



Tuberculosis in Colorado 2016



COLORADO
Department of Public
Health & Environment

colorado.gov/cdphe/tb

Summary

In Colorado, 64 people were diagnosed with active tuberculosis (TB) disease in 2016, a decrease of 12 percent from the 73 reported in 2015 (Figure 1 and Table 1). The overall case rate decreased to 1.2 per 100,000 persons from 1.3 per 100,000 persons in 2015. This compares to the U.S. case rate which is 2.9 per 100,000 persons according to the March 2016 TB report from the Centers for Disease Control and Prevention (CDC) (Figure 2). Although the number of cases in Colorado has fluctuated over the past six years, TB cases have declined approximately 50 percent from 2001.

Fourteen (22 percent) of the state's 64 counties reported at least one person with active TB disease in 2016. There were 23 new patients reported in Denver, the most of any single Colorado county. Tri-County Health Department, comprised of Adams, Arapahoe, and Douglas counties, reported 22 patients with TB disease in 2016, and Larimer County reported four. Forty of Colorado's 64 counties have reported at least one new patient with active TB disease in the past ten years (2007-2016) (Table 1).

In 2016, TB burden in Colorado remained highest among racial and ethnic minorities (Figure 4), which is consistent with national observations. Though comprising only 31 percent of the state's population, 86 percent of new TB cases occurred in racial and ethnic minority populations making being a minority the most at-risk demographic group for developing TB disease. The largest change among demographic groups was in the Asian population (14 people in 2016 down from 25 in 2015). Having a diabetes diagnosis is the strongest modifiable risk factor for developing active TB disease (31 percent of all patients in 2016). 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 22 percent of all patients in 2016 (Table 2 and Figure 11).

In 2016, TB was reported among people ranging from 1 to 95 years of age with an average age of 53 years. The largest percentage (39 percent) occurred in the 45-64 year age group and the smallest percentage (5 percent) in the less than 15 year age group. Active TB in children is particularly concerning, as it indicates ongoing transmission in the community as well as evidence of missed opportunities for prevention (Figure 7).

In 2016, 53 percent of new TB patients were male and 47 percent were female (Figure 8). The number of cases in females has remained relatively consistent over the last six years whereas cases in males have fluctuated.

Drug susceptibility testing is recommended for all culture-positive TB cases in the U.S. In 2016, all 39 patients with culture-positive TB had drug susceptibility results. Four (10 percent) of the 39 patients were resistant to one or more first-line drugs (isoniazid-INH, rifampin-RIF, pyrazinamide-PZA, ethambutol-EMB) and three (8 percent) were resistant to non first-line drugs. None were multi-drug resistant (MDR) TB (defined as being resistant to at least INH and RIF), and there was no extensively drug resistant (XDR) TB identified in 2016 (Figure 13).

Due to the length of time it takes to complete TB drug treatment, completion rates are pending for 2016. Of the 73 TB patients reported in 2015, the most recent year where final completion data are available, one patient was dead at diagnosis. Of the remaining 72, 69 (95 percent) completed treatment; one moved out of the U.S. (completion data not available), one was lost to follow-up, and one was uncooperative with completing treatment (Figure 15 and Figure 16). All new patients counted in 2016 have initiated treatment.

TB disease incidence remained steady over the past five years in Colorado. The Colorado Department of Public Health and Environment, local public health agencies and other TB stakeholders and partners have collaborated to create a 10-year TB elimination plan in efforts to reduce the burden of TB in Colorado. This plan will guide programming to support people and populations at increased risk for developing TB disease. 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 and test for both TB infection and TB disease.

TB elimination can only be achieved by identifying and treating people with TB infection who are at high risk of developing active disease in the future. Timely evaluation of people identified as contacts to an infectious TB case and of those who arrive in Colorado with a Class B TB designation means we can identify and treat additional cases of both active 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. They affect communities differently and have a greater influence on health outcomes than either individual choices or one’s ability to access health care. Reducing health disparities 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: Top photo, Tuberculosis patients on the balcony of the Agnes Memorial Sanatorium in Denver, built in 1903. Photo from the Denver Public Library Western History Collection.

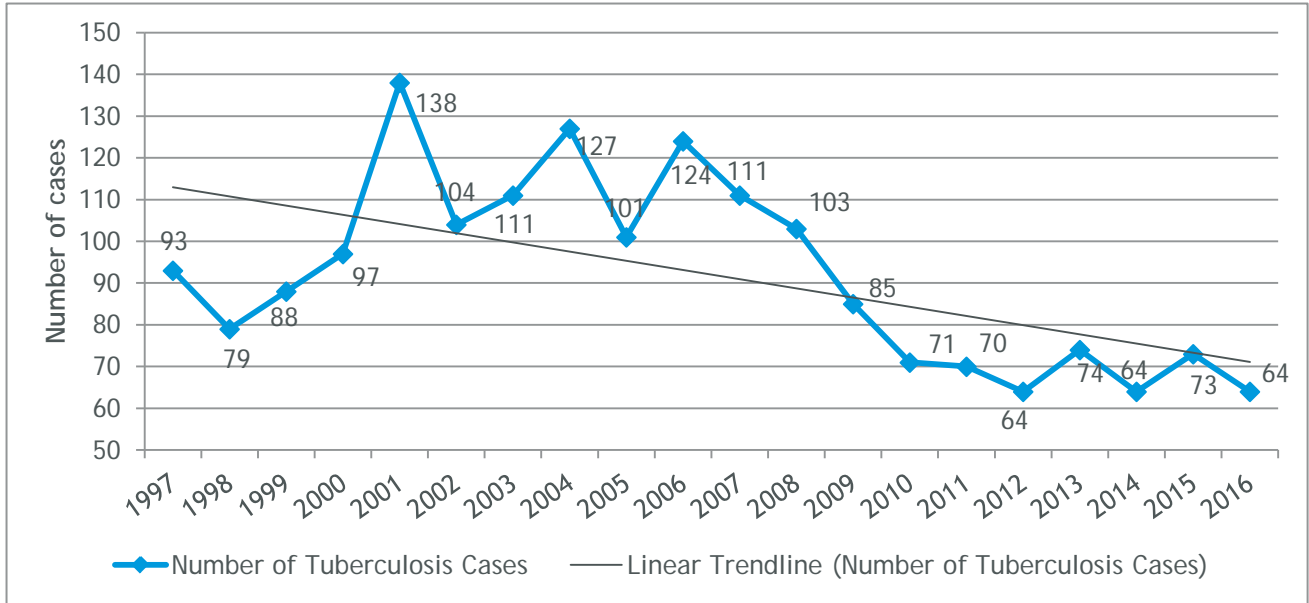
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TB cases and rates

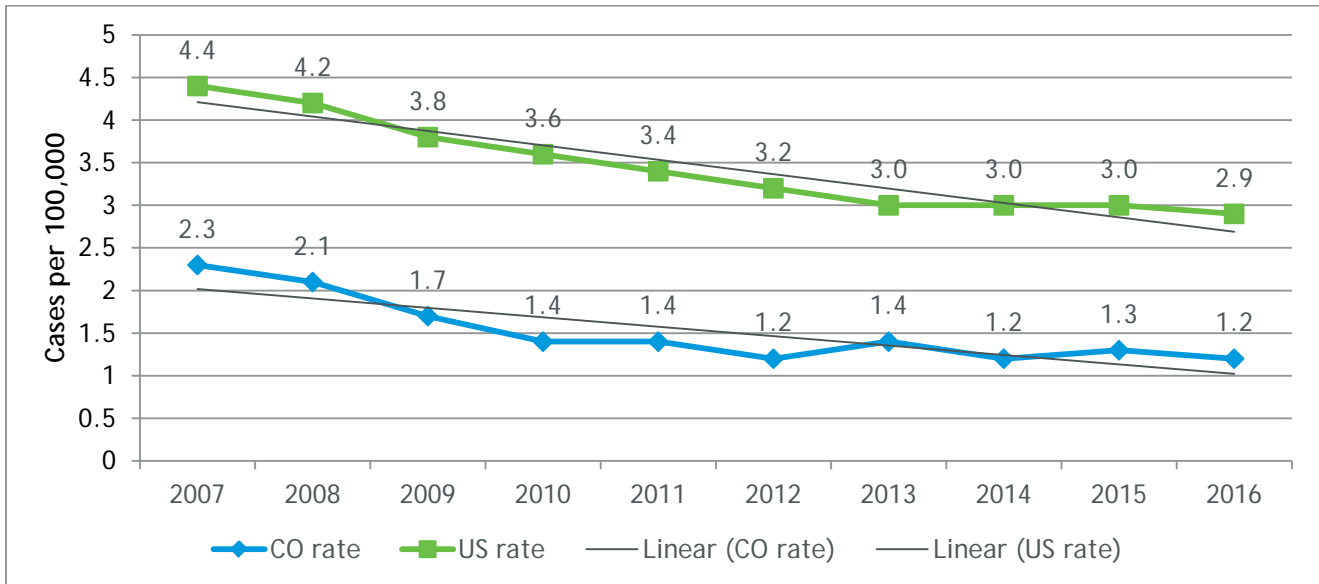
In 2016, 64 people were diagnosed and reported with active tuberculosis disease (TB) in Colorado. Although the number of cases has declined steadily since 2007, they have fluctuated in the past four years. Overall, the number of cases is trending down in Colorado.

