2016 Surveillance Report

Viral Hepatitis in Colorado

September 2017

COLORADO
Department of Public Health & Environment

About this report

This report is published by the STI/HIV/VH Branch, Disease Control and Environmental Epidemiology Division, Colorado Department of Public Health and Environment, Denver Colorado.

This report describes the epidemiology of hepatitis A, B and C in Colorado. The Colorado Department of Public Health and Environment (CDPHE) used 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 December 31, 2016.

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This publication is available on the web at colorado.gov/cdphe/hepatitis-data

Acronyms

ACIP	Advisory Committee on Immunization Practices
AIDS	Acquired Immunodeficiency Syndrome
APCD	All Payer Claims Database
ASTHO	Association of State and Territorial Health Officials
CCCR	Colorado Central Cancer Registry
CDA	Center for Disease Analysis
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
CHA	Colorado Health Association
CHED	Center for Health and Environmental Data
CHI	Colorado Health Institute
CIVHC	Center for Improving Value in Health Care
eHARS	enhanced HIV/AIDS Reporting System
ELR	Electronic Laboratory Reporting
FBP	Federal Bureau of Prisons
HAV	Hepatitis A Virus
HBIG	Hepatitis B immune globulin
HBsAg	HBV surface Antigen
HBV	Hepatitis B Virus
HCC	Hepatocellular Carcinoma
HCV	Hepatitis C Virus
HIV	Human Immunodeficiency Virus
ICP	Infection Control Practices
IDRP	Integrated Disease Reporting Program
IDU	Injection Drug Use
MSM	Men who have Sex with Men
NHANES	National Health and Nutrition Examination Survey
NHBS	National HIV Behavioral Surveillance
NNDSS	National Notifiable Disease Surveillance System
NSDUH	National Survey on Drug Use and Health
PLWHA	People Living with HIV/AIDS
Project ECHO	Project Extension for Community Healthcare Outcomes
PWID	People Who Injects Drugs
VFC	Vaccines for Children

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Executive summary

In 2016, 23 cases of hepatitis A, 29 cases of acute hepatitis B, 641 cases of chronic hepatitis B, 41 cases of acute hepatitis C, and 4,865 cases of chronic hepatitis C were reported to CDPHE. At least one case of chronic hepatitis B or C was reported in 62 of the 64 Colorado counties in 2016, and at least one case of acute hepatitis A, B, or C was reported in 42 of the 64 counties in 2012-2016. Counties without reported cases of one or more of the types of hepatitis were more likely to be frontier counties (rural areas sparsely populated that are isolated from population centers and services).

The rates of reported hepatitis A cases are high in some of the rural counties. These high rates may reflect a true burden of hepatitis A in these counties; however, the number of cases can be small and should be interpreted with caution. Overall, the number of hepatitis A cases has been stable for the past several years with international travel being the reported risk factor with the highest proportion.

The past several years has seen an increase in newly reported hepatitis B cases in Colorado. The counties to see an increase in the rate of acute cases from 2012 to 2016 were mostly along the I-25 Corridor. The highest proportion of reported risk was not being born in the U.S.

Recent increases in newly reported hepatitis C cases have been observed both in the United States and in Colorado. This increase has been associated with the increase in injection drug use (IDU) across the nation.

IDU is the primary cause of new hepatitis C cases. From 2012-2016, half of all reported acute hepatitis C cases in Colorado were among people who had injected drugs (PWID) in the previous six months. Nationally, the Centers for Disease Control and Prevention (CDC) also reports IDU as the most common risk behavior among 64.2 percent of acute hepatitis C cases reported in 2015. Nationally, and in Colorado, drug overdose rates have increased steadily from 2000-2015. Age-adjusted rates in Colorado were significantly higher than national rates in almost every year over the 15-year period. With this increase in IDU, there has also been a decrease in the average age among the new diagnoses. The largest proportion by age group for acute hepatitis C cases in Colorado 2013-2016 was the 20-29 year olds. Of the newly reported chronic hepatitis C cases, 50-59 year olds have the largest proportion but, the proportion of 20-29 year olds has been increasing the past several years.

Strengths and limitations of the data

Hepatitis has been reportable in Colorado since the 1990s. In March of 2017, CEDRS was transitioned from a case-based format to a person-based format. Case-based format is where a new record was created in CEDRS each time a disease was reported. This means a person could exist in the system multiple times. With the new person-based format, a person, or profile, is created once. Diseases, or events, are reported under a single profile over time. A person-based system allows for easier deduplication as well as easier evaluation of co-morbidities, co-infections, re-infections, and associated risk factors.

The data in this report are limited by the following factors: underdiagnosis, limited follow-up data, changes in reporting requirements, and small numbers in some instances. In addition, Colorado's surveillance system does not sufficiently track how many people have resolved hepatitis or died. Data about risk are less complete for newly reported chronic hepatitis B and C cases. Risk-factor Investigations are completed for reported and potentially acute cases of hepatitis B and C. All reports identified as true hepatitis A cases are interviewed for possible risk and exposure.

If a person reported with hepatitis is incarcerated in a county jail, that case is assigned to the county of the jail location; however, if a case is identified in a state or federal prison, a county is not assigned. These cases are designated as Colorado Department of Corrections (CDOC) for state prisons and Federal Bureau of Prisons (FBP) for federal prisons.

Two people reported as having both acute and chronic hepatitis (either B or C) in the same calendar year are counted only as acute cases in this surveillance report for that year.

Exercise caution when interpreting small numbers. Population rates based on small numbers may be particularly misleading.

Data sources

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 and are triaged by the Integrated Disease Reporting Program (IDRP) and entered into the Colorado Electronic Disease Reporting System (CEDRS). Hepatitis A cases meet the 2012 U.S. CDC surveillance case definition for hepatitis A. Hepatitis B cases meet the 2012 U.S. CDC surveillance case definition for HBV, which includes a definition for both acute cases and chronic cases. Hepatitis C cases meet the 2016 U.S. CDC surveillance case definition for HCV, which includes a definition for both acute cases and chronic cases.

Population information from the Colorado Division of Local Affairs, State Demography Office is used to compare the population to people reported with hepatitis, when possible. Otherwise, population characteristics are from the U.S. Census Bureau.

The Vital Statistics Branch of CDPHE provided prenatal screening and cause of death data from certificates filed with the department for birth and deaths in 2016.

CDOC provided data on the demographic characteristics of the state prison population. FBP provided data on the demographic characteristics of the federal prison population.

Hepatitis surveillance

Colorado law requires both laboratories and physicians to report cases of hepatitis A, B, and C. Physicians are required to report other viral hepatitis cases. Reports must be submitted to CDPHE within seven days of diagnosis for hepatitis B, C, and other viral hepatitis. Hepatitis A reports must be submitted to CDPHE within twenty-four hours. Laboratories must report all tests indicative of hepatitis, such as antibody tests and hepatitis viral loads. Viral hepatitis surveillance in Colorado is primarily based on laboratory reporting of serologic results.

In 2003, CDPHE was awarded funding to begin in 2004 to initiate an active system of surveillance for hepatitis in order to accurately characterize the epidemic in Colorado. This funding continued through 2012 before being discontinued for Colorado. Despite this loss of the primary funding of the hepatitis surveillance program, CDPHE has continued surveillance activities although with a more limited scope.

Unlike HIV and many other less common communicable diseases, funding for viral hepatitis surveillance is extremely limited. Only seven jurisdictions in the United States (five states and two cities, not including Colorado or Denver) have CDC funding for viral hepatitis surveillance.[1] Surveillance for hepatitis B and hepatitis C is limited by several factors, including failure to routinely identify: 1) all positive tests; 2) people who spontaneously clear infection; 3) people in treatment; 4) people who are cured and are no longer infected; 5) deaths due to the virus or other causes; 6) co-infections; or 7) re-infection with viral hepatitis. Completeness of reporting for acute HCV diagnoses currently is being evaluated through a project that links Colorado Hospital Association (CHA) discharge data with CEDRS.

Hepatitis A

Hepatitis A first became reportable before 1990. Hepatitis laboratory results come to CDPHE via Electronic Laboratory Reporting (ELR) from 22 different feeds representing 46 different commercial laboratories and hospital laboratories. In 2016, CDPHE received approximately 1,200 hepatitis A virus (HAV) test results via ELR and approximately 10 HAV test results by other methods (fax, mail, and direct entry into CEDRS). Negative test results are not reportable, and data on routine screening rates are not collected.

Upon receipt of these reports, CDPHE uses established case definitions to assign the appropriate diagnosis for each patient. All known confirmed cases are reported into CEDRS, where case data are available to local or state public health personnel for further investigation. CDPHE staff members assess laboratory reports to identify whether a case is new or has been previously reported. If the report is the first positive test received for a person, a new case report is developed; additional laboratory information is included in cases that were previously reported.

[1] Centers for Disease Control and Prevention. Viral hepatitis surveillance: United States 2015. Atlanta, GA.

Risk factor data can be obtained through patient interviews, medical record reviews, and information provided by a physician, hospital, or other healthcare provider. Behavioral data that is collected include, but are not limited to, IDU, household contact of a known or suspect positive hepatitis case, and people who travel or are born outside the United States. All known, confirmed hepatitis A cases are investigated and an interview is attempted. Risk 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.

Hepatitis B

Hepatitis B has been reportable since 1990. Hepatitis laboratory results come to CDPHE via ELR from 22 different feeds representing 46 different commercial laboratories and hospital laboratories. In 2016, CDPHE received approximately 15,200 hepatitis B virus (HBV) test results via ELR and approximately 200 HBV test results by other methods (fax, mail, and direct entry into CEDRS). Negative test results are not reportable, and data on routine screening rates are not collected.

Upon receipt of these reports, CDPHE uses established case definitions to assign the appropriate diagnosis and case status for each patient. All known confirmed and probable cases are reported into CEDRS, where case data are available to local or state public health personnel for further investigation. CDPHE staff members assess laboratory reports to identify whether a case is new or has been previously reported. If the report is the first positive test received for a person, a new case report is developed; additional laboratory information is included in cases that were previously reported. Some duplicates within specific diagnoses exist in the surveillance database -- a case may be counted in the chronic hepatitis numbers more than once if a prior report is not identified and/or names have changed. Also, people who have acute hepatitis that becomes chronic may be entered as both diagnoses.

CDPHE attempts to interview people with acute hepatitis B and women of childbearing age (14-45 years) who have chronic hepatitis B. Interview and follow-up includes soliciting potentially available risk and clinical information from healthcare providers. If a demographic or risk variable is reported as missing, the information was not located by or available to the disease investigators. If the variable is reported as unknown, then the investigator asked the question or located the information in a report and it was marked as unknown. Since most hepatitis B cases are reported by laboratories and since cases are not followed up due to lack of resources and lack of contact information, most demographic and risk information remain missing.

Behavioral data that is collected include, but are not limited to, IDU, household contact of a known or suspect positive hepatitis case, sexual partner contact of hepatitis case, a male who has sex with men (MSM), and people born outside the U.S. Information is more complete for those who are followed-up and 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. Typically, this risk behavior information is missing for chronic cases.

Hepatitis C

Hepatitis C has been reportable since 1993. Hepatitis laboratory results come to CDPHE via ELR from 22 different feeds representing 46 different commercial laboratories and hospital laboratories. In 2016, CDPHE received approximately 43,000 hepatitis C virus (HCV) test results via ELR and approximately 1,300 HCV test results by other methods (fax, mail, and direct entry into CEDRS). Negative test results are not reportable, and data on routine screening rates are not collected.

Upon receipt of these reports, CDPHE uses established case definitions to assign the appropriate diagnosis and case status for each patient. All known confirmed and probable cases are reported into CEDRS, where case data are available to local or state public health personnel for further investigation. CDPHE staff members assess laboratory reports to identify whether a case is new or has been previously reported. If the report is the first positive test received for a person, a new case report is developed; additional laboratory information is included in cases that were previously reported. Some duplicates within specific diagnoses exist in the surveillance database -- a case may be counted in the chronic hepatitis numbers more than once if a prior report is not identified and/or names have changed. Also, people who have acute hepatitis that becomes chronic may be entered as both diagnoses.

CDPHE attempts to interview cases that are reported to be acute and follows up on reported chronic cases that are most likely to be a potential acute case. These are chronic cases identified in people between the ages of 3-29 years old. Age 3 is used as a cutoff because HCV antibodies from the mother can last until 18 months of age and treatment is not recommended for children under age 3.[2] Limiting follow-up to under age 30 years old is based on lack of resources to investigate all chronic reports, but acute cases can also occur among older individuals. Interview and follow-up includes soliciting potentially available risk and clinical information from healthcare providers. If a demographic or risk variable is reported as missing, the information was not located or available to the disease investigators. If the variable is reported as unknown, the investigator asked the question or located the information in a report and it was marked as unknown. Since most hepatitis C cases are reported by laboratories and since most cases are not followed up due to lack of resources and inadequate contact information, most demographic and risk information remain missing.

Behavioral data that is collected include, but are not limited to, IDU, household contact of a known or suspect positive hepatitis case, sexual partner contact of hepatitis case, MSM, and people born outside the U.S. Information is more complete for those followed-up and 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. Typically, this risk behavior information is missing for chronic cases.

[2] Centers for Disease Control and Prevention. Hepatitis C FAQs for the Public. Accessed at https:\\www.cdc.gov\hepatitis\hcv\cfaq.htm#cFAQ45 on August 15, 2017.

Hepatitis A in Colorado

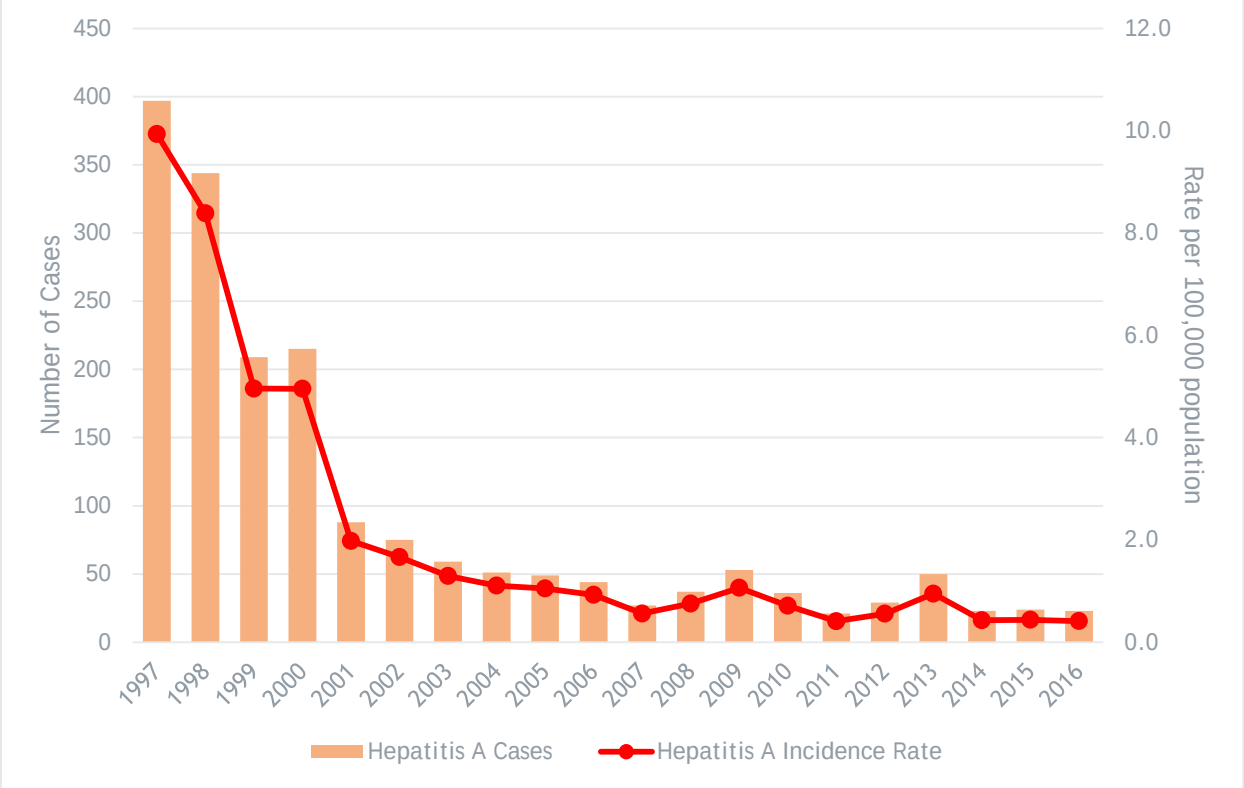
- Reports of people infected with hepatitis A virus in Colorado have decreased from almost 400 cases reported in 1997, to 50 or fewer reported cases per year since 2010, with 23 cases reported in 2016. CDC estimates about half of hepatitis A cases are reported to public health.
- There are two ways to prevent hepatitis A infection: a vaccine for HAV has been available since 1995. In addition, post-exposure prophylaxis (vaccine or immune globulin) can be administered within two weeks when a known exposure has occurred.
- People with hepatitis A can have a mild illness lasting a few weeks to a more severe illness requiring hospitalization; most usually improve without treatment.

Background

Hepatitis A is typically a foodborne illness that appears only as an acute (newly occurring) infection, which does not become chronic. The virus is transmitted by eating or drinking contaminated food or water, or by contact with an infected person. People with hepatitis A infection can have a mild illness lasting a few weeks to a more severe illness requiring hospitalization; infected people usually improve without treatment. A vaccine to prevent hepatitis A infection was introduced in 1995. Since the vaccine became available, the rate of reported hepatitis A cases has been declining and as of December 2016, was the lowest it had ever been. 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. In 2015, there were an estimated 2,800 acute hepatitis A cases in the United States.[3] Colorado had 23 cases of hepatitis A reported in 2016, which is likely almost half of all cases that occur. CDC estimates there actually are 1.95 cases for every reported case.[4] Hepatitis A cases in Colorado have declined from 500 cases reported in 1996 to 50 or fewer reported cases per year since 2010. Colorado rates are similar to national data.[5] There have been three common-source outbreaks of hepatitis A reported to CDPHE since 2006 that resulted in a total of 33 identified cases. CDPHE combines hepatitis A with other foodborne illness pathogens. Additional data is available at https://www.colorado.gov/pacific/cdphe/foodborne-illness-data.

[3] Centers for Disease Control and Prevention. Viral hepatitis surveillance: United States 2015. Atlanta, GA.
[4] Klevens RM, Liu S, Roberts H, et al. Estimating acute viral hepatitis infections from nationally reported cases. Am J Public Health 2014; 104:482-7.
[5] Centers for Disease Control and Prevention. Viral hepatitis surveillance: United States 2015. Atlanta, GA.

Figure A.1: Reported Hepatitis A Cases and Incidence Rate of Reported Hepatitis A Cases in Colorado, 1997-2016



Case reports of hepatitis A

The rate of reported hepatitis A cases in Colorado declined dramatically between 1997 and 2016 with the largest declines among children under age 10 years. It is likely that increased pediatric use of the hepatitis A vaccine is the reason for this decline. Hepatitis A vaccine is safe and effective (94% to 100%)6. The vaccine was licensed in 1995, and the first recommendations for its use were published in late 1996. In September 1998, CDPHE made hepatitis A vaccine available to children age two and older in six counties (Adams, Arapahoe, Boulder, Denver, Jefferson and Weld) through the Vaccines for Children (VFC) Program. This was expanded to all Colorado counties in 2000. In 2006, the Advisory Committee on Immunization Practices (ACIP) recommended hepatitis A vaccine for all children at age one year. The incidence of hepatitis A in Colorado now is comparable to the US rate. Hepatitis A vaccine remains a recommended, and not required, vaccine in Colorado.

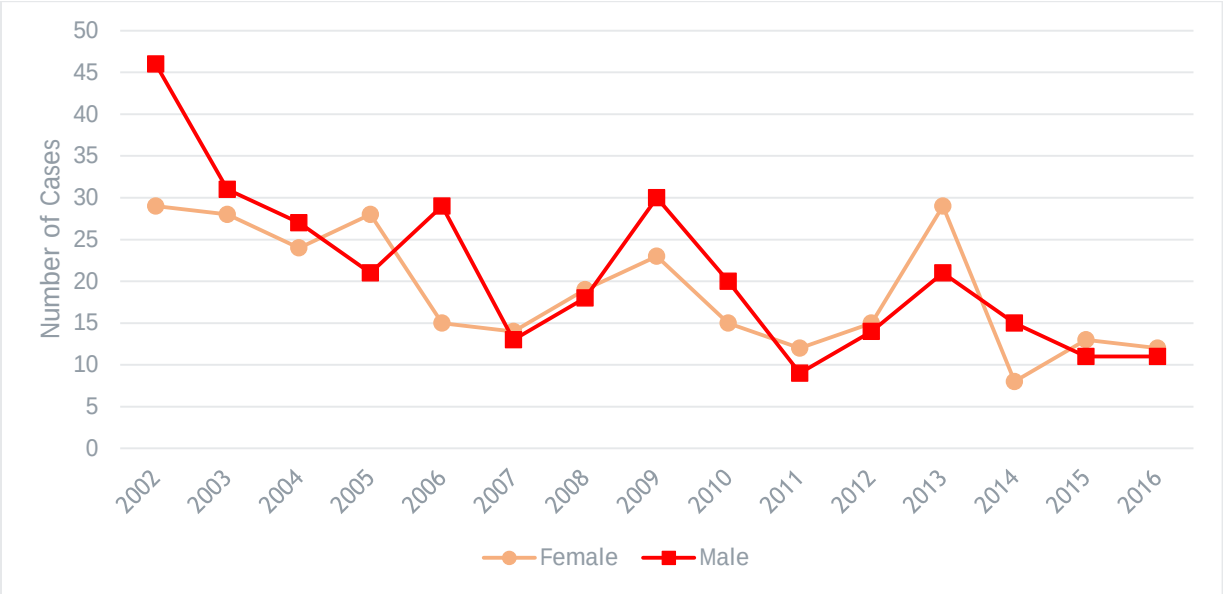
[6] Centers for Disease Control and Prevention. Immunology and Vaccine-Preventable Diseases - Pink Book, Hepatitis A. https://www.cdc.gov/vaccines/pubs/pinkbook/downloads/hepa.pdf

Hepatitis A epidemiology

Gender

Historically, the incidence rate of hepatitis A was higher among males than females. Since 2000, there has been a large and sustained decline for both sexes. During 2012 to 2016, the rates among females have been slightly higher than men.

Figure A.2: Reported Hepatitis A Cases by Gender in Colorado, 2002-2016



Age

Rates of hepatitis A are now lowest among children, which is likely due to use of the pediatric hepatitis A vaccine. During 2005 to 2009, the highest rates of hepatitis A in Colorado were among people ages 15-19 years (1.12 per 100,000), followed by those ages 20-39 years (1.11 per 100,000). During 2012 to 2016, the highest rates are among people who are 80 years old and older (1.11 per 100,000), followed by those who are 60-79 year old (0.79 per 100,000). The largest burden of illness is among adults, for whom vaccine is not routinely offered. Detailed tables can be found in the appendix.

Figure A.3: Percent of Reported Hepatitis A Cases by Age Group in Colorado, 2002-2016

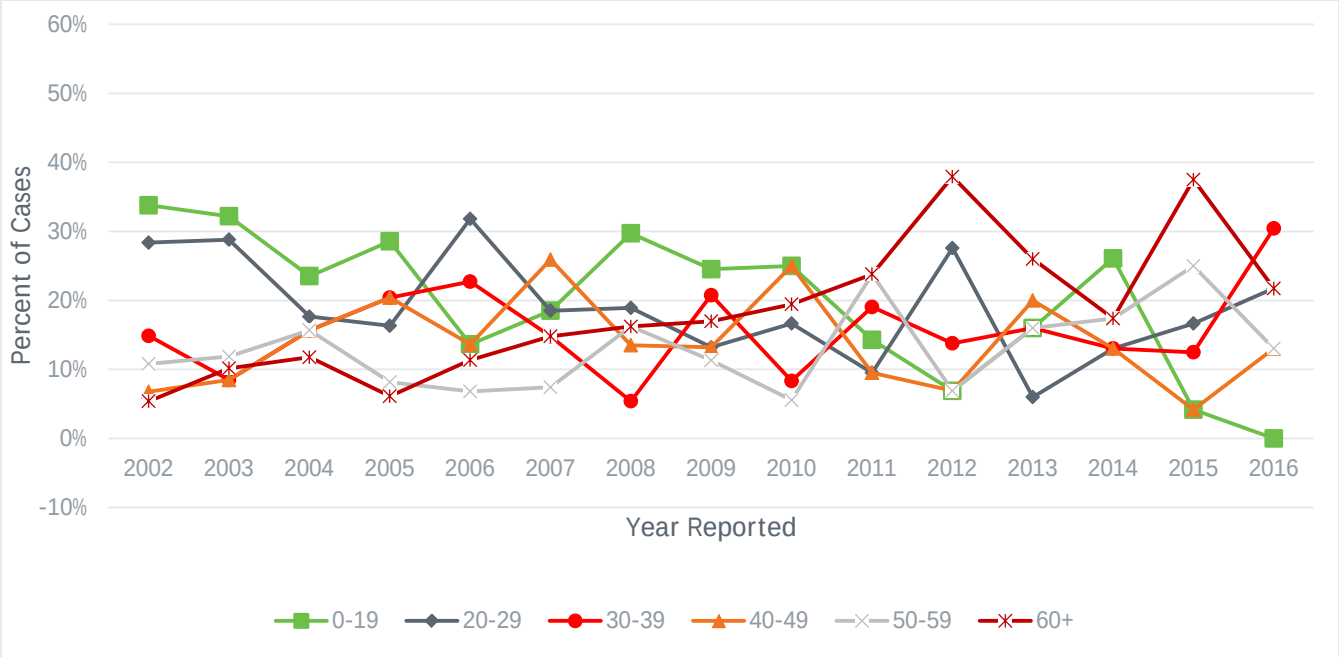
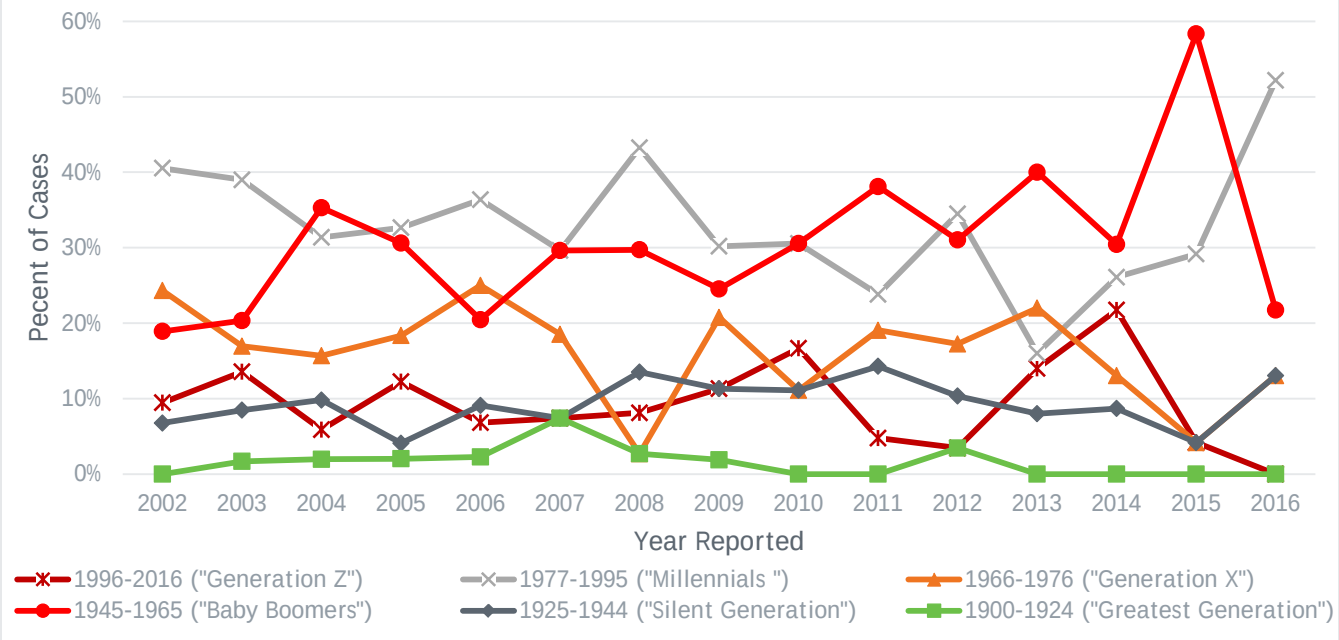


Figure A.4: Percent of Reported Hepatitis A Cases by Birth Cohort in Colorado, 2002-2016



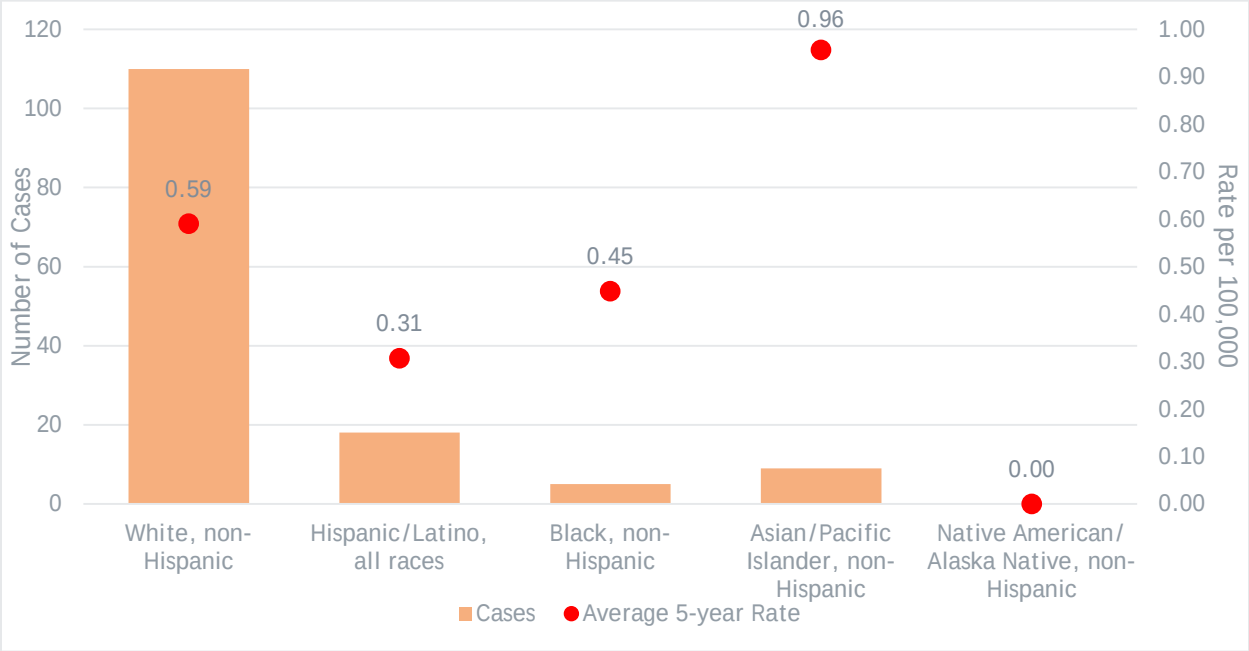
There are no definitive birth year ranges for the birth cohorts presented in this report and are for the purposes of this report only.
Note about birth cohorts; you can be born within three years on either side of the beginning or ending of a generation and have all the characteristics of the generation before or after. This has to do with a number of factors including the age of your parents, if you grew up in an urban or rural environment affluence and more. Being raised in a military household can also change your generational identity.

Race/ethnicity

During 2012 to 2016 the average incidence rate was highest for Asian/Pacific Islanders, at 0.96 per 100,000, as depicted in Figure A.5. These numbers are small and must be interpreted with caution. However, five of these nine cases (55.6%) reported international travel before the onset of symptoms, suggesting a need to improve messaging around recommendations for pre-travel vaccinations.

Incidence among Hispanics/Latinos was lower during 2012-2016 than for other racial or ethnic groups. This is notable, since as recently as 2005 to 2009, Hispanics/Latinos had the highest incidence of hepatitis A infection in Colorado and a fivefold difference in incidences rates between Non-Hispanic Whites and Hispanics/Latinos existed during 1989 to 1993.

