

# Tuberculosis in Colorado

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2018



**COLORADO**  
Department of Public  
Health & Environment

[colorado.gov/cdphe/tb](http://colorado.gov/cdphe/tb)

# Summary

In Colorado, 64 people were diagnosed with tuberculosis (TB) disease in 2018, a decrease of 24% from the 84 reported in 2017 ([Figure 1](#) and [Table 1](#)). The Colorado case rate decreased to 1.1 per 100,000 people (the lowest rate on record) from 1.5 per 100,000 people in 2017. The U.S. case rate was 2.8 per 100,000 people according to the [March 2019 TB report](#) from the Centers for Disease Control and Prevention (CDC), ([Figure 2](#)). Although the number of new TB patients in Colorado has fluctuated over the past ten years, incidence of TB disease has declined approximately 54% from 2001.

Fourteen (22%) of the state's 64 counties reported at least one person with TB disease in 2018. There were 14 new patients reported in Denver County, the most of any single Colorado county followed by Adams County with 12 and Arapahoe County with 10. Seventy-two percent of all TB patients were reported in the Denver-Metro area (defined as Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, and Jefferson counties). Over half (56%) of Colorado's counties (36 of 64) have reported at least one new patient with TB disease in the past 10 years (2009-2018) ([Table 1](#)).

In 2018, TB disease burden in Colorado remained highest among racial and ethnic minorities ([Figure 4](#)), which is consistent with national epidemiologic trends. Though comprising only 31% of the state's population, 89% of new TB patients were racial and ethnic minorities. The largest change among demographic groups was in the Asian population (30 patients in 2018, up from 25 in 2017). Having a diabetes diagnosis is the strongest medical risk factor for developing TB disease (13% of all patients in 2018). In addition, birth in one of the [30 countries with highest TB burden](#), as defined by the World Health Organization, remains a strong risk factor, comprising 38% of all patients in 2018 ([Table 2](#) and [Figure 11](#)).

In 2018, TB disease was reported among people ranging in age from 18 to 88 years, with an average age of 49 years ([Figure 7](#)). The largest percentage (36%) occurred in the 25-44 year age group (down from 41% in 2017). It was encouraging that no patients were diagnosed in the under-15-year age group. TB disease in children is particularly concerning because it indicates ongoing transmission in the community as well as evidence of missed opportunities for prevention. Fifty-six percent of new TB patients were female, and 44% were male ([Figure 8](#)).

Drug susceptibility testing is recommended for all culture-positive TB patients in the U.S. In 2018, 50 patients were culture-positive for TB and all 50 had drug susceptibility results. Seven (14%) of the 50 patients were resistant to one or more first-line TB drugs (isoniazid-INH, rifampin-RIF, pyrazinamide-PZA, ethambutol-EMB). There was no multi-drug resistant (MDR) TB (defined as being resistant to at least INH and RIF), or extensively drug resistant (XDR) TB (defined as being resistant to isoniazid and rifampin, plus any fluoroquinolone and at least one of three injectable second-line drugs [i.e., amikacin, kanamycin, or capreomycin]) identified in 2018 ([Figure 13](#)).

TB drug treatment is lengthy, so completion rates are pending for 2018. Of the 84 TB patients reported in 2017, the most recent year where final completion data are available, 82 initiated treatment (the other two patients were dead at diagnosis). Seventy (85%) completed treatment; three moved out of the U.S. (completion data not available), two were lost to follow-up, five died during treatment, and two did not complete treatment ([Figure 15](#) and [Figure 16](#)). All new patients reported in 2018 initiated treatment.

Except for 2017, TB disease incidence remained steady over the past five years in Colorado. Colorado's TB elimination plan guides and informs programming to support people and populations at increased risk for developing TB disease as well as the providers who care for them. A key goal of the plan is to encourage people at risk to "know their TB status" while increasing public and private provider capacity to screen, test and treat for TB infection.

The key path to TB elimination in Colorado will be to identify and treat people with TB infection who are at elevated risk of developing TB disease. Timely evaluation of people identified as contacts to an infectious TB patient and those who arrive in Colorado with a Class B TB designation (defined as being known to be non-infectious but in need of additional TB evaluation) will allow us to identify and treat additional patients with TB disease and TB infection. The Colorado Department of Public Health and Environment acknowledges that generations-long social, economic and environmental inequities result in adverse health outcomes including TB infection and disease. These inequities affect communities differently and have a greater influence on health outcomes than either individual choices or a person's ability to access health care. Reducing the health disparities that can lead to TB infection and disease through policies, practices and organizational systems can help improve opportunities for all Coloradans. The TB elimination plan is available on the TB Program website <https://www.colorado.gov/pacific/cdphe/tb>.

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**On the cover:** A digitally colorized scanning electron microscopic image of a group of *Mycobacterium tuberculosis* bacteria, which cause tuberculosis (TB) in human beings. Photo from the Centers for Disease Control and Prevention.

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# TB Cases and Rates

In 2018, 64 people were diagnosed and reported with tuberculosis disease (TB) in Colorado, a decrease of 24% from 2017. Although the number of patients has declined between 2007 and 2018, the decline has leveled off since 2012. Further progress towards the CDC TB elimination goal of 1 case per million (~5-6 cases per year) in Colorado will require continued vigilance of the current public health TB control model in addition to investment in new interventions and expansion to and collaboration with private health care partners. Overall, the number of patients and corresponding case rates are trending down in Colorado as the linear trend lines in Figures 1 and 2 illustrate.

Figure 1. Number of TB Patients and Trend Line: Colorado 1999-2018

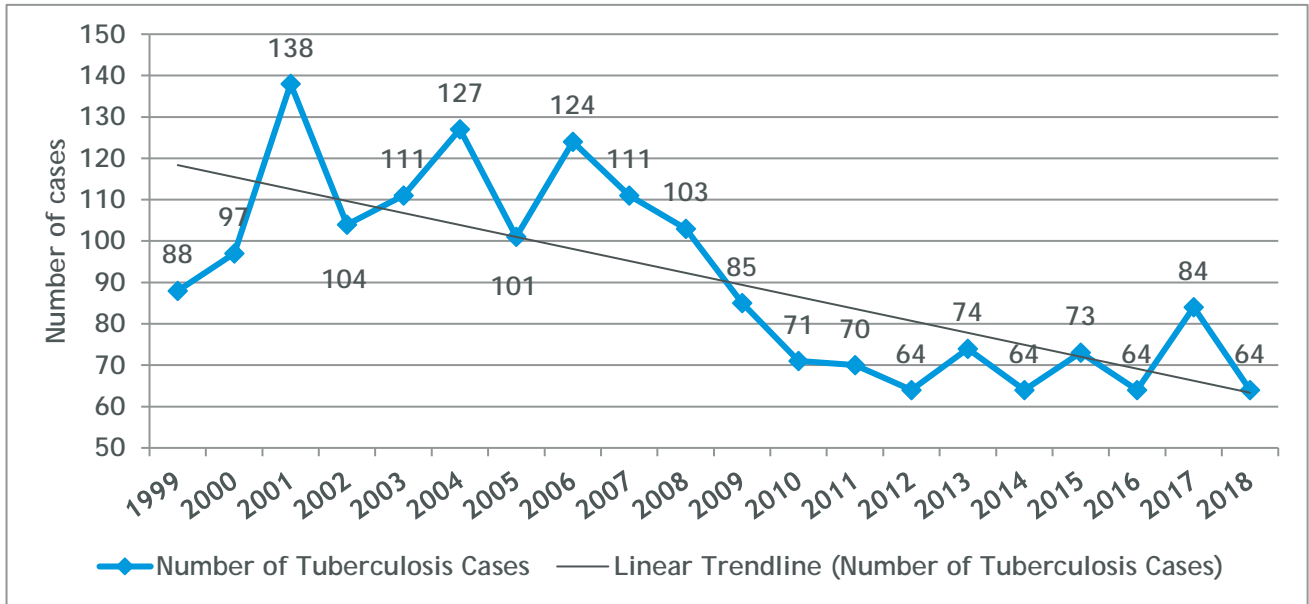
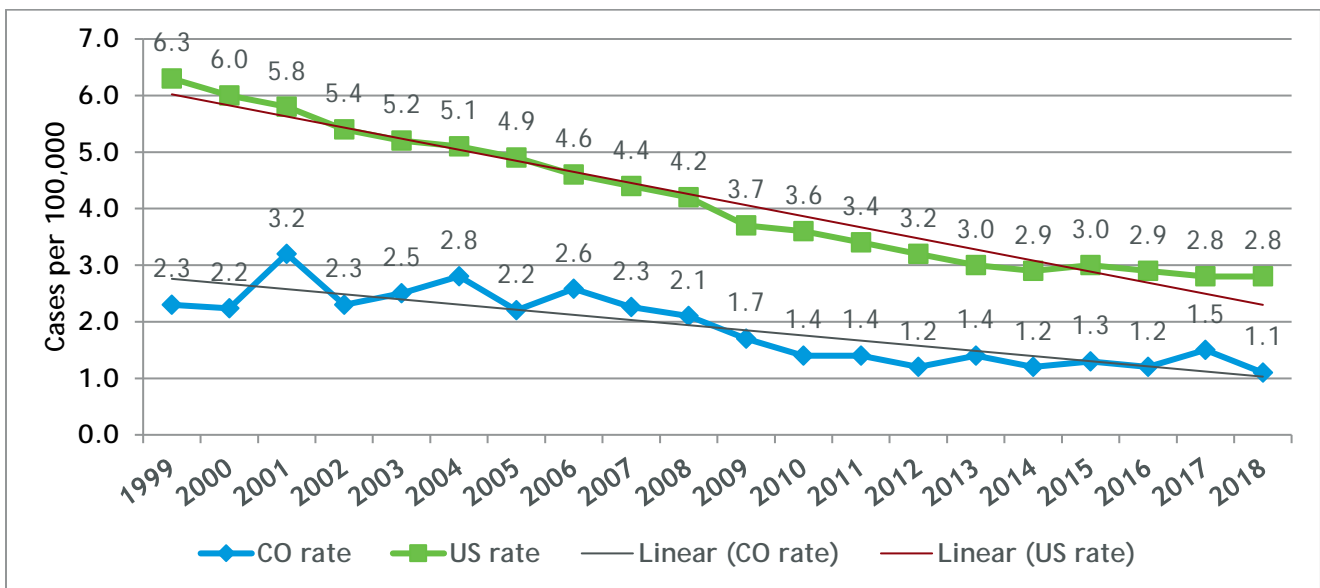