Figure 1. Number of TB Cases and Trend Line: Colorado 1997-2016



Colorado’s case rate dropped from 2.3 per 100,000 persons in 2007 to 1.2 per 100,000 persons in 2016 (with slight fluctuation in the past four years).

Figure 2. Case Rates per 100,000 Persons in the U.S. and Colorado 2007 - 2016



TB by county

Fourteen of Colorado's 64 counties reported a new person with active TB disease in 2016. Denver County consistently reports the most with 23; this is followed by Arapahoe (17), Adams (4), and Larimer (4) counties (Figure 3). Forty of Colorado's 64 counties have reported at least one new person with active TB in the past ten years (Table 1).

Figure 3.

2016 Tuberculosis Cases by County, State of Colorado (N=64)

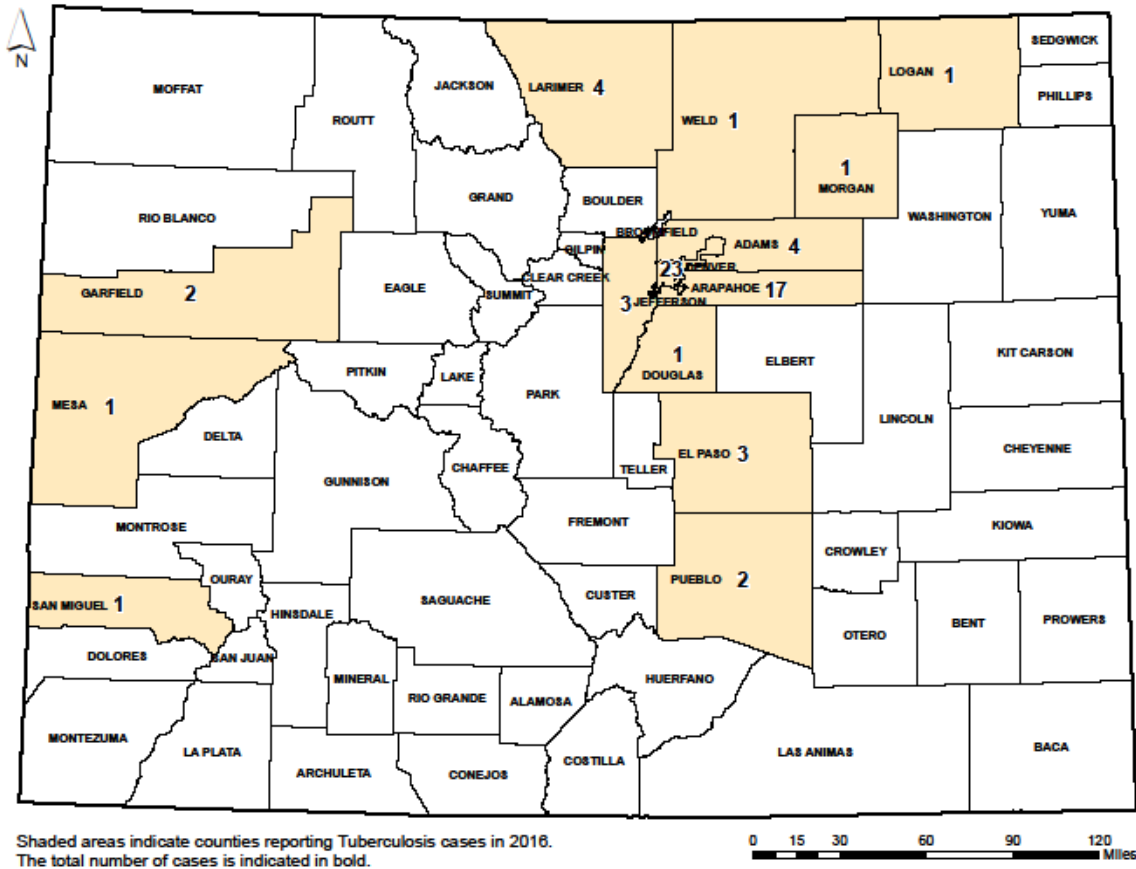


Table 1. TB in Colorado: Cases by County and Year of Report 2007-2016

County ^a	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016 ^b	5-Year Case Rate 2012-2016 ^{cd}
Adams	14	14	4	7	12	7	7	7	7	4	1.3
Arapahoe	17	14	11	17	5	11	14	14	14	17	2.3
Archuleta	0	0	0	0	0	0	1	0	0	0	1.6
Baca	0	0	0	0	0	0	1	0	0	0	5.4
Bent	1	0	0	0	0	0	0	0	0	0	0.0
Boulder	5	7	3	0	5	9	6	3	5	0	1.5
Broomfield	0	0	0	1	0	0	1	0	1	0	0.6
Clear Creek	0	0	1	0	0	0	0	0	0	0	0.0
Conejos	0	2	0	0	0	0	0	0	0	0	0.0
Delta	1	0	1	0	0	0	0	0	0	0	0.0
Denver	37	24	29	23	21	10	21	23	17	23	2.8
Douglas	2	3	4	1	2	1	2	1	8	1	0.8
Eagle	0	1	2	0	0	1	0	1	1	0	1.1
El Paso	7	10	7	8	7	5	8	1	3	3	0.6
Fremont	1	0	1	1	0	0	0	0	0	0	0.0
Garfield	2	1	2	0	0	0	0	1	2	2	1.7
Gunnison	0	0	2	0	0	0	0	0	0	0	0.0
Huerfano	0	0	0	1	0	0	0	0	0	0	0.0
Jefferson	9	12	8	0	8	3	2	4	3	3	0.5
Kit Carson	0	0	0	1	0	0	0	0	0	0	0.0
La Plata	0	0	0	0	0	1	0	0	0	0	0.4
Lake	1	1	0	0	0	0	0	0	0	0	0.0
Larimer	2	3	2	5	2	4	3	1	2	4	0.9
Las Animas	2	1	2	0	0	0	0	0	0	0	0.0
Logan	0	1	0	0	0	0	0	1	0	1	1.8
Mesa	0	0	1	0	1	1	2	0	1	1	0.7
Montezuma	1	0	0	0	0	0	0	0	0	0	0.0
Montrose	0	0	0	0	0	0	0	0	1	0	0.5
Morgan	2	1	1	0	2	1	0	1	0	1	2.1
Otero	0	1	0	0	0	0	0	0	0	0	0.0
Pitkin	0	0	0	0	0	0	0	1	1	0	2.3
Prowers	0	0	0	0	0	0	2	0	0	0	3.3
Pueblo	4	3	1	2	1	1	2	2	3	2	1.2
Rio Grande	1	0	0	1	0	0	0	0	0	0	0.0
Saguache	0	1	0	0	0	0	1	0	2	0	9.5
San Miguel	0	0	0	0	0	0	0	0	0	1	2.6
Summit	0	0	0	1	0	1	0	0	0	0	0.7
Teller	0	0	1	0	0	1	0	0	1	0	1.7
Weld	1	3	2	2	4	7	0	3	1	1	0.9
Yuma	1	0	0	0	0	0	1	0	0	0	2.0
TOTAL	111	103	85	71	70	64	74	64	73	64	1.3

^aOnly counties reporting an active case of TB (2007-2016) are included.

^b Highlighted counties reported at least one case of active TB in 2016.

