



2015 Surveillance Report
Viral Hepatitis in Colorado



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About this report

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

Data are presented for all hepatitis A, B, and C cases reported to CDPHE by Dec. 31, 2015.

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

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Executive summary

This report describes the epidemiology of hepatitis A, B and C in Colorado. The three hepatitis viruses cause similar symptoms, but have different modes of transmission and can affect the liver differently. The Colorado Department of Public Health and Environment (CDPHE) used available data resources to describe 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.

Hepatitis A

- Hepatitis A is typically a foodborne illness that appears only as a newly occurring (acute) infection which does not become chronic.
- Reports of people infected with hepatitis A virus (HAV) in Colorado have decreased from 500 cases reported in 1996, to 50 or fewer reported cases per year since 2010, with 24 cases reported in 2015. 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; infected people usually improve without treatment.

Hepatitis B

- Hepatitis B is typically a bloodborne illness that can occur as acute or chronic infection.
- Prevalence in the United States is estimated to be 0.3 percent (range of 0.2 percent to 0.4 percent), which equates to an estimated 16,370 (range of 10,913 to 21,826) Coloradans currently infected with hepatitis B virus (HBV).
- 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 24 to 32 cases annually, but CDC estimates there are an additional 6.48 acute cases for each case reported to public health.
- An effective vaccine is available. The vaccine, coupled with improvements in prenatal screening (96.5 percent of pregnant women were screened in 2015) and treatment, has resulted in no acute childhood infections and large declines in chronic childhood infections.
- Most Colorado children (92.1 percent in 2015) receive the three doses of HBV vaccine by age 3, yet only 76.4 percent of newborns received the first dose of vaccine within the first three days of birth.
- Trends in Colorado indicate males consistently have higher numbers of reported cases of acute and chronic hepatitis B, and adults age 50-plus represent an increasing proportion of chronic hepatitis B.
- Data regarding race/ethnicity is incomplete for many hepatitis B case reports, but indicate Asian/Pacific Islanders and African-Americans are disproportionately affected by the disease, particularly if they were born in another country.
- Both urban and rural counties in Colorado are affected by hepatitis B.

Hepatitis C

- Hepatitis C is typically a bloodborne illness that can occur as acute or chronic infection.
- Prevalence in the United States is estimated to be 1.3 percent (range of 1.0 percent to 2.0 percent), which equates to an estimated 70,935 (range of 54,566 to 109,131) Coloradans currently infected with hepatitis C Virus (HCV).

- CDPHE receives approximately 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.
- There is no vaccine to prevent hepatitis C.
- 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 infections.
- Trends in Colorado indicate adults ages 20 to 29 represent an increasing proportion of chronic hepatitis C infections in the past five years; most acute hepatitis C infections have occurred in this age group as well.
- Data regarding race/ethnicity is incomplete for many hepatitis C case reports, but indicate African-Americans and American Indians are disproportionately affected.
- 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 infections 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.
- Effective treatment is available but only about one in ten chronically infected people in the U.S receives treatment.
- Improvements in screening and treatment can help decrease the burden of hepatitis C in Colorado.

Other topics

- 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 plateaued.
- 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.

Hepatitis surveillance

Viral hepatitis surveillance in Colorado is primarily based on laboratory reporting of serologic results. Hepatitis A is a nationally notifiable condition. The Colorado Board of Health requires physicians and other health care providers to report suspected cases of hepatitis A within 24 hours of detection. Although hepatitis B and hepatitis C are not nationally notifiable, Colorado statute requires healthcare providers to report acute hepatitis B and hepatitis C within seven days and laboratories to report positive HBV and HCV serologic tests (including positive serum antibody titers with signal-to-cutoff ratios or more specific tests) within seven days.

Hepatitis laboratory results come to CDPHE via Electronic Laboratory Reporting (ELR) from 23 different feeds from commercial laboratories, hospital systems, and the Colorado Health Information Organization exchange (CORHIO). Each feed can include reporting from many different laboratories. In 2015, CDPHE received approximately 1,450 HAV, 27,000 HBV and 44,000 HCV test results via ELR and approximately 100 HAV, 5,000 HBV, and 10,000 HCV test results by other methods (fax, mail, and direct entry into the Colorado Electronic Disease Reporting system (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, probable and suspect 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. Two people reported as having both acute and chronic hepatitis C in 2015 are counted only as acute cases in this surveillance report.

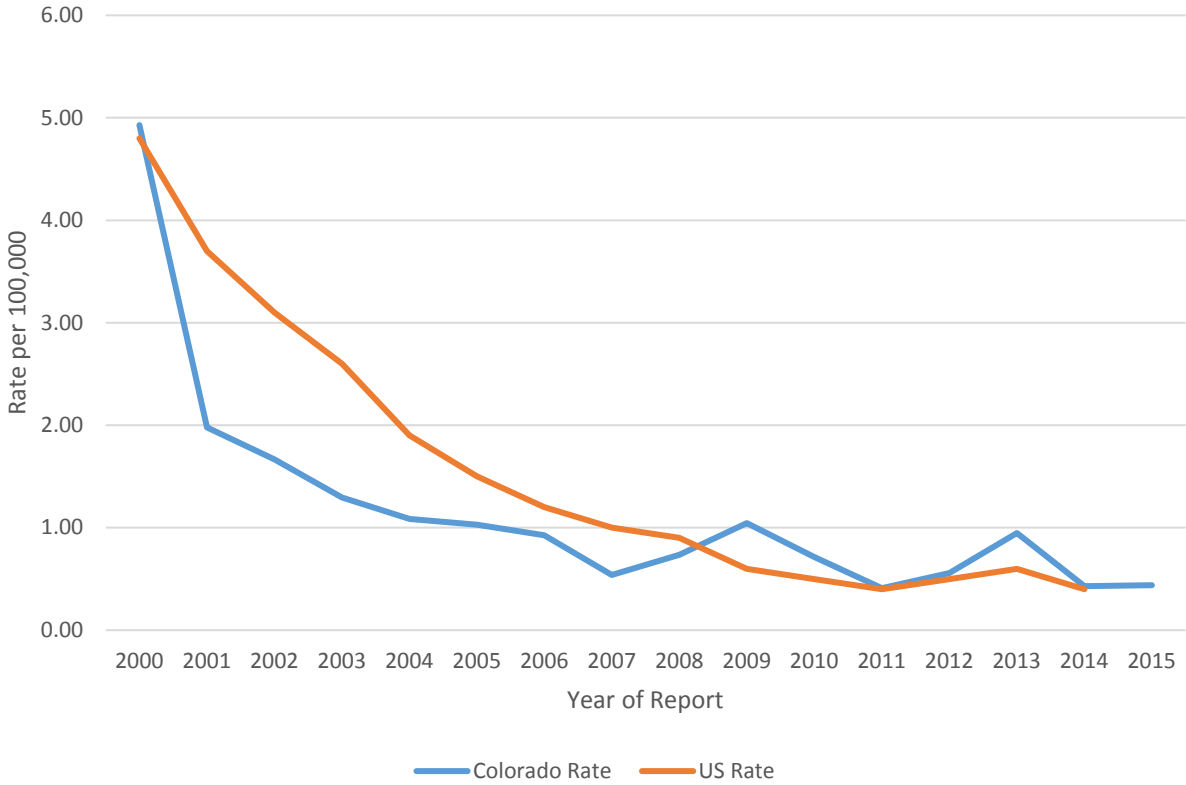
Unlike HIV and many other less common communicable diseases, funding for viral hepatitis surveillance is extremely limited. Only seven jurisdictions in the United States (five states and two cities, not including Colorado or Denver) have CDC funding for viral hepatitis surveillance.¹ Surveillance for 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 in Colorado

Background

Hepatitis A is typically a foodborne illness that appears only as an acute (newly occurring) infection, which does not become chronic. The Hepatitis A virus (HAV) is transmitted by eating or drinking contaminated food and/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 hepatitis A infection has been declining and is the lowest it has 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 2014, there were an estimated 2,500 acute hepatitis A infections in the United States.¹ Colorado had 24 cases of hepatitis A reported in 2015, which is likely almost half of all cases that occur. CDC estimates there actually are 1.95 cases for every reported case.² 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 data¹ as shown in Figure A.1. 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>.

Figure A.1: Incidence Rates of Reported Hepatitis A Infections in Colorado³ and the United States, 2000-2015



Case reports of Hepatitis A

The rate of reported hepatitis A cases in Colorado declined dramatically between 2000 and 2015 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. The vaccine was licensed in 1995, and the first recommendations for its use were published in late 1996.

During the 1990s, Colorado was considered an “intermediate incidence” state, with a rate of hepatitis A infection between 10 and 20 cases per 100,000, above the national average of 10 cases per 100,000 population. As such, 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 infection in Colorado now is comparable to the US rate. Hepatitis A vaccine remains a recommended, and not required, vaccine in Colorado.

Table A.1: Confirmed Hepatitis A Cases Reported 2011-2015 in Colorado by Sex, Age and Race/ethnicity.

	Number	% of total	Average annual rate per 100,000‡
Sex			
Female	70	47.6	0.53
Male	77	52.4	0.58
Age (years)			
<1	1	0.7	0.31
1-4	4	2.7	0.30
5-9	4	2.7	0.22
10-14	3	2.0	0.17
15-19	8	5.4	0.46
20-39	42	28.6	0.57
40-59	43	29.3	0.59
60-79	36	24.5	0.91
80+	6	4.1	0.76
Race/ethnicity			
White, non-Hispanic	105	71.43	0.57
Hispanic	18	12.24	0.32
Black, non-Hispanic	5	3.4	0.46
Asian/Pacific Islander, non-Hispanic	10	6.8	1.12
American Indian, non-Hispanic	0	N/A	N/A

‡ Rates per 100,000 were calculated using State Demography Data.³

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 2011 to 2015, the rates among males and females have been essentially the same.

Age

Rates of hepatitis A are now lowest among children, which likely is 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 2011 to 2015, the highest rates are among people who are 60-79 years old (0.91 per 100,000), followed by those who are 80 or older (0.76 per 100,000). The largest burden of illness is among adults, for whom vaccine is not routinely offered.

Race/ethnicity

During 2011 to 2015 the average incidence rate was highest for Asian/Pacific Islanders, at 1.12 per 100,000. These numbers are small and must be interpreted with caution. However, four of these five cases (80 percent) reported international travel before the onset of symptoms, suggesting there is room to improve messaging around recommendations for pre-travel vaccinations.

In contrast with previous hepatitis A data summaries, incidence among Hispanics was lower during 2011-2015 than for other racial or ethnic groups. This is notable, since as recently as 2005 to 2009, Hispanics had the highest incidence of hepatitis A infection in Colorado and a fivefold difference in incidences rates between white non-Hispanics and Hispanics existed during 1989 to 1993 (CDPHE, data not shown).

Table A.2: Clinical Characteristics of Confirmed Hepatitis A Cases Reported 2011-2015 in Colorado (n=147)

Characteristic	Number	Percent
Fatigue	124	84.4%
Loss of appetite	116	78.9%
Nausea	110	74.8%
Dark urine	106	72.1%
Abdominal pain	106	72.1%
Jaundice	105	71.4%
Fever	86	58.5%
Hospitalized	63	42.9%
Diarrhea	60	40.8%
Death	0	0.0%

Clinical characteristics of Hepatitis A

The most commonly reported symptoms among reported hepatitis A cases were fatigue, loss of appetite, nausea and dark urine. Jaundice was reported by 71% of cases. Forty-two percent of cases were hospitalized. This is higher than in previous reports⁴ and is likely a reflection of the older average age of cases. No deaths were reported.

Table A.3: Reported Exposure to Potential Risk Factors for Hepatitis A Infection Among Confirmed Hepatitis A Cases in Colorado, 2011-2015 (n=147).

Potential Exposure*	Yes		No		Unknown	
	Number	%	Number	%	Number	%
International travel	45	30.6	98	66.7	4	2.7
Member of household traveled internationally in past 3 months	28	19.0	111	75.5	8	5.4
Part of a known common source outbreak	26	17.7	86	58.5	35	23.8
Consumed raw shellfish	11	7.5	119	81.0	17	11.6
Contact of person who attends/works in child care	11	7.5	129	87.8	7	4.8
Contact with a person with hepatitis A**	10	6.8	122	83.0	15	10.2
Patient attends or works in child care	4	2.7	138	93.9	5	3.4
Injection drug use	1	0.7	132	89.8	14	9.5

*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 (5); categories not mutually exclusive.