Figure 2. Case Rates per 100,000 People in the U.S. and Colorado 1999-2018



# TB by County and Demographic Characteristics

Fourteen of Colorado's 64 counties reported at least one new person with TB disease in 2018. Denver County reported 14; followed by Adams (12), Arapahoe (10), and Boulder and El Paso counties (five each) (Figure 3). Thirty-six of Colorado's 64 counties have reported at least one new person with TB disease in the past ten years (Table 1). Table 2 offers a comparison between the demographics of 2017 and 2018 TB patients.

Figure 3. Tuberculosis Disease Patients by County: Colorado 2018

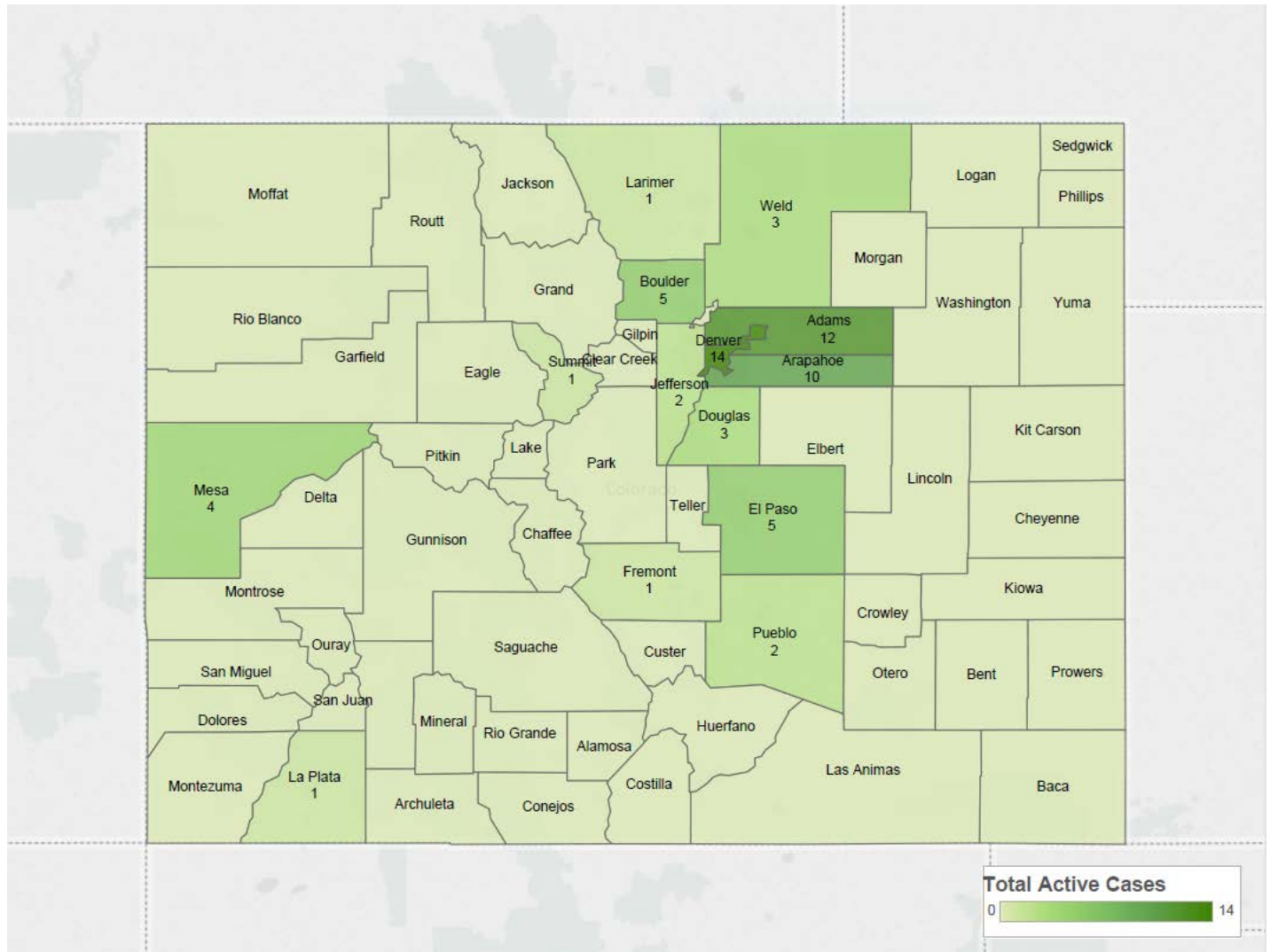


Table 1. TB in Colorado: Cases by County and Year of Report 2009-2018

County <sup>a</sup>	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018 <sup>b</sup>	5-Year Case Rate 2014-2018 <sup>cd</sup>
Adams	4	7	12	7	7	7	7	4	6	12	1.4
Arapahoe	11	17	5	11	14	14	14	18	19	10	2.4
Archuleta	0	0	0	0	1	0	0	0	0	0	0.0
Baca	0	0	0	0	1	0	0	0	0	0	0.0
Boulder	3	0	5	9	6	3	5	0	5	5	1.1
Broomfield	0	1	0	0	1	0	1	0	0	0	0.3
Clear Creek	1	0	0	0	0	0	0	0	0	0	0.0
Delta	1	0	0	0	0	0	0	0	0	0	0.0
Denver	29	23	21	10	21	23	17	22	25	14	2.9
Douglas	4	1	2	1	2	1	8	1	0	3	0.8
Eagle	2	0	0	1	0	1	1	0	0	0	0.7
El Paso	7	8	7	5	8	1	3	3	10	5	0.6
Fremont	1	1	0	0	0	0	0	0	1	1	0.8
Garfield	2	0	0	0	0	1	2	2	1	0	2.0
Gunnison	2	0	0	0	0	0	0	0	0	0	0.0
Huerfano	0	1	0	0	0	0	0	0	0	0	0.0
Jefferson	8	0	8	3	2	4	3	3	3	2	0.5
Kit Carson	0	1	0	0	0	0	0	0	0	0	0.0
La Plata	0	0	0	1	0	0	0	0	0	1	0.4
Larimer	2	5	2	4	3	1	2	4	1	1	0.5
Las Animas	2	0	0	0	0	0	0	0	0	0	0.0
Logan	0	0	0	0	0	1	0	1	0	0	1.8
Mesa	1	0	1	1	2	0	1	1	0	4	0.8
Montrose	0	0	0	0	0	0	1	0	0	0	0.5
Morgan	1	0	2	1	0	1	0	1	2	0	2.8
Park	0	0	0	0	0	0	0	0	1	0	1.2
Pitkin	0	0	0	0	0	1	1	0	1	0	3.4
Prowers	0	0	0	0	2	0	0	0	0	0	0.0
Pueblo	1	2	1	1	2	2	3	2	3	2	1.5
Rio Grande	0	1	0	0	0	0	0	0	0	0	0.0
Saguache	0	0	0	0	1	0	2	0	0	0	6.3
San Miguel	0	0	0	0	0	0	0	1	0	0	2.5
Summit	0	1	0	1	0	0	0	0	1	1	1.3
Teller	1	0	0	1	0	0	1	0	0	0	0.8
Weld	2	2	4	7	0	3	1	1	4	3	0.8
Yuma	0	0	0	0	1	0	0	0	1	0	2.0
<b>TOTAL</b>	<b>85</b>	<b>71</b>	<b>70</b>	<b>64</b>	<b>74</b>	<b>64</b>	<b>73</b>	<b>64</b>	<b>84</b>	<b>64</b>	<b>1.3</b>

<sup>a</sup>Only counties reporting an active case of TB (2009-2018) are included.

<sup>b</sup> Highlighted counties reported at least one case of active TB in 2018.

<sup>c</sup>TB cases per 100,000 persons

<sup>d</sup> Population data for determining the case rates throughout this report are from the Colorado Division of Local Government, State Demography Office.