^cTB cases per 100,000 persons

^d 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 2015 and 2016 Active TB Cases

	2015		2016	
	n	%	n	%
Age Group (years)				
<15	7	9.6	3	4.7
15-24	5	6.8	5	7.8
25-44	20	27.4	12	18.7
45-64	21	28.8	25	39.1
65+	20	27.4	19	29.7
TOTAL	73	100	64	100
Gender				
Male	43	58.9	34	53.1
Female	30	41.1	30	46.9
TOTAL	73	100	64	100
Race/Ethnicity				
White	11	15.1	9	14.1
Black or African American	14	19.2	16	25.0
Hispanic	22	30.1	25	39.1
American Indian or Alaska Native	0	0	0	0
Asian	25	34.2	14	21.9
Native Hawaiian or Other Pacific Islander	0	0	0	0
Multiple race/Unknown	1	1.4	0	0
TOTAL	73	100	64	100
Region				
Denver-metro ^a	55	75.3	48	75.0
Outside Denver-metro	18	24.7	16	25.0
TOTAL	73	100	64	100
HIV Status				
HIV Negative	67	91.8	57	89.1
HIV Positive	3	4.1	2	3.1
Testing done, results unknown	0	0	0	0
Refused testing	2	2.7	1	1.5
Not offered	1	1.4	4	6.3
TOTAL	73	100	64	100
Risk factors^b				
Birth in one of the 30 highest TB-burden countries ^c	29	39.7	14	22.8
Homeless within past year	1	1.4	4	6.3
Diabetes	12	16.4	20	31.2
Resident of correctional facility at diagnosis	0	0	3	4.7
Resident of long-term care facility	1	1.4	0	0
Injected drug use within past year	0	0	2	3.1
Non-injected drug use within past year	1	1.4	3	4.7
Excess alcohol use within past year	3	4.1	6	9.4
Health care worker within past year	3	4.1	1	1.5

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/ 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 percent of the state’s population, 86 percent of new TB occurred in racial and ethnic minority populations (Figure 4). At 3.7 cases per 100,000 persons the case rates in racial and ethnic minorities is 19 times that of the majority white population (Figure 5).

Figure 4. TB Cases by Race/Ethnicity: Colorado, 2016

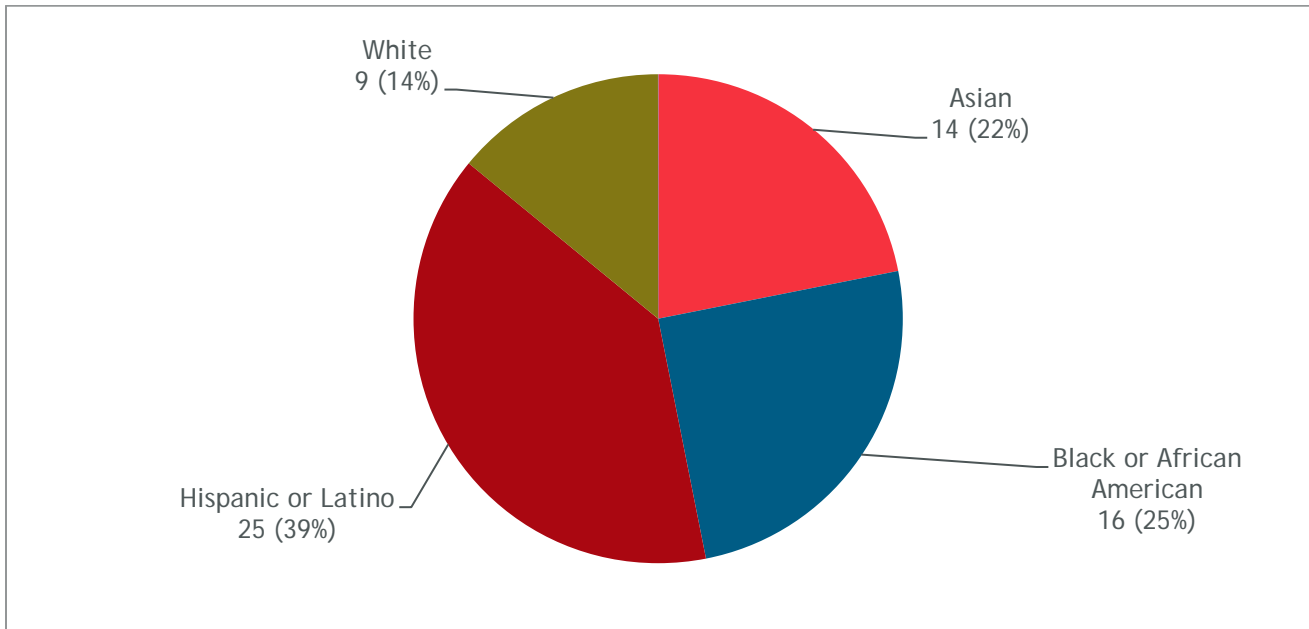
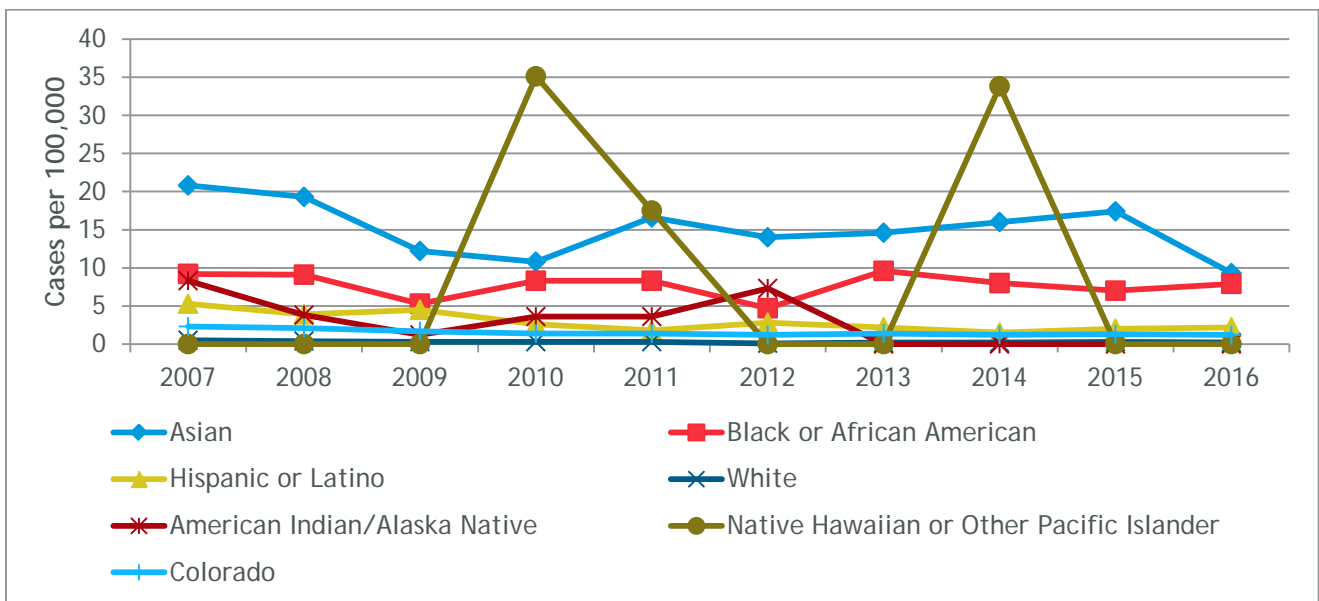


