Twin Cities Metro†	30 (2.7)	27 (2.4)	26 (2.2)	23 (2.0)	26 (2.2)
Olmsted County	10 (7.4)	15 (10.9)	20 (14.3)	4 (2.8)	8 (5.6)
Other Counties	24 (1.1)	36 (1.6)	31 (1.4)	43 (1.9)	25 (1.1)
Total	199 (3.9)	217 (4.2)	238 (4.6)	211 (4.0)	161 (3.1)

* Rate per 100,000 population. Rates for 2009 were calculated using population estimates extrapolated from U.S. Census 2000 data. Statewide total rates were calculated using state population estimates from the U.S. Census Bureau.

† Anoka, Carver, Dakota, Scott, and Washington counties

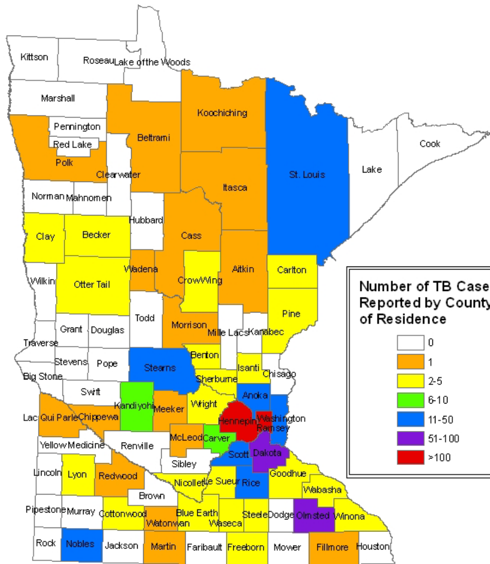
This slide presents the number of new TB cases reported and the incidence rate of TB disease by county of residence in Minnesota from 2005 through 2009. County-specific data are presented for Hennepin, Ramsey, and Olmsted counties, which are the only counties in Minnesota with public TB clinics. The slide also presents data for the five-county suburban Twin Cities metropolitan area and for Greater Minnesota, excluding Olmsted County. Although 21 (24%) of the state's 87 counties reported at least one case of TB disease in 2009, the risk of TB disease was focused in certain areas of the state.

In 2009, the highest TB incidence rate was reported in Ramsey County (8.1 cases per 100,000 population), followed by Olmsted County (5.6 cases per 100,000 population) and Hennepin County (5.3 cases per 100,000 population). In 2009, Ramsey, Olmsted, and Hennepin counties' rates each exceeded the statewide rate. From 2008 to 2009, the TB incidence rates in Greater Minnesota, Hennepin County, and Ramsey County decreased 42%, 38%, and 8%, respectively. In contrast, the TB incidence rate in Twin Cities suburban metropolitan area increased 10% from 2008 to 2009.



This slide presents a map of Minnesota with counties shaded according to the number of TB cases reported in their jurisdictions during 2009. Of the state's 87 counties, 21 (24%) reported at least one case of TB disease during 2009. This slide illustrates, however, that the greatest burden of TB disease was focused in certain areas of the state. In particular, the largest number of cases occurred in Hennepin County, followed by Ramsey County and other counties located primarily in the suburban Twin Cities metropolitan area.

Tuberculosis Disease, Minnesota, 2005-2009



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This slide presents data on TB cases, by county of residence, reported in Minnesota from 2005 through 2009. Similar to the previous slide, these data emphasize that the greatest burden of TB disease occurred primarily in certain areas of the state, although the geographic distribution of cases was very broad. Of the state's 87 counties, 51 (59%) reported at least one case of TB disease during this 5-year period.

Number of Cases of Tuberculosis by Location of Residence, Minnesota, 2005-2009

Location of Residence	2005 No. (%)	2006 No. (%)	2007 No. (%)	2008 No. (%)	2009 No. (%)
Hennepin County	99 (50)	95 (44)	114 (48)	97 (46)	61 (38)
Ramsey County	36 (18)	44 (20)	47 (20)	44 (21)	41 (25)
Suburban Twin Cities Metro*	30 (15)	27 (12)	26 (11)	23 (11)	26 (16)
Olmsted County	10 (5)	15 (7)	20 (8)	4 (2)	8 (5)
Other Counties	24 (12)	36 (17)	31 (13)	43 (20)	25 (16)
Total	199 (100)	217 (100)	238 (100)	211 (100)	161 (100)

* Anoka, Carver, Dakota, Scott, and Washington counties

This slide presents data on TB cases reported in Minnesota from 2005 through 2009, by county of residence and year of diagnosis. Similar to previous slides, these data emphasize that the burden of TB disease was focused in certain areas of the state, with the majority of TB cases statewide occurring in a small number of counties. Cumulatively from 2005 through 2009, Hennepin and Ramsey counties, respectively, accounted for 45% and 21% of TB cases reported statewide. During this 5-year period, however, the percentage of TB cases statewide that occurred in Hennepin County declined 24%, whereas the percentage of cases that occurred in Ramsey County increased 39%. Cumulatively during this period, Greater Minnesota (excluding Olmsted County), the five-county suburban Twin Cities metropolitan area, and Olmsted County, respectively, each accounted for approximately 15%, 13%, and 6% of TB cases in Minnesota, although the annual percentages of cases reported in these areas varied from year to year.

