

# **Viral Hepatitis Surveillance United States, 2016**

## Contents

SUMMARY .....	3
BACKGROUND .....	6
Sources of Information.....	10
INVESTIGATION OF HEALTHCARE-ASSOCIATED OUTBREAK CASES.....	14
HEPATITIS A .....	15
HEPATITIS B.....	28
Acute Hepatitis B.....	28
Chronic Hepatitis B.....	41
Perinatal Hepatitis B .....	48
HEPATITIS C.....	50
Acute Hepatitis C.....	50
Chronic Hepatitis C.....	62
DISCUSSION .....	69
REFERENCES .....	71
ADDITIONAL RESOURCES.....	75

# Surveillance of Viral Hepatitis – United States, 2016

## SUMMARY

The Centers for Disease Control and Prevention's (CDC) National Notifiable Diseases Surveillance System (NNDSS) (1) receives viral hepatitis case reports electronically each week from state and territorial health departments in the United States (U.S.) via CDC's National Electronic Telecommunications System for Surveillance (NETSS), a computerized public health surveillance system. The surveillance system accepts case reports of viral hepatitis from all states and the District of Columbia, though not all jurisdictions report their data. In 2016, all 50 states and the District of Columbia submitted reports of acute hepatitis A virus (HAV) infection, 48 states submitted reports of acute hepatitis B virus (HBV) infection, 42 submitted reports of acute hepatitis C virus (HCV) infection, 43 submitted reports of chronic HBV infection, and 42 submitted reports of chronic HCV infection.

Viral hepatitis cases reported to NNDSS represent persons who were tested for and diagnosed with viral hepatitis infection based on specific surveillance case definitions (<https://wwwn.cdc.gov/nndss/conditions/>). Most persons infected with viral hepatitis are asymptomatic and so are not identified or reported. This summary describes estimated trends during 2001–2016 and reported cases of HAV, HBV, and HCV infections in 2016. In 2011, CDC developed a statistical method to account for cases that were neither diagnosed nor reported in estimating the actual number of new (acute) cases of HAV, HBV, and HCV infections from the number of cases reported for each disease (2); estimates adjusted for under-ascertainment and under-reporting in this report were derived using this method. Note that estimates before 2011 were obtained using a different, unpublished method, and cannot be compared with estimates in this report.

**Hepatitis A:** Between 2012 and 2016, the number of hepatitis A virus (HAV) infections reported to CDC fluctuated because large outbreaks occurred. After a long downward trend, the first increase between 2012 and 2013 (1,562 and 1,781 reported cases, respectively), was due to a large multi-state outbreak associated with pomegranate arils imported from Turkey (3). Between 2015 and 2016, the reported cases again increased by 44.4% from 1,390 in 2015 to 2,007 cases in 2016. The 2016 increase was due to two HAV outbreaks, each of which was linked to imported foods (<https://www.cdc.gov/hepatitis/outbreaks/index.htm>). Infant hepatitis A vaccination was first recommended for states west of the Mississippi in 1996; subsequently, routine vaccination of children aged >1 year in the United States was recommended in 2006. Since then, vaccination rates and evidence of vaccine-induced immunity in young persons have increased in the past decade (4, 5). As a result, the lowest rates of HAV cases have occurred in younger age groups (0–19 years) since 2012. Yet hepatitis A vaccination coverage levels among young children remain lower than those for other routinely recommended vaccines (6). Additionally, many adults remain unvaccinated and susceptible to HAV infection. International travel is the most commonly reported risk for HAV infection (7). After adjusting for under-ascertainment and under-reporting (2), the estimated number of new HAV infections in 2016 was 4,000 (95% confidence interval [CI], 2,800–4,400).

**Hepatitis B:** After a marked decline in acute hepatitis B virus (HBV) infections reported to CDC since the 1990s—with the widespread introduction of hepatitis B vaccination—there has been no

consistent trend in acute HBV cases since 2012; that is, reported cases have been fluctuating around 3,000 cases each year. In 2016, there were 3,218 cases reported to CDC. After adjusting for under-ascertainment and under-reporting (2), the estimated number of new HBV infections in 2016 was 20,900 (95% CI, 11,900–51,200).

In addition to new HBV infections, chronic HBV infections remain a major public health challenge. For 2011–2012, an estimated 847,000 (95% CI, 565,000–1,130,000) persons were living with HBV in the United States (8); a 2009 estimate, using other adjustment methods, was reported to be as high as 2.2 million (9). Excluding case reports with unknown or missing data, about one half of chronic HBV infections were among Asian/Pacific Islanders, and three quarters of chronic HBV infections were among persons born outside of the United States. Among persons born outside of the United States with chronic HBV infection, an estimated 58% migrated from Asia (9). CDC mortality data show that disproportionate numbers of Asian/Pacific Islanders are dying with hepatitis B. CDC and the U.S. Preventive Services Task Force (USPSTF) recommend HBV testing for persons born in countries where HBV infection is endemic and for persons with sexual or blood-borne risks for infection (10). Testing and diagnosis of infection are the first steps toward receipt of recommended care and treatment (11, 12).

**Hepatitis C:** Reported cases of acute hepatitis C virus (HCV) infection increased about 3.5-fold from 2010 through 2016 (from 850 to 2,967 reported cases), rising annually throughout this period. Examining annual trends beginning in 2012, reported cases of acute HCV infection increased 20.2% from 2012 to 2013 (n=1,778 and 2,138 cases, respectively), increased 2.6% to 2,194 cases in 2014, increased 11.0% to 2,436 cases in 2015, and increased 21.8% to 2,967 cases in 2016. The increase in acute HCV case reports reflects new infections associated with rising rates of injection-drug use, and, to a lesser extent, improved case detection (13, 14). Several early investigations of newly acquired HCV infections reveal that most occur among young, white persons who inject drugs and live in non-urban areas (particularly in states within the Appalachian, Midwestern, and New England regions of the country) (14, 15); trends in these states likely indicate an overall increase in HCV incidence throughout the country (13, 16). The great majority of acute HCV are not reported as few adults and adolescents with HCV have symptoms, and only a minority of them are then diagnosed and reported to health authorities. After adjusting for under-ascertainment and under-reporting (2), an estimated 41,200 (95% CI, 32,600–140,600) new HCV infections occurred in 2016.

Based on the data from national health surveys conducted during 2003–2010 and adjusted for underreporting, approximately 3.5 million persons were infected with HCV (17). This prevalence estimate reflects changes in HCV incidence, cures of HCV infections, and mortality from HCV and other causes. Mortality among HCV-infected persons—primarily adults aged 55–64 years—increased during 2006–2010 (18, 19). In 2013, HCV-related deaths, as recorded on death certificates, exceeded the combined number of deaths of 60 other infectious diseases as underlying or contributing causes (20). The overall hepatitis C-related mortality rate remained steady from 2012 through 2014 (5.0 deaths/100,000 population); it then declined to 4.9 deaths/100,000 in 2015 and declined still further to 4.5 deaths/100,000 in 2016. However, some evidence suggests that deaths in HCV-infected persons may have been under enumerated (18); the only large U.S. study of deaths among persons with confirmed HCV infection indicated that only 19% had HCV listed anywhere on the death certificate despite 75% having evidence of substantial liver disease (19). With current treatment regimens, over 90% of HCV infected persons can be cured of HCV infection with an 8–12 week oral therapy (21). To increase the proportion of persons with HCV who are tested and linked to recommended care including curative treatment for HCV (12, 22),

CDC and USPSTF recommend one-time testing for HCV infection among all adults born during 1945–1965 and among others at increased risk for HCV infection (23).

## BACKGROUND

Viral hepatitis is caused by infection with any of at least five distinct viruses: hepatitis A virus (HAV), hepatitis B virus (HBV), hepatitis C virus (HCV), hepatitis D virus (HDV), and hepatitis E virus (HEV). Most viral hepatitis infections in the United States are attributable to HAV, HBV, and HCV. All three of these unrelated viruses can produce acute illness characterized by nausea, malaise, abdominal pain, and jaundice, although many of these acute infections are asymptomatic or cause only mild disease. Both HBV and HCV can also cause chronic disease that remains largely asymptomatic; thus, many persons infected with HBV or HCV are unaware they are infected and have clinically silent infections for decades until developing cirrhosis, end-stage liver disease, or hepatocellular carcinoma (HCC).

### Hepatitis A

Transmitted through the fecal-oral route, HAV is acquired in the United States primarily through close personal contact with an infected person and during foodborne outbreaks (21). Unlike hepatitis B and C, hepatitis A does not cause chronic infection. Since 1995, effective vaccines to prevent HAV infection have been available in the United States, increasing feasibility of eliminating indigenous transmission. In 1996, CDC's Advisory Committee on Immunization Practices (ACIP) recommended administration of hepatitis A vaccine to persons at increased risk for the disease, including international travelers, men who have sex with men (MSM), persons who use drugs and persons who inject drugs (PWID), and children living in communities with high rates of disease (24). In 1999, ACIP expanded these recommendations to include children living in 11 states with average hepatitis A rates of  $\geq 20$  cases per 100,000 population and recommended that vaccination be considered for children in an additional six states with rates of 10–20 cases per 100,000 population (25). In 2006, ACIP expanded these recommendations to include routine vaccination of children aged  $\geq 1$  year in all 50 states (4).

### Hepatitis B

HBV is transmitted by percutaneous or mucosal exposure to blood or body fluids of an infected person, such as from an infected mother to her newborn during childbirth, through close personal contact within households, through unscreened blood transfusion or unsafe injections in health-care settings, through injection drug use, and from sexual contact with an infected person. Adults with diabetes mellitus are at an increased risk for acquiring HBV infection if they share diabetes-care equipment such as blood glucose meters, finger stick devices, syringes and/or insulin pens. Hepatitis B vaccination is recommended for persons with diabetes between 19–59 years of age (26).

Risk for chronic HBV infection decreases with increasing age at onset of infection. Of infants who acquired HBV infection from their mothers at birth, as many as 90% become chronically infected compared with 30%–50% of children infected at age 1–5 years (27). This percentage is smaller among adults, for whom approximately 5% of all acute HBV infections progress to chronic infection (28, 29).

Effective vaccines to prevent HBV infection have been available in the United States since 1981. Ten years later, in 1991, a comprehensive strategy was recommended for the elimination of HBV transmission in the United States (28–30); the strategy was revised to include catch-up

vaccination of older children, adolescents, and other populations. The current vaccine-based strategy for the elimination of HBV transmission encompasses the following components:

- Universal vaccination within 24 hours of birth for medically stable infants weighing  $\geq 2,000$  grams;
- Prevention of perinatal HBV infection through routine screening of all pregnant women for HBV infection (including HBV DNA testing for infected women) and provision of hepatitis B vaccine and HBIG immunoprophylaxis to infants born to hepatitis B surface antigen (HBsAg)-positive mothers;
- Routine vaccination of previously unvaccinated children and adolescents;
- Vaccination of adults at increased risk for infection (including PWID, persons with two or more sexual partners, MSM, adults with HIV infection or those seeking treatment for HIV or any sexually transmitted infections, persons at risk for occupational exposure, hemodialysis and end stage renal disease patients, adults with diabetes, household contacts and sex partners of persons with chronic HBV infection, developmentally disabled persons in long-term care facilities, persons in correctional facilities, and travelers to HBV endemic countries) including pregnant women with any of these risks; and
- Vaccination of persons with HCV infection or chronic liver disease.

In addition to hepatitis B vaccination, efforts have been made to improve care and treatment for the estimated 1-2 million persons living with hepatitis B in the United States. Many HBV-infected persons are unaware of their infection status (11). Because testing is the first critical step towards receipt of recommended care and treatment (10), in 2008 CDC and USPSTF recommended HBV testing for immigrant persons born in countries where HBV infection is endemic and for other persons at risk. These guidelines stress the need for testing persons at high risk for infection, conducting contact management, educating patients, linking infected persons to health care providers, and administering FDA-approved therapies for treating hepatitis B. Other guidelines address the appropriate management of chronic HBV infection among surgeons, other health-care workers, and students (31).

## **Hepatitis C**

HCV is transmitted primarily through percutaneous (parenteral) exposure that can result from injection-drug use, needle stick injuries, and inadequate infection control in health-care settings. Much less often, HCV transmission occurs among HIV-positive persons, especially MSM, as a result of sexual contact with an HCV-infected partner (32, 33), among persons who receive tattoos in unregulated settings (33), and among infants born to HCV-infected mothers (34). After adjustment for populations not sampled in the 2003-2010 National Health and Nutrition Examination Survey (NHANES) household surveys (e.g., incarcerated and homeless populations), an estimated 3.5 million persons were living with HCV infection in the United States (17). This prevalence has been affected by trends in mortality and curative treatment and is considered to be lower today.

Approximately 75%–85% of newly infected adults and adolescents develop chronic HCV infection (35). A single positive anti-HCV result cannot distinguish between acute and chronic HCV infection or between current or resolved (cleared) HCV infection. The 2016 case definition for chronic HCV infection requires anti-HCV testing and if positive, a nucleic acid test (NAT) or a test

indicating presence of hepatitis C viral antigen(s) (HCV antigen test). No clinical symptoms are required; however, the case must be known to not be acute. For reporting purposes, health departments must make the distinction between acute and chronic HCV infection based on both 1) laboratory testing and 2) clinical criteria from providers regarding the presence of signs and symptoms indicative of liver disease or acute HCV infection. Repeat laboratory tests may be used to determine serologic conversion from anti-HCV negative to anti-HCV positive.

National recommendations for preventing HCV infection include screening and testing donors of blood, other tissues and organs, inactivating HCV in plasma-derived products, testing persons at risk for HCV infection, providing risk-reduction counseling and recommended care and treatment, increasing access to safe injection equipment for PWID, and consistently implementing and practicing infection control in health-care settings (36). In 2010, FDA approved point-of-care tests for HCV infection that yield prompt results available to patients during the same clinical visit (37). In 2012, CDC augmented existing recommendations for HCV screening based on risk to include recommendations for one-time screening for HCV infection among all persons born during 1945–1965 (39); persons born during these years have an estimated 3% prevalence of HCV antibodies, which is six times higher than the prevalence seen in adults born in other years (38). Of all persons living with HCV infection, about 75% were born during 1945–1965; a similar percentage of HCV-associated deaths can be attributed to this birth cohort (39). The goal of birth-cohort HCV testing is to identify unrecognized infections among the segment of the population at highest risk for HCV-associated morbidity and mortality, thereby increasing opportunities for persons infected with HCV to benefit from appropriate care and treatment.