Table 2. Demographic Comparison of 2017 and 2018 Active TB Cases

	2017		2018	
	n	%	n	%
<b>Age Group (years)</b>				
<15	4	4.8	0	0
15-24	5	6.0	5	7.8
25-44	34	40.5	23	35.9
45-64	15	17.9	19	29.7
65+	26	31.0	17	26.6
<b>TOTAL</b>	<b>84</b>	<b>100</b>	<b>64</b>	<b>100</b>
<b>Gender</b>				
Male	47	56.0	28	43.8
Female	37	44.0	36	56.3
<b>TOTAL</b>	<b>84</b>	<b>100</b>	<b>64</b>	<b>100</b>
<b>Race/Ethnicity</b>				
White	12	14.3	7	10.9
Black or African American	20	23.8	4	6.3
Hispanic	24	28.6	22	34.4
American Indian or Alaska Native	1	1.2	1	1.6
Asian	25	29.8	30	46.9
Native Hawaiian or Other Pacific Islander	2	2.4	0	0
Multiple race/Unknown	0	0	0	0
<b>TOTAL</b>	<b>84</b>	<b>100</b>	<b>64</b>	<b>100</b>
<b>Region</b>				
Denver-metro <sup>a</sup>	58	69	46	71.9
Outside Denver-metro	26	31	18	28.1
<b>TOTAL</b>	<b>84</b>	<b>100</b>	<b>64</b>	<b>100</b>
<b>HIV Status</b>				
HIV Negative	80	95.2	62	96.9
HIV Positive	1	1.2	0	0
Testing done, results unknown	0	0	0	0
Refused testing	0	0	0	0
Not offered	3	3.6	2	3.1
<b>TOTAL</b>	<b>84</b>	<b>100</b>	<b>64</b>	<b>100</b>
<b>Risk factors<sup>b</sup></b>				
Birth in one of the 30 highest TB-burden countries <sup>c</sup>	27	32.1	24	37.5
Homeless within past year	4	4.8	4	6.3
Diabetes	17	20.2	8	12.5
Resident of correctional facility at diagnosis	3	3.6	2	3.1
Resident of long-term care facility	0	0	0	0
Injected drug use within past year	1	1.2	0	0
Non-injected drug use within past year	6	7.1	1	1.6
Excess alcohol use within past year	7	8.3	6	9.4
Health care worker within past year	1	1.2	0	0

Note: percentages may not equal 100 due to rounding.

a. Denver metro includes: Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas and Jefferson counties.

b. A case may have more than one risk factor indicated.

c. According to the World Health Organization's definition of 30 highest-burden countries [http://www.who.int/tb/publications/global\\_report/en/](http://www.who.int/tb/publications/global_report/en/) Annex 2. Country profiles



# TB by Race/Ethnicity

The number of people reported with TB in Colorado for the last decade has been highest among racial and ethnic minorities. Though comprising only 31% of the state's population, 89% of new TB disease occurred in racial and ethnic minority populations (Figure 4). At 3.3 cases per 100,000 people in Colorado, the case rate in racial and ethnic minorities is 16 times that of the majority white population (Figure 5).

Figure 4. TB Patients by Race/Ethnicity: Colorado, 2018

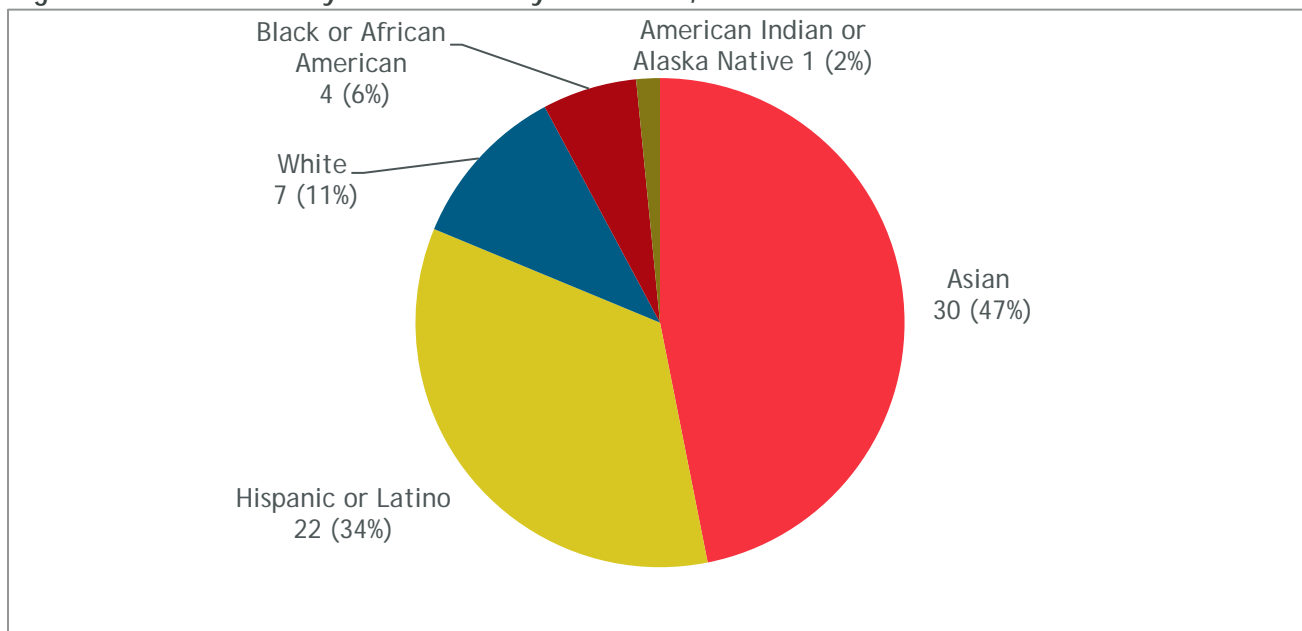
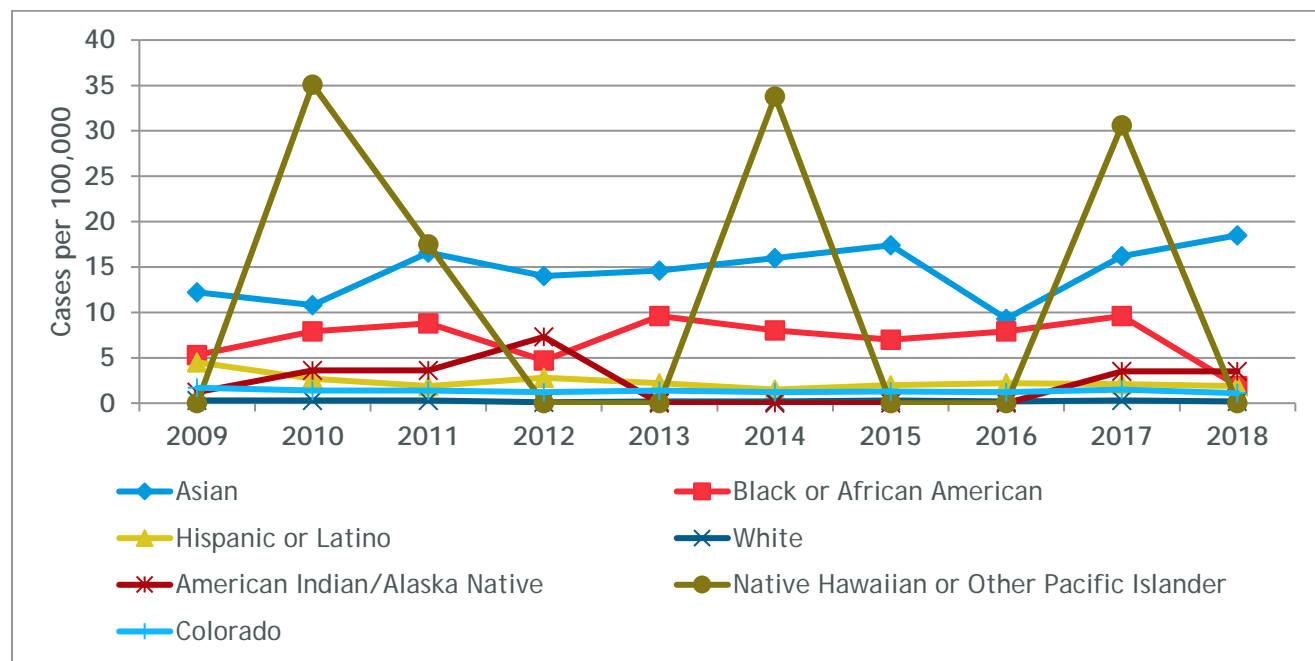