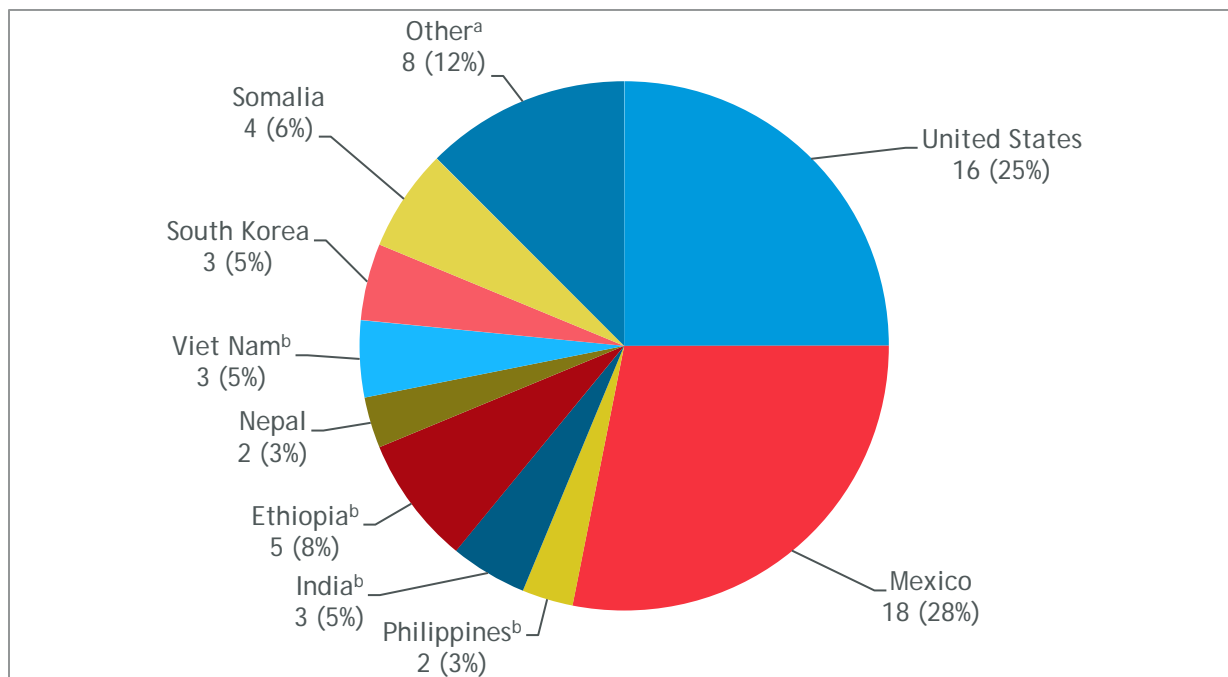
Figure 5. TB Case Rates by Race/Ethnicity: Colorado, 2007 - 2016



TB by country of birth

TB disease was diagnosed in people originating from 17 different countries. The largest cohort came from Mexico, with 18 people followed by the United States with 16. Of those people born outside of the United States, 14 came from one of the top 30 highest-burdened countries that comprise 85-89 percent of all global active TB disease according to the World Health Organization (Figure 6).

Figure 6. TB Cases by Country of Birth: Colorado, 2016



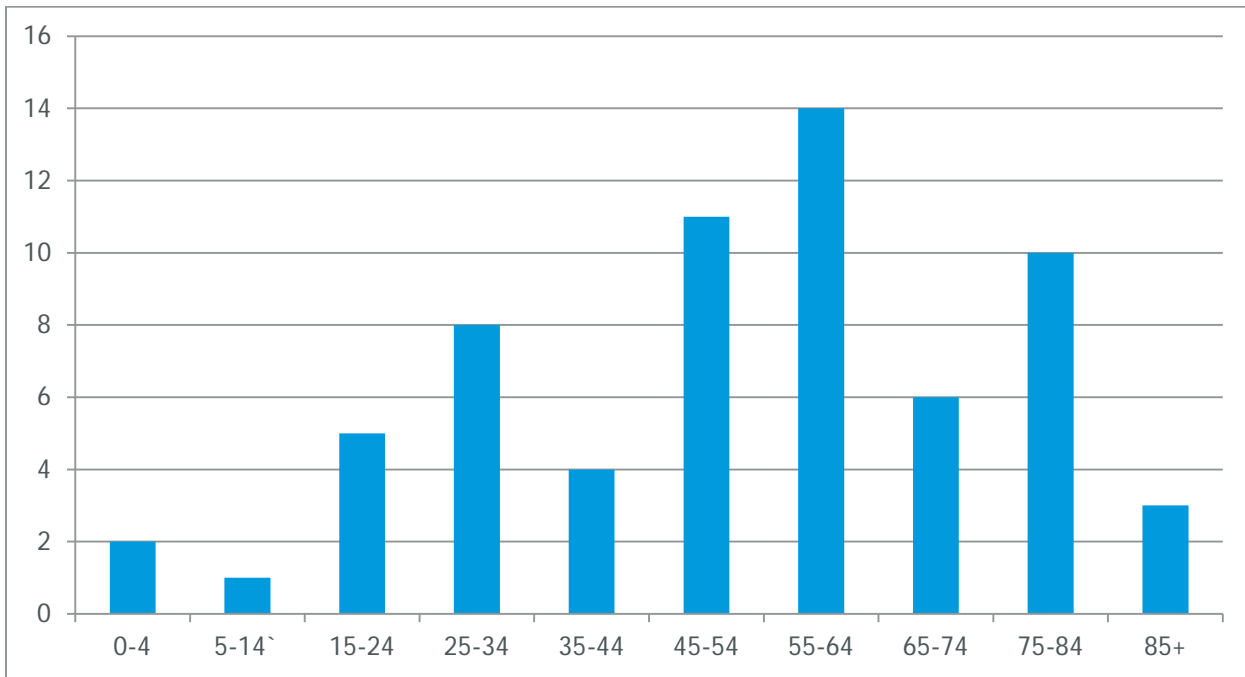
^aOther countries: Bhutan-1, Democratic Republic of the Congo^b-1, Guinea-1, Mali-1, Moldova-1, Poland-1, Puerto Rico-1, Romania-1

^bDenotes 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_2_Country_profiles))

Tuberculosis by age group

In 2016, TB was reported among people ranging from 1 to 95 years of age. Thirty-nine percent of TB occurred among people 45-64 years old, followed by those aged 65+ years (29 percent) and 25-44 years (19 percent). Three new TB patients were children (<15 years of age). Active TB in children is particularly concerning, as it is a sign of recent transmission and missed opportunities for TB prevention. Of those three children, two were younger than five years of age (Figure 7).

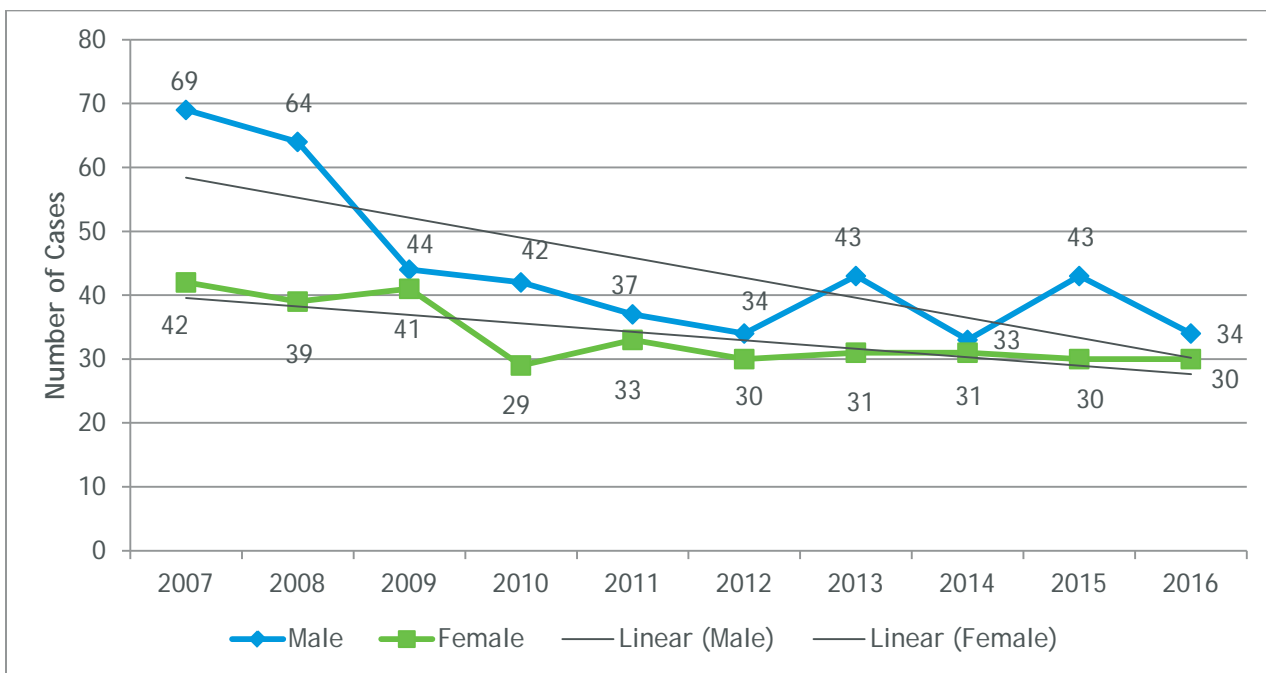
Figure 7. TB Cases by Age Group: Colorado 2016



Tuberculosis by gender

Tuberculosis tends to infect and lead to active TB disease in males more often than females. In 2016, 34 (53 percent) TB patients were male and 30 (47 percent) were female.

