Viral Hepatitis Surveillance in Colorado

2018 Annual Report

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COLORADO
Department of Public
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About this report

This report is published by the Colorado Department of Public Health and Environment (CDPHE), Denver, Colorado.

This report describes the epidemiology of hepatitis A, B and C in Colorado. CDPHE uses available data resources to report the burden and distribution of disease, as well as trends over time. A summary of each of the three types of viral hepatitis is followed by a more detailed description. Data are presented for all hepatitis A, B, and C cases reported to CDPHE by Dec. 31, 2018.

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This publication is available on the web at www.colorado.gov/cdphe/hepatitis-data. This report is compliant with data release guidelines established by CDPHE's Division of Disease Control and Environmental Epidemiology to ensure the protection of sensitive health information.

CDPHE 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 and organizational systems can help improve opportunities for all Coloradans.

Acronyms

CCCR	Colorado Central Cancer Registry
CDC	Centers for Disease Control and Prevention
CDOC	Colorado Department of Corrections
CDPHE	Colorado Department of Public Health and Environment
CEDRS	Colorado Electronic Disease Reporting System
CI	Confidence Interval
CSTE	The Council for State and Territorial Epidemiologists
DAAs	Direct-acting antivirals
ELR	Electronic Laboratory Reporting
HAV	Hepatitis A Virus
HBIG	Hepatitis B immune globulin
HBsAg	HBV surface Antigen
HBV	Hepatitis B Virus
HCC	Hepatocellular Carcinoma
HCV	Hepatitis C Virus
IDU	Injection Drug Use
MSM	Men who have Sex with Men
NH	Non-Hispanic
NHANES	National Health and Nutrition Examination Survey
PEH	People Experiencing Homelessness
PWID	People Who Inject Drugs
PHBPP	Perinatal Hepatitis B Prevention Program
SVR	Sustained Virologic Response
TGA	Transitional Grant Areas

Definitions

CDPHE is the Colorado Department of Public Health and Environment. The Colorado Department of Public Health and Environment is the principal department of the Colorado state government responsible for public health and environmental regulation.

CEDRS refers to the Colorado Electronic Disease Reporting System. This database is used to capture reportable conditions across Colorado.

Cirrhosis is a chronic disease of the liver marked by degeneration of cells, inflammation, and fibrous thickening of tissue.

Cisgender refers to persons whose gender identity aligns with the sex they were assigned at birth.

Confidence interval is a range of values with a specified probability that the value of a parameter lies within it.

ELR refers to electronic lab reports that are sent by certain hospitals and labs directly to CDPHE.

Front Range refers to the following counties in Colorado: Larimer, Weld, Boulder, Denver, Arapahoe, Adams, Jefferson, Douglas, Broomfield, Elbert, Park, Clear Creek, Gilpin, El Paso, Teller, Fremont, and Pueblo.

Gender non-binary/non-conforming is an umbrella term for individuals who do not identify as strictly a woman or a man.

HBsAg is the hepatitis B surface antigen. HBsAg is a marker of infectivity. Its presence indicates either acute or chronic HBV Hinfection.

HCV antibody testing, also referred to as anti-HCV, indicates past or present infection with HCV. If a person has spontaneously cleared the virus or has been cured, they will still test positive for HCV antibodies.

Incidence represents the number of new infections per year of a disease in a population.

Prevalence represents the total number of people living with a disease.

Rates per 100,000 persons are calculated by dividing the number of cases by the population for a given time period and multiplying by 100,000.

RNA (ribonucleic acid) refers to the level of virus existing in a person. As opposed to a positive test for HCV antibodies, which may indicate past or present HCV infection, HCV RNA signifies current infection with HCV.

Rural counties in Colorado, according to the Office of Rural Health Policy, are Alamosa, Archuleta, Baca, Bent, Chaffee, Cheyenne, Clear Creek, Conejos, Costilla,

Crowley, Custer, Delta, Dolores, Eagle, Elbert, Fremont, Garfield, Gilpin, Grand, Gunnison, Hinsdale, Huerfano, Jackson, Kiowa, Kit Carson, La Plata, Lake, Las Animas, Lincoln, Logan, Mineral, Moffat, Montezuma, Montrose, Morgan, Otero, Ouray, Park, Phillips, Pitkin, Prowers, Rio Grande, Rio Blanco, Routt, Saguache, San Juan, Sedgwick, San Miguel, Summit, Teller, Washington, and Yuma counties.

Sex assigned at birth is the assignment of people as male, female, intersex, or another sex assigned at birth often based on physical anatomy at birth.

Signal-to-cutoff ratio is a calculation that can be done for specific HCV antibody tests that is predictive of a true antibody-positive result.

The Denver transitional grant area (TGA) includes counties that are most severely impacted by the HIV epidemic. The Denver TGA covers 3,756 square miles and consists of six counties as follows: Adams, Arapahoe, Broomfield, Denver, Douglas, and Jefferson and became eligible for federal funding in March of 1994 when it reported 2,000 cumulative AIDS cases. Since there is no corresponding distinction for viral hepatitis, this definition of TGA was used to provide a distinction between counties surrounding Denver and counties further from Denver.

Urban non-TGA counties are El Paso, Larimer, Mesa, Pueblo, Weld, and Boulder.

Summary

Background

Viral hepatitis is a significant public health challenge. Hepatitis A virus (HAV), hepatitis B virus (HBV), and hepatitis C virus (HCV) can be transmitted in different ways, but each virus causes damage to the liver and can lead to severe complications and premature death.

In 2018, the United States experienced new or ongoing outbreaks of hepatitis A in 28 states (1). No cure exists for hepatitis B, and full vaccination coverage among the general adult population was 21.2% (2). Hepatitis C kills more Americans each year than all other 60 reportable infectious diseases combined (3).

Methods

This report provides a summary of confirmed viral hepatitis cases reported to CDPHE by laboratories and health care providers in 2018. Data from 2009-2017 is also included to examine trends over time. Reported cases represent a combination of new infections and new diagnoses from previously acquired infections. Surveillance of reported cases helps to highlight trends in disease reporting but gives an underestimate of the true burden of disease. Cases were grouped into age groups and county types for increased statistical reliability and for ease of interpretation.

Findings

There were a total of 3,723 confirmed cases of hepatitis A, B, and C reported to CDPHE in 2018. From 2014 to 2018, there were a cumulative 17,819 reported cases, 97% of which were chronic, lifelong conditions. Approximately half of all deaths among reported viral hepatitis cases occurred within two years of disease diagnosis.

The rate of reported hepatitis A cases decreased from 2017 (1.2 per 100,000) to 2018 (0.5 per 100,000), but an ongoing outbreak that began in October 2018 will result in a dramatic increase in the rate of cases in 2019. The outbreak is primarily among people experiencing homelessness (PEH), substance use issues, and/or incarceration.

In 2018, the rate of reported acute hepatitis B cases decreased from 0.6 per 100,000 population in 2017 to 0.4 per 100,000. Similarly, the rate of reported chronic hepatitis B decreased from 4.3 to 3.9 per 100,000. For the first time, the rate of newly reported chronic hepatitis B cases among 40-59 year olds (6.2 per 100,000), who are less likely than younger age groups to have been vaccinated for the disease, surpassed the rate among 20-39 year olds (5.1 per 100,000) in 2018. There were zero perinatal hepatitis B cases. The HBV birth dose vaccination rate was 82% in both 2017 and 2018.

The rate of reported acute hepatitis C cases remained stable from 2017 to 2018 (0.8 per 100,000), but the number of reported cases increased by 4.5%. The rate of reported chronic hepatitis C cases increased from 51.1 per 100,000 in 2017 to 52.2 per 100,000 in 2018. The rate of reported chronic hepatitis C cases among 20-39 year

olds (78.1 per 100,000) continued to rise and surpassed the rate among 40-59 year olds (72.1 per 100,000) for the first time in 2018. There were two cases of perinatal hepatitis C, which became a reportable disease in 2018. The odds of PEH in metro Denver being diagnosed with chronic hepatitis C were 120.9 (95% CI: 102.3-141.7, $p < 0.05$) times greater than that of a person not experiencing homelessness. Rural counties had the highest standardized rates of reported chronic hepatitis C cases (42.1 per 100,000), and incarcerated individuals accounted for a quarter of reported cases.

Discussion

There are effective and safe vaccinations for hepatitis A and B and curative treatment options for hepatitis C. Efforts to prevent perinatal hepatitis B infection through case management have proven effective, but perinatal hepatitis C is a growing concern with the rise in infections among women of childbearing age. The populations most affected by viral hepatitis often face stigma and other barriers to accessing care.

Statewide surveillance data, while limited by underreporting and gaps in demographic data, highlight the dynamic nature of the epidemiology of each disease. In 2018, a significant outbreak of hepatitis A began, the disease burden of hepatitis B shifted to an older population which has a higher risk of advanced morbidity and mortality, and the number of new hepatitis C cases among adults under the age of 40 continued to rise.

Conclusion

Colorado can reduce the disease burden and improve health outcomes for people with viral hepatitis by implementing cross-cutting strategies. Such strategies include strengthening surveillance activities for acute and chronic viral hepatitis, expanding testing, linkage to care and treatment, access to direct-acting antiviral (DAA) medications for hepatitis C, and immunizations. These strategies should focus on priority populations, including men who have sex with men (MSM), people who inject drugs (PWID), PEH, and detained and incarcerated populations.

Data sources

Colorado Electronic Disease Reporting System (CEDRS)

Colorado law requires both laboratories and health care providers to report cases of viral hepatitis to CDPHE. Reports of diagnosis for HBV, HCV, and other viral hepatitis infections must be submitted to CDPHE within four calendar days. HAV reports must be submitted to CDPHE within one working day. Viral hepatitis surveillance in Colorado is primarily based on laboratory reporting of serologic results.

The data that form the basis of this report are principally reports of hepatitis among people living in Colorado at the time of their diagnosis. Cases are reported via electronic lab reporting (ELR) and are entered into the Colorado Electronic Disease

Reporting System (CEDRS). Hepatitis laboratory results come to CDPHE via ELR from 22 different feeds representing 46 different commercial laboratories and hospital laboratories. Per state reporting requirements, laboratories must report all tests indicative of hepatitis, such as antibody tests and hepatitis viral loads. Upon receipt of these reports, CDPHE uses established case definitions to assign the appropriate diagnosis for each patient. If a case is listed as "probable" in CEDRS and a new test confirms the case, the case is reassigned as "confirmed" but retains the original reporting year.

Exposure or behavioral risk factor data can be obtained through patient interviews, medical record reviews, and information provided by a physician, hospital, or other health care provider. Information is more complete for those who are interviewed. These risk behavior data are collected with options of "Yes", "No", and "Unknown" when indicated, or as checkboxes. The time period of inquiry is generally the six months prior to onset of symptoms for acute cases.

CDPHE attempts to interview all newly reported hepatitis A, acute hepatitis B, and acute hepatitis C cases but does not have the capacity to interview chronic cases. Local public health agencies sometimes perform acute case interviews.

Additionally, CDPHE follows all women 14 to 45 years of age who are reported to be living with HBV to ensure that, if they become pregnant, they are enrolled in the Perinatal Hepatitis B Prevention Program (PHBPP) to help prevent perinatal transmission. Infants born to women living with hepatitis B should receive hepatitis B immune globulin (HBIG) and the first dose of the three dose HBV vaccine series within 12 hours of birth to begin immediate protection. PHBPP ensures infants receive these crucial shots at birth in addition to completing the vaccine series and receiving post vaccination serology to determine immune protection.

Viral hepatitis surveillance is impacted by several factors, including the inability to routinely identify people who spontaneously clear infection or who are in treatment or cured. A Colorado Board of Health rule change made negative confirmatory results for chronic HCV reportable, which will address this issue in future years. Additionally, most demographic and risk information remains missing for chronic events, since most events are reported by laboratories and the resources do not exist to follow up with cases.

Data collection options that included transgender identities were not available until March 2017, and case counts are small. To protect privacy, people who identified as transgender were included in the case counts of the gender with which they identify. No data collection options currently exist to track viral hepatitis among gender non-binary/non-conforming individuals. Additionally, some of the data may represent the sex assigned at birth rather than the current gender identity of individuals, but this level of detail does not exist within the data.

Population data

Population information from the Colorado Division of Local Affairs, State Demography Office is used to compare the population to people reported with hepatitis by gender, age, race, ethnicity and county (4). If a person reported with hepatitis is incarcerated in a county jail, that event is assigned to the county of the jail location; however, if an event is identified in a state or federal prison, a county is not assigned. Instead, an institution type is selected in the event, and for the purposes of this report, the county is labeled "Prison".

Center for Health and Environmental Data (CHED)

CDPHE's Vital Statistics Branch provided cause of death data from 1993 to 2018. The Colorado Central Cancer Registry (CCCR) Branch of CDPHE provided data on liver cancer from 1993 to 2018.

Background

Hepatitis A

Hepatitis A is a viral infection that affects the liver and appears only as an acute (newly occurring) infection that does not become chronic. The virus is transmitted fecal-orally through contact with a person infected with HAV, including sexual activity or shared drug use, or through eating or drinking contaminated food or water. Other risk factors for HAV transmission include homelessness or unstable housing and international travel. People with hepatitis A can have a mild illness lasting a few weeks to a more severe illness requiring hospitalization, but mortality is low. A safe and effective vaccine to prevent HAV was introduced in 1995 and has been a recommended routine vaccination of all children aged 12-23 months since 2006. If a person knows they have been exposed to HAV, post-exposure prophylaxis (either immune globulin or hepatitis A vaccine) can be administered within two weeks of exposure to prevent illness.

Hepatitis B

Hepatitis B is a bloodborne illness that can occur as an acute or chronic infection. It can range in severity from a mild illness that clears on its own to a serious, lifelong illness that can result in death. The virus can replicate in the liver for years causing damage, often without symptoms. However, hepatitis B is preventable and can be managed if treated appropriately.

Transmission of HBV occurs most often by three routes: perinatally (mother to child at birth), through direct contact with blood, or through direct contact with semen or vaginal fluids. The likelihood of perinatal transmission ranges from 30% to 90%, and 90% of infants who perinatally acquire HBV and 5% of adults will develop a chronic, incurable infection (5).

Hepatitis C

Hepatitis C is a bloodborne illness that can be transmitted perinatally or through direct contact with blood. Acute HCV infection occurs an average of 14 (two to 26) weeks after exposure to the virus. Approximately 70 to 80% of people with acute hepatitis C will not exhibit symptoms, and most remain unaware of the infection (6). Abnormal liver function tests are one of the most characteristic features of HCV infection.

The screening test for probable chronic HCV infection is an antibody test that, if positive, indicates a past or present exposure to HCV. An estimated 15 to 25% of people exposed to the virus will clear it spontaneously, while the remainder will develop chronic infection (6). Due to the unknown number of past cases that have either cleared the virus spontaneously or have been cured, only cases that have confirmatory lab results are included in this report. Hepatitis C is often asymptomatic until later stages of disease and can result in liver fibrosis, cirrhosis, cancer and/or death. Of people living with unresolved, chronic hepatitis C, 10 to 20% will develop cirrhosis over a period of 20 to 30 years (6).

Case definitions

The Council for State and Territorial Epidemiologists (CSTE) develops and maintains *case definitions* for hepatitis A, B, and C to standardize reporting at the state and national level (7). Case definitions are modified or added when new technologies, methodologies, or clinical data become available (7). Details of all case definitions can be found at https://wwwn.cdc.gov/nndss/conditions/notifiable/2017/infectious-diseases/

Changes to case definitions have an impact on the number of cases reported and the status of cases (8). **Reported trends over time should be interpreted with caution if the case definition for that disease has changed.** In 2017, CDPHE conducted an analysis of the impact of the 2016 case definition change on chronic hepatitis C case counts and found a possible artificial decrease in the number of confirmed cases due to a more restrictive case definition (9). Regardless of case status definitions, reported cases do not represent the true incidence of viral hepatitis (10). There is evidence of increasing incidence of hepatitis C, particularly among adults born after 1965, and this trend is closely linked to the opioid crisis (10).

This report focuses largely on five- and 10-year trends in data. The following changes have occurred during these time periods:

- In 2016, **the case definition of chronic HCV infection changed** to require RNA or NAT tests to confirm cases. Previously, the laboratory criteria for diagnosis included positive antibodies to HCV with a signal to cut-off ratio predictive of a true positive as determined for the particular assay as defined by CDC.
- In 2016, **the clinical description for acute HCV infection changed** from ALT level at >400IU/L to ALT level >200 IU/L. The time frame for seroconversion was changed from six months to 12 months. These changes **made criteria less restrictive when determining if a case met acute case definition**.

- In 2017, **the case definition of perinatal HBV infection was updated** to include additional labs that were added as options to diagnosis of a case. This may make it easier for case finding, however, it was also added that the HBsAg-positive acceptance is dependent on there being at least four weeks between last dose of hepatitis B vaccine and testing to avoid false positivity. This in turn could make case finding more challenging if the child's vaccination status is unknown or cannot be located.
- In 2018, **a case definition of perinatal HCV infection was established** for the first time
  - Prior to 2018, perinatal hepatitis C cases were not considered to meet case definition and were not included in the case counts.