Tuberculosis Cases by Age and Place of Birth, Minnesota, 2005-2009

Age (years)	Foreign-Born Cases No. (%)	U.S.-Born Cases* No. (%)	Total No. (%)
< 5	10 (1)	35 (18)	45 (4)
5-14	50 (6)	21 (11)	71 (7)
15-24	232 (28)	18 (9)	250 (24)
25-44	341 (41)	39 (20)	380 (37)
45-64	121 (14)	41 (21)	162 (16)
≥ 65	81 (10)	37 (19)	118 (12)
Total	835 (100)	191 (100)	1,026 (100)

* Includes U.S.-born children of foreign-born parent(s)

The age distribution of TB case-patients reported in Minnesota differs markedly between U.S.-born and foreign-born patients. The majority (69%) of foreign-born TB case-patients reported in Minnesota from 2005 to 2009 were 15 to 44 years of age, whereas persons 45 years of age or older constituted 41% of U.S.-born TB case-patients. These strikingly different age distributions reflect the differing risks of exposure to TB among these populations. For example, just over half of newly-arrived immigrants with Class B TB designation and refugees that arrived in Minnesota during this 5-year period are young adults; TB case-patients of this age likely were infected with TB in their countries of origin prior to being diagnosed with active TB disease in Minnesota. Among U.S.-born persons, adults who were alive 50 or more years ago, when TB was much more prevalent in Minnesota than during more recent decades, are much more likely than younger U.S.-born persons to have been infected with TB. As these older U.S.-born persons age and develop other medical conditions that may weaken their immune systems, they may progress from remotely acquired latent TB infection to active TB disease.

The proportion of children less than 5 years of age was much larger among U.S.-born TB case-patients reported in Minnesota from 2005 through 2009 than among foreign-born case-patients (18% versus 1%, respectively). Approximately 75% of these young U.S.-born pediatric case-patients were attributed to children born in the U.S. to foreign-born parents. These first-generation U.S.-born children appear to experience an increased risk of TB disease that more closely resembles that of foreign-born persons. Presumably, these children may have been exposed to TB as a result of travel to their parents' country of origin and/or visiting or recently-arrived family members who may be at increased risk for TB acquired overseas.

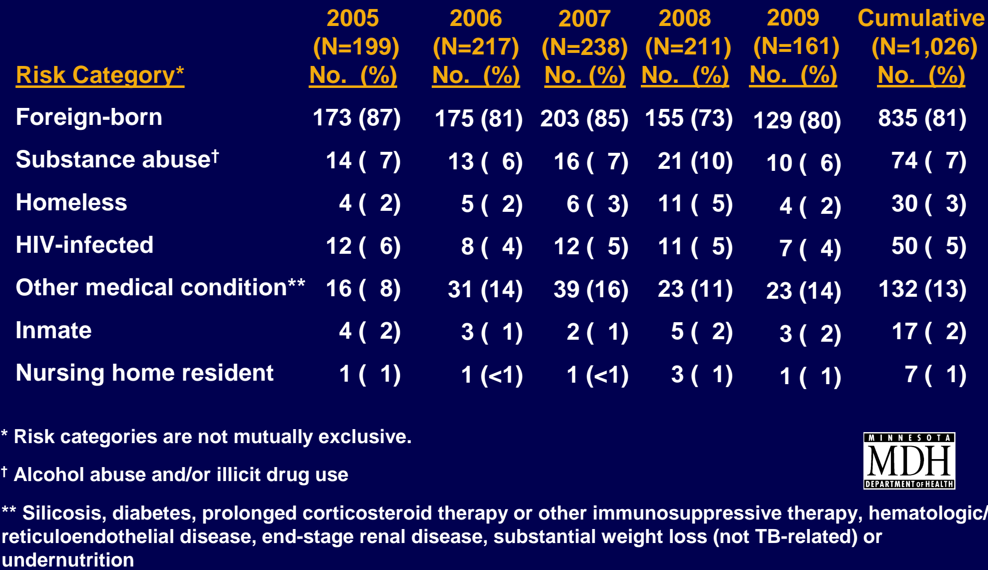
Number of Cases and Incidence of Tuberculosis by Race/Ethnicity, Minnesota, 2005-2009

Race/Ethnicity*	2005 No. (rate)†	2006 No. (rate)†	2007 No. (rate)†	2008 No. (rate)†	2009 No. (rate)†
White	12 (0.3)	26 (0.6)	15 (0.3)	16 (0.4)	19 (0.4)
Black	111 (52.5)	110 (50.0)	147 (64.5)	112 (47.9)	80 (33.6)
Asian	53 (30.6)	49 (27.3)	50 (27.0)	48 (25.2)	43 (22.0)
American Indian	5 (9.0)	8 (14.2)	2 (3.5)	4 (6.9)	2 (3.4)
Multi-racial	0 (0.0)	1 (1.4)	0 (0.0)	0 (0.0)	0 (0.0)
Hispanic/Latino	18 (9.4)	23 (11.5)	24 (11.4)	31 (14.2)	17 (7.5)
Total	199 (3.9)	217 (4.2)	238 (4.6)	211 (4.0)	161 (3.1)

* Race categories do not include persons of Hispanic/Latino origin.

† Rate per 100,000 population. Rates were calculated using mid-year population estimates from the U.S. Census Bureau.