Figure A.5: Reported Hepatitis A by Race/Ethnicity in Colorado, 2012-2016



Clinical characteristics of hepatitis A

The most commonly reported symptoms among reported hepatitis A cases in 2012-2016 were fatigue, loss of appetite, nausea and dark urine. Jaundice was reported by 68.5% of cases. Forty-two percent of cases were hospitalized. This is higher than in previous reports7 and is likely a reflection of the older average age of cases. No deaths were reported.

[7] Klevens MR, Ly, KN. Trends in Disease and Complications of Hepatitis A Virus Infection in the United States, 1999-2011: A New Concern for Adults. J Infect Dis. (2015) 212 (2): 176-182.

Hepatitis A exposure

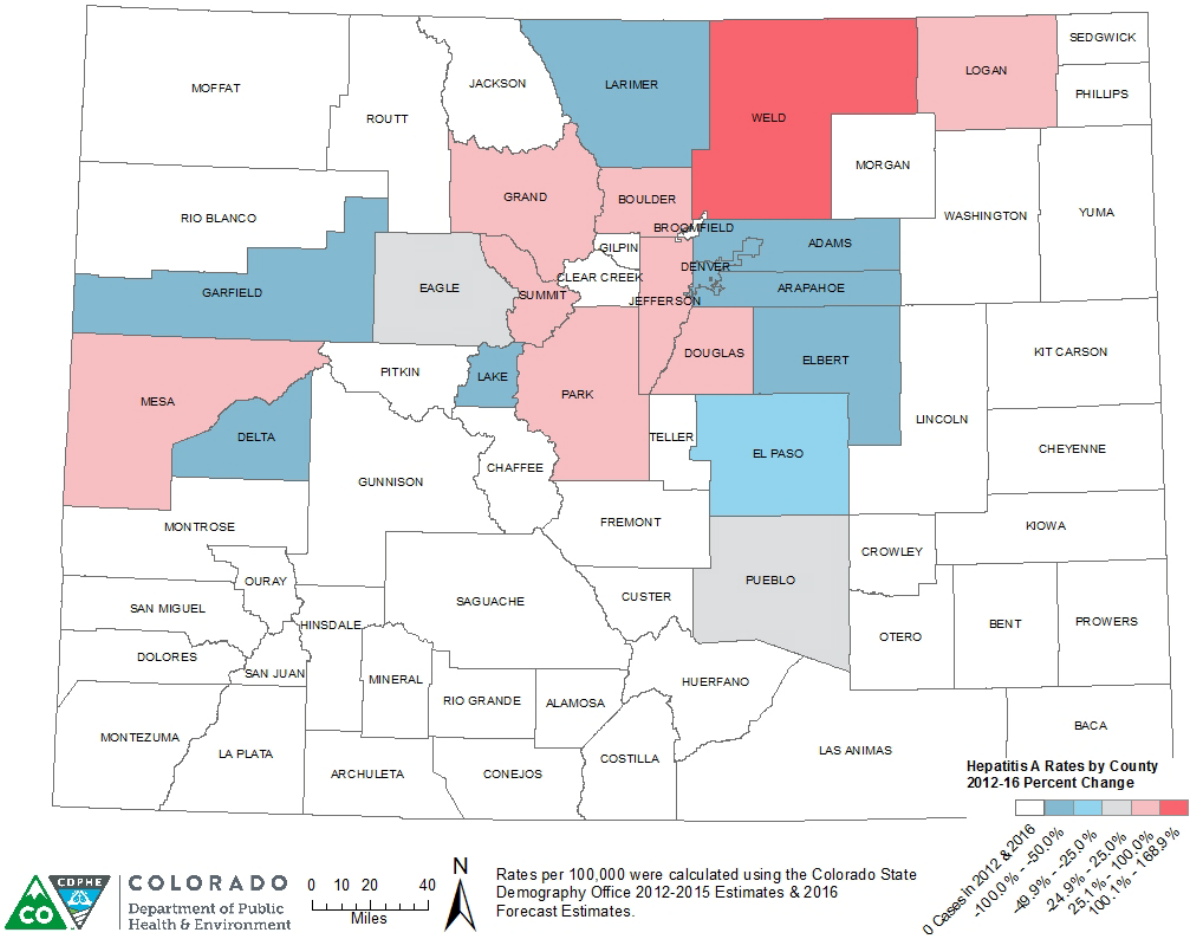
Sixty-seven cases (45%) had a known source of exposure, defined as international travel, close contact with a known case, and/or being part of a known common source outbreak. The most commonly reported risk factor for hepatitis A was international travel during the two to six weeks before onset. However, this accounts for less than one-third of cases reported during 2012-2016. The proportion of cases who report international travel has declined from closer to 50 percent during the mid-2000s, suggesting the messaging about hepatitis A vaccine before international travel may be having an effect.

One notable multistate foodborne outbreak associated with contaminated pomegranate arils used primarily for smoothies occurred during 2013 and resulted in 26 Colorado cases that year. Multistate outbreaks associated with commercially distributed products such as berries and pomegranate arils have become more common in recent years.

Geographic distribution

Figure A.6 shows the percent change in the rate of reported hepatitis A cases in 2016 compared to 2012 by county. Table A.4, in the appendix, describes the distribution of hepatitis A cases by county of residence. Hepatitis A cases were reported in 29 of the 64 Colorado counties from 2012-2016. Counties without reported cases were more likely to be frontier counties (rural areas sparsely populated that are isolated from population centers and services). The rates of reported cases are high in some of the rural counties. These high rates may reflect a true burden of hepatitis A in these counties, however, the number of cases can be small and should be interpreted with caution.

Figure A.6: Percent Change of Hepatitis A Incidence Rates in Colorado by County, 2012 to 2016



Hepatitis B in Colorado

- CDPHE receives approximately 500-600 new reports of chronic hepatitis B each year, and the number of cases is increasing. Acute cases fluctuate at approximately 25 to 32 cases annually, but CDC estimates there are an additional 6.48 acute cases for each case reported to public health.
- The number of cases and the rate of reported chronic hepatitis B cases have been increasing in the last four years.
- An effective vaccine is available. The vaccine, coupled with improvements in prenatal screening (98.6% of pregnant women were screened in 2016) and treatment, has resulted in no acute childhood infections and large declines in chronic childhood infections.
- Trends in Colorado indicate males consistently have higher numbers of reported cases of acute and chronic hepatitis B.
- Data regarding race/ethnicity is incomplete for many hepatitis B case reports, but indicate Asian/Pacific Islanders and Non-Hispanic Blacks are disproportionately affected by the disease, particularly if they were born in another country.

Background

Hepatitis B is typically a bloodborne illness that can occur as 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, oftentimes without symptoms. When symptoms do occur, they include fever, fatigue, lack of appetite, nausea, vomiting, dark urine, grey-colored stool, joint pain, jaundice (yellowing of the skin and eyes), and symptoms of decompensated liver disease in advanced cases.[8]

Hepatitis B accounts for almost 2,000 annual deaths in the United States.[9] Viral hepatitis, of which hepatitis B is the second most common type, has surpassed HIV and AIDS to become the seventh leading cause of death worldwide.[10] Hepatitis B and C cause an estimated 61 percent of hepatocellular carcinoma (HCC) in the U.S.[11]

[8] American Liver Foundation, The progression of liver disease. Accessed at http://www.liverfoundation.org/abouttheliver/info/progression/ on December 28, 2016.
[9] Centers for Disease Control and Prevention. Viral hepatitis surveillance: United States 2015. Atlanta, GA.
[10] Stanaway JD, Flaxman AD, Naghavi M, et al. The global burden of viral hepatitis from 1990 to 2013: findings from the Global Burden of Disease Study 2013. Lancet 2016;388(10049):1081-8.
[11] National Academies of Sciences, Engineering, and Medicine. 2016. Eliminating the public health problem of hepatitis B and C in the United States: Phase one report. Washington, DC: The National Academies Press. doi: 10.17226/23407.

HCC is the most common form of liver cancer, and liver cancer is the fastest rising cause of cancer deaths in the U.S., with a tripling of incidence since the early 1980s.[12]

Hepatitis B is preventable and can be managed if treated appropriately. However, barriers to prevention and treatment of hepatitis persist. Fewer than one-third of people with chronic hepatitis B are aware of their infection.[13] Hepatitis B vaccination became a school entry requirement in 1997. At that time, the Colorado Board of Health required all day care students aged fifteen months through four years of age, kindergarten and seventh grade students, to have three doses of hepatitis B vaccine to attend school. Currently, all students aged 15 months through twelfth grade are required to have three doses of the vaccine. Three doses of the HBV vaccine confer greater than 95 percent immunity. Vaccination has helped decrease rates of hepatitis B, particularly among school-age children.

HBV is transmitted three main ways: from an infected mother to her child, from direct contact with infected blood, or from condomless sex with an infected partner. The prevalence of chronic hepatitis B in the United States disproportionately affects people born in countries with endemic hepatitis B, such as countries in East Asia and sub-Saharan Africa.[14] Vaccination of all high-risk groups, not just children, can help reduce the number of new infections.

Acute hepatitis B

Acute hepatitis B is a short-term illness that occurs within the first six months of infection with HBV. Symptoms are usually mild to moderate, and include fatigue, nausea, vomiting, abdominal pain, jaundice and abnormal liver function tests. Older children and adults are more likely to develop symptoms than younger children. The hepatitis B IgM antibody can be detected in sera and used as a marker of acute infection. CDPHE uses case definitions published by the National Notifiable Diseases Surveillance System (NNDSS) to define an acute case. The acute hepatitis B case definition has been the same since 2012 and can be found at https://wwwn.cdc.gov/nndss/conditions/hepatitis-b-acute.

Chronic hepatitis B

Chronic hepatitis B results when HBV remains in the body after the acute phase of illness. People with a chronic infection do not develop protective antibodies to the hepatitis B surface antigen (HBsAg). Among those infected, 90 percent of infants will develop chronic hepatitis B.15 Over time, chronic hepatitis B can result in liver disease,

[12] El-Serag HB and Kanwal F. Epidemiology of hepatocellular carcinoma in the United States: Where are we? Where do we go? Hepatology 2014;60(5):1767-1775.
[13] National Academies of Sciences, Engineering, and Medicine. 2016. Eliminating the public health problem of hepatitis B and C in the United States: Phase one report. Washington, DC: The National Academies Press. doi: 10.17226/23407.
[14] National Academies of Sciences, Engineering, and Medicine. 2016. Eliminating the public health problem of hepatitis B and C in the United States: Phase one report. Washington, DC: The National Academies Press. doi: 10.17226/23407.
[15] Centers for Disease Control and Prevention. Viral hepatitis surveillance: United States 2015. Atlanta, GA.

cirrhosis, or cancer. The surveillance case definition for chronic hepatitis B has not changed since 2012 and can be found at https://wwwn.cdc.gov/nndss/conditions/hepatitis-b-chronic.

Perinatal hepatitis B

Perinatal hepatitis B is defined as HBsAg positivity in any infant aged 1-24 months who was born in the United States or in U.S. territories to an HBsAg-positive mother. CDPHE follows all women 14-45 years of age reported with hepatitis B to determine whether they are pregnant. If the woman is pregnant, she is enrolled in the Perinatal Hepatitis B Prevention Program to help prevent transmission to the infant. A dose of HBV vaccine combined with hepatitis B immune globulin (HBIG) administered within 12 hours of birth and completing the full series of three vaccines can help prevent transmission to the infant. Additionally, the infant receives post-vaccine serologic testing at nine to 12 months to verify conversion to immunity from the vaccine. Infants that remain susceptible after completing the three dose series are recommended to receive an additional three dose series in order to achieve immunity.

Hepatitis B prevalence estimate

CDPHE estimates there are currently about 15,436 (range of 10,291 to 20,581) people in Colorado living with chronic, unresolved hepatitis B infection. This estimate is based on the Colorado State Demography Office 2016 Forecast population aged 6 years and older, estimated at 5,145,270, and a national published HBV prevalence rate estimate from 2007-2012 National Health and Nutrition Examination Survey (NHANES)[16] data of 0.3 percent (range of 0.2%-0.4%).

In the 2015 CDPHE Viral Hepatitis Surveillance Report[17], estimates were based similarly on the 2003-2010 NHANES data. However, it did not take into account the NHANES not collecting testing information on those participants less than 6 years of age.

Colorado's surveillance system does not sufficiently track how many people have resolved hepatitis B infection or died; therefore, surveillance case numbers are not used to estimate the number of Coloradans who are currently living with chronic hepatitis infection. National estimates of hepatitis B are limited since they are based on surveys of the general population and under-represent sub-populations of interest, such as minorities. Specifically, Asian/Pacific Islanders are greatly affected by hepatitis B and not well-represented in the NHANES survey.[18] Applying national rates to Colorado is further limited by the fact that national rates may not reflect hepatitis B in Colorado.

[16] Roberts H, Kruszon-Moran D, Ly KN, et al. Prevalence of chronic hepatitis B virus (HBV) infection in U.S. households: National Health and Nutrition Examination Survey (NHANES), 1988-2012. Hepatology 2016;63:388-397.
[17] Colorado Department of Public Health and Environment. 2015 Surveillance Report Viral Hepatitis in Colorado. Denver, CO. January 2017. https://www.colorado.gov/pacific/cdphe/hepatitis-data
[18] H, Baik SY. Health disparities or data disparities: sampling issues in hepatitis B virus infection among Asian American Pacific Islander studies. Appl Nurs Res; 2011:24(2):e9-e15.

Cumulative case reports of hepatitis B

From 1990 through 2016, a total of 1,331 acute and 15,697 chronic hepatitis B cases were reported into CEDRS. Detection of whether a hepatitis B case is acute or chronic began in 1996; therefore, before this year some HBV cases may be misclassified as chronic when they are in fact, acute. Figures B.1 and B.7 show hepatitis B cases reported in Colorado by year. The number of acute hepatitis B cases declined initially and has remained around 25 to 32 reported annually in the last five years. The number of chronic hepatitis B cases declined from 1992 to 2005 and has fluctuated since with an increase in the last four years.

Hepatitis B epidemiology

Colorado has seen a rise in reported cases of hepatitis B over the past several years. In Colorado in 2016, a total of 29 cases of acute hepatitis B and 641 cases of chronic hepatitis B were reported. Table B.1, in the appendix, describes the distribution of reported cases by gender, age, and race/ethnicity. There were a total of 154 pregnant women with hepatitis B in 2015. Fifty-one of those women were newly diagnosed in 2016, and 103 had previously been diagnosed but had a new pregnancy in 2016. Applying published multipliers to adjust for under-ascertainment and underreporting[19] to the 29 acute hepatitis B case reports in 2016, we estimate that Colorado actually had 188 acute hepatitis B cases in the last year. Colorado has a slightly lower rate of reported acute hepatitis B (years 2012-2016) compared to the U.S. rate (years 2011-2015), 0.5 per 100,000 population in Colorado versus 0.9 per 100,000 population in the U.S.[20] However, reporting practices vary across states; therefore, comparing rates may be misleading.

Surveillance cannot determine the number of men and women tested in Colorado since only positive HBV test results are reported. However, Colorado birth certificate data for 2016 show that of 66,325 pregnant women with known screening status (873 had unknown screening status), 98.6 percent of women were screened for HBV during pregnancy[21] as recommended by the CDC ACIP and the U.S. Preventive Services Taskforce. There is no recommendation to routinely test men.

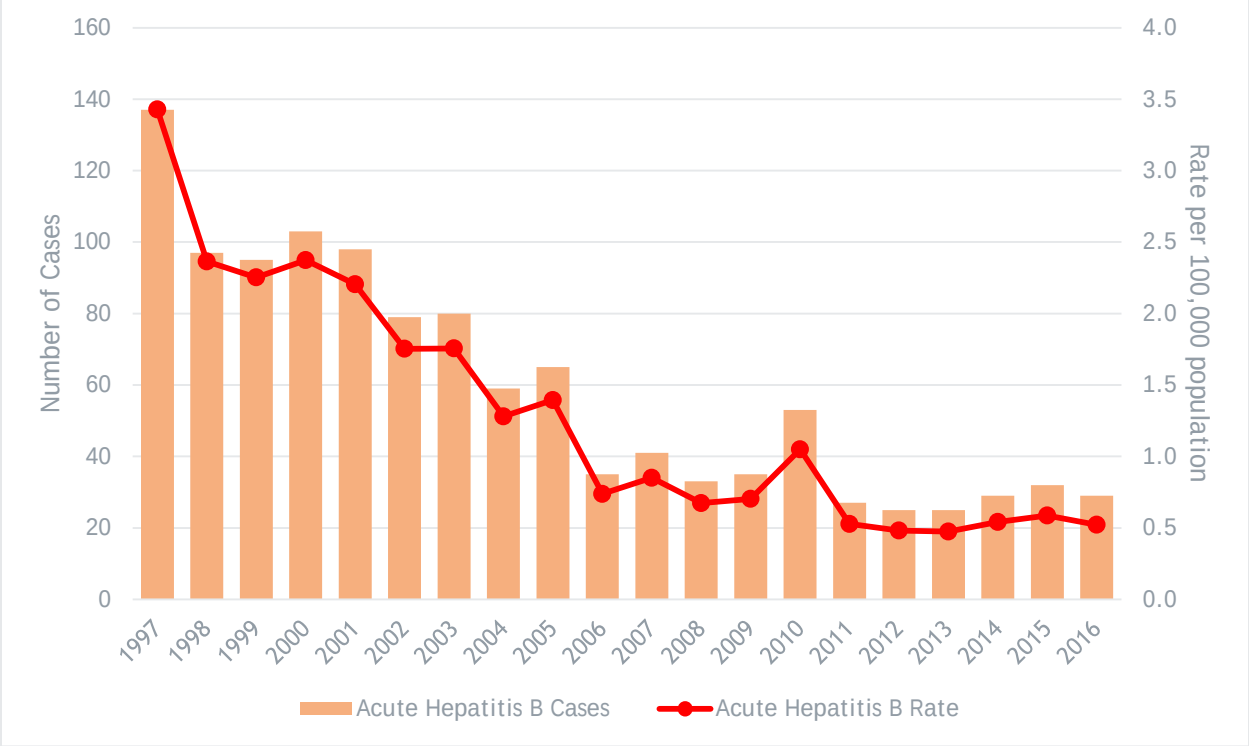
There are several Healthy People 2020 objectives for hepatitis B regarding acute infections and vaccination.[22] One is to reduce to zero new (acute) hepatitis cases among people ages 2 to 18 years. This goal has been met nationwide since 2009. Another objective is to achieve and maintain an effective coverage level of a birth dose of HBV vaccine (zero to three days between birth date and date of vaccination) reported by the annual birth cohort, with a target of 85 percent. Colorado had an HBV first dose vaccination rate of 76.4 percent in 2015.[23] Similarly, another objective is to maintain an effective vaccination coverage level of three doses of HBV vaccine

[19] Klevens, MR, Ly, KN. Trends in Disease and Complications of Hepatitis A Virus Infection in the United States, 1999–2011: A New Concern for Adults. J Infect Dis. (2015) 212 (2): 176-182.
[20] Centers for Disease Control and Prevention. Viral hepatitis surveillance: United States 2015. Atlanta, GA.
[21] Vital Statistics Program, Colorado Department of Public Health and Environment.
[22] Healthy People 2020 Objectives, https://www.healthypeople.gov. Accessed September 20, 2016.
[23] Vital Statistics Program, Colorado Department of Public Health and Environment.

among children by age 19 to 35 months, with a target of 90 percent. Colorado reached this goal with a rate of 92.1 percent in 2015. The goal has been met nationally with a coverage rate of 92.6 percent.[24]

Acute hepatitis B

Figure B.1: Reported Acute Hepatitis B Cases and Rate in Colorado, 1997-2016

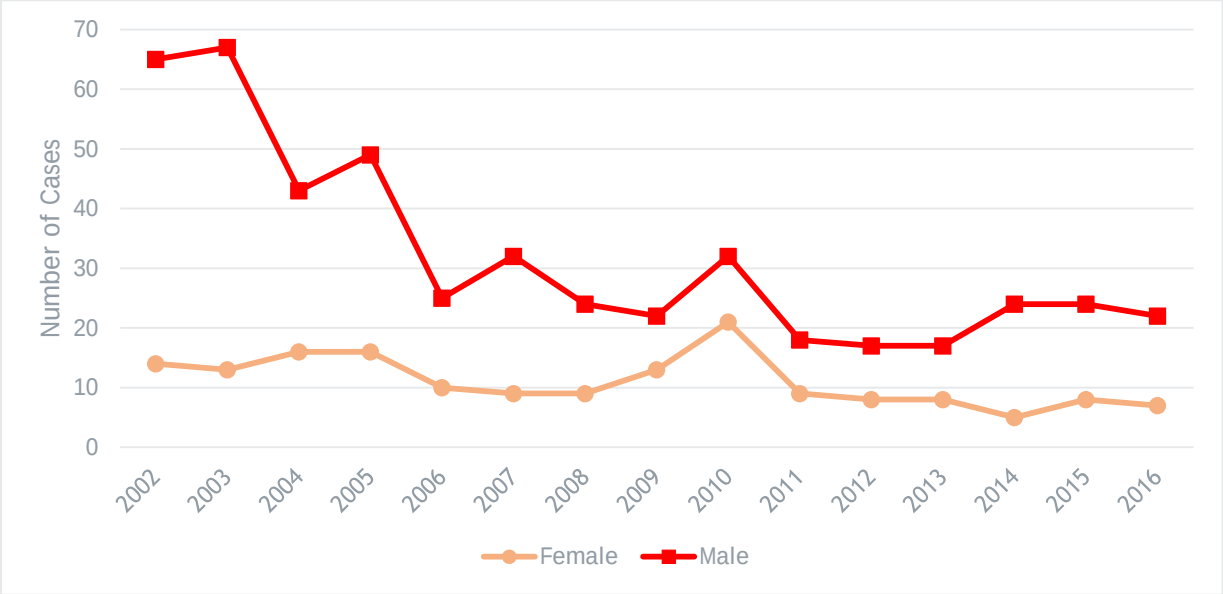


Gender

Among hepatitis B acute cases reported in 2012-2016, 104 (74.3%) were reported in men, and 36 (25.7%) in women. Figure B.2 demonstrates that men are consistently reported with acute hepatitis B more frequently than women.

[24] Centers for Disease Control and Prevention. National Immunization Survey. Accessed at: https://www.cdc.gov/vaccines/imz-managers/coverage/childvaxview/data-reports/hepb/reports/2015.html on August 19, 2017.

Figure B.2: Reported Acute Hepatitis B Cases by Gender in Colorado, 2002-2016



Age

Table B.1, in the appendix, shows that all but one reported acute hepatitis B case in 2012-2016 occurred among people > 19 years of age. People >19 years of age are less likely to be immunized for hepatitis B based on a school-entry requirement that began in 1997. The higher rate of acute cases in people over this age suggests that individuals in these age groups could benefit from vaccine. The median age of acute hepatitis B cases at time of report was typically in the mid-30s until 2008. In the years following, the median age was in the 40s.

Figure B.3: Percent of Reported Acute Hepatitis B Cases by Age Group in Colorado, 2002-2016

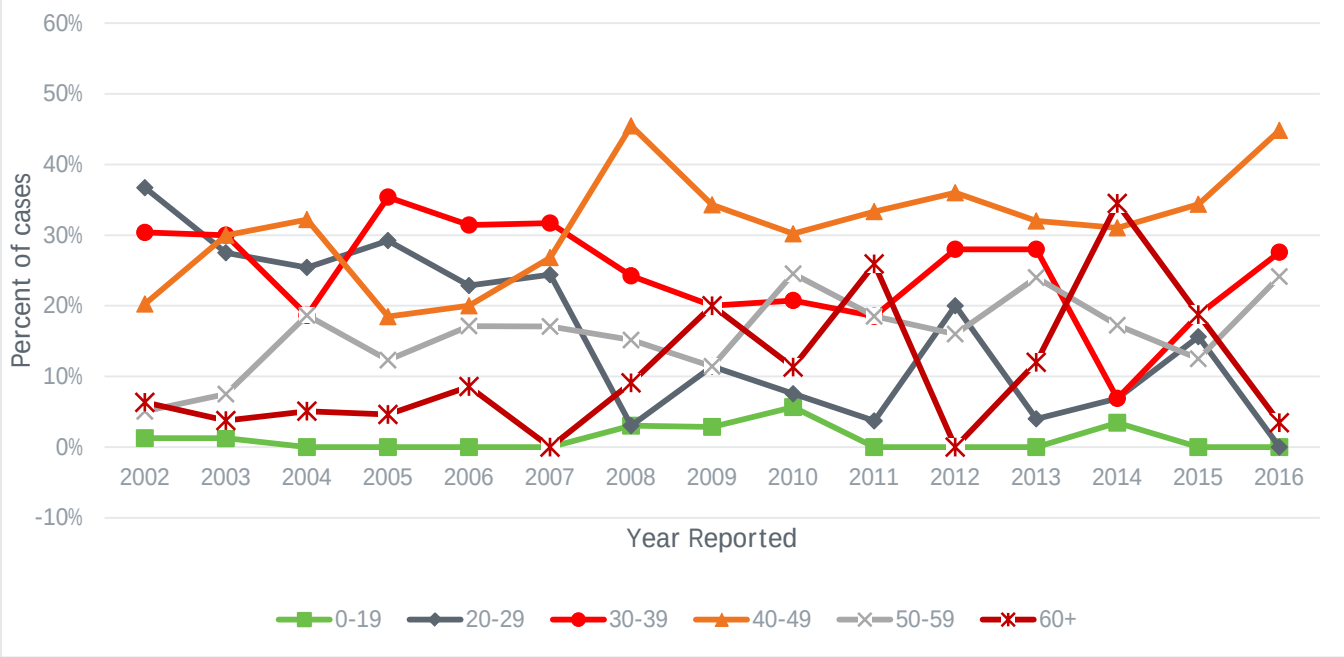
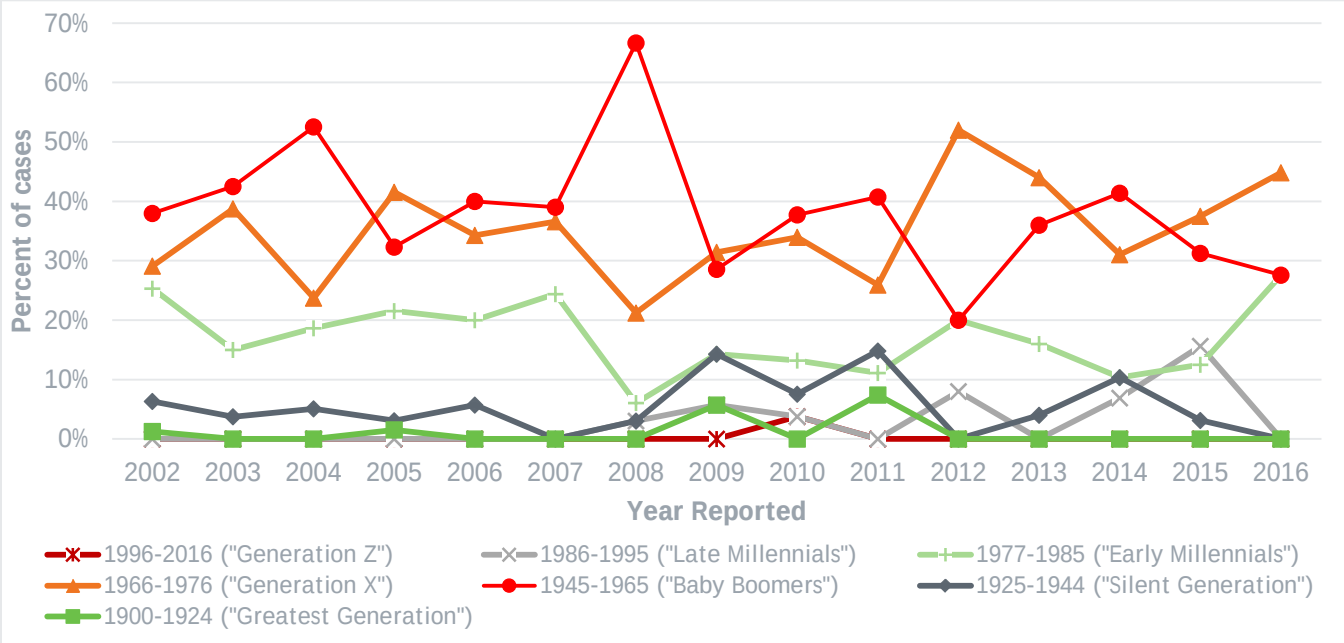


Figure B.4: Percent of Reported Acute Hepatitis B Cases by Birth Cohort in Colorado, 2002-2016



There are no definitive birth year ranges for the birth cohorts presented in this report and are for the purposes of this report only.
Note about birth cohorts; you can be born within three years on either side of the beginning or ending of a generation and have all the characteristics of the generation before or after. This has to do with a number of factors including the age of your parents, if you grew up in an urban or rural environment affluence and more. Being raised in a military household can also change your generational identity.

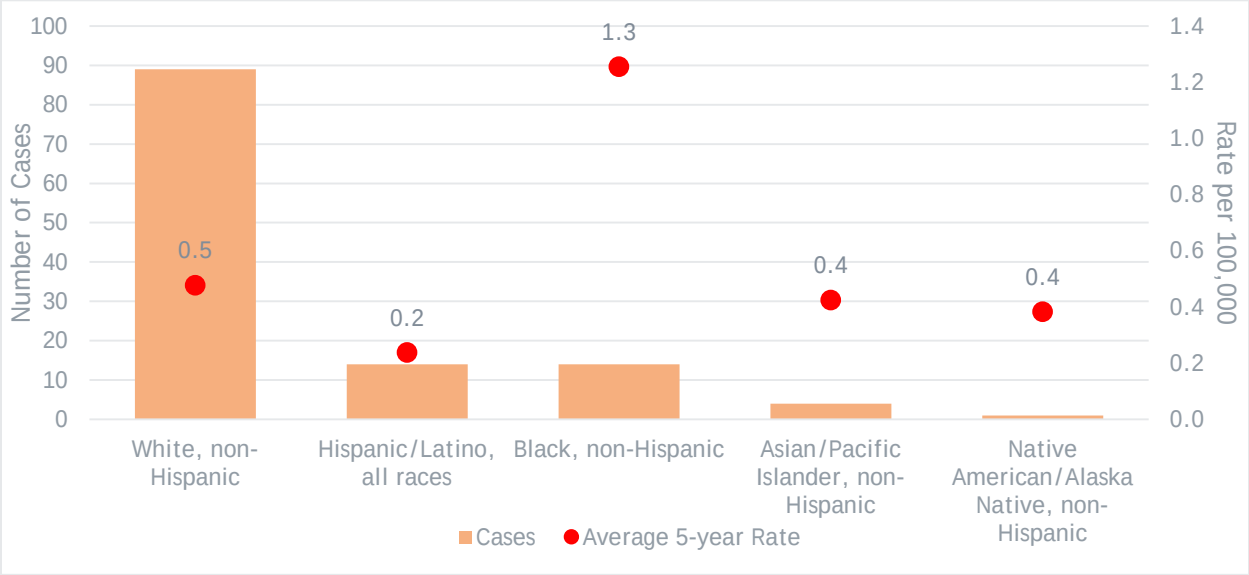
Race/ethnicity

Data on race and ethnicity was available for 90.0 percent of acute cases. Most acute cases of hepatitis B were reported among Non-Hispanic Whites (n=89). Data from Colorado's Perinatal Hepatitis B Unit indicate that foreign-born pregnant women are significantly more likely to be reported with a hepatitis B infection than other pregnant women born in the U.S. National data also describes significant disparities in reported chronic hepatitis B cases by race/ethnicity.[25]

When comparing the 2016 forecast population of Colorado to all acute hepatitis B cases in 2012-2016, reporting the five main race/ethnic groups (87.1% of all cases reported during this time period), Non-Hispanic Blacks are overrepresented among acute hepatitis B cases and Hispanics/Latinos are underrepresented when compared to the general population of Colorado. Nationally, rates of acute hepatitis B have been consistently higher for Blacks compared to all other racial/ethnic groups.

[25] Centers for Disease Control and Prevention. Viral hepatitis surveillance: United States 2015. Atlanta, GA.

