The purpose of this slide set is to characterize the epidemiology of tuberculosis (TB) disease in Minnesota. The slides describe the demographic and clinical characteristics of TB statewide. The data in these slides pertain to confirmed cases of active TB disease reported from 2014 through 2018. In accordance with the Minnesota Communicable Disease Reporting Rule, physicians, laboratories, and other health care providers are required to report all probable and confirmed 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.
The Division of Tuberculosis was created by the Minnesota State Board of Health in 1918. During the first half of the twentieth century, many TB patients were sent to designated sanatoria in hopes that rest, fresh air, and a healthy diet would cure their TB. Between 1920-1950, some TB patients were treated with artificial pneumothorax. After 1950, Minnesota’s sanatoria began to close. The use of antibiotics to treat TB disease and prevent others from developing TB, along with active case finding methods like contact investigations and broad chest x-ray recommendations, started the decline of TB cases in the late 1940s. The lowest number of incident cases on record during this time period was 91 cases (2.2 per 100,000) in 1988. Rates among Minnesota’s US-born population have continued to decrease. However, the resettlement of new arrivals to the US and the global rise of multi-drug resistant TB have created a disparity in TB incidence between the US and non-US-born populations in Minnesota. TB anywhere is TB everywhere, and the TB Prevention and Control Program in Minnesota is dedicated to protecting, maintaining and improving the health of all Minnesotans.
In 2018, 172 new cases of active TB disease among persons in Minnesota were reported to the Minnesota Department of Health, a decrease of 3% from 2017, when there were 178 new cases of TB. This number corresponds to an incidence rate of 3.1 cases per 100,000 population. In comparison, 9,029 new cases of TB disease (2.8 cases per 100,000 population) were reported in the United States during 2018; the median TB incidence rate among 51 states and reporting areas nationally was 1.9 cases per 100,000 population.

This slide also depicts the number of deaths attributed to TB among new cases in Minnesota from 2014-2018. Overall, 3% of TB cases during this time period have died as a result of TB, ranging from 1% of new cases in 2018 to 5% in 2016. These data do not include individuals who died from causes other than TB.
The mean number of TB cases reported annually in Minnesota is lower this decade than in the previous decade. From 2000-2009, Minnesota received an average 209 cases per year. From 2010-2018, Minnesota received an average of 155 cases per year. There was a recent upward trend from 2015-2017 followed by a decrease in 2018.
This slide depicts the annual incidence rate for TB in Minnesota and the United States from 2000 to 2018. From 2000-2015, the rate of TB in Minnesota had generally been lower than the national rate (with the exception of 2007). In 2018, there were 3.1 new TB cases per 100,000 population in Minnesota, and 2.8 per 100,000 nationally. TB case counts and case rates in the US in 2018 were the lowest on record since national TB surveillance started in the 1950s. The rates of TB in Minnesota and nationally have not met the Healthy People 2010 and 2020 objective of 1.0 TB case per 100,000, nor the CDC 2020 objective of 1. per 100,000.
During the past decade, the proportion of non-US-born persons among TB cases reported in Minnesota has averaged 83%, ranging from 73% in 2014 to 90% in 2016. The average non-US-born percentage during this time period among cases reported nationally was 66%, but has been increasing steadily. In 2018, 83% of TB cases in Minnesota were born outside the US, compared to 70% of TB cases reported nationally. The percentage of TB cases born outside of the US in Minnesota has consistently been higher than reportedly nationally.
The age distribution of TB cases reported in Minnesota differs markedly between US-born and non-US-born patients. The largest group (41%) of non US-born TB cases reported in Minnesota from 2014 to 2018 was between 25 to 44 years of age, whereas the number of US-born cases was relatively more evenly distributed, with the highest number in the 45 to 64 year age group (24%). These strikingly different age distributions reflect the differing risks of exposure to TB among these populations. For example, newly-arrived refugees and immigrants to Minnesota tend to be younger, and TB cases in these age groups likely were already infected with TB before arriving in the US. Among US-born persons, adults who were born 50 or more years ago when TB was much more prevalent in Minnesota are more likely than younger US-born persons to have been infected with TB. As these older US-born persons age and develop other medical conditions that may weaken their immune systems, they may progress from latent TB infection to active TB disease.