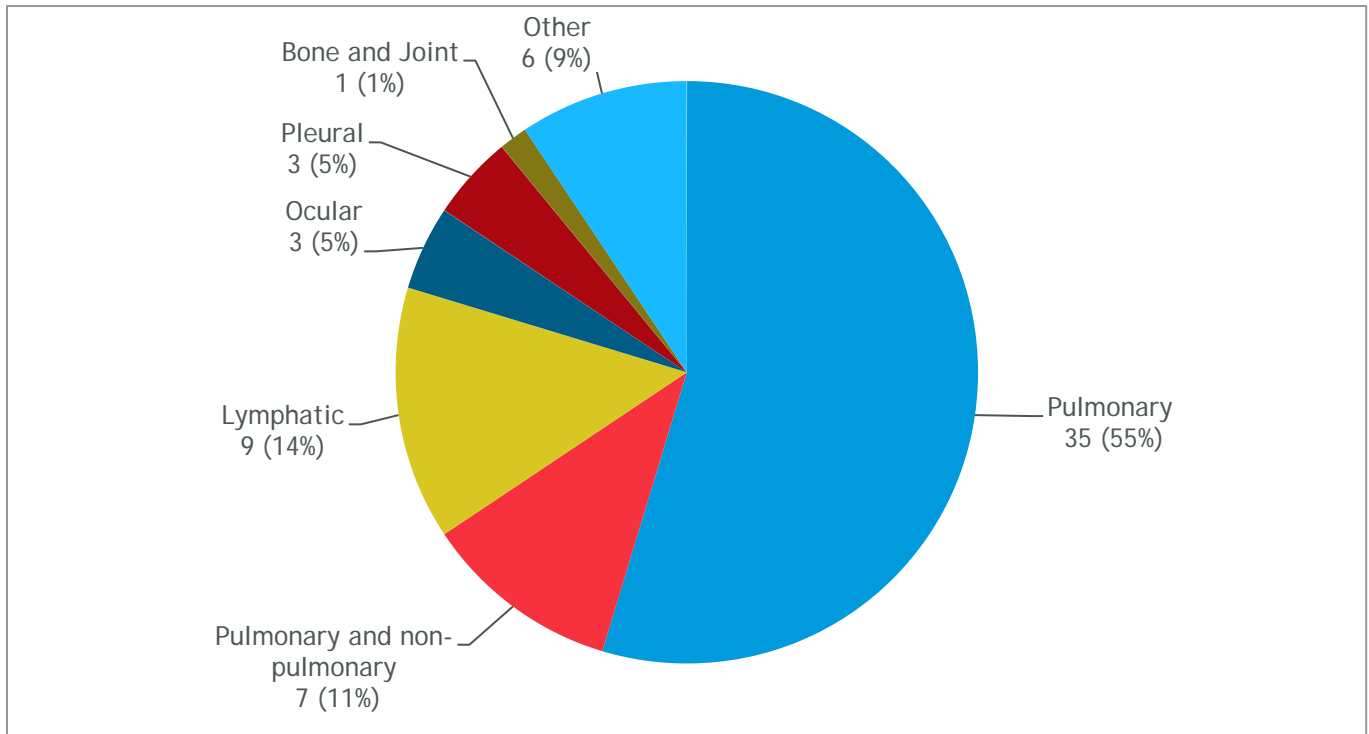
Figure 8. TB Cases by Gender: Colorado 2007 - 2016



Tuberculosis cases 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 2016, 42 of the 64 (66 percent) patients were found to have pulmonary or both a pulmonary and extra-pulmonary sites of disease. The next most common site of infection in 2016 was lymphatic TB with 9 (14 percent) incidents. Sites classified as other included colon, brain, epidermal and endometrial (Figure 9).

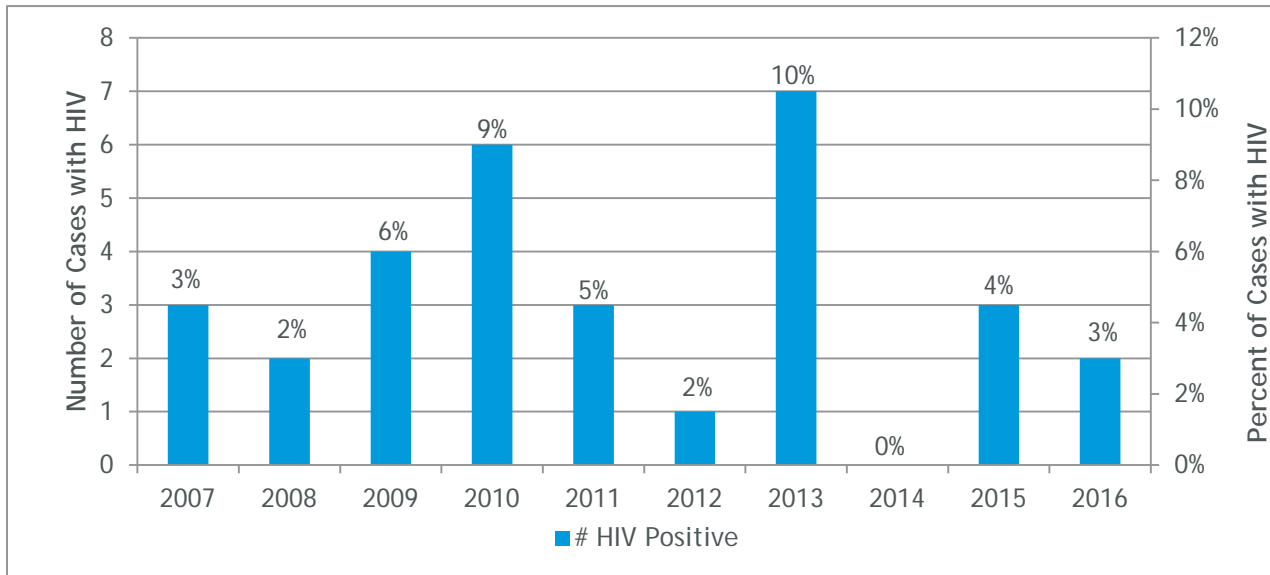
Figure 9. TB Cases by Major Site of Disease: Colorado 2016



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 active TB because HIV weakens the immune system. Of the 64 people with TB in 2016, recent test results for HIV were available for 59 (92 percent of total). Of those 59, two (3.1 percent) were found to be co-infected with HIV. Of the five people who were not tested, two were dead at diagnosis, two were not offered an HIV test and one refused testing (Figure 10). Over the past 10 years, HIV/TB co-infection has fluctuated between seven cases in 2012 to zero cases in 2014. When analyzing small numbers, the annual percentages can fluctuate widely and incidence rates, being unstable and imprecise, are likely to lack statistical significance.