HAV exposure

Sixty-nine cases (47 percent) 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 2011-2015. 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.

Table A4: Average Hepatitis A Incidence Rates in Colorado by County, 2011-2015

County*	Number of Cases 2011-2015	Population‡	Average Rate per 100,000
Adams	7	469971	0.30
Alamosa	1	15824	1.26
Arapahoe	15	607751	0.49
Archuleta	1	12202	1.64
Baca		3681	
Bent		5713	
Boulder	13	310384	0.84
Broomfield	2	60024	0.67
Chaffee		18281	
Cheyenne		1898	
Clear Creek	1	9076	2.20
Conejos		8223	
Costilla		3539	
Crowley		5274	
Custer		4286	
Delta	2	30326	1.32
Denver	15	649214	0.46
Dolores		2017	
Douglas	7	306604	0.46
Eagle	7	52441	2.67
Elbert	1	23649	0.85
El Paso	24	657413	0.73
Fremont		46413	
Garfield	2	57103	0.70
Gilpin		5575	
Grand		14281	
Gunnison		15614	
Hinsdale		805	
Huerfano		6484	
Jackson		1355	
Jefferson	9	551695	0.33
Kiowa		1403	
Kit Carson		8276	
Lake	1	7319	2.73
La Plata	1	53404	0.37

County	Number of Cases 2011-2015	Population‡	Average Rate per 100,000
Larimer	20	316303	1.26
Las Animas		14376	
Lincoln		5423	
Logan		21815	
Mesa	1	148331	0.13
Mineral		725	
Moffat		13099	
Montezuma	1	25660	0.78
Montrose	1	40730	0.49
Morgan		28246	
Otero		18516	
Ouray		4544	
Park		16149	
Phillips		4361	
Pitkin	2	17388	2.30
Prowers	1	12258	1.63
Pueblo	3	161207	0.37
Rio Blanco		6724	
Rio Grande		11721	
Routt		23450	
Saguache		6243	
San Juan		702	
San Miguel		7645	
Sedgwick		2347	
Summit	2	28788	1.39
Teller		23261	
Washington		4764	
Weld	7	270175	0.52
Yuma		10208	

* County of residence is determined at the time the case is reported.

‡ 2013 population estimates used for mid-point calculation.³

**Rates per 100,000 were calculated using State Demography Data.³ 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.

Hepatitis B in Colorado

Acute and chronic

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.⁵

Hepatitis B accounts for almost 2,000 annual deaths in the United States.¹ 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.⁶ Hepatitis B and C cause an estimated 61 percent of hepatocellular carcinoma (HCC) in the U.S.⁷ 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.⁸

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.⁷ 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 hepatitis B virus (HBV) vaccine confer greater than 95 percent immunity. Vaccination has helped decrease rates of hepatitis B, particularly among school-age children.

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. Among those infected, 25 to 50 percent of children ages 1-5 years, and up to 90 percent of infants will develop chronic hepatitis B.⁹ Over time, chronic hepatitis B can result in liver disease, cirrhosis, or cancer. The surveillance case definition for chronic hepatitis B infection has not changed since 2012 and can be found at <https://wwwn.cdc.gov/nndss/conditions/hepatitis-b-chronic>.

Perinatal hepatitis B infection

Perinatal hepatitis B Infection is defined as HBV surface antigen (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 baby. A dose of HBV vaccine at birth, completing the full series of three vaccines, and HBV immune globulin administered within 12 hours of birth can help prevent

transmission to the baby. The baby receives post-vaccine serologic testing at 9 months to verify conversion to immunity from the vaccine.

HBV case follow-up

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.

HBV transmission

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 East Asia and sub-Saharan Africa.⁷ Vaccination of all high-risk groups, not just children, can help reduce the number of new infections.

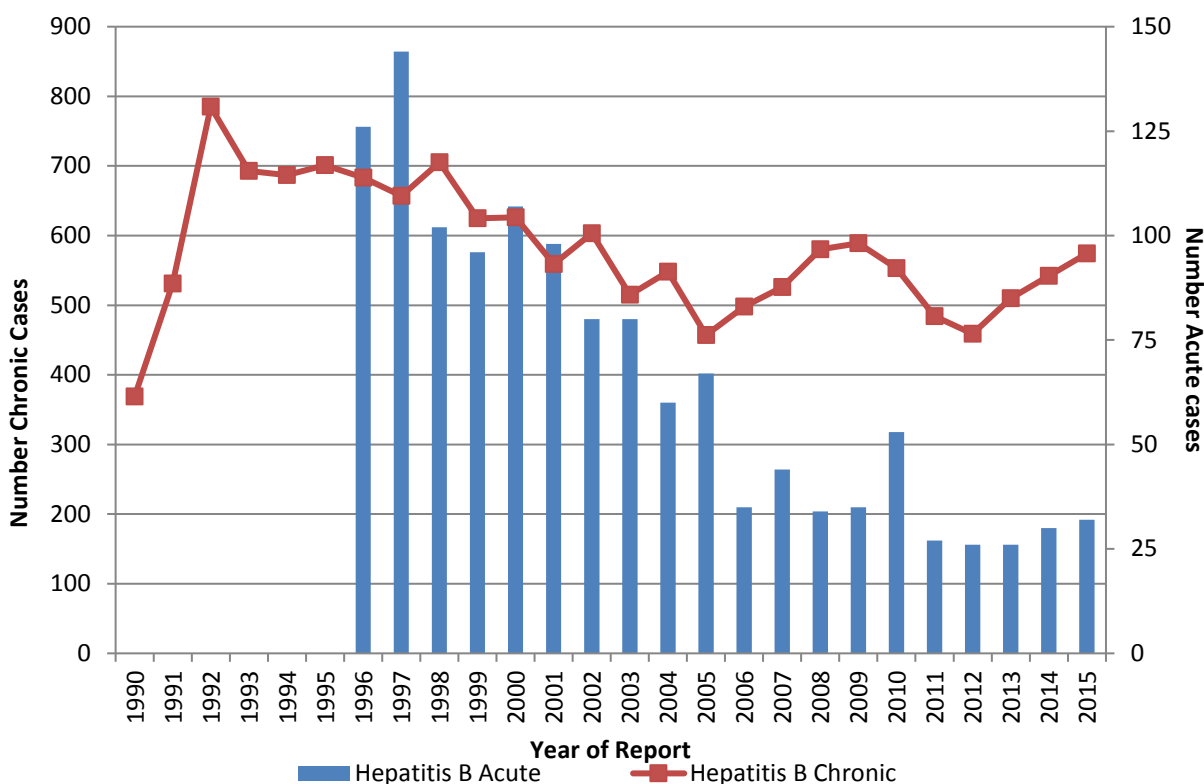
Hepatitis B infection prevalence estimate

CDPHE estimates there are currently about 16,370 (range of 10,913 to 21,826) people in Colorado living with chronic, unresolved HBV infection. This estimate is based on the U.S. Census 2015 Colorado population, estimated at 5,456,574, and a national published HBV prevalence rate estimate from 2007-2012 NHANES data¹⁰ of 0.3 percent (range of 0.2 percent-0.4 percent). Colorado's surveillance system does not sufficiently track how many people have resolved HBV 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.¹¹ Applying national rates to Colorado is further limited by the fact that national rates may not reflect hepatitis B in Colorado.

Cumulative case reports of acute and chronic hepatitis B

From 1990 through 2015, a total of 1,302 acute and 15,055 chronic HBV infections 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. Figure B.1 shows hepatitis B cases reported in Colorado by year. The number of acute hepatitis B cases declined initially and has remained around 26 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 three years.

Figure B.1. Number of Reported Acute and Chronic Hepatitis B Cases in Colorado, 1990-2015.



Hepatitis B epidemiology

In Colorado in 2015, a total of 32 cases of acute hepatitis B and 573 cases of chronic hepatitis B were reported. Table B.1 describes the distribution of reported cases by gender, age, and race/ethnicity. There were a total of 141 pregnant women with hepatitis B in 2015. Fifty of those women were newly diagnosed in 2015, and 91 had previously been diagnosed but had a new pregnancy in 2015. Rates presented in the table include both acute and chronic case reports. Applying published multipliers to adjust for under-ascertainment and underreporting⁴ to the 32 acute hepatitis B case reports in 2015, we estimate that Colorado actually had 208 acute hepatitis B cases in the last year. Colorado has a slightly lower rate of reported acute hepatitis B compared to the U.S. rate (years 2010-2014), 0.5 per 100,000 population in Colorado versus 0.9 per 100,000 population in the U.S.¹ However, reporting practices vary across states; therefore, comparing rates may be misleading.

There are several Healthy People 2020 objectives for hepatitis B regarding acute infections and vaccination.¹² 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 2015.¹³ Similarly, another objective is to maintain an effective vaccination coverage level of three doses of HBV vaccine 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.¹⁴

Table B.1: Reported Hepatitis B Cases by Case Status, Sex, Age, and Race/Ethnicity: Colorado, 2015.

	Acute Hepatitis B Cases		Chronic Hepatitis B Cases		All Hepatitis B Cases	
	Number	% of Total	Number	% of Total	Total	Rate of Reported Cases/ 100,000 ‡
Total	32		573		605	11.1
Case Status						
Confirmed	28	87.5%	215	37.5%	243	N/A
Probable	4	12.5%	358	62.5%	362	N/A
Gender						
Female	8	25.0%	246	42.9%	254	9.4
Male	24	75.0%	327	57.1%	351	12.8
Age (years)						
0-4	0	0.0%	3	0.5%	3	0.9
5-9	0	0.0%	5	0.9%	5	1.4
10-19	0	0.0%	23	4.0%	23	3.3
20-29	5	15.6%	104	18.2%	109	13.5
30-39	6	18.8%	139	24.3%	145	18.7
40-49	11	34.4%	119	20.8%	130	18.3
50-59	4	12.5%	104	18.2%	108	14.8
60+	6	18.8%	76	13.3%	82	7.9
Cases by birth date related to the 1997 school immunization requirement						
Born before 1986	27		443		470	14.5
Born 1986 and after	5		130		135	6.1
Race/ethnicity						
White	23	71.9%	46	8.0%	69	Not calculated
Black	3	9.4%	54	9.4%	57	
Hispanic	1	3.1%	8	1.4%	9	
American Indian	0	0.0%	2	0.4%	2	
Asian	1	3.1%	157	27.4%	158	
Pacific Islander	0	0.0%	2	0.4%	2	
Other	0	0.0%	4	0.7%	4	
Multiple races	2	6.2%	3	0.5%	5	
Missing/Unknown	2	6.2%	297	51.8%	299	