Linkage to care and treatment is critical to improving health outcomes for persons found to be infected with HCV. Such linkage is particularly important in light of major advancements that have been made in HCV treatments. For patients infected with HCV, treatment previously consisted of pegylated interferon (PEG-INF) combined with oral doses of ribavirin (40). Approximately 40%-50% of HCV-infected patients receiving this therapy cleared their infection (40). However, HCV treatment improved drastically in 2011 with development of the initial HCV direct-acting oral agents telaprevir and boceprevir, which were capable of achieving a sustained virologic response (SVR) rate of  $\geq 80\%$  (40, 41). In 2013 in the United States, these two drugs were replaced with all-oral direct-acting antiviral agents (DAAs), simeprevir and sofosbuvir (42). When given in combination with PEG-INF and ribavirin or as an all-oral combination regimen for a duration of 8-12 weeks, these agents increased SVR rates to  $\geq 90\%$  (43, 44). In 2014, two all-oral regimens, Harvoni (ledipasvir/sofosbuvir) and Viekira Pak (ombitasvir, paritaprevir, and ritonavir tablets; dasabuvir tablets), were licensed for the treatment of HCV. Daklinza (daclatasvir) was approved in July 2015 for use with sofosbuvir as the first 12-week, all-oral treatment option for patients with chronic hepatitis C virus genotype 3. Also approved in July 2015 was Technivie (ombitasvir, paritaprevir and ritonavir), used in combination with ribavirin for the treatment of HCV genotype 4 infections in patients that do not have scarring or poor liver function (cirrhosis). Newer, all-oral agents are being added continually and have become the standard of care in the United States. In 2016, Zepatier (elbasvir/grazoprevir) and Epclusa (sofosbuvir/velpatasvir) (45) were FDA approved, the latter drug for all HCV genotypes. In 2017, Mavyret (glecaprevir/pibrentasvir) was approved as the first eight-week treatment for all HCV genotypes (46), and Harvoni and Sovaldi (sofosbuvir) were approved for adolescents (47). Evidence-based guidance is available from the American Association for the Study of Liver Diseases (AASLD)/ Infectious Disease Society of America (IDSA) to assist providers caring for HCV-infected patients (48). The AASLD/IDSA HCV guidance is updated continuously to incorporate new information regarding HCV testing, linkage to care, and treatment



<http://www.hcvguidelines.org>

## Sources of Information

CDC relies on several sources of information to determine the incidence, prevalence, trends, and burden of viral hepatitis A, B, and C disease.

### National Notifiable Diseases Surveillance System (NNDSS)

The basis for most case reports is passive surveillance through the National Notifiable Diseases Surveillance System (NNDSS). State, local, and territorial health departments report acute (incident) cases of hepatitis A, hepatitis B, and hepatitis C through this system on a weekly basis. Some but not all states also report cases of chronic hepatitis B and chronic hepatitis C through NNDSS. Since 1990, states have been electronically submitting individual case reports (absent of personal identifiers) to CDC. States' participation in notifying CDC of cases of nationally notifiable diseases, including viral hepatitis, is voluntary. Collecting, verifying, and reporting the many cases of hepatitis B and C in the United States (estimated at more than 4 million) are beyond the capability of many health departments. Reports of chronic hepatitis B and C are included in this Surveillance Summary only from those states granting CDC permission to publish those counts.

National surveillance for viral hepatitis (including acute hepatitis A, hepatitis B, and hepatitis C; and chronic hepatitis B and hepatitis C) is based on case definitions developed and approved by the Council of State and Territorial Epidemiologists (CSTE) and CDC. Reported cases of acute and chronic viral hepatitis are required to meet specific clinical and laboratory criteria (available at: <https://wwwn.cdc.gov/nndss/conditions/notifiable/2016/>). However, these criteria are evaluated at state or local health departments and are not validated by CDC. Although states may classify cases as confirmed, probable, and suspect, only confirmed cases of acute viral hepatitis are presented in this report. Updated CSTE Case definitions are available at the CSTE website: <https://wwwn.cdc.gov/nndss/case-definitions.html>.

### Adjustments to Reported Cases from the National Notifiable Diseases Surveillance System

To better estimate the incidence of acute hepatitis A, hepatitis B, and hepatitis C in the United States, CDC developed a model to account for under-ascertainment and under-reporting of cases of viral hepatitis. The model factors in the probabilities of an infected person developing symptoms such as jaundice, referral to care and treatment, and rates of reporting to local and state health departments. Results of the analysis estimated that reported cases represent 1 of every 2 hepatitis A cases, 1 of every 6.5 acute hepatitis B cases, and 1 of every 13.9 acute hepatitis C cases (2). To obtain the estimated number of cases of acute HAV, HBV, and HCV infections after accounting for under-ascertainment and under-reporting, these new estimators were applied to the acute hepatitis case data from NNDSS beginning in 2011. Incidence data reported in Surveillance Summaries from 2011 onward, including this report, reflect these estimators. Because earlier estimates were based on different (and unpublished) calculations, current estimates cannot be used to deduce trends by comparison with estimations obtained in years prior to 2011; still, trends in reported cases can be evaluated (e.g., the trend in the increase in acute hepatitis C first observed in 2011 among nationally reported cases).

### Enhanced Viral Hepatitis Surveillance Sites

## Background

From 2012 through 2017, CDC funded seven health departments to conduct enhanced viral hepatitis surveillance. Each quarter, a dataset of cumulative cases from each site is sent to CDC through the CDC Secure Access Management System (SAMS), a secure electronic file transfer portal.

## Methods

The seven funded sites (the states of Florida, Massachusetts, Michigan, New York, and Washington and cities of Philadelphia and San Francisco) represent a combined population of approximately 57.8 million persons. In each of these jurisdictions, clinical laboratories are mandated to submit laboratory reports from persons with positive HBV and HCV test results to state or local health departments. Participating health departments routinely review each report to assess whether current case definitions are met as established by CSTE and CDC. Sites are also required to de-duplicate all chronic cases of viral hepatitis. To determine whether a case is new, each site matches new case reports to existing cases in the surveillance registry using personal identifying information. New cases are added to an electronic registry, whereas duplicate cases are used to update previous reports. Most health departments collect basic demographic data (e.g., age and sex) from the laboratory reports. Efforts vary by site regarding the level of investigation undertaken to collect and store supplemental information (e.g., risk factor data) from patients or their providers. Health departments in all funded sites conduct follow-up for a sample of cases (and all cases in some sites such as New York State) to obtain clinical, laboratory, and epidemiologic information, including risk exposures and behaviors.

Data analyses from participating enhanced surveillance sites presented in this surveillance report were conducted on all serologically confirmed cases of chronic hepatitis B and chronic hepatitis C infection reported for the year 2016. Rates were calculated using appropriate jurisdiction-specific (state, county, or city) 2016 population estimates obtained from the U.S. Census Bureau.

## Limitations

The number of cases of chronic HBV infection and chronic HCV infection from participating enhanced surveillance sites included in this report is likely an underestimate of the true burden of disease, because cases of chronic infection are generally asymptomatic and less likely to be identified and reported. Additionally, data from these sites are not representative of the U.S. population; because not all sites conduct comprehensive follow-up, data regarding race/ethnicity, place of birth, and risk exposures and behaviors are missing for some case reports.

## Mortality/Death Certificates

### Background

Death certificates are completed for all deaths registered in the United States. Information from death certificates is provided by funeral directors, attending physicians, medical examiners, and coroners; certificates are filed in vital statistics offices within each state and the District of Columbia. Through a program called the National Vital Statistics System (NVSS) (49), information from death certificates is compiled by CDC's National Center for Health Statistics (NCHS) to produce national multiple-cause-of-death (MCO) data (49); causes of death are coded in accordance with the International Classification of Diseases, Tenth Revision (ICD-10) (50). MCO data are used to determine the national burden of mortality associated with viral hepatitis and to characterize decedents.

A major study of death certificates from 1999–2007 revealed that in 2007, the annual number of deaths associated with HCV infection exceeded the annual number of deaths associated with HIV infection (18). A more recent study using death certificate data from 2003–2013 showed that the number of deaths associated with HCV infection continued to increase and in 2012 surpassed the combined number of deaths associated with 60 other nationally notifiable infectious conditions that are routinely reported to CDC (20).

### Methods

We obtained and analyzed 2012–2016 national multiple-cause mortality data through NVSS. The following case definitions were used to identify a death associated with hepatitis A, B, and C.

Any death record with a report of any of the following ICD-10 codes listed as the underlying or one of the multiple (e.g., contributing) causes of death in the record axis:

- Hepatitis A (ICD-10: B15),
- Hepatitis B (ICD-10: B16, B17.0, B18.0, and B18.1), or
- Hepatitis C (ICD-10: B17.1 and B18.2).

Demographic information on age, race/ethnicity, and sex were examined. Deaths were divided into six age categories: 0–34, 35–44, 45–54, 55–64, 65–74, and  $\geq 75$  years. Race was divided into the following categories: white, non-Hispanic; black, non-Hispanic; Hispanic; Asian/Pacific Islander (API); and American Indian/Alaska Native (AI/AN). To calculate national mortality rates, the number of deaths associated with each type of hepatitis was divided by the total U.S. Census population for each demographic characteristic. Rates on race/ethnicity, sex, and overall total were standardized to the age distribution of the U.S. standard population in 2000 (51).

### Limitations:

The following limitations to the mortality data should be taken into account when interpreting these data.

- Differences in recording practices of death certificate information may cause misclassification of ICD-10 codes and demographic information.
- Certain racial/ethnic populations likely are underrepresented in U.S. Census data (the

denominator for calculating rates), potentially causing overestimated rates for these populations.

- HBV and HCV infections are often underreported as causes of death on death certificates. These analyses do not adjust for deaths resulting from undiagnosed viral hepatitis infections.
- Death records listing more than one type of viral hepatitis infection were counted once for each type of infection. For example, a death with ICD-10 codes for both hepatitis B and C virus infections is counted once as a hepatitis B death and once as a hepatitis C death.

## INVESTIGATION OF HEALTHCARE-ASSOCIATED OUTBREAK CASES

In 2016, CDC participated in 3 state-based investigations of healthcare-associated outbreaks of HBV or HCV infection with two or more confirmed outbreak-related cases. Additional information may be found at the following link that summarizes known outbreaks that occurred during 2008–2016 (<https://www.cdc.gov/hepatitis/outbreaks/healthcarehepoutbreaktable.htm>).

**Table 1.1. Hepatitis B and C Outbreaks by Setting — United States, 2016**

Hepatitis B (HBV) Outbreaks by Setting				
Setting	State	Persons Notified for Screening	Outbreak-Associated Infections	Known or suspected mode of transmission
<b>Outpatient</b>				
Personal care home	Pennsylvania	82	2	Multiple infection control breaches including suboptimal universal precautions during provision of care including assistance with personal hygiene and blood glucose monitoring
Hepatitis C (HCV) Outbreaks by Setting				
Setting	State	Persons Notified for Screening	Outbreak-Associated Infections	Known or suspected mode of transmission
<b>Hemodialysis</b>				
Outpatient hemodialysis facility	Anonymous State X	203	2	Specific lapses in infection control were suspected but not identified at the time of the investigation
Outpatient hemodialysis facility	Pennsylvania	154	2	Breaches in environmental cleaning and disinfection practices identified including lapses in hand hygiene, mixing of clean and dirty areas, and inadequate cleaning of stations between patients

# HEPATITIS A

## Hepatitis A

In 2016, a total of 2,007 cases of hepatitis A were reported to CDC from 50 states and the District of Columbia (Table 2.1). The overall incidence rate in 2016 was 0.6 reported cases per 100,000 population. Actual cases are estimated to be 2.0 times the number of reported cases in any year. After adjusting for under-ascertainment and under-reporting, an estimated 4,000 hepatitis A cases (95% CI=2,800-4,400) occurred in 2016.

### 2012 CSTE/CDC Case Definition (NNDSS)

#### Clinical Description

Acute hepatitis is defined as acute illness with 1) discrete onset of symptoms (e.g., fever, headache, malaise, anorexia, nausea, vomiting, diarrhea, and abdominal pain) and 2) jaundice, elevated serum alanine aminotransferase (ALT), or aspartate aminotransferase (AST) levels.

#### Laboratory Criteria

Immunoglobulin M (IgM) antibody to hepatitis A virus (anti-HAV) positive.

Table 2.1. Reported cases of hepatitis A, nationally and by state or jurisdiction — United States, 2012–2016

State	2012		2013		2014		2015		2016	
	No.	Rate*	No.	Rate*	No.	Rate*	No.	Rate*	No.	Rate*
Alabama	19	0.4	10	0.2	15	0.3	23	0.5	19	0.4
Alaska	1	0.1	1	0.1	1	0.1	4	0.5	2	0.3
Arizona	93	1.4	66	1.0	29	0.4	54	0.8	32	0.5
Arkansas	8	0.3	9	0.3	2	0.1	10	0.3	13	0.4
California	209	0.5	255	0.7	142	0.4	179	0.5	229	0.6
Colorado	28	0.5	51	1.0	23	0.4	25	0.5	22	0.4
Connecticut	23	0.6	19	0.5	23	0.6	9	0.3	16	0.4
Delaware	9	1.0	4	0.4	1	0.1	2	0.2	1	0.1
District of Columbia	U	U	U	U	U	U	U	U	4	0.6
Florida	87	0.5	115	0.6	90	0.5	108	0.5	115	0.6
Georgia	46	0.5	36	0.4	24	0.2	30	0.3	44	0.4
Hawaii	5	0.4	16	1.1	5	0.4	6	0.4	285	20.0
Idaho	11	0.7	8	0.5	7	0.4	9	0.5	7	0.4
Illinois	67	0.5	79	0.6	82	0.6	57	0.4	71	0.6
Indiana	11	0.2	32	0.5	20	0.3	19	0.3	18	0.3
Iowa	7	0.2	17	0.6	12	0.4	16	0.5	16	0.5
Kansas	15	0.5	11	0.4	7	0.2	7	0.2	5	0.2
Kentucky	25	0.6	24	0.5	19	0.4	16	0.4	9	0.2
Louisiana	7	0.2	14	0.3	5	0.1	5	0.1	12	0.3
Maine	9	0.7	10	0.8	8	0.6	8	0.6	8	0.6
Maryland	28	0.5	29	0.5	27	0.5	19	0.3	37	0.6
Massachusetts	40	0.6	43	0.6	43	0.6	34	0.5	64	0.9
Michigan	100	1.0	83	0.8	45	0.5	51	0.5	112	1.1
Minnesota	29	0.5	32	0.6	19	0.3	21	0.4	15	0.3
Mississippi	11	0.4	5	0.2	3	0.1	2	0.1	2	0.1
Missouri	20	0.3	8	0.1	20	0.3	9	0.1	16	0.3
Montana	6	0.6	6	0.6	5	0.5	2	0.2	3	0.3
Nebraska	16	0.9	13	0.7	9	0.5	6	0.3	21	1.1
Nevada	10	0.4	19	0.7	5	0.2	11	0.4	14	0.5
New Hampshire	6	0.5	9	0.7	5	0.4	2	0.2	8	0.6
New Jersey	60	0.7	68	0.8	59	0.7	59	0.7	74	0.8
New Mexico	10	0.5	20	1.0	8	0.4	6	0.3	4	0.2
New York	111	0.6	167	0.8	84	0.4	123	0.6	99	0.5



**Table 2.1 (cont'd). Reported cases of hepatitis A, nationally and by state or jurisdiction  
— United States, 2012–2016**

State	2012		2013		2014		2015		2016	
	No.	Rate*	No.	Rate*	No.	Rate*	No.	Rate*	No.	Rate*
<b>North Carolina</b>	34	0.3	46	0.5	38	0.4	45	0.4	52	0.5
<b>North Dakota</b>	2	0.3	9	1.2	9	1.2	5	0.7	2	0.3
<b>Ohio</b>	36	0.3	59	0.5	32	0.3	36	0.3	36	0.3
<b>Oklahoma</b>	12	0.3	14	0.4	17	0.4	11	0.3	11	0.3
<b>Oregon</b>	9	0.2	29	0.7	13	0.3	28	0.7	15	0.4
<b>Pennsylvania</b>	62	0.5	53	0.4	48	0.4	43	0.3	62	0.5
<b>Rhode Island</b>	3	0.3	4	0.4	8	0.8	4	0.4	4	0.4
<b>South Carolina</b>	6	0.1	14	0.3	6	0.1	16	0.3	21	0.4
<b>South Dakota</b>	0	0.0	4	0.5	3	0.4	2	0.2	1	0.1
<b>Tennessee</b>	23	0.4	20	0.3	12	0.2	14	0.2	7	0.1
<b>Texas</b>	134	0.5	109	0.4	124	0.5	147	0.5	139	0.5
<b>Utah</b>	4	0.1	12	0.4	8	0.3	8	0.3	12	0.4
<b>Vermont</b>	2	0.3	7	1.1	1	0.2	3	0.5	5	0.8
<b>Virginia</b>	49	0.6	36	0.4	27	0.3	50	0.6	190	2.3
<b>Washington</b>	29	0.4	45	0.6	26	0.4	26	0.4	31	0.4
<b>West Virginia</b>	8	0.4	4	0.2	12	0.6	8	0.4	15	0.8
<b>Wisconsin</b>	21	0.4	37	0.6	7	0.1	9	0.2	7	0.1
<b>Wyoming</b>	1	0.2	0	0.0	1	0.2	3	0.5	0	0.0
<b>U.S.</b>	<b>1562</b>	<b>0.5</b>	<b>1781</b>	<b>0.6</b>	<b>1239</b>	<b>0.4</b>	<b>1390</b>	<b>0.4</b>	<b>2007</b>	<b>0.6</b>

Source: CDC, National Notifiable Diseases Surveillance System.