Some diseases have case definitions that are broken down into "Probable" and "Confirmed" cases statuses. **This report only includes data on viral hepatitis cases classified as "Confirmed".**

Hepatitis A

- In 2018, there were 31 (0.5 per 100,000 population) reported cases of hepatitis A.
- With the exception of 2017, the number of reported cases and rates per 100,000 were fairly stable from 2014 to 2018.
- Outbreaks of hepatitis A greatly impact the number of cases reported in a single year.
- An outbreak of hepatitis A that disproportionally affected MSM accounted for the majority of the 65 reported cases in 2017.
- Fifteen of the 31 cases reported in 2018 were associated with an outbreak among people with risk factors including homelessness, drug use, and incarceration that began in October 2018.
  - This ongoing outbreak will result in a large increase in hepatitis A cases in 2019.
  - Outside of Colorado, 27 other states experienced or are currently experiencing hepatitis A outbreaks that were ongoing or began in 2018 associated with similar risk factors (1).
  - Epidemiologic response to this outbreak impacted CDPHE and local public health activities related to hepatitis A in 2018 and 2019. Activities included:
    - Prompt investigation and response to all outbreak cases.
    - Vaccination clinics.
    - Outreach and education.
    - Communication with different partner agencies, including shelters, nonprofits serving at risk populations, syringe access programs, and jails.
  - The above activities required additional funding and personnel.

Table 1: Reported hepatitis A cases and rate per 100,000, 2009-2018

Measure†	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Cases	52	36	21	29	50	23	24	23	65	31
Rate	1.0	0.7	0.4	0.6	0.9	0.4	0.4	0.4	1.2	0.5
(95% CI)	(0.8, 1.3)	(0.5, 0.9)	(0.2, 0.6)	(0.4, 0.8)	(0.7, 1.2)	(0.3, 0.6)	(0.3, 0.6)	(0.2, 0.6)	(0.9, 1.4)	(0.4, 0.7)

†95% CI for rates were calculated using normal approximation to the Poisson distribution. Precision increases as CI narrows.

Hepatitis A: Gender, age, and race/ethnicity

Gender

- In 2018, men accounted for over half (67.7%) of reported hepatitis A cases (0.7 per 100,000 population), likely due to increased risk of drug use among men (7).
- The rate among women was 0.4 per 100,000 in 2018.
- In 2017, 70.8% of cases were among men due to an outbreak among MSM.

Figure 1: Rate per 100,000 of hepatitis A cases by gender, 2009-2018

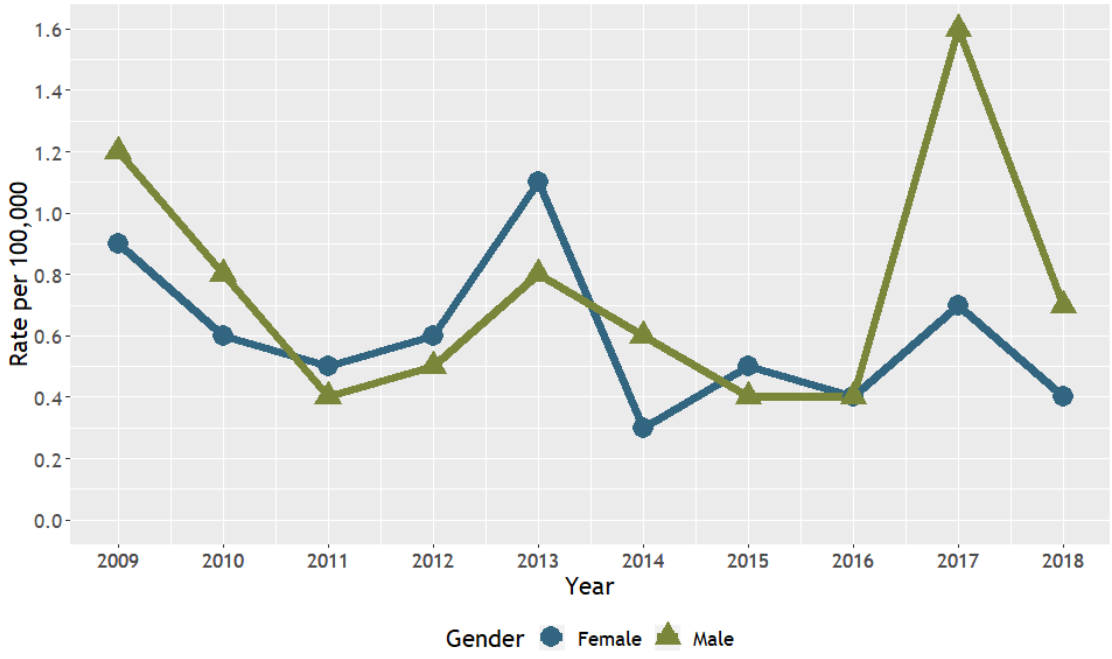


Table 2: Reported hepatitis A by gender, 2009-2018

Age	Measure *†	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Female	Cases	23	15	12	15	29	8	13	12	19	10
	(%)	44.2%	41.7%	57.1%	51.7%	58.0%	34.8%	54.2%	52.2%	29.2%	32.3%
	Rate	0.9	0.6	0.5	0.6	1.1	0.3	0.5	0.4	0.7	0.4
	(95% CI)	(0.6, 1.4)	(0.3, 1.0)	(0.2, 0.8)	(0.3, 1.0)	(0.7, 1.6)	(0.1, 0.6)	(0.3, 0.8)	(0.2, 0.8)	(0.4, 1.1)	(0.2, 0.6)
Male	Cases	29	21	9	14	21	15	11	11	46	21
	(%)	55.8%	58.3%	42.9%	48.3%	42.0%	65.2%	45.8%	47.8%	70.8%	67.7%
	Rate	1.2	0.8	0.4	0.5	0.8	0.6	0.4	0.4	1.6	0.7
	(95% CI)	(0.8, 1.7)	(0.5, 1.3)	(0.2, 0.7)	(0.3, 0.9)	(0.5, 1.2)	(0.3, 0.9)	(0.2, 0.7)	(0.2, 0.7)	(1.2, 2.2)	(0.5, 1.1)
Unk.	Cases	0	0	0	0	0	0	0	0	0	0
	(%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

*Rates per 100,000 population. Rates may be unreliable when there are fewer than 20 cases. Interpret with caution.

†95% CI for rates were calculated using gamma distribution when n<20 and normal approximation to the Poisson distribution when n>19. Precision increases as CI narrows.

Age

- The median age of cases in 2018 was 37, which was the lowest median age since 2014.
  - Injection drug use is typically initiated under the age of 30, which may explain the lower median age in 2018 associated with the ongoing hepatitis A outbreak for which injection drug use is a risk factor (11).
- The mean age in 2018 was 43.1.
- People between the ages of 20-39 accounted for 51.6% of the cases.
  - The rate of reported cases among 20-39 year olds was 1.0 per 100,000 population.
  - The second highest rate was among 40-59 year olds at 0.5 per 100,000 population.

Table 3: Reported hepatitis A by age, 2009-2018

Age	Measure *†	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
0-19	Cases	12	9	3	2	8	6	1	0	2	1
	(%)	23.1%	25.0%	14.3%	6.9%	16.0%	26.1%	4.2%	0.0%	3.1%	3.2%
	Rate	0.9	0.7	0.2	0.1	0.6	0.4	0.1	0	0.1	0.1
	(95% CI)	(0.5, 1.6)	(0.3, 1.2)	(0, 0.6)	(0, 0.5)	(0.2, 1.1)	(0.2, 0.9)	(0, 0.4)	(0, 0.2)	(0, 0.5)	(0, 0.4)
20-39	Cases	18	9	6	12	11	6	7	12	27	16
	(%)	34.6%	25.0%	28.6%	41.4%	22.0%	26.1%	29.2%	52.2%	41.5%	51.6%
	Rate	1.3	0.6	0.4	0.8	0.7	0.4	0.4	0.8	1.7	1.0
	(95% CI)	(0.7, 2.0)	(0.3, 1.2)	(0.2, 0.9)	(0.4, 1.4)	(0.4, 1.3)	(0.1, 0.9)	(0.2, 0.9)	(0.4, 1.3)	(1.1, 2.4)	(0.6, 1.6)
40-59	Cases	13	11	7	4	18	7	7	6	26	7
	(%)	25.0%	30.6%	33.3%	13.8%	36.0%	30.4%	29.2%	26.1%	40.0%	22.6%
	Rate	0.9	0.8	0.5	0.3	1.2	0.5	0.5	0.4	1.8	0.5
	(95% CI)	(0.5, 1.6)	(0.4, 1.4)	(0.2, 1.0)	(0.1, 0.7)	(0.7, 2.0)	(0.2, 1.0)	(0.2, 1.0)	(0.2, 0.9)	(1.2, 2.6)	(0.2, 1.0)
60-79	Cases	7	7	5	9	12	2	8	2	9	6
	(%)	13.5%	19.4%	23.8%	31.0%	24.0%	8.7%	33.3%	8.7%	13.8%	19.4%
	Rate	1.1	1.0	0.7	1.2	1.5	0.2	0.9	0.2	1.0	0.6
	(95% CI)	(0.4, 2.3)	(0.4, 2.1)	(0.2, 1.6)	(0.5, 2.3)	(0.8, 2.7)	(0, 0.9)	(0.4, 1.8)	(0, 0.8)	(0.4, 1.8)	(0.2, 1.3)
80-99	Cases	2	0	0	2	1	2	1	3	1	1
	(%)	3.8%	0.0%	0.0%	6.9%	2.0%	8.7%	4.2%	13.0%	1.5%	3.2%
	Rate	1.4	0	0	1.3	0.6	1.2	0.6	1.8	0.6	0.6
	(95% CI)	(0.2, 5.0)	(0, 2.1)	(0, 2.0)	(0.2, 4.7)	(0, 3.6)	(0.2, 4.5)	(0, 3.4)	(0.4, 5.2)	(0, 3.2)	(0, 3.1)
Unk.	Cases	0	0	0	0	0	0	0	0	0	0
	(%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

*Rates per 100,000 population. Rates may be unreliable when there are fewer than 20 cases. Interpret with caution.

†95% CI for rates were calculated using gamma distribution when n<20 and normal approximation to the Poisson distribution when n>19. Precision increases as CI narrows.

Race/ethnicity

- Race/ethnicity data were available for 64.5% of hepatitis A cases in 2018.
- Among cases with known race/ethnicity in 2018, 54.8% were Non-Hispanic (NH) White and 9.7% were Hispanic (all races).
- No cases were reported among other racial groups.

Table 4: Reported hepatitis A by race/ethnicity, 2009-2018

Age	Measure*†	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
NH NA/AN	Cases	0	0	0	0	0	0	0	0	0	0
	(%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Rate	0	0	0	0	0	0	0	0	0	0
	(95% CI)	(0, 3.4)	(0, 3.2)	(0, 3.2)	(0, 3.1)	(0, 3.0)	(0, 3.0)	(0, 2.9)	(0, 2.9)	(0, 2.8)	(0, 2.8)
NH Asian/PI	Cases	0	2	1	1	1	2	3	1	1	0
	(%)	0.0%	5.6%	4.8%	3.4%	2.0%	8.7%	12.5%	4.3%	1.5%	0.0%
	Rate	0	1.2	0.6	0.5	0.5	1.0	1.5	0.5	0.4	0
	(95% CI)	(0, 1.8)	(0.1, 4.2)	(0, 3.1)	(0, 3.0)	(0, 2.9)	(0.1, 3.6)	(0.3, 4.2)	(0, 2.6)	(0, 2.5)	(0, 1.3)
NH Black	Cases	3	2	0	1	3	0	0	0	1	0
	(%)	5.8%	5.6%	0.0%	3.4%	6.0%	0.0%	0.0%	0.0%	1.5%	0.0%
	Rate	1.2	0.8	0	0.4	1.1	0	0	0	0.3	0
	(95% CI)	(0.3, 3.6)	(0.1, 2.9)	(0, 1.2)	(0, 2.1)	(0.2, 3.3)	(0, 1.1)	(0, 1.1)	(0, 1.0)	(0, 1.9)	(0, 1.0)
NH White	Cases	31	23	11	19	34	16	15	17	40	17
	(%)	59.6%	63.9%	52.4%	65.5%	68.0%	69.6%	62.5%	73.9%	61.5%	54.8%
	Rate	0.7	0.5	0.2	0.4	0.7	0.3	0.3	0.3	0.8	0.3
	(95% CI)	(0.4, 0.9)	(0.3, 0.7)	(0.1, 0.4)	(0.2, 0.6)	(0.5, 1.0)	(0.2, 0.5)	(0.2, 0.5)	(0.2, 0.5)	(0.6, 1.1)	(0.2, 0.5)
Hispanic, all races	Cases	11	7	3	6	4	1	4	3	9	3
	(%)	21.2%	19.4%	14.3%	20.7%	8.0%	4.3%	16.7%	13.0%	13.8%	9.7%
	Rate	1.1	0.7	0.3	0.6	0.4	0.1	0.3	0.3	0.7	0.2
	(95% CI)	(0.5, 1.9)	(0.3, 1.4)	(0.1, 0.8)	(0.2, 1.2)	(0.1, 0.9)	(0, 0.5)	(0.1, 0.9)	(0.1, 0.7)	(0.3, 1.4)	(0.1, 0.7)
Unk.	Cases	7	2	6	2	8	4	2	2	14	11
	(%)	13.5%	5.6%	28.6%	6.9%	16.0%	17.4%	8.3%	8.7%	21.5%	35.5%

*Rates per 100,000 population. Rates may be unreliable when there are fewer than 20 cases. Interpret with caution.

†95% CI for rates were calculated using gamma distribution when n<20 and normal approximation to the Poisson distribution when n>19. Precision increases as CI narrows.

Hepatitis A: Risk factors and mortality

- Injection drug use (IDU) was identified as a risk factor for six cases in 2018 and is associated with the ongoing hepatitis A outbreak in Colorado.
- In 2018, PEH made up 33.3% (n = 5) of the 15 cases that were identified as part of the outbreak.
- In 2017, an outbreak among MSM accounted for 63 of the 65 cases that year.
- Of all reported hepatitis A cases since 2009, 7.1% had died as of September 2019 of any cause.

- Of total deaths among cases of hepatitis A from 2009 to 2017, 72.7%occurred less than two years after their case was reported to CDPHE.

Hepatitis A: Geographic distribution

- From 2014 to 2018, the distribution of cases migrated towards more urban counties.
- Hepatitis A cases were reported in 9 counties in 2018.
- In 2018, there were more than 2 cases reported in Adams, Arapahoe, Denver, El, Paso, Jefferson, and Pueblo counties.
- The highest number of cases were reported in El Paso and Denver counties.
- *Appendix A* lists case counts for all counties.

Figure 2: Case counts by county of hepatitis A, 2014-2017

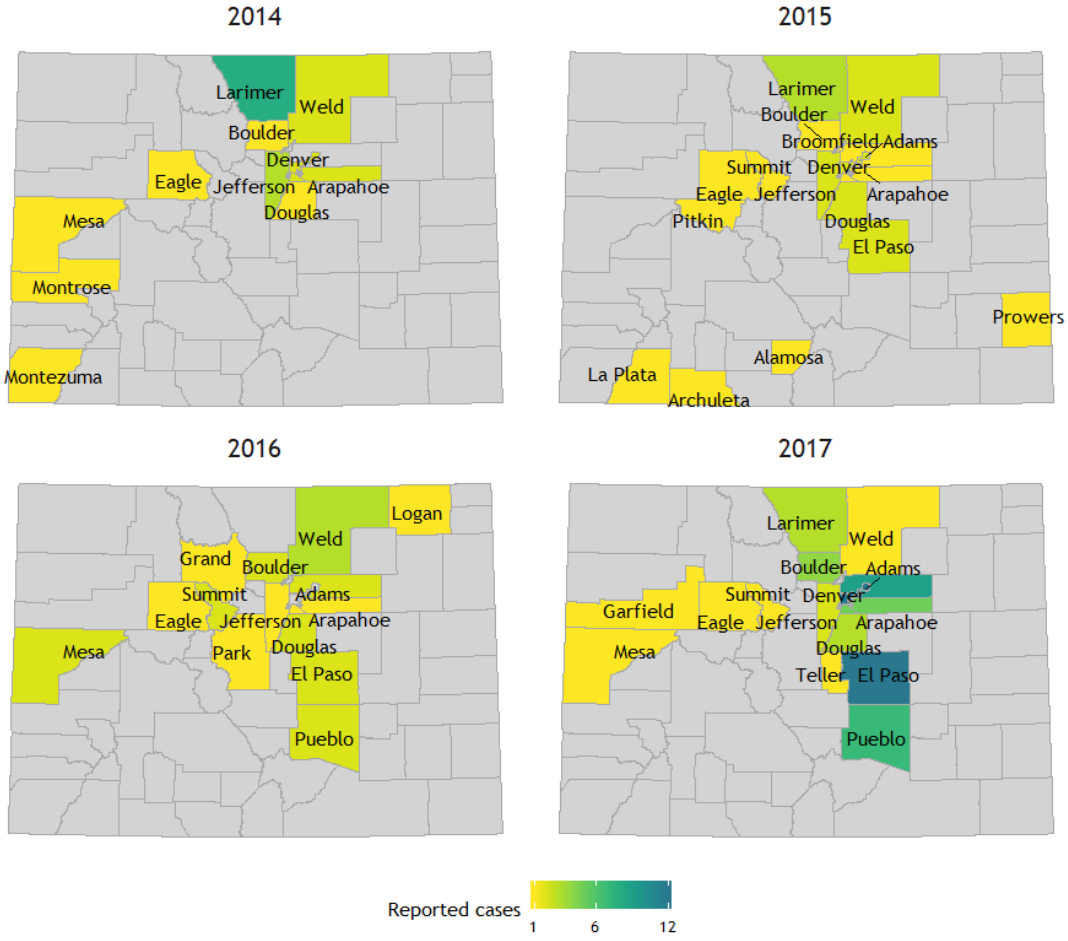
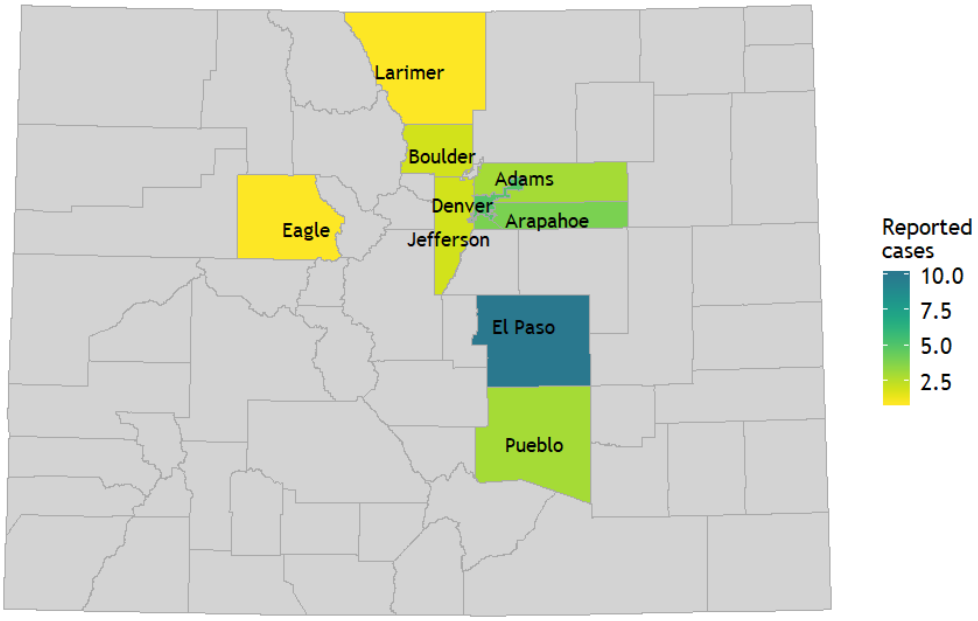


Figure 3: Case counts by county of hepatitis A, 2018



Acute hepatitis B

- In 2018, there were 21 (0.4 per 100,000 population) reported cases of acute hepatitis B.
- The number of reported cases in 2018 was lower than in the previous four years.
- According to CDC, acute hepatitis B cases are underreported by a factor of 6.5 (7).
  - Accounting for underreporting, there would be an estimated 137 cases in 2018.
- From 2009 to 2018, 20 acute hepatitis B cases were later reported as chronic.