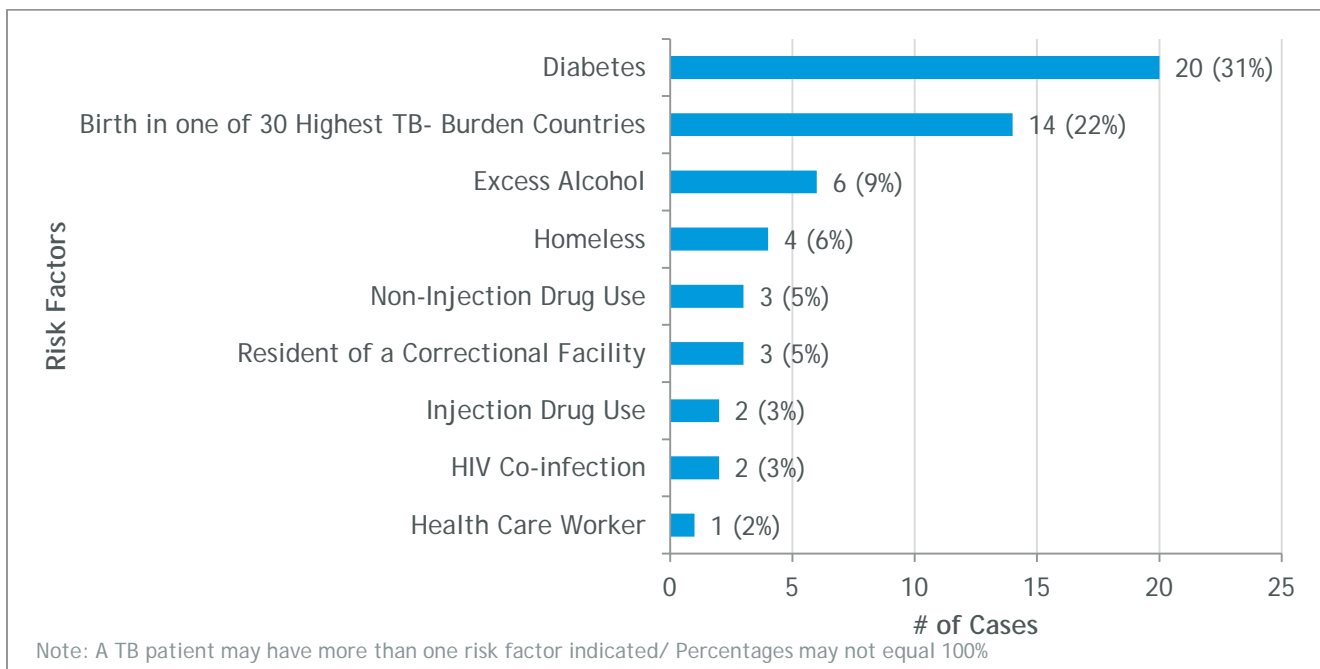
Figure 10. HIV-Positive TB Cases and Percentage of Annual Total: Colorado 2007-2016



Risk factors

In 2016, the most common risk factor for active TB was diabetes, followed by birth in one of the 30 highest TB-burden countries.

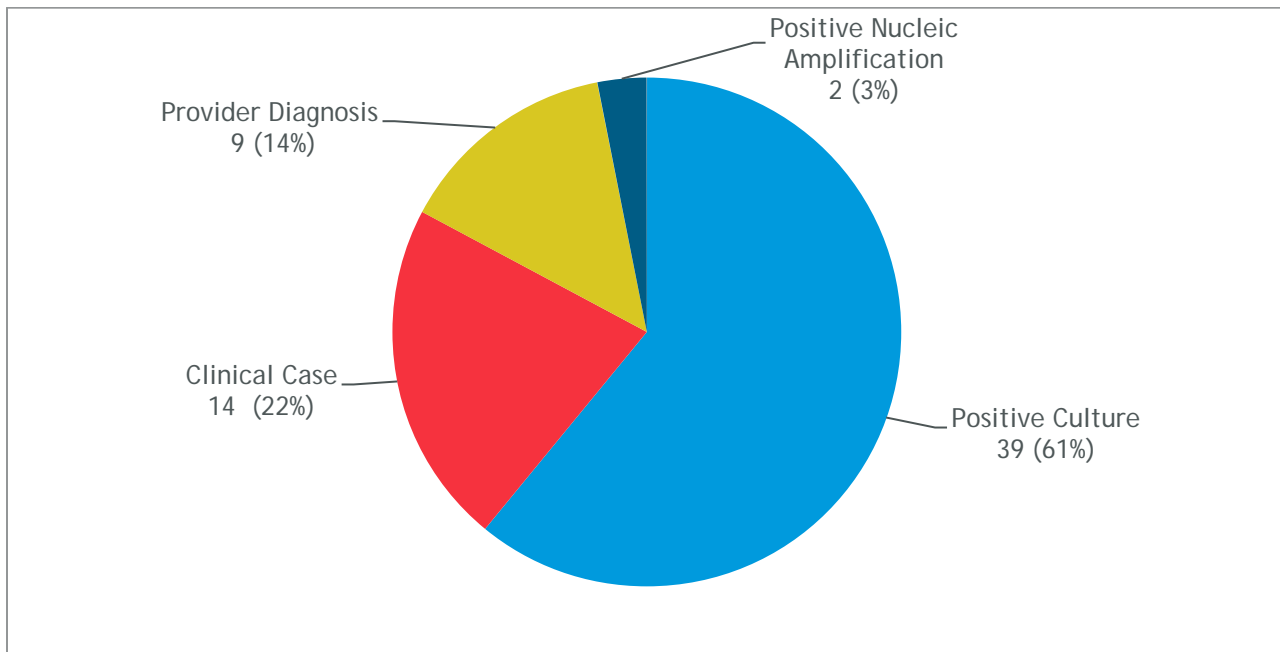
Figure 11. Risk Factors for TB: Colorado 2016



Tuberculosis case verification

Mycobacterium tuberculosis complex was culture-positive in 61 percent of the TB patients in 2016. Another 22 percent met the clinical case definition (positive tuberculin skin test or interferon gamma release assay, abnormal chest radiograph), 14 percent were verified by provider diagnosis and 3 percent had a positive nucleic amplification test.

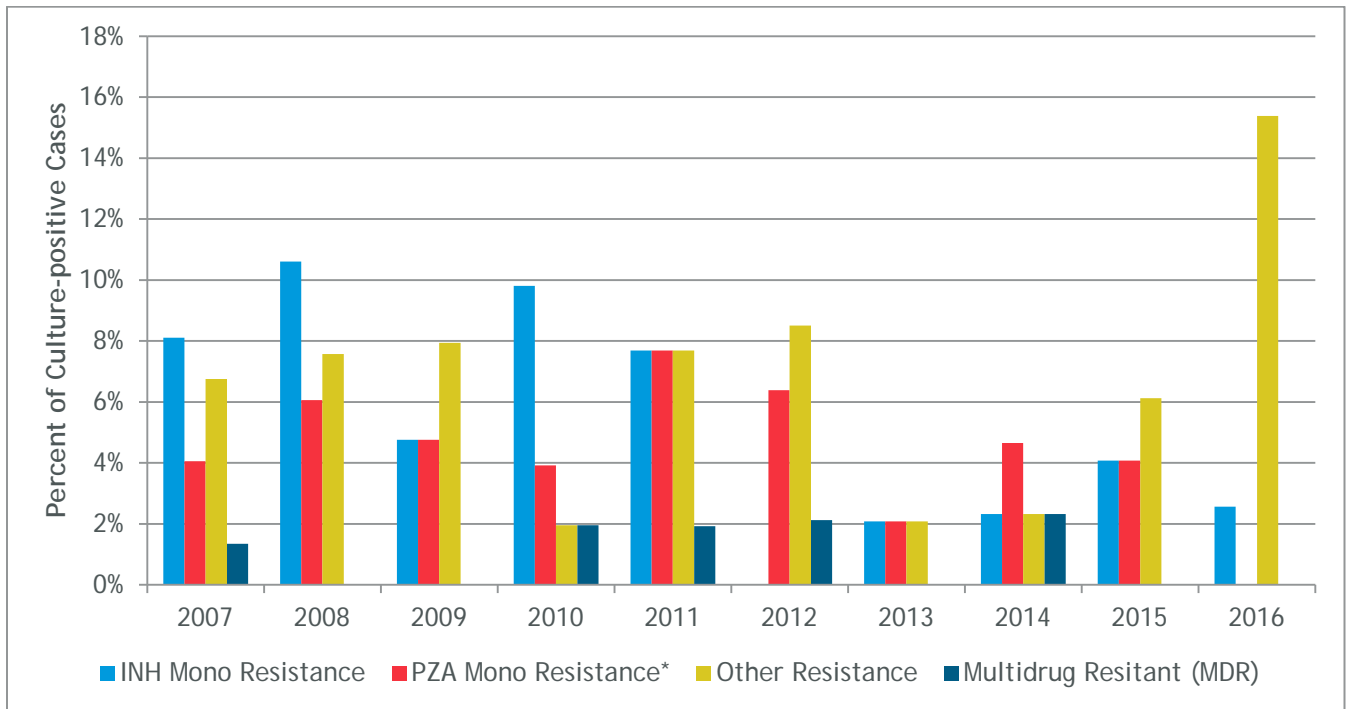
Figure 12. TB Cases by Verification Criteria: Colorado 2016



Drug resistance and tuberculosis

Of the 64 new TB patients reported in 2016, 39 (61 percent) had a positive culture and of those, seven were found to be resistant to one or more TB drugs. Four (10 percent) were resistant to one or more of the four first-line TB drugs: isoniazid (INH), rifampin (RIF), pyrazinamide (PZA) and ethambutol (EMB). Of those four patients, one had INH mono-resistance, two were resistant to INH and streptomycin and one was resistant to RIF, PZA and rifabutin. The other three patients were resistant to streptomycin (not considered a first-line TB drug and not currently used to treat TB). There was no multi-drug resistant (MDR: defined as being resistant to at least INH and RIF), or extensively-drug resistant TB (XDR-TB) identified in 2016 (Figure 13).