This slide presents the number of TB cases and the incidence rate of TB disease by race/ethnicity in Minnesota from 2005 through 2009. Non-white racial and ethnic populations in Minnesota are disproportionately affected by TB. In particular, the incidence rate of TB disease reported during each of the past 5 years was highest among blacks, followed by Asians; the rates of TB disease in these populations, respectively, were, on average, approximately 135 times and 71 times higher than that among non-Hispanic whites. On average during this period, the TB incidence rates among Hispanics/Latinos and American Indians, respectively, were 29 times and 18 times greater than that among non-Hispanic whites. While most race/ethnicity-specific TB incidence rates in Minnesota varied considerably from year to year during this period, several trends were apparent. From 2005 to 2009, the TB incidence rate among blacks declined 36%, reflecting, in part, a similar decline in the number of new TB cases reported among new refugees and immigrants from sub-Saharan Africa, which is depicted in subsequent slides. Also during this 5-year period, the TB incidence rates among American Indians and Asians decreased 62% and 28%, respectively, although the reasons for those declines are less obvious.



Cases of Tuberculosis by Risk Category, Minnesota, 2005-2009

Risk Category*	2005 (N=199) No. (%)	2006 (N=217) No. (%)	2007 (N=238) No. (%)	2008 (N=211) No. (%)	2009 (N=161) No. (%)	Cumulative (N=1,026) No. (%)
Foreign-born	173 (87)	175 (81)	203 (85)	155 (73)	129 (80)	835 (81)
Substance abuse†	14 (7)	13 (6)	16 (7)	21 (10)	10 (6)	74 (7)
Homeless	4 (2)	5 (2)	6 (3)	11 (5)	4 (2)	30 (3)
HIV-infected	12 (6)	8 (4)	12 (5)	11 (5)	7 (4)	50 (5)
Other medical condition**	16 (8)	31 (14)	39 (16)	23 (11)	23 (14)	132 (13)
Inmate	4 (2)	3 (1)	2 (1)	5 (2)	3 (2)	17 (2)
Nursing home resident	1 (1)	1 (<1)	1 (<1)	3 (1)	1 (1)	7 (1)

* Risk categories are not mutually exclusive.

† Alcohol abuse and/or illicit drug use

** Silicosis, diabetes, prolonged corticosteroid therapy or other immunosuppressive therapy, hematologic/ reticuloendothelial disease, end-stage renal disease, substantial weight loss (not TB-related) or undernutrition

Tuberculosis disproportionately affects certain high-risk subgroups of the population. This slide presents several of the common risk factors for TB disease and the number and percentage of TB cases reported in Minnesota from 2005 through 2009 that had any of these risk factors. The risk categories presented in this slide are not mutually exclusive; an individual TB case-patient may have more than one or none of the risk factors.

The most distinguishing characteristic of the epidemiology of TB disease in Minnesota is the very large proportion of cases that occur among foreign-born persons. Eighty-one percent of TB case-patients reported in Minnesota during the past 5 years were born outside the United States. In contrast, 58% of TB case-patients reported nationwide in the U.S. during this 5-year period were foreign-born. The very high percentage of TB cases in Minnesota that occur among foreign-born persons is influenced by the large per capita number of refugees and immigrants in Minnesota and the demographics of those newly arriving refugees and immigrants, many of whom come from regions of the world where TB is prevalent. Notably, however, the percentage of foreign-born TB case-patients reported in Minnesota declined 8% from 2005 to 2009, which reflects decreasing numbers of new primary refugees and immigrants arriving in Minnesota, particularly since 2006.

Other high-risk population subgroups represented much smaller proportions of the TB cases reported in Minnesota during this period, each representing no more than 13% of the total cases reported statewide. Persons with certain medical conditions that increase the risk for progression from latent TB infection to active TB disease were the largest of these other high-risk population subgroups, representing 13% of TB cases. Substance abuse (including alcohol abuse and/or illicit drug use) was the second most common of these other risk factors, with 7% of TB case-patients having a history of substance abuse during the 12 months prior to their TB diagnosis. Five percent of TB cases were co-infected with HIV, which was a lower prevalence than that among TB cases reported nationwide during this period. Three percent of TB case-patients reported in Minnesota from 2005 through 2009 were homeless, 2% were correctional facility inmates, and 1% were residents of nursing homes. Notably, after having increased to 5% and 10%, respectively, in 2008 during two outbreaks that occurred among homeless persons and/or persons with a history of substance abuse, the percentages of homeless TB case-patients and those with a history of substance abuse declined to 2% and 6%, respectively, in 2009.

The percentages of TB cases reported in Minnesota during 2008 who had a history of substance abuse and/or who were homeless were higher than the comparable percentages for those risk factors reported since 2005. This increase can be attributed to 2 outbreaks that occurred in 2008 which had a high percentage of homeless persons and substance abusers.

Tuberculosis Cases With Other Medical Conditions, by Type of Condition, Minnesota, 2005-2009

Medical Condition*	Cases (N=1,026) No.	(%)
Diabetes	77	(8)
Prolonged Corticosteroid Therapy	20	(2)
Other Immunosuppressive Therapy	30	(3)
End Stage Renal Disease	10	(1)
Hematologic/Reticuloendothelial Disease	8	(1)
Weight loss/Undernutrition	6	(1)

*Medical conditions categories are not mutually exclusive.