Table 5: Reported acute hepatitis B cases and rate per 100,000, 2009-2018

Measure†	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Cases	27	46	23	25	23	29	29	28	32	21
Rate	0.5	0.9	0.4	0.5	0.4	0.5	0.5	0.5	0.6	0.4
(95% CI)	(0.3, 0.7)	(0.6, 1.2)	(0.3, 0.6)	(0.3, 0.7)	(0.3, 0.6)	(0.3, 0.7)	(0.3, 0.7)	(0.3, 0.7)	(0.4, 0.8)	(0.2, 0.5)

†95% CI for rates were calculated using normal approximation to the Poisson distribution. Precision increases as CI narrows.

Acute hepatitis B: Gender, age, and race/ethnicity

Gender

- The rate of cases among men was 0.5 per 100,000 in 2018 and 0.2 per 100,000 among women.
- Men have historically made up a larger proportion of cases due to heightened risk among MSM (7).

Figure 4: Rate per 100,000 of acute hepatitis B cases by gender, 2009-2018

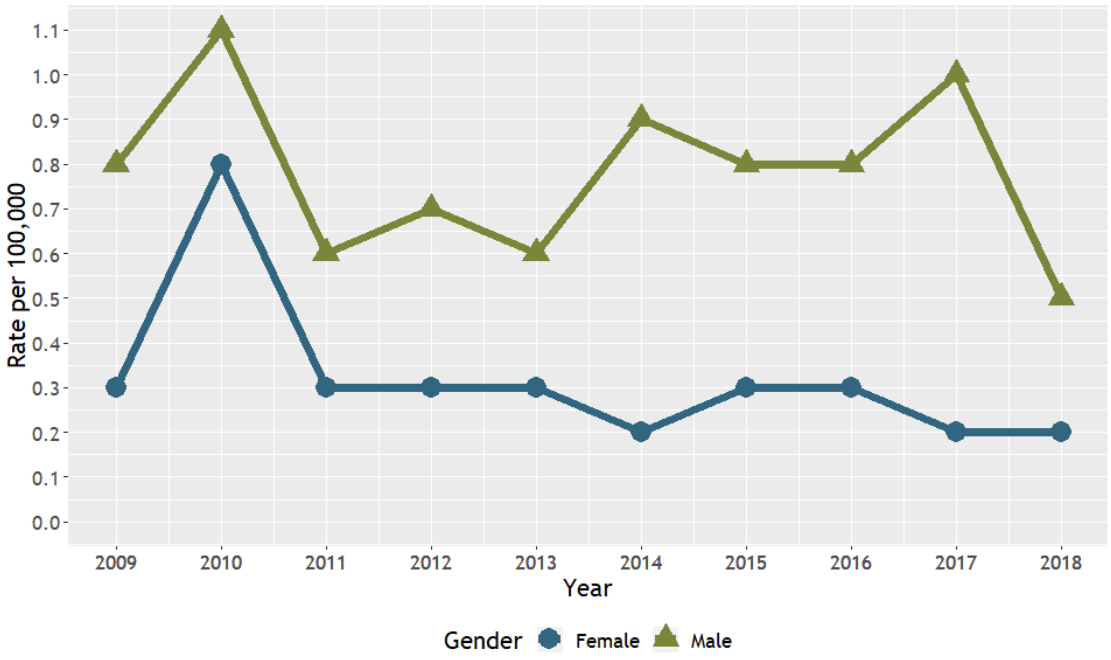


Table 6: Reported acute hepatitis B by gender, 2009-2018

Age	Measure *†	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Female	Cases	8	19	8	8	8	5	8	7	5	7
	(%)	29.6%	41.3%	34.8%	32.0%	34.8%	17.2%	27.6%	25.0%	15.6%	33.3%
	Rate	0.3	0.8	0.3	0.3	0.3	0.2	0.3	0.3	0.2	0.2
	(95% CI)	(0.1, 0.6)	(0.5, 1.2)	(0.1, 0.6)	(0.1, 0.6)	(0.1, 0.6)	(0.1, 0.4)	(0.1, 0.6)	(0.1, 0.5)	(0.1, 0.4)	(0.1, 0.5)
Male	Cases	19	27	15	17	15	24	21	21	27	14
	(%)	70.4%	58.7%	65.2%	68.0%	65.2%	82.8%	72.4%	75.0%	84.4%	66.7%
	Rate	0.8	1.1	0.6	0.7	0.6	0.9	0.8	0.8	1.0	0.5
	(95% CI)	(0.5, 1.2)	(0.7, 1.6)	(0.3, 1.0)	(0.4, 1.0)	(0.3, 0.9)	(0.6, 1.3)	(0.5, 1.2)	(0.5, 1.2)	(0.6, 1.4)	(0.3, 0.8)
Unk.	Cases	0	0	0	0	0	0	0	0	0	0
	(%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

*Rates per 100,000 population. Rates may be unreliable when there are fewer than 20 cases. Interpret with caution.

†95% CI for rates were calculated using gamma distribution when n<20 and normal approximation to the Poisson distribution when n>19. Precision increases as CI narrows.

Age

- The median age of cases in 2018 was 44, which was the lowest median age since 2014.
- The mean age in 2018 was 46.8.
- People between the ages of 40-59 had the highest rate of cases (1.0 per 100,000).
  - Case counts among other age groups were too low to calculate rates.
- Since 2014, there has only been one reported acute case in an individual less than 20 years old.
- People older than 19 years are less likely to be immunized for HBV based on a school-entry requirement that began in 1997.
- The relatively high numbers of acute cases among individuals ages 40-59 underscores the need for catch-up vaccination, particularly for individuals in priority populations.

Table 7: Reported acute hepatitis B by age, 2009-2018

Age	Measure *†	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
0-19	Cases	1	2	0	0	0	1	0	0	0	0
	(%)	3.7%	4.3%	0.0%	0.0%	0.0%	3.4%	0.0%	0.0%	0.0%	0.0%
	Rate	0.1	0.1	0	0	0	0.1	0	0	0	0
	(95% CI)	(0, 0.4)	(0, 0.5)	(0, 0.2)	(0, 0.2)	(0, 0.2)	(0, 0.4)	(0, 0.2)	(0, 0.2)	(0, 0.2)	(0, 0.2)
20-39	Cases	9	14	5	12	8	4	10	8	13	4
	(%)	33.3%	30.4%	21.7%	48.0%	34.8%	13.8%	34.5%	28.6%	40.6%	19.0%
	Rate	0.6	1.0	0.3	0.8	0.5	0.3	0.6	0.5	0.8	0.2
	(95% CI)	(0.3, 1.2)	(0.5, 1.6)	(0.1, 0.8)	(0.4, 1.4)	(0.2, 1.1)	(0.1, 0.7)	(0.3, 1.2)	(0.2, 1.0)	(0.4, 1.4)	(0.1, 0.6)
40-59	Cases	11	24	12	13	13	14	13	19	17	15
	(%)	40.7%	52.2%	52.2%	52.0%	56.5%	48.3%	44.8%	67.9%	53.1%	71.4%
	Rate	0.8	1.7	0.8	0.9	0.9	1.0	0.9	1.3	1.2	1.0
	(95% CI)	(0.4, 1.4)	(1.1, 2.5)	(0.4, 1.5)	(0.5, 1.5)	(0.5, 1.5)	(0.5, 1.6)	(0.5, 1.5)	(0.8, 2.0)	(0.7, 1.9)	(0.6, 1.7)
60-79	Cases	4	5	4	0	2	9	5	1	2	2
	(%)	14.8%	10.9%	17.4%	0.0%	8.7%	31.0%	17.2%	3.6%	6.2%	9.5%
	Rate	0.6	0.7	0.6	0	0.3	1.1	0.6	0.1	0.2	0.2
	(95% CI)	(0.2, 1.6)	(0.2, 1.7)	(0.2, 1.4)	(0, 0.4)	(0, 0.9)	(0.5, 2.1)	(0.2, 1.4)	(0, 0.6)	(0, 0.8)	(0, 0.7)
80-99	Cases	2	1	2	0	0	1	1	0	0	0
	(%)	7.4%	2.2%	8.7%	0.0%	0.0%	3.4%	3.4%	0.0%	0.0%	0.0%
	Rate	1.4	0.7	1.4	0	0	0.6	0.6	0	0	0
	(95% CI)	(0.2, 5.0)	(0, 3.9)	(0.2, 4.9)	(0, 2.0)	(0, 1.9)	(0, 3.5)	(0, 3.4)	(0, 1.8)	(0, 1.7)	(0, 1.7)
Unk.	Cases	0	0	0	0	0	0	0	0	0	0
	(%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

*Rates per 100,000 population. Rates may be unreliable when there are fewer than 20 cases. Interpret with caution.

†95% CI for rates were calculated using gamma distribution when n<20 and normal approximation to the Poisson distribution when n>19. Precision increases as CI narrows.

Race/ethnicity

- Nationally, rates of acute hepatitis B have been consistently higher for NH Blacks compared to all other racial/ethnic groups, and rates of HBV vaccination among adults and those at high risk for infection were significantly lower among NH Blacks than among NH Whites (12).
- From 2014 to 2018, NH Whites and Hispanics (all races) accounted for the highest proportions of acute hepatitis B cases in Colorado

Table 8: Reported acute hepatitis B by race/ethnicity, 2009-2018

Age	Measure*†	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
NH NA/AN	Cases	0	2	0	0	0	0	0	0	0	0
	(%)	0.0%	4.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Rate	0	2.1	0	0	0	0	0	0	0	0
	(95% CI)	(0, 3.4)	(0.3, 7.7)	(0, 3.2)	(0, 3.1)	(0, 3.0)	(0, 3.0)	(0, 2.9)	(0, 2.9)	(0, 2.8)	(0, 2.8)
NH Asian/PI	Cases	5	1	0	0	0	1	1	2	1	0
	(%)	18.5%	2.2%	0.0%	0.0%	0.0%	3.4%	3.4%	7.1%	3.1%	0.0%
	Rate	3.0	0.6	0	0	0	0.5	0.5	0.9	0.4	0
	(95% CI)	(1.0, 7.0)	(0, 3.2)	(0, 1.7)	(0, 1.6)	(0, 1.6)	(0, 2.8)	(0, 2.7)	(0.1, 3.4)	(0, 2.5)	(0, 1.3)
NH Black	Cases	2	7	1	3	2	2	3	4	3	2
	(%)	7.4%	15.2%	4.3%	12.0%	8.7%	6.9%	10.3%	14.3%	9.4%	9.5%
	Rate	0.8	2.8	0.4	1.2	0.8	0.7	1.1	1.4	1.0	0.7
	(95% CI)	(0.1, 3.0)	(1.1, 5.8)	(0, 2.2)	(0.2, 3.4)	(0.1, 2.7)	(0.1, 2.6)	(0.2, 3.1)	(0.4, 3.5)	(0.2, 3.0)	(0.1, 2.4)
NH White	Cases	14	18	15	16	9	14	20	15	17	14
	(%)	51.9%	39.1%	65.2%	64.0%	39.1%	48.3%	69.0%	53.6%	53.1%	66.7%
	Rate	0.3	0.4	0.3	0.3	0.2	0.3	0.4	0.3	0.3	0.3
	(95% CI)	(0.2, 0.5)	(0.2, 0.6)	(0.2, 0.5)	(0.2, 0.6)	(0.1, 0.4)	(0.2, 0.5)	(0.3, 0.6)	(0.2, 0.5)	(0.2, 0.5)	(0.2, 0.5)
Hispanic, all races	Cases	6	6	2	1	5	5	1	2	6	5
	(%)	22.2%	13.0%	8.7%	4.0%	21.7%	17.2%	3.4%	7.1%	18.8%	23.8%
	Rate	0.6	0.6	0.2	0.1	0.5	0.4	0.1	0.2	0.5	0.4
	(95% CI)	(0.2, 1.3)	(0.2, 1.2)	(0, 0.7)	(0, 0.5)	(0.1, 1.1)	(0.1, 1.0)	(0, 0.5)	(0, 0.6)	(0.2, 1.1)	(0.1, 1.0)
Unk.	Cases	0	12	5	5	7	7	4	5	5	0
	(%)	0.0%	26.1%	21.7%	20.0%	30.4%	24.1%	13.8%	17.9%	15.6%	0.0%

*Rates per 100,000 population. Rates may be unreliable when there are fewer than 20 cases. Interpret with caution.

†95% CI for rates were calculated using gamma distribution when n<20 and normal approximation to the Poisson distribution when n>19. Precision increases as CI narrows.

Acute hepatitis B: Risk factors and mortality

- Risk factors were unknown for 66.7% of reported acute hepatitis B cases in 2018.
  - Risk factor data was also missing for over 60% of cases in 2016 and 2017.
  - Nationally, PWID, people with multiple sex partners, and MSM had the highest risk of acquiring acute hepatitis B (7).
- PEH at the time of reporting made up 14.3% (n = 3) of cases in 2018, 100% of whom identified IDU as a risk factor.

- Of all reported acute hepatitis B cases since 2009, 11.7% had died as of September 2019 of any cause.
- Of total deaths among cases of acute hepatitis B reported from 2009 to 2017, 64.5% occurred less than two years after their case was reported to CDPHE.

Acute hepatitis B: Geographic distribution

- From 2014 to 2018, acute hepatitis B cases were primarily reported in urban counties.
- Acute hepatitis B cases were reported in 11 counties in 2018.
- In 2018, there were more than 2 cases reported in Denver, El Paso, and Jefferson counties.
- As with hepatitis A, the highest numbers of cases came from Denver and El Paso counties.
- Appendix A lists case counts for all counties.