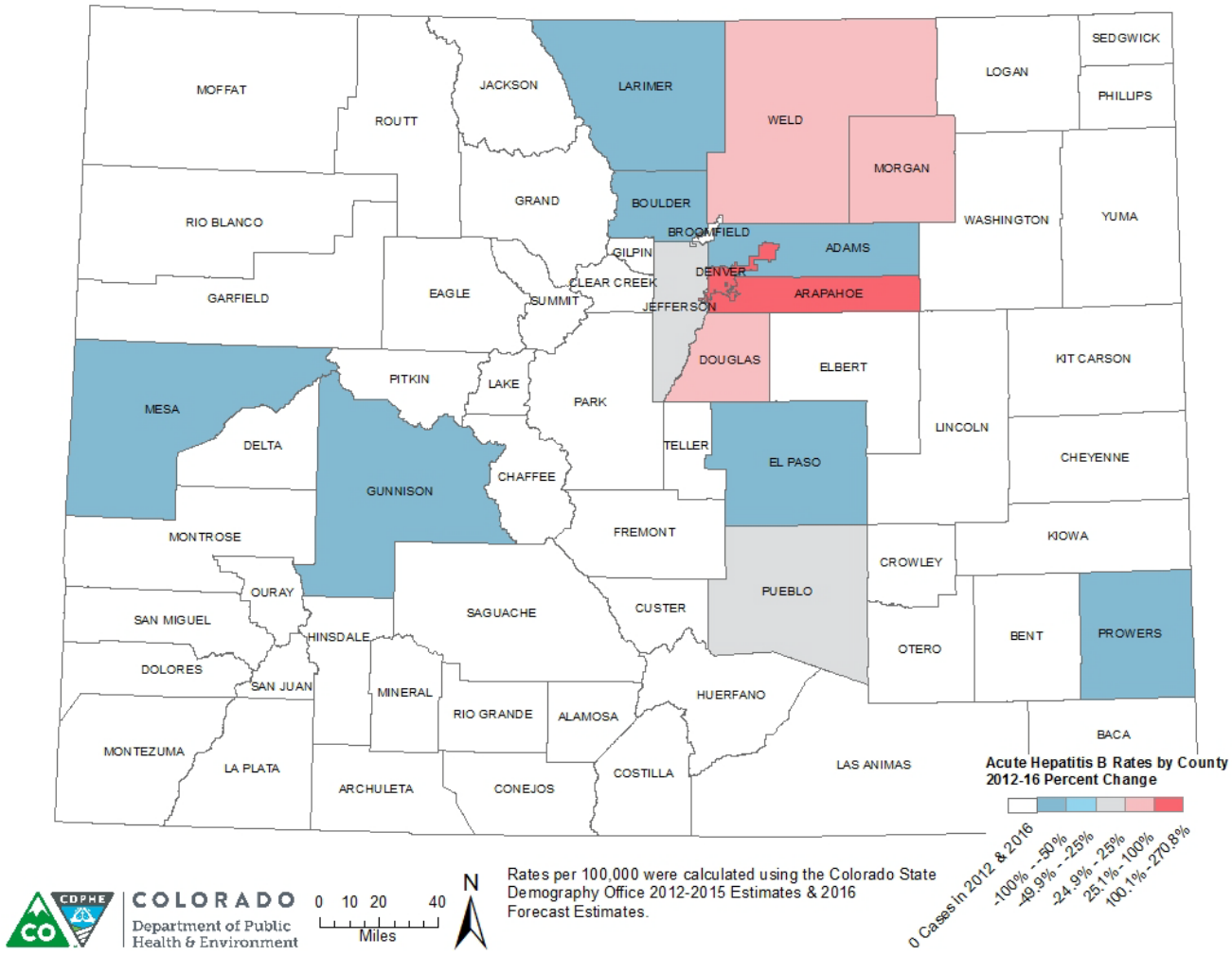
Figure B.5: Reported Acute Hepatitis B Cases by Race/Ethnicity in Colorado, 2012-2016



Geographic distribution

Figure B.6 shows the percent change in the rate of reported acute hepatitis B cases in 2016 compared to 2012 by county. Table B.2, in the appendix, describes the distribution of acute hepatitis B cases by county of residence. Acute hepatitis B cases were reported in 19 of the 64 Colorado counties from 2012-2016. Counties without reported cases were more likely to be frontier counties (rural areas sparsely populated that are isolated from population centers and services). If a person reported with hepatitis is incarcerated in a county jail, that case is assigned to the county of the jail location. The rates of reported cases are high is some of the rural counties. These high rates may reflect a true burden of hepatitis B in these counties, however, the number of cases can be small and should be interpreted with caution.

Figure B.6: Percent Change of Reported Acute Hepatitis B Rates by County, Colorado 2012 to 2016



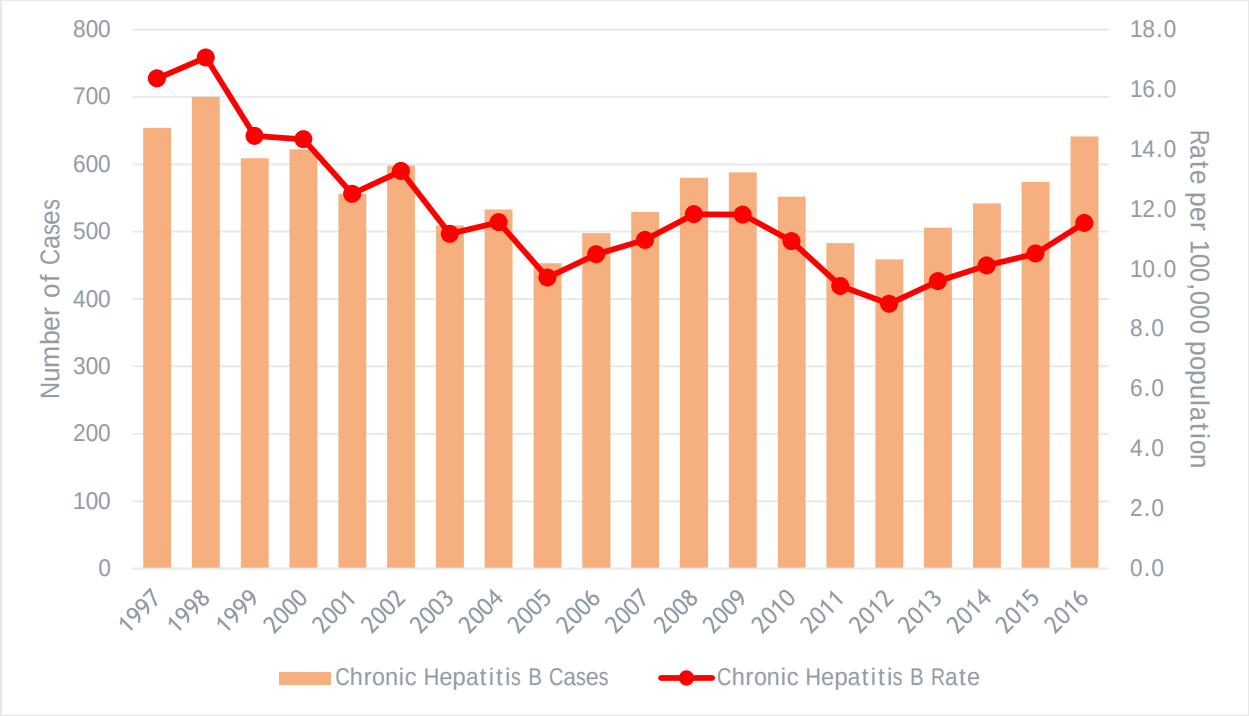
Behavioral risk factors

Seventeen percent of acute cases are missing information about intravenous drug use behavior. IDU is the most commonly reported risk factor for acute cases (n=26) in Colorado. Nationally, this was also the most commonly reported risk factor for acute hepatitis B cases; 30.3 percent of people included information on use of injection drugs.[26] A hepatitis B case can report more than one risk factor.

[26] Centers for Disease Control and Prevention. Viral hepatitis surveillance: United States 2015. Atlanta, GA.

Chronic hepatitis B

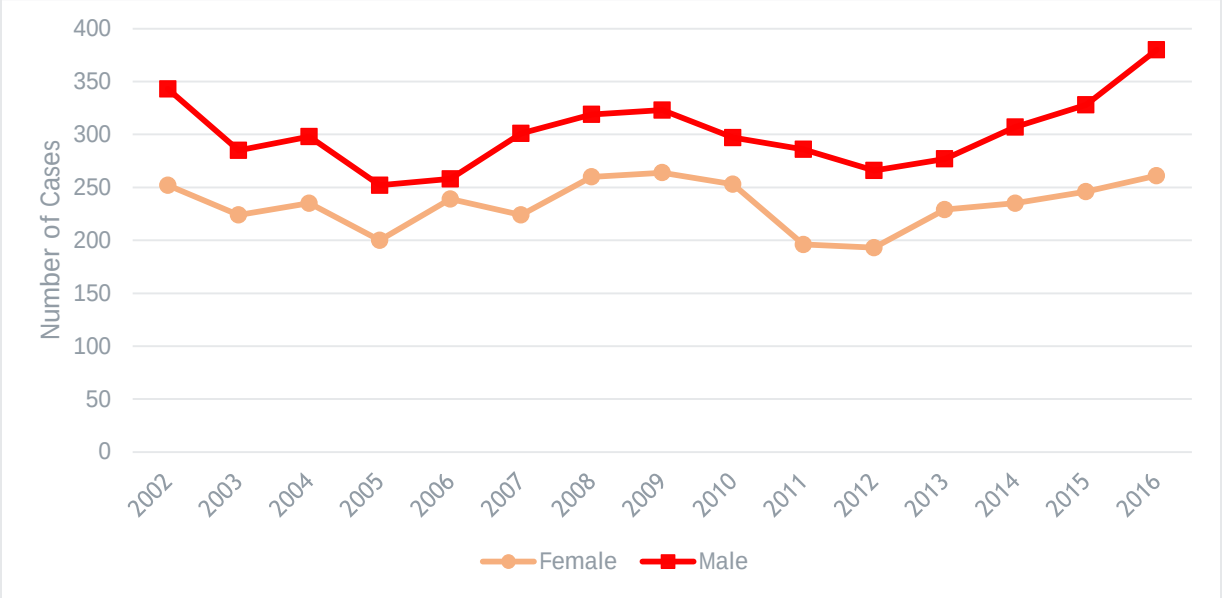
Figure B.7: Reported Chronic Hepatitis B Cases and Rate in Colorado, 1997-2016



Gender

Among chronic hepatitis B cases, more than half of the reported cases were among men (59.3%). Figure B.8 demonstrates that men are consistently reported with chronic hepatitis B more frequently than women.

Figure B.8: Reported Chronic Hepatitis B Cases by Gender in Colorado, 2002-2016



Age

Table B.1, in the appendix, shows people ages 30-39 years represent the greatest proportion of chronic cases (27.3%). The proportions of chronic hepatitis B cases by age category have changed over time and are shown from 2002 to 2016 in Figure B.9.

Figure B.9: Percent of Reported Chronic Hepatitis B Cases by Age Group in Colorado, 2002-2016

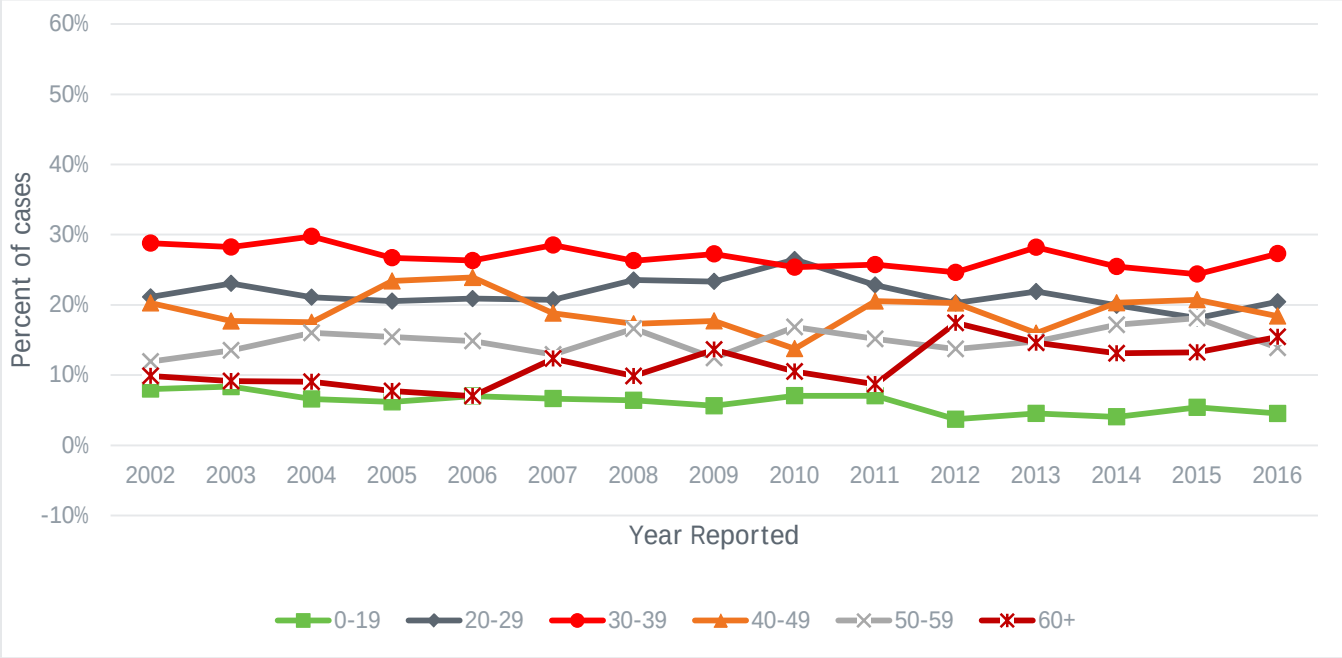
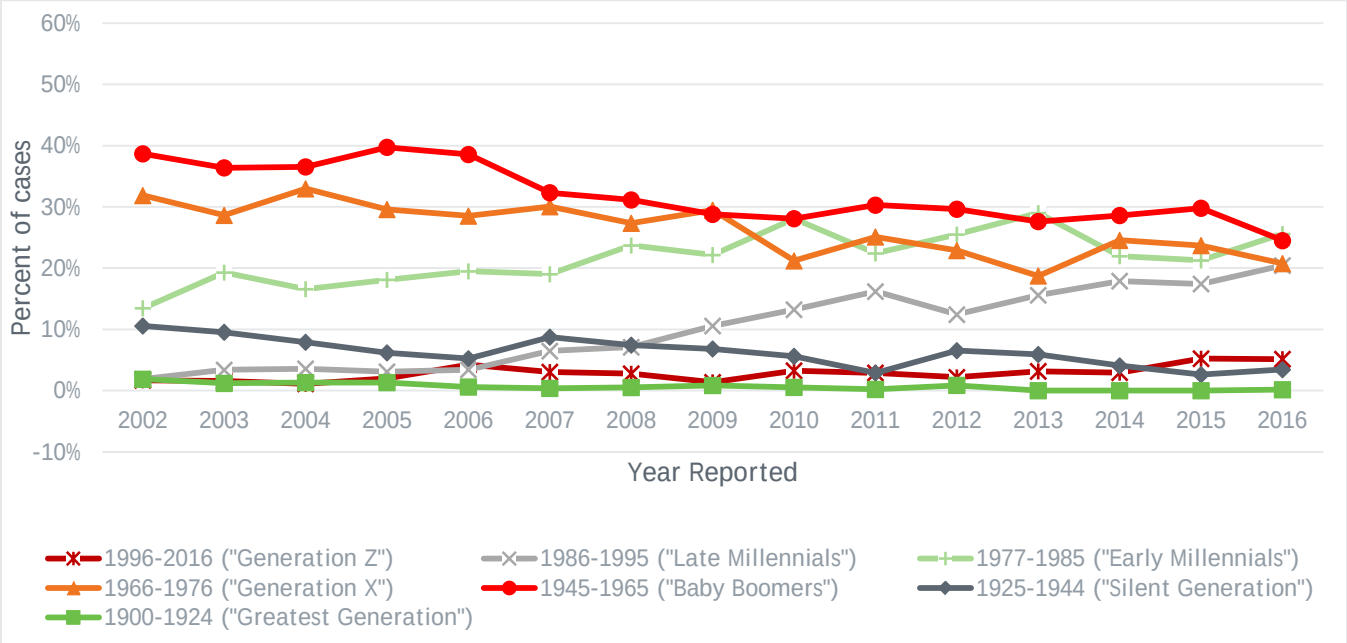


Figure B.10: Percent of Reported Chronic Hepatitis B Cases by Birth Cohort in Colorado, 2002-2016



There are no definitive birth year ranges for the birth cohorts presented in this report and are for the purposes of this report only.
Note about birth cohorts; you can be born within three years on either side of the beginning or ending of a generation and have all the characteristics of the generation before or after. This has to do with a number of factors including the age of your parents, if you grew up in an urban or rural environment affluence and more. Being raised in a military household can also change your generational identity.

Race/ethnicity

Data on race and ethnicity was available for 48.7 percent of chronic cases. The highest number of chronic hepatitis B cases were reported among Non-Hispanic Asians/Pacific Islanders (n=122). Rates were not calculated by race/ethnicity because this information is missing for a large proportion of chronic hepatitis B cases (51.3%). Data from Colorado's Perinatal Hepatitis B Unit indicate that foreign-born pregnant women are significantly more likely to be reported with hepatitis B infection than other pregnant women born in the U.S. National data also describes significant disparities in chronic hepatitis B cases by race/ethnicity.[27] The prevalence of chronic hepatitis is highest in East Asia and sub-Saharan Africa.[28]

When comparing the 2016 forecast population of Colorado to all chronic hepatitis B cases in 2016, Non-Hispanic Asian/Pacific Islanders and Non-Hispanic Blacks are overrepresented among chronic hepatitis B cases and Non-Hispanic-Whites and Hispanics/Latinos are underrepresented when compared to the general population of Colorado.

Nationally, NHANES 1999-2006 data regarding national chronic hepatitis B rates by race/ethnicity indicate that people of Black and "Other" race were about ten times more likely to have chronic

[27] Centers for Disease Control and Prevention. Viral hepatitis surveillance: United States 2015. Atlanta, GA.
[28] National Academies of Sciences, Engineering, and Medicine. 2016. Eliminating the public health problem of hepatitis B and C in the United States: Phase one report. Washington, DC: The National Academies Press. doi: 10.17226/23407.

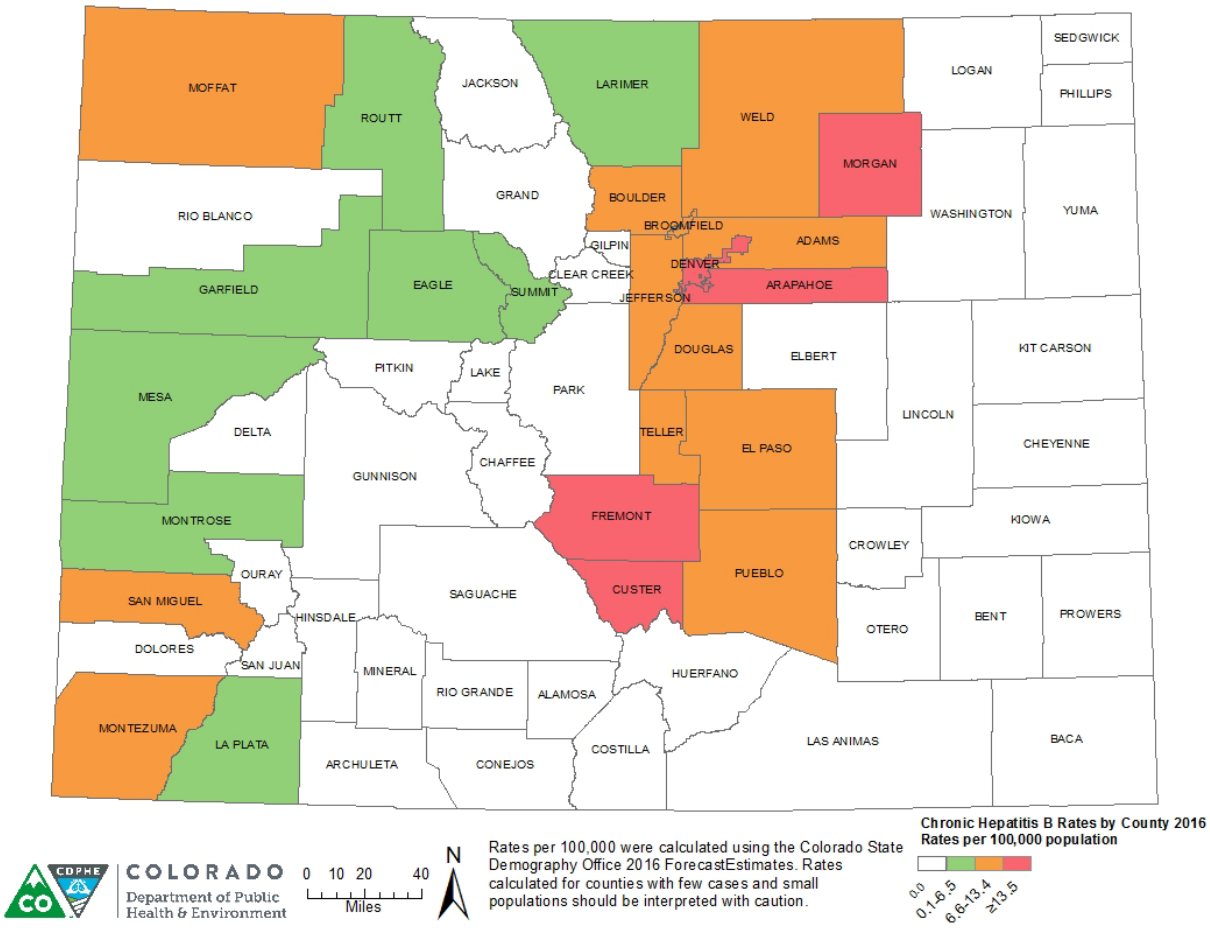
infection than Whites and Hispanics/Latinos. Asian/Pacific Islanders and Native Americans/Alaska Natives did not have substantial sample size to be analyzed in their own group. People born outside of the U.S. had a rate that was five times higher than U.S.-born survey participants.[29]

Geographic distribution

Figure B.11 shows chronic hepatitis B rates by county and Table B.2, in the appendix, describes the distribution of acute and chronic hepatitis B cases by county of residence. Chronic hepatitis B cases were reported in 25 of the 64 Colorado counties in 2016. Counties without reported cases were more likely to be frontier counties (rural areas sparsely populated that are isolated from population centers and services). There were 15 chronic cases reported from inmates in state prisons in Colorado. If a person reported with hepatitis is incarcerated in a county jail, that case is assigned to the county of the jail location; however, if a case is identified in a state or federal prison, a county is not assigned. These cases are designated as CDOC for state prisons and FBP for federal prisons. The 9 of the 15 incarcerated hepatitis B chronic cases reported in 2016 were in the CDOC and the remaining 6 were in the FBP. The rates of reported cases are high is some of the rural counties. These high rates may reflect a true burden of hepatitis B in these counties, however, the number of cases can be small and should be interpreted with caution. Quantile ranges in Figure B.11 were determined using the Natural Breaks (Jenks) method in ArcGIS.

[29] Wasley A, Kruszon-Moran D, Kuhnert W, et al. The prevalence of hepatitis B infection in the United States in the era of vaccination. J Inf Dis 2010;202(2):192-201.

Figure B.11: Reported Chronic Hepatitis B Rates by County, Colorado 2016



Behavioral risk factors

Eighty-three percent of chronic cases are missing information about IDU behavior. Foreign-born is the most common risk factor for chronic cases reported in Colorado (n=133). A hepatitis B case can report more than one risk factor.

Perinatal hepatitis B

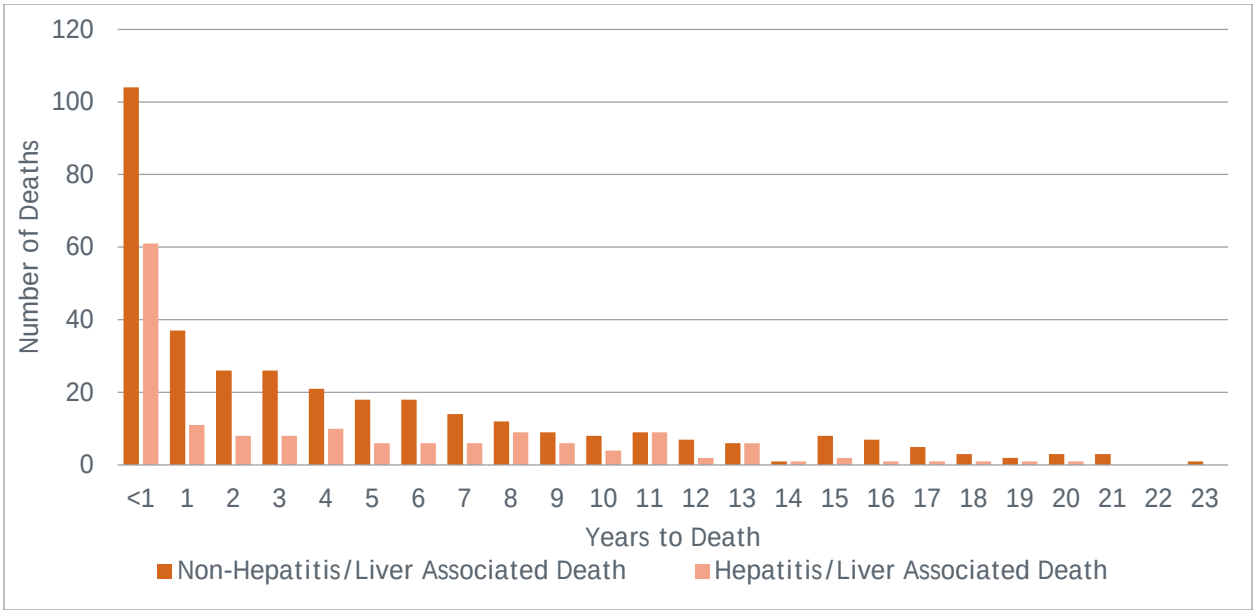
There were zero perinatal hepatitis B cases reported in Colorado in 2016. CDPHE had 154 women total enrolled in the Perinatal Hepatitis B Prevention Case Management Program in the same time period. Of those 154 women, 67 had never before been enrolled in the program.

Deaths among people with hepatitis B

The national rate of hepatitis B-related deaths as the underlying cause has remained stable in the past five years and was 0.45 per 100,000 population in 2015.[30] Colorado specific death rates for hepatitis B are not presented because of the estimates being too small and unreliable.

The CEDRS surveillance includes diagnosis date of hepatitis B for reported cases, however, death certificate data does not provide a date of hepatitis diagnosis. Conversely, CEDRS disease reports for hepatitis B may be missing death information for some cases and do not include the cause of death. For those cases which matched to vital statistics death data (n=508), the median time between first known report of hepatitis B and death was three years for non-hepatitis/liver associated deaths and two and a half years for hepatitis/liver associated deaths, shown in Figure B.12.

Figure B.12: Timing of Mortality Among Hepatitis B Cases with Date of Death, Colorado Hepatitis B Cases Reported 1993-2016



Among these hepatitis B cases with known date of death, the median age at death from all causes was 55 years of age, versus a life expectancy of 75.5 to 78.8 years of age for the general population during a similar time period (1993-2014).31,32 Even though all of these deaths are not attributable to hepatitis B, it strongly suggests that people living with hepatitis B have health complications and comorbidities that create a significant health burden.

[30] Centers for Disease Control and Prevention. Viral hepatitis surveillance: United States 2015. Atlanta, GA.
[31] National Center for Health Statistics. Vital statistics of the United States, 1993, preprint of vol II, mortality, part A sec 6 life tables. Hyattsville, Maryland. 1997.
[32] National Center for Health Statistics. Health, United States, 2015: With Special Feature on Racial and Ethnic Health Disparities. Hyattsville, MD. 2016.

Hepatitis C in Colorado

- CDPHE receives approximately 3,000-4,000 new reports of chronic hepatitis C each year, and these numbers are increasing. In addition, approximately 25 to 40 cases of acute hepatitis C are reported annually. These numbers are much lower than actual infections due to underreporting. CDC estimates there are 13.9 actual acute infections for each acute case reported.
- Due to limited testing data in Colorado, it is unclear how many individuals have been screened for HCV and whether those who should be tested **are** tested. More hepatitis C cases are reported in males, but from available laboratory data, more females are tested for the virus.
- People born between 1945 and 1965 historically and currently represent most of chronic HCV cases.
- Data about risk behaviors is incomplete, but prison inmates and people who inject drugs are at the highest risk for acute hepatitis C infection. Most acute hepatitis C cases are related to injection drug use.
- Both urban and rural counties in Colorado are affected by hepatitis C. Rural counties sometimes have higher rates.
- Mortality due to hepatitis C is increasing in Colorado, particularly among people born between 1945 and 1965.

Background

Hepatitis C virus is a bloodborne illness that can occur as acute or chronic infection. It is a contagious liver disease that mainly spreads through contact with blood and 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, oftentimes without symptoms. When symptoms do occur, they include fever, fatigue, lack of appetite, nausea, vomiting, dark urine, grey-colored stool, joint pain, and jaundice (yellowing of the skin and eyes), and symptoms of decompensated liver disease in advanced cases.[33]

Hepatitis C is one of the most commonly reported infectious diseases worldwide and is the single most common bloodborne pathogen in the U.S.[34] Hepatitis C-associated mortality is increasing in the U.S. and has surpassed the 60 other nationally notifiable infection conditions combined.[35] Hepatitis C accounts for almost 20,000 annual

[33] American Liver Foundation, The progression of liver disease. Accessed at http://www.liverfoundation.org/abouttheliver/info/progression/ on December 28, 2016.
[34] Zibbell JE, Iqbal K, Patel RC, et al. Increases in Hepatitis C virus infection related to injection drug use among people aged <30 years – Kentucky, Tennessee, Virginia, and West Virginia, 2006-2012. MMWR Morb Mortal Wkly Rep 2015;64:453-8.
[35] Ly KN, Hughes EM, et al. Rising mortality associated with hepatitis C virus in the United States, 2003-2013. Clin Infect Dis 2016;62(10):1287-8.

deaths in the United States.[36] Viral hepatitis, of which hepatitis C is the most common type, has surpassed HIV to become the seventh leading cause of death worldwide.[37] Hepatitis B and hepatitis C cause an estimated 61 percent of U.S. hepatocellular carcinoma[38], the most common form of liver cancer. Liver cancer is the fastest rising cause of cancer deaths in the U.S., with a tripling of incidence since the early 1980s.[39]

Hepatitis C is preventable and curable. Newly available antiviral treatments for chronic hepatitis C can cure infection, with sustained virologic response in more than 95 percent of patients, with few associated side effects.[40] However, barriers to prevention and treatment of viral hepatitis persist.

HCV is transmitted through contact with infected blood, such as sharing injectable drug equipment, blood monitoring devices, razors, tattoo equipment, or other sharps that can contain blood. HCV is less commonly spread through sexual contact or from mother to child. Approximately 5 to11 percent of infants born to HCV-infected mothers will become infected, with rates in the higher range when the mother is also infected with HIV.[41] Currently, those at greatest risk of contracting HCV are PWID.[42]

Acute hepatitis C

Acute hepatitis C is the first stage of infection and may cause symptoms within 2 to 26 weeks after exposure to the virus. Approximately 70 to 80 percent of people with acute hepatitis C do not have symptoms, and most do not know they are infected.43 If symptoms occur, they may include fever, fatigue, loss of appetite, nausea, vomiting, abdominal pain, dark urine, clay-colored bowel movements, joint pain and jaundice (yellow color in the skin or eyes). Abnormal liver function tests are one of the most characteristic features of hepatitis C infection. CDPHE uses case definitions published by the NNDSS to define an acute case of hepatitis C. The acute hepatitis C case definition was updated in 2016. These case definitions can be found at https://wwwn.cdc.gov/nndss/conditions/hepatitis-c-acute/case-definition/2016/.