Certain medical conditions increase the risk that latent TB infection will progress to active TB disease. Of the 1,026 TB cases reported in Minnesota during 2005-2009, 8% also were reported as having diabetes and 5% were on prolonged corticosteroid or other immunosuppressive therapy at the time of the TB diagnosis. End stage renal disease, hematologic/reticuloendothelial disease and weight loss/undernutrition unrelated to TB each were present in 1% of TB cases. This illustrates that screening for tuberculosis (and treatment for latent TB infection, if indicated) should be routinely considered for individuals with these medical conditions.

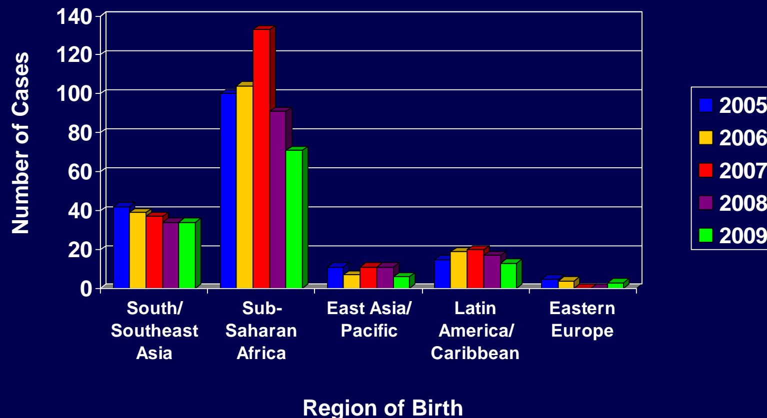
Tuberculosis Cases by HIV Status and Place of Birth, Minnesota, 2005-2009

HIV Status	Foreign-Born Cases No.	(%)	U.S.-Born Cases No.	(%)	Total No.	(%)
Negative	711	(85)	129	(68)	840	(82)
Positive	41	(5)	9	(5)	50	(5)
Refused	20	(2)	1	(1)	21	(2)
Not Offered	60	(7)	51	(27)	111	(11)
Unknown	3	(<1)	1	(1)	4	(<1)
Total	835	(100)	191	(100)	1,026	(100)

Co-infection with HIV is the most significant medical risk factor for progression from latent to active TB. It is estimated that individuals infected with both TB and HIV have up to 10% annual risk of developing active TB disease. For this reason, TB diagnostic and treatment guidelines recommend that patients with active TB disease receive HIV testing at the time of diagnosis, unless they already are known to be HIV-positive.

This slide presents TB cases reported in Minnesota during 2005-2009 by HIV status and place of birth. Overall, 5% of those tested were HIV-positive. The prevalence of HIV co-infection among U.S.-born TB cases was identical to that of foreign-born TB cases.

Although 87% of TB cases in Minnesota during this 5-year period were tested for HIV, the proportion of TB case-patients that did not receive HIV testing was nearly 3 times higher for U.S.-born than for foreign-born individuals. Although a very small proportion (2%) of TB case-patients declined HIV testing, the majority of those who were not screened were not offered the opportunity for HIV testing. Clinicians should consider HIV testing for all TB cases, regardless of age, place of birth, or the presence of other HIV risk factors.



This slide depicts the number of TB cases reported in Minnesota from 2005 through 2009 by region of birth and year of diagnosis. The different colors represent the year of diagnosis. The bars representing the number of TB cases are grouped by region of birth - - for example, South/Southeast Asia, sub-Saharan Africa, etc. The trends visible in this slide are influenced by both the global incidence of TB in specific regions worldwide and also by the constantly changing trends and demographics of immigration to Minnesota. For example, Minnesota is home to a large population of persons born in South/Southeast Asia, which is a region of the world where TB is highly prevalent. Consequently, the annual numbers of TB cases reported among this population have been moderately high but relatively stable from 2005 through 2009. The number of TB case-patients reported in Minnesota among persons originating from sub-Saharan Africa (which is another area where TB is very common) was high during each of the past 5 years. Notably, however, as the number of new primary refugees and immigrants arriving in Minnesota from sub-Saharan Africa has declined markedly since 2006, the number and percentage of TB case-patients reported statewide who originate from that region also has decreased, from 66% of foreign-born TB cases reported in Minnesota during 2007 to 55% in 2009.

Tuberculosis Cases by Site of Disease and Place of Birth, Minnesota, 2005-2009

Site of Disease	Foreign-Born Cases No. (%)	U.S.-Born Cases No. (%)	Total No. (%)
Pulmonary	387 (46)	126 (66)	513 (50)
Extrapulmonary	357 (43)	36 (19)	393 (38)
Both*	91 (11)	29 (15)	120 (12)
Total	835 (100)	191 (100)	1,026 (100)

* TB cases with both pulmonary and extrapulmonary sites of disease, including miliary TB

Tuberculosis disease most commonly affects the lungs, although almost any site of the body can be affected. For reasons that are not yet understood despite extensive study, extrapulmonary TB occurs more frequently among foreign-born persons with TB disease than among U.S.-born TB case-patients. Consequently, due to the large proportion of TB cases in Minnesota that occur among foreign-born persons, extrapulmonary TB is very common in Minnesota. More than half (54%) of foreign-born TB case-patients reported in Minnesota from 2005 through 2009 had an extrapulmonary site of disease; in contrast, only 34% of U.S.-born TB case-patients had extrapulmonary involvement. This slide illustrates the need, especially in Minnesota, for clinicians to have a high index of suspicion for TB, particularly for foreign-born patients, even when the patient does not present with a cough or other common symptoms of pulmonary TB.