Table B.1a: Total Number of Pregnant Women Reported with Hepatitis B, N = 141

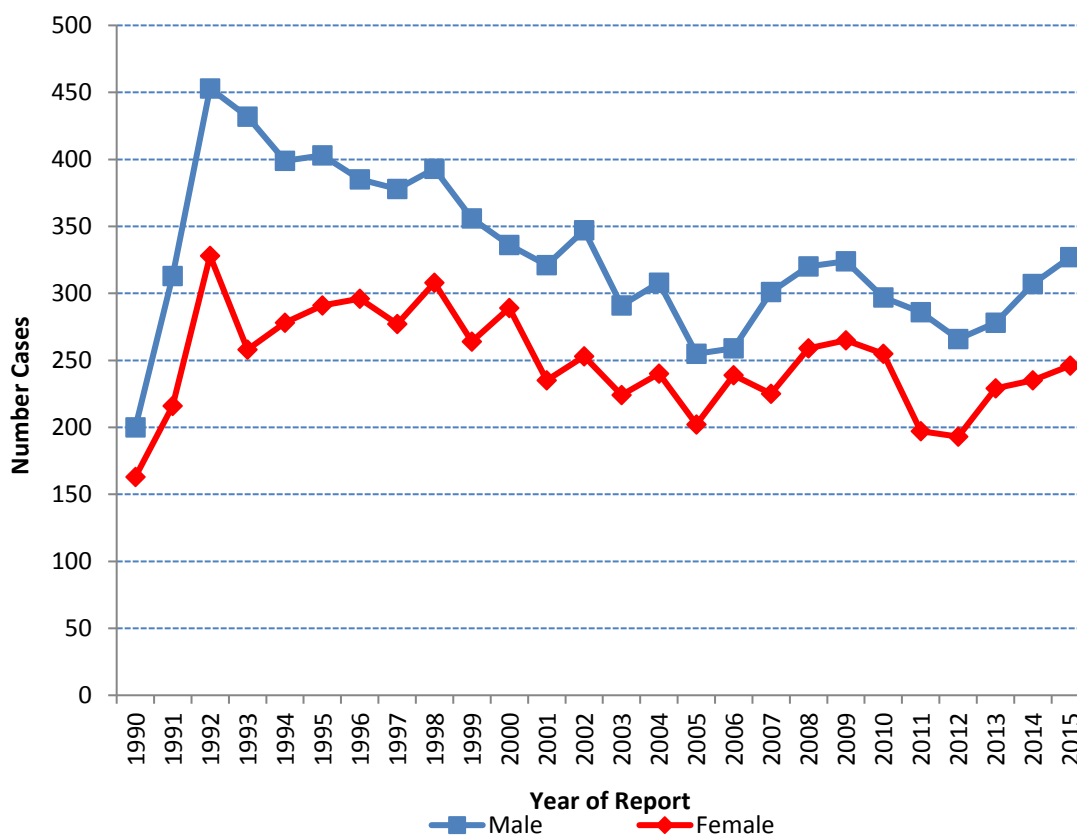
Newly reported HBV cased in 2015	Previous HBV cases/new pregnancy
50	91

‡ Rates per 100,000 were calculated using the U.S. Census Bureau.¹⁵ Rates calculated for small populations should be interpreted with caution. This is not a rate of disease incidence.
N/A=Not applicable

Gender

Among hepatitis B acute cases reported in 2015, 24 (75.0 percent) were reported in men, and eight (25.0 percent) in women. For chronic infections, more than half of the reported cases were among men (57.1 percent). Figure B.2 demonstrates that men are consistently reported with chronic hepatitis B more frequently than women.

Figure B.2. Number of Male and Female Chronic Hepatitis B Case Reports in Colorado, 1990-2015.



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 2015 show that of 66,438 pregnant women with known screening status (720 had unknown screening status), 96.5 percent of women were screened for HBV during pregnancy¹³ as recommended by the CDC Advisory Committee on Immunization Practices and the U.S. Preventive Services Taskforce. There is no recommendation to routinely test men.

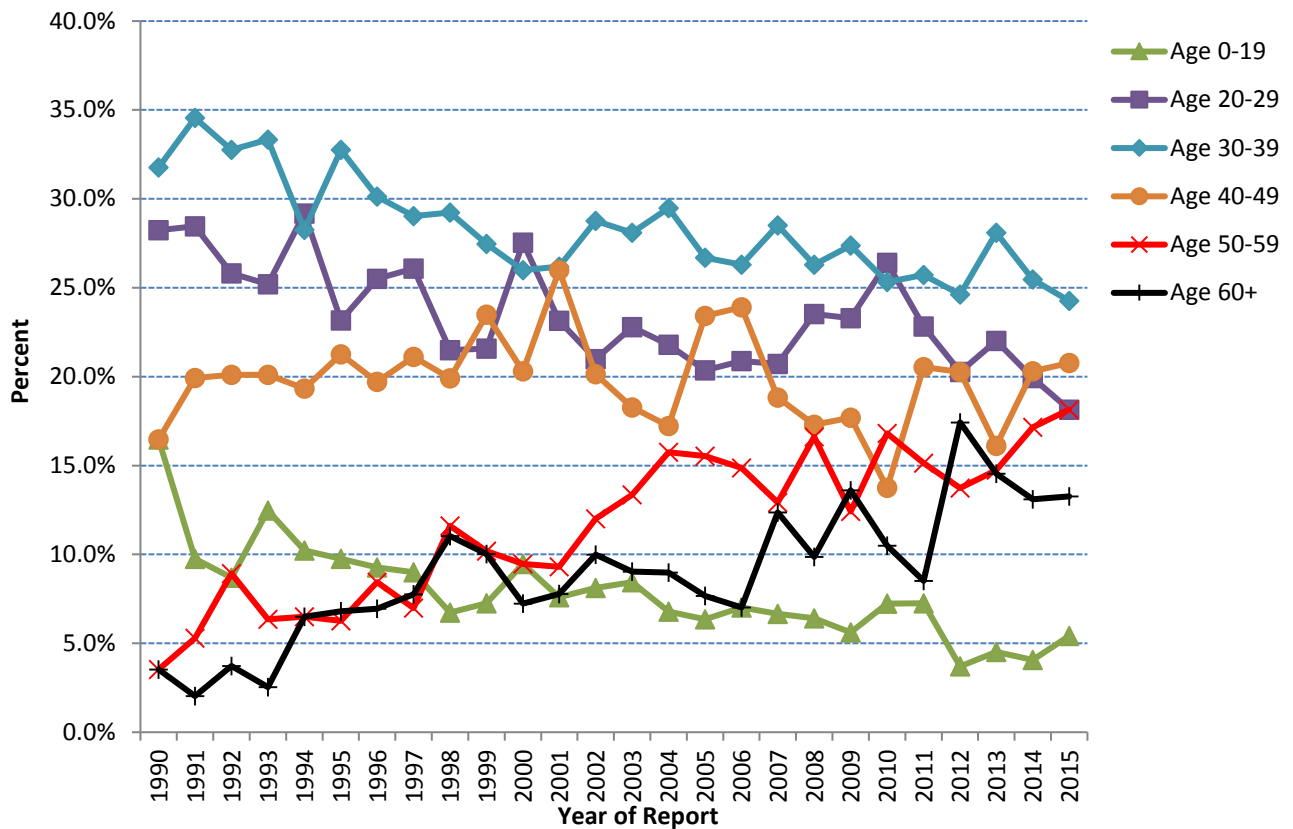
Age

Table B.1 shows that all reported acute hepatitis B infections in 2015 occurred among people > 19 years of age. Persons >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 incidence of acute infections in people over this age suggests that individuals in these age groups continue to engage in high-risk behavior and 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.

People ages 30-39 years represent the greatest proportion of chronic cases (24.4 percent). The proportions of chronic hepatitis B cases by age category have changed over time and are shown from 1990 to 2015 in Figure B.3. The proportion of cases in people ages 50 years and older has been increasing, while the proportion of cases in people under age 50 has decreased.

There was one perinatal hepatitis B case reported in Colorado in 2015 who had received appropriate preventive measures (HBV immune globulin within 12 hours of birth and the 3 dose vaccine series) yet still developed disease. This perinatal case did not meet the case definition for acute hepatitis B. The CDPHE enrolled 77 women in case management who had never before been enrolled in the Perinatal Hepatitis B Prevention Case Management Program.

Figure B.3. Proportion of Cases by Age Category for Chronic HBV Reports in Colorado, 1990-2015.



Race/ethnicity

Data on race and ethnicity was available for 93.8 percent of acute cases and 47.2 percent of chronic cases. Most acute cases of hepatitis B were reported among white non-Hispanics (n=23). The highest number of chronic hepatitis B infections were reported among Asians (n=157). Rates were not calculated by race/ethnicity because this information is missing for a large proportion of hepatitis B cases. 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 infections by race/ethnicity.¹ The prevalence of chronic hepatitis is highest in East Asia and sub-Saharan Africa.⁷

Table B.2 compares the 2015 general population of Colorado to all hepatitis B cases in 2011-2015, reporting the five main race/ethnic groups (66.4 percent of all cases reported during this time period). From this information, Asian/Pacific Islanders and African-Americans are over-represented among hepatitis B cases and whites and Hispanics are under-represented when compared to the general population of Colorado.

Table B.2: Race/Ethnic Proportions for Colorado Population and Reported (Acute and Chronic) Hepatitis Cases 2011-2015

Race/ethnicity	Percent of Colorado Population 2015*	Number Hepatitis B cases reporting these race/ethnicities 2011-2015	Percent of Hepatitis B cases reporting these race/ethnicities 2011-2015
White	69.0%	424	24.4%
African-American	4.1%	392	22.6%
Hispanic	22.3%	87	5.0%
American Indian	1.0%	12	0.7%
Asian/Pacific Islander	3.6%	823	47.4%
Unknown		911	33.6%
Multiple races/Other race		59	2.2%

*Percentages determined by Colorado State Demography Office.¹⁶

Nationally, rates of acute hepatitis B infection have been consistently higher for African-Americans compared to all other racial/ethnic groups. NHANES 1999-2006 data regarding national chronic hepatitis B rates by race/ethnicity indicate that persons of African-American and “other” race were about ten times more likely to have chronic infection than Whites and Hispanics. Asian/Pacific Islanders and American Indians did not have substantial sample size to be analyzed in their own group. Persons born outside of the U.S. had a rate that was five times higher than U.S.-born survey participants.¹⁷

Geographic distribution

Table B.3 describes the distribution of acute and chronic hepatitis B cases by county of residence. Acute hepatitis B cases were reported in nine of the 64 Colorado counties. Chronic hepatitis B cases were reported in 31 of the 64 Colorado counties. 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 10 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 Colorado Department of Corrections (CDOC) for state prisons and Federal Correctional Institute (FCI) for federal prisons. The 10 incarcerated hepatitis B chronic cases reported in 2015 were in the Colorado Department of Corrections (CDOC). Figure B.3 shows combined acute and chronic hepatitis B rates by county. The rates of reported cases are high in 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.

Table B.3: Number and Percentage of Reported Acute and Chronic Hepatitis B Cases by County of Residence, * Colorado, 2015.

	Acute Hepatitis B Cases		Chronic Hepatitis B Cases		All Hepatitis B Cases	
	Number	% of Total	Number	% of Total	Total	Rate of Reported Cases/ 100,000 ‡
Total	32		573		605	11.1
County of Residence*						
Adams	0	0.0%	58	10.1%	58	11.8
Alamosa	0	0.0%	0	0.0%	0	0.0
Arapahoe	2	6.2%	98	17.1%	100	15.8
Archuleta	0	0.0%	0	0.0%	0	0.0
Baca	0	0.0%	0	0.0%	0	0.0
Bent	0	0.0%	0	0.0%	0	0.0
Boulder	2	6.2%	19	3.3%	21	6.6
Broomfield	0	0.0%	7	1.2%	7	10.8
Chaffee	0	0.0%	0	0.0%	0	0.0
Cheyenne	0	0.0%	0	0.0%	0	0.0
Clear Creek	0	0.0%	0	0.0%	0	0.0
Conejos	0	0.0%	1	0.2%	1	12.3
Costilla	0	0.0%	0	0.0%	0	0.0
Crowley	0	0.0%	0	0.0%	0	0.0
Custer	0	0.0%	0	0.0%	0	0.0
Delta	0	0.0%	1	0.2%	1	3.3
Denver	8	25.0%	113	19.7%	121	17.7
Dolores	0	0.0%	0	0.0%	0	0.0
Douglas	0	0.0%	27	4.7%	27	8.4
Eagle	0	0.0%	3	0.5%	3	5.6
Elbert	0	0.0%	0	0.0%	0	0.0
El Paso	7	21.9%	75	13.1%	82	12.2
Fremont	0	0.0%	7	1.2%	7	15.0
Garfield	1	3.1%	2	0.4%	3	5.2
Gilpin	0	0.0%	1	0.2%	1	17.2
Grand	0	0.0%	0	0.0%	0	0.0
Gunnison	0	0.0%	0	0.0%	0	0.0
Hinsdale	0	0.0%	0	0.0%	0	0.0
Huerfano	0	0.0%	3	0.5%	3	46.2
Jackson	0	0.0%	0	0.0%	0	0.0
Jefferson	4	12.5%	41	7.1%	45	8.0
Kiowa	0	0.0%	0	0.0%	0	0.0
Kit Carson	0	0.0%	1	0.2%	1	12.9