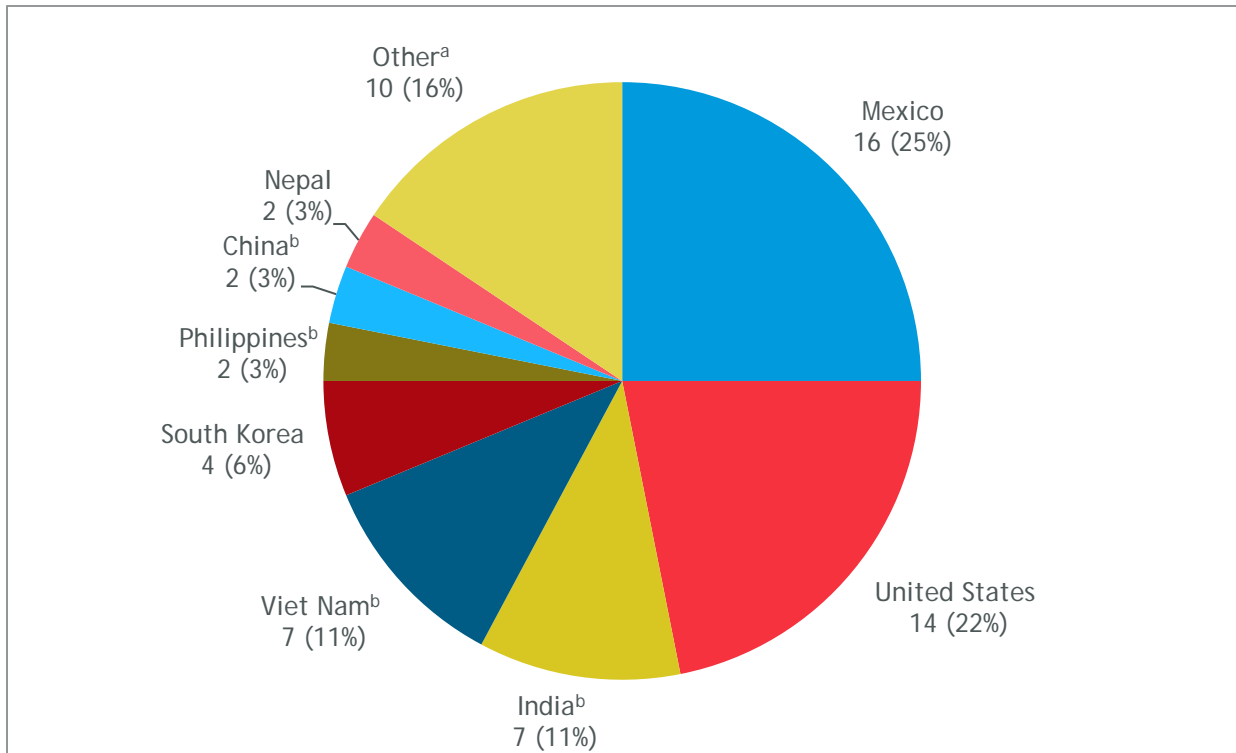
Figure 5. TB Case Rates by Race/Ethnicity: Colorado, 2009-2018



## TB by Country of Birth

TB disease was diagnosed in people originating from 18 different countries in 2018. The largest cohort came from Mexico with 16 people followed by the United States with 14. Of people born outside of the United States, 24 (38% of all patients) came from one of the [top 30 highest-burdened countries](#), which comprise 85-89% of all global TB disease according to the World Health Organization (WHO) (Figure 6).

Figure 6. TB Patients by Country of Birth: Colorado, 2018



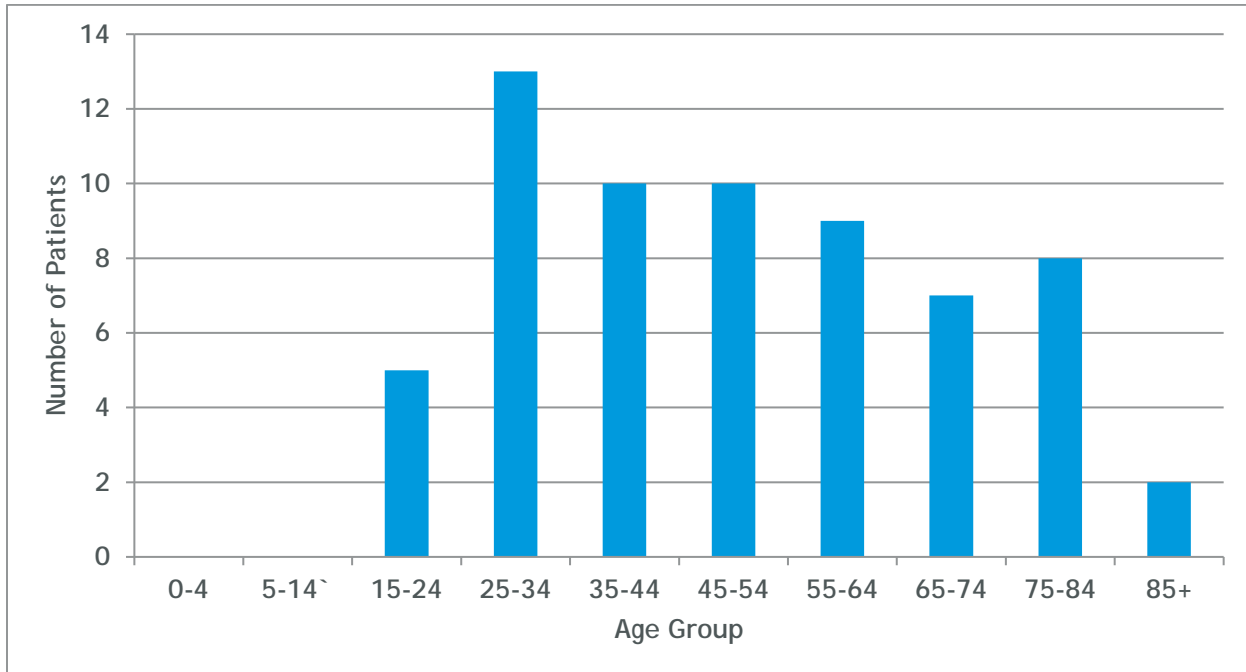
<sup>a</sup>Other countries: Afghanistan-1, Cambodia<sup>b</sup>-1, Central African Republic<sup>b</sup>-1, Cuba-1, Ethiopia<sup>b</sup>-1, Indonesia<sup>b</sup>-1, Laos-1, Nigeria<sup>b</sup>-1, Pakistan<sup>b</sup>-1, Somalia-1

<sup>b</sup>Denotes one of the 30 highest TB burden countries according to the World Health Organization ([http://www.who.int/tb/publications/global\\_report/en/Annex 2. Country profiles](http://www.who.int/tb/publications/global_report/en/Annex%20Country%20profiles))

## Tuberculosis by Age Group

In 2018, TB was reported among people ranging in age from 18 to 88 years. Thirty-six percent of TB occurred among people 25-44 years old, followed by those aged 45-64 years old (30%) and those 65+ years (26%). There were no children (<15 years of age) diagnosed with TB disease in 2018. This is encouraging because TB in children is a sign of recent transmission and missed opportunities for TB prevention (Figure 7).

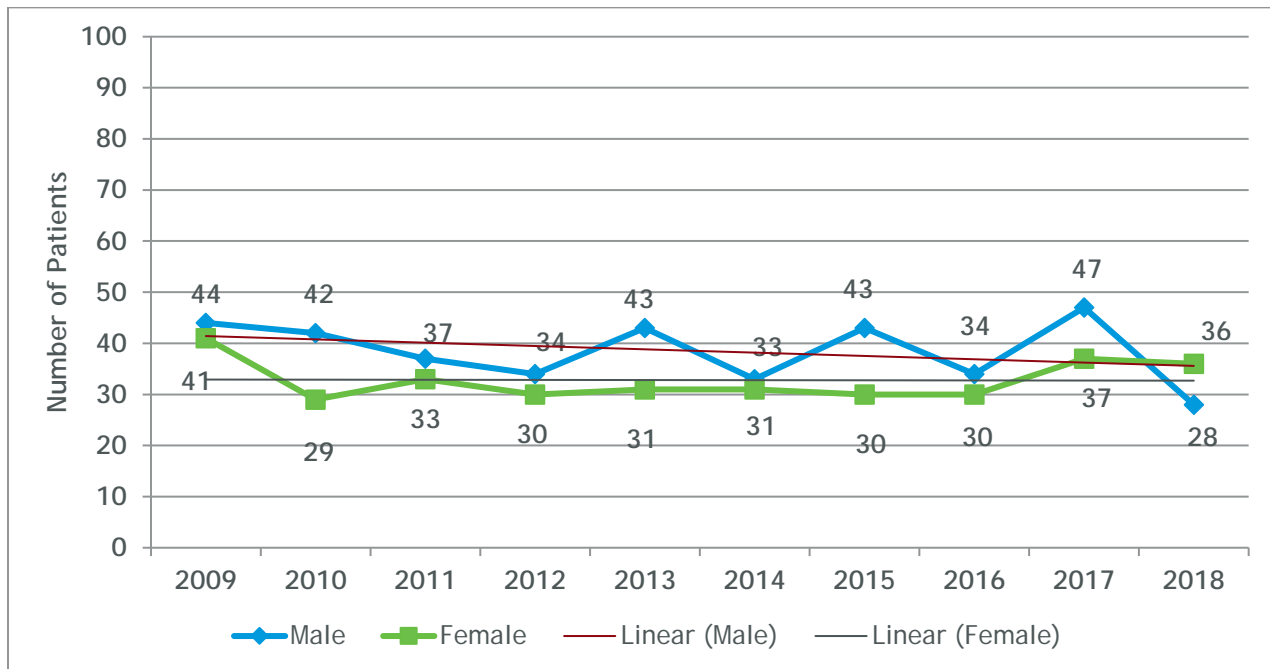
Figure 7. TB Patients by Age Group: Colorado 2018



## Tuberculosis by Gender

In most years, TB disease is diagnosed in males in greater numbers than females in Colorado; however, in 2018 56% of TB patients were females (Figure 8).