Extrapulmonary* Tuberculosis Cases by Site of Disease, Minnesota, 2005-2009

Site of Disease	Cases No.	(%)
Lymphatic	286	(56)
Pleural	49	(10)
Bone/Joint	46	(9)
Peritoneal	37	(7)
Meningeal	19	(4)
Genito-Urinary	13	(3)
Miliary	4	(1)
Other	59	(12)
Total	513	(100)

* Includes TB cases with or without concurrent pulmonary disease

Among extrapulmonary TB case-patients reported in Minnesota from 2005 through 2009, the majority (56%) had lymphatic disease. Pleural, bone/joint, and peritoneal TB affected 10%, 9%, and 7% of extrapulmonary TB case-patients, respectively. Less than 5% of extrapulmonary TB case-patients each had meningeal, genito-urinary, or miliary sites of disease. Fifty-nine (12%) case-patients had other extrapulmonary sites of disease that did not fall into any of the aforementioned categories.

Tuberculosis Cases by Sex and Place of Birth, Minnesota, 2005-2009

Sex	Foreign-Born Cases No. (%)	U.S.-Born Cases No. (%)	Total No. (%)
Male	417 (50)	118 (62)	535 (52)
Female	418 (50)	73 (38)	491 (48)
Total	835 (100)	191 (100)	1,026 (100)

This slide presents TB cases, by sex, reported in Minnesota from 2005 through 2009. Slightly more males than females were represented among TB cases reported statewide, which is typical of TB cases reported in the United States. The preponderance of males versus females, however, was limited to U.S.-born TB case-patients (62% versus 38%, respectively), among whom the differential was markedly pronounced. Among foreign-born TB case-patients, essentially half were male and half were female.

Tuberculosis Cases with Pulmonary Involvement by Chest X-Ray Result, Minnesota, 2005-2009

Chest X-Ray Result	Cases No. (%)
Normal	17 (3)
Abnormal, cavitary	146 (23)
Abnormal, non-cavitary (TB)	460 (73)
Abnormal, non-TB	8 (1)
Not done/unknown	2 (<1)
Total	633 (100)

A posterior-anterior radiograph of the chest is one of the primary diagnostic tests performed to detect and describe abnormalities that may be suggestive of active pulmonary TB disease. In pulmonary TB, chest x-ray abnormalities often are seen in the apical and posterior upper lobes of the lungs or in the superior segments of the lower lobes. Cavitary lesions are indicative of severe or advanced disease and also are a risk factor for increased likelihood of infectiousness in TB patients. In TB patients co-infected with HIV, pulmonary TB may present with atypical, or even normal, radiographic findings.

Among 633 pulmonary TB case-patients reported in Minnesota from 2005 through 2009, the vast majority (96%) had radiographic findings consistent with TB disease, including 146 (23%) patients with cavitary lesions. Only 4% of pulmonary TB case-patients had chest x-ray results that were normal or inconsistent with TB disease.

Tuberculosis Cases with Pulmonary Involvement by Sputum AFB Smear Result, Minnesota, 2005-2009

Sputum AFB Smear	Cases No. (%)
Positive	237 (37)
Negative	318 (50)
Not done/unknown	78 (12)
Total	633 (100)

* 42% of cases without sputum smear results were under age 5 years.

Persons with pulmonary or laryngeal TB disease may be infectious or able transmit TB to others. Except for very unusual circumstances, extrapulmonary TB disease is not infectious. The detection of acid-fast bacillus (AFB) in smears of sputum specimens collected from patients with pulmonary TB disease are considered one indicator of the patient's likely level of infectiousness. Patients with positive AFB smears from sputum are considered potentially infectious. Although transmission of TB germs from sputum AFB smear-negative patients has been documented, such patients are less likely than sputum AFB smear-positive patients to be infectious.

Among 633 patients with pulmonary TB disease reported in Minnesota from 2005 through 2009, 37% had at least one sputum specimen with an AFB-positive smear result and half had negative AFB smears. Twelve percent had no sputum smear result reported to the Minnesota Department of Health. The majority (60%) of those patients without sputum smear results were children under the age of 16 years; this reflects the difficulty obtaining specimens for laboratory confirmation in many pediatric cases. These data suggest that nearly 40% of pulmonary TB case-patients in Minnesota likely are infectious and have the potential to spread TB germs to others prior to receiving several weeks or more of adequate treatment for TB disease.

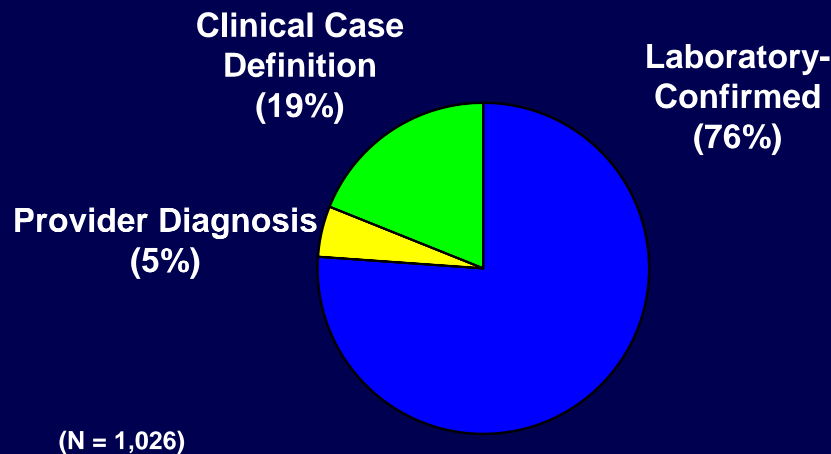
Tuberculosis Cases by Mycobacterial Culture Result, Minnesota, 2005-2009