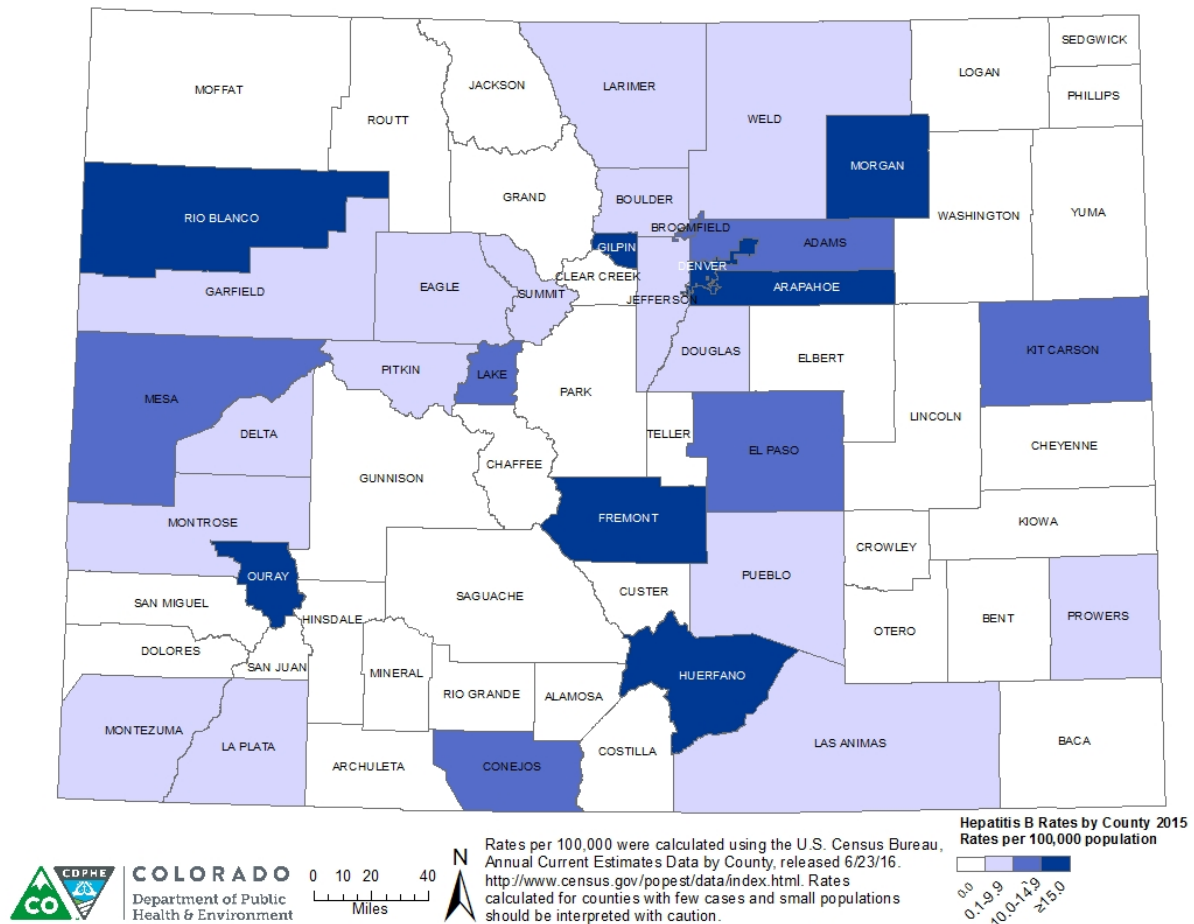
	Acute Hepatitis B Cases		Chronic Hepatitis B Cases		All Hepatitis B Cases	
	Number	% of Total	Number	% of Total	Total	Rate of Reported Cases/ 100,000 ‡
Lake	0	0.0%	1	0.2%	1	13.4
La Plata	0	0.0%	5	0.9%	5	9.1
Larimer	3	9.4%	19	3.3%	22	6.6
Las Animas	0	0.0%	1	0.2%	1	7.1
Lincoln	0	0.0%	0	0.0%	0	0.0
Logan	0	0.0%	0	0.0%	0	0.0
Mesa	3	9.4%	13	2.3%	16	10.8
Mineral	0	0.0%	0	0.0%	0	0.0
Moffat	0	0.0%	0	0.0%	0	0.0
Montezuma	0	0.0%	2	0.4%	2	7.6
Montrose	0	0.0%	1	0.2%	1	2.4
Morgan	0	0.0%	5	0.9%	5	17.6
Otero	0	0.0%	0	0.0%	0	0.0
Ouray	0	0.0%	1	0.2%	1	21.3
Park	0	0.0%	0	0.0%	0	0.0
Phillips	0	0.0%	0	0.0%	0	0.0
Pitkin	0	0.0%	1	0.2%	1	5.6
Prowers	0	0.0%	1	0.2%	1	8.4
Pueblo	0	0.0%	11	1.9%	11	6.7
Rio Blanco	0	0.0%	1	0.2%	1	15.2
Rio Grande	0	0.0%	0	0.0%	0	0.0
Routt	0	0.0%	0	0.0%	0	0.0
Saguache	0	0.0%	0	0.0%	0	0.0
San Juan	0	0.0%	0	0.0%	0	0.0
San Miguel	0	0.0%	0	0.0%	0	0.0
Sedgwick	0	0.0%	0	0.0%	0	0.0
Summit	0	0.0%	2	0.4%	2	6.6
Teller	0	0.0%	0	0.0%	0	0.0
Washington	0	0.0%	0	0.0%	0	0.0
Weld	2	6.2%	24	4.2%	26	9.1
Yuma	0	0.0%	0	0.0%	0	0.0
CDOC**	0	0.0%	10	1.7%	10	N/A
Unspecified	0	0.0%	18	3.1%	18	N/A

* 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, then the county of the jail location is assigned. If the case is in a state or federal prison, then county is not assigned.

‡ Rates per 100,000 were calculated using the U.S. Census Bureau.¹⁵ Rates calculated for counties with few cases and small populations should be interpreted with caution.

**CDOC - Incarcerated in the Colorado Department of Corrections.

Figure B.3. Reported Hepatitis B (Acute and Chronic) Case Rates by County, Colorado 2015.



Behavioral risk factors for hepatitis B infection

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) persons who inject drugs (PWIDs), household contact of a known or suspect positive HBV case, sexual partner contact of an hepatitis B case, a male who has sex with men (MSM), and people born outside the U.S. Information is more complete for acute cases and for females, which are more likely to be investigated. 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 hepatitis B cases. As an example, 6.2 percent of acute cases and 93.2 percent of chronic cases are missing information about intravenous drug use behavior. Injection drug use is the most commonly reported risk factor for acute cases (n=6) in Colorado. Nationally, this was also the most commonly reported risk factor for acute hepatitis B cases; 25.8 percent of people included information on use of injection drugs.¹ Foreign-born is the most common risk factor for chronic cases reported in Colorado (n=177). A hepatitis B case can report more than one risk factor.

Table B.3. Reported Hepatitis B Cases by Risk Factor and Percentage of Cases Reporting the Risk Factor, Colorado, 2015 †

	Acute HBV Cases		Chronic HBV Cases	
	Number	Percent	Number	Percent
Total	32		573	
IDU (2 weeks to 6 months prior to onset of symptoms)				
Yes	6	18.8%	7	1.2%
No	24	75.0%	30	5.2%
Unknown	0	0.0%	2	0.4%
Missing	2	6.2%	534	93.2%
Household Contact (2 weeks to 6 months prior to onset of symptoms)				
Yes	1	3.1%	5	0.9%
Sex Partner Contact (2 weeks to 6 months prior to onset of symptoms)				
Yes	3	9.4%	3	0.5%
MSM (6 months prior to onset of symptoms)				
	24 male cases		327 male cases	
Yes	7	29.2%	1	0.3%
No	14	58.3%	0	0.0%
Unknown	0	0.0%	2	0.6%
Missing	3	12.5%	324	99.1%
Born in Foreign Country				
Yes	3	9.4%	177	30.9%
No	23	71.9%	20	3.5%
Unknown	1	3.1%	6	1.0%
Missing	5	15.6%	370	64.6%

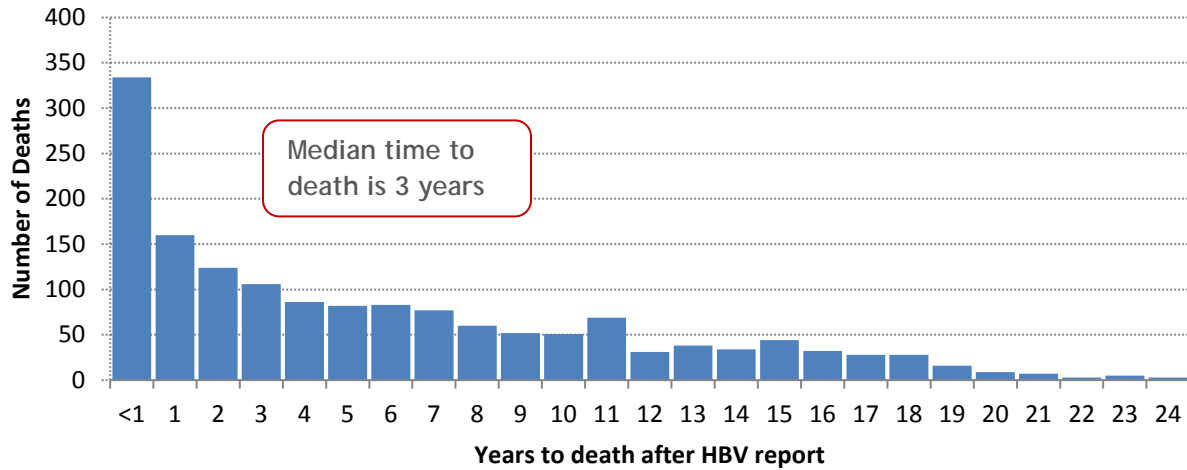
†Risk factor categories are not mutually exclusive.

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 0.50 per 100,000 population in 2014.¹⁸ 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. A total of 1,950 cases (13.0 percent of all cases reported through 2015) had a date of death, of which 388 had a date of death that was prior to report of hepatitis B. For those cases in which death was reported on the same date or after hepatitis B (n=1,562), the median time between first known report of hepatitis B and death from all causes was three years and the range was zero days through 24 years, shown in Figure B.4. This large range is indicative of the varying health implications of hepatitis B and the fact that testing and diagnosis can occur all along the disease spectrum from initial infection to death.

Figure B.4. Timing of Mortality Among Hepatitis B Cases with Date of Death, Colorado Hepatitis B Cases Reported 1993-2015.



Among these hepatitis B cases with known date of death, the median age at death from all causes was 56.6 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).^{19,20} Even though all of these deaths are not attributable to hepatitis B infection, it strongly suggests that people living with hepatitis B have health complications and co-morbidities that create a significant health burden.

Hepatitis C in Colorado

Acute and chronic (past or present)

Background

Hepatitis C virus is typically 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.⁵

Hepatitis C is one of the most commonly reported infectious diseases worldwide and is the single most common bloodborne pathogen in the U.S.²¹ Hepatitis C-associated mortality is increasing in the U.S. and has surpassed the 60 other nationally notifiable infection conditions combined.²² Hepatitis C accounts for almost 20,000 annual deaths in the United States.¹ Viral hepatitis, of which hepatitis C is the most common type, has surpassed HIV and AIDS to become the seventh leading cause of death worldwide.⁶ Hepatitis B and hepatitis C cause an estimated 61 percent of U.S. hepatocellular carcinoma⁷, 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.⁸

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.²³ However, barriers to prevention and treatment of viral hepatitis persist.

Acute hepatitis C

Acute hepatitis C is the first stage of infection and may have symptoms typically within two weeks 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.²⁴ 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 National Notifiable Diseases Surveillance System (NNDSS) to define an acute case of hepatitis C. The acute hepatitis C case definition was updated in 2016; however, the 2012 case definition was used for cases reported in 2015. These case definitions can be found at <https://wwwn.cdc.gov/nndss/conditions/hepatitis-c-acute>.

Chronic (past or present) 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 resolve their infection naturally, 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.²⁴ When symptoms appear, they often are a sign of advanced liver disease and may include the same symptoms as with acute infection. Since symptoms may not appear, only about half of those with chronic hepatitis C are aware of their infection.⁶ The 2012 surveillance case definition relates to past or present cases of hepatitis C rather than current chronic infections. Therefore, a person could have cleared the infection and still be counted as a chronic hepatitis C case. A present case can only be identified with additional viral load testing. The case definition for chronic hepatitis C was updated in

2016, however, the 2012 case definition was used for cases reported in 2015. These case definitions can be found at <https://www.cdc.gov/nndss/conditions/hepatitis-c-chronic>.