The proportion of children under five years of age was much higher among US-born TB cases reported in Minnesota from 2014 through 2018 than among non US-born cases (18.5% versus 1%, respectively). Eighty-eight percent of these young US-born cases had at least one non-US-born parent or guardian. These second-generation children appear to experience an increased risk of TB disease that more closely resembles that of non-US-born persons. These children were likely exposed to TB as a result of travel to their parents’ country of origin or from family members or friends with active disease.
This slide presents data on TB cases, by sex at birth, reported in Minnesota from 2014 through 2018. More males than females were represented among TB cases reported statewide (53% to 47%), which is typical of TB cases reported in the United States. Among the US-born TB cases, the difference in sex at birth was a little wider (57% males to 43% females). Among non-US-born TB cases, the distribution of sex at birth was closer to the statewide percentages (52% males to 48% females). The difference in TB rates by sex at birth and birthplace could be due to the unequal distribution of TB risk factors among US-born cases.
This slide presents a map of Minnesota with counties shaded according to the number of TB cases reported in their jurisdictions during 2018. Although 27 (31%) of the state’s 87 counties reported at least one new case of TB disease in 2018, the majority of cases occurred in the Twin Cities metropolitan area. The largest number of cases occurred in Hennepin County (54, or 31%) and Ramsey County (34, or 20%). Almost one-third (30%) of the new TB cases in 2018 were reported by Greater Minnesota counties.
This slide presents data on TB cases, by county of residence, reported in Minnesota from 2014 through 2018. 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 more widespread. Of the state’s 87 counties, 48 (55%) reported at least one case of TB disease during this five-year period. Hennepin and Ramsey counties accounted for 58% of all new TB cases reported during this time period, while 27% of cases were reported in Greater Minnesota.
This slide presents the number and rate of new TB cases reported by county of residence in Minnesota from 2014 through 2018. County-specific data are presented for Hennepin, Ramsey, and Olmsted counties, which are the three counties in Minnesota that operate public TB clinics. The slide also presents data for the five-county suburban Twin Cities metropolitan area and for Greater Minnesota, excluding Olmsted County. Among the seven-county metro area counties, the highest TB incidence rate in 2018 was reported in Ramsey County (6.2 cases per 100,000 population), followed by Hennepin County (4.3 cases per 100,000 population).

<table>
<thead>
<tr>
<th>Location of Residence</th>
<th>2014 No. (Rate)*</th>
<th>2015 No. (Rate)*</th>
<th>2016 No. (Rate)*</th>
<th>2017 No. (Rate)*</th>
<th>2018 No. (Rate)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hennepin County</td>
<td>51 (4.3)</td>
<td>57 (4.7)</td>
<td>73 (6.0)</td>
<td>70 (5.7)</td>
<td>54 (4.3)</td>
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<tr>
<td>Ramsey County</td>
<td>26 (4.9)</td>
<td>29 (5.4)</td>
<td>40 (7.4)</td>
<td>38 (7.0)</td>
<td>34 (6.2)</td>
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<tr>
<td>Suburban Twin Cities Metro†</td>
<td>24 (2.0)</td>
<td>25 (2.0)</td>
<td>16 (1.3)</td>
<td>22 (1.7)</td>
<td>33 (2.6)</td>
</tr>
<tr>
<td>Olmsted County</td>
<td>16 (10.7)</td>
<td>12 (8.0)</td>
<td>11 (7.3)</td>
<td>12 (7.8)</td>
<td>12 (7.7)</td>
</tr>
<tr>
<td>Greater Minnesota (excluding Olmsted)</td>
<td>30 (1.3)</td>
<td>27 (1.2)</td>
<td>28 (1.2)</td>
<td>36 (1.5)</td>
<td>39 (1.7)</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>147 (2.7)</strong></td>
<td><strong>150 (2.7)</strong></td>
<td><strong>168 (3.0)</strong></td>
<td><strong>178 (3.2)</strong></td>
<td><strong>172 (3.1)</strong></td>
</tr>
</tbody>
</table>