Mycobacterial Culture	Cases No.	(%)
Positive	774	(75)
Negative	219	(21)
Not done/unknown	33	(3)
Total	1,026	(100)

Identification of *Mycobacterium tuberculosis* grown in culture from a clinical specimen is the "gold standard" for definitive diagnosis of TB disease, although the national surveillance case definition for TB disease also allows cases to be counted on the basis of a positive nucleic acid amplification test (performed in accordance with current guidelines of the U.S. Food and Drug Administration) or clinical signs and symptoms in the absence of a positive culture for *M. tuberculosis*. In particular, culture confirmation of TB disease is critically important for the clinical management of TB case-patients, because drug susceptibility testing is performed on isolates grown in culture. Also, for pulmonary TB case-patients, documentation of the conversion of a sputum culture result from an initially positive culture to a negative culture is an important marker of successful response to TB treatment.

Seventy-five percent of TB cases reported in Minnesota from 2005 through 2009 were confirmed by the identification of *M. tuberculosis* from culture. Mycobacterial culture was not performed or culture results were not reported for only 3% of case-patients.

Tuberculosis Cases by Case Verification Criterion*, Minnesota, 2005-2009



*Based on the public health surveillance definition for TB

[CDC. (2009, June) CDC Tuberculosis Surveillance Data Training: Report of Verified Case of Tuberculosis (RVCT) Instruction Manual. Atlanta, GA: U.S. Department of Health and Human Services, CDC. (Appendix A - Tuberculosis Case Definition for Public Health Surveillance)]

This slide shows the proportions of TB cases reported in Minnesota from 2005 through 2009 who met the various hierarchical levels of the national surveillance case definition for reportable TB disease. Over three-fourths (76%) of Minnesota's TB cases were counted on the basis of a culture that was positive for *Mycobacterium tuberculosis* or (rarely) a positive nucleic acid amplification test. Cultures were either negative for *M. tuberculosis* or not done in the remaining 24% of cases. Most of those cases (19% of cases reported statewide) met the clinical component of the national TB case definition, which includes case-patients with positive Mantoux tuberculin skin tests, but without positive cultures, who show clinical and/or radiologic improvement after several months of multi-drug therapy for TB disease. Very few (5%) cases met neither the laboratory nor clinical criteria and, therefore, were counted based solely on provider diagnosis, which the national surveillance TB case definition allows.

Tuberculosis Cases by Drug Susceptibility Patterns and Year, Minnesota, 2005-2009

Year	Cases With Susceptibility Results*	Any Drug Resistance† No. (%)	INH-Resistant** No. (%)	MDR-TB‡ No. (%)
2005	151	15 (10)	14 (9)	4 (3)
2006	177	27 (15)	18 (10)	2 (1)
2007	176	22 (13)	17 (10)	3 (2)
2008	149	23 (15)	17 (11)	2 (1)
2009	120	20 (17)	12 (10)	2 (2)
Total	773	107 (14)	78 (10)	13§ (2)

* Culture-confirmed cases with drug susceptibility results available

† Resistance to at least one first-line anti-TB drug [i.e., isoniazid (INH), rifampin, pyrazinamide (PZA), or ethambutol]

** INH-resistant cases may also be resistant to other drugs.

‡ Multi-drug resistant TB, defined as resistance to at least INH and rifampin

§ Three of these cases were resistant to INH, rifampin, PZA, and ethambutol.

Drug-resistant TB is a serious public health concern globally, nationally, and in Minnesota. This slide presents drug susceptibility data among culture-confirmed TB cases reported in Minnesota from 2005 through 2009. Drug susceptibility testing was performed on all culture-confirmed TB cases reported in Minnesota during this period. Among culture-confirmed TB cases, 14% were resistant to at least one first-line anti-TB medication [i.e., isoniazid (INH), rifampin, pyrazinamide, or ethambutol], including 10% of cases that were resistant to INH and 2% that were multidrug-resistant, which is defined as resistance to at least INH and rifampin. Of the 13 multidrug-resistant (MDR) TB cases reported during this period, three (23%) were resistant to all four first-line anti-TB drugs; one of these MDR-TB cases (reported in 2006) also met the definition of extensively drug-resistant (XDR) TB. During this 5-year period, the prevalence of drug-resistant TB overall increased 70%, from 10% in 2005 to 17% in 2009.