Hepatitis C case follow-up

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 anti-HCV from the mother can last until 18 months of age and treatment is not recommended for children under age 3.²⁴ 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.

HCV transmission

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 to 11 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.²⁵ Currently, those at greatest risk of contracting HCV are people who inject drugs (PWID).⁷

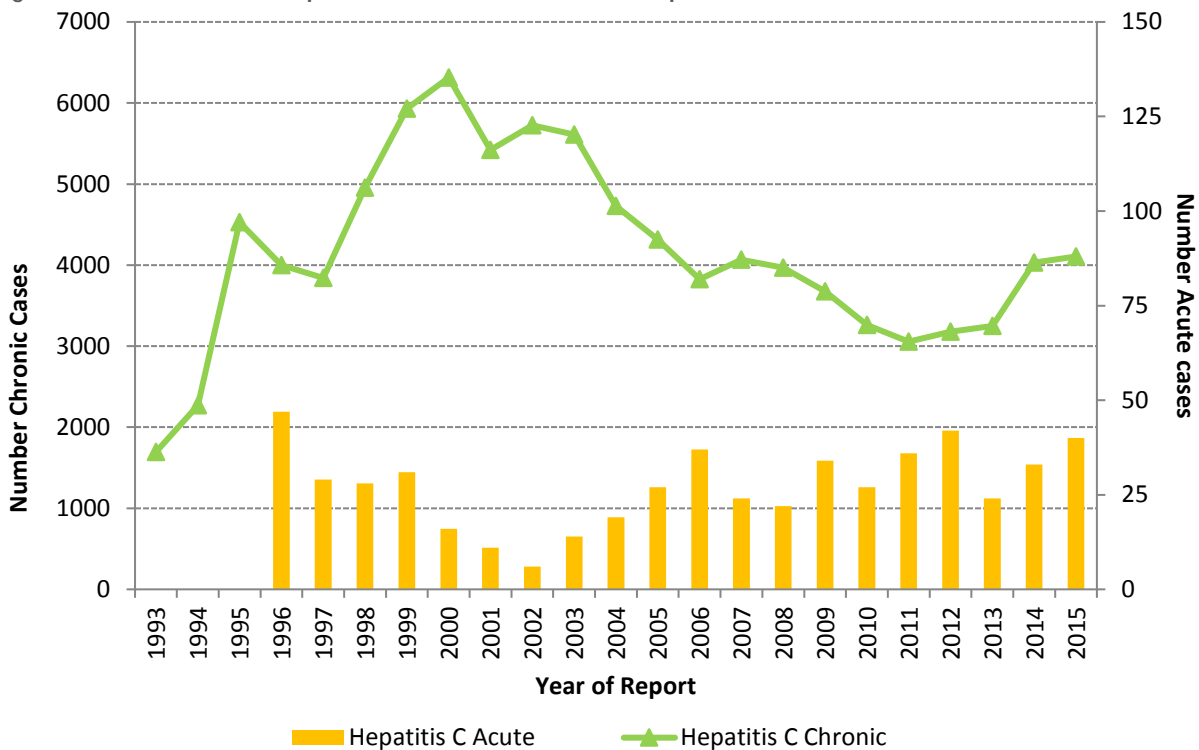
Hepatitis C infection prevalence estimate

CDPHE estimates there currently are about 70,935 (range of 54,566 to 109,131) people in Colorado living with chronic, unresolved hepatitis C. This estimate is based on the U.S. Census 2015 Colorado population estimated at 5,456,574 and a national published hepatitis C prevalence rate estimate from 2003-2010 NHANES data (adjusted for the limitations of not including populations of homeless, incarcerated, and institutionalized persons) of 1.3 percent (range of 1.0 percent to 2.0 percent).^{26,27,28} Colorado's surveillance system does not sufficiently track how many people have resolved hepatitis C infection or died, therefore, surveillance case numbers are not be used to estimate the number of Coloradans who are currently living with chronic hepatitis infection. National estimates of hepatitis C are limited since they are based on surveys of the general population with adjustments of estimated rates from missed sub-populations, and some national estimates are of current infections, whereas others include past and present infections. Applying these rates to Colorado is further limited by the fact that national rates may not reflect hepatitis C in Colorado.

Cumulative case reports of acute and chronic hepatitis C

Hepatitis C became a notifiable disease in Colorado in 1993. From 1993 through 2015, a total of 547 acute and 95,743 chronic hepatitis C infections 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. Figure C.1 shows hepatitis C cases reported in Colorado by year. The number of acute hepatitis C cases declined initially and has fluctuated between 24 and 42 cases reported annually in the past five years. Nationally, the number of acute hepatitis C cases has increased between 2010 and 2014.¹ 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.

Figure C.1. Number of Reported Acute and Chronic Hepatitis C Cases in Colorado, 1993-2015.



Hepatitis C epidemiology

In Colorado in 2015, a total of 40 acute cases and 4,104 chronic cases of hepatitis C were reported. Table C.1 describes the distribution of reported cases by case status, gender, age and race/ethnicity. Rates combine both acute and chronic case reports. 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-reporting² to the 40 acute hepatitis C cases reports in 2015, we estimate Colorado actually had 556 acute hepatitis C cases in 2015.

Colorado's reported acute hepatitis C rate is similar to that of the U.S., with 0.6 per 100,000 population in Colorado versus 0.7 per 100,000 population nationally. 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.¹² Nationally, however, the rate has been increasing since 2010. In the U.S. there has been an approximate 2.6-fold increase in number of acute hepatitis C cases, from 850 reported cases in 2010 to 2,194 reported cases in 2014.¹

Chronic hepatitis C disproportionately affects people born between 1945 and 1965 (who likely were exposed before HCV was discovered in 1989), African-Americans, and people in jail and prison. Nationally, CDC estimates that although persons born between 1945 and 1965 comprise 27 percent of the population, they account for 65 to 70 percent of all hepatitis C infections in the U.S.^{29,30} The rate of antibody-positive HCV is 3.5 percent in this birth cohort compared to 1.3 percent for the general population.²⁶ CDC recommends that adults born between 1945 and 1965 should receive one-time testing for HCV without prior ascertainment of hepatitis C risk.²⁹ CDC also suggests other age groups with risk factors specific to hepatitis C should be tested.

Table C.1. Reported Hepatitis C Cases by Case Status, Sex, Age, and Race/Ethnicity, Colorado 2015.

	Acute Hepatitis C Cases		Chronic Hepatitis C Cases †		All Hepatitis C Cases	
	Number	Percent	Number	Percent	Total	Rate of Reported Cases/ 100,000 ‡
Total	40		4104		4144	75.9
Case Status						
Confirmed	40	100.0%	3588	87.4%	3628	N/A
Probable	0	0.0%	516	12.6%	516	N/A
Gender						
Female	16	40.0%	1462	35.6%	1478	54.5
Male	24	60.0%	2639	64.3%	2663	97.1
Unknown	0	0.0%	3	0.1%	3	N/A
Age						
0-4	0	0.0%	5	0.1%	5	1.5
5-9	0	0.0%	2	0.1%	2	0.6
10-19	3	7.5%	43	1.0%	46	6.5
20-29	29	72.5%	646	15.7%	675	83.7
30-39	5	12.5%	719	17.5%	724	92.7
40-49	2	5.0%	661	16.1%	663	93.5
50-59	1	2.5%	1187	28.9%	1188	162.7
60+	0	0.0%	829	20.2%	829	80.3
Unknown	0	0.0%	12	0.3%	12	N/A
Race/Ethnicity						
White	17	42.5%	836	20.4%	853	Not calculated
African American	0	0.0%	65	1.6%	65	
Hispanic	9	22.5%	150	3.6%	159	
American Indian	0	0.0%	20	0.5%	20	
Asian	0	0.0%	21	0.5%	21	
Pacific Islander	0	0.0%	1	0.0%	1	
Other	2	5.0%	23	0.6%	25	
Multiple races	1	2.5%	8	0.2%	9	
Missing/Unknown	11	27.5%	2980	72.6%	2991	

†Chronic cases may include cases who have resolved infection.

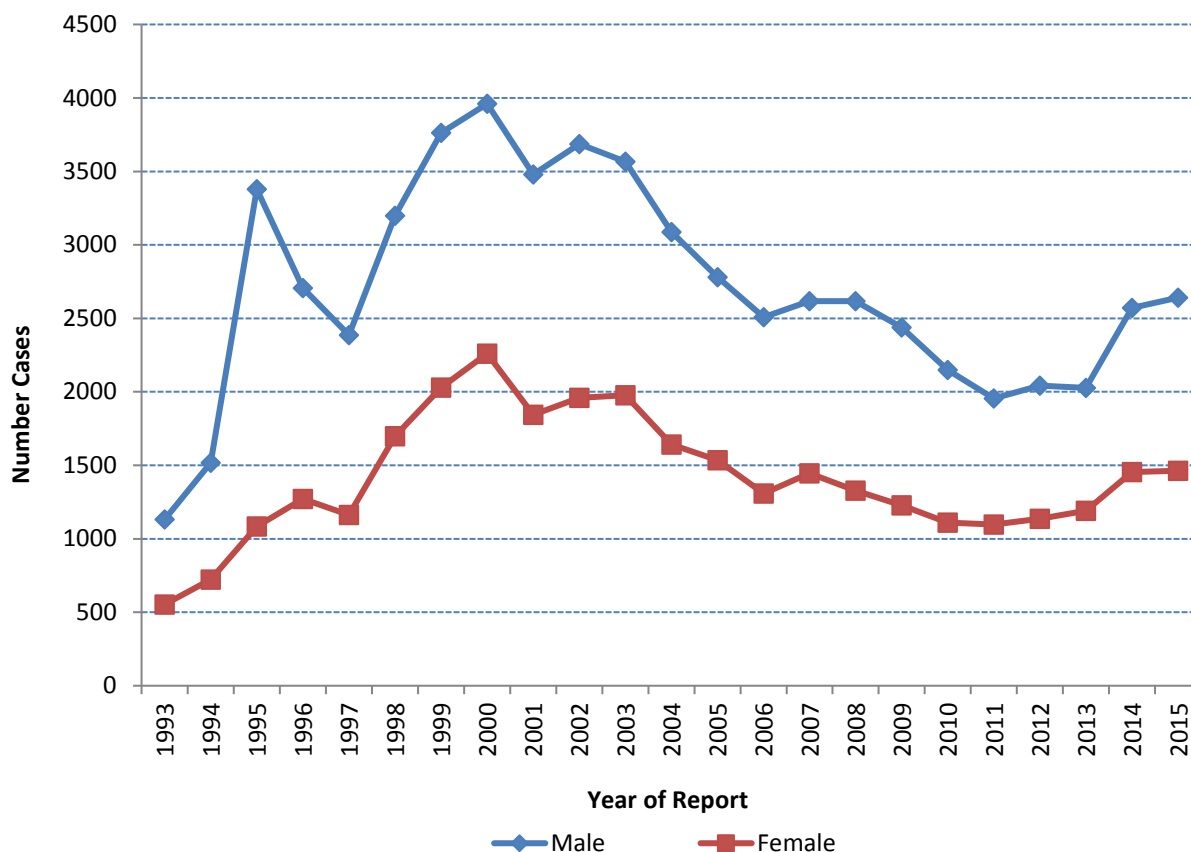
‡ Rates per 100,000 were calculated using the U.S. Census Bureau.¹⁵ Rates calculated for small populations should be interpreted with caution. This is not a rate of disease incidence.

N/A=Not applicable

Gender

In 2015, a total of 40 acute cases of hepatitis C were reported in Colorado. More of the reported acute cases of hepatitis C were male -- 60 percent. For chronic hepatitis C infections, 64.3 percent of the total 4,104 reported cases were among men. Among cumulative acute cases reported from 1993 to 2015, 55.1 percent were men. Figure C.2 demonstrates that men are consistently reported with chronic hepatitis C more frequently than women.

Figure C.2. Number of Male and Female Chronic Hepatitis C Case Reports in Colorado, 1993-2015.



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.