* Cases per 100,000 population. Rates calculated using state population estimates from the U.S. Census Bureau.
† Anoka, Carver, Dakota, Scott, and Washington counties
This slide depicts the incidence rate of TB disease by race/ethnicity in Minnesota from 2014 through 2018. Non-white racial and ethnic populations in Minnesota are disproportionately affected by TB. In particular, the incidence rate of TB disease reported in 2018 remain highest among Africans/African-Americans (24.9 cases per 100,000 population), followed by Asians or Pacific Islanders (17.5 cases per 100,000 population). In comparison, the TB case rate among non-Hispanic whites was 0.3 cases per 100,000 population. The TB incidence rates among Hispanics/Latinos in 2018 was 3.3 cases per 100,000 population. No cases among American Indians or Alaska Natives were identified in 2018. During this five-year period, TB rates were generally highest among Africans/African-Americans and Asians or Pacific Islanders.
The racial and ethnic distribution of TB cases reported in Minnesota from 2014 through 2018 differed between non-US-born and US-born populations. Among non-US-born cases, the majority (56%) were black, 35% were Asian, 6% were Hispanic or Latino, 3% were white, and two cases were Native Hawaiian or Pacific Islander (<1%). Among the much smaller number of US-born TB cases, the largest proportion (32%) were white, 31% were black, 16% were Hispanic or Latino, 11% were American Indian or Alaska Native, 9% were Asian, and two cases were reported as multi-racial (1%). Regardless of place of birth, non-white racial and ethnic populations were disproportionately affected by TB, comprising larger proportions among TB cases than their proportional representation in the overall state population.
Persons arriving as refugees or immigrants seeking permanent residence in the United States are screened prior to immigration for conditions of public health significance, including communicable diseases such as pulmonary TB disease. (It is also recommended that all refugees be screened again within three months of their arrival in the US) Forty-two percent of the non-US-born TB cases reported in Minnesota from 2014 through 2018 initially arrived to the US as refugees, and another 33% arrived as immigrants. Nineteen percent of non-US-born TB cases arrived with other non-immigrant visa classifications, including visitors, tourists, students, and those with employment visas; TB screening prior to US arrival is not required for these persons. Visa status upon arrival was unknown for 6% of non-US-born TB cases.
Almost twenty percent of non-US-born TB cases reported in Minnesota from 2014 to 2018 had resided in the United States for less than one year when they were diagnosed with TB disease. These patients most likely acquired latent TB infection outside the US and began progressing to active TB disease just prior to or soon after arriving in the US. Although many such cases may not be preventable in the US, there is additional TB screening required for a number of new arrivals to promptly diagnose active disease and initiate treatment.

Most of the non-US-born TB patients developed active disease after living in the US for a number of years. Over half of non-US-born TB cases reported in Minnesota from 2014-2018 had been in the US for six years or longer prior to being diagnosed with TB disease, the largest group (40%) developing active disease at least 10 years after arrival. Many of these patients reported advanced age and co-morbidities increasing the likelihood of progressing to active TB disease. These data show the importance of thorough domestic screening of recent arrivals as well as evaluation and treatment of latent TB infection among older populations with co-morbidities.
As mentioned in a previous slide, immigrants and refugees undergo medical evaluation, including TB screening, prior to coming to the United States. Individuals with TB-related conditions identified overseas are assigned a TB Class designation, ranging from Class A, which indicates active and potentially infectious TB disease, to Class B1, which may indicate active, non-infectious TB, to Class B2, which indicates latent TB infection. For immigrants and refugees with a TB Class condition, the US Centers for Disease Control and Prevention (CDC) notifies the state public health department where the patient is expected to arrive. State and local public health professionals in Minnesota collaborate to ensure that these individuals are referred to a local health care provider for comprehensive TB evaluation and treatment, as indicated.