Figure 5: Case counts by county of acute hepatitis B, 2014-2017

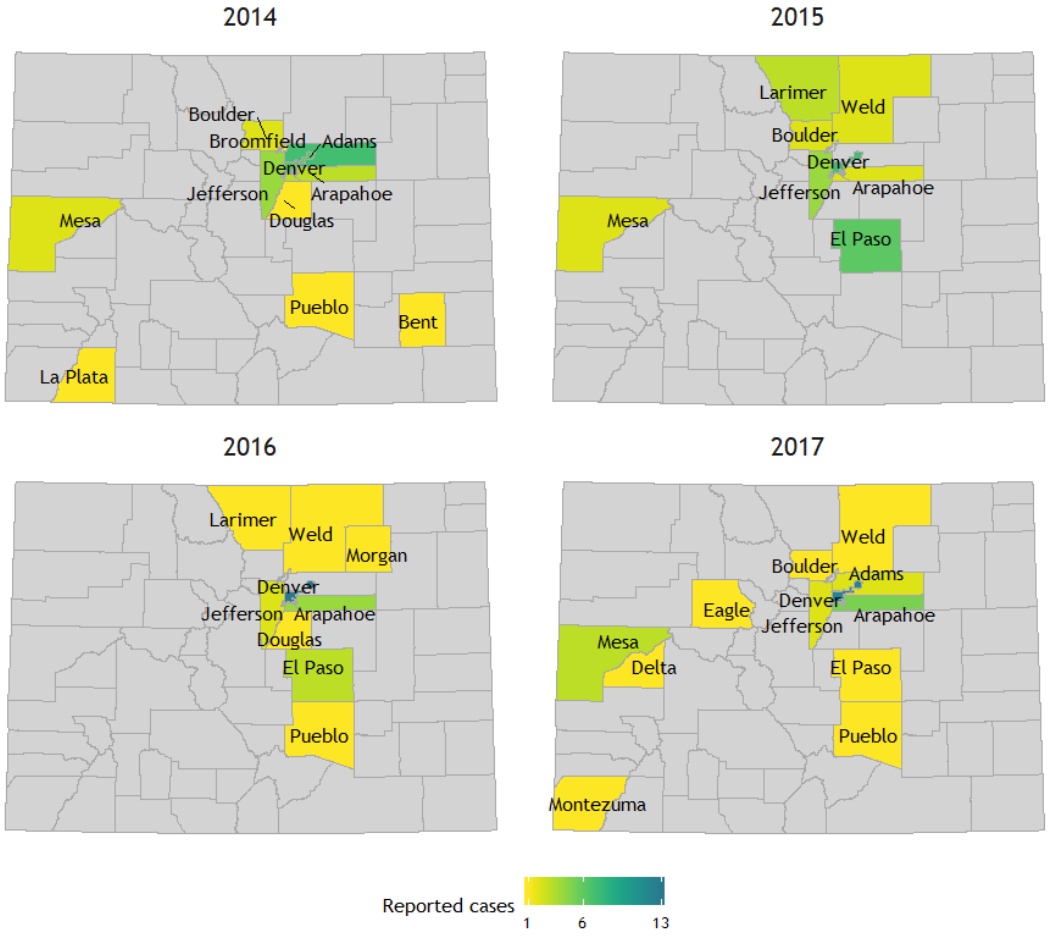
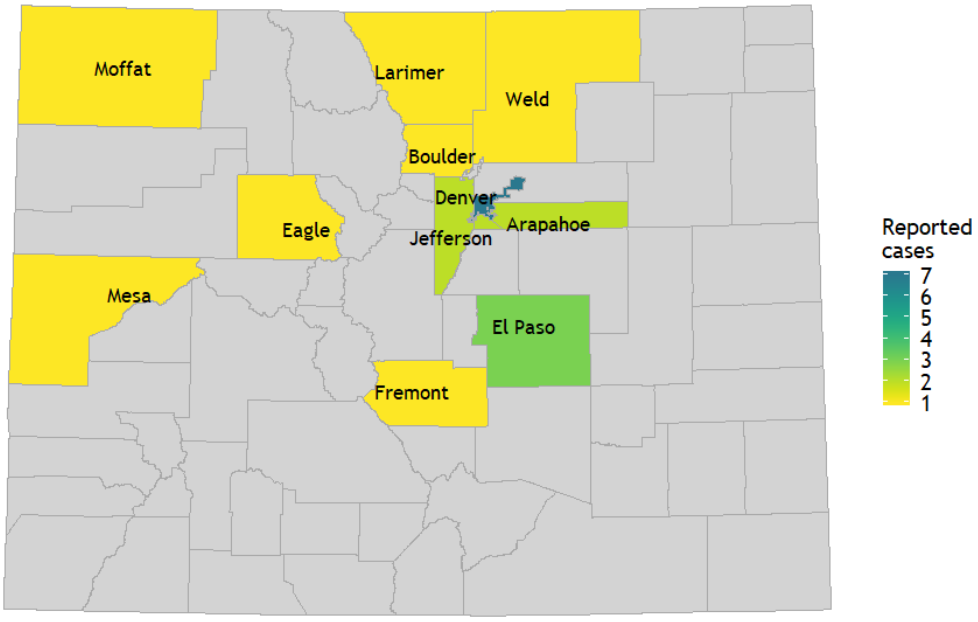


Figure 6: Case counts by county of acute hepatitis B, 2018



Chronic hepatitis B

- In 2018, there were 220 (3.9 per 100,000 population) cases of chronic hepatitis B.
- The data indicate that the rate of reported confirmed chronic hepatitis B cases per 100,000 decreased each year from 2015 to 2018.
- The number of reported cases was lower in 2018 than in 2017, but there may be a lag in conducting the second test needed at least six months after the first to confirm a case.
- Using the most recent national prevalence estimate, an estimated 17,086 individuals in Colorado were living with chronic, unresolved hepatitis B (13,14).

Table 9: Reported chronic hepatitis B cases and rate per 100,000, 2009-2018

Measure†	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Cases	335	306	259	247	264	302	315	308	240	220
Rate	6.7	6.1	5.1	4.8	5.0	5.6	5.8	5.6	4.3	3.9
(95% CI)	(6.0, 7.5)	(5.4, 6.7)	(4.4, 5.7)	(4.2, 5.3)	(4.4, 5.6)	(5.0, 6.3)	(5.1, 6.4)	(4.9, 6.2)	(3.7, 4.8)	(3.4, 4.4)

†95% CI for rates were calculated using normal approximation to the Poisson distribution. Precision increases as CI narrows.

Chronic hepatitis B: Gender, age, and race/ethnicity

Gender

- The rate of cases among men was 4.8 per 100,000 in 2018 and 2.9 per 100,000 among women.
  - In 2018, men made up 62.3% of cases and women made up 37.7%.
- The gender distribution has been fairly stable and evenly distributed until 2018.

Figure 7: Rate per 100,000 of chronic hepatitis B cases by gender, 2009-2018

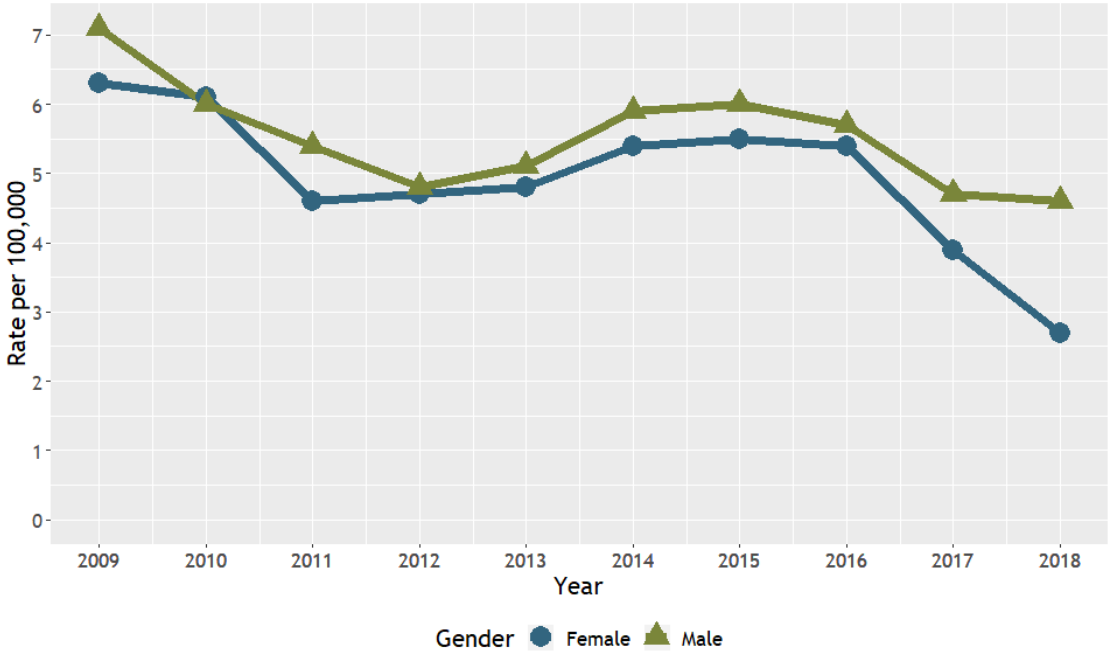


Table 10: Reported chronic hepatitis B by gender, 2009-2018

Age	Measure *†	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Female	Cases	156	153	120	122	127	144	149	150	109	83
	(%)	46.6%	50.0%	46.3%	49.4%	48.1%	47.7%	47.3%	48.7%	45.4%	37.7%
	Rate	6.3	6.1	4.7	4.7	4.8	5.4	5.5	5.4	3.9	2.9
	(95% CI)	(5.3, 7.3)	(5.1, 7.0)	(3.9, 5.5)	(3.9, 5.5)	(4.0, 5.7)	(4.5, 6.3)	(4.6, 6.4)	(4.6, 6.3)	(3.2, 4.6)	(2.3, 3.5)
Male	Cases	179	153	139	125	137	158	166	158	131	137
	(%)	53.4%	50.0%	53.7%	50.6%	51.9%	52.3%	52.7%	51.3%	54.6%	62.3%
	Rate	7.1	6.0	5.4	4.8	5.2	5.9	6.1	5.7	4.7	4.8
	(95% CI)	(6.1, 8.2)	(5.1, 7.0)	(4.5, 6.3)	(4.0, 5.6)	(4.3, 6.1)	(5.0, 6.8)	(5.2, 7.0)	(4.8, 6.6)	(3.9, 5.5)	(4.0, 5.6)
Unk.	Cases	0	0	0	0	0	0	0	0	0	0
	(%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

*Rates per 100,000 population. Rates may be unreliable when there are fewer than 20 cases. Interpret with caution.

†95% CI for rates were calculated using gamma distribution when n<20 and normal approximation to the Poisson distribution when n>19. Precision increases as CI narrows.

Age

- The median age of cases in 2018 was 42, and the mean age was 43.0.
- People between the ages of 40-59 had the highest rate of cases (6.2 per 100,000).
- Only one acute hepatitis B case in individuals under the age of 20 was reported between 2014 and 2018, but 57 cases of chronic hepatitis B in this population were reported during this time.
- The HBV vaccine has been a mandated childhood vaccination since 1997 in Colorado.
    - Some of the cases among 0-19 year olds were born outside of the U.S.
    - Other cases were not born outside of the U.S. but may not have been vaccinated at birth, when HBV is most likely to be transmitted perinatally.
    - The number of cases among people under 20 highlights the importance of PHBPP to prevent possible perinatal transmission in families.
    - Increased outreach and testing among adults is needed for linkage to care and to control viral load among those living with chronic hepatitis B.
    - Catch-up vaccination is important for those who were born before HBV vaccination became routine, as mentioned in the Acute hepatitis B age section.

Figure 8: Rates per 100,000 of chronic hepatitis B by age, 2009-2018

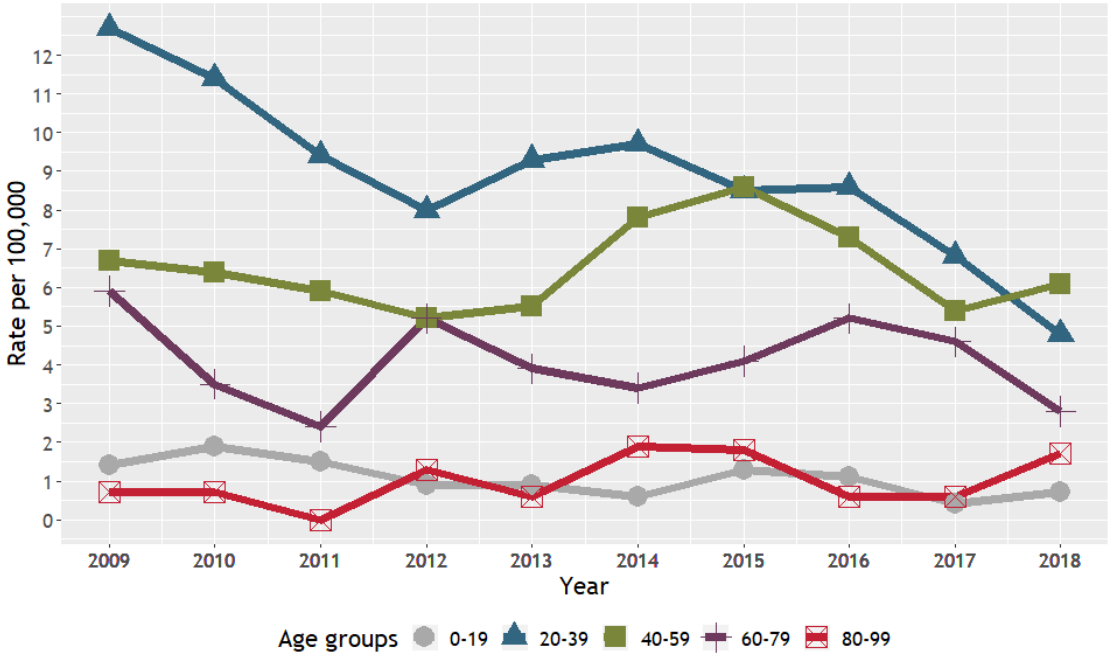


Table 11: Reported chronic hepatitis B cases by age, 2009-2018

Age	Measure *†	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
0-19	Cases	19	26	20	12	12	9	18	15	5	10
	(%)	5.7%	8.5%	7.7%	4.9%	4.5%	3.0%	5.7%	4.9%	2.1%	4.5%
	Rate	1.4	1.9	1.5	0.9	0.9	0.6	1.3	1.1	0.4	0.7
	(95% CI)	(0.9, 2.2)	(1.2, 2.8)	(0.9, 2.2)	(0.4, 1.5)	(0.4, 1.5)	(0.3, 1.2)	(0.8, 2.0)	(0.6, 1.7)	(0.1, 0.8)	(0.3, 1.3)
20-39	Cases	182	164	137	118	140	148	134	139	112	85
	(%)	54.3%	53.6%	52.9%	47.8%	53.0%	49.0%	42.5%	45.1%	46.7%	38.6%
	Rate	12.7	11.4	9.5	8.0	9.4	9.7	8.6	8.7	6.9	5.1
	(95% CI)	(10.9, 14.6)	(9.7, 13.2)	(7.9, 11.0)	(6.6, 9.5)	(7.8, 10.9)	(8.1, 11.2)	(7.1, 10.0)	(7.2, 10.1)	(5.6, 8.1)	(4.0, 6.2)
40-59	Cases	95	91	85	76	80	114	125	106	79	91
	(%)	28.4%	29.7%	32.8%	30.8%	30.3%	37.7%	39.7%	34.4%	32.9%	41.4%
	Rate	6.7	6.4	5.9	5.3	5.5	7.9	8.6	7.3	5.4	6.2
	(95% CI)	(5.4, 8.0)	(5.1, 7.7)	(4.7, 7.2)	(4.1, 6.5)	(4.3, 6.7)	(6.4, 9.3)	(7.1, 10.1)	(5.9, 8.6)	(4.2, 6.6)	(4.9, 7.5)
60-79	Cases	38	24	17	39	31	28	35	47	43	31
	(%)	11.3%	7.8%	6.6%	15.8%	11.7%	9.3%	11.1%	15.3%	17.9%	14.1%
	Rate	5.9	3.5	2.4	5.2	3.9	3.4	4.1	5.2	4.6	3.2
	(95% CI)	(4.0, 7.8)	(2.1, 4.9)	(1.2, 3.5)	(3.6, 6.8)	(2.6, 5.3)	(2.1, 4.7)	(2.7, 5.4)	(3.7, 6.7)	(3.2, 6.0)	(2.1, 4.3)
80-99	Cases	1	1	0	2	1	3	3	1	1	3
	(%)	0.3%	0.3%	0.0%	0.8%	0.4%	1.0%	1.0%	0.3%	0.4%	1.4%
	Rate	0.7	0.7	0	1.3	0.6	1.9	1.8	0.6	0.6	1.7
	(95% CI)	(0, 3.8)	(0, 3.9)	(0, 2.0)	(0.2, 4.7)	(0, 3.6)	(0.4, 5.5)	(0.4, 5.3)	(0, 3.3)	(0, 3.2)	(0.3, 4.9)
Unk.	Cases	0	0	0	0	0	0	0	0	0	0
	(%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

*Rates per 100,000 population. Rates may be unreliable when there are fewer than 20 cases. Interpret with caution.

†95% CI for rates were calculated using gamma distribution when n<20 and normal approximation to the Poisson distribution when n>19. Precision increases as CI narrows.

Race/ethnicity

- Race/ethnicity data is not routinely reported for chronic hepatitis B cases in Colorado, and 43.6% of reported cases 2018 were missing data.
- CDC does not include cases and rates by race/ethnicity for chronic hepatitis B in annual surveillance reporting (7), but the national prevalence of chronic HBV in 2012 was estimated to be 10-fold higher in the NH Asian population than in the general population and 2- to 3-fold higher in the NH Black population than in the general population (14).

- In Colorado, the NH Asian/PI population accounted for 22.7% of all cases and had the highest rates per 100,000 population annually from 2009 to 2018.
- NH Blacks had the second highest rates of reported chronic hepatitis B.