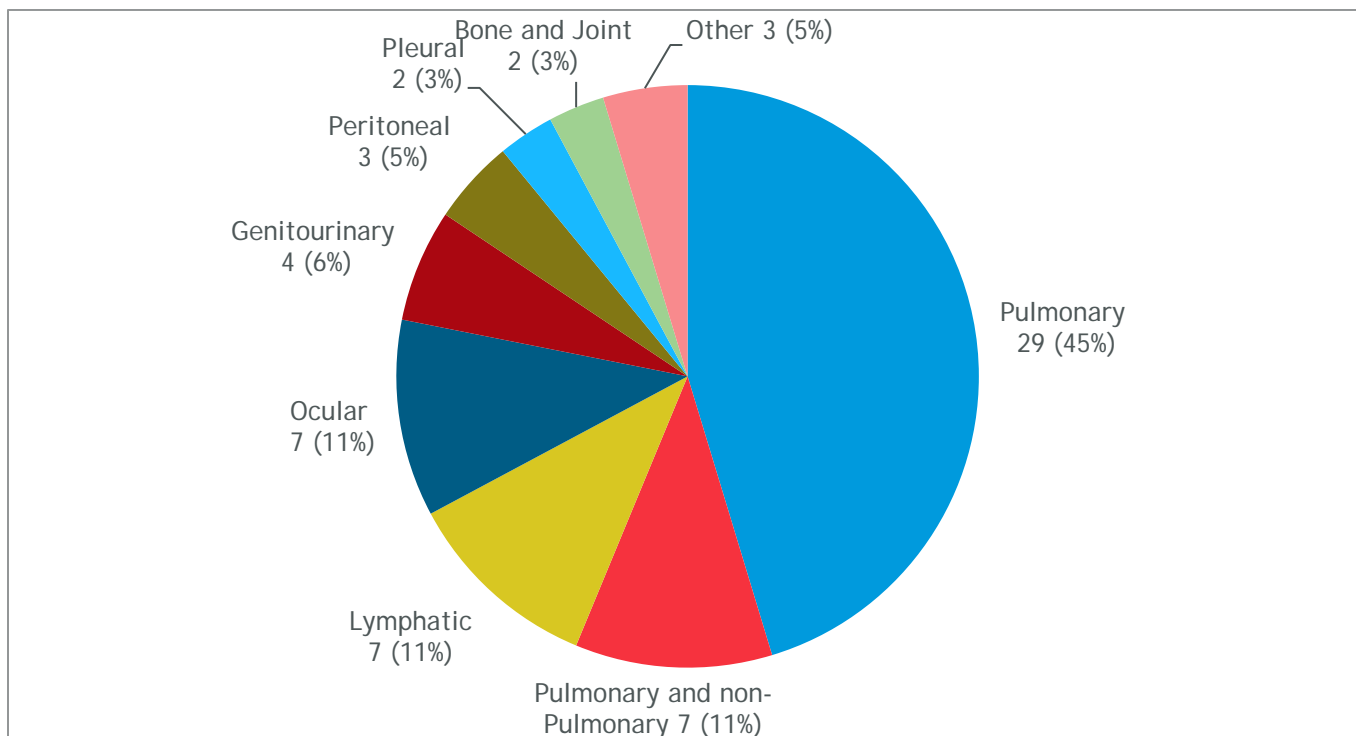
Figure 8. TB Patients by Gender: Colorado 2009-2018



## Tuberculosis Patients by Major Site of Disease

Tuberculosis most often attacks the lungs (pulmonary TB) but may also affect any part of the body (extra-pulmonary TB). In 2018, 36 of the 64 (43%) patients were found to have a pulmonary or both a pulmonary and extra-pulmonary site of disease. The next most common sites of infection in 2018 were lymphatic TB and ocular TB, both with 7 incidences (11%). Sites classified as “other” included cutaneous-2, and meningeal-1 (Figure 9).

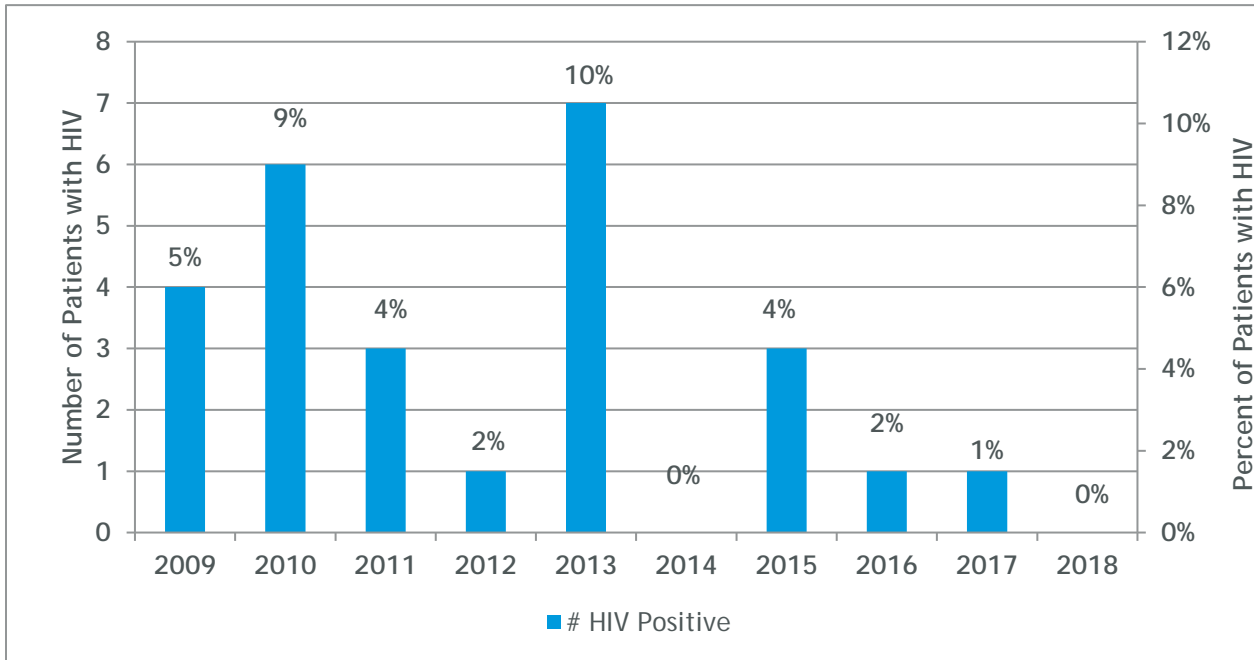
Figure 9. TB Patients by Major Site of Disease: Colorado 2018



## HIV Co-infection

Worldwide, one in four people with HIV who die of AIDS-defining conditions do so as a result of TB disease. HIV-infected people with TB infection are at higher risk of progression to TB disease because HIV weakens the immune system. Of the 64 people with TB in 2018, recent HIV test results were available for 62 (97% of total). No one was found to be co-infected with HIV in the 2018 cohort. Of the two people who were not tested one was not offered an HIV test and one was dead at diagnosis (Figure 10). Over the past 10 years, HIV/TB co-infection has fluctuated between seven patients in 2013 (10% of total) to zero patients in 2014 and 2018. When analyzing small numbers, the annual percentages can fluctuate widely and incidence rates, being unstable and imprecise, are likely to lack statistical significance (Figure 10).

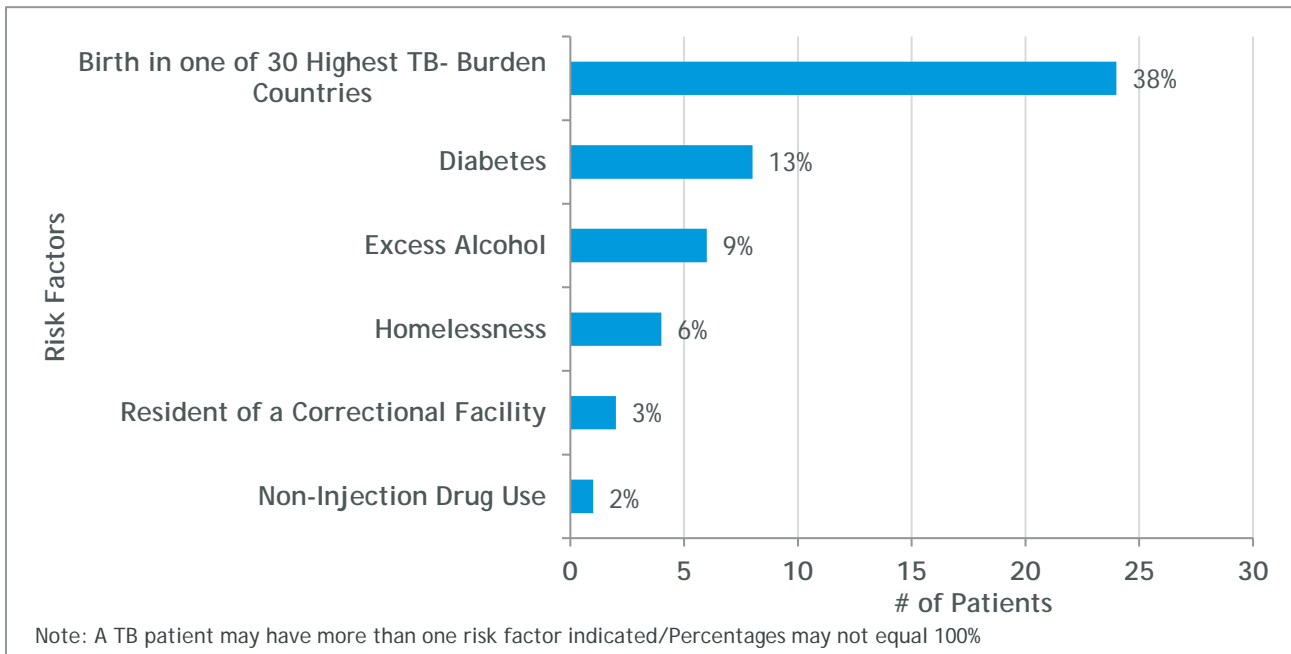
Figure 10. HIV-Positive TB Patients and Percentage of Annual Total: Colorado 2009-2018