[36] Centers for Disease Control and Prevention. Viral hepatitis surveillance: United States 2015. Atlanta, GA.
[37] Stanaway JD, Flaxman AD, Naghavi M, et al. The global burden of viral hepatitis from 1990 to 2013: findings from the Global Burden of Disease Study 2013. Lancet 2016;388(10049):1081-8.
[38] National Academies of Sciences, Engineering, and Medicine. 2016. Eliminating the public health problem of hepatitis B and C in the United States: Phase one report. Washington, DC: The National Academies Press. doi: 10.17226/23407.
[39] El-Serag HB and Kanwal F. Epidemiology of hepatocellular carcinoma in the United States: Where are we? Where do we go? Hepatology 2014;60(5):1767-1775.
[40] Feld JJ, Jacobson IM, et al. Sofosbuvir and Velpatasvir for HCV genotype 1, 2, 4, 5, and 6 infection. N Engl J Med 2015;373(27):2599-607.
[41] Benova L, Mohamoud YA, et al. Vertical transmission of hepatitis C virus: systematic review and meta-analysis. Clin Infect Dis 2014;59(6):765-73.
[42] National Academies of Sciences, Engineering, and Medicine. 2016. Eliminating the public health problem of hepatitis B and C in the United States: Phase one report. Washington, DC: The National Academies Press. doi: 10.17226/23407.
[43] Centers for Disease Control and Prevention. Hepatitis C FAQs for the Public. Accessed at https:\\www.cdc.gov\hepatitis\hcv\cfaq.htm#cFAQ45 on August 15, 2017.

Chronic hepatitis C

The screening test for HCV is an antibody test that, if positive, could represent a past or present case of hepatitis C. An estimated 15 to 25 percent of people clear the virus spontaneously, while the remainder will develop chronic infection. Hepatitis C often is asymptomatic until later stages of disease and can result in liver fibrosis, cirrhosis, cancer and death. Of people who live with unresolved chronic hepatitis C, chronic liver disease develops in approximately 60 to 70 percent; 5-20 percent will develop cirrhosis over a period of 20-30 years, and 1 to 5 percent will die from cirrhosis or liver cancer.44 Since symptoms may not appear, only about half of those with chronic hepatitis C are aware of their infection.45 The case definition for chronic hepatitis C was updated in 2016. The 2016 case definition defines a new chronic case as an incident chronic hepatitis C case that meets the case criteria for chronic hepatitis C and has not previously been reported. The case definition can be found at https://wwwn.cdc.gov/nndss/conditions/hepatitis-c-chronic/case-definition/2016/

Hepatitis C prevalence estimate

Estimating the number of people living with hepatitis C in Colorado is challenging for a number of reasons, including limitations in case ascertainment (see the section "Hepatitis surveillance," above) and public health surveillance systems: Colorado's surveillance system does not sufficiently track how many people have resolved hepatitis C infection or died, therefore, surveillance case numbers are not used to estimate the number of Coloradans who are currently living with chronic hepatitis infection.

Several mechanisms are being utilized to address this critical gap: first, the Center for Disease Analysis (CDA) has been developing a model to estimate the incidence and prevalence of hepatitis C in Colorado.[add reference] This model provides valuable information about hepatitis C epidemiology in Colorado, although it is highly sensitive to the quality of data inputs and results may change as better information becomes available for modeling. Second, the Colorado Health Institute (CHI) has been developing a report based on insurance claims data from the Colorado APCD. This analysis also provides additional hepatitis C insights, but likewise has significant constraints including missing claims data and time lag in claims submissions. With findings from CDA and CHI investigations, CDPHE will be in an improved position to generate a substantiated, stable prevalence of hepatitis C infection in the state. Towards this end, CDPHE will be adding to the modeling and APDC analysis work with an update of NHANES-derived prevalence estimates, similar to the methodology used in the 2015 CDPHE Viral Hepatitis Surveillance Report[46] but incorporating more recent NHANES data and more sophisticated age stratification to adjust for Colorado-specific demographics. With all of these pieces, CDPHE will follow the current surveillance report with an in-depth analysis of hepatitis C prevalence estimation methodology and conclusions.

[44] Centers for Disease Control and Prevention. Hepatitis C FAQs for the Public. Accessed at https:\\www.cdc.gov\hepatitis\hcv\cfaq.htm#cFAQ45 on August 15, 2017.
[45] Stanaway JD, Flaxman AD, Naghavi M, et al. The global burden of viral hepatitis from 1990 to 2013: findings from the Global Burden of Disease Study 2013. Lancet 2016;388(10049):1081-8.
[46] Colorado Department of Public Health and Environment. 2015 Surveillance Report Viral Hepatitis in Colorado. Denver, CO. January 2017. https://www.colorado.gov/pacific/cdphe/hepatitis-data

Cumulative case reports of hepatitis C

From 1993 through 2016, a total of 591 acute and 100,629 chronic hepatitis C cases were reported into CEDRS. Detection of whether an hepatitis C case is acute or chronic has not been consistent over the years due to lack of adequate funding support to follow-up on positive laboratory reports; therefore, some hepatitis C cases may be misclassified as chronic when they are, in fact, acute. Figures C.12 and C.19 shows acute and chronic hepatitis C cases reported in Colorado by year. The number of acute hepatitis C cases declined initially and has fluctuated between 23 and 42 cases reported annually in the past five years. Nationally, the number of acute hepatitis C cases has increased every year from 2011 and 2015.47 Chronic hepatitis C cases in Colorado increased to a high in 2000; then declined until 2011, but in recent years the number of reported cases has been increasing.

Hepatitis C epidemiology

In Colorado in 2016, a total of 41 acute cases and 4,865 chronic cases of hepatitis C were reported. Table C.1, in the appendix, describes the distribution of reported cases by case status, gender, age and race/ethnicity. Case counts of hepatitis only include those that are reported into national and state surveillance systems and, as such, are known to be under-counted. Applying published multipliers to adjust for under-ascertainment and under-reporting[48] to the 41 acute hepatitis C cases reports in 2016, we estimate Colorado actually had 504 acute hepatitis C cases in 2016.

Colorado's reported acute hepatitis C rate is similar to that of the U.S., with 0.7 per 100,000 population in Colorado in 2016 versus 0.8 per 100,000 population nationally in 2015. However, reporting practices vary across states and direct comparison of rates may be misleading. The Healthy People 2020 objective is to reduce new (acute) hepatitis C infections to at least 0.25 cases per 100,000 population.[49] Nationally, however, the rate has been increasing since 2011. In the U.S. there has been a nearly twofold increase in number of acute hepatitis C cases, from 1,232 reported cases in 2011 to 2,436 reported cases in 2015.[50]

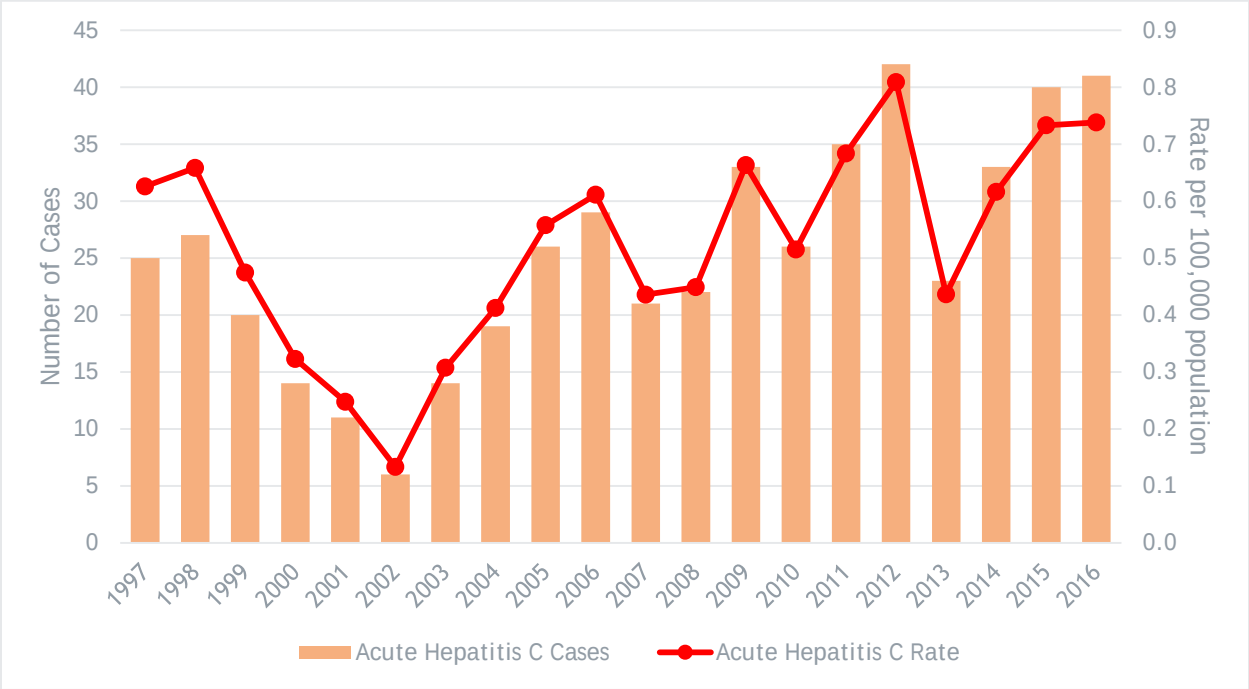
Chronic hepatitis C disproportionately affects people born between 1945 and 1965 (who likely were exposed before HCV was discovered in 1989), Non-Hispanic Blacks, and people in jail and prison. Nationally, CDC estimates that although people born between 1945 and 1965 comprise 27 percent of the population, they account for 65 to 70 percent of all hepatitis C cases in the U.S.[51,52] The rate of antibody-positive HCV is 3.5 percent in this birth cohort compared to 1.3 percent for the general

[47] Centers for Disease Control and Prevention. Viral hepatitis surveillance: United States 2015. Atlanta, GA.
[48] Klevens MR, Liu S, Roberts H, et al. Estimating acute viral hepatitis infections from nationally reported cases. Am J Public Health 2014;104:482-7.
[49] Healthy People 2020 Objectives, https://www.healthypeople.gov. Accessed September 20, 2016.
[50] Centers for Disease Control and Prevention. Viral hepatitis surveillance: United States 2015. Atlanta, GA.
[51] Centers for Disease Control and Prevention. Recommendations for the Identification of Chronic Hepatitis C Virus Infection Among Persons Born During 1945–1965. *MMWR 61*(RR04), 1-18.
[52] Ditah I, Ditah F, et al. The changing epidemiology of hepatitis C virus infection in the United States: National health and nutrition examination survey 2001 through 2010. J Hepatology 2014;60:691-8.

population.[53] CDC recommends that adults born between 1945 and 1965 should receive one-time testing for HCV without prior ascertainment of hepatitis C risk.[54] CDC also suggests other age groups with risk factors specific to hepatitis C should be tested.

Acute hepatitis C

Figure C.1: Reported Acute Hepatitis C Cases and Rate in Colorado, 1997-2016

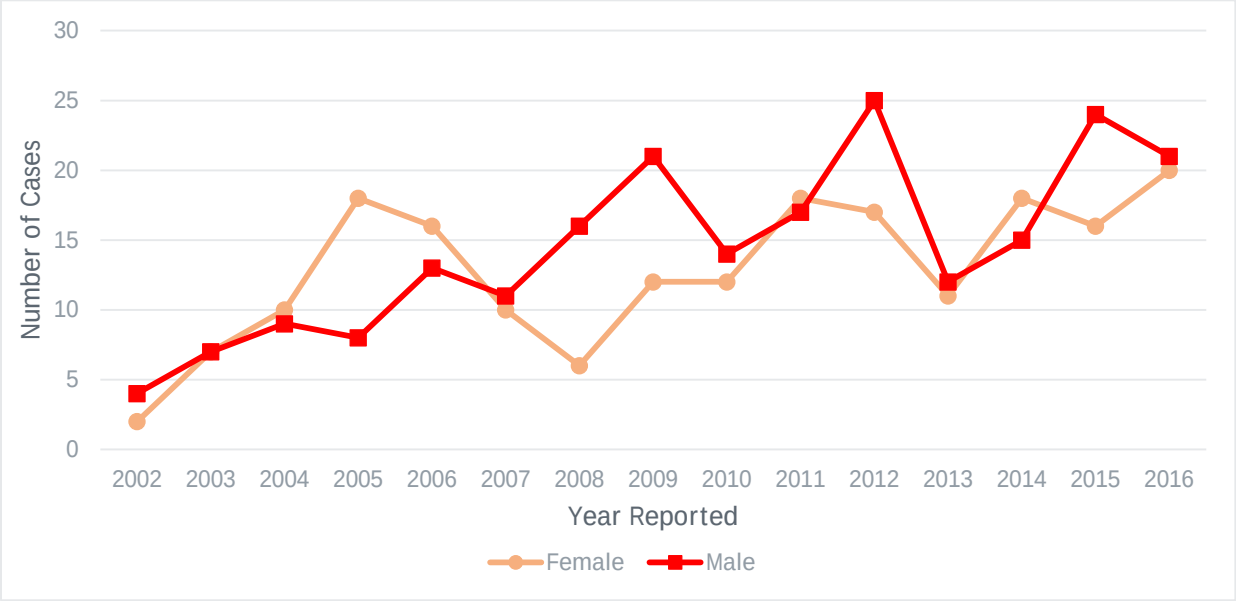


Gender

In 2016, a total of 41 acute cases of hepatitis C were reported in Colorado. More of the reported acute cases of hepatitis C were male (51.2%). Among cumulative acute cases reported from 1997 to 2016, 54.0 percent were men.

[53] Denniston MM, Jiles RB, Drobeniuc J, et al. Chronic hepatitis C virus infection in the United States, National Health and Nutrition Examination Survey 2003 to 2010. Ann Intern Med 2014;160(5):293-300.
[54] Centers for Disease Control and Prevention. Recommendations for the Identification of Chronic Hepatitis C Virus Infection Among Persons Born During 1945–1965. *MMWR 61*(RR04), 1-18.

Figure C.2: Reported Acute Hepatitis C Cases by Gender in Colorado, 2002-2016



Age

Table C.1, in the appendix, demonstrates that people aged 20 to 29 years had the highest number of reported acute hepatitis C cases in Colorado in 2016, representing 39.0 percent of all acute cases. The median age of acute hepatitis C cases at time of diagnosis was typically in the mid-30s, including 2016, except for 2014 and 2015, in which the median age was 27 years.

Figure C.3: Percent of Reported Acute Hepatitis C Cases by Age Group in Colorado, 2002-2016

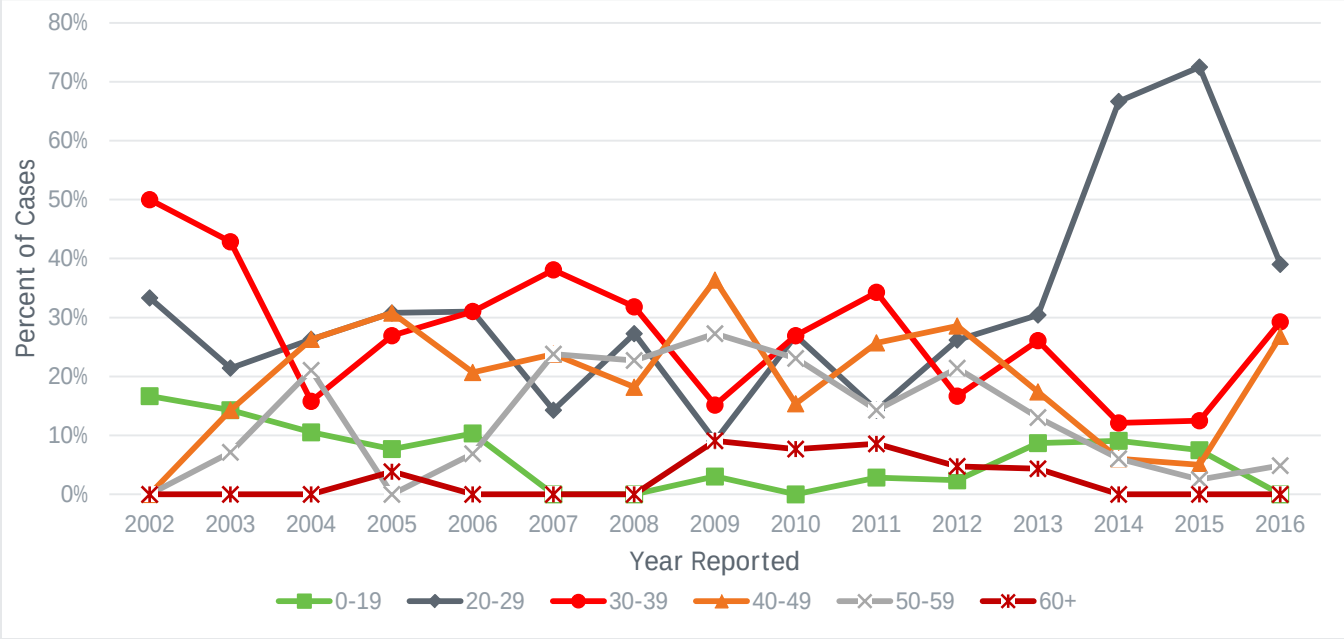
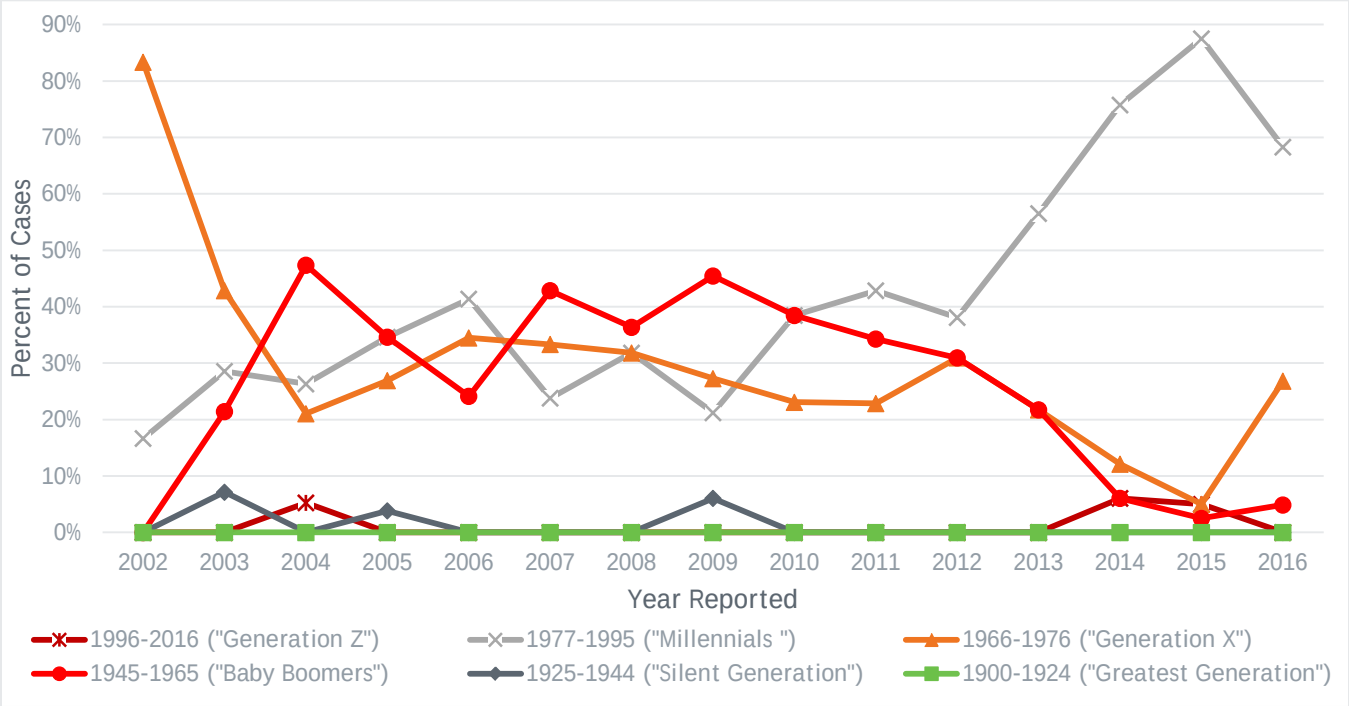


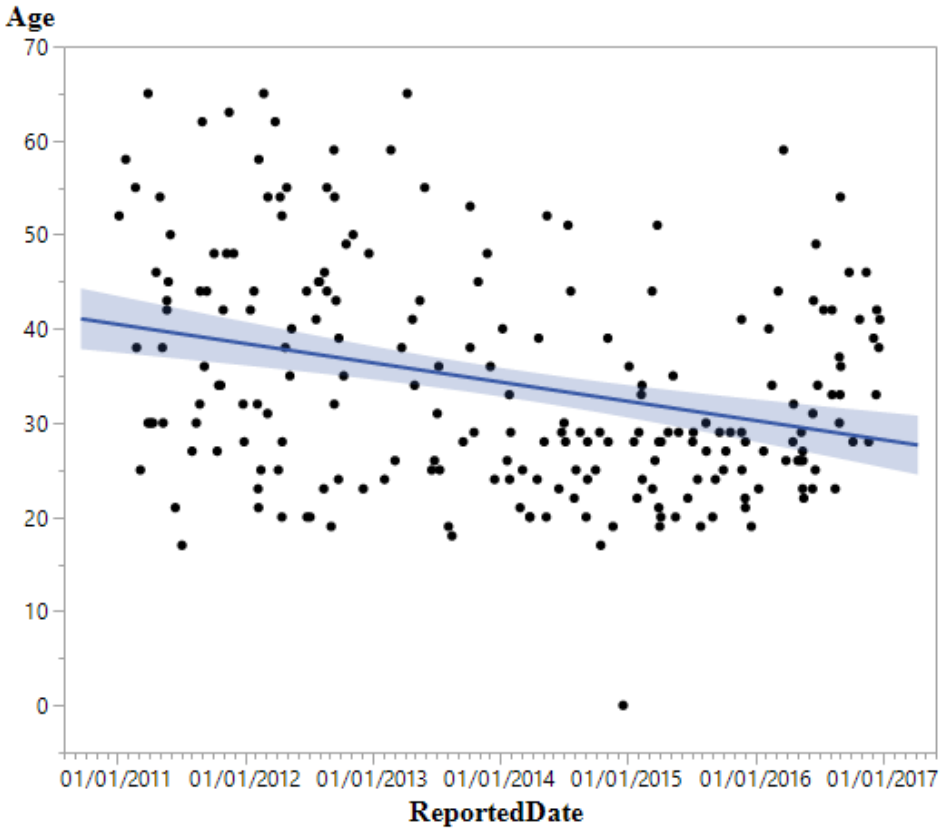
Figure C.4: Percent of Reported Acute Hepatitis C Cases by Birth Cohort in Colorado, 2002-2016



There are no definitive birth year ranges for the birth cohorts presented in this report and are for the purposes of this report only.
Note about birth cohorts; you can be born within three years on either side of the beginning or ending of a generation and have all the characteristics of the generation before or after. This has to do with a number of factors including the age of your parents, if you grew up in an urban or rural environment affluence and more. Being raised in a military household can also change your generational identity.

As seen in Figure C.5, recent years have a larger concentration of youth (under 30). This was significant at the p=0.05 level and was consistent when broken out by gender.

Figure C.5: Bivariate Fit of Age by Reported Date, Acute Hepatitis C Cases, Colorado 2011-2016



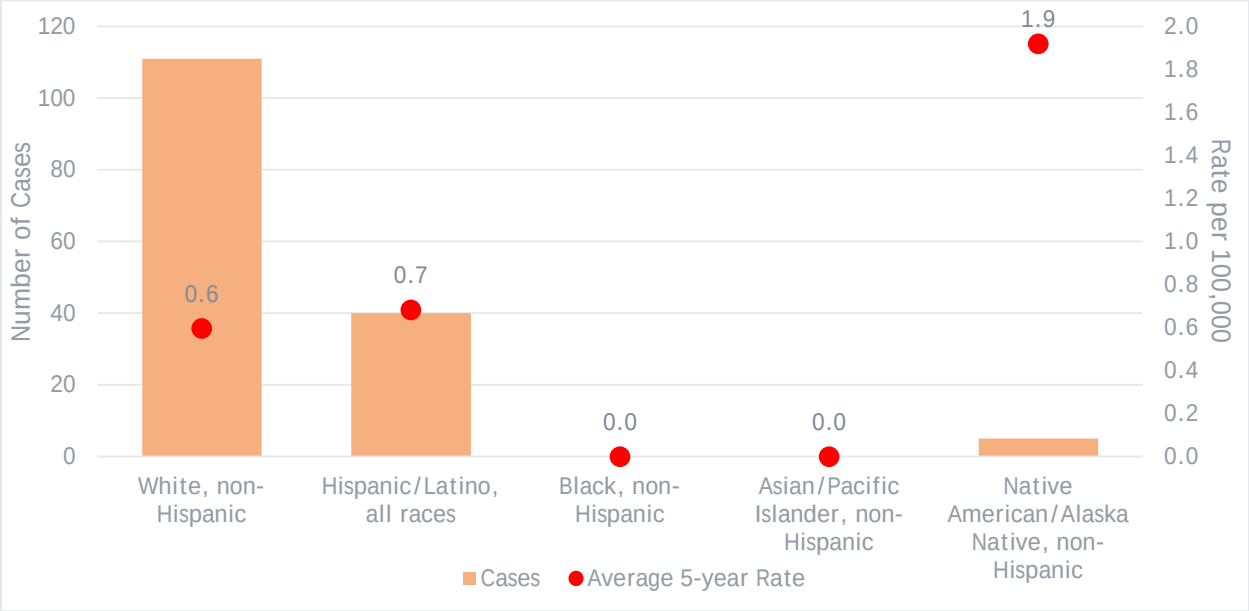
Race/ethnicity

As shown in Table C.1, in the appendix, data on race and ethnicity was missing or unknown for 9.5 percent of acute cases from 2012-2016. Among the reported cases that had race/ethnicity data available, Non-Hispanic Whites had the highest number of acute (n=111), followed by Hispanic/Latino (n=40).

Nationally, rates of acute hepatitis C have been consistently higher for Non-Hispanic Native Americans/Alaska Natives compared to all other racial/ethnic groups.[55] Data regarding race/ethnicity is incomplete with surveillance data and creates challenges in identifying health disparities for viral hepatitis.

[55] Centers for Disease Control and Prevention. Viral hepatitis surveillance: United States 2015. Atlanta, GA.

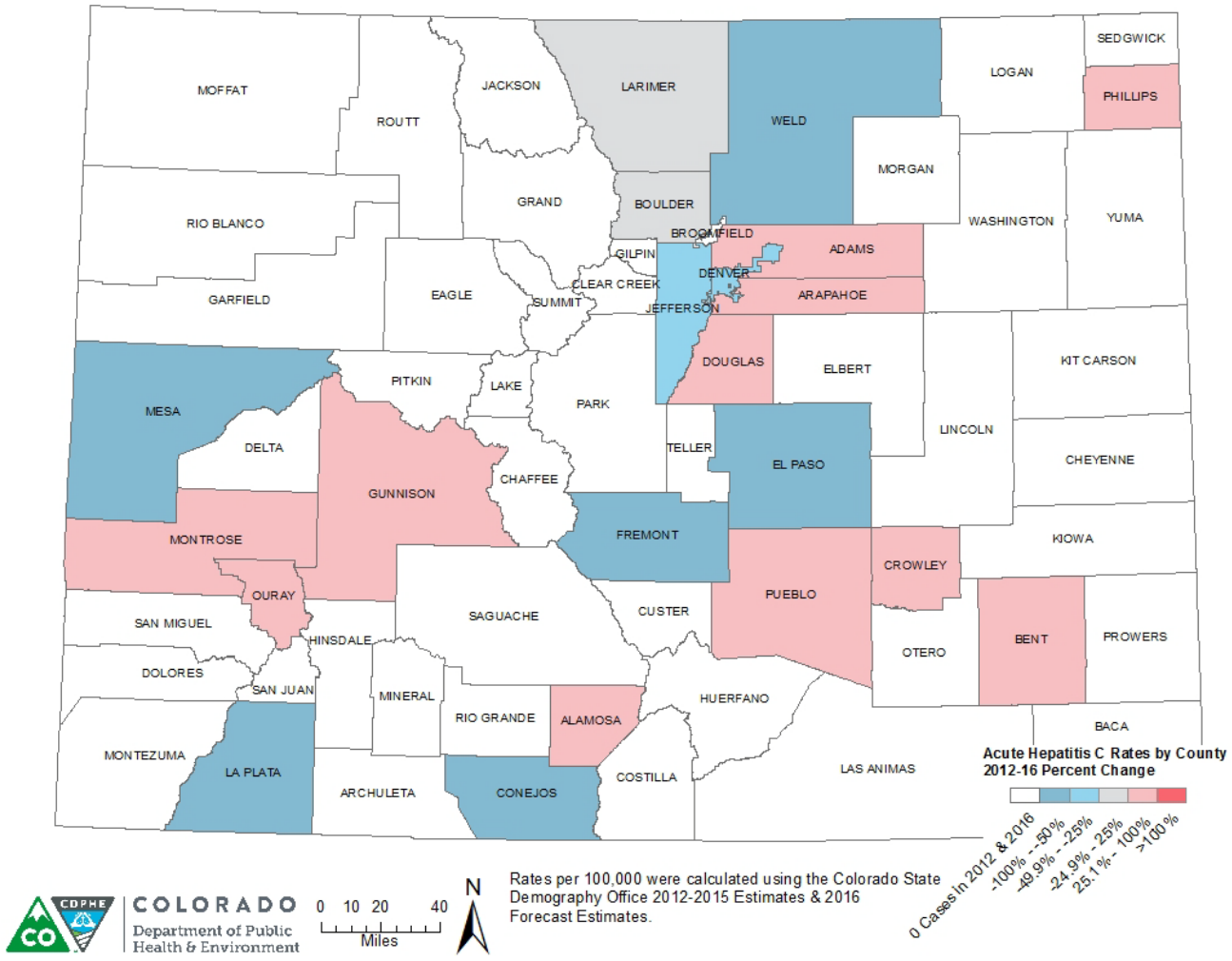
Figure C.6: Reported Acute Hepatitis C Cases by Race/Ethnicity in Colorado, 2012-2016



Geographic distribution

Figure C.7 shows the percent change in the rate of reported acute hepatitis C cases in 2016 compared to 2012 by county. Table C.3 describes the distribution of acute hepatitis C cases reported from 2012-2016 by county of residence. Acute hepatitis C was reported in 29 of the 64 Colorado counties. In addition, six acute cases were reported from inmates in state and federal prisons in Colorado. If a person reported with viral hepatitis is incarcerated in a county jail then that case is assigned to the county of the jail location, however, if a case is identified in a state or federal prison then a county is not assigned. These cases are designated as CDOC for state prisons and FBP for federal prisons (Additional information regarding hepatitis C and incarcerated populations is detailed below; see "Addressing viral hepatitis in Colorado"). There are six counties with at least 5 percent of reported acute hepatitis C cases (Figure C.17, in the appendix) that are also the counties with the highest general population. These are Arapahoe (5.7%), Larimer (6.2%), Jefferson (6.7%), El Paso (12.0%), Pueblo (12.0%), and Denver (18.7%). The rates of reported cases are high in some of the rural counties. These high rates may reflect a true burden of hepatitis C in these counties; however, the number of cases can be small and should be interpreted with caution.