Table 12: Reported chronic hepatitis B by race/ethnicity, 2009-2018

Age	Measure*†	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
NH NA/AN	Cases	2	0	0	0	0	1	1	0	1	0
	(%)	0.6%	0%	0%	0%	0%	0.3%	0.3%	0%	0.4%	0%
	Rate	2.2	0	0	0	0	1.0	1.0	0	0.9	0
	(95% CI)	(0.3, 8.1)	(0, 3.2)	(0, 3.2)	(0, 3.1)	(0, 3.0)	(0, 5.6)	(0, 5.4)	(0, 2.9)	(0, 5.2)	(0, 2.8)
NH Asian/PI	Cases	143	141	102	106	92	103	111	75	65	50
	(%)	42.7%	46.1%	39.4%	42.9%	34.8%	34.1%	35.2%	24.4%	27.1%	22.7%
	Rate	86.2	81.8	57.2	57.5	48.1	52.0	53.7	34.9	29.1	22.1
	(95% CI)	(72.1, 100.4)	(68.3, 95.3)	(46.1, 68.3)	(46.5, 68.4)	(38.3, 57.9)	(41.9, 62.0)	(43.7, 63.7)	(27.0, 42.8)	(22.0, 36.2)	(16.0, 28.2)
NH Black	Cases	57	58	47	39	41	64	26	34	25	24
	(%)	17.0%	19.0%	18.1%	15.8%	15.5%	21.2%	8.3%	11.0%	10.4%	10.9%
	Rate	23.6	23.5	18.6	15.0	15.4	23.4	9.2	11.7	8.4	8.0
	(95% CI)	(17.5, 29.8)	(17.4, 29.5)	(13.3, 23.9)	(10.3, 19.8)	(10.7, 20.1)	(17.6, 29.1)	(5.7, 12.7)	(7.8, 15.6)	(5.1, 11.7)	(4.8, 11.2)
NH White	Cases	50	35	40	36	21	35	23	26	30	38
	(%)	14.9%	11.4%	15.4%	14.6%	8.0%	11.6%	7.3%	8.4%	12.5%	17.3%
	Rate	1.1	0.8	0.9	0.8	0.4	0.7	0.5	0.5	0.6	0.8
	(95% CI)	(0.8, 1.4)	(0.5, 1.0)	(0.6, 1.1)	(0.5, 1.0)	(0.3, 0.6)	(0.5, 1.0)	(0.3, 0.7)	(0.3, 0.7)	(0.4, 0.8)	(0.5, 1.0)
Hispanic, all races	Cases	10	10	11	8	11	11	4	5	10	12
	(%)	3.0%	3.3%	4.2%	3.2%	4.2%	3.6%	1.3%	1.6%	4.2%	5.5%
	Rate	1.0	1.0	1.0	0.7	1.0	1.0	0.3	0.4	0.8	1.0
	(95% CI)	(0.5, 1.8)	(0.5, 1.8)	(0.5, 1.8)	(0.3, 1.4)	(0.5, 1.8)	(0.5, 1.7)	(0.1, 0.9)	(0.1, 1.0)	(0.4, 1.5)	(0.5, 1.7)
Unk.	Cases	73	62	59	58	99	88	150	168	109	96
	(%)	21.8%	20.3%	22.8%	23.5%	37.5%	29.1%	47.6%	54.5%	45.4%	43.6%

*Rates per 100,000 population. Rates may be unreliable when there are fewer than 20 cases. Interpret with caution.

†95% CI for rates were calculated using gamma distribution when n<20 and normal approximation to the Poisson distribution when n>19. Precision increases as CI narrows.

Chronic hepatitis B: Risk factors and mortality

- Risk factor data is not routinely collected for chronic cases, but individuals born in countries where hepatitis B is endemic are considered to be at greater risk than individuals born in the United States (14).
  - Data from PHBPP indicate that foreign-born pregnant people in Colorado are more likely to be reported with chronic hepatitis B than other pregnant people born in the U.S.
- PEH did not make up a disproportionate amount of reported chronic hepatitis B cases.
- Of all reported chronic hepatitis B cases since 2009, 4.4% had died as of September 2019 of any cause.
- Of total deaths among cases of chronic hepatitis B reported from 2009 to 2017, 47.9% occurred fewer than 2 years after their case was reported to CDPHE.

Chronic hepatitis B: Geographic Distribution

- Chronic hepatitis B cases were reported in 24 counties in 2018.
- Incarcerated individuals made up 6.2% of reported cases and experienced the highest increase in cases from 2017 to 2018.
- Arapahoe County accounted for the highest proportion of reported cases every year from 2014 to 2018.

  Appendix A lists case counts for all counties.

Figure 9: Case counts by county of chronic hepatitis B, 2014-2017

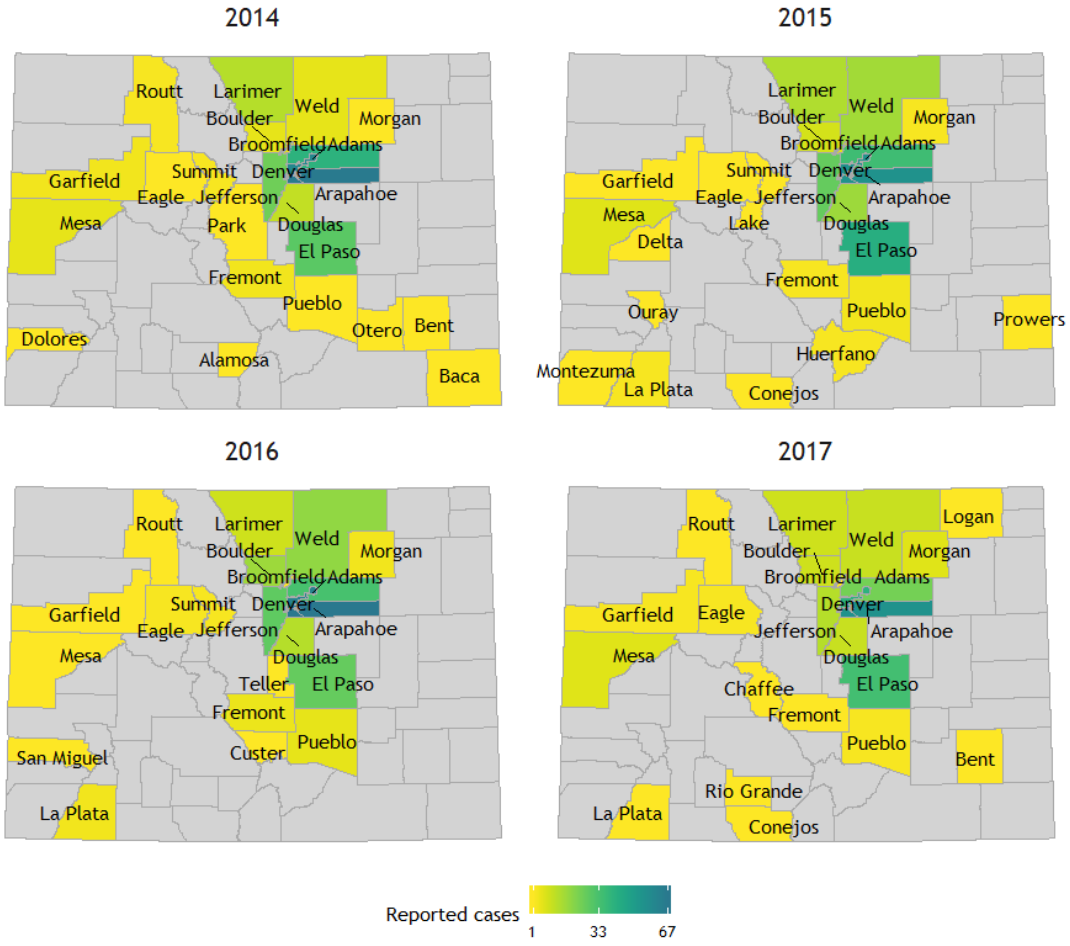
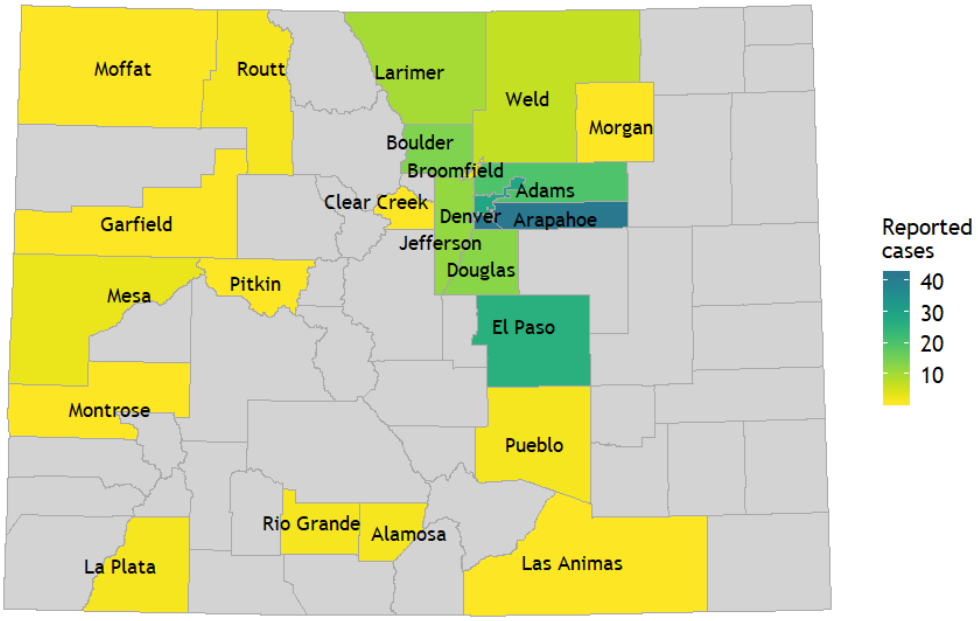


Figure 10: Case counts by county of chronic hepatitis B, 2018



Acute hepatitis C

- In 2018, there were 46 (0.8 per 100,000 population) cases of acute hepatitis C.
- While there were two more reported cases in 2018 than in 2017, the rate per 100,000 population did not change.
  - There was a 31.4% increase in cases between 2016 and 2018.
- CDC estimates that acute hepatitis C cases are underreported by a factor of 13.9, so there were likely at least 639 incident cases in 2018 (7).
- Between 2009 and 2018, there were 96 reported acute cases that were later diagnosed with chronic hepatitis C.
  - In 2018, there were 11 chronic cases reported that were previously reported as acute cases.
  - The average age of these cases reported as chronic in 2018 was 31.
  - The average time to diagnosis of chronic hepatitis C in 2018 from a previous acute diagnosis was 2.8 years.
  - As of the time of this report, 10.4% of people who were diagnosed with acute and chronic hepatitis C between 2009 and 2018 had died.
  - According to CDC, approximately 25% of acute cases spontaneously clear the virus before becoming chronic.
  - An estimated 111 (48.5%) more acute cases that were not reported deceased likely went on to become chronic.

Table 13: Reported acute hepatitis C cases and rate per 100,000, 2009-2018

Measure†	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Cases	32	25	32	42	23	32	40	35	44	46
Rate	0.6	0.5	0.6	0.8	0.4	0.6	0.7	0.6	0.8	0.8
(95% CI)	(0.4, 0.9)	(0.3, 0.7)	(0.4, 0.8)	(0.6, 1.1)	(0.3, 0.6)	(0.4, 0.8)	(0.5, 1.0)	(0.4, 0.8)	(0.6, 1.0)	(0.6, 1.0)

†95% CI for rates were calculated using normal approximation to the Poisson distribution. Precision increases as CI narrows.

Acute hepatitis C: Gender, age, and race/ethnicity distributions

Gender

- The rate of cases among men was 1.1 per 100,000 in 2018 and 0.5 per 100,000 among women.
- Rates among men have increased since 2015, while rates among women have decreased slightly.

Figure 11: Rate per 100,000 of acute hepatitis C cases by gender, 2009-2018

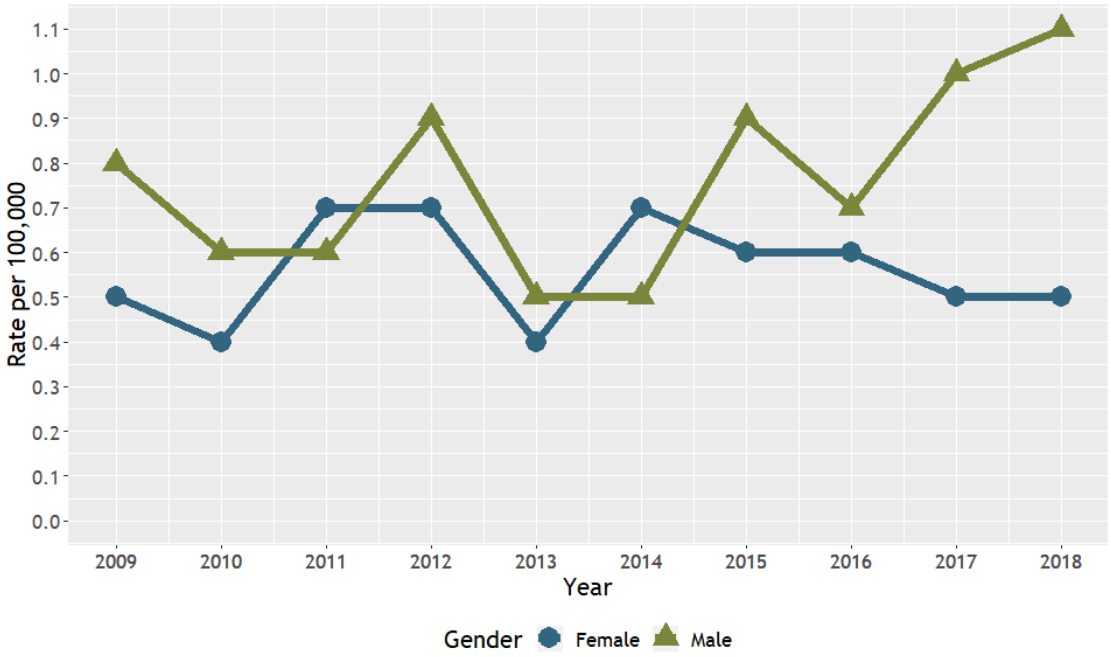


Table 14: Reported acute hepatitis C by gender, 2009-2018

Age	Measure *†	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Female	Cases	12	11	17	18	11	18	16	16	15	14
	(%)	37.5%	44.0%	53.1%	42.9%	47.8%	56.2%	40.0%	45.7%	34.1%	30.4%
	Rate	0.5	0.4	0.7	0.7	0.4	0.7	0.6	0.6	0.5	0.5
	(95% CI)	(0.3, 0.8)	(0.2, 0.8)	(0.4, 1.1)	(0.4, 1.1)	(0.2, 0.7)	(0.4, 1.1)	(0.3, 1.0)	(0.3, 0.9)	(0.3, 0.9)	(0.3, 0.8)
Male	Cases	20	14	15	24	12	14	24	19	29	32
	(%)	62.5%	56.0%	46.9%	57.1%	52.2%	43.8%	60.0%	54.3%	65.9%	69.6%
	Rate	0.8	0.6	0.6	0.9	0.5	0.5	0.9	0.7	1.0	1.1
	(95% CI)	(0.4, 1.1)	(0.3, 0.8)	(0.3, 0.9)	(0.6, 1.3)	(0.2, 0.7)	(0.2, 0.8)	(0.5, 1.2)	(0.4, 1.0)	(0.7, 1.4)	(0.7, 1.5)
Unk.	Cases	0	0	0	0	0	0	0	0	0	0
	(%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

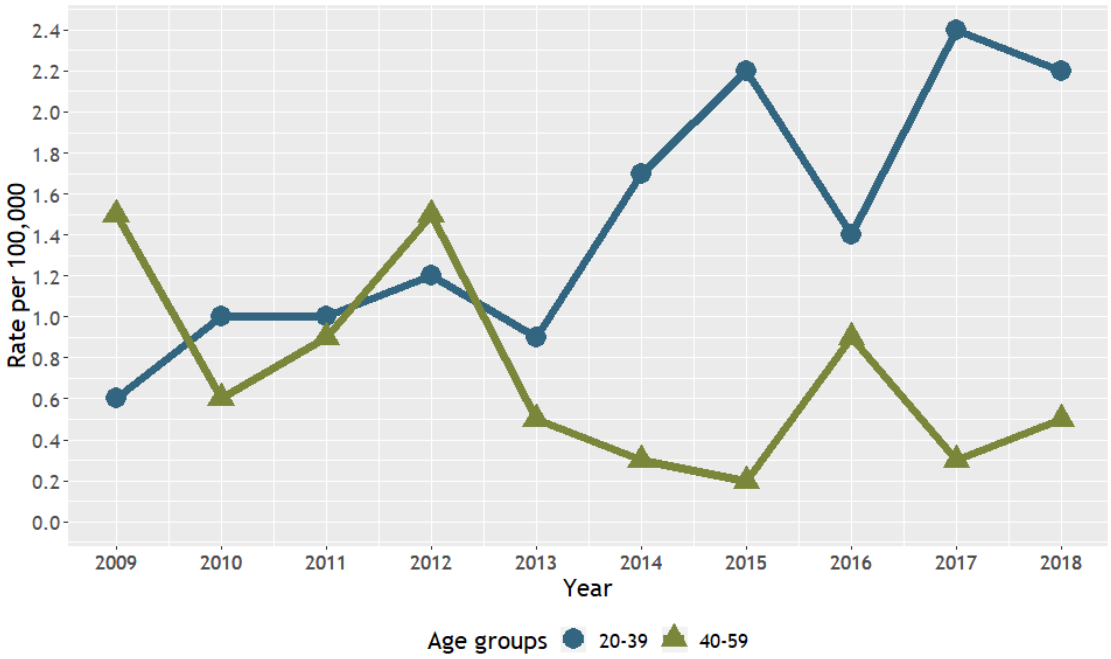
*Rates per 100,000 population. Rates may be unreliable when there are fewer than 20 cases. Interpret with caution.

†95% CI for rates were calculated using gamma distribution when n<20 and normal approximation to the Poisson distribution when n>19. Precision increases as CI narrows.

Age

- The median age of cases in 2018 was 28, and the mean age was 31.4.
- People between the ages of 20-39 had the highest rate of cases (2.2 per 100,000) and made up over 80% of cases in 2014, 2015, 2017, and 2018.
- Figure 12 illustrates the trend of rising rates of acute hepatitis C among 20-39 years and declining rates among 40-59 year olds.
  - Other age groups were not included due to small case counts.

Figure 12: Rates per 100,000 of acute hepatitis C among 20-39 and 40-59 year olds, 2009-2018



Age groups with a mean number of cases below 5 from 2009-2018 are not displayed.