Cases of Drug-Resistant Tuberculosis by Place of Birth and Year, Minnesota, 2005-2009

	Foreign-Born Cases		U.S.-Born Cases	
Year	Cases with Susceptibility Results*	Resistant† No. (%)	Cases with Susceptibility Results*	Resistant† No. (%)
2005	131	13 (10)	20	2 (10)
2006	144	23 (16)	33	4 (12)
2007	152	18 (12)	24	4 (17)
2008	115	22 (19)	34	1 (3)
2009	98	17 (17)	22	3 (14)
Total	640	93 (15)	133	14 (11)

* Culture-confirmed cases with drug susceptibility results available

† Resistance to at least one first-line anti-TB drug [i.e., isoniazid (INH), rifampin, pyrazinamide (PZA), or ethambutol]

This slide presents data on drug resistance identified in culture-confirmed TB cases among foreign-born and U.S.-born TB case reported in Minnesota from 2005-2009. The prevalence of drug resistance among foreign-born TB cases persons ranged from 10% in 2005 to 19% in 2008, with 15% of cases reported overall having resistance to at least one first-line TB medication. During this 5-year period, the prevalence of drug resistance among foreign-born TB cases increased 70%, from 10% in 2005 to 17% in 2009. The prevalence of drug resistance among culture-confirmed TB cases reported among U.S.-born persons varied from year to year, ranging from 3% in 2008 to 17% in 2007, with 11% of cases overall being drug-resistant. During this period, drug resistance was approximately 1.4 times more common among foreign-born TB case-patients than among U.S.-born case-patients.

Tuberculosis Cases by Drug Susceptibility Patterns and Place of Birth, Minnesota, 2005-2009

Place of Birth	Cases With Susceptibility Results*	Any Drug Resistance† No. (%)	INH-Resistant** No. (%)	MDR-TB‡ No. (%)
Foreign-Born Cases	640	93 (15)	69 (11)	9 (1)
U.S.-Born Cases	133	14 (11)	9 (7)	4 (3)
Total	773	107 (14)	78 (10)	13§ (2)

* Culture-confirmed cases with drug susceptibility results available

† Resistance to at least one first-line anti-TB drug [i.e., isoniazid (INH), rifampin, pyrazinamide (PZA), or ethambutol]

** INH-resistant cases may also be resistant to other drugs.

‡ Multi-drug resistant TB, defined as resistance to at least INH and rifampin

§ Three of these cases were resistant to INH, rifampin, PZA, and ethambutol.

Among culture-confirmed TB cases reported in Minnesota from 2005 through 2009, foreign-born case-patients were approximately 1.4 times more likely than U.S.-born case-patients to be resistant to any first-line anti-TB drug and 1.6 times more likely than U.S.-born case-patients to be resistant to isoniazid, in particular. Although the reported prevalence of multidrug-resistant (MDR) TB among U.S.-born case-patients was three times that among foreign-born case-patients, many of the U.S.-born MDR-TB case-patients either had lived extensively outside the U.S. or resided in a household with foreign-born persons. These U.S.-born cases also had several other TB risk factors such as history of drug/alcohol use and homelessness.

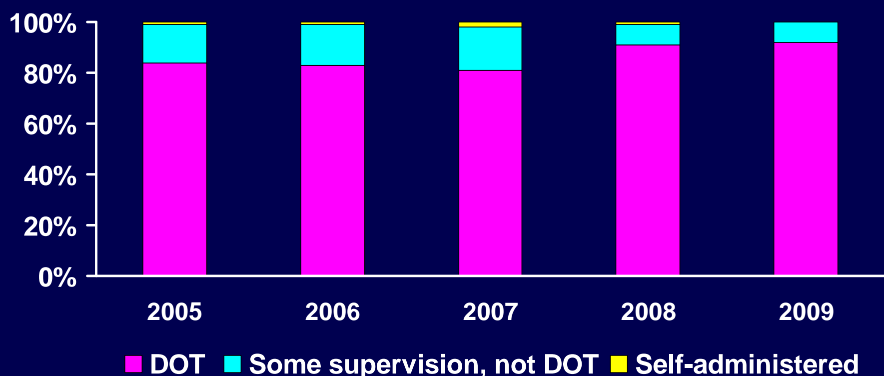
Tuberculosis Cases by Method of Case Identification, Minnesota, 2005-2009

How Identified	2005 No. (%)	2006 No. (%)	2007 No. (%)	2008 No. (%)	2009 No. (%)
Presented with symptoms	156 (78)	170 (78)	193 (81)	163 (77)	131 (81)
TB contact investigation	8 (4)	10 (5)	15 (6)	27 (13)	10 (6)
Refugee health exam (domestic)	15 (8)	17 (8)	13 (5)	6 (3)	1 (1)
Pre-immigration exam (overseas)	6 (3)	5 (2)	7 (3)	4 (2)	3 (2)
Other*	14 (7)	15 (7)	10 (4)	11 (5)	16 (10)
Total	199 (100)	217 (100)	238 (100)	211 (100)	161 (100)

* e.g., occupational screening, other targeted tuberculin skin testing, etc.