Among new refugees and immigrants who were diagnosed with TB disease in Minnesota from 2014 to 2018 within one year after their arrival in the US, only 38% had a TB Class designation assigned overseas, while 23% had documented overseas screening results showing no indication of a TB Class condition. The results of the overseas medical evaluations were unknown for 39% of these non-US-born TB cases. These patients included persons who initially resettled in another US state and whose overseas screening results were not available to the Minnesota Department of Health. These findings strongly suggest that clinicians cannot rely solely on the results of pre-immigration medical examinations performed overseas to identify TB disease among non-US-born persons. Clinicians should have a high index of suspicion for TB in any non-US-born patient from TB endemic areas who presents with signs or symptoms consistent with active TB disease.
From 2014 to 2018, 83% (680) of TB cases in Minnesota were born outside the United States and 17% (135) were US-born. Among the non-US-born TB cases reported in Minnesota during this five-year time period, the largest percentage (27%) were born in Somalia. Other countries of birth representing the top five were Ethiopia (13%), Laos (9%), India (7%), and Viet Nam (6%). Patients from a geographically and ethnically diverse group of 53 other countries comprised the remaining 38% of non-US-born TB cases reported during this period. This diversity among non-US-born TB cases in Minnesota poses challenges for those providing TB treatment, and prevention and control services that are appropriate for persons from such a wide array of cultural, linguistic, and socioeconomic backgrounds.
This map shows the number of TB cases in Minnesota in 2018 by country of birth. Details are provided for places with ten or more 2018 Minnesota TB cases. Case rates were calculated using 2017 ACS data for place of birth of people in Minnesota. As noted in the previous slide, non-US-born TB cases are diverse. People from around the world have arrived in Minnesota for a variety of reasons at different points throughout history. Recently, TB cases born in India have been in the US on average (median) for 1 year. Many arrive on work visas which do not require international or domestic TB screening. TB cases from Lao People’s Democratic Republic are primarily Hmong elders, resettled in the US as refugees in waves in the 1980s and mid-2000s. The originating countries of TB patients have varying rates of TB, from low-incidence countries like the United States to high incidence countries where TB is widespread.
This slide depicts the number of non-US-born TB cases reported in Minnesota from 2014 through 2018 by region of birth and year of diagnosis. The trends seen in this slide are influenced by both the global incidence of TB in specific regions worldwide and also by the changing trends and demographics of immigration to Minnesota. Over the past five years, the number of TB cases reported in Minnesota has been highest among persons originating from sub-Saharan Africa, a region of the world where TB is common. Minnesota is also home to a large population of persons born in South/Southeast Asia, another TB endemic area. Persons from this region accounted for the second largest group of cases.
While the vast majority (80%) of TB cases reported in Minnesota from 2014 through 2018 were identified only after presenting at clinics or hospitals with symptoms of TB disease, a number of cases were identified from TB screening or other active case finding methods. Seven percent of TB cases were found as a result of contact investigations conducted by local health departments surrounding individuals with infectious TB. Three percent were identified during follow-up evaluations of newly-arrived immigrants and refugees with a TB Class condition, and 1% were identified through the domestic health assessment recommended for all refugees within three months of their arrival in the US. Other immigration exams (such as change of status exams) identified <1% of TB cases. Three percent of cases were identified through other targeted testing, including TB screening of international students in colleges or overseas adoptees. Screening for employment purposes identified another 2% of cases. The remaining 3% of TB cases reported during this time period were identified as a result of laboratory or radiologic tests performed for reasons other than suspected TB disease.
The distribution of risk factors for TB infection and progression to active disease differs greatly by place of birth. Note that a patient can have multiple TB risk factors. Among TB cases reported in Minnesota from 2014 and 2018, patients born in the US were more likely to have been a contact to an infectious TB patient within the past 2 years, have a history of travel to a TB endemic area, a history of substance abuse, experienced homelessness within the year prior to TB diagnosis, been incarcerated within the last 5 years or at time of diagnosis, and resided in a long-term care facility at the time of diagnosis. Non-US-born cases, on the other hand, were more likely to be co-infected with HIV and also more likely to have worked in a healthcare setting in the year preceding their diagnosis. No cases among healthcare workers were attributed to occupational exposure.