## Risk Factors

In 2018, the most common risk factor for TB disease was birth in one of the [30 highest TB-burden countries](#), followed by a diabetes diagnosis (Figure 11).

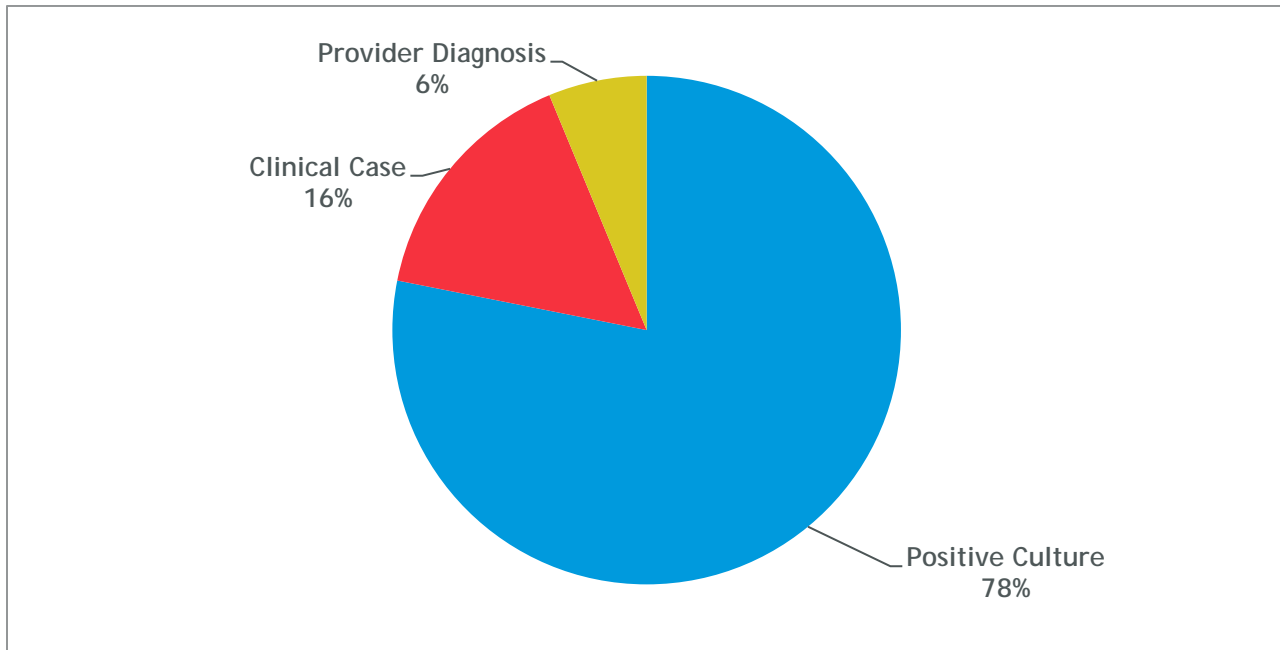
Figure 11. Risk Factors for TB: Colorado 2018



# Tuberculosis Case Verification

*Mycobacterium tuberculosis complex* was culture-positive in 78% of the TB patients in 2018. Another 16% met the clinical case definition (positive tuberculin skin test or interferon gamma release assay [IGRA] with an abnormal chest radiograph), and 6% were verified by provider diagnosis (Figure 12). For more information on verification criteria visit CDC's [website](#).

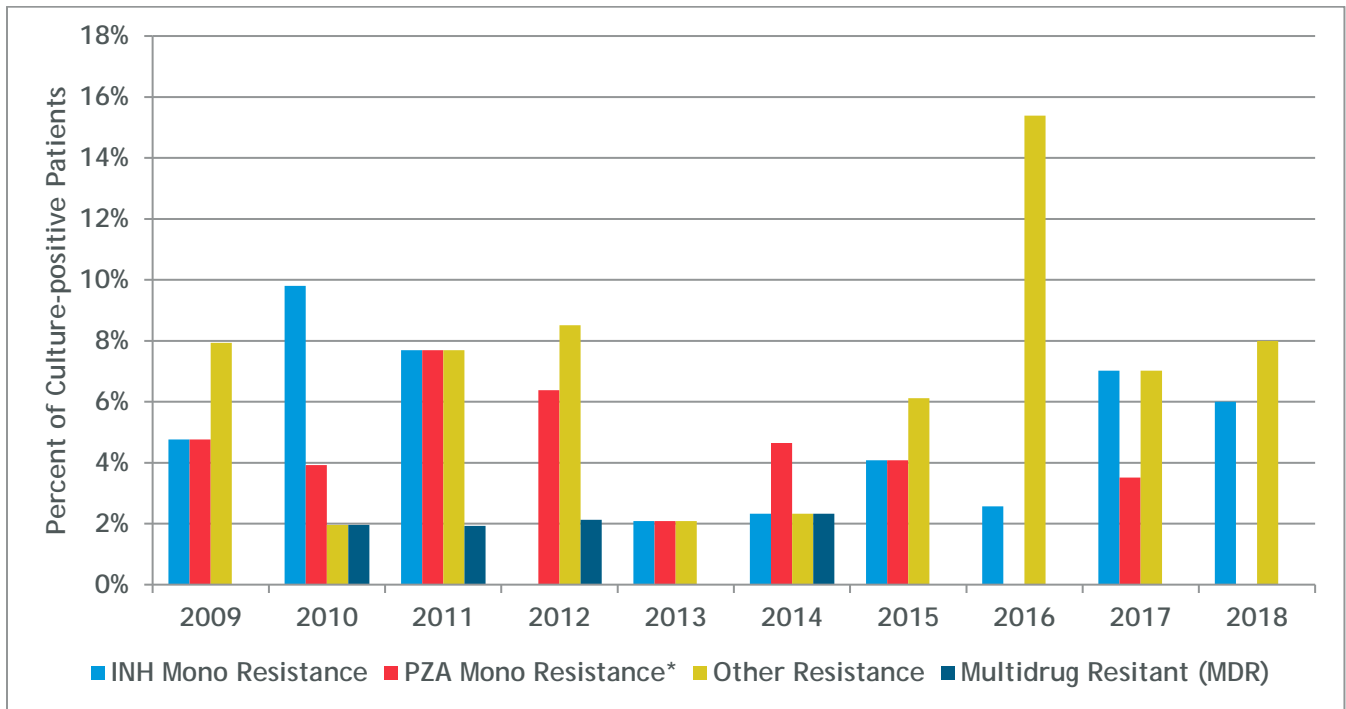
Figure 12. TB Patients by Verification Criteria: Colorado 2018



## Drug Resistance and Tuberculosis

Of the 64 new TB patients reported in 2018, 50 (78%) had a positive culture and of those, seven (14% of culture positive patients) were found to be resistant to one or more TB drugs. All seven were resistant to one or more of the four first-line TB drugs: isoniazid (INH), rifampin (RIF), pyrazinamide (PZA) and ethambutol (EMB). Of those seven patients, three had INH mono-resistance, two were resistant to INH and streptomycin, one was resistant to ethambutol and one was resistant to INH, PZA and a second line drug. There was no multi-drug resistant (MDR: defined as being resistant to at least INH and RIF), or extensively-drug resistant TB (XDR: defined as being resistant to isoniazid and rifampin, plus any fluoroquinolone and at least one of three injectable second-line drugs [i.e., amikacin, kanamycin, or capreomycin]) identified in 2018 (Figure 13).