\*Rate per 100,000 population.

U=No data available for reporting.

- The number of hepatitis A cases reported in the United States increased 14.0% from 2012 through 2013 (1,562 cases to 1,781 cases), declined 30.4% from 2013 through 2014, then increased 12.2% from 2014 through 2015. Compared with data for 2015, cases of hepatitis A increased 44.4% to 2,007 cases in 2016.
- The national rate of hepatitis A increased from 0.4 cases/100,000 population in 2015 to 0.6 cases/100,000 population in 2016.
- Some state-specific increases from 2015 to 2016 are due to two separate foodborne hepatitis A outbreaks occurring primarily in Hawaii, Maryland, North Carolina, Virginia, and West Virginia (<https://www.cdc.gov/hepatitis/outbreaks/index.htm>).

Map 2.1 State Acute Hepatitis A Incidence Compared to Healthy People 2020 National Goal\*  
United States, 2016



Source: CDC, National Notifiable Diseases Surveillance System (NNDSS)

\*National goal: 0.3 cases/100,000 population

- Of the 50 reporting states, 18 (36%) met the *Healthy People 2020* goal (<https://www.healthypeople.gov/>) of reducing hepatitis A incidence to  $\leq 0.3$  cases/100,000 population: Alaska, Delaware, Indiana, Kansas, Kentucky, Louisiana, Minnesota, Mississippi, Missouri, Montana, New Mexico, North Dakota, Ohio, Oklahoma, South Dakota, Tennessee, Wisconsin, and Wyoming.
- The incidence of hepatitis A was above the *Healthy People 2020* goal for 32 states and the District of Columbia: Alabama, Arizona, Arkansas, California, Colorado, Connecticut, Florida, Georgia, Hawaii, Idaho, Illinois, Iowa, Maine, Maryland, Massachusetts, Michigan, Nebraska, Nevada, New Hampshire, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Rhode Island, South Carolina, Texas, Utah, Vermont, Virginia, Washington, and West Virginia.
- Of the 32 states with rates above the *Healthy People 2020* goal, eight states (Hawaii, Massachusetts, Michigan, Nebraska, New Jersey, Vermont, Virginia, and West Virginia) had rates more than twice the national goal.

**Table 2.2. Select clinical characteristics of hepatitis A cases\* reported in the United States, 2016**

Clinical characteristic	Availability of valid data <sup>†</sup> for clinical characteristic		Cases with clinical characteristic <sup>§</sup>	
	No.	%	No.	%
<b>Jaundice</b>	1,137	56.7	621	54.6
<b>Hospitalized for hepatitis A</b>	1,097	54.7	456	41.6
<b>Died from hepatitis A</b>	1,026	51.1	7	0.7

Source: CDC, National Notifiable Diseases Surveillance System.

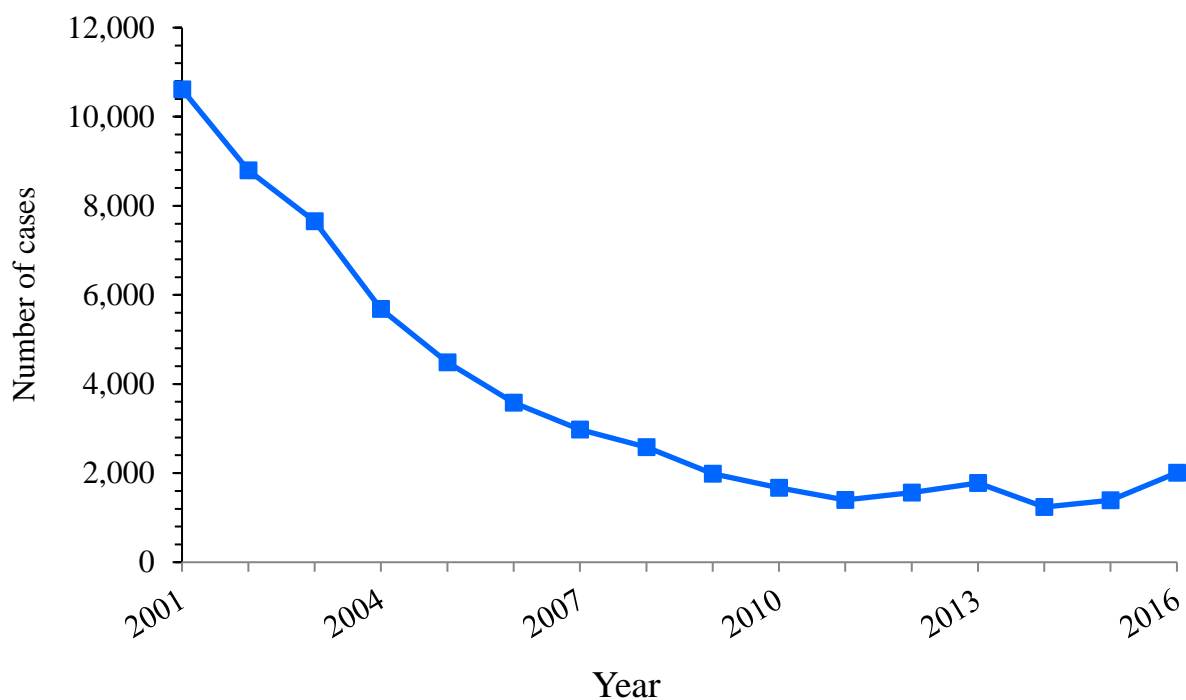
\*A total of 2,007 hepatitis A cases were reported during 2016.

<sup>†</sup>Case reports for which questions regarding clinical characteristics were answered with “yes” or “no.” Reports with any other response were excluded.

<sup>§</sup>Numbers and percentages represent only those case reports for which data regarding clinical characteristics were available; numbers likely are underestimates.

- Of the 2,007 case reports of hepatitis A received during 2016, 56.7% included information about whether the patient had jaundice, 54.7% included information regarding hospitalization caused by hepatitis A, and 51.1% included information on deaths from hepatitis A.
- Jaundice was reported for 621 (54.6%) of the 1,137 hepatitis A case reports that included information about jaundice.
- Hospitalization as the result of hepatitis A was reported for 456 (41.6%) of the 1,097 hepatitis A case reports that included information about hospitalization.
- Death as the result of hepatitis A was reported for 7 (0.7%) of the 1,026 hepatitis A case reports that included information about death.

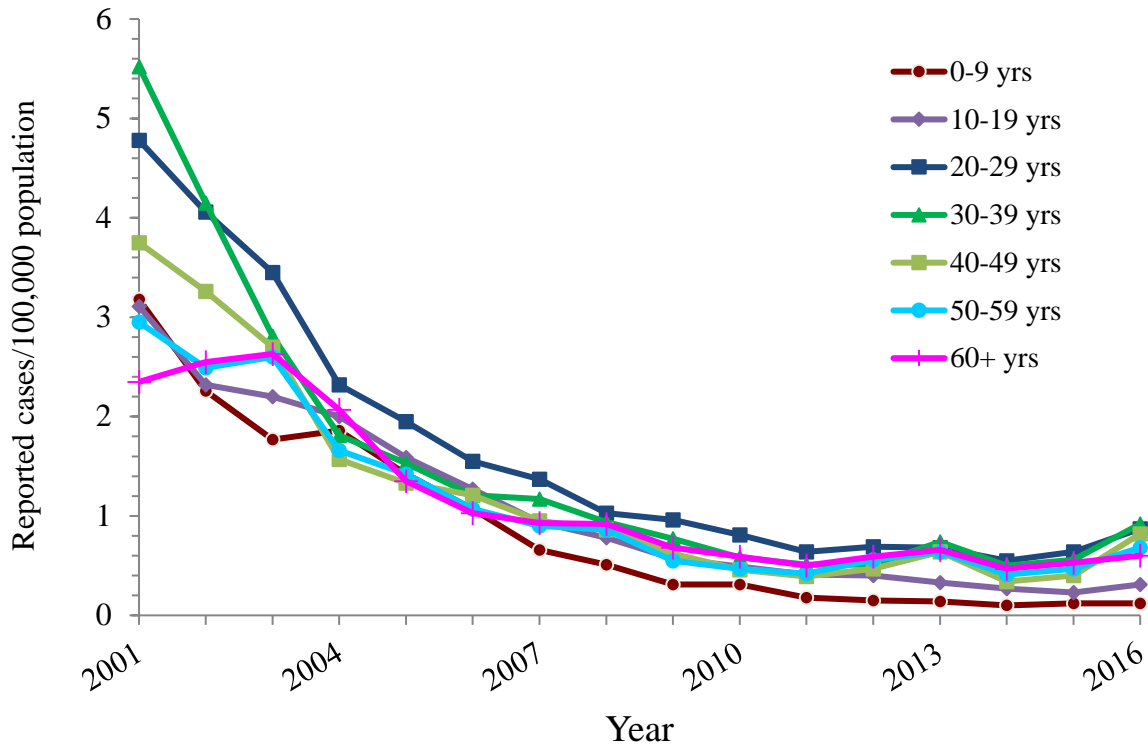
Figure 2.1. Reported number of hepatitis A cases — United States, 2001-2016



Source: CDC, National Notifiable Diseases Surveillance System.

- The number of reported hepatitis A cases declined 85.3%, from 10,615 in 2001 to 1,562 in 2012; increased 14.0% (to 1,781 cases) from 2012 through 2013; declined 30.4% (to 1,239 cases) from 2013 through 2014; and increased 12.2% (to 1,390 cases) from 2014 through 2015. Compared with 2015, cases increased 44.4% to 2,007 cases in 2016.

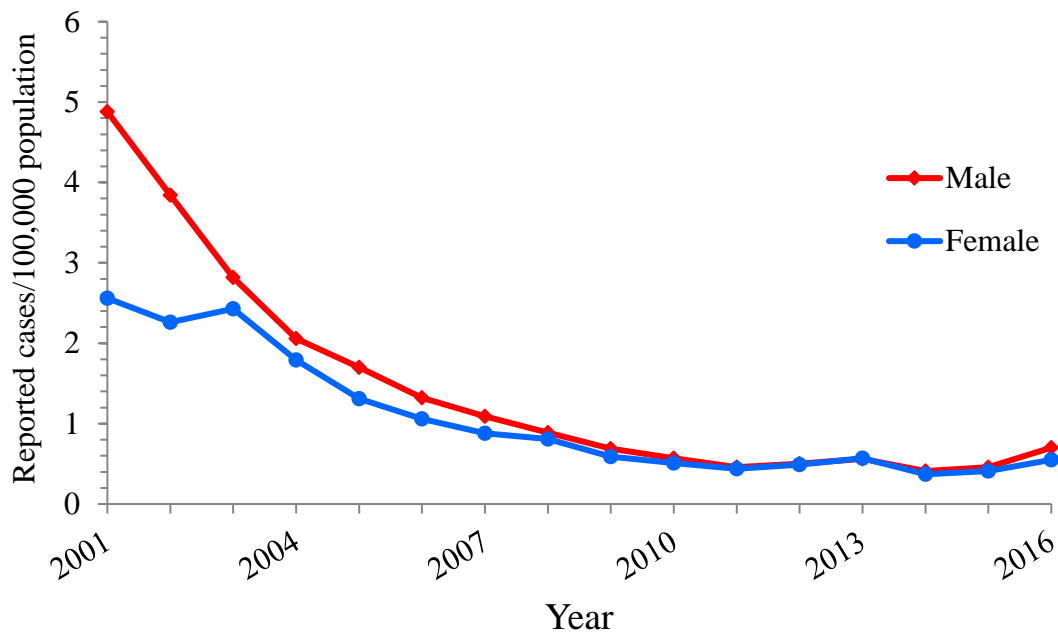
**Figure 2.2. Incidence of hepatitis A, by age group — United States, 2001–2016**



Source: CDC, National Notifiable Diseases Surveillance System.

- Rates of reported hepatitis A reached a low point in 2014 for all age groups except those aged 10–19 years, for which the low point occurred in 2015. Rates increased for all age groups from 2015 through 2016, except for those aged 0–9 whose rates remained stable.
- When comparing the 2016 hepatitis A rates of all age groups, persons aged 20–29 years and 30–39 years had the highest rate (0.9 cases per 100,000 population) and persons aged 0–9 years had the lowest rate (0.1 cases per 100,000 population).

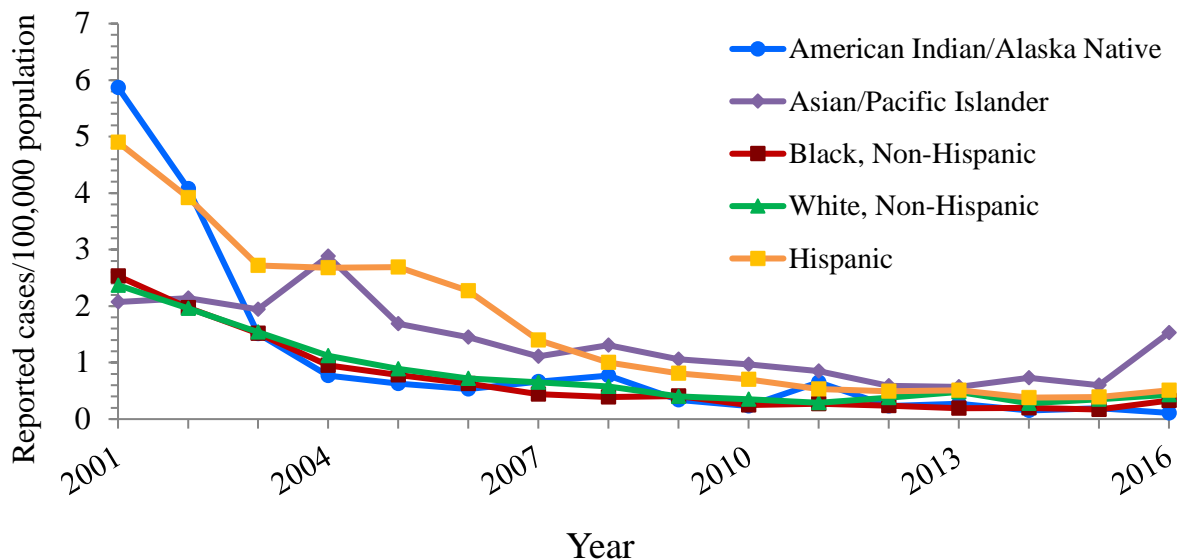
Figure 2.3. Incidence of hepatitis A, by sex — United States, 2001–2016



Source: CDC, National Notifiable Diseases Surveillance System.