Table 15: Reported acute hepatitis C by age, 2009-2018

Age	Measure *†	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
0-19	Cases	0	0	1	1	2	2	3	0	0	0
	(%)	0.0%	0.0%	3.1%	2.4%	8.7%	6.2%	7.5%	0.0%	0.0%	0.0%
	Rate	0	0	0.1	0.1	0.1	0.1	0.2	0	0	0
	(95% CI)	(0, 0.2)	(0, 0.2)	(0, 0.4)	(0, 0.4)	(0, 0.5)	(0, 0.5)	(0, 0.6)	(0, 0.2)	(0, 0.2)	(0, 0.2)
20-39	Cases	8	14	15	18	13	26	34	22	39	37
	(%)	25.0%	56.0%	46.9%	42.9%	56.5%	81.2%	85.0%	62.9%	88.6%	80.4%
	Rate	0.6	1.0	1.0	1.2	0.9	1.7	2.2	1.4	2.4	2.2
	(95% CI)	(0.2, 0.9)	(0.5, 1.5)	(0.5, 1.6)	(0.7, 1.8)	(0.4, 1.3)	(1.0, 2.4)	(1.4, 2.9)	(0.8, 1.9)	(1.6, 3.1)	(1.5, 2.9)
40-59	Cases	21	9	13	21	7	4	3	13	4	8
	(%)	65.6%	36.0%	40.6%	50.0%	30.4%	12.5%	7.5%	37.1%	9.1%	17.4%
	Rate	1.5	0.6	0.9	1.5	0.5	0.3	0.2	0.9	0.3	0.5
	(95% CI)	(0.9, 2.3)	(0.3, 1.2)	(0.5, 1.5)	(0.9, 2.2)	(0.2, 1.0)	(0.1, 0.7)	(0, 0.6)	(0.5, 1.5)	(0.1, 0.7)	(0.2, 1.1)
60-79	Cases	2	2	3	2	1	0	0	0	1	0
	(%)	6.2%	8.0%	9.4%	4.8%	4.3%	0.0%	0.0%	0.0%	2.3%	0.0%
	Rate	0.3	0.3	0.4	0.3	0.1	0	0	0	0.1	0
	(95% CI)	(0, 1.1)	(0, 1.1)	(0.1, 1.2)	(0, 1.0)	(0, 0.7)	(0, 0.4)	(0, 0.3)	(0, 0.3)	(0, 0.6)	(0, 0.3)
80-99	Cases	1	0	0	0	0	0	0	0	0	1
	(%)	3.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.2%
	Rate	0.7	0	0	0	0	0	0	0	0	0.6
	(95% CI)	(0, 3.8)	(0, 2.1)	(0, 2.0)	(0, 2.0)	(0, 1.9)	(0, 1.9)	(0, 1.8)	(0, 1.8)	(0, 1.7)	(0, 3.1)
Unk.	Cases	0	0	0	0	0	0	0	0	0	0
	(%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

*Rates per 100,000 population. Rates may be unreliable when there are fewer than 20 cases. Interpret with caution.

†95% CI for rates were calculated using gamma distribution when n<20 and normal approximation to the Poisson distribution when n>19. Precision increases as CI narrows.

Race/ethnicity

- Race/ethnicity was unknown for 10.9% of cases in 2018.
  - The percentages of missing race/ethnicity data for acute hepatitis C varied from 2.3% in 2017 to 32.5% in 2015.
- NH Whites made up 60.9% of reported cases in 2018, followed by Hispanics (all races) at 26.1%.
  - From 2009 to 2018, NH Whites have accounted for the highest proportions of reported acute hepatitis C cases.

- Nationally, rates of acute hepatitis C have increased most drastically since 2010 among the NH NA/AN population, followed by NH Whites (7).

Table 16: Reported acute hepatitis C by race/ethnicity, 2009-2018

Age	Measure*†	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
NH NA/AN	Cases	1	0	1	2	0	1	0	2	0	1
	(%)	3.1%	0.0%	3.1%	4.8%	0.0%	3.1%	0.0%	5.7%	0.0%	2.2%
	Rate	1.1	0	1.1	2.1	0	1.0	0	1.9	0	0.9
	(95% CI)	(0, 6.3)	(0, 3.2)	(0, 5.9)	(0.3, 7.5)	(0, 3.0)	(0, 5.6)	(0, 2.9)	(0.2, 6.9)	(0, 2.8)	(0, 5.2)
NH Asian/PI	Cases	0	0	0	0	0	0	0	0	0	0
	(%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Rate	0	0	0	0	0	0	0	0	0	0
	(95% CI)	(0, 1.8)	(0, 1.7)	(0, 1.7)	(0, 1.6)	(0, 1.6)	(0, 1.5)	(0, 1.5)	(0, 1.4)	(0, 1.3)	(0, 1.3)
NH Black	Cases	1	0	0	0	0	0	0	0	1	0
	(%)	3.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.3%	0.0%
	Rate	0.4	0	0	0	0	0	0	0	0.3	0
	(95% CI)	(0, 2.3)	(0, 1.2)	(0, 1.2)	(0, 1.2)	(0, 1.1)	(0, 1.1)	(0, 1.1)	(0, 1.0)	(0, 1.9)	(0, 1.0)
NH White	Cases	18	18	18	19	16	20	18	19	34	28
	(%)	56.2%	72.0%	56.2%	45.2%	69.6%	62.5%	45.0%	54.3%	77.3%	60.9%
	Rate	0.4	0.4	0.4	0.4	0.3	0.4	0.4	0.4	0.7	0.6
	(95% CI)	(0.2, 0.6)	(0.2, 0.6)	(0.2, 0.6)	(0.2, 0.6)	(0.2, 0.5)	(0.2, 0.6)	(0.2, 0.5)	(0.2, 0.6)	(0.5, 0.9)	(0.3, 0.8)
Hispanic, all races	Cases	8	5	6	11	6	6	9	7	8	12
	(%)	25.0%	20.0%	18.8%	26.2%	26.1%	18.8%	22.5%	20.0%	18.2%	26.1%
	Rate	0.8	0.5	0.6	1.0	0.5	0.5	0.8	0.6	0.7	1.0
	(95% CI)	(0.3, 1.5)	(0.2, 1.1)	(0.2, 1.2)	(0.5, 1.8)	(0.2, 1.2)	(0.2, 1.2)	(0.4, 1.5)	(0.2, 1.2)	(0.3, 1.3)	(0.5, 1.7)
Unk.	Cases	4	2	7	10	1	5	13	7	1	5
	(%)	12.5%	8.0%	21.9%	23.8%	4.3%	15.6%	32.5%	20.0%	2.3%	10.9%

*Rates per 100,000 population. Rates may be unreliable when there are fewer than 20 cases. Interpret with caution.

†95% CI for rates were calculated using gamma distribution when n<20 and normal approximation to the Poisson distribution when n>19. Precision increases as CI narrows.

Acute hepatitis C: Risk factors and mortality

- IDU was identified as a risk factor for 54.3% (n = 25) of cases in 2018.
  - Nationally, the opioid epidemic is driving an increase in acute hepatitis C incidence, and IDU was the most commonly reported risk factor in 2017 (7).
- The proportion of cases with unknown risk factors varied widely between 2009 and 2018.
  - In 2018, 43.5% (n = 20) of cases were missing risk factor data, an increase from 2017, when 15.9% (n = 7) of cases were missing risk factor data.
- MSM was identified as a risk factor for 6.5% (n = 3) of cases.
- PEH at the time of reporting made up 10.9% (n = 5) of cases in 2018, 60 percent of whom identified IDU as a risk factor.
- Of all reported acute hepatitis C cases since 2009, 8.8% had died as of September 2019 of any cause.
- Of total deaths among cases of acute hepatitis C reported from 2009 to 2017, 54.5% occurred fewer than 2 years after their case was reported to CDPHE.

Table 17: Acute hepatitis C risk factors, 2009-2018

Age	Measure*†	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
IDU only	Cases	3	5	10	13	11	18	26	13	34	22
	(%)	9.4%	20.0%	31.2%	31.0%	47.8%	56.2%	65.0%	37.1%	77.3%	47.8%
MSM only	Cases	3	2	2	4	0	0	1	0	0	1
	(%)	9.4%	8.0%	6.2%	9.5%	0.0%	0.0%	2.5%	0.0%	0.0%	2.2%
Unregulated tattoo only	Cases	1	0	1	0	0	0	1	2	1	0
	(%)	3.1%	0.0%	3.1%	0.0%	0.0%	0.0%	2.5%	5.7%	2.3%	0.0%
IDU & MSM	Cases	0	0	0	1	0	2	0	1	1	2
	(%)	0.0%	0.0%	0.0%	2.4%	0.0%	6.2%	0.0%	2.9%	2.3%	4.3%
IDU & Unregulated tattoo	Cases	1	3	1	0	0	0	0	1	1	1
	(%)	3.1%	12.0%	3.1%	0.0%	0.0%	0.0%	0.0%	2.9%	2.3%	2.2%
Unknown	Cases	24	15	18	24	12	12	12	18	7	20
	(%)	75.0%	60.0%	56.2%	57.1%	52.2%	37.5%	30.0%	51.4%	15.9%	43.5%

Acute hepatitis C: Geographic distribution

- Acute hepatitis C cases were reported in 16 counties in 2018.
- There were more than 2 cases reported in Adams, Boulder, Denver, El Paso, Larimer, and Mesa counties.
- Cases reported from prisons accounted for 6.5% of all cases.

- The age distribution in rural counties may be different from the age distribution in urban areas, and lower case counts in counties with small populations may result in unstable rates and bias.
  - To combat this, counties were grouped together and standardized to the statewide population (see Appendix B for a description of methodology).
- When age-adjusted to the state population, rural counties and urban TGA counties had the same rate per 100,000 of reported acute hepatitis C cases in 2018.
  - From 2014 to 2016, rural counties had higher reported rates than both urban non TGA and urban TGA counties.
  - Appendix A lists case counts for all counties.

Figure 13: Case counts by county of acute hepatitis C, 2014-2017

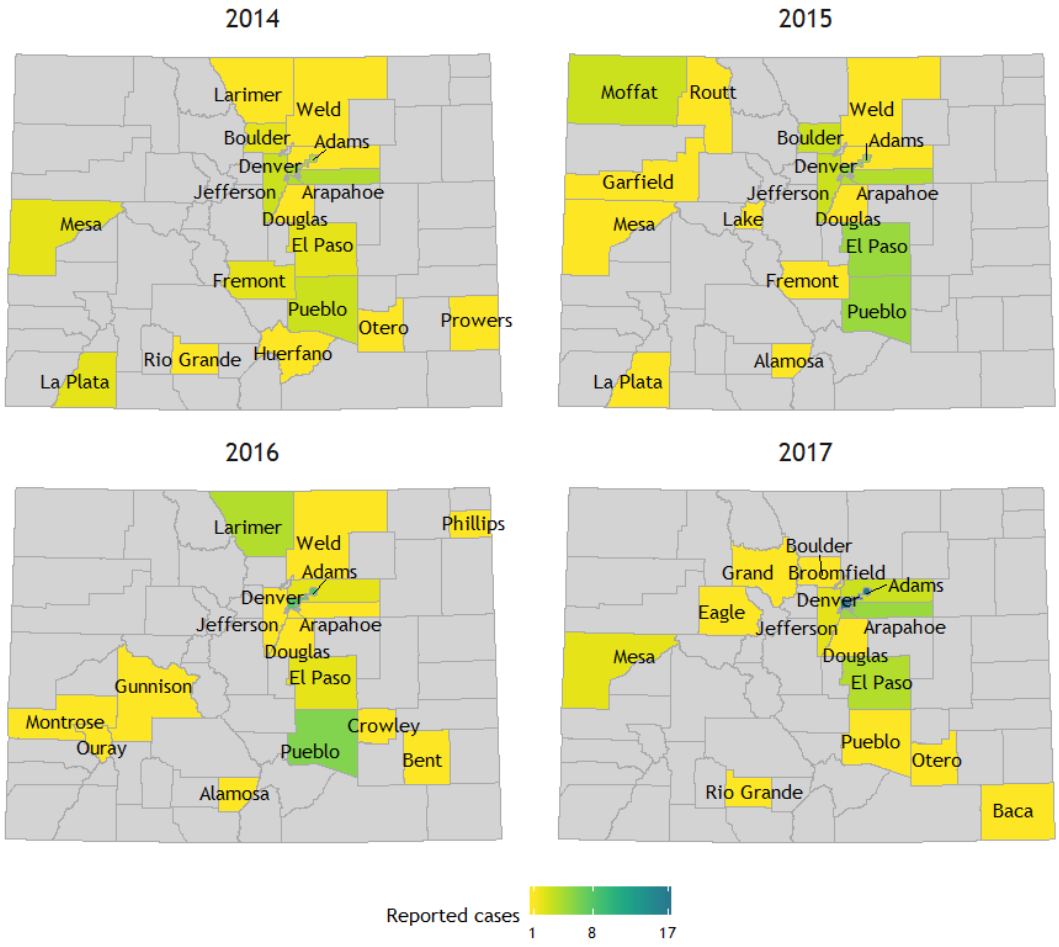


Figure 14: Case counts by county of acute hepatitis C, 2018

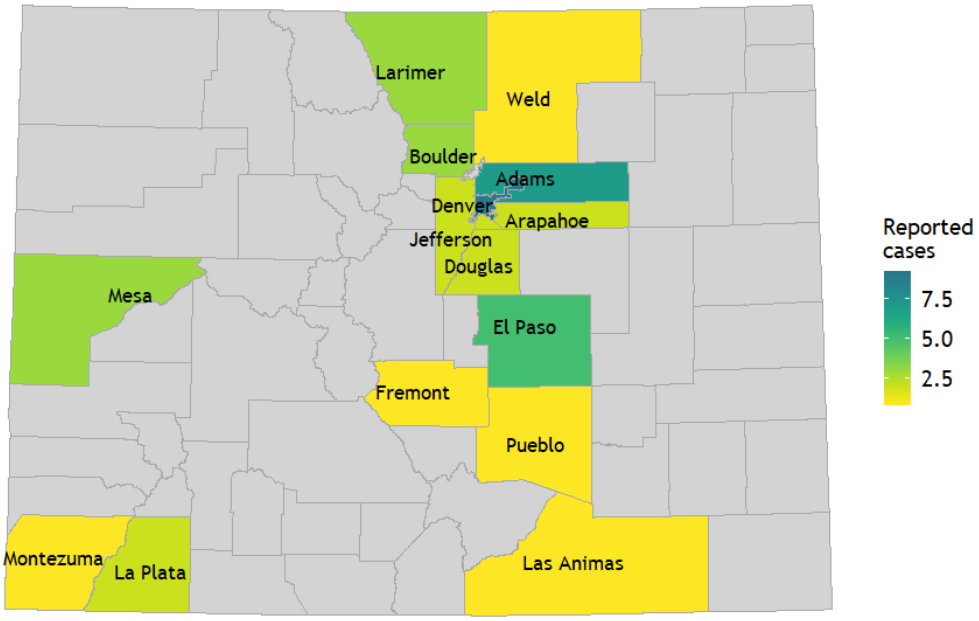


Table 18: Age-adjusted rates per 100,000 of acute hepatitis C by county group, 2014-2018

Year	Urban non TGA	Urban TGA	Rural
2014	0.6	0.4	1.1
2015	0.8	0.4	1.4
2016	0.6	0.4	1.0
2017	0.4	1.0	0.7
2018	0.8	0.7	0.7

*Rates standardized to Colorado statewide population age distributions.
**Incarcerated individuals were excluded.

Chronic hepatitis C

- In 2018, there were 2,975 (52.2 per 100,000 population) cases of chronic hepatitis C.
- There were 3.7% more reported cases in 2018 than in 2017, and the rate increased from 51.1 per 100,000 in 2017.
- The case definition change, described in the Background section, may have played a role in the drop in reported cases after 2015.

- In 2012, CDC recommended that all people born between 1945 and 1965 be tested, and screening increased fivefold among this population from 2012 to 2016 (15).
- There were an estimated 43,688 (95% CI: 25,667 – 54,101) people living with confirmed, chronic hepatitis C in 2018, representing a decrease from an estimated prevalence of 45,898 (95% CI: 27,985 – 56,182) in 2017 and 48,138 (95% CI: 30,366 – 58,314) in 2016 (10).
  - The decline in overall prevalence is driven by increased diagnoses and curative treatment rates, primarily among Baby Boomers.
  - Due to large increases of incident cases among 15 to 44 year olds, the prevalence of chronic hepatitis C is projected to rise in this age group, indicating a shift in the demographics of people living with hepatitis C in Colorado (10).
  - Nationally, although the prevalence of HCV is falling due to increases in screening and curative treatment, the incidence is increasing, associated with rising rates of IDU (10,15,16).

Table 19: Reported chronic hepatitis C cases and rate per 100,000, 2009-2018

Measure†	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Cases	3,441	3,115	2,906	2,979	3,000	3,680	3,616	2,942	2,868	2,975
Rate	69.1	61.7	56.7	57.3	56.9	68.7	66.3	53.1	51.1	52.2
(95% CI)	(66.8, 71.4)	(59.5, 63.8)	(54.7, 58.8)	(55.3, 59.4)	(54.9, 58.9)	(66.5, 71.0)	(64.1, 68.5)	(51.2, 55.0)	(49.2, 52.9)	(50.4, 54.1)

†95% CI for rates were calculated using normal approximation to the Poisson distribution. Precision increases as CI narrows.

Chronic hepatitis C: Gender, age, and race/ethnicity

Gender

- The rate of cases among men was 72.4 per 100,000 in 2018 and 32.0 per 100,000 among women.
- The gender gap has been consistent since 2009, with men accounting for more than 60% of cases annually.