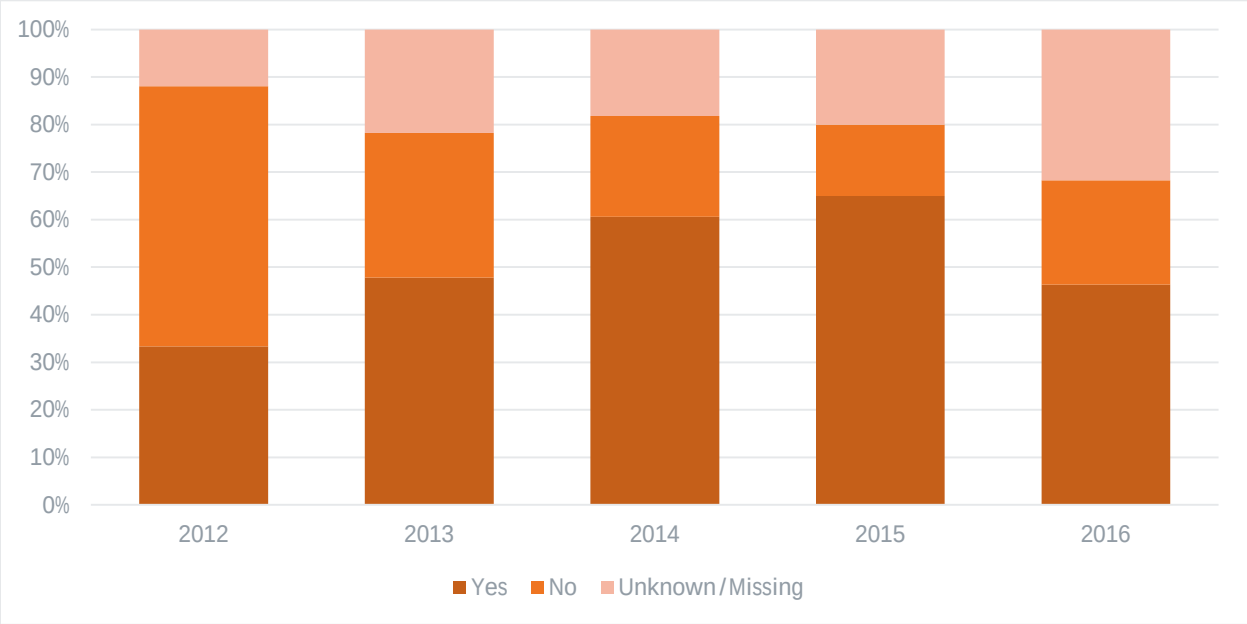
Figure C.7: Percent Change of Reported Acute Hepatitis C Rates by County, Colorado 2012 to 2016



Behavioral risk factors

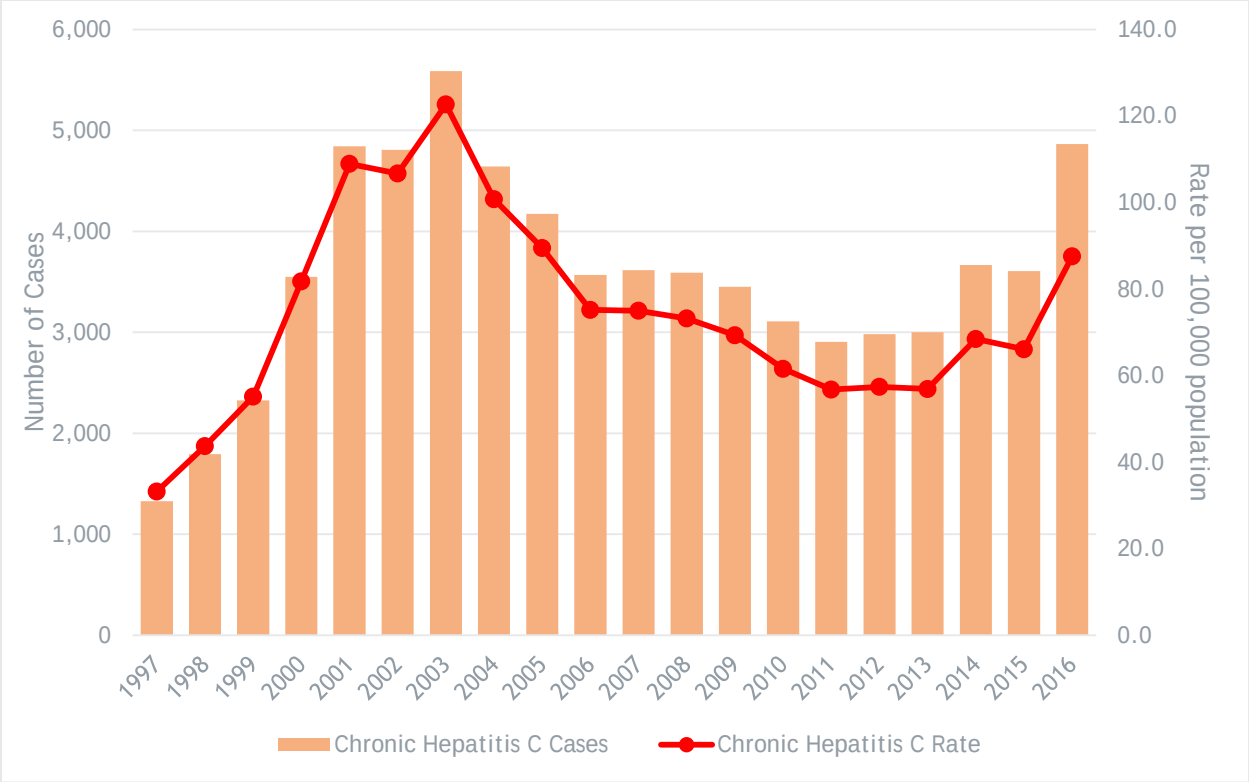
Twenty percent of 2012-2016 acute cases are missing or reported unknown IDU behavior. IDU is the most commonly reported risk factor for acute (n=90) hepatitis C. As shown in Table C.4, this represents 50.3 percent of all reported acute cases from 2012-2016. However, when considered using only case reports with complete information, IDU is the identified risk factor in 67.2 percent of acute cases (90/134). As Figure C.8 shows, the proportion of cases that report IDU behavior has been increasing from 2012 to 2015. There was a slight dip in 2016 corresponding with an increase in unknown IDU behavior. This increase in the proportion of unknown IDU behavior in 2016 is believed to be, in part, caused by a gap in staffing for case ascertainment of acute hepatitis cases at the beginning of 2016. A hepatitis C case can have more than one risk factor.

Figure C.8: Reported IDU for Acute Hepatitis C Cases Reported in Colorado, 2012-2016



Chronic hepatitis C

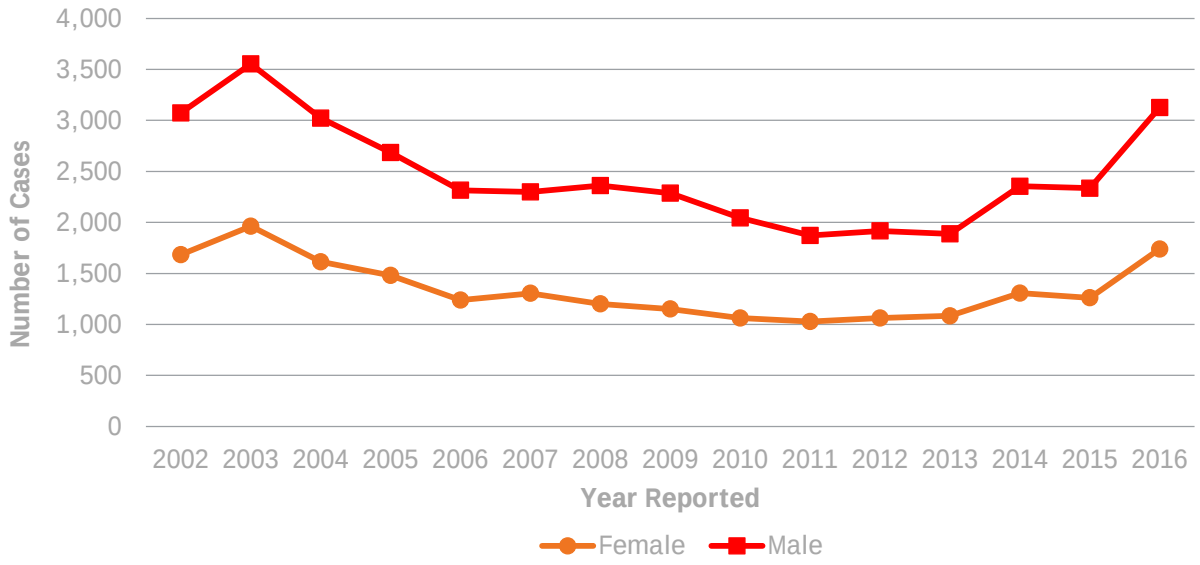
Figure C.9: Reported Chronic Hepatitis C Cases and Rate in Colorado, 1997-2016



Gender

In 2016, a total of 4,865 chronic cases of hepatitis C were reported in Colorado. More of the reported chronic cases of hepatitis C were male (64.3%). Among cumulative chronic cases reported from 1997 to 2016, 65.0 percent were men. Figure C.10 demonstrates that men are consistently reported with chronic hepatitis C more frequently than women.

Figure C.10: Reported Chronic Hepatitis C Cases by Gender in Colorado, 2002-2016



CDPHE receives summary numbers of HCV antibody and RNA testing from two of the largest commercial laboratories. Although these laboratories are the largest in Colorado, they may not be representative of statewide testing. In 2015 these two labs conducted 66,246 screening tests of HCV antibody for which there was sufficient demographic information regarding gender and age. More tests were performed among women, 60.3 percent, than among men. But men had a higher rate of testing positive for the HCV antibody: 7.2 percent, compared to women, 3.2 percent. These data are limited because they are a subset of all screening, yet they indicate more testing of men would help identify cases of hepatitis C.

Age

Table C.1, in the appendix, demonstrates that people aged 50 to 59 years had the highest number of reported cases, representing 24.0 percent of chronic cases in 2016. This age group also had the highest rate of chronic hepatitis C at 156.8 reported cases per 100,000 population. The proportions of chronic hepatitis C cases by age group have changed over time and are shown from 2002 to 2016 in Figure C.11. The proportion of cases in people aged 40 to 49 years have been declining with a slight increase from 2015 to 2016. The proportion of cases in people aged 30 to 39 years declined until the past five years, when it started to increase. Meanwhile, the

proportion of cases in people aged 20 to 29 years were fairly stable until it started to increase in the past several years. The recent increase among cases in people aged 20 to 29 years, from 11.3 percent of all cases in 2012 to 17.4 percent in 2016 may be explained by earlier acquisition of infection (through IDU) or misclassification of reports, although a definitive cause has not been identified.

Figure C.11: Percent of Reported Chronic Hepatitis C Cases by Age Group in Colorado, 2002-2016

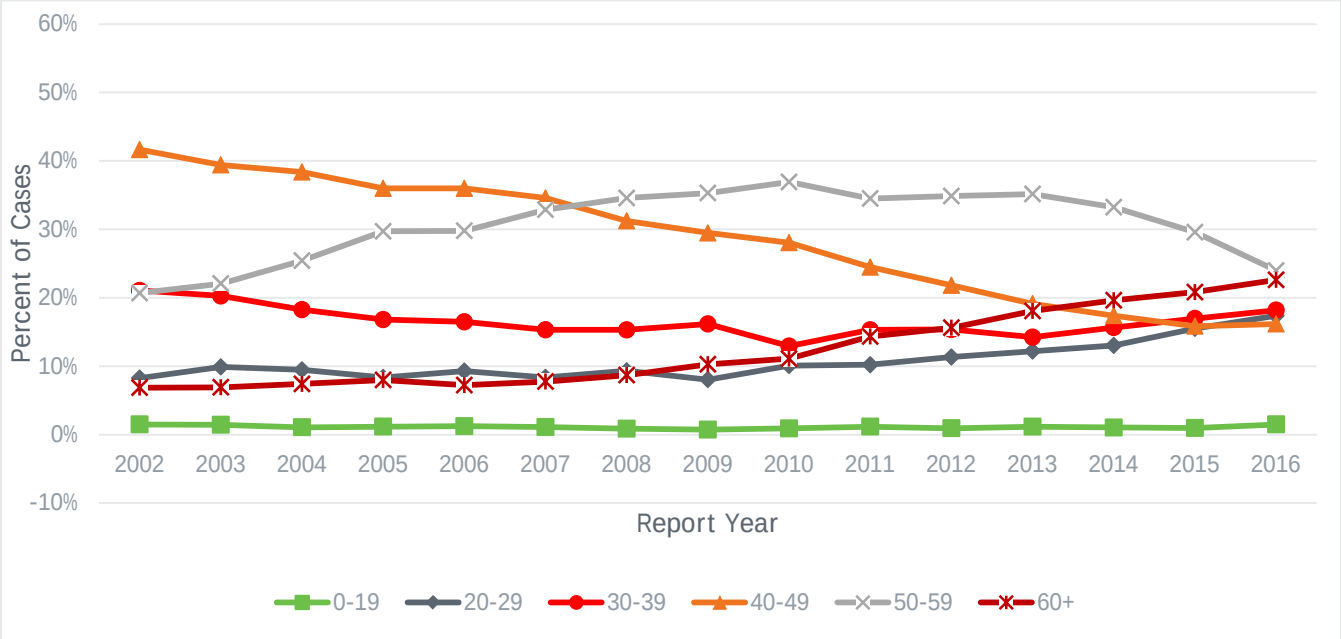
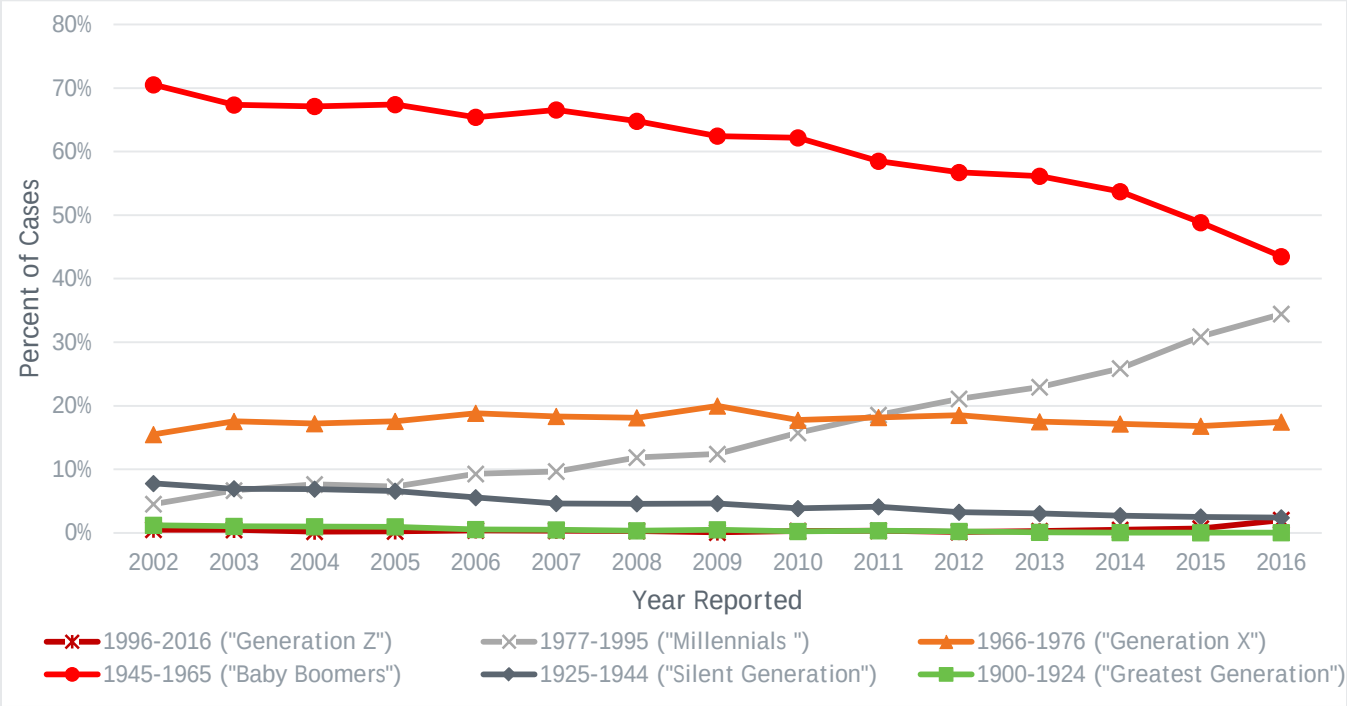


Figure C.12: Percent of Reported Chronic Hepatitis C Cases by Birth Cohort in Colorado, 2002-2016



There are no definitive birth year ranges for the birth cohorts presented in this report and are for the purposes of this report only.
Note about birth cohorts; you can be born within three years on either side of the beginning or ending of a generation and have all the characteristics of the generation before or after. This has to do with a number of factors including the age of your parents, if you grew up in an urban or rural environment affluence and more. Being raised in a military household can also change your generational identity.

Almost half, 43.5 percent (n=2,115 of 4,856 cases with available birth date), of chronic cases reported in 2016 and 65.6 percent (n=62,597 of 95,439 cases with available birth date) of cumulative reported chronic cases in Colorado were in people born between 1945 and 1965.

As with gender, data from the two largest commercial laboratories were available to the CDPHE by age category for 66,246 screening tests of HCV antibody in 2015. Almost a third of tests for women were performed among 25-to 34-year-old females of childbearing age. The rate of testing positive for the HCV antibody was highest for men ages 55-64 (13.6%) and 45-54 years (10.4%) and for women in the same age categories (7.6% and 6.0%, respectively). These data are limited because they are only a subset of all screening, but they indicate more testing of people aged 45-64 years would help identify cases of hepatitis C.

Race/ethnicity

As shown in Table C.1, in the appendix, data on race and ethnicity was missing or unknown for 77.6 percent of chronic hepatitis C cases. Among the reported cases that had race/ethnicity data available, Non-Hispanic Whites had the highest number of chronic cases (n=781), followed by Hispanics/Latinos (n=189). Hepatitis C rates were not calculated by race/ethnicity because this information is missing for so many cases.

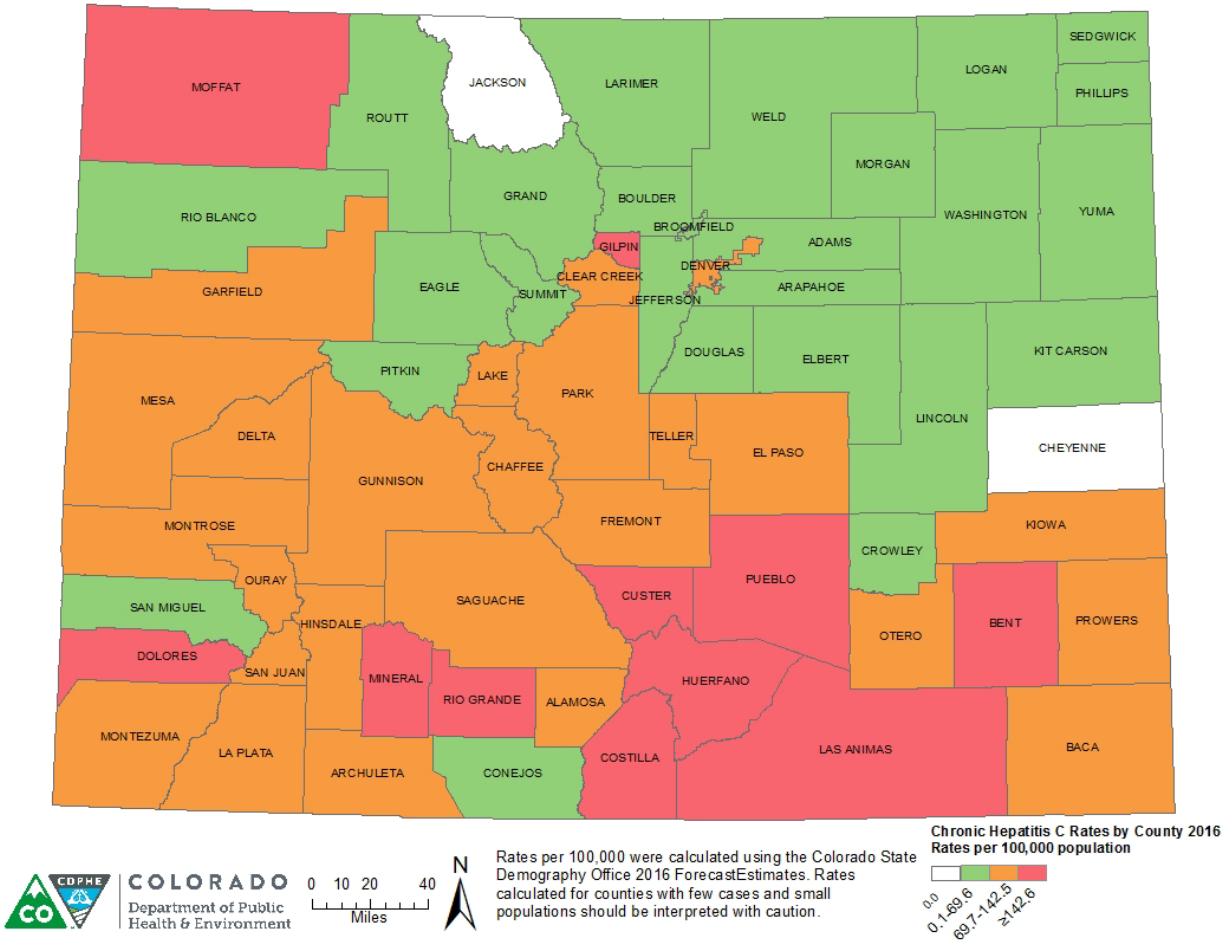
Nationally, chronic hepatitis C rates by race/ethnicity are not available; however, analysis of NHANES data from 2003-2010 found that Non-Hispanic Blacks were more likely to have chronic infection.[56] Data regarding race/ethnicity is incomplete with surveillance data and creates challenges in identifying health disparities for viral hepatitis.

Geographic distribution

Figure C.13 shows chronic hepatitis C rates by county for reported cases in 2016 and Table C.3, in the appendix, describes the distribution of chronic hepatitis C cases reported in 2016 by county of residence. Chronic hepatitis C was reported in 62 of the 64 Colorado counties. In addition, 592 chronic cases were reported from inmates in state and federal prisons in Colorado. If a person reported with viral hepatitis is incarcerated in a county jail then that case is assigned to the county of the jail location, however, if a case is identified in a state or federal prison then a county is not assigned. These cases are designated as CDOC for state prisons and FBP for federal prisons. Additional information regarding hepatitis C and incarcerated populations is detailed below (see "Addressing viral hepatitis in Colorado"). There are six counties with at least 5 percent of reported chronic hepatitis C cases (Figure C.19, in the appendix) that are also the counties with the highest general population. These are Pueblo (5.7%), Jefferson (6.3%), Adams (6.4%), Arapahoe (7.6%), El Paso (11.8%), and Denver (15.2%). The rates of reported cases are high in some of the rural counties. These high rates may reflect a true burden of hepatitis C in these counties; however, the number of cases can be small and should be interpreted with caution. Quantile ranges in Figure C.13 were determined using the Natural Breaks (Jenks) method in ArcGIS.

[56] Denniston MM, Jiles RB, Drobeniuc J, et al. Chronic hepatitis C virus infection in the United States, National Health and Nutrition Examination Survey 2003 to 2010. Ann Intern Med 2014;160(5):293-300.

Figure C.13: Reported Chronic Hepatitis C Rates by County, Colorado 2016



Behavioral risk factors

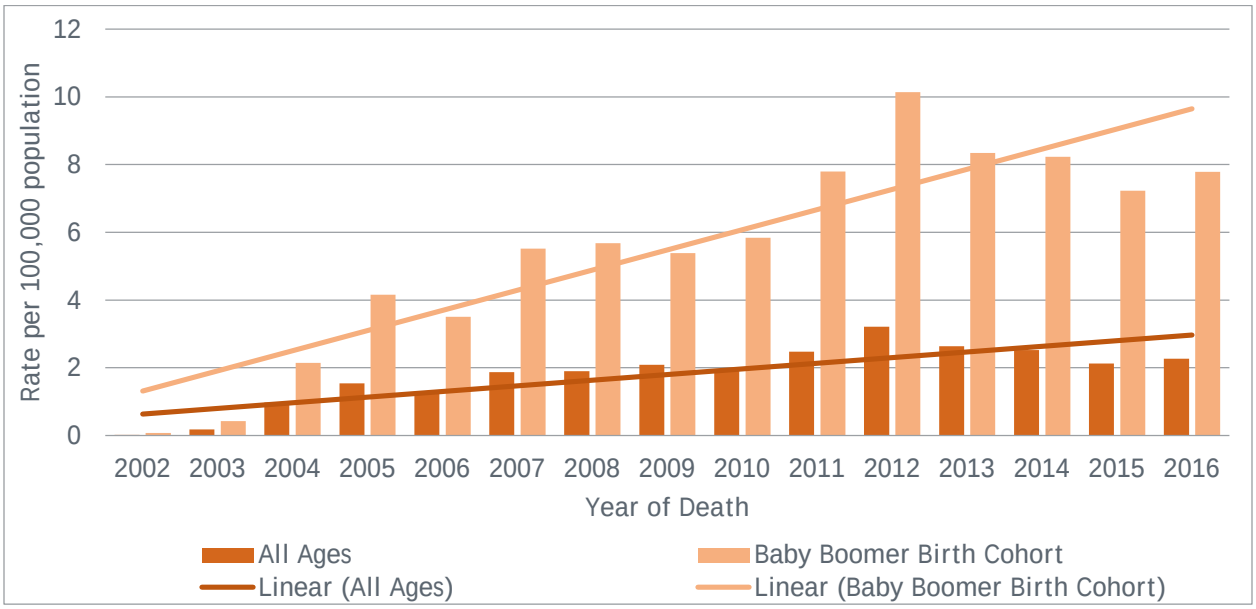
Ninety-seven percent of chronic cases are missing IDU behavior. IDU is the most commonly reported risk factor for chronic (n=117) hepatitis C. As shown in Table C.4, this represents 2.4 percent of all reported chronic cases in 2016. However, when considered using only case reports with complete information, IDU is the identified risk factor in 94.4 percent of chronic cases (117/124). A hepatitis C case can have more than one risk factor.

Deaths among people with hepatitis C

Figure C.14 shows that in Colorado, the hepatitis C mortality rate increased through 2012, particularly among people born between 1945 and 1965, then stayed relatively stable. Based on the single underlying cause of death reported on the death certificate, Coloradans had a hepatitis C (acute or chronic) mortality rate of 2.27 per 100,000 population in 2016, up from 0.02 per 100,000 in 2002. Trends in mortality for the 1945-1965 birth cohort is expected to increase as it ages; however, since rates of hepatitis C are higher in this birth cohort, hepatitis C mortality trends in this cohort were assessed. Coloradans in the 1945-1965 birth cohort had an increased hepatitis C mortality rate of 7.79 per 100,000 population in 2016, up from 0.07 per 100,000 population

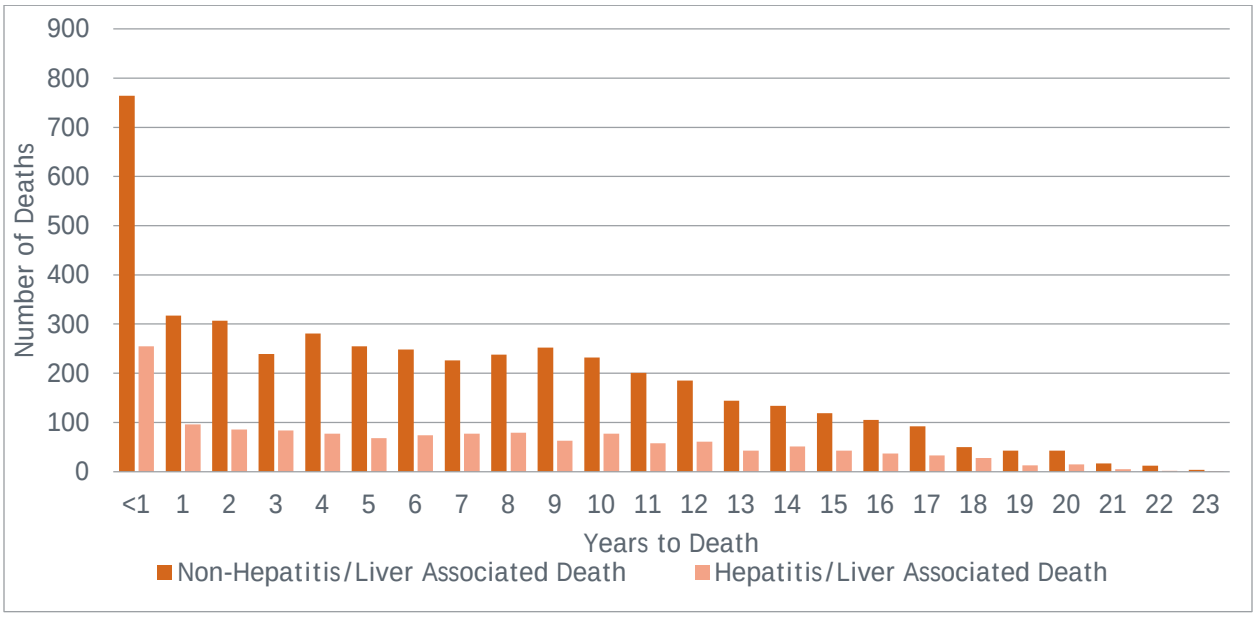
in 2002. These rates may be lower than actual rates because of missed or miscoding of underlying cause of death.

Figure C.14: Mortality Rate of Hepatitis C as Underlying Cause of Death by Year of Death, Colorado, 2002-2016



The CEDRS surveillance includes the diagnosis date of hepatitis C for reported cases; however, death certificate data does not provide a date of hepatitis diagnosis. Conversely, CEDRS disease reports for hepatitis C may be missing death information for some cases and do not include the cause of death. For those cases which matched to vital statistics death data (n=5,934), the median time between first known report of hepatitis C and death was six years for both those with a hepatitis/liver associated death and those with a non-hepatitis/liver associated death, shown in Figure C.15.

Figure C.15: Timing of Mortality among Hepatitis C Cases with Date of Death, Colorado Hepatitis C Cases Reported 1993-2016



Among these hepatitis C cases with known date of death, the median age at death from all causes was 50 years of age, versus a life expectancy of 75.5 to 78.8 years of age for the general population during a similar period (1993-2014).[57,58] Even though these deaths are not attributable to hepatitis C infection, it strongly suggests that people living with hepatitis C have health complications and comorbidities that create a significant health burden.

[57] National Center for Health Statistics. Vital statistics of the United States, 1993, preprint of vol II, mortality, part A sec 6 life tables. Hyattsville, Maryland. 1997.
[58] National Center for Health Statistics. Health, United States, 2015: With Special Feature on Racial and Ethnic Health Disparities. Hyattsville, MD. 2016.

Co morbidities with hepatitis

- Most of the subsequent hepatitis cases among B and C in 2012-2016 were diagnosed with a subsequent hepatitis B diagnosis after living with hepatitis C.
- There were 493 and 1,326 PLWHA diagnosed with hepatitis B and hepatitis C, respectively, in 2012-2016.
- Untreated hepatitis B and hepatitis C can lead to liver disease, liver cancer, and death. Nationally, rates of liver cancer are increasing, while rates for most other kinds of cancer have improved or reached a plateau.

Hepatitis B and hepatitis C co-infections

Hepatitis B and hepatitis C can have similar transmission routes, and both viruses can be infectious if present in blood. For those with a reported hepatitis C infection in Colorado, 61 had a subsequent hepatitis B diagnosis between the years 2012-2016. For those with a reported hepatitis B infection, 35 had a subsequent hepatitis C diagnosis in the same time period. From 2012-2016, 87 individuals were diagnosed with both hepatitis B and C within 30 days of each other. As of December 31, 2016, there were an estimated 644 people living in Colorado who were co-infected with hepatitis B and hepatitis C.

Hepatitis B and hepatitis C cases co-infected with HIV

HIV has some risk behaviors in common with both hepatitis B and hepatitis C, and co-infection with HIV and viral hepatitis commonly occur. Reported hepatitis B and hepatitis C cases from CEDRS were linked to the HIV cases reported into the enhanced HIV/AIDS Reporting System (eHARS). As of December 31, 2016, there were 493 people living with HIV/AIDS (PLWHA) with a diagnosis of hepatitis B and 1,326 PLWHA had a diagnosis of hepatitis C. The number of cases with a subsequent new HIV diagnosis, number of PLWHA with a subsequent new hepatitis diagnosis, or number of co-infections all in 2012-2016 are shown in Table D.2 in the appendix.

Liver cancer and hepatitis C

Liver cancer is the second most common cause of death from cancer worldwide[59] and the seventh largest cause in Colorado.[60] Rates of new liver cancer cases went up 38 percent in the U.S. from 2003-2012 and deaths increased 56 percent in this same period.[61] Although the overall cancer death rate in the U.S. has decreased 1.5

[59] National Academies of Sciences, Engineering, and Medicine. 2016. Eliminating the public health problem of hepatitis B and C in the United States: Phase one report. Washington, DC: The National Academies Press. doi: 10.17226/23407.