- From 2001 through 2011, reported rates of hepatitis A among males and females declined, and from 2011 through 2015, rates in these two groups were similar.
- From 2015 through 2016, rates increased for both males and females, but slightly more for males.
- In 2016, the incidence rate was 0.7 cases per 100,000 population for males and 0.6 cases per 100,000 population for females.

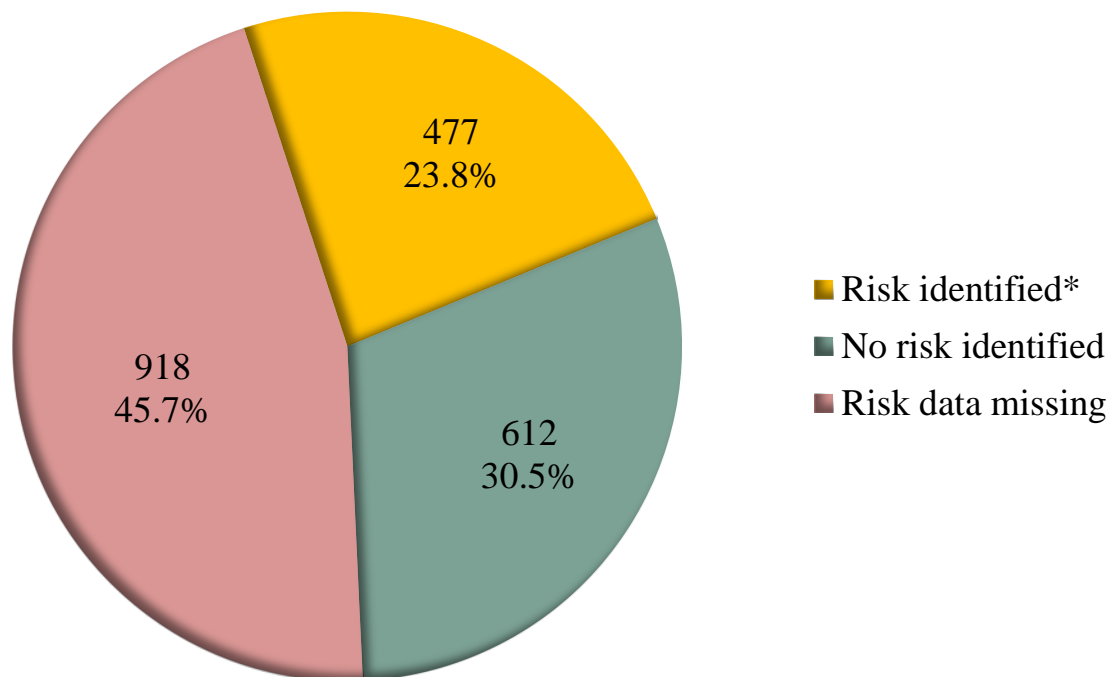
**Figure 2.4. Incidence of hepatitis A, by race/ethnicity — United States, 2001–2016**



Source: CDC, National Notifiable Diseases Surveillance System.

- Since 2008, the incidence rate of hepatitis A has been higher for Asians/Pacific Islanders than for other racial/ethnic populations.
- From 2015 through 2016, the rate for Asian/Pacific Islanders increased the most of all racial/ethnic groups from 0.6 cases per 100,000 population to 1.5 cases per 100,000 population.

**Figure 2.5. Availability of information on risk exposures/behaviors associated with hepatitis A — United States, 2016**



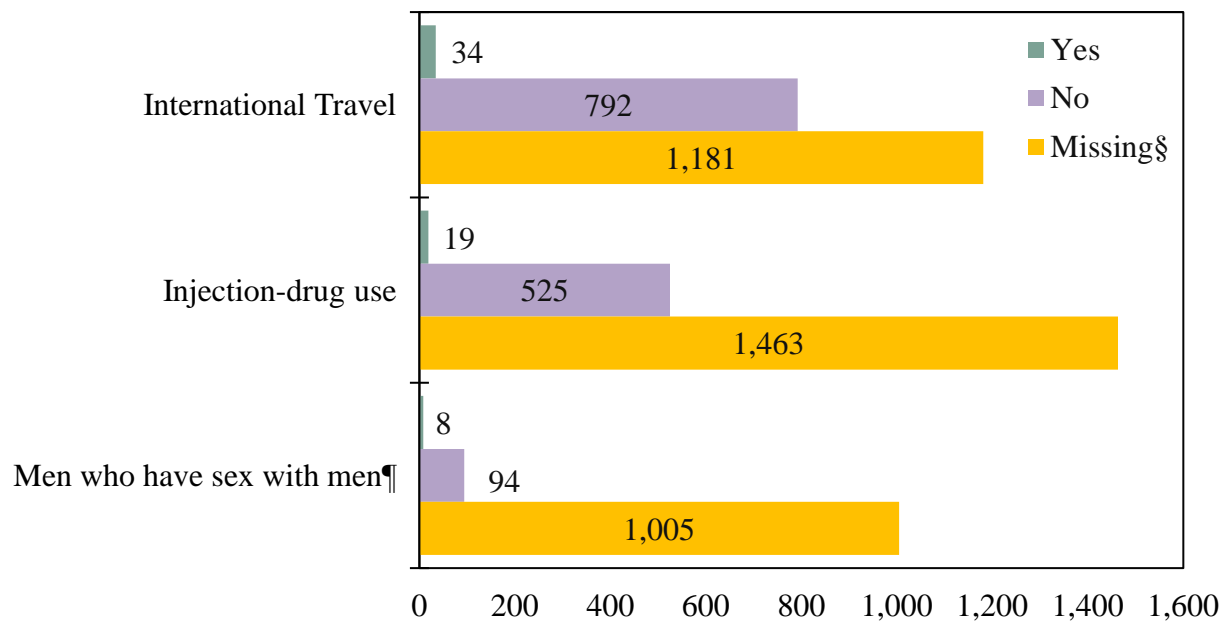
Source: CDC, National Notifiable Diseases Surveillance System.

\*Includes case reports indicating the presence of at least one of the following risks 2–6 weeks prior to onset of acute, symptomatic hepatitis A: 1) having traveled to hepatitis A-endemic regions of Mexico, South/Central America, Africa, Asia/South Pacific, or the Middle East; 2) having sexual/household or other contact with suspected/confirmed hepatitis A patient; 3) being a child/employee in day-care center/nursery/preschool or having had contact with such persons; 4) being involved in a foodborne/waterborne outbreak; 5) being a man who has sex with men; and 6) using injection drugs.

- Of the 2,007 case reports of hepatitis A received by CDC during 2016, a total of 918 (45.7%) did not include a response (i.e., a “yes” or “no” response to any of the questions about risk exposures and behaviors) to enable assessment of risk exposures or behaviors.
- Of the 1,089 case reports that contained risk exposure/behavior information:
  - 612 (56.2%) indicated no risk exposures/behaviors for hepatitis A and
  - 477 (43.8%) indicated at least one risk exposure/behavior for hepatitis A during the 2–6 weeks prior to onset of illness.



**Figure 2.6a. Hepatitis A reports\*, by risk exposure/behavior† — United States, 2016**



Source: CDC, National Notifiable Diseases Surveillance System.

\*A total of 2,007 case reports of hepatitis A were received in 2016.

†More than one risk exposure/behavior may be indicated on each case report.

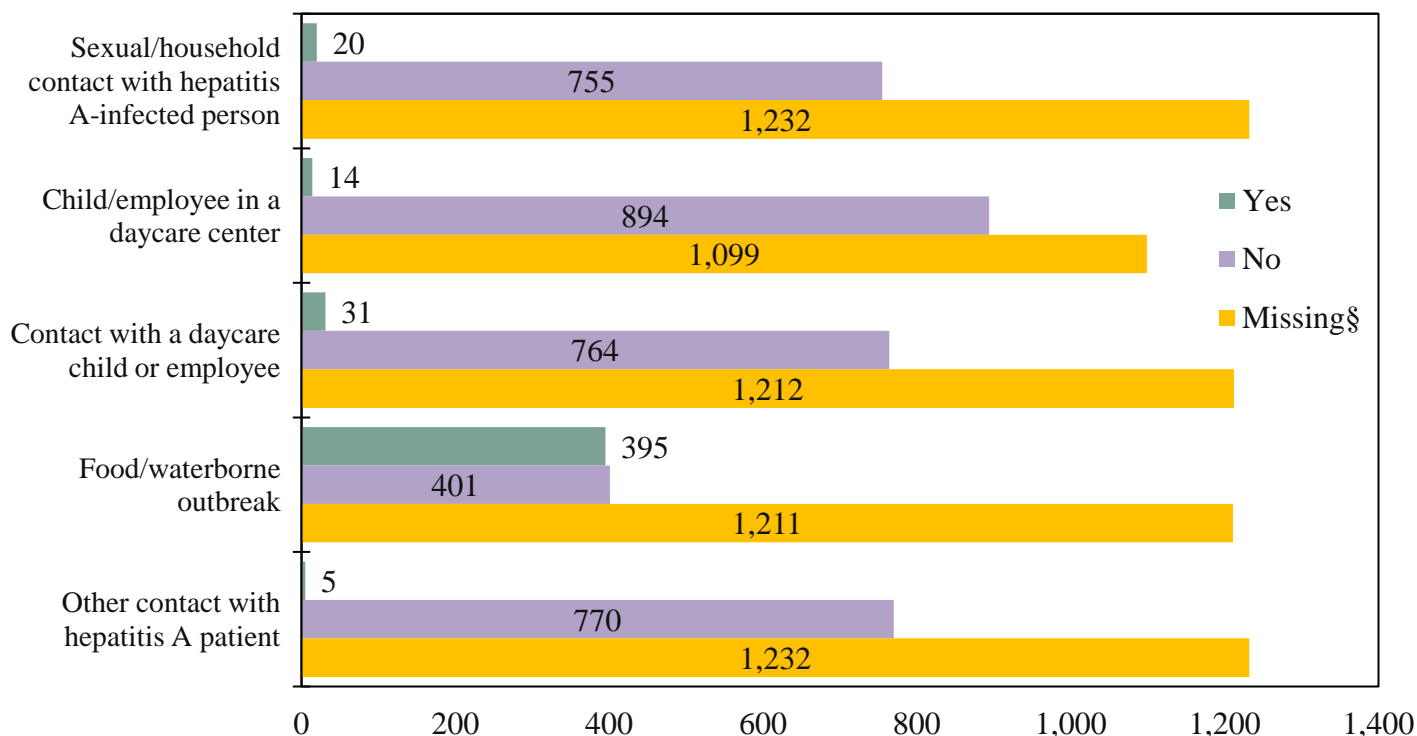
§No risk data reported.

¶A total of 1,107 hepatitis A cases were reported among males in 2016. Source: CDC.

Figure 2.6a presents reported risk exposures/behaviors for hepatitis A during the incubation period, 2–6 weeks prior to onset of symptoms.

- Of the 826 case reports that included information about travel, 4.1% (n= 34) indicated travel outside of the United States or Canada.
- Of the 544 case reports that included information about injection-drug use, 3.5% (n=19) indicated use of injection drugs.
- Of the 102 case reports from males that included information about sexual preference/practices, 7.8% (n=8) indicated having sex with another man.

**Figure 2.6b. Hepatitis A reports\*, by risk exposure/behavior†– United States, 2016**



Source: CDC, National Notifiable Diseases Surveillance System.

\*A total of 2,007 case reports with hepatitis A were received in 2016.

†More than one risk exposure/behavior may be indicated on each case report.

§No risk data reported.

Figure 2.6b presents reported risk exposures/behaviors for hepatitis A during the incubation period, 2–6 weeks prior to onset of symptoms:

- Of the 775 case reports that contained information about sexual/household contact with a hepatitis A-infected person, 2.6% (n=20) indicated such contact.
- Of the 908 case reports that included information about employment or attendance at a nursery, day-care center, or preschool, 1.5% (n=14) indicated working at or attending one of these facilities.
- Of the 795 case reports that included information about household contact with an employee of or a child attending a nursery, day-care center, or preschool, 3.9% (n=31) indicated such contact.
- Of the 796 case reports that included information about linkage to an outbreak, 49.6% (n=395) indicated exposure that may have been linked to a common-source foodborne or waterborne outbreak.
- Of the 775 case reports that included information about additional contact (i.e., other than household or sexual contact) with a person confirmed or suspected of having hepatitis A, 0.6% (n=5) indicated such contact.

**Table 2.3. Number and rate\* of hepatitis A-related deaths†, by demographic characteristics and year — United States, 2012–2016**

Demographic characteristic		2012§		2013		2014		2015		2016	
		No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Age Group (years)	0–34	2	0.00	2	0.00	0	0.00	1	0.00	2	0.00
	35–44	5	0.01	2	0.00	4	0.01	4	0.01	4	0.01
	45–54	12	0.03	13	0.03	7	0.02	6	0.01	13	0.03
	55–64	23	0.06	30	0.08	28	0.07	19	0.05	20	0.05
	65–74	17	0.07	19	0.08	19	0.07	16	0.06	14	0.05
	≥75	18	0.09	14	0.07	18	0.09	21	0.10	17	0.08
Race/ethnicity§	White, NH (non-Hispanic)	51	0.02	63	0.02	51	0.02	45	0.02	50	0.02
	Black, NH	8	0.02	6	0.01	11	0.03	7	0.02	7	0.02
	Hispanic	8	0.02	8	0.02	10	0.02	10	0.03	9	0.02
	Asian/Pacific Islander	7	0.05	3	0.02	2	0.01	4	0.02	4	0.03
	American Indian/Alaskan Native	2	0.08	0	0.00	2	0.10	1	0.04	0	0.00
Sex	Male	46	0.03	50	0.03	42	0.02	38	0.02	38	0.02
	Female	31	0.02	30	0.01	34	0.02	29	0.02	32	0.02
<b>Overall</b>		<b>77</b>	<b>0.02</b>	<b>80</b>	<b>0.02</b>	<b>76</b>	<b>0.02</b>	<b>67</b>	<b>0.02</b>	<b>70</b>	<b>0.02</b>

Source: CDC, National Vital Statistics System.

\*Rates for race, sex, and overall total are age-adjusted per 100,000 U.S. standard population in 2000.

†Cause of death is defined as the underlying cause of death or one of the multiple causes of death and is based on the International Classification of Diseases, 10th Revision (ICD-10) codes B15 (hepatitis A).

\*One death in 2012 is not represented under the race/ethnicity category due to missing data.