Figure 13. TB Drug Resistance: Colorado 2007-2016

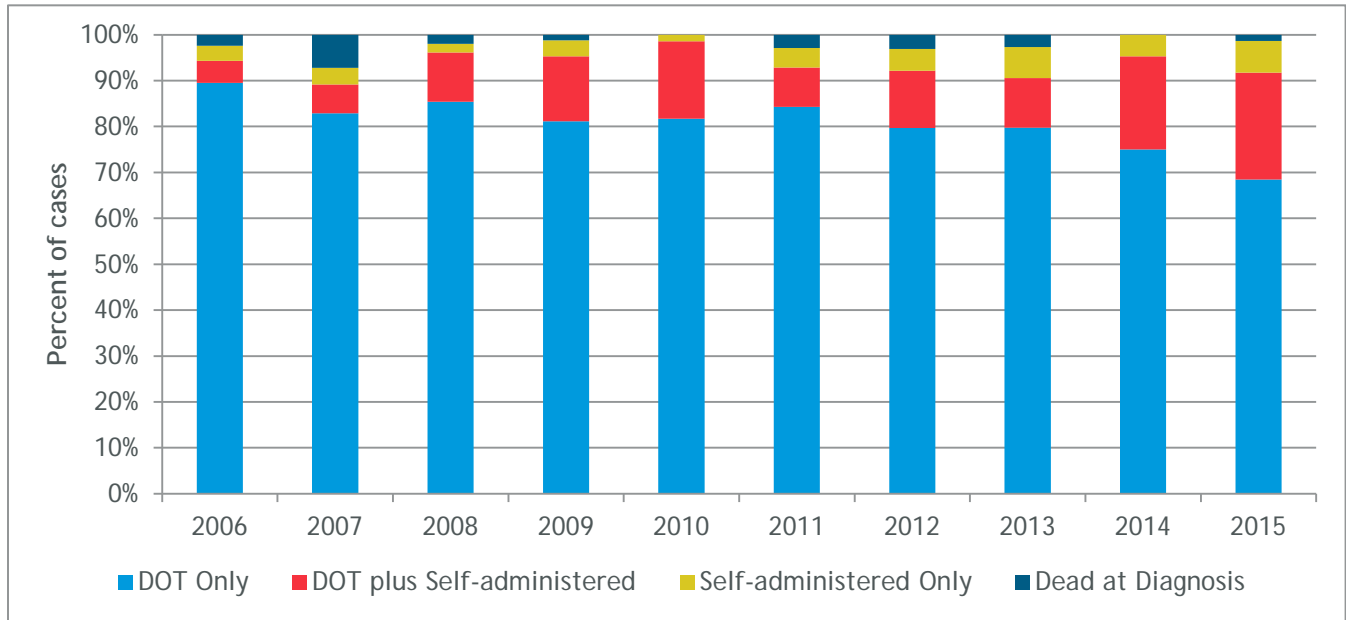


*Isolates with PZA resistance may indicate *Mycobacterium Bovis*, a form of tuberculosis, which causes tuberculosis in humans, cattle, and mammals. It is characteristically resistant to PZA.

Directly observed therapy

Directly observed therapy (DOT) is required for all patients with pulmonary TB in Colorado and involves health care workers observing the patient taking every dose of his/her medications. During 2015 (the most recent year with complete data), 69 percent of patients received medications via DOT, 7 percent self-administered medications (non-infectious extra-pulmonary patients) and 23 percent received a combination of DOT and self-administered therapy (Figure 14).

Figure 14. Mode of TB Therapy: Colorado 2006-2015



Tuberculosis treatment outcomes

The standard treatment for active TB disease is six months using isoniazid, rifampin, ethambutol and pyrazinamide. Of the 73 patients in 2015, (the most recent year with complete data), one patient was dead at diagnosis. Of the remaining 72 eligible TB patients, 69 completed treatment, one was lost to follow-up, one was uncooperative in completing a full course of treatment and one moved outside the U.S. before treatment completion (completion data unavailable). All 2016 patients have initiated treatment.

Figure 15. TB Treatment Outcomes: Colorado 2015

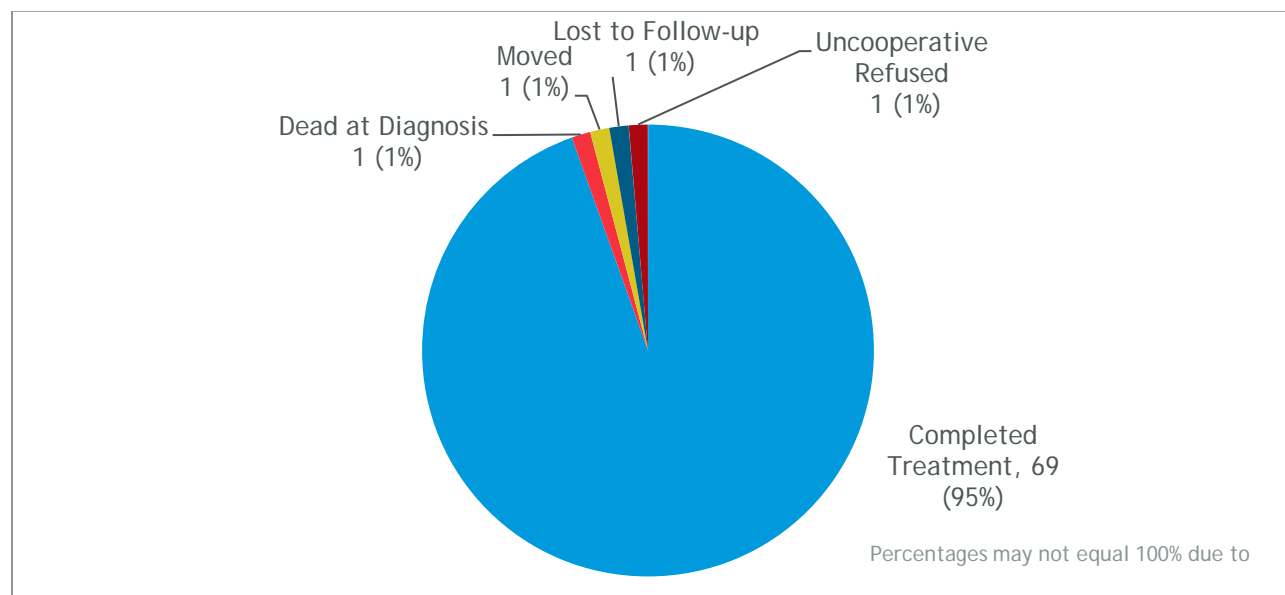
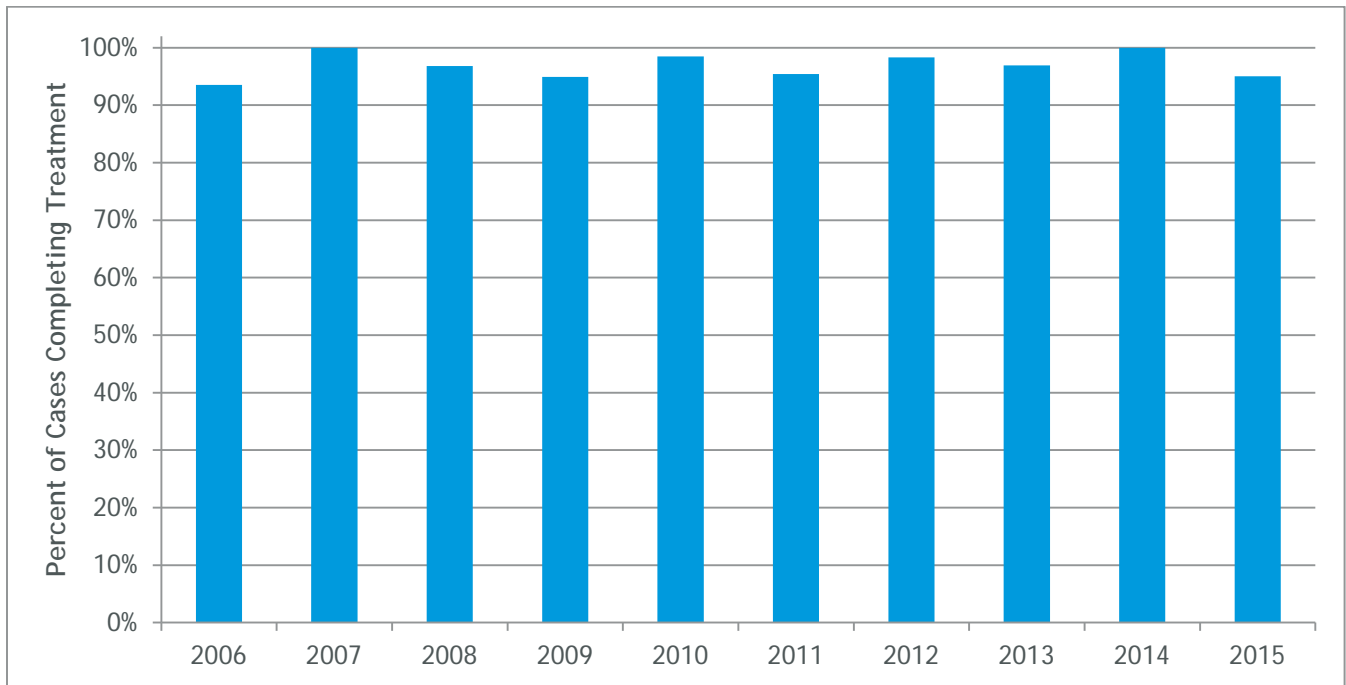