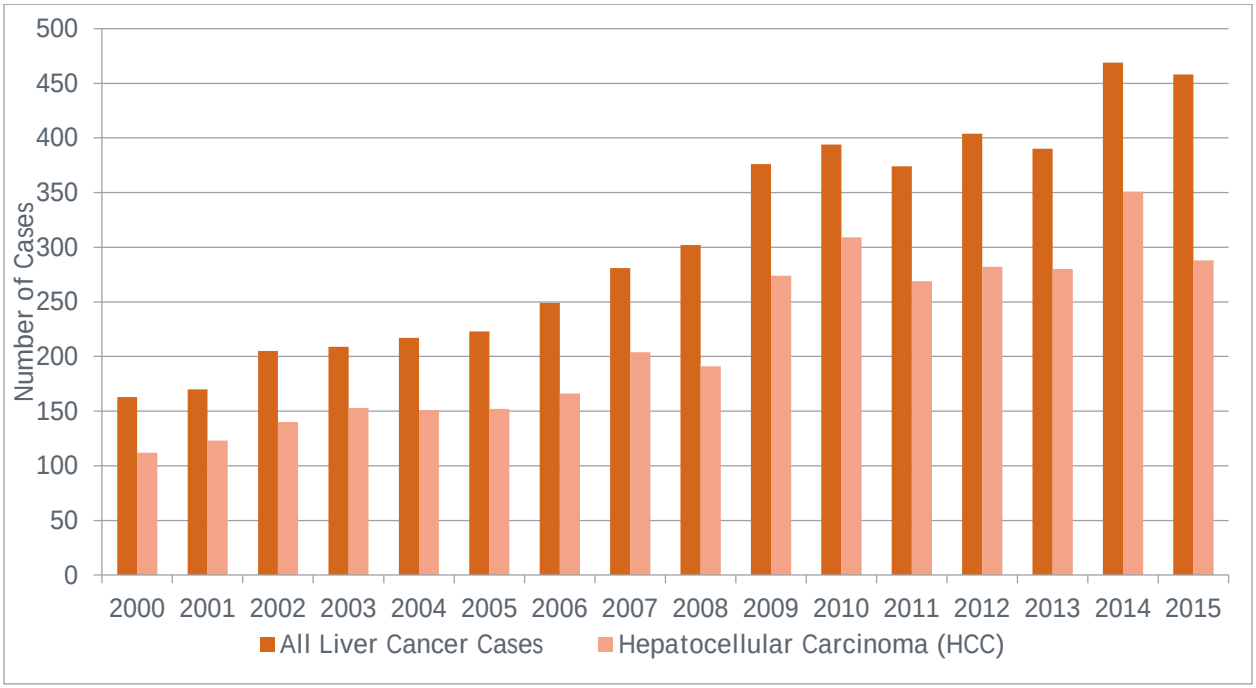
[60] Colorado Department of Public Health and Environment. Colorado Cancer Plan 2016-2020. Accessed at https://www.colorado.gov/pacific/sites/default/files/DC_cancer_Colorado-Cancer-Plan-2016-2020.pdf on December 28, 2016.

[61] U.S Cancer Statistics Working Group. United States Cancer Statistics: 1999-2013 Incidence and Mortality Web-based Report. Atlanta, GA: Department of Health and Human Services, Centers for Disease Control and Prevention, and National Cancer Institute; 2016. Accessed at http://www.cdc.gov/uscs on October 11, 2016.

percent per year from 2003 to 2012, deaths from liver cancer increased at the highest rate for all cancer sites, and incidence rates increased at the second highest rate.[62] The five-year survival rate for liver cancer and intrahepatic bile duct cancer was 18.5 percent in the U.S from 2007-2013.[63]

As shown in Figure D.1, the number of diagnosed liver cancers and HCC in Colorado has more than doubled in the period 2000 to 2015 (2.8 and 2.6, respectively).[64]

Figure D.1: Number of Liver Cancers and Hepatocellular Carcinoma By Year of Diagnosis, Colorado, 2000-2015



CDPHE matched reported cases of acute and chronic hepatitis C that were reported into CEDRS through 2014 to the Colorado Central Cancer Registry (CCCR). There was sufficient information to match almost 100,000 hepatitis C case records to 3,544 reports of HCC liver cancer. HCC is the predominant form of primary liver cancer. HCC was diagnosed among 1,532 individuals with reported hepatitis C. Of these linked cases, 80.4 percent were male. People born between 1945 and 1965 have the highest hepatitis C burden and are experiencing an increasing amount of hepatitis C-associated liver cancer and mortality[65]; 75.1 percent of the matched cases were in this birth cohort. The matched cases are likely an underestimate of the total number of liver cancers attributable to

[62] Ryerson AB, Eheman CR, et al. Annual report to the nation on the status of cancer, 1975-2012, featuring the increasing incidence of liver cancer. Cancer 2016;122(():1312-37.
[63] Howlader N, Noone AM, et al. SEER Cancer Statistics Review (CSR), 1975-2014. National Cancer Institute. Bethesda, MD, http://seer.cancer.gov/csr/1975_2014/, based on November 2016 SEER data submission, posted to the SEER web site, April 2017.
[64] Colorado Central Cancer Registry, Colorado Department of Public Health and Environment. pulled on June 27, 2017.
[65] Smith BD, Beckett PC, et al. Previous exposure to HCV among persons born during 1945-1965: prevalence and predictors, United States, 1999-2008. Am J Public Health 2014;104(3):474-81.

hepatitis C in Colorado. Matched cases only included hepatitis C cases reported into the statewide surveillance system. Particularly in earlier years, clinicians were less likely to test liver cancer patients for hepatitis C. Linkage of hepatitis B case reports and the CCCR has not yet occurred.

Addressing viral hepatitis in Colorado

- Injection drug use is the primary cause of new hepatitis C cases in Colorado and nationally.
- The incarcerated population has a greater prevalence of hepatitis than the general population.
- Healthcare exposures to HBV and HCV have declined dramatically since screening of blood banks began in the 1980s, but they still occur and can cause disease outbreaks.
- Eliminating hepatitis B and hepatitis C is feasible if key barriers are addressed. These include strengthening surveillance, expanding diagnosis, addressing new infections related to injection drug use, reaching poor and marginalized populations, including prison inmates, and improving access to direct-acting antiviral drugs for hepatitis C.

Populations of importance

People who inject drugs (PWID)

Today, IDU is the primary cause of new hepatitis C cases. From 2012-2016, half, 50.3 percent, of all reported acute hepatitis C cases in Colorado were among PWID in the previous six months, shown in Figure C.5. Since CDPHE attempts to follow up on all acute cases, risk behavior information is more complete for these cases; however, IDU behavior is still missing for 19.0 percent of acute cases in this time period. If cases with unknown IDU behavior are excluded from the proportions, then 51.1 percent of all acute cases in this period reported IDU. The proportion of cases that report IDU has increased from 33.3 percent in 2012 to 46.3 percent in 2016. Cases that report IDU can also report other risk behaviors, but is the most commonly reported risk behavior. Nationally, CDC also reports IDU as the most common risk behavior among 64.2 percent of acute HCV cases reported in 2015.[66]

The Center for Health and Environmental Data (CHED) at CDPHE recently produced a report on drug overdose deaths.[67] Nationally, and in Colorado, rates have increased steadily from 2000-2015. Age-adjusted rates in Colorado were significantly higher than national rates in almost every year over the 15-year period. In Colorado, age-adjusted rates doubled from 7.8 per 100,000 population in 2000 to 15.7 per 100,000 population in 2015. Opioid-related drug overdoses make up the largest proportion of total drug overdose deaths in Colorado; heroin-related drug overdoses specifically have increased the most. Drug overdoses are not all injection-related, but most heroin users are injecting.[68] Overdose deaths are frequently used as a marker of increased IDU activity.

[66] Centers for Disease Control and Prevention. Viral hepatitis surveillance: United States 2015. Atlanta, GA.
[67] Rosenthal A, Bol K, Gabella B. Examining opioid and heroin-related drug overdose in Colorado. Health Watch 2016; 100:1-10. Accessed at http://www.chd.dphe.state.co.us/Resources/pubs/Colorado-Opioid-and-Heroin-Overdose.pdf, on November 15, 2016.
[68] U.S. Department of Health and Human Services, National Institutes of Health. Epidemiologic Trends in Drug Abuse: Proceedings of the Community Epidemiology Work Group, volume 1, June 2009.

CDC, in collaboration with state and local health departments, initiated the National HIV Behavioral Surveillance (NHBS) to monitor risk behaviors among three risk populations: MSM, IDU and heterosexual adults. The NHBS has been conducted in Denver among PWID populations in 2006, 2009 and 2012. PWID are recruited via respondent-driven sampling, in which health department staff members select a small number of initial participants, or "seeds," who complete the survey and then recruit peers to participate until a target of 500 eligible people are recruited.

The NHBS survey data from Denver has found high usage of a non-sterile needle or syringe in the last 12 months, fluctuating from 73.0 percent in 2006, to 80.0 percent in 2009, to 64.5 percent in 2012.[69] HCV testing is recommended at least annually for people who currently inject drugs.[70] Although 87.8 percent of 2012 study participants reported ever being tested for HCV, only 38.0 percent reported being tested in the past year (note, some participants may already know they have hepatitis C and not test each year). About half of survey participants reported having ever been told they had hepatitis C by a healthcare professional: 51.3 percent in 2006; 49.8 percent in 2009; and 46.9 percent in 2012. In year 2009 only, participants were offered a standard HCV antibody test. Of the 430 participants in 2009, 395 provided a blood specimen to test for HCV antibody and 73.2 percent were HCV antibody positive.[71]

Estimating the number of PWID is of public health interest, but is challenging. One commonly used estimate of national prevalence is from a published article, which predicted that 2.6 percent (95% CI: 1.8%-3.3%) of the U.S. population aged 13 years and older (both males and females) have injected drugs at some point in their lifetime and 0.3 percent (95% CI: 0.19%-0.41%) have injected in the past year.[72] These estimates were derived from the review of multiple national population studies. Applying these published numbers to the Colorado population, there are an estimated 13,878 current PWID and 120,277 ever PWID, as shown in Table E.1.

It can be challenging to link PWID who test positive for HCV to care. PWID may not have insurance or stable housing, and may feel stigmatized by the healthcare system and not pursue follow-up care. Under Colorado law and local regulation, syringe exchange programs have been authorized in seven counties that have 11 sites within the state. These programs provide risk-reduction counseling services, HCV testing, safe disposal of used needles and syringes, and clean needles, syringes, cookers, cottons, and water. The programs are growing, and some sites are unable to keep up with the demand for clean needles and safe disposal of injection equipment. Syringe

[69] Denver Public Health. HIV Behavioral Surveillance in the Denver Metro Area: Understanding HIV risk and prevention behaviors among persons who inject drugs. 2014. Accessed at http://www.denverhealth.org/NHBS. on October 19, 2016.

[70] American Association for the Study of Liver Diseases, Infectious Diseases Society of America, and International Antiviral Society – USA. Recommendations for testing, managing, and treating hepatitis C. Accessed at http://www.hcvguidelines.org. on October 19, 2016.

[71] Denver Public Health. HIV Behavioral Surveillance in the Denver Metro Area: Understanding HIV risk and prevention behaviors among persons who inject drugs. 2014. Accessed at http://www.denverhealth.org/NHBS. on October 19, 2016.

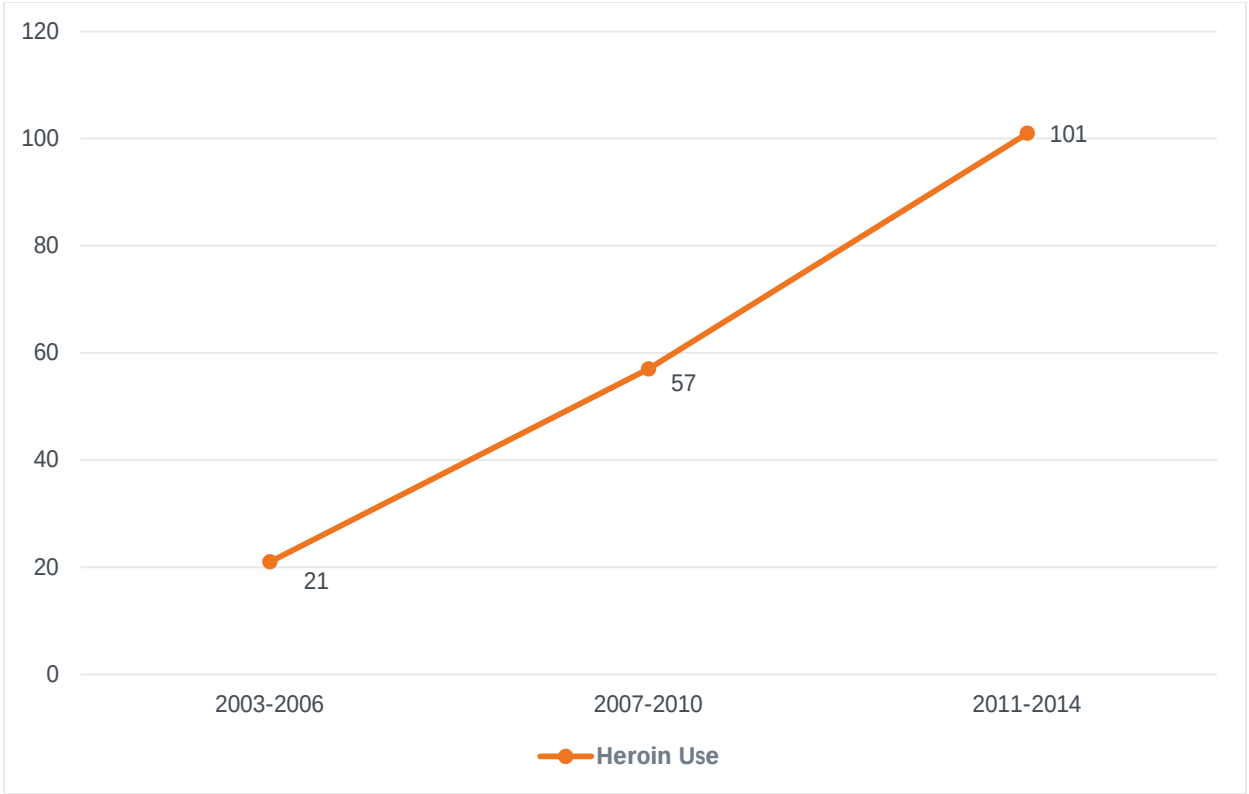
[72] Lansky A, Finlayson T, et al. Estimating the number of persons who inject drugs in the United States by meta-analysis to calculate national rates of HIV and hepatitis C virus infections. 2014; PLoS ONE 9(5): e97596. Doi:10.1371/journal.pone.0097596.

exchange programs are proven to prevent bloodborne disease transmission.[73] Public health cannot stop the hepatitis C epidemic without addressing the co-occurring epidemics of addiction and injection drug use.

CHI recently produced an unpublished analysis regarding IDU and correlations between the rising rates of heroin and HCV infections in Colorado. Heroin abuse rates, overdose deaths, and emergency department visits due to heroin poisoning have all increased in recent years. Rates of heroin deaths were highest among young adults between 25-34 years of age. Rates of heroin overdose deaths were highest in southeast Colorado and in Denver. Heroin-related data was analyzed for this report based on heroin being a drug that is usually injected for consumption, and because it is the most commonly injected drug in Colorado.

As seen in Figure E.1, the rate of Coloradans reporting heroin abuse or dependency has gone up nearly fivefold, climbing from 21 per 100,000 in 2003 to 101 per 100,000 in 2014, based on state-collected survey results from the National Survey on Drug Use and Health (NSDUH).

Figure E.1: Rate of Past Year Reported Heroin Abuse or Dependency per 100,000 Residents

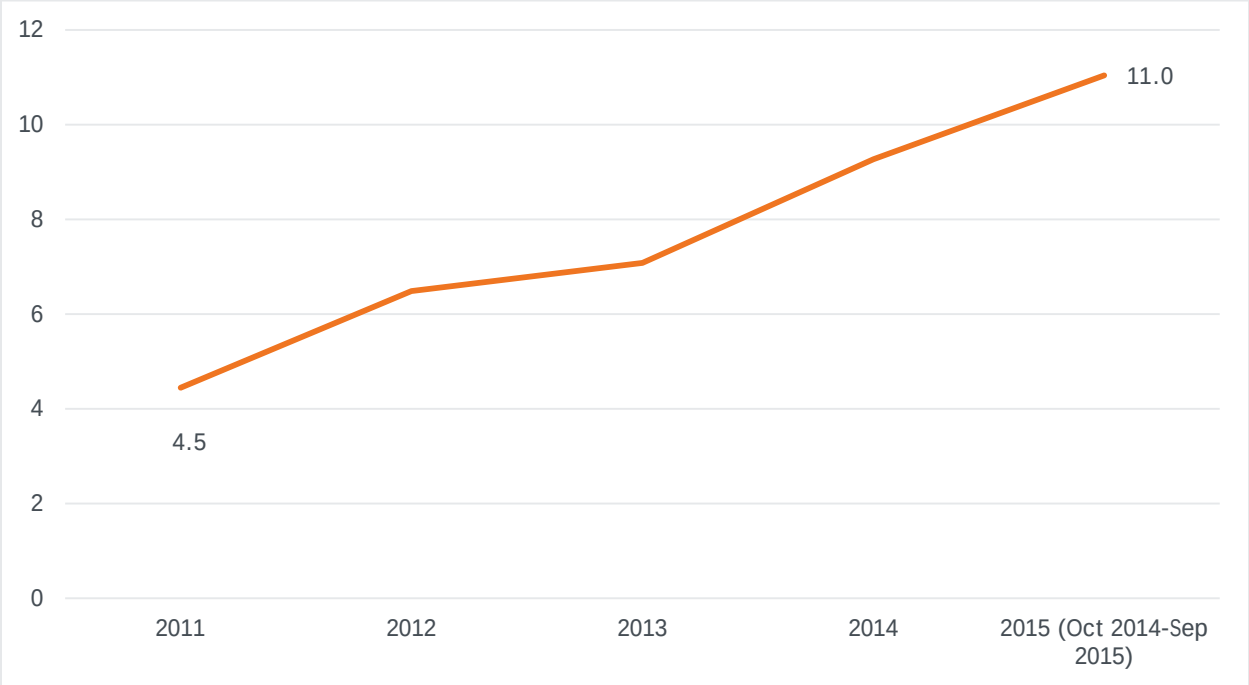


Data Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2003-2005, 2006-2008 and 2009-2010, 2011-2014.
Author: Colorado Health Institute

[73] Abdul-Quader AS, Feelemyer J, et al. Effectiveness of structural-level needle/syringe programs to reduce HCV and HIV infection among people who inject drugs: a systematic review. AIDS Behav 2013;17(9):2878-92.

As seen in Figure E.2, the age-adjusted rate of heroin-related emergency department visits more than doubled between 2011 and 2015 in Colorado, increasing from 4.5 visits per 100,000 residents to 11.0 visits per 100,000 residents.

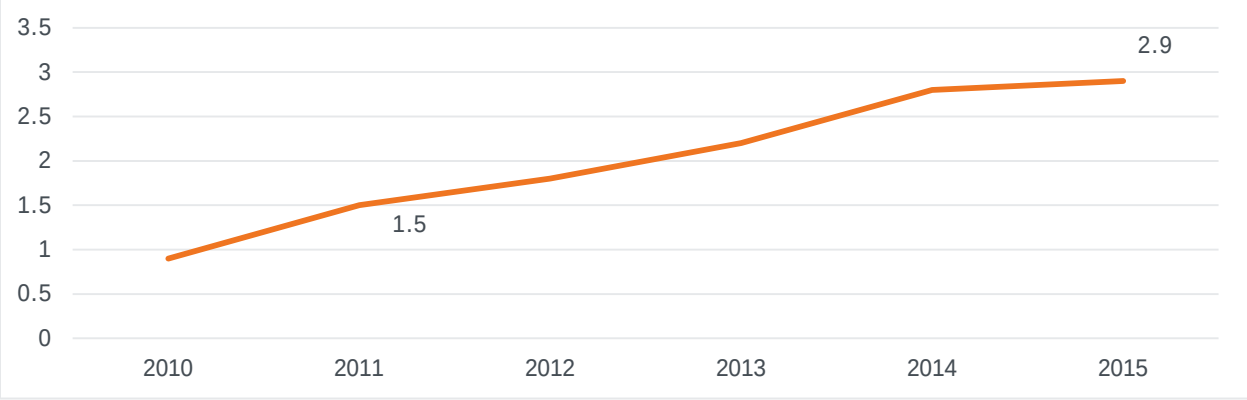
Figure E.2: Age-Adjusted Rate of Emergency Department Visits due to Heroin Poisoning per 100,000 Residents



Data Source: Colorado Hospital Association, 2015
Author: Colorado Health Institute

As seen in Figure E.3, from 2011 to 2015, the age-adjusted rate of heroin related overdose deaths in Colorado increased by 93 percent, from 1.5 deaths per 100,000 in 2011 to 2.9 deaths per 100,000 in 2015.

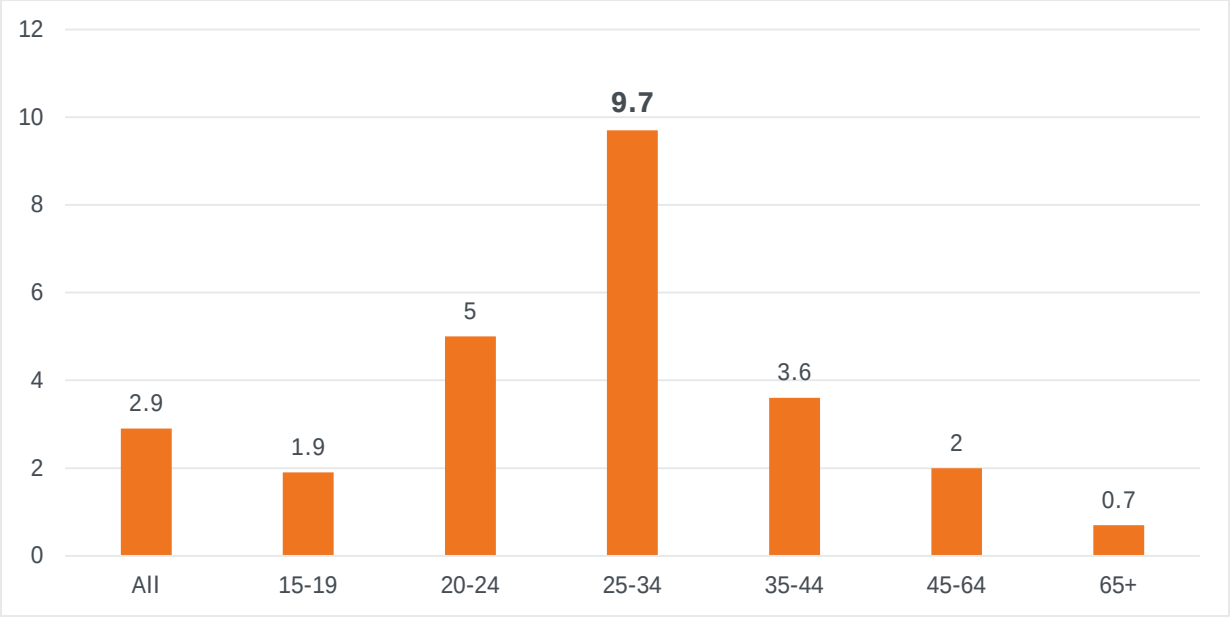
Figure E.3: Age-Adjusted Rate of Heroin Overdose Deaths per 100,000 Residents



Data Source: CDPHE Vital Statistics Branch, 2015
Author: Colorado Health Institute

As mentioned above, heroin overdose death rates are currently the highest in young adults in Colorado. As seen in Figure E.4, the highest rate of such deaths was among people age 25-34. This age group's rate of overdose deaths was 9.7 per 100,000. This correlates with the majority of acute HCV cases in 2016 falling into the 20-39 age range.

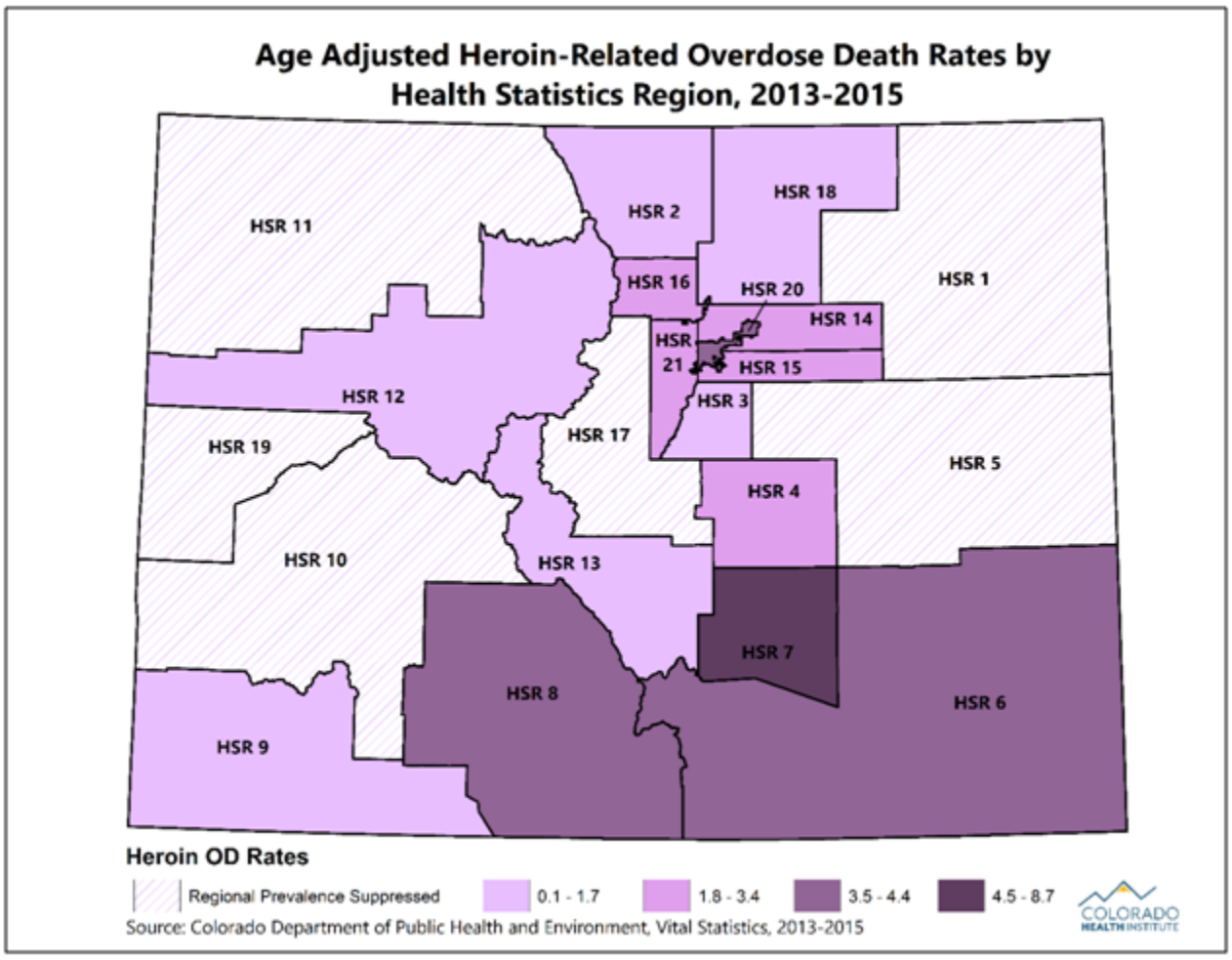
Figure E.4: Rate of Heroin Overdose Deaths by Age per 100,000 Residents, 2015



Data Source: CDPHE Vital Statistics Branch, 2015
Author: Colorado Health Institute

The highest heroin overdose death rates appear in the southeast corner of Colorado as well as in urban areas such as Denver and its surrounding metropolitan area. Figure E.5 illustrates this trend based on pre-determined Health Statistics Regions.

Figure E.5: Age-Adjusted Heroin-Related Overdose Death Rates by Health Statistics Region, 2013-2015



Author: Colorado Health Institute

People who are incarcerated

Approximately 26 percent of the U.S. incarcerated population is HCV-antibody positive, much higher than the general population.[74] An analysis of sero-prevalence data from U.S. prisons with routine HCV testing found that correctional populations represent almost one-third of total HCV infections in the U.S.[75] The number of people estimated to be under correctional supervision in prison or jail in 2014 in Colorado was 119,800, or 2.89% of

[74] Larney S, Zaller ND, et al. A systematic review and meta-analysis of racial and ethnic disparities in hepatitis C antibody prevalence in United States correctional populations. Annals of Epidemiology 2016;26:570-8.
[75] Varan AK, Mercer DW, et al. Hepatitis C seroprevalence among prison inmates since 2011: still high but declining. Public Health Rep 2014; 129(2): 187-195.

Colorado residents. Just over one-quarter (26.3%) of these individuals were incarcerated and 73.7 percent were under community supervision.[76] This is a transient population.

The CDOC offers HCV testing to inmates upon intake into a prison. Individuals diagnosed with hepatitis C are evaluated for treatment, and the CDOC applies a clinical designation for prioritizing offenders for treatment. In 2016, the CDOC incarcerated population accounted for 9.7 percent of all reported cases. An additional 2.5 percent of reported cases were inmates screened by the Federal Bureau of Prisons. More reported cases came from the incarcerated population than from 97 percent of counties in Colorado, even though the population in 23 percent of counties exceeds the estimated prison population.

Counties have jurisdiction over jails that house people who are awaiting a court date or who have been adjudicated and are serving a sentence. Since jail sentences are typically short and medical staff is limited in most county jails, HCV testing is generally only offered upon request of a symptomatic person. Due to the high prevalence of hepatitis C, correctional settings are excellent places for testing to identify infected people.

Health care exposures to hepatitis B and C

The risk of acquiring hepatitis B and hepatitis C virus from blood or blood products has dramatically declined in the U.S. since screening of blood, plasma and organ tissue for HCV became available in 1992. If infection control practices (ICP) and standard precautions are followed consistently, medical and dental procedures do not pose a risk for spread of bloodborne pathogens. Lapses in IPC do, however, occur and can cause a risk of HIV, HBV and/or HCV transmission. This can result in large public notifications involving many potentially exposed patients and screening for these pathogens. CDC identified 23 hepatitis B related outbreaks and 33 hepatitis C related outbreaks in U.S. healthcare settings from 2008-2015.[77] This included more than 175 outbreak-associated hepatitis B cases and 239 outbreak-associated hepatitis C cases. Nearly 11,000 people at risk for hepatitis B and almost 1 million people at risk for hepatitis C were notified to be screened for infection. CDC notes that it is likely that only a fraction of outbreaks are detected and reported, and these numbers greatly underestimate the actual burden.

One of these hepatitis C outbreaks was in 2009 in Colorado, in a hospital-based surgery service. In this investigation, a healthcare worker who was positive for HCV diverted drugs and used the same syringe and needle as patients. Almost 6,000 people were notified to be screened for HCV at two different facilities. Testing

[76] Kaeble D, Glaze L, et al. Correctional Populations in the United States, 2014. U.S. Department of Justice, Office of Justice Programs, Bureau of Justice Statistics. December 2015; NCJ 249513.
[77] Centers for Disease Control and Prevention. Healthcare-associated hepatitis B and C outbreaks reported to the Centers for Disease Control and Prevention (CDC) 2008-2015. Accessed at https://www.cdc.gov/hepatitis/statistics/healthcareoutbreaktable.htm on December 7, 2016.

resulted in 18 cases of hepatitis C that were genetically linked and an additional eight cases that were epidemiologically linked to the healthcare worker.[78]

CDPHE continues to actively engage Colorado hospitals and other healthcare, home health, and emergency healthcare service providers to assure adherence to national and state regulations, and implementation and maintenance of infection-control practices. This includes appropriate sterilization and/or disinfection of medical and dental devices and the single use and appropriate disposal of needles, syringes and other sharp instruments. It also includes appropriate storage and handling of medications and ongoing professional and public education.