- From 2012–2016, the hepatitis A-related mortality rate remained steady at 0.02 deaths/100,000 population each year.
- In 2016, age-specific mortality rates for hepatitis A increased with advancing age: no deaths/100,000 population among persons aged 0–34 years, 0.01 deaths/100,000 population among persons aged 35–44 years, 0.03 deaths/100,000 population among persons 45–54 years, 0.05 deaths/100,000 population among persons 55–64 years and 65–74 years, and 0.08 deaths/100,000 population among persons aged ≥75 years.
- In 2016, non-Hispanic whites accounted for the greatest number of hepatitis A-related deaths (n=50) when compared to other race/ethnic groups (n≤9), but rates were similar between groups. In previous years, American Indians/Alaska Natives have often had the highest hepatitis A-related mortality rate; however, there were no deaths reported for this group in 2016.
- In 2016, hepatitis A-related mortality rates were the same for both females and males (0.02 deaths/100,000 population). From 2012–2016, the hepatitis A-related mortality rate remained relatively stable for males and females.

## HEPATITIS B

### Acute Hepatitis B

In 2016, a total of 3,218 cases of acute hepatitis B were reported to CDC from 48 states (Table 3.1); the actual number of acute cases is estimated to be 6.5 times the number of reported cases in any year. The overall incidence rate for 2016 was 1.0 reported cases per 100,000 population. After adjusting for under-ascertainment and under-reporting, an estimated 20,900 acute hepatitis B cases (95% CI=11,900–51,200) occurred in 2016. (Data for 2016 were unavailable for the District of Columbia, Rhode Island, and Wyoming.)

### 2012 CSTE/CDC Case Definition (NNDSS)

#### Clinical Description

Acute hepatitis is defined as acute illness with 1) discrete onset of symptoms\* (e.g., fever, headache, malaise, anorexia, nausea, vomiting, diarrhea, and abdominal pain) and 2) jaundice or elevated serum alanine aminotransferase (ALT) >100 IU/L.

#### Laboratory Criteria

- Hepatitis B surface antigen (HBsAg) positive

AND

- Immunoglobulin M (IgM) antibody to hepatitis B core antigen (IgM anti-HBc) positive (if done).

\*A documented negative HBsAg laboratory test result within 6 months prior to a positive test result (either by HBsAg, hepatitis B "e" antigen [HBeAg], or hepatitis B virus nucleic acid testing [HBV NAT] including genotype) does not require an acute clinical presentation to meet the surveillance case definition.

**Table 3.1. Reported cases of acute hepatitis B, nationally and by state or jurisdiction — United States, 2012–2016**

State	2012		2013		2014		2015		2016	
	No.	Rate*	No.	Rate*	No.	Rate*	No.	Rate*	No.	Rate*
Alabama	79	1.6	90	1.9	117	2.4	101	2.1	59	1.2
Alaska	1	0.1	1	0.1	3	0.4	3	0.4	6	0.8
Arizona	14	0.2	28	0.4	31	0.5	25	0.4	14	0.2
Arkansas	74	2.5	50	1.7	28	0.9	36	1.2	49	1.6
California	136	0.4	138	0.4	110	0.3	160	0.4	115	0.3
Colorado	24	0.5	24	0.5	29	0.5	28	0.5	28	0.5
Connecticut	15	0.4	8	0.2	9	0.3	6	0.2	7	0.2
Delaware	11	1.2	14	1.5	8	0.9	8	0.8	3	0.3
District of Columbia	U	U	U	U	U	U	U	U	U	U
Florida	247	1.3	323	1.7	313	1.6	432	2.1	558	2.7
Georgia	109	1.1	104	1.0	103	1.0	119	1.2	100	1.0
Hawaii	5	0.4	4	0.3	6	0.4	14	1.0	0	0.0
Idaho	5	0.3	13	0.8	6	0.4	8	0.5	6	0.4
Illinois	86	0.7	94	0.7	58	0.5	55	0.4	37	0.3
Indiana	90	1.4	101	1.5	126	1.9	133	2.0	146	2.2
Iowa	13	0.4	11	0.4	9	0.3	16	0.5	10	0.3
Kansas	9	0.3	11	0.4	11	0.4	19	0.7	21	0.7
Kentucky	180	4.1	214	4.9	164	3.7	162	3.7	222	5.0
Louisiana	44	1.0	82	1.8	87	1.9	87	1.9	48	1.0
Maine	9	0.7	11	0.8	12	0.9	9	0.7	53	4.0
Maryland	52	0.9	43	0.7	40	0.7	40	0.7	27	0.4
Massachusetts	75	1.1	71	1.1	30	0.4	25	0.4	31	0.5
Michigan	81	0.8	53	0.5	50	0.5	56	0.6	45	0.5
Minnesota	17	0.3	19	0.4	16	0.3	19	0.3	21	0.4
Mississippi	78	2.6	55	1.8	48	1.6	50	1.7	31	1.0
Missouri	48	0.8	61	1.0	31	0.5	35	0.6	40	0.7
Montana	2	0.2	4	0.4	0	0.0	4	0.4	1	0.1
Nebraska	10	0.5	9	0.5	8	0.4	3	0.2	8	0.4
Nevada	28	1.0	29	1.0	21	0.7	25	0.9	22	0.7
New Hampshire	4	0.3	2	0.2	4	0.3	0	0.0	0	0.0
New Jersey	70	0.8	65	0.7	77	0.9	85	0.9	59	0.7
New Mexico	3	0.1	3	0.1	2	0.1	2	0.1	1	0.0
New York	113	0.6	117	0.6	95	0.5	80	0.4	103	0.5

Table 3.1 (cont'd). Reported cases of acute hepatitis B, nationally and by state or jurisdiction — United States, 2012–2016

State	2012		2013		2014		2015		2016	
	No.	Rate*	No.	Rate*	No.	Rate*	No.	Rate*	No.	Rate*
North Carolina	73	0.7	75	0.8	100	1.0	165	1.6	170	1.7
North Dakota	0	0.0	0	0.0	0	0.0	2	0.3	2	0.3
Ohio	178	1.5	225	1.9	171	1.5	409	3.5	299	2.6
Oklahoma	79	2.1	40	1.0	57	1.5	37	0.9	32	0.8
Oregon	25	0.6	32	0.8	32	0.8	24	0.6	20	0.5
Pennsylvania	63	0.5	43	0.3	68	0.5	61	0.5	43	0.3
Rhode Island	U	U	U	U	U	U	U	U	U	U
South Carolina	37	0.8	58	1.2	37	0.8	30	0.6	34	0.7
South Dakota	2	0.2	5	0.6	3	0.4	2	0.2	2	0.2
Tennessee	240	3.7	262	4.0	232	3.5	243	3.7	204	3.1
Texas	170	0.7	142	0.5	122	0.5	159	0.6	156	0.6
Utah	13	0.5	5	0.2	11	0.4	10	0.3	5	0.2
Vermont	2	0.3	2	0.3	4	0.6	3	0.5	2	0.3
Virginia	84	1.0	72	0.9	61	0.7	69	0.8	56	0.7
Washington	34	0.5	33	0.5	44	0.6	34	0.5	45	0.6
West Virginia	141	7.6	195	10.5	186	10.1	272	14.7	268	14.6
Wisconsin	22	0.4	9	0.2	11	0.2	5	0.1	9	0.2
Wyoming	0	0.0	U	U	U	U	U	U	U	U
<b>Total</b>	<b>2895</b>	<b>0.9</b>	<b>3050</b>	<b>1.0</b>	<b>2791</b>	<b>0.9</b>	<b>3370</b>	<b>1.1</b>	<b>3218</b>	<b>1.0</b>

Source: CDC, National Notifiable Diseases Surveillance System.

\*Rate per 100,000 population.

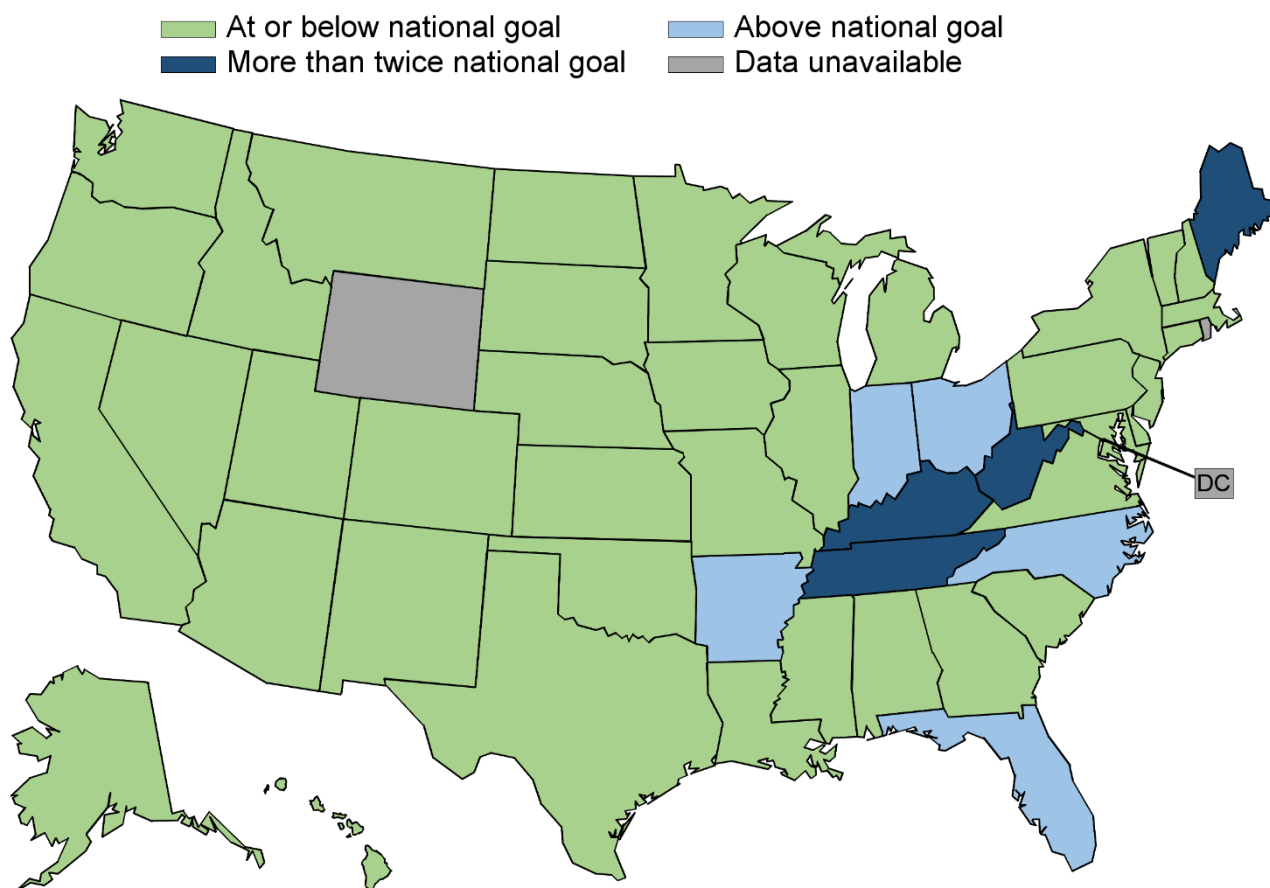
U=No data available for reporting.

- The number of acute hepatitis B cases reported in the United States increased 5.4% from 2012 through 2013 (2,895 cases to 3,050 cases), decreased 8.5% (to 2,791 cases) from 2013 through 2014, and increased 20.7% (to 3,370 cases) from 2014 through 2015. Compared with data for 2015, cases of acute hepatitis B decreased 4.5% to 3,218 cases in 2016.
- The national rate of acute hepatitis B decreased from 1.1 cases/100,000 population in 2015 to 1.0 cases/100,000 population in 2016.
- By state, 2016 rates of acute hepatitis B ranged from no cases reported in Hawaii and New Hampshire to 14.6 cases per 100,000 population in West Virginia.
  - A 5-fold increase was observed in the number of acute hepatitis B cases reported in Maine, from 9 cases in 2015 to 53 cases in 2016.
  - While Alaska and Nebraska reported at least 2-fold increases from 2015 through 2016,

the number of reported cases remained <10, and rates remain lower than those at the national level.

- Of the 48 states reporting cases of acute hepatitis B in 2016, a total of eight (i.e., Florida, Ohio, West Virginia, Kentucky, Tennessee, North Carolina, Texas, and Indiana) accounted for 62.9% of acute hepatitis B cases.

Map 3.1 State Acute Hepatitis B Incidence Compared to Healthy People 2020 National Goal\*  
United States, 2016



Source: CDC, National Notifiable Diseases Surveillance System (NNDSS)

\*National goal: 1.5 cases/100,000 population

- Of the 48 reporting states, 39 (81.3%) met the *Healthy People 2020* goal (<https://www.healthypeople.gov/>) of reducing hepatitis B incidence to  $\leq 1.5$  cases/100,000 population among adults, including: Alabama, Alaska, Arizona, California, Colorado, Connecticut, Delaware, Georgia, Hawaii, Idaho, Illinois, Iowa, Kansas, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Oklahoma, Oregon, Pennsylvania, South Carolina, South Dakota, Texas, Utah, Vermont, Virginia, Washington, and Wisconsin.
- The incidence of acute hepatitis B was above the *Healthy People 2020* goal for 9 states: Arkansas, Florida, Indiana, Kentucky, Maine, North Carolina, Ohio, Tennessee, and West Virginia.
- Of the 9 states with rates above the *Healthy People 2020* goal, four (Kentucky, Maine, Tennessee, and West Virginia) had rates of acute hepatitis B more than twice the national goal.



**Table 3.2. Select clinical characteristics of acute hepatitis B cases\* reported in the United States, 2016.**

Clinical characteristic	Availability of valid data <sup>†</sup> for clinical characteristic		Cases with clinical characteristic <sup>§</sup>	
	No.	%	No.	%
<b>Jaundice</b>	1,955	60.8	1,330	68.0
<b>Hospitalized for acute hepatitis B</b>	1,867	58.0	1,086	58.2
<b>Died from acute hepatitis B</b>	1,651	51.3	44	2.7

Source: CDC, National Notifiable Diseases Surveillance System.