Figure 15: Rate per 100,000 of chronic hepatitis C cases by gender, 2009-2018

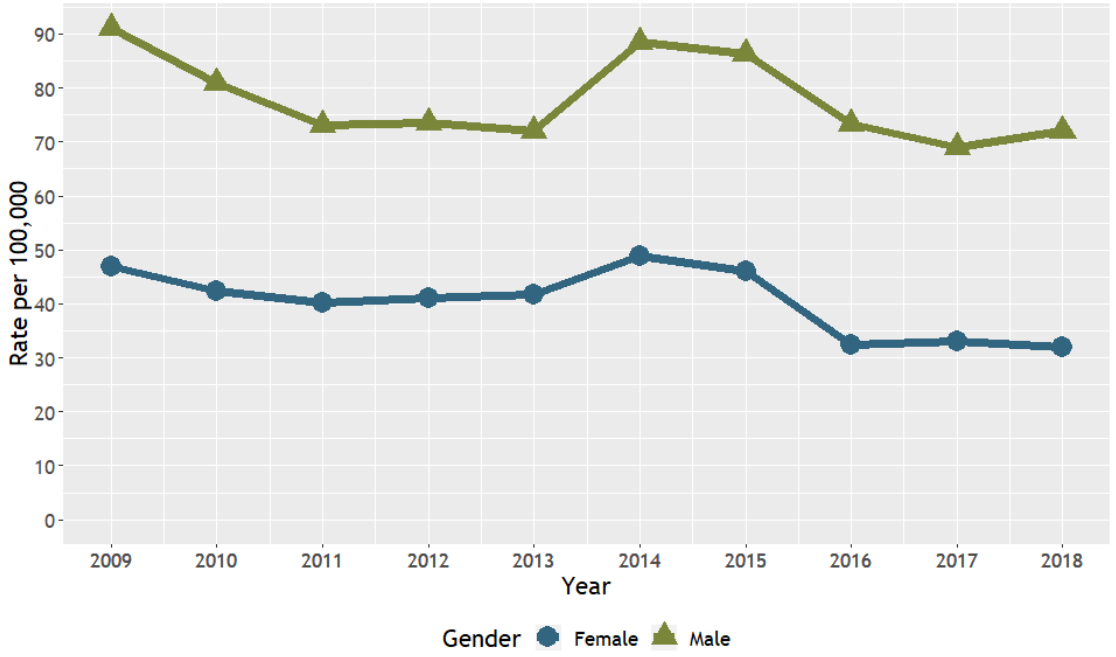


Table 20: Reported chronic hepatitis C by gender, 2009-2018

Age	Measure*†	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Female	Cases	1,157	1,067	1,030	1,063	1,095	1,306	1,256	900	926	911
	(%)	33.6%	34.3%	35.4%	35.7%	36.5%	35.5%	34.7%	30.6%	32.3%	30.6%
	Rate	46.9	42.4	40.3	41.0	41.6	48.9	46.1	32.5	33.0	32.0
	(95% CI)	(44.2, 49.6)	(39.8, 44.9)	(37.8, 42.8)	(38.5, 43.5)	(39.2, 44.1)	(46.2, 51.5)	(43.6, 48.7)	(30.4, 34.7)	(30.9, 35.1)	(29.9, 34.1)
Male	Cases	2,284	2,048	1,874	1,916	1,905	2,373	2,360	2,042	1,942	2,064
	(%)	66.4%	65.7%	64.5%	64.3%	63.5%	64.5%	65.3%	69.4%	67.7%	69.4%
	Rate	91.1	80.9	73.0	73.6	72.1	88.5	86.4	73.5	69.1	72.4
	(95% CI)	(87.3, 94.8)	(77.4, 84.4)	(69.7, 76.3)	(70.3, 76.9)	(68.9, 75.4)	(84.9, 92.1)	(82.9, 89.9)	(70.4, 76.7)	(66.0, 72.1)	(69.3, 75.5)
Unk.	Cases	0	0	2	0	0	1	0	0	0	0
	(%)	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

*Rates per 100,000 population. Rates may be unreliable when there are fewer than 20 cases. Interpret with caution.
†95% CI for rates were calculated using gamma distribution when n<20 and normal approximation to the Poisson distribution when n>19. Precision increases as CI narrows.

Age

- The median age of cases in 2018 was 42, and the mean age was 44.4.

- People between the ages of 20-39 had the highest rate of cases (78.1 per 100,000) for the first time in 2018.
  - People in the 20-39 age group have been most affected by the opioid crisis nationally (7).
- The increase in chronic rates among 20-39 year olds, when compared to the low case counts of acute hepatitis C overall, indicates that acute cases are severely underreported and 20-39 year olds are not diagnosed at the earliest stage of disease.
- Rates of reported cases continued to trend downwards among 40-59 year olds.

Figure 16: Rates per 100,000 of chronic hepatitis C by age, 2009-2018

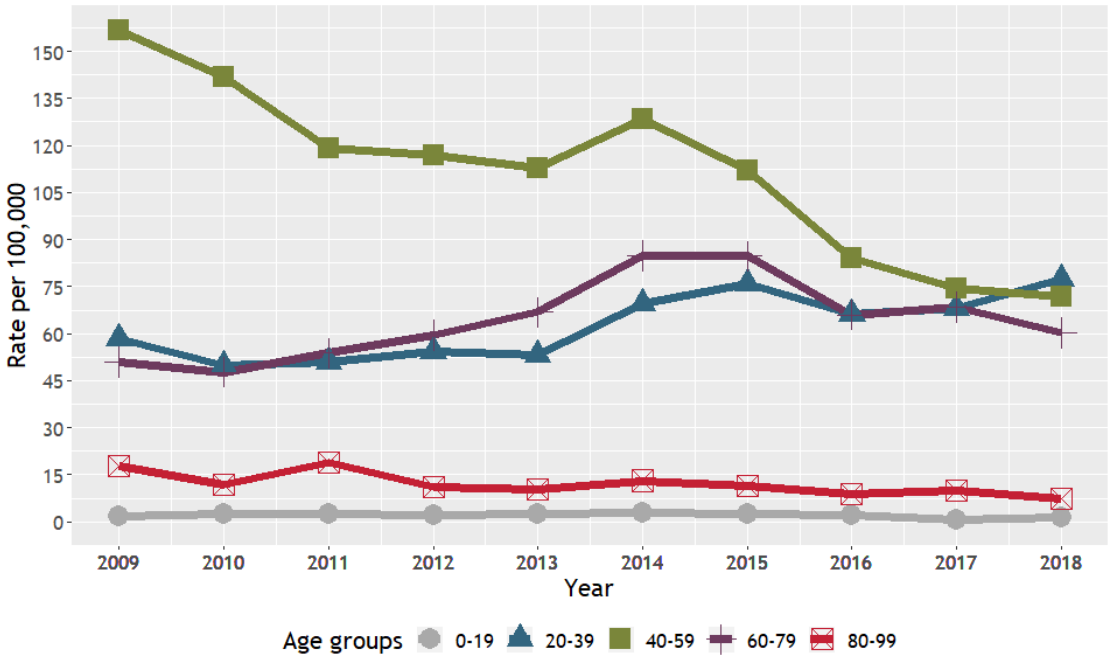


Table 21: Reported chronic hepatitis C cases by age, 2009-2018

Age	Measure*†	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
0-19	Cases	25	32	36	29	33	37	37	28	7	19
	(%)	0.7%	1.0%	1.2%	1.0%	1.1%	1.0%	1.0%	1.0%	0.2%	0.6%
	Rate	1.9	2.3	2.6	2.1	2.4	2.7	2.6	2.0	0.5	1.3
	(95% CI)	(1.1, 2.6)	(1.5, 3.2)	(1.8, 3.5)	(1.3, 2.9)	(1.6, 3.2)	(1.8, 3.5)	(1.8, 3.5)	(1.2, 2.7)	(0.1, 0.9)	(0.7, 1.9)
20-39	Cases	835	715	740	797	797	1,060	1,186	1,061	1,113	1,297
	(%)	24.3%	23.0%	25.5%	26.8%	26.6%	28.8%	32.8%	36.1%	38.8%	43.6%
	Rate	58.4	49.9	51.1	54.3	53.2	69.4	75.8	66.3	68.2	78.1
	(95% CI)	(54.4, 62.3)	(46.2, 53.6)	(47.4, 54.8)	(50.5, 58.1)	(49.5, 56.9)	(65.2, 73.5)	(71.5, 80.1)	(62.3, 70.3)	(64.2, 72.2)	(73.8, 82.3)
40-59	Cases	2,223	2,016	1,711	1,687	1,628	1,860	1,638	1,235	1,089	1,055
	(%)	64.6%	64.7%	58.9%	56.6%	54.3%	50.5%	45.3%	42.0%	38.0%	35.5%
	Rate	156.8	141.8	119.2	117.0	112.6	128.4	112.3	84.5	74.6	72.1
	(95% CI)	(150.2, 163.3)	(135.6, 148.0)	(113.5, 124.8)	(111.4, 122.6)	(107.1, 118.1)	(122.5, 134.2)	(106.9, 117.7)	(79.8, 89.2)	(70.2, 79.1)	(67.7, 76.4)
60-79	Cases	326	327	385	447	526	700	730	593	640	585
	(%)	9.5%	10.5%	13.2%	15.0%	17.5%	19.0%	20.2%	20.2%	22.3%	19.7%
	Rate	50.9	47.7	53.8	59.5	66.8	84.9	84.7	66.0	68.5	60.3
	(95% CI)	(45.4, 56.5)	(42.6, 52.9)	(48.5, 59.2)	(54.0, 65.0)	(61.1, 72.5)	(78.7, 91.2)	(78.5, 90.8)	(60.7, 71.3)	(63.2, 73.8)	(55.4, 65.2)
80-99	Cases	26	17	28	17	16	21	19	15	17	13
	(%)	0.8%	0.5%	1.0%	0.6%	0.5%	0.6%	0.5%	0.5%	0.6%	0.4%
	Rate	17.8	11.8	18.9	11.1	10.2	13.1	11.5	8.9	9.8	7.3
	(95% CI)	(11.7, 26.1)	(6.9, 18.9)	(12.6, 27.3)	(6.5, 17.8)	(5.8, 16.6)	(8.1, 20.0)	(6.9, 18.0)	(5.0, 14.7)	(5.7, 15.7)	(3.9, 12.5)
Unk.	Cases	6	8	6	2	0	2	6	10	2	6
	(%)	0.2%	0.3%	0.2%	0.1%	0.0%	0.1%	0.2%	0.3%	0.1%	0.2%

*Rates per 100,000 population. Rates may be unreliable when there are fewer than 20 cases. Interpret with caution.

†95% CI for rates were calculated using gamma distribution when n<20 and normal approximation to the Poisson distribution when n>19. Precision increases as CI narrows.

Race/ethnicity

- Race/ethnicity data is not routinely reported for chronic hepatitis C cases in Colorado, and 70.6% of reported cases 2018 were missing data.
  - Due to high proportions of missing data, race/ethnicity data for chronic hepatitis C are not included in this report.
- CDC does not include cases and rates by race/ethnicity for chronic hepatitis C in annual surveillance reporting (7), but the national prevalence of chronic hepatitis C in 2010 was highest among NH Blacks, followed by NH Whites (17).

Chronic hepatitis C: Risk factors and mortality

- Risk factor data is not routinely collected for chronic cases, but the rising rate of cases among 20-39 year olds mirrors national trends related to the opioid crisis (7).
- PEH at the time of reporting made up 7.9% (n = 236) of cases.
- Of all reported chronic hepatitis C cases since 2009, 10.6% had died as of September 2019 of any cause.
- Of total deaths among cases of chronic hepatitis C reported from 2009 to 2017, 44.7% occurred fewer than 2 years after their case was reported to CDPHE.

Chronic hepatitis C: Geographic distribution

- Chronic hepatitis C cases were reported in 57 counties in 2018.
- When standardized to the state population, rural counties had the highest rates of reported chronic cases every year from 2015-2018 (see Appendix B for methodology).
- Cases among incarcerated individuals represented 24.5% of all reported cases, which was higher than the proportion of any individual county.
- Case counts from 2014 to 2017 by county were not noticeably different by visualization, but Appendix A lists case counts for all counties.

Figure 17: Case counts by county of chronic hepatitis C, 2018

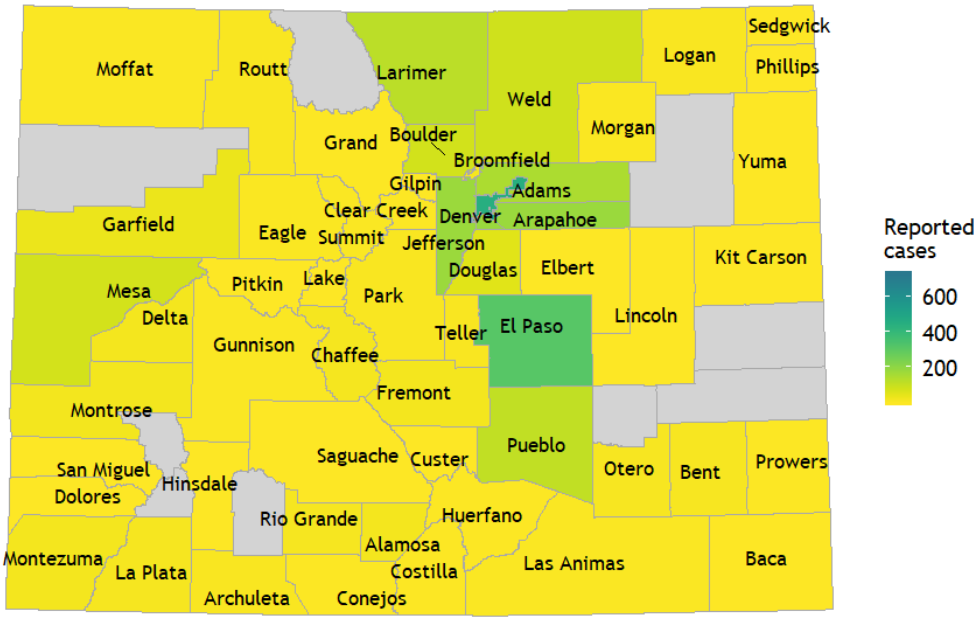


Table 22: Age-adjusted rates per 100,000 of chronic hepatitis C by county group, 2014-2018

Year	Urban non TGA	Urban TGA	Rural
2014	50.9	51.7	51.6
2015	52.8	47.3	58.2
2016	44.5	37.9	48.0
2017	43.4	36.6	43.7
2018	40.8	35.6	42.1

*Rates standardized to Colorado statewide population age distributions.
**Incarcerated individuals were excluded.

Perinatal hepatitis B and C

- There were zero **perinatal hepatitis B cases** reported in Colorado in 2018.
- CDPHE had 135 pregnant people enrolled in the PHBPP with an estimated due date (EDD) in 2018.
  - This number is not inclusive of all pregnant people that were enrolled in the PHBPP in 2018.
- Of the 135 people enrolled in PHBPP, 67 pregnant people had never been enrolled in the program, and 68 had previously been enrolled in the program but had a new pregnancy with an EDD in 2018.
- CDC, ACIP, and the U.S. Preventive Services Taskforce recommend that all people are screened for HBV infection during pregnancy.
- Colorado birth certificate data for 2018 show that of 63,466 total births, 61,472 pregnant people had known screening status (96.8%).
  - This is down from 97.5% in 2017.
- Colorado had an HBV birth dose vaccination rate of 82% in 2018, which is consistent with the 82% in 2017.
- Perinatal hepatitis C became reportable in 2018.
- In Colorado, there were two **perinatal hepatitis C cases** reported in 2018, and both had confirmatory test results.

Coinfections and liver cancer

- In 2018, 29 cases were reported to have more than one type of viral hepatitis.
  - Included in this count were people for whom more than one viral hepatitis infection was reported on the same date in 2018 and previously reported cases who were reported with another viral hepatitis infection in 2018.

- Coinfection with HBV and HCV is associated with faster progression of disease as well as higher rates of hepatocellular carcinoma (HCC) development (18).
- Managing patients who are living with both hepatitis B and C presents unique challenges.
    - In some cases, treatment with direct-acting antivirals (DAAs) for HCV infection may result in reactivation of previously suppressed HBV infection (18).
- There were 142 cases of HBV/HCV coinfection from 2009 to 2018.
- From 2009 to 2018, there were 1,524 cases of liver cancer diagnosed in Colorado among previously reported hepatitis C cases and 128 among reported hepatitis B cases.
- The average time from disease reporting to liver cancer diagnosis was 9.0 years among reported hepatitis C cases and 7.3 years among reported hepatitis B cases, illustrating the need to connect more people to HBV/HCV treatment in the course of their illness.

Table 23: Number of cases with multiple diagnoses in CEDRS

Diagnoses reported to CEDRS	2009-2018	At least one dx in 2018
HAV/acute or chronic HCV	5	2
Acute HBV/chronic HBV	20	0
Acute HBV/acute or chronic HCV	29	3
Chronic HBV/acute or chronic HCV	113	13
Acute HCV/chronic HCV	96	11

People experiencing homelessness

PEH are disproportionately affected by hepatitis A and C and make up high proportions of reported cases in Colorado (7,19). In 2018, PEH made up 33.3% (n = 5) of the 15 cases that were identified as part of the hepatitis A outbreak that began in October 2018 among people with risk factors that included homelessness, drug use, and incarceration and has escalated throughout 2019. From 2014 to 2018, PEH made up 12.9% (n = 18) of newly diagnosed acute hepatitis B cases, 9.1 percent (n = 18) of acute hepatitis C cases, and 6.7% (n = 1,085) of chronic hepatitis C cases in Colorado. Estimates of homelessness among reported hepatitis A cases that were not part of the outbreak are unknown, and homelessness data for 2014 to 2017 are not available.

According to the 2018 Annual Homeless Assessment Report to Congress, there were approximately 10,857 PEH in Colorado, 2,571 of whom were chronically homeless

(20). Prevalence estimates of HCV RNA among PEH range from 10.8% to 31.2% (21,22). Using these estimates, there are an estimated 1,170 to 3,490 PEH in Colorado living with chronic hepatitis C. However, depending on the proportion of PEH who inject drugs, the estimated hepatitis C prevalence could well be higher. The estimates of the number of PEH may also be an underestimate. More studies are needed to determine the extent of the health disparities among this population.