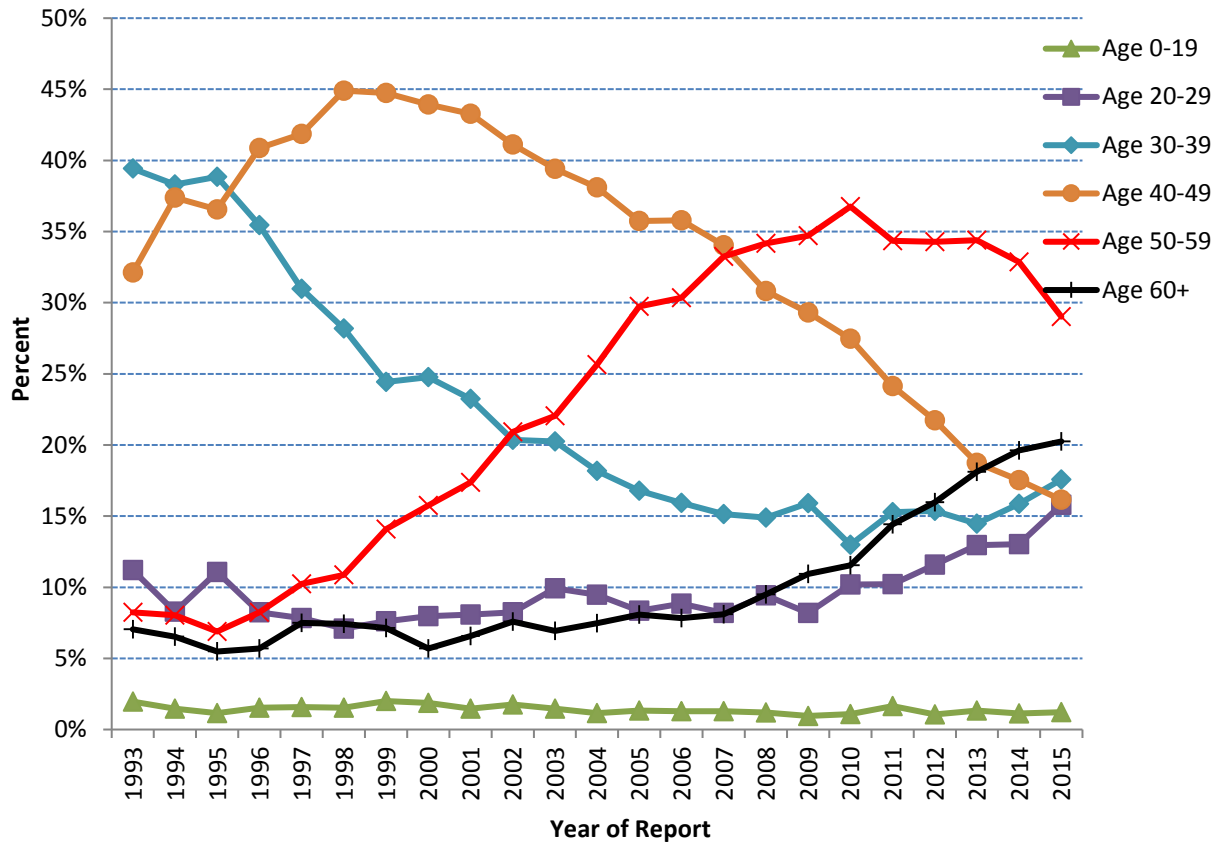
Age

Table C.1 demonstrates that people 20 to 29 years of age had the highest number of reported acute hepatitis C cases in Colorado in 2015, representing 72.5 percent of all acute cases. The median age of acute hepatitis C cases at time of diagnosis was typically in the mid-30s up until 2014 and 2015, in which the median age was 27 years.

For chronic infections, people 50 to 59 years of age had the highest number of reported cases, representing 28.9 percent of chronic cases in 2015. This age group also had the highest rate of total (acute and chronic) hepatitis C at 162.7 reported cases per 100,000 population. The proportions of chronic hepatitis C cases by age category have changed over time and are shown from 1993 to 2015 in Figure C.3. The proportion of cases in people ages 40 to 49 years old have been declining. The proportion of cases in people ages 30 to 39 years declined until the past five years, when it started to increase. Meanwhile, the proportion of cases in people ages 50 to 59 increased until it started to decline in the past five years. Reported cases in people ages 20 to 29 and 60-plus were fairly stable until an increase in the past seven years. The recent increase among cases in people ages 20 to 29,

from 11.5 percent of all cases in 2010 to 20.2 percent in 2015 may be explained by earlier acquisition of infection (through IDU) or misclassification of reports, although a definitive cause has not been identified.

Figure C.3. Proportion of Cases by Age Category for Chronic Hepatitis C Reports in Colorado, 1993-2015.



Almost half -- 47.6 percent (n=1,948 of 4,091 cases with available birth date) -- of chronic cases reported in 2015 and 66.8 percent (n=60,459 of 90,522 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 percent) and 45-54 years (10.4 percent) and for women in the same age categories (7.6 percent and 6.0 percent, respectively). These data are limited because they are only a subset of all screening, but they indicate more testing of people ages 45-64 would help identify cases of hepatitis C.

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

	Number Tested	Percent of Tests	Percent Positive
Males	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	18.1%	13.6%
65+	2,603	9.9%	5.3%
Females	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.

Race/ethnicity

As shown in Table C.1, data on race and ethnicity was missing or unknown for 27.5 percent of acute cases and 72.6 percent of chronic cases. Among the reported cases that had race/ethnicity data available, white non-Hispanics had the highest number of acute (n=17) and chronic cases (n=836), followed by Hispanic for both acute (n=9) and chronic (n=150). Hepatitis C rates were not calculated by race/ethnicity because this information is missing for so many cases. Table C.3 compares the 2015 general population of Colorado to all hepatitis C cases in 2011-2015, reporting the five main race/ethnic groups (only 39.9 percent of all cases reported during this time period). From this limited information, African-Americans and American Indians are overrepresented for hepatitis C cases and Asians/Pacific Islanders are underrepresented when compared to the general population of Colorado.

Table C.3. Race/Ethnic Proportions for Colorado Population and Reported (Acute and Chronic) Hepatitis C Cases, 2011-2015.

Race/ethnicity	Percent of Colorado Population 2015*	Number Hepatitis C cases reporting these race/ethnicities 2011-2015	Percent of Hepatitis C cases reporting these race/ethnicities 2011-2015
White	69.0%	4975	70.0%
African-American	4.1%	609	8.6%
Hispanic	22.3%	1304	18.3%
American Indian	1.0%	126	1.8%
Asian/Pacific Islander	3.6%	97	1.3%
Unknown		10,525	59.2%
Multiple races/Other race		156	0.9%

*Percentages determined by Colorado State Demography Office.¹⁶

Nationally, rates of acute hepatitis C infection have been consistently higher for American Indian/Alaska Natives compared to all other racial/ethnic groups.¹ Data regarding national chronic hepatitis C rates by race/ethnicity are not available; however, analysis of NHANES data from 2003-2010 found that African-Americans were more likely to have chronic infection.²⁶ Data regarding race/ethnicity is incomplete with surveillance data and creates challenges in identifying health disparities for viral hepatitis.

Geographic distribution

Table C.4 describes the distribution of acute and chronic hepatitis C cases reported in 2015 by county of residence. Acute hepatitis C was reported in 18 of the 64 Colorado counties and chronic hepatitis C was reported in 58 of the 64 Colorado counties. In addition, one acute case and 357 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 Colorado Department of Corrections (CDOC) for state prisons and Federal Correctional Institute (FCI) for federal prisons. There are five counties with at least 5 percent of reported chronic hepatitis C cases that are also the counties with the highest general population. These are Adams (5.4 percent), Arapahoe (6.8 percent), Denver (14.9 percent), El Paso (11.0 percent), and Jefferson (7.0 percent). Figure C.4 shows combined acute and chronic hepatitis C rates by county for reported cases in 2015. 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.

Table C.4. Number and Percentage of Reported Acute and Chronic Hepatitis C Cases by County of Residence*, Colorado, 2015.

	Acute Hepatitis C Cases		Chronic Hepatitis C Cases †		All Hepatitis C Cases	
	Number	Percent	Number	Percent	Total	Rate of Reported Cases/100,000 ‡
Total	40		4104		4144	75.9
County of Residence						
Adams	1	2.5%	224	5.4%	225	45.8
Alamosa	1	2.5%	31	0.8%	32	194.0
Arapahoe	4	10.0%	281	6.8%	285	45.2
Archuleta	0	0.0%	10	0.2%	10	81.0
Baca	0	0.0%	2	0.1%	2	55.3
Bent	0	0.0%	12	0.3%	12	205.8
Boulder	3	7.5%	125	3.0%	128	40.1
Broomfield	0	0.0%	18	0.4%	18	27.7
Chaffee	0	0.0%	12	0.3%	12	64.3
Cheyenne	0	0.0%	0	0.0%	0	0.0
Clear Creek	0	0.0%	12	0.3%	12	129.0
Conejos	0	0.0%	12	0.3%	12	147.6
Costilla	0	0.0%	2	0.1%	2	55.8
Crowley	0	0.0%	6	0.2%	6	107.9
Custer	0	0.0%	9	0.2%	9	202.5
Delta	0	0.0%	22	0.5%	22	73.4

	Acute Hepatitis C Cases		Chronic Hepatitis C Cases †		All Hepatitis C Cases	
	Number	Percent	Number	Percent	Total	Rate of Reported Cases/ 100,000 ‡
Denver	5	12.5%	612	14.9%	617	90.4
Dolores	0	0.0%	4	0.1%	4	202.2
Douglas	1	2.5%	75	1.8%	76	23.9
Eagle	0	0.0%	12	0.3%	12	22.4
Elbert	0	0.0%	5	0.1%	5	20.2
El Paso	5	12.5%	450	11.0%	455	67.5
Fremont	1	2.5%	52	1.3%	53	113.5
Garfield	1	2.5%	40	1.0%	41	70.6
Gilpin	0	0.0%	1	0.0%	1	17.2
Grand	0	0.0%	4	0.1%	4	27.4
Gunnison	0	0.0%	7	0.2%	7	43.6
Hinsdale	0	0.0%	0	0.0%	0	0.0
Huerfano	0	0.0%	6	0.2%	6	92.4
Jackson	0	0.0%	0	0.0%	0	0.0
Jefferson	3	7.5%	288	7.0%	291	51.5
Kiowa	0	0.0%	0	0.0%	0	0.0
Kit Carson	0	0.0%	2	0.1%	2	25.8
Lake	1	2.5%	4	0.1%	5	66.8
La Plata	1	2.5%	50	1.2%	51	93.3
Larimer	0	0.0%	166	4.0%	166	49.8
Las Animas	0	0.0%	29	0.7%	29	206.3
Lincoln	0	0.0%	7	0.2%	7	126.0
Logan	1	2.5%	12	0.3%	13	59.0
Mesa	1	2.5%	131	3.2%	132	88.9
Mineral	0	0.0%	0	0.0%	0	0.0
Moffat	3	7.5%	11	0.3%	14	108.2
Montezuma	0	0.0%	27	0.7%	27	103.2
Montrose	0	0.0%	16	0.4%	16	39.1
Morgan	0	0.0%	6	0.2%	6	21.2
Otero	0	0.0%	15	0.4%	15	81.8
Ouray	0	0.0%	2	0.1%	2	42.6
Park	0	0.0%	11	0.3%	11	66.6
Phillips	0	0.0%	2	0.1%	2	46.0
Pitkin	0	0.0%	4	0.1%	4	22.5
Prowers	0	0.0%	10	0.2%	10	83.7
Pueblo	5	12.5%	193	4.7%	198	121.0
Rio Blanco	0	0.0%	7	0.2%	7	106.5
Rio Grande	0	0.0%	11	0.3%	11	95.3
Routt	1	2.5%	11	0.3%	12	49.7

	Acute Hepatitis C Cases		Chronic Hepatitis C Cases †		All Hepatitis C Cases	
	Number	Percent	Number	Percent	Total	Rate of Reported Cases/ 100,000 ‡
Saguache	0	0.0%	3	0.1%	3	48.0
San Juan	0	0.0%	1	0.0%	1	142.7
San Miguel	0	0.0%	3	0.1%	3	38.1
Sedgwick	0	0.0%	1	0.0%	1	41.7
Summit	0	0.0%	7	0.2%	7	23.1
Teller	0	0.0%	22	0.5%	22	94.1
Washington	0	0.0%	0	0.0%	0	0.0
Weld	1	2.5%	126	3.1%	127	44.5
Yuma	0	0.0%	2	0.1%	2	19.7
CDOC**	1	2.5%	335	8.2%	336	N/A
FBP***	0	0.0%	21	0.5%	21	N/A
Unspecified	0	0.0%	521	12.7%	521	N/A

*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, then the county of the jail location is assigned. If the case is in a state or federal prison, then county is not assigned.