Figure 13. TB Drug Resistance: Colorado 2009-2018

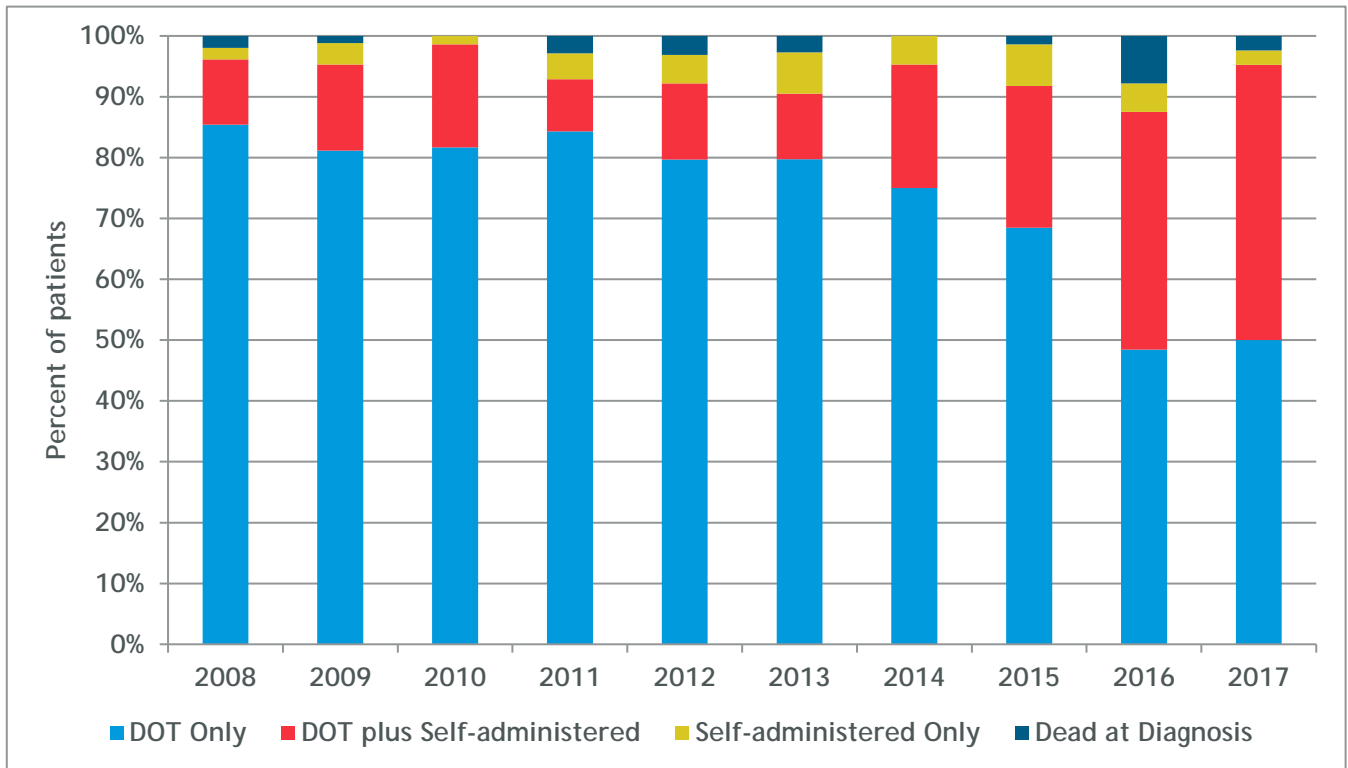


\*Isolates with PZA resistance may indicate *Mycobacterium Bovis*, a form of tuberculosis, which causes tuberculosis in humans, cattle, and mammals. It is characteristically resistant to PZA.

## Directly Observed Therapy

Directly observed therapy (DOT) is required for all patients with pulmonary TB in Colorado. DOT means health care workers observe the patient taking every dose of his/her TB medications. During 2017 (the most recent year with complete data), of the 82 patients who initiated treatment, 50% received medications via DOT, 2% self-administered medications (non-infectious extra-pulmonary patients) and 45% received a combination of DOT and self-administered therapy (Figure 14).

Figure 14. Mode of TB Therapy: Colorado 2008-2017

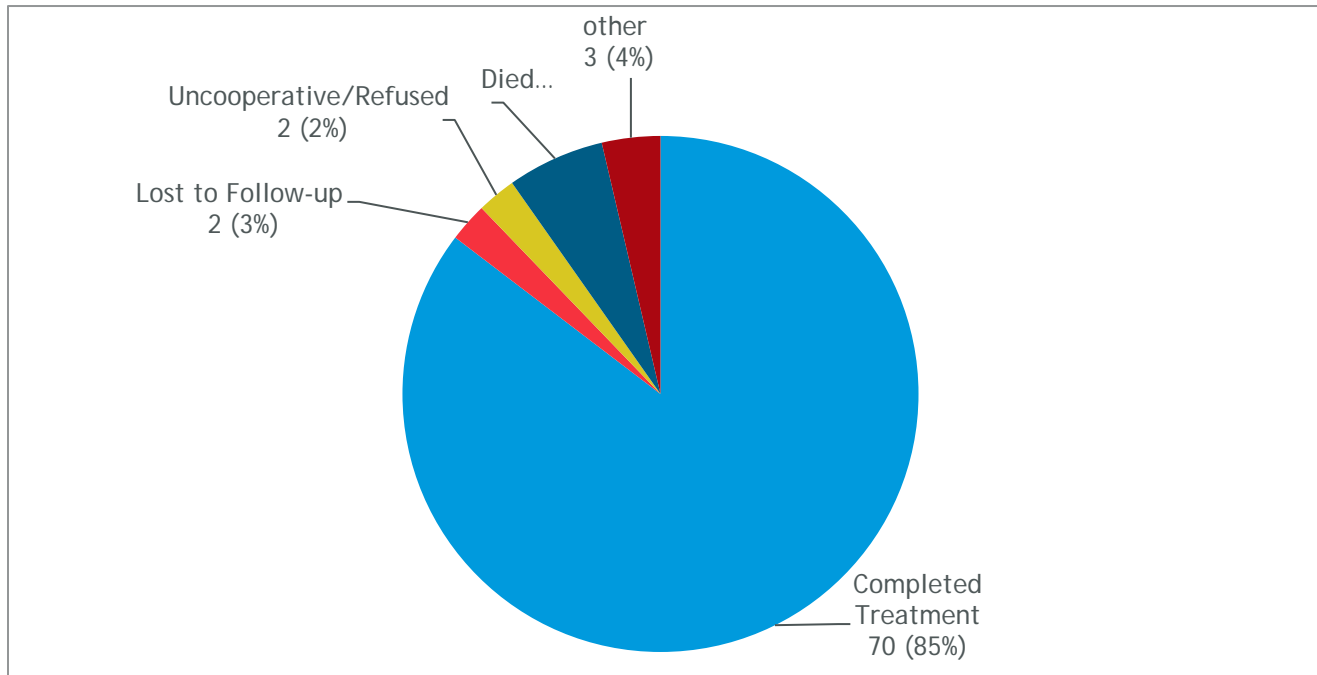


## Tuberculosis Treatment Outcomes

The standard treatment for TB disease is six months using isoniazid, rifampin, ethambutol and pyrazinamide. Of the 84 patients in 2017 (the most recent year with complete data), 82 TB patients (98%) initiated treatment (2 patients were dead at diagnosis). For those who initiated treatment, 70 completed; two were lost to follow-up; two did not complete a full course of treatment; three moved outside of the U.S. before treatment completion (completion data unavailable); and five died during treatment (Figure 15). All 2018 patients have initiated treatment.

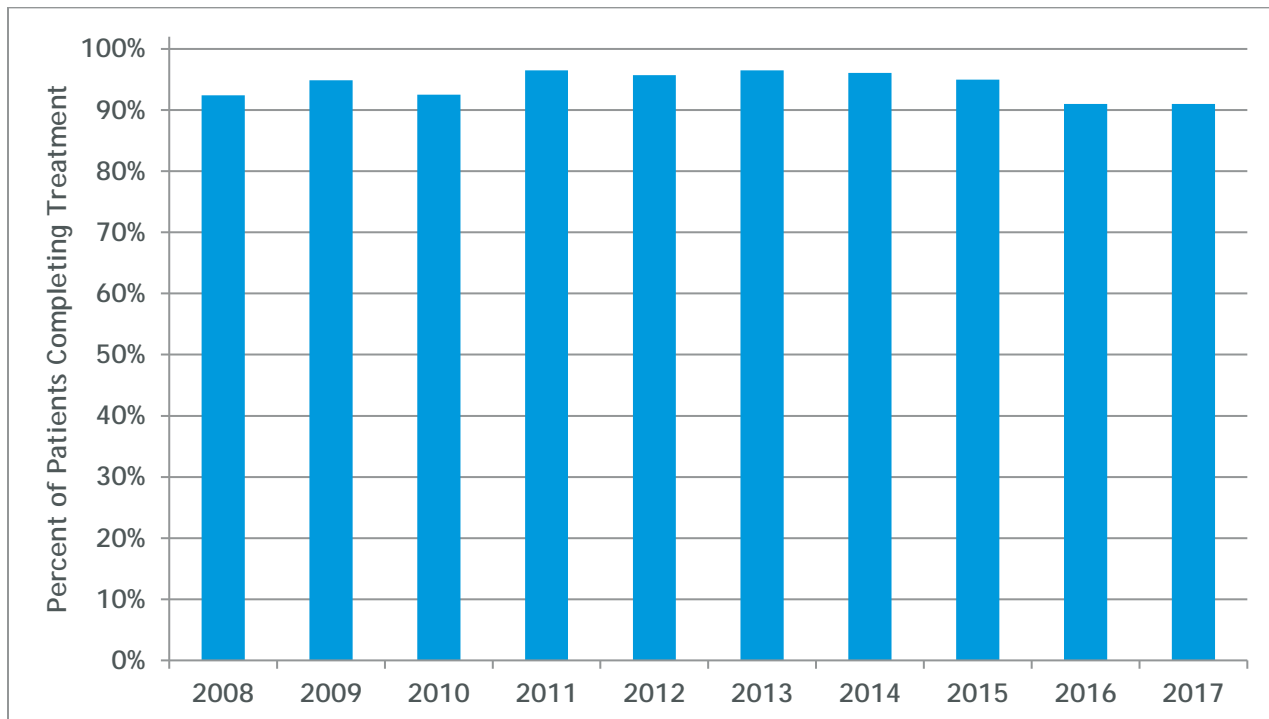


Figure 15. TB Treatment Outcomes: Colorado 2017



In 2017, there were 68 patients who were expected to complete TB treatment within one year of diagnosis and of those, 62 (91%) completed within that expected timeframe. Two others completed treatment in greater than one year, and four were either lost to follow-up or refused to complete treatment (Figure 16).