TB patients born in the US were more likely to report having a medical risk factor for progression to active TB disease (excluding HIV/AIDS): 33% of US-born TB cases compared to 24% of non-US-born cases. Among US-born cases, the two most commonly reported medical risk factors were immunosuppressive conditions (not HIV/AIDS) or therapy (13%) and diabetes (11%). Among non-US-born patients, the most commonly reported medical condition was diabetes (15%), followed by immunosuppressive conditions (not HIV/AIDS) or therapy (7%).
As mentioned in the previous slide, certain medical risk factors, in addition to HIV/AIDS, increase the likelihood that latent TB infection will progress to active TB disease. The most commonly reported condition was diabetes, accounting for 14% of all TB cases reported in Minnesota during 2014-2018. Eight percent reported having an immunosuppressive condition (not including HIV/AIDS) or were on immunosuppressive therapy at the time of the TB diagnosis.

Smaller proportions of TB cases reported other conditions: end stage renal disease (2%) and significant weight loss (not as a result of TB disease) or undernutrition (1%). Five percent reported other factors increasing the risk of TB disease progression, including chronic kidney disease, active smoking, and hematologic disease. This slide illustrates that screening for tuberculosis (and treatment for latent TB infection, if indicated) should be routinely considered for individuals with these medical conditions.
It is critical that all TB patients with an unknown HIV status be screened for HIV, since the TB treatment regimen for co-infected individuals is more complex. Starting in 2010, the scope of the national objective for HIV testing of TB cases expanded from those in the 25-44 age group to all age groups. Since this change, the percentage of Minnesota TB cases with a known HIV status has consistently been high, on average over 96%. Conversely, it is also important that HIV-infected patients be screened for latent TB infection (LTBI), as these individuals are a high priority group for LTBI treatment.
Co-infection with HIV is the most significant medical risk factor for progression from latent TB infection to active TB disease. It is estimated that individuals infected with both TB and HIV have up to a 10% annual risk of developing active TB disease, compared to a 5-10% lifetime risk for those with latent TB infection in general. 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 are already known to be HIV-positive.

This slide presents TB cases reported in Minnesota from 2014 through 2018 by HIV status and place of birth. During this time period, HIV status was known for 97% of TB cases in Minnesota. Four percent tested positive for HIV. The prevalence of HIV co-infection among non-US-born TB cases was greater than that of US-born TB cases (5% versus 3%, respectively).

The 24 of the 26 cases without a known HIV status were not offered the test by their provider. The proportion of TB cases who were not offered HIV testing was higher for US-born than for non-US-born individuals (6% versus 3%), although it is recommended for all TB cases, regardless of their place of birth.
The TB-HIV co-infection rate has generally been lower in Minnesota than in the United States over the past decade, with the exception of 2015 and 2016. On average, 4% of all Minnesota TB cases in the past decade were co-infected with HIV. In comparison, an average of 7% of all TB cases in the U.S. since 2009 were also infected with HIV, although the rate has been decreasing.
Tuberculosis disease most commonly affects the lungs, although it can affect almost any site in the body. Over half (53%) of the cases reported from 2014 to 2018 had TB disease exclusively in the lungs, and another 14% had TB in both pulmonary and extrapulmonary sites. TB was found exclusively in extrapulmonary sites in 33% of cases.

Among extrapulmonary TB cases reported in Minnesota from 2014 through 2018, over half (56%) had lymphatic disease. The musculoskeletal system (includes the bone/joint and any surrounding muscles or tissues) was the second most common site, accounting for 18% of extrapulmonary cases. The next three most common sites were pleural, peritoneal, and genitourinary sites, affecting 11%, 8%, and 6% of extrapulmonary TB cases, respectively. Note that a person can have more than one extrapulmonary site of disease.