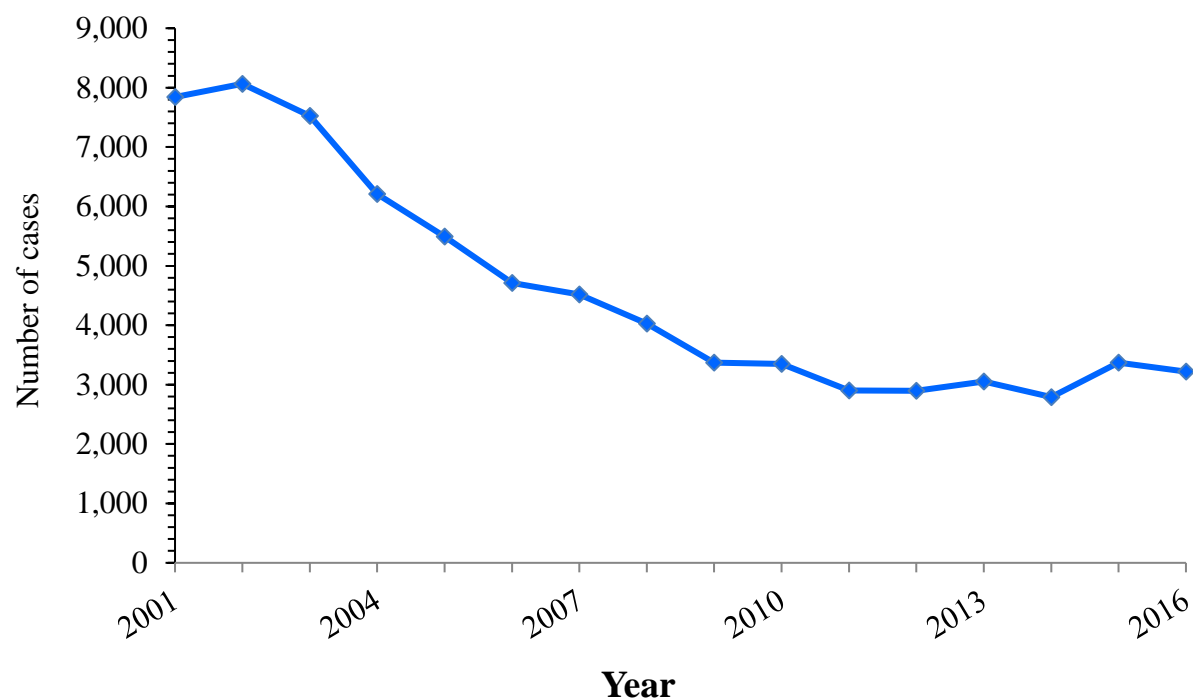
\*A total of 3,218 hepatitis B cases were reported during 2016.

<sup>†</sup>Case reports for which questions regarding clinical characteristics were answered with “yes” or “no.” Reports with any other response were excluded.

<sup>§</sup>Numbers and percentages represent only those case reports for which data regarding clinical characteristics were available; numbers likely are underestimates.

- Of the 3,218 case reports of acute hepatitis B received in 2016, 60.8% included information regarding whether the patient had jaundice, 58.0% included information regarding hospitalization caused by hepatitis B, and 51.3% included information on death from hepatitis B. (Note: more severe cases are likely to be ascertained and reported.)
- Jaundice was reported for 1,330 (68.0%) of the 1,955 acute hepatitis B case reports that included information about jaundice.
- Hospitalization as the result of acute hepatitis B was reported for 1,086 (58.2%) of the 1,867 acute hepatitis B case reports that included information about hospitalization.
- Death from hepatitis B was reported for 44 (2.7%) of the 1,651 acute hepatitis B case reports that included information about death.

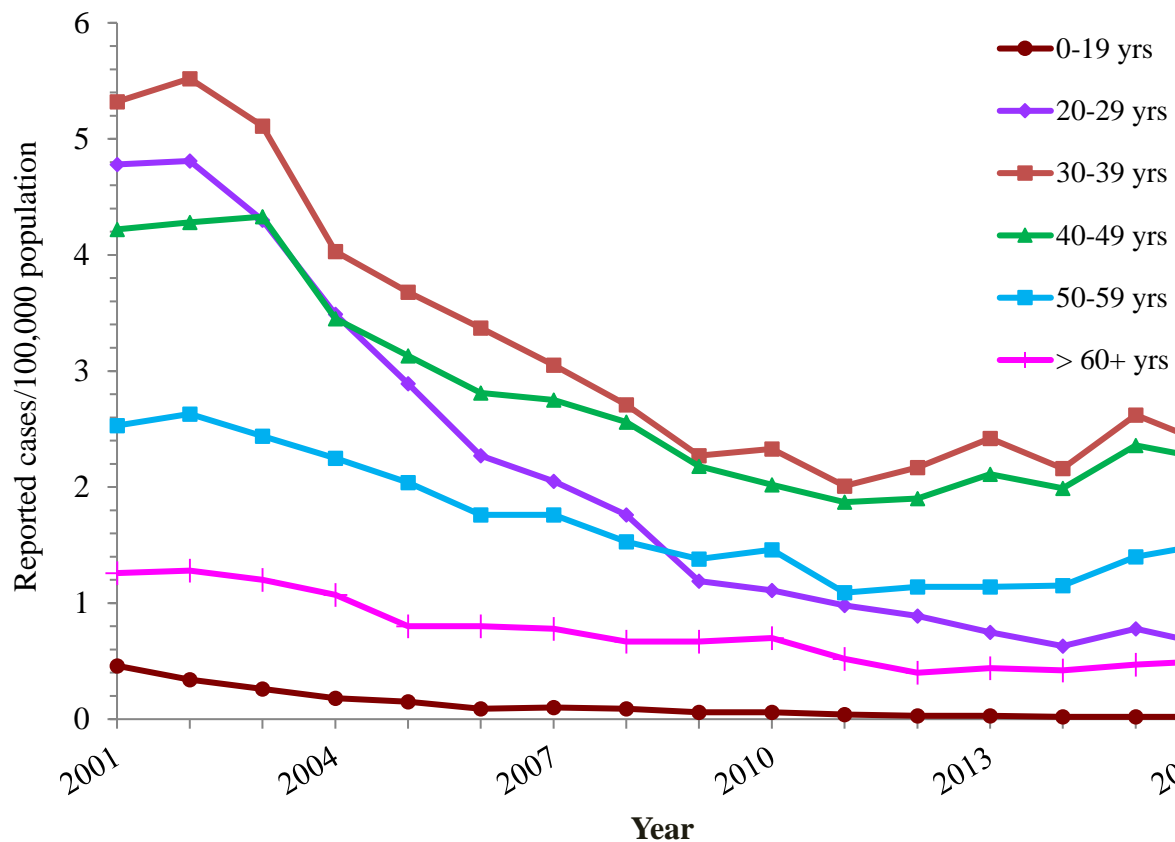
**Figure 3.1. Reported number of acute hepatitis B cases — United States, 2001–2016**



Source: CDC, National Notifiable Diseases Surveillance System.

- The number of reported acute hepatitis B cases declined 63.1%, from 7,844 in 2001 to 2,895 in 2012; increased 5.4% (to 3,050 cases) in 2013; declined 8.5% (to 2,791 cases) from 2013 through 2014; and increased 20.7% (to 3,370 cases) from 2014 through 2015. Compared with 2015, cases decreased 4.5% to 3,218 cases in 2016.

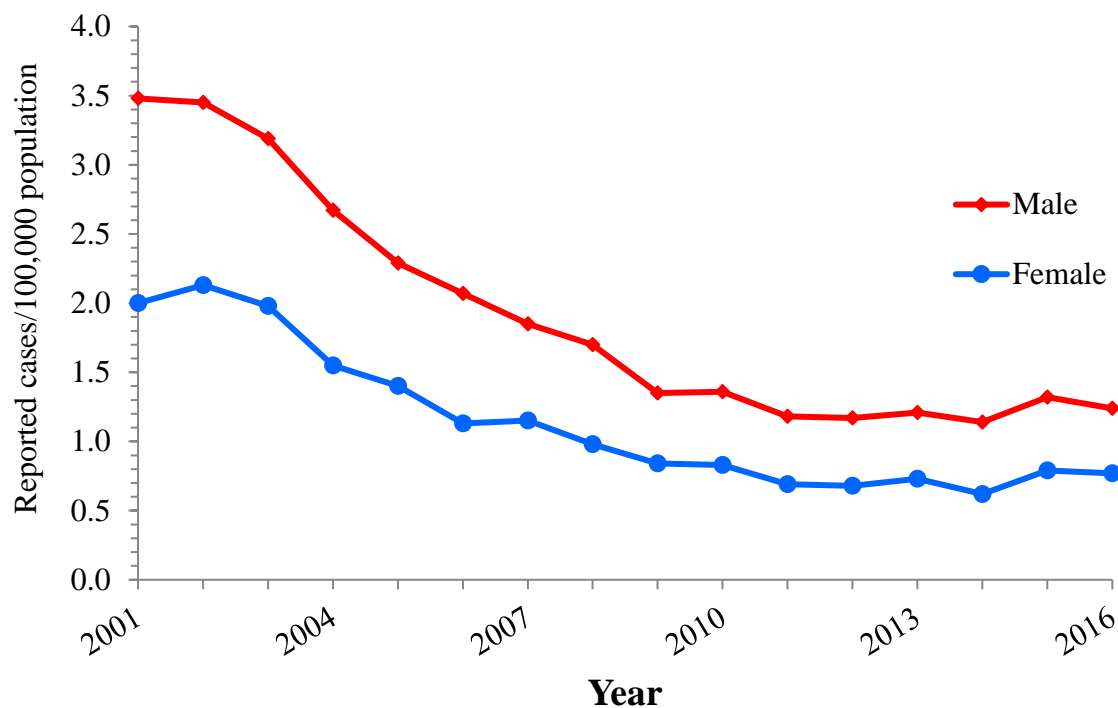
**Figure 3.2. Incidence of acute hepatitis B, by age group — United States, 2001–2016**



Source: CDC, National Notifiable Diseases Surveillance System.

- From 2001 through 2016, the incidence of hepatitis B cases reported in the United States was consistently highest among those aged 30–39 years and lowest among those aged 0–19 years.
- From 2015 through 2016, the incidence of hepatitis B cases reported in the United States increased for persons aged 50–59 years and those aged 60 or older.
- In 2016, rates were highest for persons aged 30–39 years (2.4 cases/100,000 population); the lowest rates were among children and adolescents aged <19 years (0.0 cases/100,000 population).

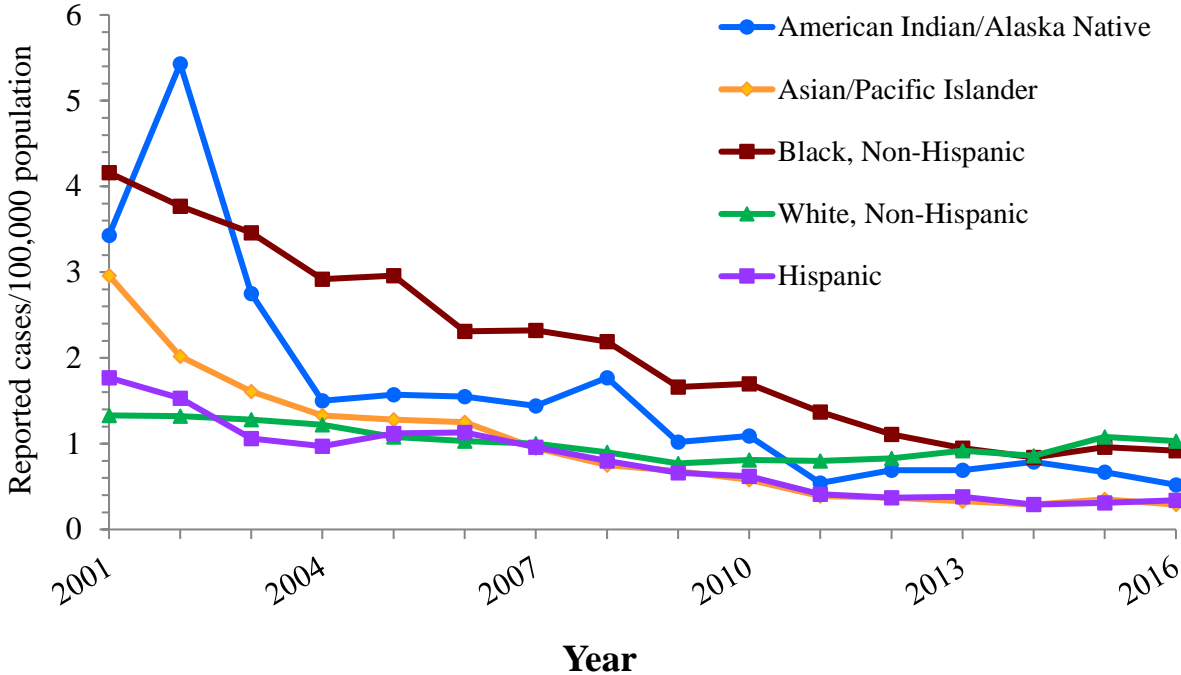
Figure 3.3. Incidence of acute hepatitis B, by sex — United States, 2001-2016



Source: CDC, National Notifiable Diseases Surveillance System.

- While the incidence of reported acute hepatitis B remained higher for males than for females from 2001 through 2016, the gap narrowed from 2002 through 2016.
- In 2016, the rate for males was approximately 1.5 times higher than that for females (1.2 cases and 0.8 cases per 100,000 population, respectively).

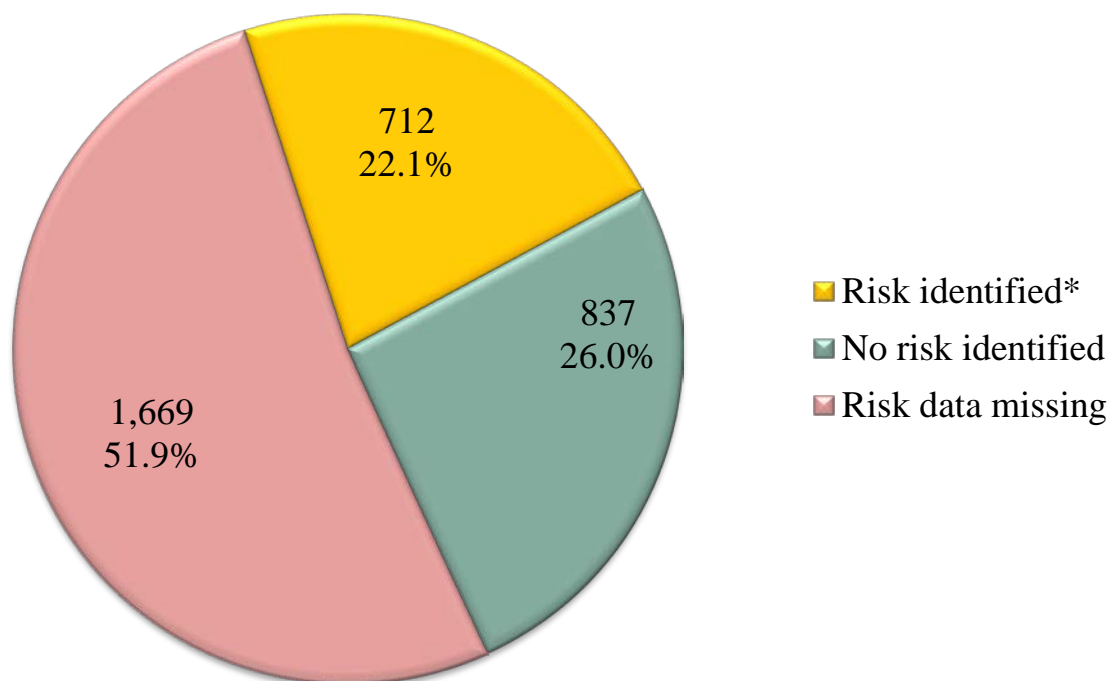
**Figure 3.4. Incidence of acute hepatitis B, by race/ethnicity — United States, 2001-2016**



Source: CDC, National Notifiable Diseases Surveillance System.

- In 2001 and 2003 through 2013, non-Hispanic Blacks had the highest incidence rate of acute hepatitis B. These rates were followed by American Indian/Alaska Native populations in 2001 and 2003 through 2010.
- Acute hepatitis B incidence rates declined for all race/ethnic groups from 2001 through 2016, with the exception of non-Hispanic Whites, for which rates increased beginning in 2009.
- In 2016, the rate of acute hepatitis B was highest for non-Hispanic Whites (1.0 cases per 100,000 population) and lowest among Hispanics and Asian/Pacific Islanders (0.3 cases per 100,000 population).