Figure 16. Completion of TB Treatment within One Year: Colorado 2008-2017



Note: Excludes patients with rifampin-resistant disease, patients with meningeal, bone and/or joint, or central nervous system disease, patients less than 15 years of age with disseminated tuberculosis disease, and patients that died less than one year after treatment initiation or moved out of the country.

# Cascade of Care for Individuals at High Risk for TB Infection

The key strategy for eliminating TB in Colorado is to identify and treat people with TB infection (also known as latent TB infection or LTBI) who are at high risk of developing TB disease. Timely evaluation of people identified as contacts to an infectious TB patient and of those who arrive in Colorado with a Class B TB designation is vital to the success of this strategy. Class B TB is designated in immigrants and refugees who are traveling to the United States. They are evaluated for TB prior to arrival as required by U.S. immigration law and are assigned a classification according to the status of their disease. CDC's Division of Global Migration and Quarantine notifies CDPHE's TB Program of all individuals who are known to be non-infectious but are in need of additional TB evaluation (referred to as Class B TB). By evaluating those at high risk, specifically contacts to pulmonary TB patients and Class Bs, and treating those diagnosed with TB disease and infection (Figure 17 and Table 3), further cases of TB disease will be prevented.

Figure 17. Cascade of Care for High Risk Individuals (Contacts and Class B TB): Colorado 2017

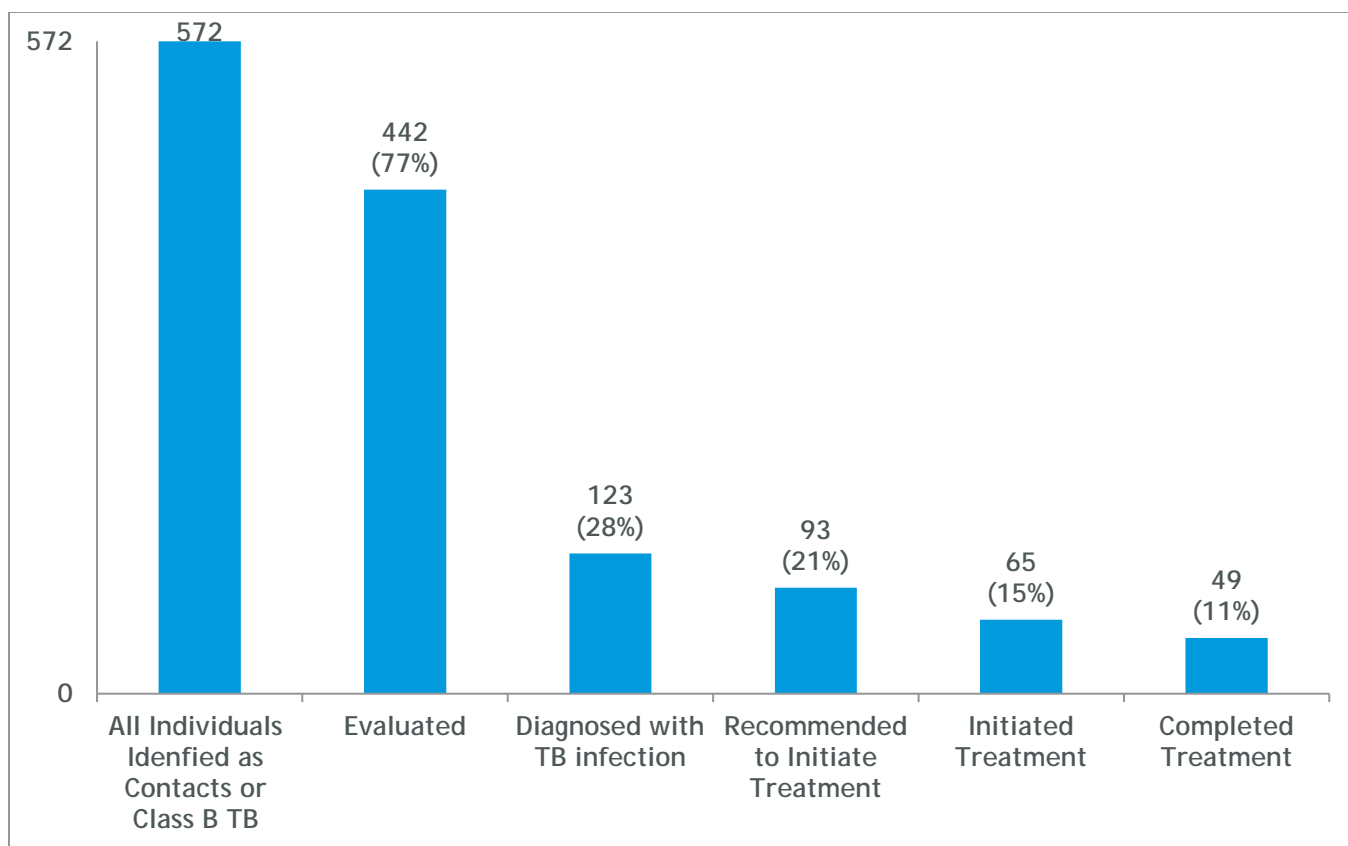


Table 3. Treatment Outcomes for High Risk Individuals (Contacts and Class B TB) Recommended to Initiate TB Infection Treatment: Colorado 2017

Outcomes	No.	(%)
Total Diagnosed with TB Infection	123	(100%)
Recommended to Initiate Treatment	93	(76%)
Initiated Treatment	65	(70%)
Completed Treatment	49	(75%)
<b>Did Not Complete Treatment (Reasons below)</b>		
Died	0	(0%)
Moved	2	(3%)
Developed TB disease	0	(0%)
Adverse Effect/s	0	(0%)
Patient Chose to Stop	3	(5%)
Lost to Follow-up	4	(6%)
Provider Decision to Stop	0	(0%)
Pending Outcome Documentation	7	(11%)

## Conclusions and Next Steps

The number of TB disease patients in Colorado decreased in 2018 from 2017. The case rate in Colorado decreased to 1.1 in 2018 from 1.5 per 100,000 in 2017, a 24% decline. To ensure a continued downward trend, private providers and local public health agencies must continue to identify and screen those most at-risk for TB infection and initiate treatment where appropriate in order to reduce the chance of developing TB disease. As the demographic breakdowns in this report attest, the key risk factors and the most at-risk groups for developing TB disease have been identified (see [Figures 5 and 11](#)). TB elimination plan activities initiated in 2018 include the expansion of comprehensive over-the-phone interpretation for non-English speaking TB patients as well as those presumptive for TB; the continued expansion of video directly-observed treatment services (V-DOT); and expanded access to reliable, no cost (to patient or local public health agency) TB blood testing services. Next steps for 2019-2020 include promoting and facilitating a regional collaboration model toward improving case management and community engagement activities in under-resourced jurisdictions; the continued expansion of V-DOT services to local public health agencies statewide; and pursuing opportunities to replicate the ongoing TB infection screening, testing and treatment pilot underway by a private healthcare provider network.

Monthly enhanced TB case management (ECM) sessions to educate providers and increase capacity among those caring for TB patients will continue. These ECM sessions allow non-Denver-metro LPHAs and providers that care for TB patients the opportunity to review current patients with subject matter experts from CDPHE and the Denver Metro TB Clinic via a web-based, HIPAA-compliant platform. Other plans include developing site-specific screening and testing algorithms to succinctly explain the chronological steps necessary for private providers to care for their TB-infected patients without over-burdening local public health agencies with referrals, as past practice dictated.

It will be both a challenge and an opportunity to engage affected communities and populations in TB elimination activities. CDPHE's TB Training and Education Coordinator will spearhead the planning, collaboration, and implementation of these activities. Community participation is essential to developing meaningful messaging that will resonate with individuals at-risk for TB infection and progression to TB disease. Colorado's TB stakeholders look forward to working with new partners with a shared vision of reduced TB morbidity and mortality among Coloradans. Reducing health disparities through improved policies, practices and organizational systems will benefit the entire state and help in the improved TB-specific health outcomes for all Coloradans impacted by the top infectious disease killer in the world.

Colorado's TB elimination plan is available on the TB Program website <https://www.colorado.gov/pacific/cdphe/tb>.