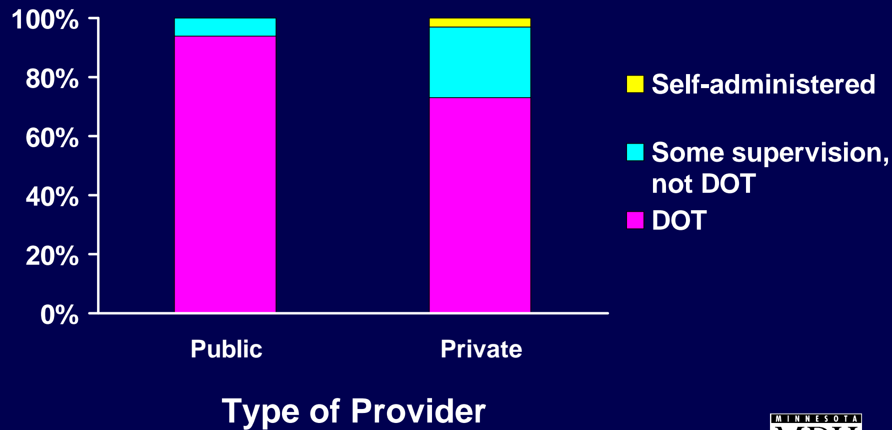
While the vast majority (79%) of TB cases reported in Minnesota from 2005 through 2009 were identified as a result of the case-patient presenting at a clinic or hospital with symptom of TB disease, a significant number of cases also were identified through other public health disease prevention and control activities. For example, TB contact investigations surrounding individual infectious TB case-patients accounted for 7% of TB cases reported statewide. Notably, the percentage of TB cases identified through TB contact investigations increased from an annual average of 5% from 2005 through 2007 to 13% in 2008; this increase can be attributed to cases identified as part of contact investigations surrounding three TB outbreaks that occurred in 2008. In 2009, as those outbreaks were controlled, the annual percentage of new TB cases identified through contact investigations decreased to 6%. During the past 5 years, 5% of TB cases reported in Minnesota were identified through the domestic health examination that is recommended for all refugees within 3 months of their arrival in the U.S. As the number of new primary refugee arrivals in Minnesota has decreased (particularly since 2006), however, this percentage has decreased steadily, from 8% in 2005 and 2006 to 1% in 2009. Two percent of cases were identified through the follow-up of notifications received by the Minnesota Department of Health from the national Centers for Disease Control and Prevention for newly arrived immigrants or refugees who were identified as having an abnormal chest x-ray and/or positive sputum smear during a required medical examination performed overseas prior to immigration. The purpose of this overseas exam is to identify individuals who may have active infectious pulmonary TB disease and may therefore pose an immediate public health threat. Overall from 2005 through 2009, 6% of TB cases were identified through other means, such as occupational TB screening or other targeted tuberculin skin testing, although the annual percentage of cases identified through such "other" means increased to 10% in 2009.

Tuberculosis Cases by Mode of Treatment Administration, Minnesota, 2005-2009



This slide and the following two slides present data on the treatment of TB disease in Minnesota.

This slide presents the mode by which TB treatment was administered for all TB case-patients reported in Minnesota from 2005 through 2009. The use of directly observed therapy (DOT) for the treatment of TB disease in Minnesota increased from 84% of TB case-patients in 2005 to 92% of patients in 2009. DOT, which involves having a health care provider or trained outreach worker observe a TB case-patient taking each dose of TB medications, is the recommended standard of care for the treatment of TB disease. The vast majority of patients who did not receive standard DOT received some other less frequent form of supervision of their TB therapy. For example, since 2005, only 1% to 2% of TB case-patients reported each year received self-administered TB treatment. The increased and widespread use of DOT in Minnesota is facilitated by the highly dedicated and diligent work of the local public health nurses in each county who are primarily responsible for administering DOT for TB case-patients residing in their jurisdictions.



The use of directly observed therapy (DOT) is considered the standard of care for the treatment of TB disease. This slide illustrates that, among TB cases reported in Minnesota from 2005 through 2009, the use of DOT was significantly more common among patients who received treatment for TB disease at public TB clinics than among patients who received TB treatment from private clinicians. Specifically, 94% of new TB case-patients treated at any of the three public TB clinics statewide from 2005 through 2009 received DOT, whereas only 73% of such patients treated for TB by private providers received DOT. Three percent of TB case-patients treated by private providers received exclusively self-administered therapy, while no TB case-patients treated at public TB clinics received self-administered therapy. Some intermediate form of less-than-daily supervision was used more commonly among TB case-patients treated by private clinicians (24%) than among those treated at public TB clinics (6%).

Completion and Length of Therapy Among Tuberculosis Cases by Type of Health Care Provider, Minnesota, 2008

Type of Provider	Started Treatment*	Completed Within 12 mos. No. (%)	Completed Overall No. (%)
Public	113	101 (89)	106 (94)
Private	86	78 (91)	82 (95)
Total	199	179 (90)	188 (94)

* Patients for whom $\le$ 12 months of therapy is indicated - - i.e., excluding patients with rifampin resistance or meningeal TB and patients 15 years of age or younger with miliary TB

This slide presents the outcome of TB treatment for the 199 TB case-patients reported in Minnesota during 2008 who began a course of treatment and for whom 12 months or less of treatment was indicated. (2008 is the most recent annual cohort of patients for whom data on the outcome of therapy are available.) This slide excludes patients with rifampin-resistant or meningeal TB and pediatric patients with miliary TB, all of whom require a longer course of treatment. While most uncomplicated cases of TB disease are eligible for 6-9 month courses of treatment, the Centers for Disease Control and Prevention (CDC) has established an objective of 90% of TB case-patients completing adequate therapy within 12 months, which allows a margin of error for the often unavoidable obstacles that can prolong therapy.

These data indicate that a strong majority (90%) of 199 eligible TB case-patients reported in Minnesota during 2008 successfully completed an adequate course of treatment within 1 year. Of the 199 eligible TB case-patients, 94% ultimately completed a full course of TB treatment, although nine patients did so in longer than 12 months. The data on this slide also indicate that patients who received treatment administered by private clinicians were slightly more likely to complete treatment within 1 year and also marginally more likely to complete treatment overall than those patients treated by public TB clinics. These data, however, do not take into account potentially confounding differences between the characteristics of the patient populations at each type of clinic.