A quarter of TB patients from 2014-2018 had a more unique site of disease, including, but not limited to, eye and eye appendages, brain, liver, spleen, and blood.
Extrapulmonary TB occurs more frequently among non-US-born persons than among US-born TB cases. Consequently, due to the large proportion of TB cases in Minnesota that occur among non-US-born persons, extrapulmonary TB is more common in Minnesota than nationally (46% of Minnesota cases in 2018, compared to only 31% of US cases in the same period, had extrapulmonary disease). Just over half of non-US-born TB cases reported in Minnesota from 2014 through 2018 had an extrapulmonary site of disease, as compared to only 24% of US-born cases. This slide illustrates the need, especially in Minnesota, for clinicians to have a high index of suspicion for TB particularly for non-US-born patients, even when the patient does not present with a cough or abnormal chest radiograph or other common signs and symptoms of pulmonary TB.
This slide shows the proportions of TB cases reported in Minnesota from 2014 through 2018 who met the various hierarchical levels of the national surveillance case definition for reportable TB disease. About 80% of Minnesota’s TB cases were laboratory-confirmed: counted on the basis of a culture that was positive for *Mycobacterium tuberculosis* complex, or less commonly, a positive nucleic acid amplification test for TB, or demonstration of acid-fast bacilli when cultures could not be done. Lab tests were either negative for *M. tuberculosis* complex or not done in the remaining 19% of cases. Most of those patients (16% of all cases) met the clinical component of the national TB case definition: they had a positive tuberculin skin test (TST) or positive interferon gamma release assay (IGRA, or TB blood test), but no laboratory confirmation of TB. Clinical cases also must have signs or symptoms of TB, and be on anti-TB treatment. Very few (3%) cases met neither the laboratory nor the clinical case criteria and, therefore, were counted solely on the basis of a provider diagnosis.
Identification of *Mycobacterium tuberculosis* (or related species known to cause active TB disease, collectively called the *M. tuberculosis* complex) grown in culture from a clinical specimen is the “gold standard” for definitive diagnosis of TB disease, although the national surveillance case definition also allows cases to be counted on the basis of other criteria, as seen in the previous slide. Culture confirmation of TB disease is critically important for the clinical management of TB cases, because most drug susceptibility testing is performed on isolates grown in culture. Also, for pulmonary TB cases, documentation of the conversion of an initially positive sputum culture to a negative culture is an important marker of successful response to TB treatment.

Genetic sequencing is routinely performed on isolates to support or rule out related clusters of cases, which helps prioritize interventions to prevent ongoing transmission.

Seventy-eight percent of TB cases reported in Minnesota from 2014 through 2018 were confirmed by the identification of *M. tuberculosis* complex from culture, while 18% had negative culture results. Initial mycobacterial culture was not performed or culture results were not reported for about 4% of cases.
Persons with TB in the lungs or larynx may be infectious or able to transmit TB to others. The detection of acid-fast bacilli (AFB) in smears of sputum specimens obtained from a patient with pulmonary or laryngeal TB disease is one indicator of the patient’s level of infectiousness. Patients with positive AFB smears from sputum are considered potentially infectious. Although transmission of TB bacteria from sputum AFB smear-negative patients has been documented, such patients are less likely than sputum AFB smear-positive patients to be infectious.

Among 542 patients with pulmonary TB disease reported in Minnesota from 2014 through 2018, 69% had at least one initial sputum specimen with an AFB-positive smear result, and thus potentially able to spread TB to others prior to receiving several weeks of adequate treatment for TB disease. Fourteen percent had no initial sputum smear result reported. The majority (62%) of these pulmonary patients without sputum smear results were children under the age of 15 years; this reflects the difficulty in obtaining sputum specimens for laboratory confirmation in many pediatric cases. Gastric aspirates are usually recommended for young children.
A posterior-anterior radiograph of the chest is one of the primary diagnostic tests performed to detect abnormalities 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 increase the likelihood of infectiousness in TB patients.