CDPHE investigates unsafe injection practices in any healthcare setting, and previous investigations have included unsafe practices related to pediatric immunizations, acupuncture, paramedic services, dental offices, nursing homes, medical offices, outpatient surgery centers, assisted living facilities, research facilities, and hospitals. Unsafe practices are often identified by the public, healthcare providers, staff surveyors in the Health Facilities and Emergency Medical Services Division at CDPHE, or through public health disease surveillance.

Strategies

Both public health and patient-centered strategies are needed to stop the spread of viral hepatitis and limit the impact on people who are infected. Public health must work with communities and health care providers to identify new cases and stop transmission. Hepatitis A and B have effective vaccines; screening, education, and treatment are the primary tools available to prevent new hepatitis C infections, in context of identified cross-cutting barriers that include sporadic and under-funded surveillance systems.79

Screening

Healthcare providers and public health communities identify people who are living with viral hepatitis through screening tests for HCV antibody and HBV surface antigen. According to the CDC, most people with hepatitis B and hepatitis C are unaware of their status. Additional screening of people at risk will help identify previously undiagnosed cases.

Education

Hepatitis education for both professional healthcare workers and the public is important. There is a need for more health care providers who can serve people living with chronic hepatitis B and hepatitis C. Colorado is helping meet this need through Project ECHO (Extension for Community Healthcare Outcomes). Project ECHO provides video training of specialized medical knowledge to expand treatment capacity. Project ECHO Colorado began hepatitis C training in 2016 with the goal of preparing primary care physicians to both manage their patients' hepatitis C infections and to cure patients using newer therapies.

[78] Warner AE, Schaefer MK, et al. Outbreak of hepatitis C virus infection associated with narcotics diversion by an hepatitis C virus-infected surgical technician. Am J Infection Control 2015;43:53-8.
[79] National Academies of Sciences, Engineering, and Medicine. 2016. Eliminating the public health problem of hepatitis B and C in the United States: Phase one report. Washington, DC: The National Academies Press. doi: 10.17226/23407.

Public awareness of hepatitis is a public and private effort. Public funds are being used to raise awareness among high-risk groups and promote HCV testing. Drug makers are in an increasingly competitive market and have undertaken large marketing campaigns to connect patients with treatment.

Treatment

People with detectable HBV and HCV need additional medical management and evaluation for treatment. These patients also need counseling and education related to their diagnosis. The current healthcare 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.[80] Treatment of viral hepatitis prevents progression to fibrosis, cirrhosis, and hepatocellular carcinoma by eradicating the virus in infected patients. Treatment also decreases transmission.

There are several antiviral medications for people with chronic hepatitis B to manage their infection, including medications that are approved for use in the third trimester of pregnancy. Post-vaccination and immune globulin is available for infants and people exposed to the virus that can prevent infection. Infants born to HBV-infected mothers should be given both HBV vaccine and immune globulin within 12 hours of birth. Other people exposed to the virus should be given post-exposure prophylaxis within 24 hours. This is usually a vaccine, but can be immune globulin in some circumstances.

New treatments that came onto the market in 2014 can cure hepatitis C infection in 95 percent of situations and help people enjoy long, productive lives. However, the cost and demand for treatment has the potential to overwhelm many healthcare systems. Hepatitis C 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 twelve billion dollars, or more than a third of the amount spent that year on new pharmaceutical treatments for all diseases.[81] Because of high treatment costs and the number of people infected with HCV, insurers are placing restrictions on who is eligible for treatment. Treatment is available and successful, yet only about one in 10 chronically infected people, nationally, receive this treatment.82

To effectively reduce morbidity and mortality related to viral hepatitis in Colorado, CDPHE recommends expanding public education, increasing screening and confirmatory testing (specifically for HCV), expanding

[80] American Association for the Study of Liver Diseases, Infectious Diseases Society of America, and International Antiviral Society – USA. Recommendations for testing, managing, and treating hepatitis C. Accessed at http://www.hcvguidelines.org. on October 19, 2016.
[81] Committee on Finance, United States Senate. The price of solvaldi and its impact on the U.S. health care system. Washington DC: US Government Publishing Office, 2015, 114th Congress, S. Prt 114-20.
[82] National Academies of Sciences, Engineering, and Medicine. 2016. Eliminating the public health problem of hepatitis B and C in the United States: Phase one report. Washington, DC: The National Academies Press. doi: 10.17226/23407.

professional education (including hepatitis C treatment in primary care settings), and providing hepatitis C treatment to more Coloradans.

Appendix

Table A.1: Confirmed Hepatitis A Cases Reported 2012-2016 in Colorado by Sex, Age, and Race/Ethnicity

	2016 Population*	Number	% of total	Average 5-year Rate per 100,000†
Total	5,555,753	149	100.0%	0.6
Sex				
Female	2,777,983	77	51.7%	0.6
Male	2,777,770	72	48.3%	0.5
Age (years)				
<1	67,837	1	0.7%	0.3
1-4	272,299	3	2.0%	0.2
5-9	363,091	4	2.7%	0.2
10-14	375,361	3	2.0%	0.2
15-19	372,056	6	4.0%	0.3
20-39	1,549,963	48	32.2%	0.6
40-59	1,476,152	42	28.2%	0.6
60-79	908,668	33	22.1%	0.8
80+	170,327	9	6.0%	1.1
Race/Ethnicity				
White, non-Hispanic	3,799,827	110	73.8%	0.59
Hispanic/Latino, all races	1,249,081	18	12.1%	0.31
Black, non-Hispanic	232,126	5	3.4%	0.45
Asian/Pacific Islander, non-Hispanic	203,572	9	6.0%	0.96
Native American/Alaska Native, non-Hispanic	53,971	0	0.0%	0.00
Other/Unknown	---	7	4.7%	---

*Colorado State Demography Office 2016 Forecast.
†Calculated using State Demography Office 2012-2015 Estimates and 2016 Forecast.

Table A.2: Clinical Characteristics of Confirmed Hepatitis A Cases Reported 2012-2016 in Colorado

Characteristic	Number	Percent
Total	149	100.0%
Fatigue	122	81.9%
Loss of appetite	115	77.2%
Nausea	111	74.5%
Dark urine	110	73.8%
Abdominal pain	103	69.1%
Jaundice	102	68.5%
Fever	86	57.7%
Vomiting	82	55.0%
Hospitalized	63	42.3%
Diarrhea	58	38.9%
Clay color stool	52	34.9%
Joint pain	50	33.6%
Death	0	0.0%

Clinical Characteristics are not mutually exclusive.

Table A.3: Reported Exposure to Potential Risk Factors for Hepatitis A Among Confirmed Hepatitis A Cases in Colorado, 2012-2016 (N=149)

Potential Exposure*	Yes		No		Unknown	
	Number	Percent	Number	Percent	Number	Percent
International travel	44	29.5%	101	67.8%	4	2.7%
Member of household traveled internationally in past 3 months	29	19.5%	109	73.2%	11	7.4%
Part of a known common source outbreak	25	16.8%	87	58.4%	37	24.8%
Consumed raw shellfish	13	8.7%	121	81.2%	15	10.1%
Contact of person who attends/works in child care	12	8.1%	129	86.6%	8	5.4%
Contact with a person with hepatitis A**	8	5.4%	124	83.2%	17	11.4%
Patient attends or works in child care	3	2.0%	140	94.0%	6	4.0%
Injection drug use	2	1.3%	133	89.3%	14	9.4%

*Exposures are during 2-6 weeks prior to onset, unless otherwise noted.
**Reported contacts include: household contact (3); sexual contact (3); child care contact (1); other contact (3); categories not mutually exclusive.

Table A.4: Hepatitis A Cases in Colorado by County, 2012-2016

	2016 Population*	Number	% of total	Average 5-year Incidence Rate per 100,000†
Total	5,555,753	149	100.0%	0.6
County of Residence‡				
Adams	502,721	8	5.4%	0.3
Alamosa	16,132	1	0.7%	1.3
Arapahoe	642,823	14	9.4%	0.5
Archuleta	12,602	1	0.7%	1.6
Baca	3,581	0	0.0%	0.0
Bent	5,960	0	0.0%	0.0
Boulder	323,457	9	6.0%	0.6
Broomfield	67,206	1	0.7%	0.3
Chaffee	18,906	0	0.0%	0.0
Cheyenne	1,839	0	0.0%	0.0
Clear Creek	9,317	1	0.7%	2.2
Conejos	8,080	0	0.0%	0.0
Costilla	3,589	0	0.0%	0.0
Crowley	5,768	0	0.0%	0.0
Custer	4,562	0	0.0%	0.0
Delta	30,008	2	1.3%	1.3
Denver	697,362	11	7.4%	0.3
Dolores	1,987	0	0.0%	0.0
Douglas	328,478	9	6.0%	0.6
Eagle	54,871	8	5.4%	3.0
El Paso	688,227	24	16.1%	0.7
Elbert	26,069	1	0.7%	0.8

	2016 Population*	Number	% of total	Average 5-year Incidence Rate per 100,000†
Fremont	46,882	0	0.0%	0.0
Garfield	59,087	2	1.3%	0.7
Gilpin	5,861	0	0.0%	0.0
Grand	14,956	1	0.7%	1.4
Gunnison	16,359	0	0.0%	0.0
Hinsdale	780	0	0.0%	0.0
Huerfano	6,482	0	0.0%	0.0
Jackson	1,344	0	0.0%	0.0
Jefferson	571,775	8	5.4%	0.3
Kiowa	1,379	0	0.0%	0.0
Kit Carson	7,779	0	0.0%	0.0
Lake	7,538	1	0.7%	2.7
La Plata	56,060	1	0.7%	0.4
Larimer	340,228	19	12.8%	1.2
Las Animas	15,051	0	0.0%	0.0
Lincoln	5,598	0	0.0%	0.0
Logan	22,254	1	0.7%	0.9
Mesa	150,614	3	2.0%	0.4
Mineral	732	0	0.0%	0.0
Moffat	12,869	0	0.0%	0.0
Montezuma	26,695	1	0.7%	0.8
Montrose	41,735	1	0.7%	0.5
Morgan	28,541	0	0.0%	0.0
Otero	18,353	0	0.0%	0.0
Ouray	4,779	0	0.0%	0.0

	2016 Population*	Number	% of total	Average 5-year Incidence Rate per 100,000†
Park	16,970	1	0.7%	1.2
Phillips	4,313	0	0.0%	0.0
Pitkin	17,909	1	0.7%	1.1
Prowers	11,834	1	0.7%	1.7
Pueblo	164,591	5	3.4%	0.6
Rio Blanco	6,467	0	0.0%	0.0
Rio Grande	11,438	0	0.0%	0.0
Routt	24,505	0	0.0%	0.0
Saguache	6,273	0	0.0%	0.0
San Juan	702	0	0.0%	0.0
San Miguel	8,113	0	0.0%	0.0
Sedgwick	2,364	0	0.0%	0.0
Summit	30,745	4	2.7%	2.7
Teller	23,708	0	0.0%	0.0
Washington	4,792	0	0.0%	0.0
Weld	294,555	9	6.0%	0.6
Yuma	10,161	0	0.0%	0.0

*Colorado State Demography Office 2016 Forecast.
†Calculated using State Demography Office 2012-2015 Estimates and 2016 Forecast.
‡County of residence is determined at the time the case is reported.
Rates calculated for counties with few cases and small populations should be interpreted with caution.
Note: Five-year average rates were calculated to minimize the potential impact of single cases being reported in small counties, however, caution should be used when interpreting rates based on small numbers of cases.

Table B.1: Reported Acute and Chronic Hepatitis B Cases by Case Status, Sex, Age, and Race/Ethnicity in Colorado, 2012-2016 and 2016

		Acute Hepatitis B Cases, 2012-2016			Chronic Hepatitis B Cases, 2016		
	2016 Population*	Number	% of total	Average 5-year Rate per 100,000†	Number	% of total	Rate per 100,000†
Total	5,555,753	140	100.0%	0.5	641	100.0%	11.5
Case Status							
Confirmed	---	134	95.7%	---	187	29.2%	---
Probable	---	6	4.3%	---	454	70.8%	---
Sex							
Female	2,777,983	36	25.7%	0.3	261	40.7%	9.4
Male	2,777,770	104	74.3%	0.8	380	59.3%	13.7
Age (years)							
<5	340,136	0	0.0%	0.0	1	0.2%	0.3
5-9	363,091	0	0.0%	0.0	6	0.9%	1.7
10-19	747,417	1	0.7%	0.0	22	3.4%	2.9
20-29	752,076	13	9.3%	0.4	131	20.4%	17.4
30-39	797,886	30	21.4%	0.8	175	27.3%	21.9
40-49	732,570	50	35.7%	1.4	118	18.4%	16.1
50-59	743,582	26	18.6%	0.7	89	13.9%	12.0
60+	1,078,995	20	14.3%	0.4	99	15.4%	9.2
Cases by birth year related to the 1997 school immunization requirement							
Born before 1986	3,273,949	131	93.6%	0.8	477	74.4%	14.6
Born 1986 and after	2,281,804	9	6.4%	0.1	164	25.6%	7.2
Race/Ethnicity							
White, non-Hispanic	3,799,827	89	63.6%	0.5	83	12.9%	2.2

Hispanic/Latino, all races	1,249,081	14	10.0%	0.2	26	4.1%	2.1
Black, non-Hispanic	232,126	14	10.0%	1.3	59	9.2%	25.4
Asian/Pacific Islander, non-Hispanic	203,572	4	2.9%	0.4	122	19.0%	59.9
Native American/Alaska Native, non-Hispanic	53,971	1	0.7%	0.4	3	0.5%	5.6
Other/Unknown	---	3	2.1%	---	0	0.0%	---

*Colorado State Demography Office 2016 Forecast.
†Acute Rate calculated using State Demography Office 2012-2015 Estimates and 2016 Forecast. Chronic Rate calculated using 2016 Forecast.
Rates calculated for small populations should be interpreted with caution. This is not a rate of disease incidence.

Table B.2: Reported Acute and Chronic Hepatitis B Cases by County of Residence in Colorado, 2012-2016 and 2016

		Acute Hepatitis B Cases, 2012-2016			Chronic Hepatitis B Cases, 2016		
	2016 Population*	Number	% of total	Average 5-year Rate per 100,000†	Number	% of total	Rate per 100,000†
Total	5,555,753	140	100.0%	0.5	641	100.0%	11.5
County of Residence‡							
Adams	502,721	14	10.0%	0.6	65	10.1%	12.9
Alamosa	16,132	0	0.0%	0.0	0	0.0%	0.0
Arapahoe	642,823	11	7.9%	0.4	126	19.7%	19.6
Archuleta	12,602	0	0.0%	0.0	0	0.0%	0.0
Baca	3,581	0	0.0%	0.0	0	0.0%	0.0
Bent	5,960	2	1.4%	6.9	0	0.0%	0.0
Boulder	323,457	6	4.3%	0.4	32	5.0%	9.9
Broomfield	67,206	1	0.7%	0.3	6	0.9%	8.9
Chaffee	18,906	0	0.0%	0.0	0	0.0%	0.0

		Acute Hepatitis B Cases, 2012-2016			Chronic Hepatitis B Cases, 2016		
	2016 Population*	Number	% of total	Average 5-year Rate per 100,000†	Number	% of total	Rate per 100,000†
Cheyenne	1,839	0	0.0%	0.0	0	0.0%	0.0
Clear Creek	9,317	0	0.0%	0.0	0	0.0%	0.0
Conejos	8,080	0	0.0%	0.0	0	0.0%	0.0
Costilla	3,589	0	0.0%	0.0	0	0.0%	0.0
Crowley	5,768	0	0.0%	0.0	0	0.0%	0.0
Custer	4,562	0	0.0%	0.0	1	0.2%	21.9
Delta	30,008	1	0.7%	0.7	0	0.0%	0.0
Denver	697,362	39	27.9%	1.2	126	19.7%	18.1
Dolores	1,987	0	0.0%	0.0	0	0.0%	0.0
Douglas	328,478	2	1.4%	0.1	26	4.1%	7.9
Eagle	54,871	0	0.0%	0.0	2	0.3%	3.6
El Paso	688,227	20	14.3%	0.6	87	13.6%	12.6
Elbert	26,069	0	0.0%	0.0	0	0.0%	0.0
Fremont	46,882	0	0.0%	0.0	7	1.1%	14.9
Garfield	59,087	0	0.0%	0.0	1	0.2%	1.7
Gilpin	5,861	0	0.0%	0.0	0	0.0%	0.0
Grand	14,956	0	0.0%	0.0	0	0.0%	0.0
Gunnison	16,359	1	0.7%	1.3	0	0.0%	0.0
Hinsdale	780	0	0.0%	0.0	0	0.0%	0.0
Huerfano	6,482	0	0.0%	0.0	0	0.0%	0.0
Jackson	1,344	0	0.0%	0.0	0	0.0%	0.0
Jefferson	571,775	18	12.9%	0.6	51	8.0%	8.9
Kiowa	1,379	0	0.0%	0.0	0	0.0%	0.0

		Acute Hepatitis B Cases, 2012-2016			Chronic Hepatitis B Cases, 2016		
	2016 Population*	Number	% of total	Average 5-year Rate per 100,000†	Number	% of total	Rate per 100,000†
Kit Carson	7,779	0	0.0%	0.0	0	0.0%	0.0
Lake	7,538	0	0.0%	0.0	0	0.0%	0.0
La Plata	56,060	1	0.7%	0.4	3	0.5%	5.4
Larimer	340,228	7	5.0%	0.4	19	3.0%	5.6
Las Animas	15,051	0	0.0%	0.0	0	0.0%	0.0
Lincoln	5,598	0	0.0%	0.0	0	0.0%	0.0
Logan	22,254	0	0.0%	0.0	0	0.0%	0.0
Mesa	150,614	7	5.0%	0.9	7	1.1%	4.6
Mineral	732	0	0.0%	0.0	0	0.0%	0.0
Moffat	12,869	0	0.0%	0.0	1	0.2%	7.8
Montezuma	26,695	0	0.0%	0.0	2	0.3%	7.5
Montrose	41,735	0	0.0%	0.0	1	0.2%	2.4
Morgan	28,541	1	0.7%	0.7	6	0.9%	21.0
Otero	18,353	0	0.0%	0.0	0	0.0%	0.0
Ouray	4,779	0	0.0%	0.0	0	0.0%	0.0
Park	16,970	0	0.0%	0.0	0	0.0%	0.0
Phillips	4,313	0	0.0%	0.0	0	0.0%	0.0
Pitkin	17,909	0	0.0%	0.0	0	0.0%	0.0
Prowers	11,834	1	0.7%	1.7	0	0.0%	0.0
Pueblo	164,591	3	2.1%	0.4	22	3.4%	13.4
Rio Blanco	6,467	0	0.0%	0.0	0	0.0%	0.0
Rio Grande	11,438	0	0.0%	0.0	0	0.0%	0.0
Routt	24,505	0	0.0%	0.0	1	0.2%	4.1

		Acute Hepatitis B Cases, 2012-2016			Chronic Hepatitis B Cases, 2016		
	2016 Population*	Number	% of total	Average 5-year Rate per 100,000†	Number	% of total	Rate per 100,000†
Saguache	6,273	0	0.0%	0.0	0	0.0%	0.0
San Juan	702	0	0.0%	0.0	0	0.0%	0.0
San Miguel	8,113	0	0.0%	0.0	1	0.2%	12.3
Sedgwick	2,364	0	0.0%	0.0	0	0.0%	0.0
Summit	30,745	0	0.0%	0.0	2	0.3%	6.5
Teller	23,708	0	0.0%	0.0	2	0.3%	8.4
Washington	4,792	0	0.0%	0.0	0	0.0%	0.0
Weld	294,555	3	2.1%	0.2	28	4.4%	9.5
Yuma	10,161	0	0.0%	0.0	0	0.0%	0.0
Unspecified	---	0	0.0%	---	1	0.2%	---
Corrections							
CDOC**	---	2	1.4%	---	9	1.4%	---
FBP***	---	0	0.0%	---	6	0.9%	---

*Colorado State Demography Office 2016 Forecast.
†Acute Rate calculated using State Demography Office 2012-2015 Estimates and 2016 Forecast. Chronic Rate calculated using 2016 Forecast.
‡County of residence is determined at the time the case is reported. If the case is in a county jail at the time of report, the county of the jail location is assigned. If the case is in a state or federal prison, then county is not assigned.
**CDOC – Incarcerated in the Colorado Department of Corrections. ***FBP – Incarcerated in the Federal Bureau of Prisons.
Note: Five-year average rates were calculated to minimize the potential impact of single cases being reported in small counties, however, caution should be used when interpreting rates based on small numbers of cases. This is not a rate of disease incidence.

Table B.3: Reported Hepatitis B Cases by Risk Factor and Percentage of Cases Reporting the Risk Factor, Colorado, 2012-2016

	Acute HBV Cases		Chronic HBV Cases	
	Number	Percent	Number	Percent
Total	140	100.0%	2,722	100.0%
IDU (2 weeks to 6 months prior to onset of symptoms)				
Yes	26	18.6%	46	1.7%
No	89	63.6%	244	9.0%
Unknown	1	0.7%	187	6.9%
Missing	24	17.1%	2,245	82.5%
Household Contact (2 weeks to 6 months prior to onset of symptoms)				
Yes	4	2.9%	0	0.0%
Sex Partner Contact (2 weeks to 6 months prior to onset of symptoms)				
Yes	11	7.9%	0	0.0%
MSM (6 months prior to onset of symptoms)	104 male cases		1,558 male cases	
Yes	20	19.2%	17	1.1%
No	52	50.0%	30	1.9%
Unknown	9	8.7%	133	8.5%
Missing	23	22.1%	1,378	88.4%
Born in Foreign Country				
Yes	86	61.4%	133	4.9%
No	14	10.0%	956	35.1%
Unknown	7	5.0%	152	5.6%

Missing	33	23.6%	1,481	54.4%

Risk factor categories are not mutually exclusive.

Table C.1: Reported Acute and Chronic Hepatitis C Cases by Case Status, Sex, Age, and Race/Ethnicity in Colorado, 2012-2016 and 2016

		Acute Hepatitis C Cases, 2012-2016			Chronic Hepatitis C Cases‡, 2016		
	2016 Population*	Number	% of total	Average 5-year Rate per 100,000†	Number	% of total	Rate per 100,000†
Total	5,555,753	179	100.0%	0.7	4,865	100.0%	87.6
Case Status							
Confirmed	---	173	96.6%	---	2,820	58.0%	---
Probable	---	6	3.4%	---	2,045	42.0%	---
Sex							
Female	2,777,983	82	45.8%	0.6	1,739	35.7%	62.6
Male	2,777,770	97	54.2%	0.7	3,126	64.3%	112.5
Age (years)							
<5	340,136	1	0.6%	0.1	11	0.2%	3.2
5-9	363,091	0	0.0%	0.0	3	0.1%	0.8
10-19	747,417	8	4.5%	0.2	59	1.2%	7.9
20-29	752,076	85	47.5%	2.3	845	17.4%	112.4
30-39	797,886	34	19.0%	0.9	885	18.2%	110.9
40-49	732,570	31	17.3%	0.9	787	16.2%	107.4
50-59	743,582	17	9.5%	0.5	1,166	24.0%	156.8
60+	1,078,995	3	1.7%	0.1	1,100	22.6%	101.9
Unknown	---	0	0.0%	---	9	0.2%	---
Birth Cohort							
Born before 1945	393,009	0	0.0%	0.0	118	2.4%	30.0

Born between 1945-1965	1,360,955	23	12.8%	0.3	2,115	43.5%	155.4
Born after 1965	3,801,789	156	87.2%	0.9	2,623	53.9%	69.0
Race/Ethnicity							
White, non-Hispanic	3,799,827	111	62.0%	0.6	781	16.1%	20.6
Hispanic/Latino, all races	1,249,081	40	22.3%	0.7	189	3.9%	15.1
Black, non-Hispanic	232,126	0	0.0%	0.0	55	1.1%	23.7
Asian/Pacific Islander, non-Hispanic	203,572	0	0.0%	0.0	23	0.5%	11.3
Native American/Alaska Native, non-Hispanic	53,971	5	2.8%	1.9	15	0.3%	27.8
Other, non-Hispanic	---	3	1.7%	---	26	0.5%	---
Multiple Races, non-Hispanic	---	3	1.7%	---	3	0.1%	---
Missing/Unknown	---	17	9.5%	---	3,773	77.6%	---

‡Chronic cases may include cases who have resolved infection.
*Colorado State Demography Office 2016 Forecast.
†Acute Rate calculated using State Demography Office 2012-2015 Estimates and 2016 Forecast. Chronic Rate calculated using 2016 Forecast.
Rates calculated for small populations should be interpreted with caution. This is not a rate of disease incidence.

Table C.2: HCV Antibody Testing at Two Large, Commercial Laboratories in Colorado, 2015*

	Number Tested	Percent of Tests	Percent Positive
Male			
Total	26,269		7.2%
<15	176	0.7%	1.7%
15-24	2,751	10.5%	2.0%
25-34	5,966	22.7%	3.6%
35-44	4,961	18.9%	6.2%
45-54	5,060	19.3%	10.4%
55-64	4,741	18.0%	13.6%
65+	2,603	9.9%	5.3%
Female			
Total	39,977		3.2%
<15	195	0.5%	0.5%
15-24	6,579	16.5%	1.0%
25-34	12,310	30.8%	1.4%
35-44	7,016	17.6%	2.8%
45-54	5,535	13.8%	6.0%
55-64	5,169	12.9%	7.6%
65+	3,171	7.9%	3.6%

*Data do not represent all testing in Colorado, therefore, may not be representative of state-wide testing. Records with missing gender and age are not included. Records with missing age, but not gender, are included in the gender totals, therefore, age category counts do not add up to gender totals.

Table C.3: Reported Acute and Chronic Hepatitis C Cases by County of Residence in Colorado, 2012-2016 and 2016

		Acute Hepatitis C Cases, 2012-2016			Chronic Hepatitis C Cases§, 2016		
	2016 Population*	Number	% of total	Average 5-year Rate per 100,000†	Number	% of total	Rate per 100,000†
Total	5,555,753	179	100.0%	0.7	4,865	100.0%	87.6
County of Residence‡							
Adams	502,721	8	4.5%	0.3	311	6.4%	61.9
Alamosa	16,132	2	1.1%	2.5	22	0.5%	136.4
Arapahoe	642,823	12	6.7%	0.4	372	7.6%	57.9
Archuleta	12,602	0	0.0%	0.0	17	0.3%	134.9
Baca	3,581	0	0.0%	0.0	4	0.1%	111.7
Bent	5,960	1	0.6%	3.4	16	0.3%	268.5
Boulder	323,457	8	4.5%	0.5	163	3.4%	50.4
Broomfield	67,206	0	0.0%	0.0	22	0.5%	32.7
Chaffee	18,906	0	0.0%	0.0	15	0.3%	79.3
Cheyenne	1,839	0	0.0%	0.0	0	0.0%	0.0
Clear Creek	9,317	0	0.0%	0.0	8	0.2%	85.9
Conejos	8,080	2	1.1%	4.9	5	0.1%	61.9
Costilla	3,589	0	0.0%	0.0	13	0.3%	362.2
Crowley	5,768	1	0.6%	3.6	4	0.1%	69.3
Custer	4,562	0	0.0%	0.0	8	0.2%	175.4
Delta	30,008	0	0.0%	0.0	30	0.6%	100.0
Denver	697,362	32	17.9%	1.0	729	15.0%	104.5
Dolores	1,987	0	0.0%	0.0	3	0.1%	151.0
Douglas	328,478	4	2.2%	0.3	83	1.7%	25.3
Eagle	54,871	0	0.0%	0.0	27	0.6%	49.2

		Acute Hepatitis C Cases, 2012-2016			Chronic Hepatitis C Cases§, 2016		
	2016 Population*	Number	% of total	Average 5-year Rate per 100,000†	Number	% of total	Rate per 100,000†
El Paso	688,227	21	11.7%	0.6	574	11.8%	83.4
Elbert	26,069	0	0.0%	0.0	7	0.1%	26.9
Fremont	46,882	5	2.8%	2.1	52	1.1%	110.9
Garfield	59,087	1	0.6%	0.3	46	0.9%	77.9
Gilpin	5,861	0	0.0%	0.0	9	0.2%	153.6
Grand	14,956	0	0.0%	0.0	4	0.1%	26.7
Gunnison	16,359	1	0.6%	1.3	12	0.2%	73.4
Hinsdale	780	0	0.0%	0.0	1	0.0%	128.2
Huerfano	6,482	1	0.6%	3.1	10	0.2%	154.3
Jackson	1,344	0	0.0%	0.0	0	0.0%	0.0
Jefferson	571,775	13	7.3%	0.5	308	6.3%	53.9
Kiowa	1,379	0	0.0%	0.0	1	0.0%	72.5
Kit Carson	7,779	0	0.0%	0.0	5	0.1%	64.3
Lake	7,538	1	0.6%	2.7	6	0.1%	79.6
La Plata	56,060	4	2.2%	1.5	47	1.0%	83.8
Larimer	340,228	12	6.7%	0.7	193	4.0%	56.7
Las Animas	15,051	0	0.0%	0.0	24	0.5%	159.5
Lincoln	5,598	0	0.0%	0.0	2	0.0%	35.7
Logan	22,254	0	0.0%	0.0	8	0.2%	35.9
Mesa	150,614	5	2.8%	0.7	131	2.7%	87.0
Mineral	732	0	0.0%	0.0	2	0.0%	273.2
Moffat	12,869	3	1.7%	4.6	21	0.4%	163.2
Montezuma	26,695	0	0.0%	0.0	36	0.7%	134.9
Montrose	41,735	1	0.6%	0.5	32	0.7%	76.7

		Acute Hepatitis C Cases, 2012-2016			Chronic Hepatitis C Cases§, 2016		
	2016 Population*	Number	% of total	Average 5-year Rate per 100,000†	Number	% of total	Rate per 100,000†
Morgan	28,541	0	0.0%	0.0	11	0.2%	38.5
Otero	18,353	1	0.6%	1.1	17	0.3%	92.6
Ouray	4,779	1	0.6%	4.3	5	0.1%	104.6
Park	16,970	0	0.0%	0.0	14	0.3%	82.5
Phillips	4,313	1	0.6%	4.6	3	0.1%	69.6
Pitkin	17,909	0	0.0%	0.0	5	0.1%	27.9
Prowers	11,834	1	0.6%	1.7	10	0.2%	84.5
Pueblo	164,591	21	11.7%	2.6	274	5.6%	166.5
Rio Blanco	6,467	0	0.0%	0.0	1	0.0%	15.5
Rio Grande	11,438	1	0.6%	1.7	18	0.4%	157.4
Routt	24,505	1	0.6%	0.8	11	0.2%	44.9
Saguache	6,273	0	0.0%	0.0	5	0.1%	79.7
San Juan	702	0	0.0%	0.0	1	0.0%	142.5
San Miguel	8,113	0	0.0%	0.0	3	0.1%	37.0
Sedgwick	2,364	0	0.0%	0.0	1	0.0%	42.3
Summit	30,745	0	0.0%	0.0	14	0.3%	45.5
Teller	23,708	0	0.0%	0.0	23	0.5%	97.0
Washington	4,792	0	0.0%	0.0	2	0.0%	41.7
Weld	294,555	8	4.5%	0.6	160	3.3%	54.3
Yuma	10,161	0	0.0%	0.0	4	0.1%	39.4
Unspecified	---	0	0.0%	---	308	6.3%	---
Corrections							
CDOC**	---	6	3.4%	---	471	9.7%	---
FBP***	---	0	0.0%	---	121	2.5%	---

§Chronic cases may include cases who have resolved infection.
*Colorado State Demography Office 2016 Forecast.
†Acute Rate calculated using State Demography Office 2012-2015 Estimates and 2016 Forecast. Chronic Rate calculated using 2016 Forecast.
‡County of residence is determined at the time the case is reported. If the case is in a county jail at the time of report, the county of the jail location is assigned. If the case is in a state or federal prison, then county is not assigned.
**CDOC – Incarcerated in the Colorado Department of Corrections. ***FBP – Incarcerated in the Federal Bureau of Prisons.
Note: Five-year average rates were calculated to minimize the potential impact of single cases being reported in small counties, however, caution should be used when interpreting rates based on small numbers of cases. This is not a rate of disease incidence.