**Figure 3.5. Availability of information on risk exposures/behaviors associated with acute hepatitis B — United States, 2016**

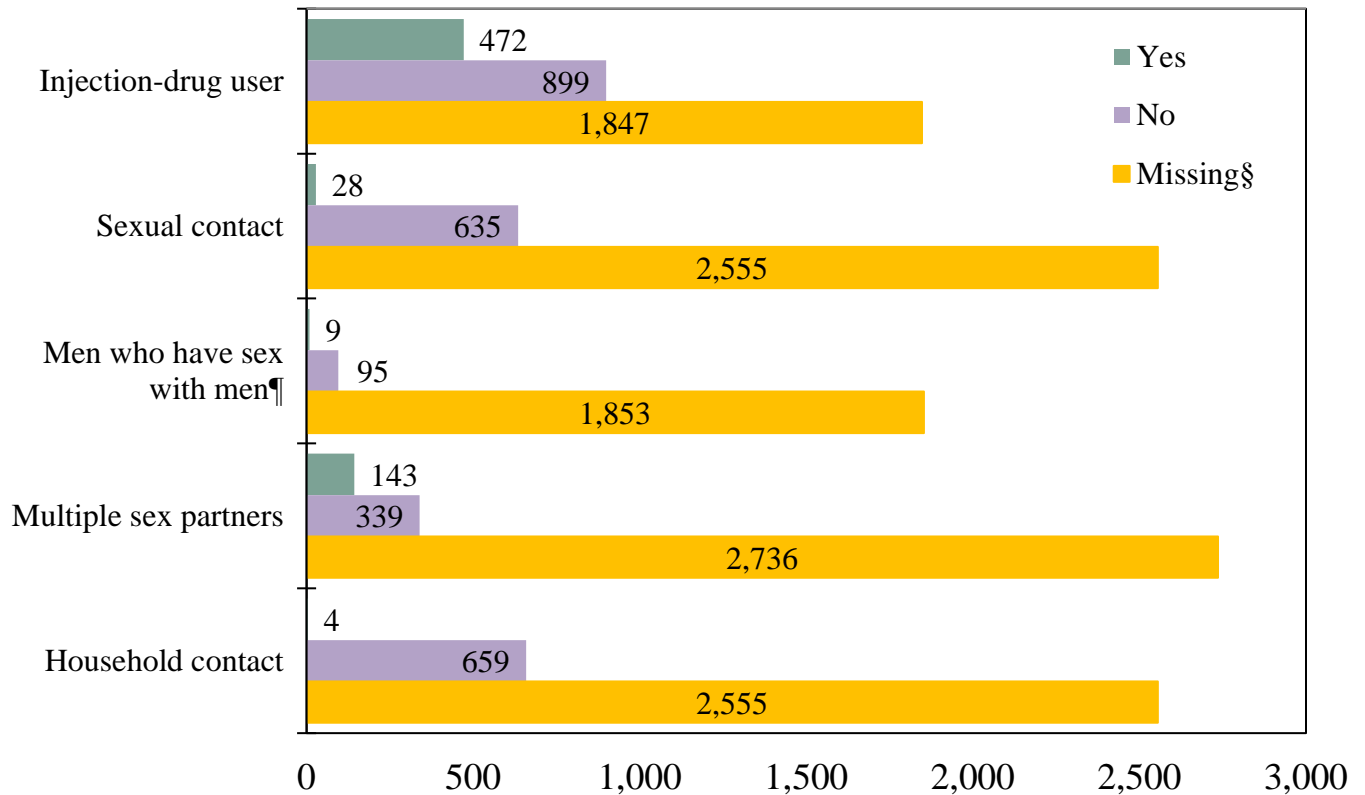


Source: CDC, National Notifiable Diseases Surveillance System.

\*Includes case reports indicating the presence of at least one of the following risks 6 weeks to 6 months prior to onset of acute, symptomatic hepatitis B: 1) using injection drugs; 2) having sexual contact with suspected/confirmed hepatitis B patient; 3) being a man who has sex with men; 4) having multiple sex partners concurrently; 5) having household contact with suspected/confirmed hepatitis B patient; 6) occupational exposure to blood; 7) being a hemodialysis patient; 8) having received a blood transfusion; 9) having sustained a percutaneous injury; and 10) having undergone surgery.

- Of the 3,218 case reports of acute hepatitis B received by CDC during 2016, a total of 1,669 (51.9%) did not include a response (i.e., a “yes” or “no” response to any of the questions about risk exposures and behaviors) to enable assessment of risk exposures or behaviors.
- Of the 1,549 case reports that contained risk exposure/behavior information:
  - 837 (54.0%) indicated no risk exposure/behavior for acute hepatitis B.
  - 712 (46.0%) indicated at least one risk exposure/behavior for acute hepatitis B during the 6 weeks to 6 months prior to illness onset.

**Figure 3.6a. Acute hepatitis B reports\*, by risk exposure/behavior† —United States, 2016**



Source: CDC, National Notifiable Diseases Surveillance System.

\*A total of 3,218 case reports of acute hepatitis B were received in 2016.

†More than one risk exposure/behavior may be indicated on each case report.

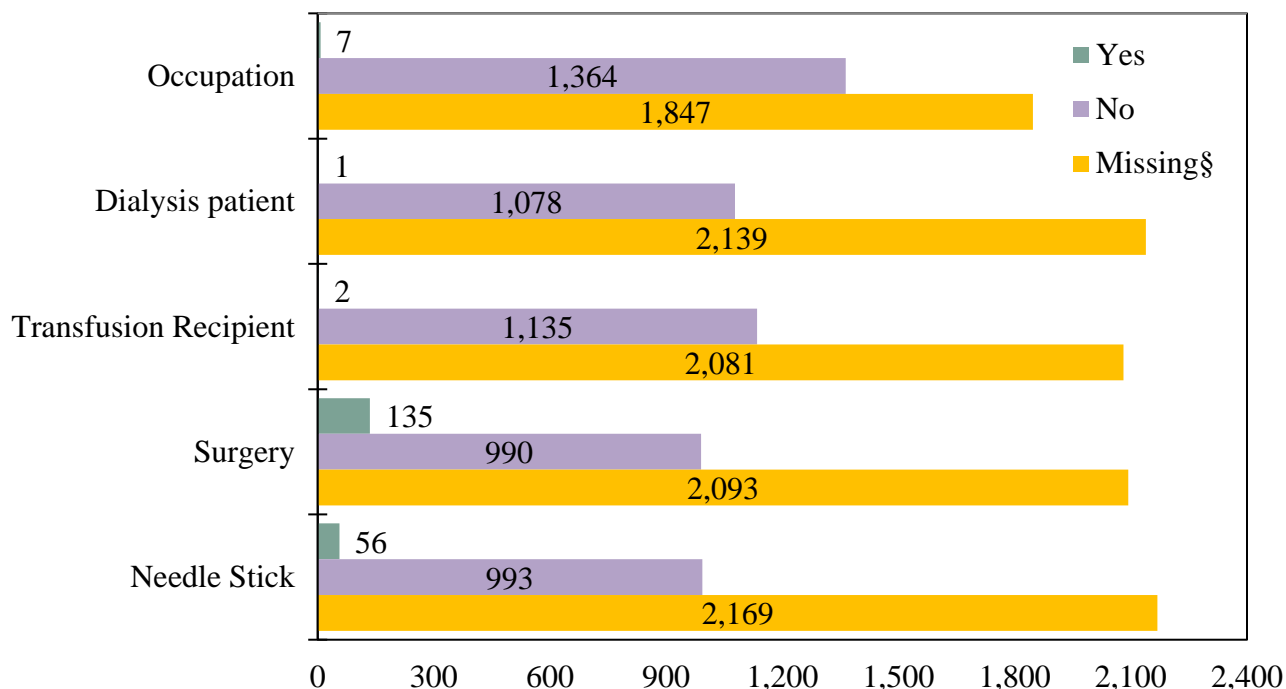
§No risk data reported.

¶A total of 1,957 acute hepatitis B cases were reported among males in 2016.

Figure 3.6a presents reported risk exposures/behaviors for acute hepatitis B during the incubation period, 2 weeks to 6 months prior to onset of symptoms.

- Of the 1,371 case reports that included information about injection-drug use, 34.4% (n=472) indicated use of injection drugs.
- Of the 663 case reports that included information about sexual contact, 4.2% (n=28) indicated sexual contact with a person with confirmed or suspected hepatitis B.
- Of the 104 case reports from males that included information about sexual preference/practices, 8.7% (n=9) indicated sex with another man.
- Of the 482 case reports that had information about number of sex partners, 29.7% (n=143) indicated having  $\geq 2$  sex partners.
- Of the 663 case reports that included information about household contact, 0.6% (n=4) indicated household contact with a person with confirmed or suspected hepatitis B.

Figure 3.6b. Acute hepatitis B reports\*, by risk exposure/behavior† — United States, 2016



Source: CDC, National Notifiable Diseases Surveillance System.

\*A total of 3,218 case reports of hepatitis B were received in 2016.

†More than one risk exposure/behavior may be indicated on each case report.

§No risk data reported.

Figure 3.6b presents reported risk exposures/behaviors for acute hepatitis B during the incubation period, 2 weeks to 6 months prior to onset of symptoms. Based on analysis of persons reporting multiple risk exposures:

- Of the 1,371 case reports that included information about occupational exposures, 0.5% (n=7) indicated employment in a medical, dental, or other field involving contact with human blood.
- Of the 1,079 case reports that included information about receipt of dialysis or kidney transplant, 0.1% (n=1) indicated patient receipt of these procedures.
- Of the 1,137 case reports that included information about receipt of blood transfusion, 0.2% (n=2) indicated patient receipt of a blood transfusion.
- Of the 1,125 case reports that included information about surgery, 12.0% (n=135) indicated having surgery.
- Of the 1,049 case reports that included information about needle stick injury, 5.3% (n=56) indicated having an accidental needle stick/puncture.



## **Chronic Hepatitis B**

In 2016, a total of 14,847 case reports of chronic hepatitis B were reported to CDC from 43 states (Table 3.3). Despite increasing immune protection in young persons vaccinated in infancy, an analysis of chronic hepatitis B prevalence in racial and ethnic populations indicates that during 2011–2012, a total of 847,000 (95% CI, 565,000-1,130,000) persons were living with HBV infection (which included approximately 400,000 non-Hispanic Asians) in the noninstitutionalized U.S. population (8); the estimate may have been as high as 2.2 million in 2009 using other adjustment methods (9).

### **2012 CSTE/CDC Case Definition (NNDSS)**

#### **Clinical Description**

No symptoms are required. Persons with chronic HBV infection may have no evidence of liver disease or may have a spectrum of disease ranging from chronic liver disease to cirrhosis or liver cancer.

#### **Laboratory Criteria**

- IgM antibodies to IgM anti-HBc negative AND a positive result on one of the following tests: HBsAg, HBeAg, or nucleic acid test for hepatitis B virus DNA (including qualitative, quantitative and genotype testing), OR
- HBsAg positive or nucleic acid test for HBV DNA positive (including qualitative, quantitative, and genotype testing) or HBeAg positive two times when tested least 6 months apart. (Any combination of these tests performed 6 months apart is acceptable.)

**Table 3.3. Number of newly reported case\* reports<sup>†</sup> of confirmed chronic hepatitis B submitted by states and jurisdictions, 2016**

<b>State/Jurisdiction</b>	<b>No. chronic hepatitis B case reports submitted<sup>†</sup></b>
<b>Alabama</b>	N
<b>Alaska</b>	88
<b>Arizona</b>	175
<b>Arkansas</b>	N
<b>California<sup>§</sup></b>	787
<b>Colorado</b>	165
<b>Connecticut</b>	70
<b>Delaware</b>	178
<b>District of Columbia</b>	U
<b>Florida</b>	1,684
<b>Georgia</b>	1,776
<b>Hawaii</b>	N
<b>Idaho</b>	63
<b>Illinois</b>	145
<b>Indiana</b>	219
<b>Iowa</b>	86
<b>Kansas</b>	76
<b>Kentucky</b>	17
<b>Louisiana</b>	170
<b>Maine</b>	51
<b>Maryland</b>	747
<b>Massachusetts</b>	334
<b>Michigan</b>	475
<b>Minnesota</b>	284
<b>Mississippi</b>	N
<b>Missouri</b>	420
<b>Montana</b>	18
<b>Nebraska</b>	122
<b>Nevada</b>	2
<b>New Hampshire</b>	11
<b>New Jersey</b>	227
<b>New Mexico</b>	20

**Table 3.3 (cont'd). Number of newly reported case\* reports<sup>†</sup> of confirmed chronic hepatitis B submitted by states and jurisdictions, 2016**

<b>State/Jurisdiction</b>	<b>No. chronic hepatitis B case reports submitted<sup>†</sup></b>
<b>New York</b>	1,943
<b>North Carolina</b>	660
<b>North Dakota</b>	89
<b>Ohio</b>	717
<b>Oklahoma</b>	56
<b>Oregon</b>	143
<b>Pennsylvania</b>	1,164
<b>Rhode Island</b>	U
<b>South Carolina</b>	145
<b>South Dakota</b>	29
<b>Tennessee</b>	624
<b>Texas</b>	N
<b>Utah</b>	69
<b>Vermont</b>	37
<b>Virginia</b>	328
<b>Washington</b>	154
<b>West Virginia</b>	244
<b>Wisconsin</b>	N
<b>Wyoming</b>	35
<b>Total</b>	<b>14,847</b>

Source: CDC, National Notifiable Diseases Surveillance System.

\*For case definition, see <https://wwwn.cdc.gov/nndss/conditions/hepatitis-c-chronic/case-definition/2016/>

<sup>†</sup> Reports may not reflect unique cases.

<sup>§</sup> Cases reported by California through NNDSS were all from San Francisco County. The number of cases in this table and Table 3.4 differ because NNDSS and CDC's Secure Access Management System (SAMS) have different data close-out dates by which all annual data must be submitted.

N= Not Reportable, chronic hepatitis B infection is not reportable in the listed state.

U=No data available for reporting.

- In 2016, 43 states provided 14,847 case reports of chronic hepatitis B.
- Nine states (California, Florida, Georgia, Maryland, New York, North Carolina, Ohio, Pennsylvania, and Tennessee) accounted for 68.0% of the chronic hepatitis B cases reported through NNDSS in 2016.
- New York submitted the largest number of case reports (n= 1,943 or 13.1%) of chronic hepatitis B in 2016.