Among 541 pulmonary TB cases with chest reported in Minnesota from 2014 through 2018, the vast majority (98%) had findings from chest imaging (chest x-ray or chest CT scan) consistent with TB disease, including 180 (33%) patients with cavitary lesions. Two percent of pulmonary TB cases had chest imaging results that were normal or not consistent with TB disease.
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 2014 through 2018. Drug susceptibility testing is performed on all culture-confirmed TB cases reported in Minnesota unless an isolate is unavailable for testing. Among culture-confirmed TB cases, 20% were resistant to at least one first-line anti-TB medication [i.e., isoniazid (INH), rifampin (RIF), pyrazinamide (PZA), or ethambutol (EMB)]. This includes 13% of cases who were resistant to at least INH and 4% who were multidrug-resistant (MDR-TB), which is defined as resistance to at least isoniazid and rifampin, two of the most effective TB medications. There were no cases in this time period with extensively drug-resistant TB (XDR-TB), which is a type of MDR-TB with additional resistance to any fluoroquinolone and at least one of three injectable second-line medications.

There was a substantial increase in MDR-TB in Minnesota beginning in 2016 largely due to an outbreak. Four cases related to the outbreak were diagnosed in 2016, six in 2017, and three in 2018. In 2018, Minnesota accounted for 7% of the MDR TB cases reported nationally, despite accounting for only 2% of TB cases overall.
This slide shows the total burden of MDR TB in Minnesota in the past 5 years. For surveillance purposes, only drug-susceptibility testing results from initial cultures count towards official cases reported to CDC as MDR TB as depicted in the previous slide. MDR TB patients included in this slide that did not meet CDC’s surveillance criteria include: cases who are treated for “presumed” MDR TB, primarily young children who are contacts to MDR TB cases and cannot produce adequate respiratory specimens; “acquired” MDR TB, cases who develop resistance due to inadequate treatment during therapy for active TB; and “non-countable” cases who were reported by another jurisdiction and moved to Minnesota during treatment or were on TB treatment within the 12 months prior to their most recent TB diagnosis (termed “relapse” cases). Non-countable cases are not reflected in Minnesota’s reported case numbers elsewhere throughout this slide set.
Among culture-confirmed TB cases reported in Minnesota from 2014 through 2018, non-US-born cases were approximately two times more likely than US-born cases to be resistant to any first-line anti-TB drug and 1.6 times more likely than US-born cases to be resistant to isoniazid (INH), in particular. The rate of MDR-TB was two times higher among those born outside the US compared to US-born cases. This difference in MDR-TB rates was largely a result of the outbreak that started in 2016, which mostly involves non-US-born patients.

<table>
<thead>
<tr>
<th>Place of birth</th>
<th>Cases With Susceptibility Results*</th>
<th>Any Drug Resistance† No. (%)</th>
<th>INH-Resistant** No. (%)</th>
<th>MDR-TB‡ No. (%)</th>
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</thead>
<tbody>
<tr>
<td>Non-US-Born</td>
<td>543</td>
<td>118 (22)</td>
<td>77 (14)</td>
<td>23 (4)</td>
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<tr>
<td>US-Born</td>
<td>87</td>
<td>10 (11)</td>
<td>8 (9)</td>
<td>2 (2)</td>
</tr>
<tr>
<td>Total</td>
<td>630</td>
<td>128 (20)</td>
<td>85 (13)</td>
<td>25 (4)</td>
</tr>
</tbody>
</table>

* Culture-confirmed cases with drug susceptibility results available
† Resistance to at least one first-line anti-TB drug [i.e., isoniazid (INH), rifampin (RIF), pyrazinamide (PZA), or ethambutol (EMB)]
** INH-resistant cases may also be resistant to other drugs
‡ Multi-drug resistant TB, defined as resistance to at least INH and rifampin
As mentioned previously, the three public TB clinics that manage patients with active TB disease are located in Hennepin, Ramsey and Olmsted counties. From 2014 to 2018, 55% of all TB patients were followed by at least one of these public clinics at some point in their disease course, while 45% were followed solely by private clinics or hospitals, or, less commonly, by Veteran Administration hospitals, correctional facility medical staff, or Indian Health Service. In 2018, the percentages were 54% and 46%, respectively.
The last two slides present data on the treatment of TB cases in Minnesota.