†Chronic cases may include cases who have resolved the infection.

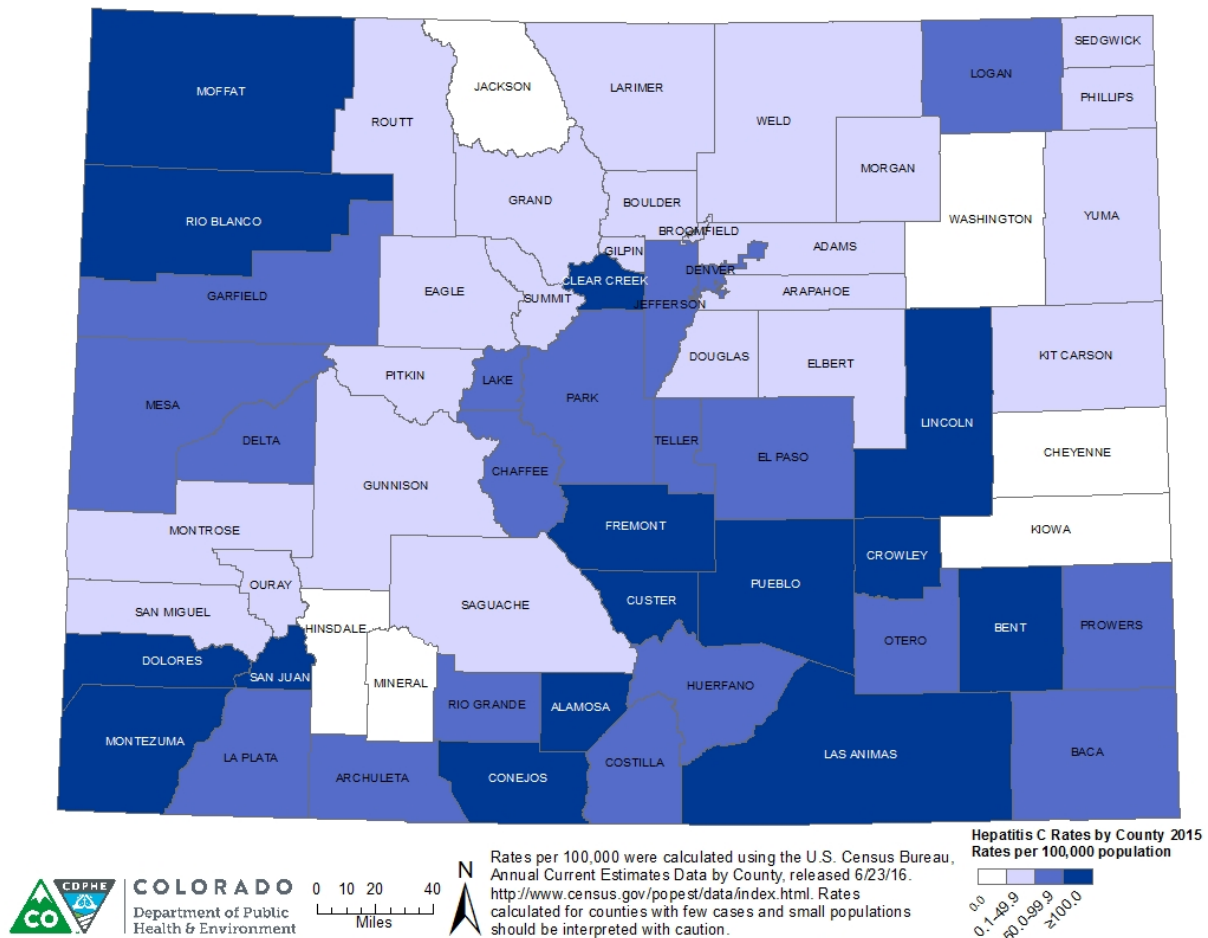
‡ Rates per 100,000 were calculated using the U.S. Census Bureau, Population Division.¹² Rates calculated for counties with few cases should be interpreted with caution. This is not a rate of disease incidence.

**CDOC - Incarcerated in the Colorado Department of Corrections.

***FBP - Incarcerated in the Federal Bureau of Prisons.

N/A=Not applicable

Figure C.4. Reported Hepatitis C Case (Acute and Chronic) Rates by County, Colorado 2015.



Behavioral risk factors for Hepatitis C infection

Risk factor data can be obtained through patient interviews, medical record reviews, and information provided by physicians, hospitals, or other healthcare providers. Behavioral data that are collected include (but are not limited to) PWID, household contact of a hepatitis C case, sexual partner contact of a hepatitis C case, and a man who has sex with men (MSM). Information is more complete for acute cases because they are more likely to be investigated. Risk behavior data are collected with options of “Yes,” “No,” and “Unknown” when indicated, or as checkboxes if there is only a “Yes” option indicated. The time of inquiry is generally the six months prior to onset of symptoms.

Typically, risk behavior information is missing for hepatitis C cases since most cases are not followed up. As an example, 20.0 percent of acute cases and 92.5 percent of chronic cases are missing intravenous drug use (IDU) behavior. IDU is the most commonly reported risk factor for both acute (n=26) and chronic (n=285) hepatitis C. As shown in table C.5, this represents 65.0 percent and 6.9 percent of all reported acute and chronic cases, respectively. However, when considered using only case reports with complete information, IDU is the identified risk factor in 81.3 percent of acute cases (26/32) and 94.7 percent of chronic cases (285/301). A hepatitis C case can have more than one risk factor.

Table C.5. Reported Hepatitis C Cases by Risk Factor, and Percentage of Cases Reporting the Risk Factor, Colorado, 2015 *

	Acute Hepatitis C Cases		Chronic Hepatitis C Cases†	
	Number	Percent	Number	Percent
Total	40		4104	
IDU (2 weeks to 6 months prior to onset of symptoms)				
Yes	26	65.0%	285	6.9%
No	6	15.0%	16	0.4%
Unknown	0	0.0%	6	0.2%
Missing	8	20.0%	3799	92.5%
Household Contact (2 weeks to 6 months prior to onset of symptoms)				
Yes	3	7.5%	4	0.1%
Sex Partner Contact (2 weeks to 6 months prior to onset of symptoms)				
Yes	2	5.0%	34	0.8%
MSM (6 months prior to onset of symptoms)				
	24 male cases		2641 male cases	
Yes	1	4.2%	3	0.1%
No	9	37.5%	6	0.2%
Unknown	1	4.2%	3	0.1%
Missing	13	54.2%	2627	99.6%

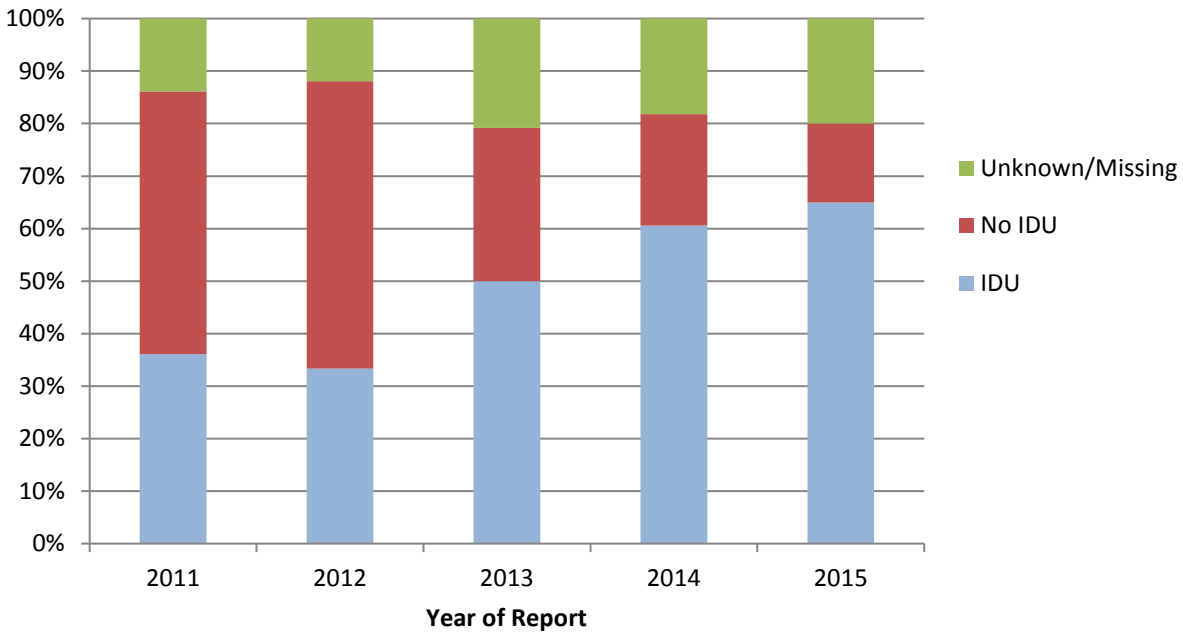
*Risk factor categories are not mutually exclusive.

†Chronic cases may include cases who have resolved infection.

People who inject drugs (PWID)

Today, injection drug use (IDU) is the primary cause of new hepatitis C infections. From 2011-2015, nearly half, 48.6 percent, of all reported acute hepatitis C infections in Colorado were among people who had injected drugs 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 16.6 percent of acute cases. If cases with unknown IDU behavior are excluded from the proportions, then 58.2 percent of all acute cases in this period reported IDU. The proportion of cases that report IDU has increased from 36.1 percent in 2011 to 65.0 percent in 2015. Cases who 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 68.2 percent of acute HCV cases reported in 2014.¹

Figure C.5. Reported IDU for Acute Hepatitis C Cases Reported in Colorado, 2011-2015.



The Center for Health and Environmental Data (CHED) at CDPHE recently produced a report on drug overdose deaths.³¹ 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, but heroin-related drug overdoses have increased the most. Drug overdoses are not all injection-related, but most heroin users are injecting.³²

C, 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 2012.³³ HCV testing is recommended at least annually for persons who currently inject drugs.³⁴ 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.³³

Estimating the number of PWIDs 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%-.41%) have injected in the past year.³⁵ These estimates were derived from the review of multiple national population studies. Applying these published numbers to the Colorado population, there are an estimated 13,646 current PWID and 118,267 ever PWID, as shown in Table C.6.

Table C.6. Estimated current and ever PWID in Colorado.

Category	2015 Colorado population age 13 years and older ¹⁴	Estimated prevalence PWID	Estimated Number in Colorado
Injection drug use behavior in the past year	4,548,739	0.30%	13,646
Lifetime injection drug use behavior	4,548,739	2.6%	118,267

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 exchange programs are proven to prevent bloodborne disease transmission.³⁶ Public health cannot stop the hepatitis C epidemic without addressing the co-occurring epidemics of addiction and injection drug use.

People who are incarcerated

Approximately 26 percent of the U.S. incarcerated population is HCV-antibody positive, much higher than the general population.³⁷ 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.³⁸ The number of people estimated to be under correctional supervision in prison or jail in 2014 in Colorado was 119,800, or 2.89 percent of Colorado residents. Just over one-quarter (26.3 percent) of these individuals were incarcerated and 73.7 percent were under community supervision.³⁹ This is a transient population.

The Colorado Department of Corrections (CDCO) offers HCV testing to inmates upon intake into a prison. Individuals diagnosed with hepatitis C are evaluated for treatment, and the CDCO applies a clinical designation for prioritizing offenders for treatment.