Figure 16. Completion of TB Treatment within One Year: Colorado 2006-2015



Note: Excludes cases with rifampin-resistant disease, cases with meningeal, bone and/or joint, or central nervous system disease, cases less than 15 years of age with disseminated tuberculosis disease, and cases 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

A key strategy for eliminating TB is to identify and treat people with TB infection who are at high risk of developing active disease in the future. Timely evaluation of people identified as contacts to an infectious TB case and of those who arrive in Colorado with a Class B TB designation. 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 assigned a classification according to the status of their disease. The 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 for infection additional cases of both active TB disease and TB infection are identified and treated.

Figure 17. Cascade of Care for High Risk Individuals (Contacts and Class B TB): Colorado 2015

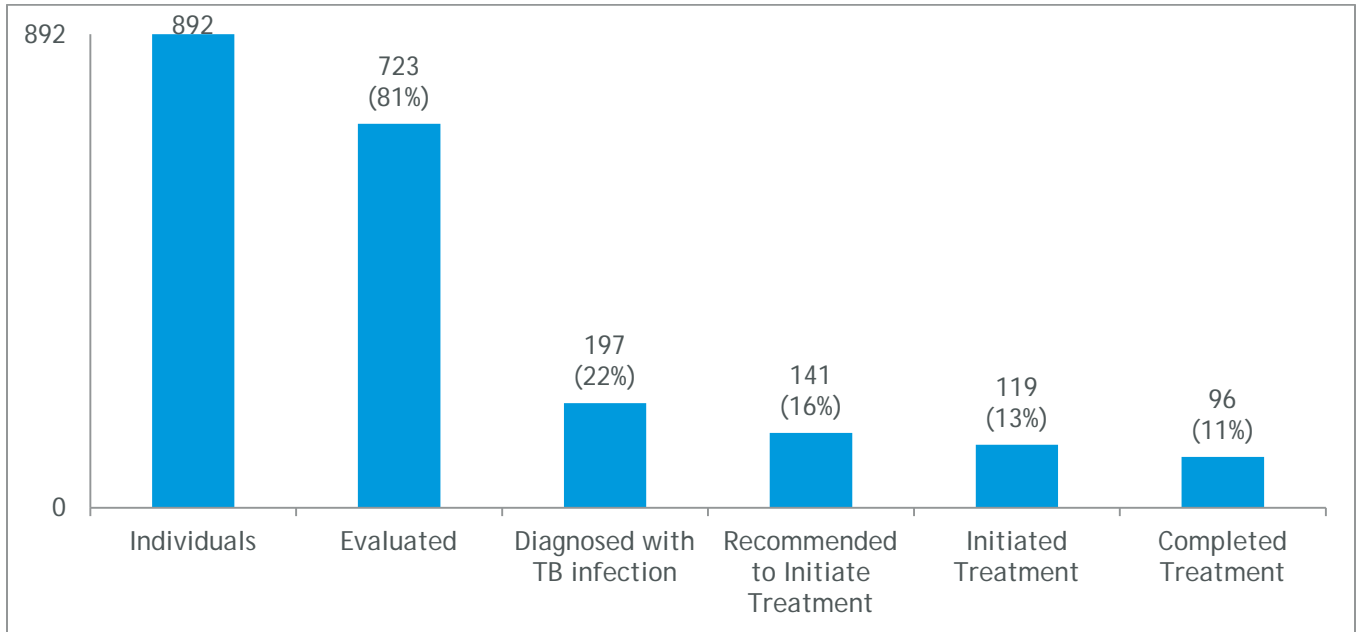


Table 3. Treatment Outcomes for High Risk Individuals (Contacts and Class B TB) Recommended to Initiate Treatment: Colorado 2015

Outcomes	No.	(%)
Total Contacts Diagnosed with TB Infection	141	(100%)
Completed Treatment	96	(68%)
Did Not Initiate Treatment	22	(15%)
Did Not Complete Treatment (Reasons below)		
Died	0	(0%)
Moved	4	(3%)
Developed Active TB	0	(0%)
Adverse Effect	1	(1%)
Patient Chose to Stop	4	(3%)
Lost to Follow-up	2	(1%)
Provider Decision to Stop	1	(1%)
Pending Outcome Documentation	11	(8%)

Next steps

Active TB cases decreased in 2016, both nationally and in Colorado with total cases down 2.7 percent in the U.S. and 12.3 percent in Colorado from 2015. The case rate for Colorado decreased from 1.3 to 1.2 per 100,000, which may be a more meaningful figure since it is adjusted for increases in population size. However, with small numbers underlying these percentage changes, it is unclear if this fluctuation will develop into a more clearly defined downward trend, vigilance is paramount. Private providers and local public health agencies must identify and screen those most at risk for TB infection and initiate treatment where appropriate in order to reduce the chances of developing TB disease later in life. As the demographic breakdowns in this report attest, the key risk factors and the most at-risk groups for development of TB disease have been identified (see Figures 5 and 11). TB elimination plan activities initiated in 2016 include comprehensive over-the-phone interpretation for TB patients and those suspected of having TB. Next steps for 2017 include the roll out of electronic DOT services to local public health agencies statewide. Monthly enhanced TB case management (ECM) sessions will continue. These allow non-Denver-metro LPHAs and providers the opportunity to review current patients with subject matter experts from CDPHE and the Denver Metro TB Clinic via a web-based HIPAA-compliant web-based platform. Other plans include the development of statewide access to interferon gamma-release assays (IGRAs) for testing of at-risk populations or those with risk factors for progression from TB infection to TB disease. The belief is these and other interventions will result in a steady decline of active TB.

It will be both a challenge and opportunity to engage affected communities and populations in TB elimination activities. Their participation is essential to developing meaningful messaging that will resonate with their peers. TB stakeholders throughout Colorado look forward to working with new partners, wherever they may be found, toward a shared vision of reduced TB morbidity and mortality among Coloradans. Reducing health disparities through policies, practices and organizational systems can help improve opportunities for all Coloradans. Colorado's TB elimination plan is available on the TB Program website <https://www.colorado.gov/pacific/cdphe/tb>