This slide presents the mode by which TB treatment was administered for TB cases reported in Minnesota from 2014 through 2018. On average, over 99% of cases received at least some portion of their TB medication through Directly Observed Therapy (DOT). DOT, which involves having a health care provider or trained outreach worker observe a TB patient taking each dose of TB medications, is the recommended standard of care for the treatment of TB disease. During this five-year period, at most only 2% of TB cases reported each year self-administered their entire course of TB treatment. The widespread use of DOT in Minnesota is facilitated by the work of the local and tribal public health nurses in each county who are primarily responsible for administering DOT for TB cases in their jurisdictions.

Local and tribal public health departments throughout Minnesota provide DOT at no cost, regardless of whether the patient is being treated by a private or public provider. This slide illustrates that, among TB cases reported in Minnesota from 2014 through 2018, the use of DOT was more common among patients who received treatment for TB disease at public health clinics than among patients who received TB treatment exclusively from private clinicians. Treatment for 3% of TB cases managed by private providers was exclusively self-administered, whereas only one TB case (accounting for <1%) treated at public TB clinics received self-administered therapy exclusively.
This last slide presents the outcome of treatment for the TB cases reported in Minnesota from 2013 to 2017 for whom 12 months or less of treatment was indicated. (2017 is the most recent annual cohort of patients for whom data on treatment outcome is complete.) This slide excludes patients with rifampin-resistant or meningeal TB, TB in the bone or central nervous system, and pediatric patients with disseminated TB, all of whom require a longer course of treatment. It also excludes patients who died or moved outside of the U.S. within one year of starting treatment. While most uncomplicated cases of TB disease are eligible for 6-9 months of treatment, the Centers for Disease Control and Prevention (CDC) has established an objective of 95% of TB cases completing adequate therapy within 12 months by 2020, which allows a margin of error for the often unavoidable obstacles that can prolong therapy.

These data indicate that the great majority (94%) of eligible TB cases reported in Minnesota from 2013 to 2017 successfully completed an adequate course of treatment within one year, very close to meeting the CDC objective for 2020. When looking at whether these eligible cases have ever completed a full course of TB treatment, regardless of duration, the proportion increases to 98%.

<table>
<thead>
<tr>
<th>Year</th>
<th>Started Treatment*</th>
<th>Completed Within 12 mos.** No. (%)</th>
<th>Completed Overall** No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>125</td>
<td>118 (94)</td>
<td>123 (98)</td>
</tr>
<tr>
<td>2014</td>
<td>122</td>
<td>113 (93)</td>
<td>120 (98)</td>
</tr>
<tr>
<td>2015</td>
<td>125</td>
<td>119 (95)</td>
<td>122 (98)</td>
</tr>
<tr>
<td>2016</td>
<td>138</td>
<td>130 (94)</td>
<td>132 (96)</td>
</tr>
<tr>
<td>2017</td>
<td>138</td>
<td>132 (96)</td>
<td>137 (99)</td>
</tr>
<tr>
<td>Total</td>
<td>648</td>
<td>612 (94)</td>
<td>634 (98)</td>
</tr>
</tbody>
</table>

* Patients for whom < 12 months of therapy is indicated. This excludes: patients with rifampin resistance, meningeal TB, TB in bone or skeletal system, TB in CNS, children 14 years of age or younger with disseminated TB, patients who died or moved out of US within 366 days of starting treatment.

** Treatment completion data as of 11/7/2019