Whether or not a person is experiencing homelessness at the time of reporting is based on address reporting, case notes, and/or case interviews. This methodology likely results in underestimates, especially for reported chronic hepatitis C cases, since routine follow-up of chronic hepatitis C cases is not conducted. No address was reported for 7% (n = 1,561) of reported chronic hepatitis C cases from 2014-2018. PEH may report the permanent address of a friend or family member in medical records.

When standardized to the population of the seven counties included in Colorado's Point in Time study (Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, and Jefferson counties) (23), the age-adjusted rate per 1,000 population of chronic HCV among PEH was 28.3, while the age-adjusted rate among people not experiencing homelessness was 0.3 per 1,000. In 2018, the odds of PEH being diagnosed with chronic hepatitis C in these counties were 120.9 (95% CI: 102.3-141.7, $p < 0.05$) times greater than that of a person not experiencing homelessness.

Outreach organizations, homeless shelters, and existing syringe services programs work to connect PEH and other marginalized populations to testing and care. The effectiveness of the efforts of these organizations to test individuals for viral hepatitis may contribute to the high numbers of reported cases among PEH. However, the data also mirror national trends in the increasing burden of disease among this population compared to other groups such as people born between 1945 and 1965 (often referred to as "Baby Boomers") (7).

People who are incarcerated

The Colorado Department of Corrections (CDOC) offers HCV testing to inmates upon intake into a prison. The CDOC plans to treat at least 2,200 inmates currently in prisons and began to scale up treatment in 2018. Since 2014, there have been 2,470 chronic HCV cases reported to CDPHE from prisons. The number of these reported cases who have been released since 2014 is unknown, but increased treatment will have a positive impact on the overall prevalence of HCV in Colorado.

The most recent National Health and Nutrition Examination Survey (NHANES) study cites an HCV RNA prevalence of 10.7% among incarcerated individuals from 2013 to 2016 (21). There was an estimated year-end prison population of 20,101 in Colorado (24). Assuming at least 2,200 individuals are still incarcerated, this would indicate that at least 10.9% of incarcerated individuals in Colorado are living with chronic, unresolved HCV infection, which is consistent with the national estimate.

Strategies to reduce the disease burden of viral hepatitis

Both public health and clinical strategies are needed to stop the spread of viral hepatitis and limit the impact on people who are living with viral hepatitis. Public health must work with communities and health care providers to identify new cases and stop transmission. Hepatitis A and B have safe and effective vaccines; screening, education, and treatment are the primary tools available to prevent new HCV infections and eliminate current chronic infections, in the context of identified cross-cutting barriers that include sporadic and under-funded surveillance systems.

Syringe services programs provide numerous benefits to priority populations, which include access to unused, sterile injection equipment, engagement with public health workers, and wound care. Harm reduction strategies, if implemented according to the needs of the local community, can help prevent the transmission of viral hepatitis and link more people to screening and care.

People living with chronic hepatitis B and/or chronic hepatitis C can benefit from additional medical management and evaluation for treatment. These patients also need counseling and education related to their diagnosis. The current health care system has been slow to address the needs of people living with chronic hepatitis. The U.S. Action Plan for Prevention, Care, and Treatment of Viral Hepatitis calls for improving linkage to care. Providing treatment for viral hepatitis can prevent complications of the disease including fibrosis, cirrhosis and HCC. While there are effective treatments now available to cure HCV infection, treatment will only suppress HBV infection. However, viral suppression among people living with hepatitis B can decrease the likelihood of transmission.

The treatment landscape for HCV infection has changed dramatically in recent years. More than 10 different DAAs have become available since their initial release in 2014 with two new drugs being approved by the FDA every year up to 2017. Before 2014, treatment for HCV was interferon-based, administered through weekly injections. The efficacy was low; interferon treatments alone had an SVR rate of 20%. While combining interferon treatments with ribavirin, an antiviral used to treat many diseases since the 1970s, increased sustained virologic response (SVR) rates to 54-63%, side effects were so severe that 20% of patients were forced to discontinue treatment. Now, the SVR rate of the ten DAAs on the market is over 95%, side effects are mild, and treatments are all oral. Four of the treatments are pan-genotypic, meaning they are effective in treating HCV genotypes 1 through 6.

The cost and demand for treatment has the potential to overwhelm many health care systems. HCV disproportionately affects individuals who are likely to receive health coverage from public payers including Medicaid, Medicare, the Veterans Administration and the state and federal prison systems. A 2015 U.S. Senate report concluded that HCV drug spending in 2014 exceeded $12 billion, or more than a third

of the amount spent that year on new pharmaceutical treatments for all diseases. Due to high treatment costs and the number of people living with hepatitis C, insurers have historically placed restrictions on eligibility criteria for treatment. Following a lawsuit in Colorado, Medicaid providers have eliminated fibrosis restrictions for treatment of HCV infection, granting access to treatment for individuals before they reach advanced disease stages.

To effectively reduce morbidity and mortality related to viral hepatitis in Colorado, the state needs cross-cutting strategies, including expanding harm reduction policies, public education, increasing screening and confirmatory testing (specifically for HCV), expanding professional education (including HCV treatment in primary care settings), and providing HCV treatment to more Coloradans. In addition, screening for HBV infection among pregnant people and people born in endemic countries should be increased. HAV and/or HBV vaccines should be offered to all populations and should be part of routine care.

Appendix A

Case counts by county

A county is only listed if it reported at least one case in 2018.

Table 24: Reported hepatitis A cases by county, 2014-2018

	2014 Cases	(%)	2015 Cases	(%)	2016 Cases	(%)	2017 Cases	(%)	2018 Cases	(%)
Adams	0	0.0	1	7.7	2	18.2	9	16.4	3	9.7
Arapahoe	2	11.8	1	7.7	1	9.1	5	9.1	4	12.9
Boulder	1	5.9	1	7.7	2	18.2	4	7.3	2	6.5
Denver	2	11.8	2	15.4	0	0.0	12	21.8	5	16.1
Eagle	1	5.9	1	7.7	1	9.1	1	1.8	1	3.2
El Paso	0	0.0	2	15.4	2	18.2	12	21.8	10	32.3
Jefferson	3	17.6	2	15.4	1	9.1	2	3.6	2	6.5
Larimer	8	47.1	3	23.1	0	0.0	3	5.5	1	3.2
Pueblo	0	0.0	0	0.0	2	18.2	7	12.7	3	9.7

Table 25: Reported acute hepatitis B cases by county, 2014-2018

	2014 Cases	(%)	2015 Cases	(%)	2016 Cases	(%)	2017 Cases	(%)	2018 Cases	(%)
Arapahoe	3	17.6	2	7.1	4	16.7	5	19.2	2	9.5
Boulder	2	11.8	2	7.1	0	0.0	1	3.8	1	4.8
Denver	6	35.3	7	25.0	13	54.2	12	46.2	7	33.3
Eagle	0	0.0	0	0.0	0	0.0	1	3.8	1	4.8
El Paso	0	0.0	6	21.4	3	12.5	1	3.8	3	14.3
Fremont	0	0.0	0	0.0	0	0.0	0	0.0	1	4.8
Jefferson	4	23.5	4	14.3	2	8.3	2	7.7	2	9.5
Larimer	0	0.0	3	10.7	1	4.2	0	0.0	1	4.8
Mesa	2	11.8	2	7.1	0	0.0	3	11.5	1	4.8
Moffat	0	0.0	0	0.0	0	0.0	0	0.0	1	4.8

	2014 Cases	(%)	2015 Cases	(%)	2016 Cases	(%)	2017 Cases	(%)	2018 Cases	(%)
Weld	0	0.0	2	7.1	1	4.2	1	3.8	1	4.8

Table 26: Reported chronic hepatitis B cases by county, 2014-2018

	2014 Cases	(%)	2015 Cases	(%)	2016 Cases	(%)	2017 Cases	(%)	2018 Cases	(%)
Adams	40	14.2	35	11.9	33	11.2	24	10.5	21	9.5
Alamosa	1	0.4	0	0.0	0	0.0	0	0.0	2	0.9
Arapahoe	66	23.5	55	18.8	67	22.7	55	24.1	45	20.5
Boulder	5	1.8	8	2.7	17	5.8	9	3.9	14	6.4
Broomfield	6	2.1	6	2.0	1	0.3	1	0.4	3	1.4
Clear Creek	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5
Denver	61	21.7	55	18.8	63	21.4	40	17.5	34	15.5
Douglas	11	3.9	16	5.5	13	4.4	10	4.4	13	5.9
El Paso	29	10.3	43	14.7	27	9.2	34	14.9	27	12.3
Garfield	3	1.1	1	0.3	1	0.3	2	0.9	1	0.5
Jefferson	25	8.9	27	9.2	28	9.5	14	6.1	12	5.5
La Plata	0	0.0	2	0.7	3	1.0	1	0.4	2	0.9
Larimer	13	4.6	14	4.8	9	3.1	9	3.9	11	5.0
Las Animas	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5
Mesa	5	1.8	6	2.0	1	0.3	6	2.6	3	1.4
Moffat	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5
Montrose	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5
Morgan	1	0.4	2	0.7	3	1.0	6	2.6	1	0.5
Pitkin	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5
Pueblo	1	0.4	3	1.0	5	1.7	2	0.9	2	0.9
Rio Grande	0	0.0	0	0.0	0	0.0	1	0.4	2	0.9
Routt	2	0.7	0	0.0	1	0.3	1	0.4	2	0.9

	2014 Cases	(%)	2015 Cases	(%)	2016 Cases	(%)	2017 Cases	(%)	2018 Cases	(%)
Weld	5	1.8	17	5.8	19	6.4	10	4.4	7	3.2
Prison	7	2.5	3	1.0	4	1.4	3	1.3	13	5.9

Table 27: Reported acute hepatitis C cases by county, 2014-2018

	2014 Cases	(%)	2015 Cases	(%)	2016 Cases	(%)	2017 Cases	(%)	2018 Cases	(%)
Adams	1	3.6	1	3.0	2	7.1	3	7.9	7	15.2
Arapahoe	4	14.3	4	12.1	1	3.6	5	13.2	2	4.3
Boulder	2	7.1	3	9.1	0	0.0	1	2.6	3	6.5
Denver	4	14.3	5	15.2	8	28.6	17	44.7	9	19.6
Douglas	1	3.6	1	3.0	1	3.6	1	2.6	2	4.3
El Paso	2	7.1	5	15.2	2	7.1	4	10.5	5	10.9
Fremont	2	7.1	1	3.0	0	0.0	0	0.0	1	2.2
Jefferson	3	10.7	3	9.1	1	3.6	2	5.3	2	4.3
La Plata	2	7.1	1	3.0	0	0.0	0	0.0	2	4.3
Larimer	1	3.6	0	0.0	4	14.3	0	0.0	3	6.5
Las Animas	0	0.0	0	0.0	0	0.0	0	0.0	1	2.2
Mesa	2	7.1	1	3.0	0	0.0	2	5.3	3	6.5
Montezuma	0	0.0	0	0.0	0	0.0	0	0.0	1	2.2
Pueblo	3	10.7	5	15.2	6	21.4	1	2.6	1	2.2
Weld	1	3.6	1	3.0	1	3.6	0	0.0	1	2.2
Prison	0	0.0	2	6.1	2	7.1	2	5.3	3	6.5

Table 28: Reported chronic hepatitis C cases by county, 2014-2018

	2014 Cases	(%)	2015 Cases	(%)	2016 Cases	(%)	2017 Cases	(%)	2018 Cases	(%)
Adams	208	5.7	192	5.3	172	5.9	157	5.5	148	5.0
Alamosa	10	0.3	28	0.8	16	0.5	16	0.6	20	0.7
Arapahoe	257	7.0	242	6.7	209	7.1	198	6.9	183	6.2
Archuleta	3	0.1	10	0.3	8	0.3	7	0.2	10	0.3
Baca	2	0.1	2	0.1	3	0.1	3	0.1	2	0.1
Bent	11	0.3	13	0.4	11	0.4	6	0.2	12	0.4
Boulder	120	3.3	108	3.0	81	2.8	95	3.3	82	2.8
Broomfield	10	0.3	16	0.4	8	0.3	17	0.6	14	0.5
Chaffee	5	0.1	9	0.2	10	0.3	4	0.1	17	0.6
Clear Creek	5	0.1	9	0.2	5	0.2	8	0.3	4	0.1
Conejos	6	0.2	12	0.3	2	0.1	1	0.0	3	0.1
Costilla	2	0.1	2	0.1	7	0.2	6	0.2	3	0.1
Custer	3	0.1	9	0.2	6	0.2	3	0.1	1	0.0
Delta	21	0.6	21	0.6	17	0.6	25	0.9	20	0.7
Denver	605	16.5	537	14.9	461	15.7	443	15.5	451	15.2
Dolores	2	0.1	4	0.1	2	0.1	1	0.0	1	0.0
Douglas	47	1.3	63	1.7	38	1.3	57	2.0	55	1.8
Eagle	14	0.4	10	0.3	15	0.5	14	0.5	8	0.3
Elbert	8	0.2	4	0.1	2	0.1	7	0.2	2	0.1
El Paso	345	9.4	370	10.3	317	10.8	297	10.4	316	10.6
Fremont	32	0.9	39	1.1	31	1.1	21	0.7	20	0.7

	2014 Cases	(%)	2015 Cases	(%)	2016 Cases	(%)	2017 Cases	(%)	2018 Cases	(%)
Garfield	39	1.1	36	1.0	27	0.9	33	1.2	34	1.1
Gilpin	6	0.2	1	0.0	6	0.2	1	0.0	1	0.0
Grand	7	0.2	4	0.1	2	0.1	2	0.1	4	0.1
Gunnison	4	0.1	7	0.2	9	0.3	6	0.2	6	0.2
Hinsdale	2	0.1	0	0.0	1	0.0	0	0.0	1	0.0
Huerfano	5	0.1	6	0.2	3	0.1	0	0.0	4	0.1
Jefferson	263	7.2	251	7.0	176	6.0	167	5.8	181	6.1
Kit Carson	2	0.1	2	0.1	2	0.1	0	0.0	1	0.0
Lake	5	0.1	3	0.1	5	0.2	3	0.1	2	0.1
La Plata	37	1.0	39	1.1	29	1.0	27	0.9	16	0.5
Larimer	90	2.5	142	3.9	124	4.2	106	3.7	125	4.2
Las Animas	21	0.6	23	0.6	12	0.4	5	0.2	7	0.2
Lincoln	2	0.1	6	0.2	1	0.0	2	0.1	2	0.1
Logan	3	0.1	10	0.3	3	0.1	5	0.2	9	0.3
Mesa	120	3.3	99	2.7	86	2.9	105	3.7	81	2.7
Moffat	7	0.2	11	0.3	18	0.6	8	0.3	6	0.2
Montezuma	23	0.6	24	0.7	18	0.6	12	0.4	20	0.7
Montrose	28	0.8	16	0.4	19	0.6	27	0.9	21	0.7
Morgan	6	0.2	4	0.1	5	0.2	13	0.5	8	0.3
Otero	12	0.3	14	0.4	14	0.5	20	0.7	14	0.5
Park	9	0.2	11	0.3	9	0.3	4	0.1	9	0.3
Phillips	0	0.0	2	0.1	2	0.1	1	0.0	2	0.1

	2014 Cases	(%)	2015 Cases	(%)	2016 Cases	(%)	2017 Cases	(%)	2018 Cases	(%)
Pitkin	2	0.1	4	0.1	3	0.1	7	0.2	2	0.1
Prowers	10	0.3	7	0.2	5	0.2	1	0.0	3	0.1
Pueblo	165	4.5	164	4.5	146	5.0	147	5.1	114	3.8
Rio Grande	8	0.2	10	0.3	11	0.4	11	0.4	15	0.5
Routt	10	0.3	10	0.3	8	0.3	8	0.3	9	0.3
Saguache	1	0.0	3	0.1	2	0.1	2	0.1	2	0.1
San Miguel	6	0.2	3	0.1	3	0.1	1	0.0	2	0.1
Sedgwick	0	0.0	1	0.0	0	0.0	4	0.1	2	0.1
Summit	5	0.1	7	0.2	9	0.3	7	0.2	7	0.2
Teller	16	0.4	18	0.5	13	0.4	15	0.5	9	0.3
Weld	103	2.8	115	3.2	102	3.5	95	3.3	87	2.9
Yuma	1	0.0	2	0.1	2	0.1	1	0.0	1	0.0
Prison	420	11.5	367	10.2	465	15.9	496	17.4	729	24.5
Unknown	514	14.0	485	13.4	171	5.8	130	4.5	66	2.2

Appendix B

Age-adjusted standardized rate methodology

Of the 64 counties in Colorado, 26 (40.6%) had a population size under 10,000 in 2018. Differences in population sizes and demographic makeup present challenges in comparing small, rural counties to populous urban counties. Rates are considered unreliable when calculated using small case counts, but calculating regional rates can be used to reduce bias in the data (25).

For this report, we were interested in comparing the disease burden of hepatitis C in rural counties and urban counties. Rural counties made up the majority of counties identified in an assessment of U.S. counties most vulnerable to hepatitis C outbreaks (26). Additionally, rural counties often lack access to harm reduction policies that can help reduce the spread of disease, such as syringe services programs, medicated-assisted treatment, and addiction treatment and rehabilitation (26). This is true in Colorado, where only one county classified as "rural" (Alamosa County) has implemented a syringe services program.

Direct age-standardization is often used to compare morbidity or mortality rates between populations with different age structures (27). Using this methodology, age-specific crude rates are multiplied by the population distribution of a standard population. For this report, the age-specific population of Colorado was used to directly standardize each of the county groups. Examples of age-adjusted rate calculations can be found on many state health department websites, such as in New York, Missouri, and Pennsylvania.

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