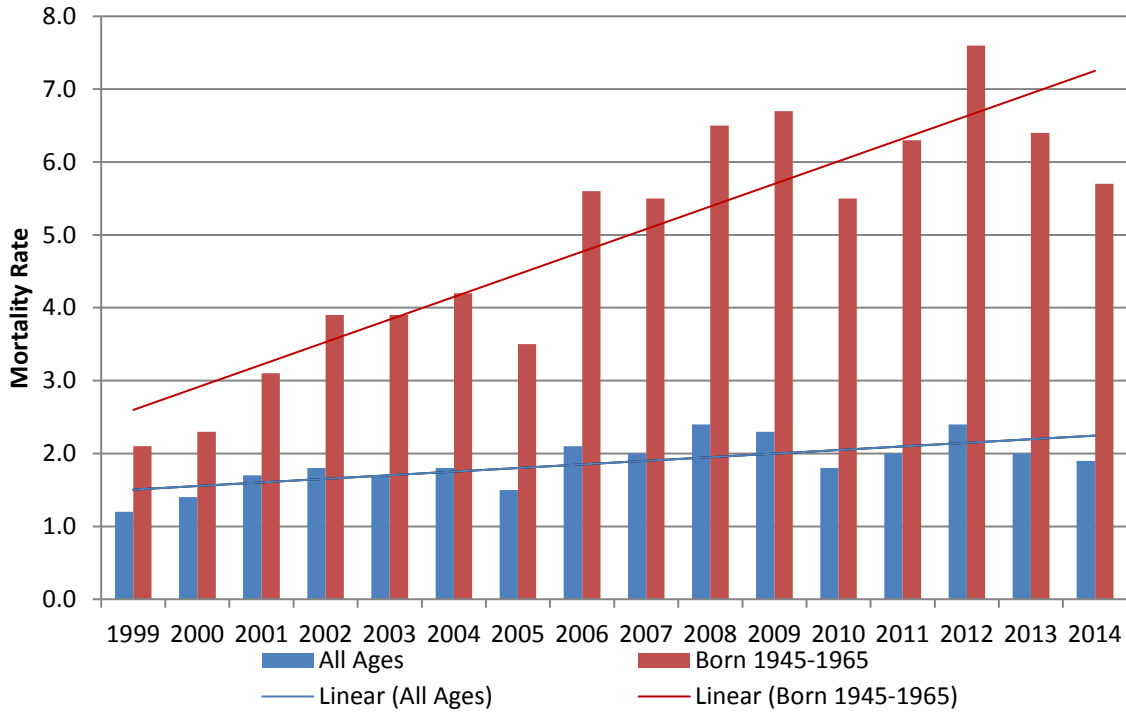
Counties have jurisdiction over jails that house people who are awaiting a court date or who have been adjudicated and are serving a sentence. Since jail sentences are typically short and medical staff is limited in most county jails, HCV testing is generally only offered upon request of a symptomatic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

Deaths among people with Hepatitis C

Figure C.6 shows that in Colorado, the hepatitis C mortality rate continues to climb, particularly among people born between 1945 and 1965. Based on the single underlying cause of death reported on the death certificate, Coloradans had a hepatitis C (acute or chronic) mortality rate of 1.9 per 100,000 population in 2014, up from 1.2 per 100,000 in 1999.¹⁸ Trends in mortality for the 1945-1965 birth

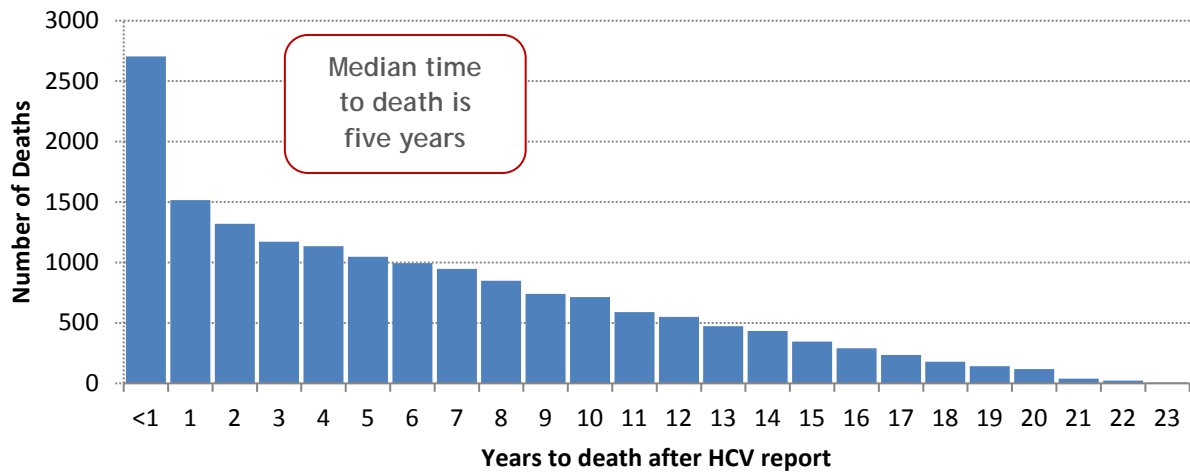
cohort is expected to increase as it ages; however, since rates of hepatitis C are higher in this birth cohort, hepatitis C mortality trends in this cohort were assessed. Coloradans in the 1945-1965 birth cohort had an increased hepatitis C mortality rate of 5.7 per 100,000 population in 2014, up from 2.1 per 100,000 population in 1999. These rates may be lower than actual rates because of missed or miscoding of underlying cause of death.

Figure C.6. Mortality Rate of Hepatitis C as Underlying Cause of Death by Year of Death, Colorado, 1999-2014.¹⁸



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. A total of 17,732 cases (18.5 percent of all cases reported through 2015) had a date of death, of which 1,175 had a date of death that was prior to report of hepatitis C. For those cases in which death was reported on the same date or after hepatitis C (n=16,557), the median time between first known report of hepatitis C and death from all causes was five years, and the range was zero days through 23 years, shown in Figure C.7. This large range is indicative of the varying health implications of hepatitis C and the fact that testing and diagnosis can occur all along the disease spectrum, from initial infection to death.

Figure C.7. Timing of Mortality among Hepatitis C Cases with Date of Death, Colorado Hepatitis C Cases Reported 1993-2015.



Among these hepatitis C cases with known date of death, the median age at death from all causes was 56.1 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).^{19,20} Even though these deaths are not attributable to hepatitis C infection, it strongly suggests that people living with hepatitis C have health complications and co-morbidities that create a significant health burden.

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 19,816 HIV/AIDS cases reported into the electronic HIV/AIDS Reporting System (eHARS) as of Dec. 31, 2015. At the time of this analysis, Dec. 19, 2016, there were 12,647 people with (63.8 percent) HIV/AIDS living. The number of linked cases and status of living or died, as reported into eHARS, is shown in Table D.1.

Table D.1. Cumulative and Living Reported Cases of Hepatitis B and Hepatitis C Who Are Co-infected with HIV/AIDS.

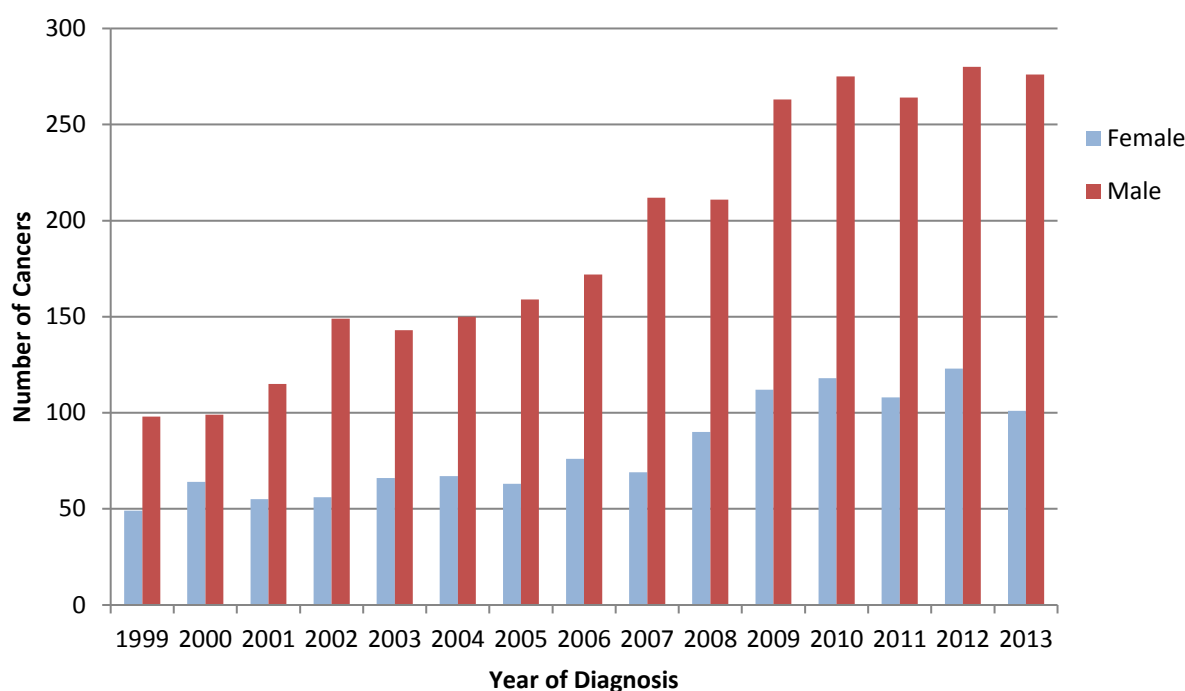
	Hepatitis B		Hepatitis C	
	Acute	Chronic	Acute	Chronic
Reported as of December 31, 2015	1,302	15,059	547	95,747
Co-infected with HIV/AIDS	60	414	9	1,897
Percent co-infected with HIV/AIDS	4.6%	2.7%	1.6%	2.0%
Alive as of December 19, 2016	51	242	9	1,385
Percent of co-infected cases living	85.0%	58.4%	100%	73.0%

Liver cancer and Hepatitis C

Liver cancer is the second most common cause of death from cancer worldwide⁷ and the seventh largest cause in Colorado.⁴⁰ 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.⁴¹ Although the overall cancer death rate in the U.S. has decreased 1.5 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.⁴² The five-year survival rate for liver cancer and intrahepatic bile duct cancer was 17.5 percent in the U.S. from 2006-2012⁴³ and is the same in Colorado according to the Colorado Central Cancer Registry.⁴⁴

As shown in Figure D.1, the number of diagnosed liver and intrahepatic bile duct cancers in Colorado has doubled for women and more than doubled for men in the period 1999 to 2013.

Figure D.1. Number of Liver and Intrahepatic Bile Duct Cancers By Year of Diagnosis, Colorado, 1999-2013.⁴⁵



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 hepatocellular carcinoma (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 mortality⁴⁶; 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 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.

Population attributable risk

The population attributable risk (PAR) proportion is the extent that a risk factor contributes to overall burden of disease at a population level, or the proportion of cases that would not occur in the population if the factor were eliminated. The PAR proportion is a measure used for cancer control policy and enables public health prevention to focus on risk factors that have the highest impact. The PAR of hepatitis C for HCC is:

$$\text{PAR} = \frac{\text{incidence of HCC in the general population} - \text{incidence of HCC in the unexposed (no hepatitis C)}}{\text{incidence of HCC in the general population}}$$

The population attributable risk of HCC liver cancer due to hepatitis C in Colorado was estimated to be 50 percent. By comparison, two publications have estimated PARs of 20.5 percent and 22.4 percent in the U.S Medicare population.^{47,48} The reason for this difference in estimated PARs is not definitively known, but potential explanations include that the Medicare population is older and has more competing comorbid conditions; and that Colorado's population and related behaviors differ from the nation. With an estimated PAR of 50 percent in Colorado, this rate means that liver cancers could be cut in half in Colorado with elimination of hepatitis C.

Healthcare exposures to HBV and HCV

The risk of acquiring hepatitis B and hepatitis C infection 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 2008-2015.⁴⁹ 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 resulted in 18 cases of hepatitis C that were genetically linked and an additional eight cases that were epidemiologically linked to the healthcare worker.⁵⁰

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.

Addressing viral hepatitis in Colorado

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.⁷

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. Since many cases of hepatitis B and hepatitis C are unaware of their infection, additional screening of people at risk will help identify 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.

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, Testing, calls for improving linkage to care.³⁴ 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.⁵¹ 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 receive this treatment.⁷

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

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