Table C.4: Reported Hepatitis C Cases by Risk Factor and Percentage of Cases Reporting the Risk Factor, Colorado, 2012-2016

	Acute HCV Cases		Chronic HCV Cases‡	
	Number	Percent	Number	Percent
Total	179	100.0%	18,119	100.0%
IDU (2 weeks to 6 months prior to onset of symptoms)				
Yes	90	50.3%	1,137	6.3%
No	52	29.1%	175	1.0%
Unknown	3	1.7%	513	2.8%
Missing	34	19.0%	16,294	89.9%
Household Contact (2 weeks to 6 months prior to onset of symptoms)				
Yes	0	0.0%	0	0.0%
Sex Partner Contact (2 weeks to 6 months prior to onset of symptoms)				
Yes	1	0.6%	0	0.0%
MSM (6 months prior to onset of symptoms)	97 male cases		11,616 male cases	
Yes	9	9.3%	22	0.2%
No	43	44.3%	38	0.3%

Unknown	6	6.2%	515	4.4%
Missing	39	40.2%	11,041	95.0%
Born in Foreign Country				
Yes	103	57.5%	110	0.6%
No	8	4.5%	942	5.2%
Unknown	9	5.0%	590	3.3%
Missing	59	33.0%	16,477	90.9%

‡Chronic cases may include cases who have resolved infection.
Risk factor categories are not mutually exclusive.

Table D.1: Cumulative and Living Reported Cases of Co-Infected Hepatitis B and Hepatitis C

	Number
Number of Hepatitis C cases with a subsequent New Diagnosis of Acute Hepatitis B 2012-2016	7
Number of Hepatitis C cases with a subsequent New Diagnosis of Chronic Hepatitis B 2012-2016	54
Number of Hepatitis B cases with a subsequent New Diagnosis of Acute Hepatitis C 2012-2016	0
Number of Hepatitis B cases with a subsequent New Diagnosis of Chronic Hepatitis C 2012-2016	35
Number Co-Infected at time of diagnosis (±30 days), 2012-2016	87
Number Living with Dual Infected Hepatitis B & C as of 12/31/16*	644

*May include those who resolved their infection, treated and cured, or moved out of state.

Table D.2: Cumulative and Living Reported Cases of Hepatitis B and Hepatitis C Who are Co-Infected with HIV

	Hepatitis B	Hepatitis C
Number with subsequent New HIV Diagnosis 2012-2016	16	41
Number PLWHA with subsequent New Hepatitis Diagnosis 2012-2016	79	351
Number Co-Infected at time of diagnosis (±30 days), 2012-2016	14	39
Number Living with Dual Infected HIV & Hepatitis as of 12/31/2016	493	1326

*May include those who resolved their infection, treated and cured, or moved out of state.

Table E.1: Estimated current and ever PWID in Colorado

	2016 Colorado population age 13 years and older*	Estimated prevalence of PWID	Estimated Number in Colorado
Injection drug use behavior in the past year	4,626,029	0.3%	13,878
Lifetime injection drug use behavior	4,626,029	2.6%	120,277

State Demography Office 2016 Forecast.

Figure A.7: Average 5-year Reported Hepatitis A Rates by County, Colorado 2012-2016

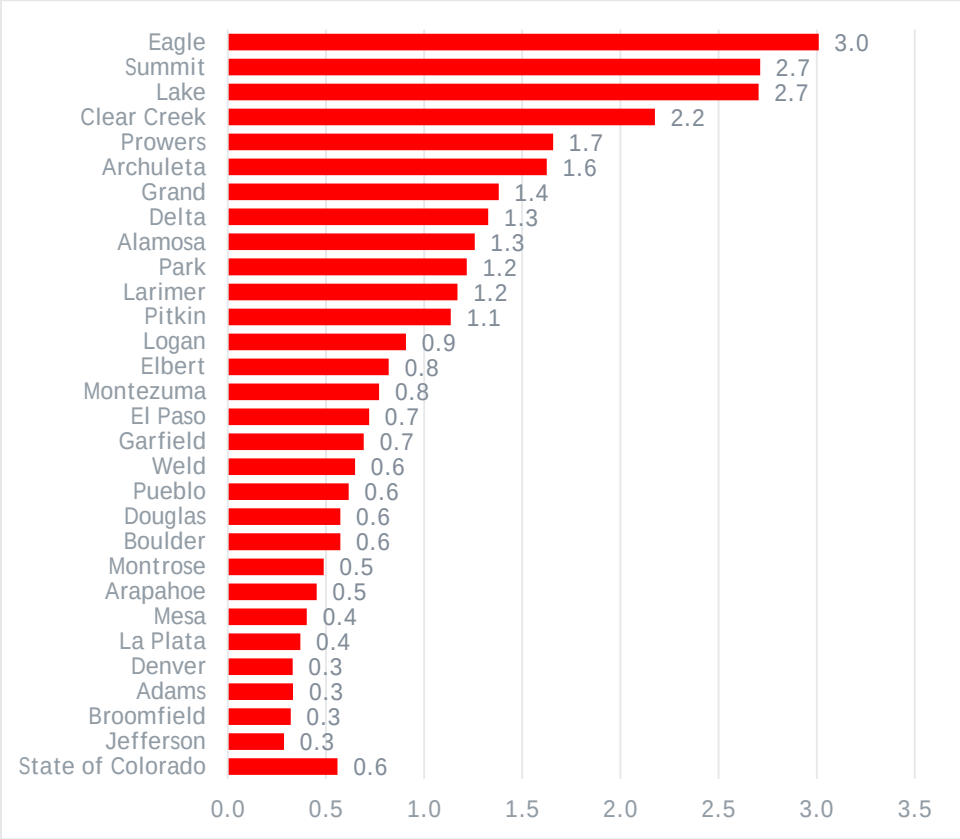


Figure A.8: Reported Hepatitis A Percent by County, Colorado 2012-2016

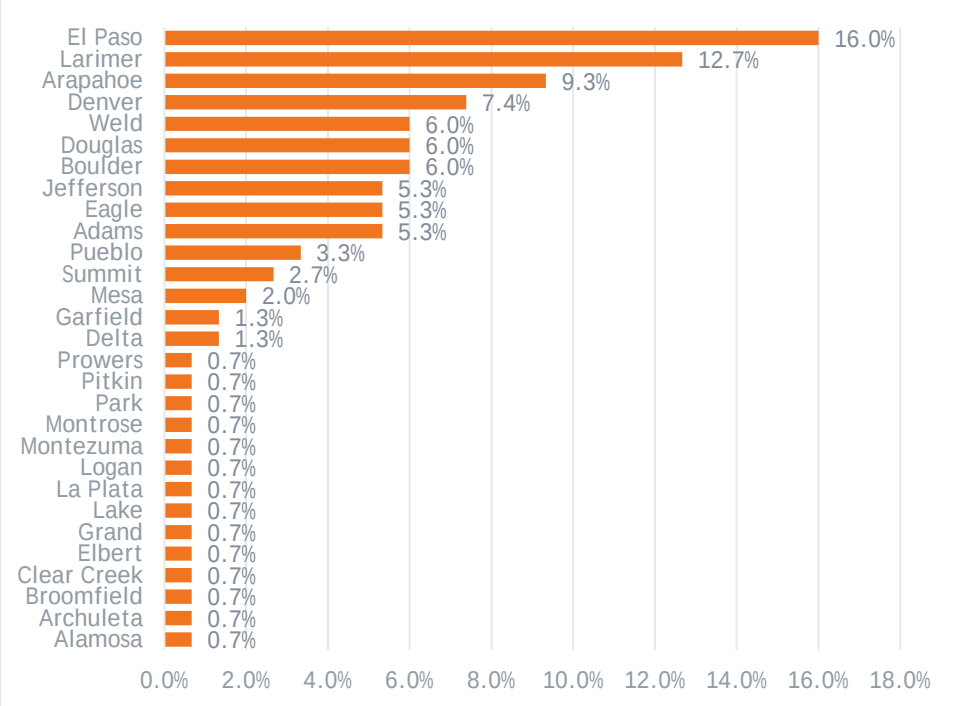
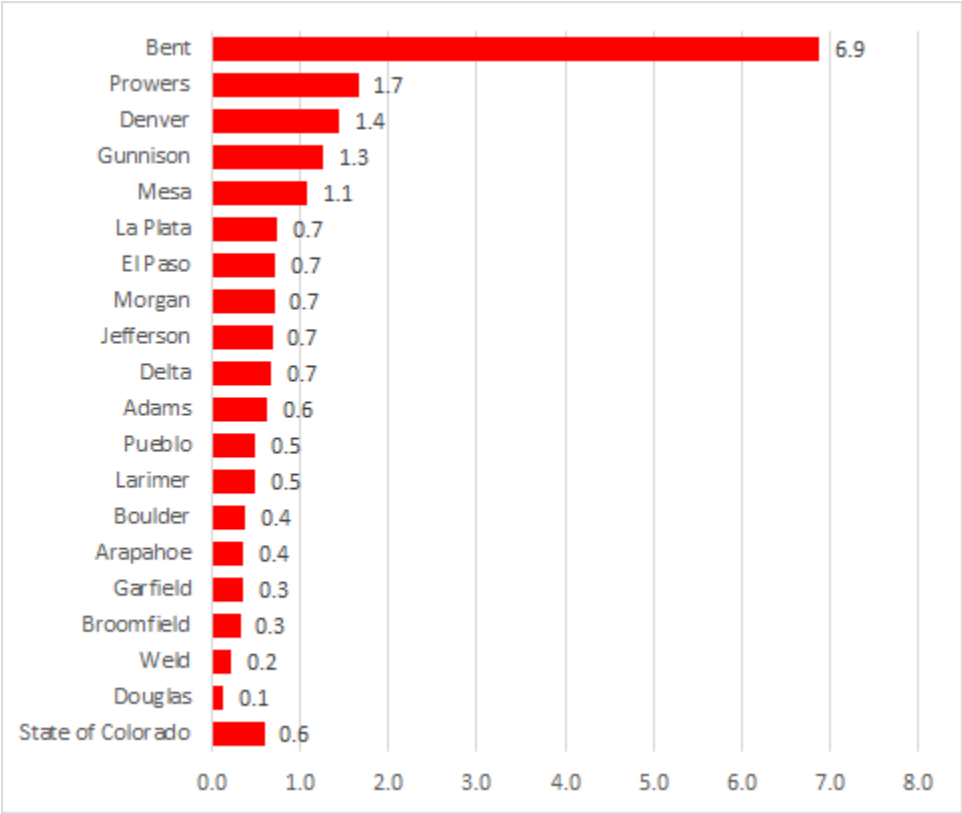
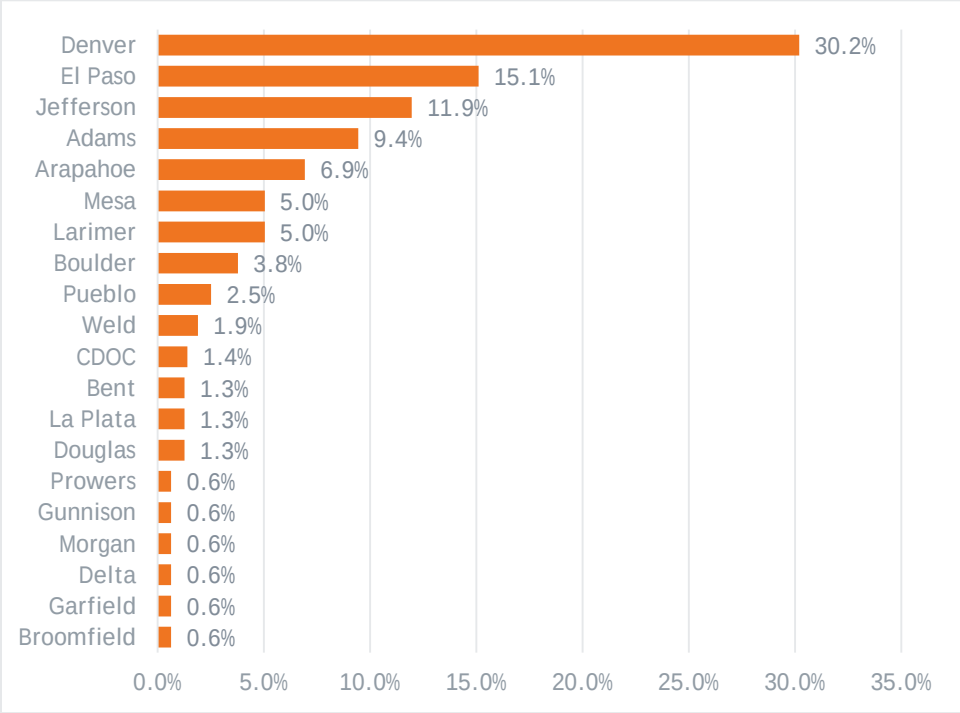


Figure B.13: Average 5-year Reported Acute Hepatitis B Rates by County, Colorado 2012-2016



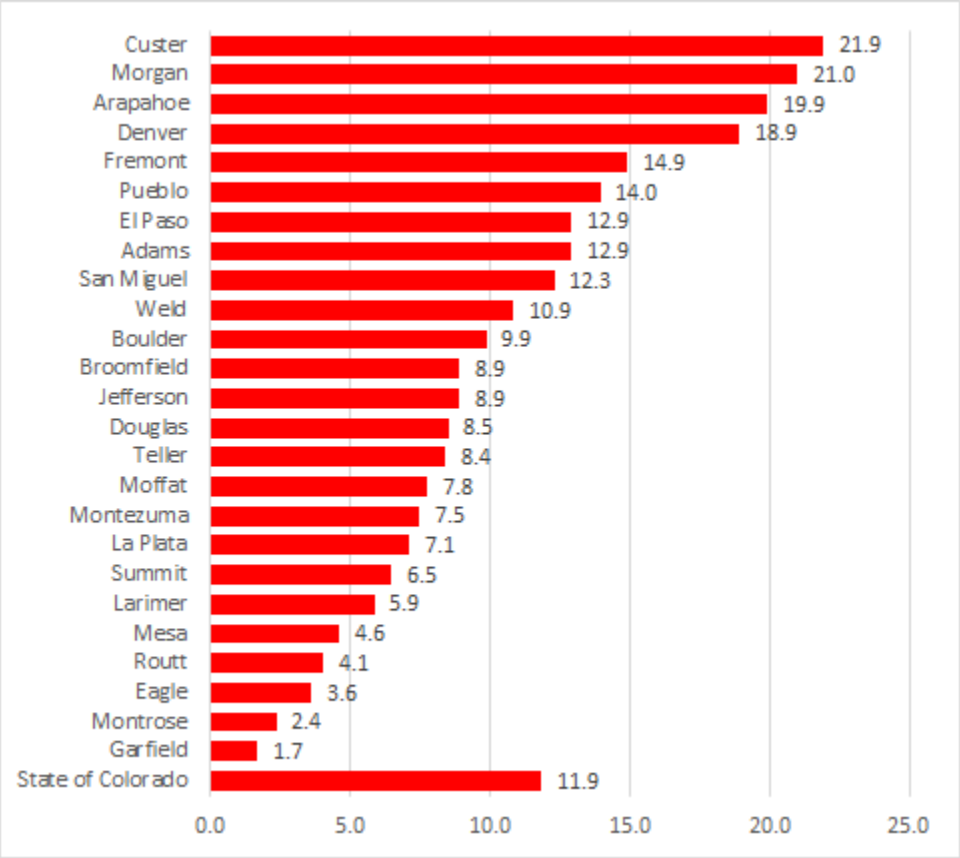
*State of Colorado rate includes those diagnosed in state or federal corrections.

Figure B.14: Reported Acute Hepatitis B Percent by County, Colorado 2012-2016



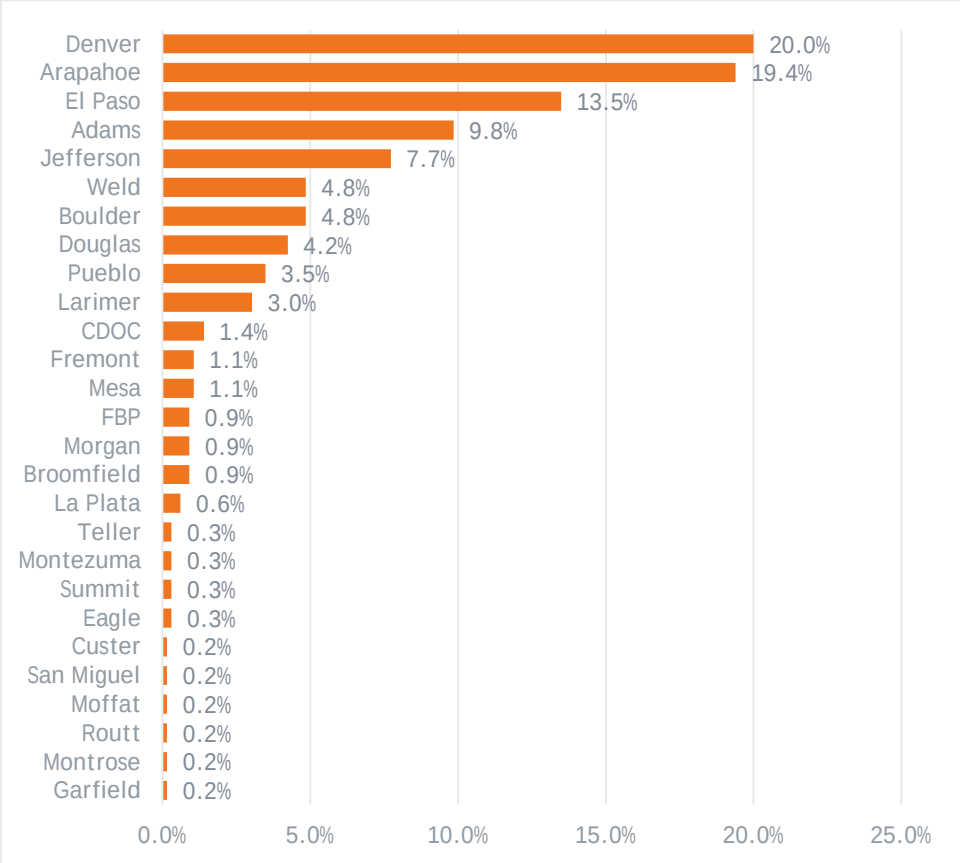
CDOC – Incarcerated in the Colorado Department of Corrections.

Figure B.15: Reported Chronic Hepatitis B Rates by County, Colorado 2016



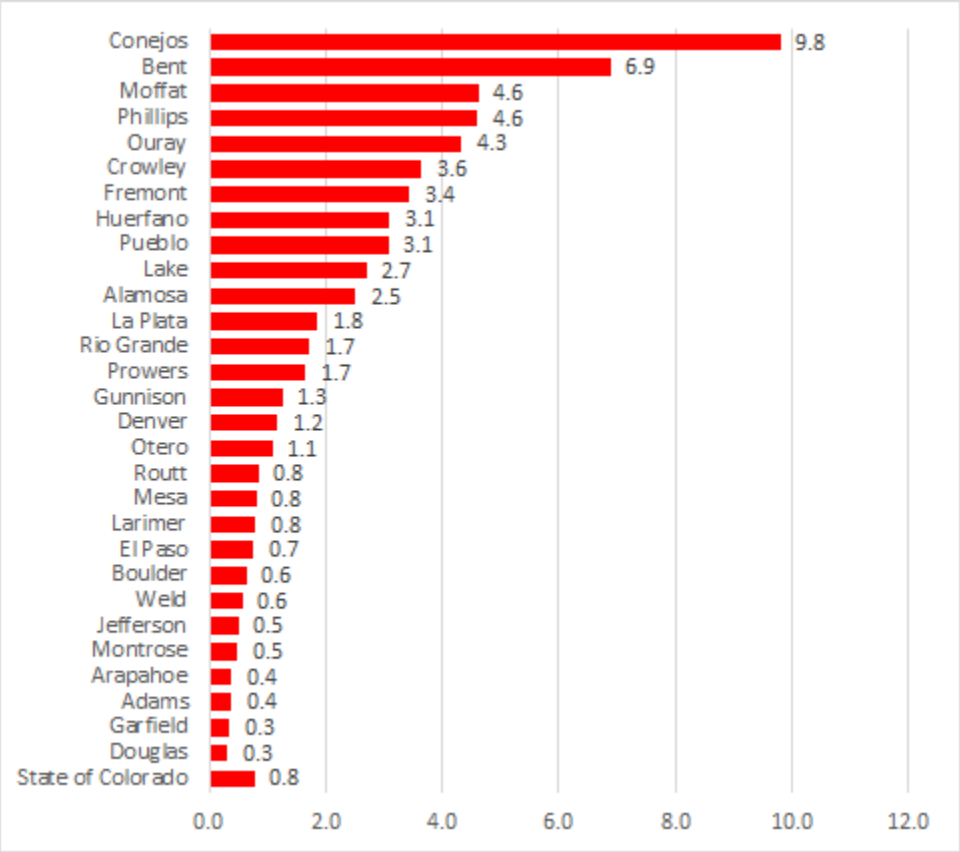
*State of Colorado rate includes those diagnosed in state or federal corrections.

Figure B.16: Reported Chronic Hepatitis B Percent by County, Colorado 2016



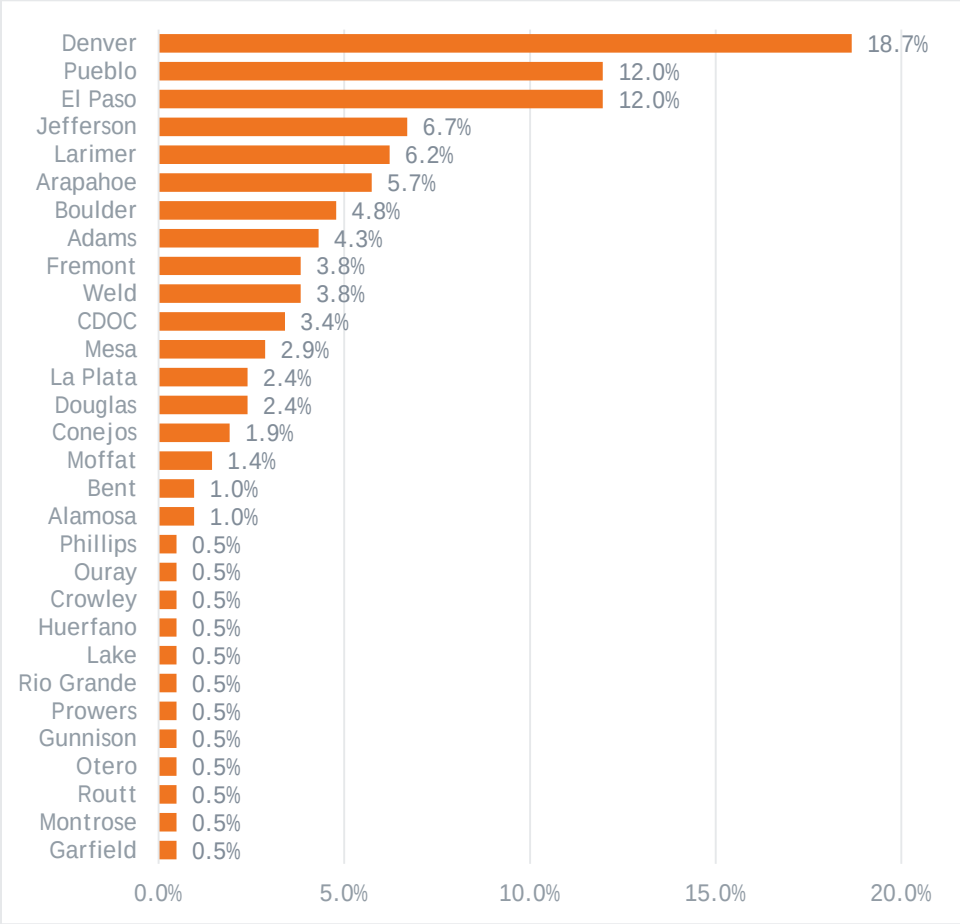
CDOC – Incarcerated in the Colorado Department of Corrections. FBP – Incarcerated in the Federal Bureau of Prisons.

Figure C.16: Average 5-year Reported Acute Hepatitis C Rates by County, Colorado 2012-2016



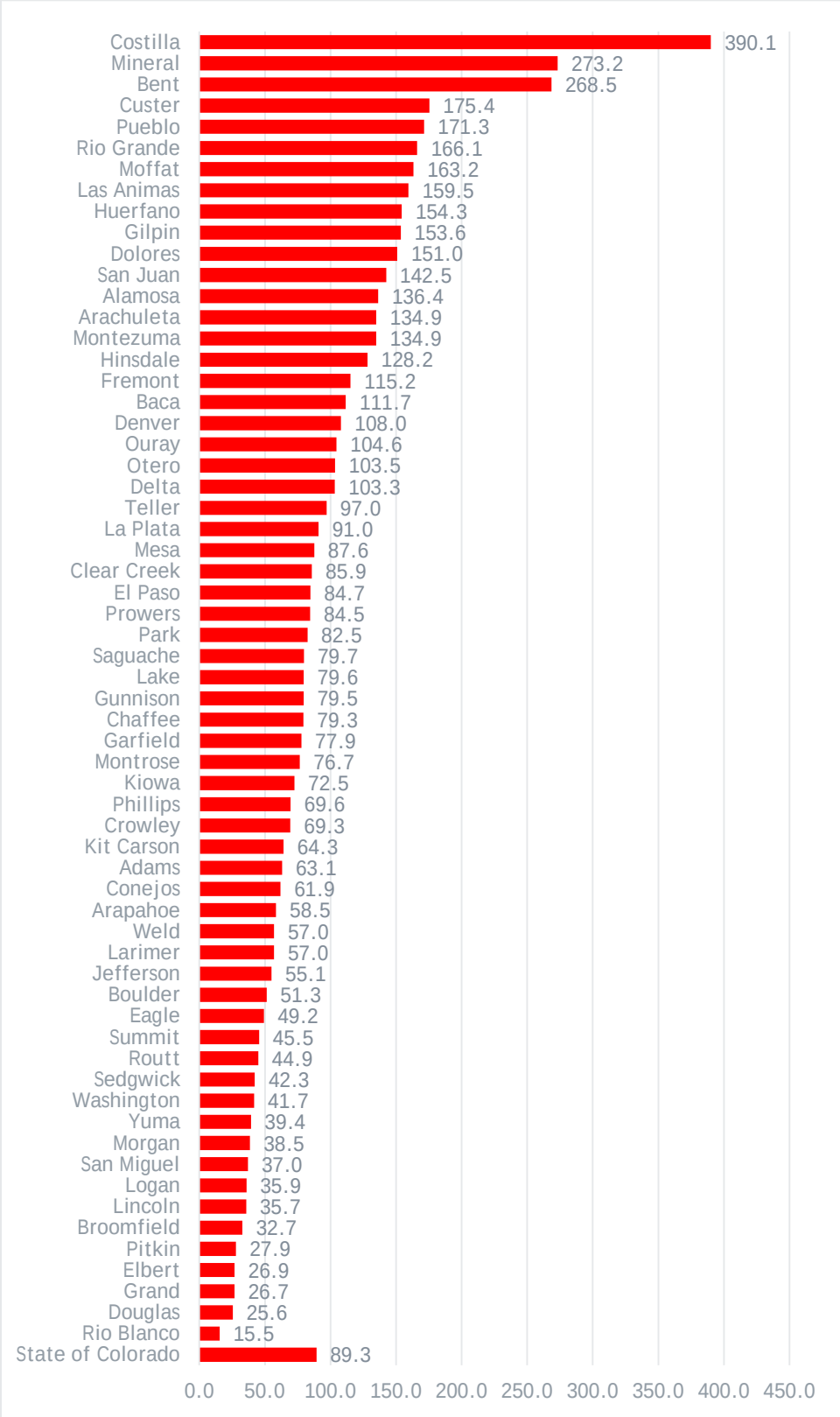
*State of Colorado rate includes those diagnosed in state or federal corrections.

Figure C.17: Reported Acute Hepatitis C Percent by County, Colorado 2012-2016



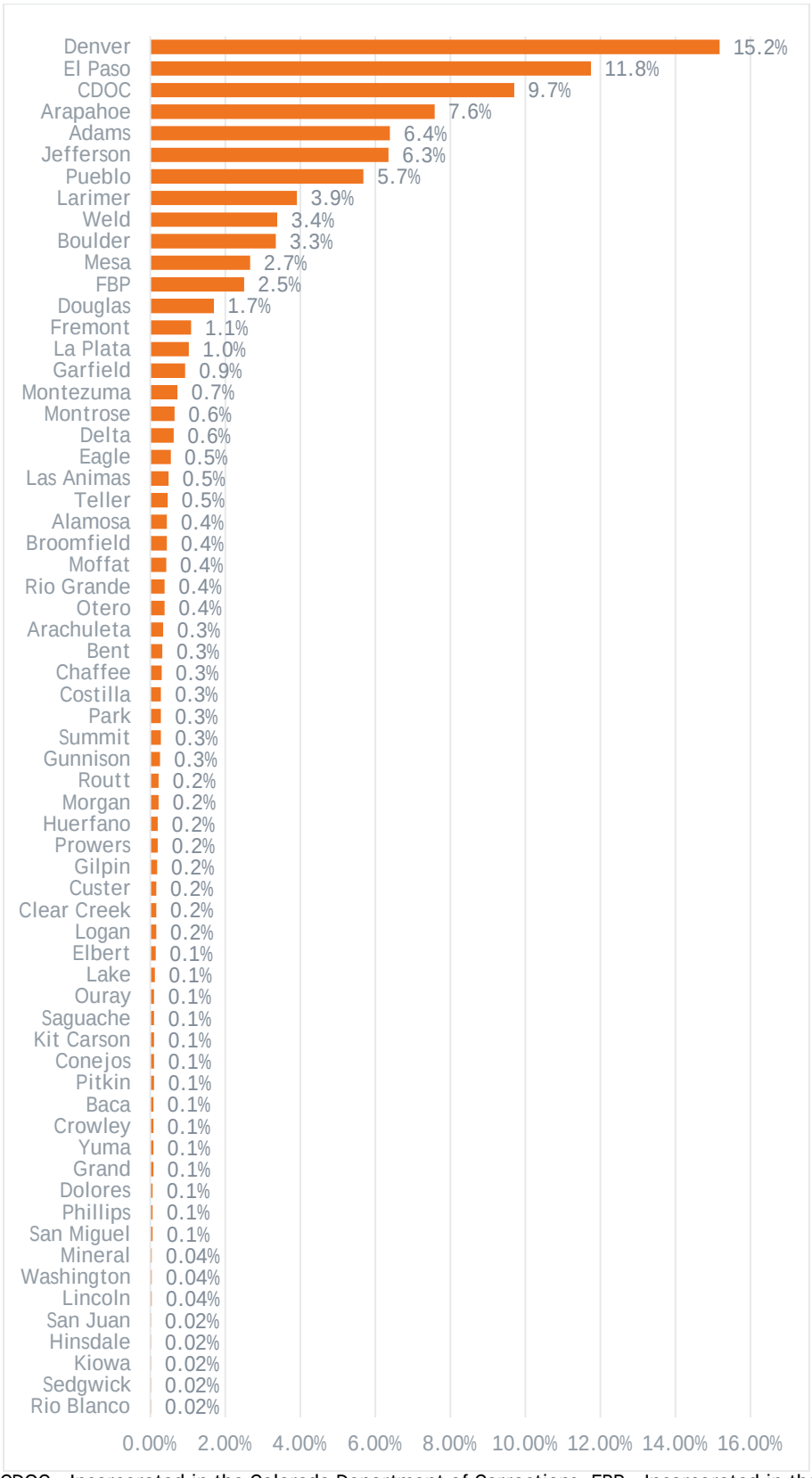
CDOC – Incarcerated in the Colorado Department of Corrections.

Figure C.18: Reported Chronic Hepatitis C Rates by County, Colorado 2016



*State of Colorado rate includes those diagnosed in state or federal corrections.

Figure C.19: Reported Chronic Hepatitis C Percent by County, Colorado 2016



CDOC – Incarcerated in the Colorado Department of Corrections. FBP – Incarcerated in the Federal Bureau of Prisons.