Table 3.4. Reported cases of chronic hepatitis B, by demographic characteristics and laboratory tests — Enhanced Viral Hepatitis Surveillance Sites, 2013-2016

Category	FL	MA	MI	NYS*	Phil	SF	WA	Total
	No.	No.	No.	No.	No.	No.	No.	No.
	% <sup>†</sup>	%	%	%	%	%	%	%
<b>Sex</b>								
Female	1,394	689	862	889	228	1,747	243	6,052
	45.8%	48.7%	47.9%	40.8%	38.0%	47.4%	42.9%	45.5%
Male	1,645	726	938	1,285	370	1,926	314	7,204
	54.1%	51.3%	52.1%	58.9%	61.7%	52.3%	55.5%	54.2%
Unknown /missing	4	1	0	6	2	11	9	33
	0.1%	0.1%	0.0%	0.3%	0.3%	0.3%	1.6%	0.2%
<b>Race/Ethnicity</b>								
American Indian/ Alaska Native, NH <sup>§</sup>	1	8	16	2	1	4	4	36
	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.3%
Asian/Pacific Islander, NH	168	474	464	701	215	1,875	103	4,000
	5.5%	33.5%	25.8%	32.2%	35.8%	50.9%	18.2%	30.1%
Black, NH	389	258	314	275	121	58	30	1,445
	12.8%	18.2%	17.4%	12.6%	20.2%	1.6%	5.3%	10.9%
White, NH	561	155	541	322	41	113	65	1,798
	18.4%	10.9%	30.1%	14.8%	6.8%	3.1%	11.5%	13.5%
Hispanic	156	83	33	97	22	46	12	449
	5.1%	5.9%	1.8%	4.4%	3.7%	1.2%	2.1%	3.4%
Other, NH	88	88	105	84	16	23	15	419
	2.9%	6.2%	5.8%	3.9%	2.7%	0.6%	2.7%	3.2%
Unknown /missing	1,681	350	327	699	184	1,565	337	5,142
	55.2%	24.7%	18.2%	32.1%	30.7%	42.5%	59.5%	38.7%
<b>Age group, years</b>								
0-14	21	16	40	15	8	25	8	131
	0.7%	1.1%	2.2%	0.7%	1.3%	0.7%	1.4%	1.0%
15-24	158	99	144	171	43	149	52	816
	5.2%	7.0%	8.0%	7.8%	7.2%	4.0%	9.2%	6.1%
25-39	887	576	562	794	208	1,200	191	4,418
	29.1%	40.7%	31.2%	36.4%	34.7%	32.6%	33.7%	33.2%
40-54	981	409	548	667	215	1,250	185	4,255
	32.2%	28.9%	30.4%	30.6%	35.8%	33.9%	32.7%	32.0%
55+	995	316	506	533	126	1,062	130	3,668
	32.7%	22.3%	28.1%	24.4%	21.0%	28.8%	23.0%	27.6%
Unknown /missing	1	0	0	0	0	0	0	1
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0%

**Table 3.4 (cont'd). Reported cases of chronic hepatitis B, by demographic characteristics and laboratory tests — Enhanced Viral Hepatitis Surveillance Sites, 2013-2016**

Category	FL	MA	MI	NYS*	Phil	SF	WA	Total
	No.	No.	No.	No.	No.	No.	No.	No.
	% <sup>†</sup>	%	%	%	%	%	%	%
<b>Place of birth</b>								
United States	0	101	433	21	289	41	1	886
	0.0%	7.1%	24.1%	1.0%	48.2%	1.1%	0.0%	6.7%
Outside United States	0	600	576	82	274	388	36	1,956
	0.0%	42.4%	32.0%	3.8%	45.7%	10.5%	6.4%	14.7%
Unknown /missing	3,043	715	791	2,077	37	3,255	359	10,447
	100.0%	50.5%	43.9%	95.3%	6.2%	88.4%	63.4%	78.6%
<b>Hepatitis B laboratory testing<sup>¶</sup></b>								
HBV surface antigen +	2,686	1,224	1,225	1,887	489	3,248	255	11,014
	88.3%	86.4%	68.1%	86.6%	81.5%	88.2%	45.1%	82.9%
[IgM anti-HBc] -	2,208	326	254	500	0	0	234	3,522
	72.6%	23.0%	14.1%	22.9%	0.0%	0.0%	41.3%	26.5%
HBV "e" antigen +	379	350	79	359	150	347	62	1,726
	12.5%	24.7%	4.4%	16.5%	25.0%	9.4%	11.0%	13.0%
HBV NAT +	1,344	1,009	212	872	503	3,034	107	7,081
	44.2%	71.3%	11.8%	40.0%	83.8%	82.4%	18.9%	53.3%
<b>Total no. cases</b>	<b>3,043</b>	<b>1,416</b>	<b>1,800</b>	<b>2,180</b>	<b>600</b>	<b>3,684</b>	<b>566</b>	<b>13,289</b>
<b>2013-2016 Estimated population total**</b>	<b>20,259,003</b>	<b>6,761,108</b>	<b>9,914,094</b>	<b>11,238,360</b>	<b>1,562,194</b>	<b>856,404</b>	<b>6,333,530</b>	<b>56,924,692</b>
<b>Rate per 100,000 population</b>	<b>15.0</b>	<b>20.9</b>	<b>18.2</b>	<b>19.4</b>	<b>38.4</b>	<b>430.2</b>	<b>8.9</b>	<b>23.3</b>

Source: CDC, Enhanced Viral Hepatitis Surveillance Sites.

Abbreviations: FL, Florida; MA, Massachusetts; MI, Michigan; NYS, New York State; Phil, Philadelphia; SF, San Francisco; WA, Washington State; HBV: Hepatitis B Virus; IgM anti-HBc (Anti-Hepatitis B core IgM); NAT: HBV nucleic acid testing. Percentages may not sum to 100% due to rounding.

\*New York City was not included in the case count for New York State, therefore cases and population estimates from New York excluded those who resided in New York City.

<sup>†</sup>The denominator used to calculate proportions was the total number of cases reported for each site.

<sup>§</sup>NH: Non-Hispanic

<sup>¶</sup>Cases can be reported with more than one laboratory test result.

\*\*Population estimates for the United States: <https://wonder.cdc.gov/bridged-race-population.html>

HBV: Hepatitis B Virus; IgM anti-HBc (Anti-Hepatitis B core IgM); NAT: HBV nucleic acid testing.

- From 2013 through 2016, a total of 13,289 chronic hepatitis B cases were reported by seven funded enhanced surveillance sites.
- Among the 13,289 chronic hepatitis B cases, 54.2% were among males and 65.3% were among persons aged 25–54 years.
- By site, the proportion of cases among males ranged from 51.3% in Massachusetts to 61.7% in Philadelphia; the proportion of Asian/Pacific Islanders with hepatitis B infection ranged from 5.5% in Florida to 50.9% in San Francisco.
- Among the 2,842 cases for which place of birth was known, those born outside of the United States accounted for the greatest number of chronic hepatitis B cases (n=1,956, 68.8%). By site, among the cases for which place of birth was known, the proportion of reported chronic hepatitis B cases born outside of the United States ranged from 48.7% in Philadelphia to 97.3% in Washington State. From 2013 through 2016, information on place of birth was not collected by Florida and it was only collected by Washington State in 2016.

**Table 3.5. Number and rate\* of hepatitis B-related deaths<sup>†</sup>, by demographic characteristics and year — United States, 2012–2016**

Demographic characteristic		2012		2013		2014		2015		2016	
		No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Age Group (years) <sup>§</sup>	0–34	38	0.03	40	0.03	35	0.02	31	0.02	40	0.03
	35–44	123	0.30	146	0.36	126	0.31	120	0.30	118	0.29
	45–54	428	0.97	389	0.89	384	0.88	332	0.77	325	0.76
	55–64	639	1.66	704	1.79	684	1.71	611	1.49	578	1.39
	65–74	314	1.31	343	1.36	358	1.36	384	1.39	384	1.34
	≥75	229	1.20	251	1.29	256	1.29	236	1.17	253	1.23
Race/ethnicity <sup>¶</sup>	White, NH (non-Hispanic)	818	0.31	868	0.33	853	0.32	809	0.30	771	0.29
	Black, NH	322	0.81	384	0.98	330	0.80	320	0.78	316	0.73
	Hispanic	139	0.39	149	0.39	155	0.38	134	0.32	128	0.30
	Asian/Pacific Islander	469	2.93	451	2.64	478	2.71	420	2.24	457	2.39
	American Indian/Alaskan Native	18	0.74	14	0.55	11	0.43	16	0.58	18	0.68
Sex	Male	1,272	0.75	1,375	0.79	1,307	0.74	1,277	0.72	1,238	0.69
	Female	499	0.27	498	0.26	536	0.27	438	0.22	460	0.23
<b>Overall</b>		<b>1,771</b>	<b>0.50</b>	<b>1,873</b>	<b>0.52</b>	<b>1,843</b>	<b>0.50</b>	<b>1,715</b>	<b>0.45</b>	<b>1,698</b>	<b>0.45</b>

Source: CDC, National Vital Statistics System.

\*Rates for race, sex, and overall total are age-adjusted per 100,000 U.S. standard population in 2000.

<sup>†</sup>Cause of death is defined as the underlying cause of death or one of the multiple causes of death and is based on the International Classification of Diseases, 10th Revision (ICD-10) codes B16, B17.0, B18.0, B18.1 (hepatitis B).

<sup>§</sup>One death in 2015 is not represented under the age group category due to missing data.

<sup>¶</sup>Five deaths in 2012, seven deaths in 2013, 16 deaths in 2014, 16 deaths in 2015, and 8 deaths in 2016 are not represented under the race/ethnicity category due to missing data.

- From 2012 through 2014, the hepatitis B-related mortality rate remained relatively stable at 0.50-0.52 deaths/100,000 population. In 2015, the rate slightly declined to 0.45 deaths/100,000 population and remained at this rate in 2016.
- Persons aged 55–64 years and 65–74 years had the highest age-specific mortality rates in 2016 at 1.39 deaths/100,000 population and 1.34 deaths/100,000 population, respectively.
- In 2016, Asians/Pacific Islanders had the highest hepatitis B-related mortality rate of 2.39 deaths/100,000 population compared with other racial/ethnic populations.
- In 2016, the hepatitis B-related mortality rate for males was three times the mortality rate for females (0.69 deaths/100,000 population vs. 0.23 deaths/100,000 population). From 2015 through 2016, the hepatitis B-related mortality rate remained relatively stable for females and decreased for males.

## Perinatal Hepatitis B

Infants born to hepatitis B surface antigen (HBsAg)-positive women who become infected with hepatitis B at or near delivery are considered to have perinatal HBV infection; 90% of infants infected at birth go on to develop chronic hepatitis B (27). In 2016, 32 cases of perinatal hepatitis B were reported to CDC from 13 states (Table 3.6).

A 2009 modeling study estimated that 952 chronic hepatitis B cases occur each year among persons infected with HBV at birth, for a baseline annual rate of 3.84% (52).

### 1995 CSTE/CDC Case Definition (NNDSS)

#### Clinical Description

Perinatal hepatitis B in the newborn may range from asymptomatic to fulminant hepatitis.

#### Laboratory Criteria

- Hepatitis B surface antigen (HBsAg) positive

#### Case Classification

##### Confirmed

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.



**Table 3.6. Number of newly reported case\* reports<sup>†</sup> of perinatal hepatitis B<sup>§</sup> submitted by states and jurisdictions, 2016**

<b>State/Jurisdiction</b>	<b>No. Perinatal hepatitis B case reports<sup>†</sup> submitted</b>
<b>California</b>	15
<b>Georgia</b>	1
<b>Kentucky</b>	2
<b>Louisiana</b>	1
<b>Minnesota</b>	1
<b>New York</b>	2
<b>North Carolina</b>	1
<b>Pennsylvania</b>	2
<b>Tennessee</b>	2
<b>Texas</b>	2
<b>Washington</b>	1
<b>West Virginia</b>	1
<b>Wisconsin</b>	1
<b>Total</b>	<b>32</b>

Source: CDC, National Notifiable Diseases Surveillance System.

\*For case-definition, see <https://www.cdc.gov/nndss/conditions/hepatitis-b-perinatal-virus-infection/case-definition/1995/>

<sup>†</sup>Reports may not reflect unique cases.

<sup>§</sup> Perinatal hepatitis B is not a reportable disease in ALL jurisdictions.

- In 2016, a total of 13 states provided 32 case reports of perinatal hepatitis B.
- California had the highest number of newly reported case reports of perinatal hepatitis B (n=15, 46.9%) in 2016.

## HEPATITIS C

### Acute Hepatitis C

In 2016, a total of 2,967 cases of acute hepatitis C were reported to CDC from 42 states (Table 4.1). The overall incidence rate for 2016 was 1.0 cases per 100,000 population, an increase from 2015 (0.8 cases per 100,000 population). Actual acute cases are estimated to be 13.9 times the number of reported cases in any year. After adjusting for under-ascertainment and under-reporting, an estimated 41,200 acute hepatitis C cases (95% CI=32,600–140,600) occurred in 2016. (Data for 2016 were unavailable for the District of Columbia, Alaska, Arizona, Hawaii, Iowa, Mississippi, New Hampshire, Rhode Island, and Wyoming.)

### 2016 CSTE/CDC Case Definition (NNDSS)

#### Clinical Description

An illness with discrete onset of any sign or symptom consistent with acute viral hepatitis (e.g., fever, headache, malaise, anorexia, nausea, vomiting, diarrhea, and abdominal pain),

#### AND

(a) jaundice, **OR**

(b) a peak elevated serum alanine aminotransferase (ALT) level >200 IU/L during the period of acute illness.

#### Laboratory Criteria

- A positive test for antibodies to hepatitis C virus (anti-HCV)
  
- Hepatitis C virus detection test:
  - Nucleic acid test (NAT) for HCV RNA positive (including qualitative, quantitative or genotype testing)
  - A positive test indicating presence of hepatitis C viral antigen(s) (HCV antigen)\*

\* When and if a test for HCV antigen(s) is approved by FDA and available.

**Table 4.1. Reported cases of acute hepatitis C, nationally and by state or jurisdiction — United States, 2012-2016**

State	2012		2013		2014		2015		2016	
	No.	Rate*	No.	Rate*	No.	Rate*	No.	Rate*	No.	Rate*
Alabama	24	0.5	30	0.6	35	0.7	70	1.4	32	0.7
Alaska	U	U	U	U	U	U	U	U	U	U
Arizona	U	U	U	U	U	U	U	U	U	U
Arkansas	5	0.2	30	1.0	13	0.4	2	0.1	0	0.0
California	63	0.2	72	0.2	73	0.2	59	0.2	60	0.2
Colorado	42	0.8	21	0.4	33	0.6	40	0.7	35	0.6
Connecticut	34	0.9	U	U	U	U	U	U	17	0.5
Delaware	U	U	U	U	U	U	4	0.4	25	2.6
District of Columbia	U	U	U	U	U	U	U	U	U	U
Florida	107	0.6	134	0.7	93	0.5	126	0.6	236	1.1
Georgia	82	0.8	48	0.5	57	0.6	84	0.8	93	0.9
Hawaii	U	U	U	U	U	U	U	U	U	U
Idaho	11	0.7	14	0.9	6	0.4	4	0.2	7	0.4
Illinois	26	0.2	37	0.3	27	0.2	31	0.2	21	0.2
Indiana	110	1.7	175	2.7	122	1.8	138	2.1	146	2.2
Iowa	3	0.1	U	U	U	U	U	U	U	U
Kansas	16	0.6	17	0.6	28	1.0	22	0.8	15	0.5
Kentucky	178	4.1	226	5.1	176	4.0	119	2.7	103	2.3
Louisiana	11	0.2	19	0.4	22	0.5	24	0.5	5	0.1
Maine	8	0.6	8	0.6	31	2.3	30	2.3	25	1.9
Maryland	39	0.7	53	0.9	42	0.7	38	0.6	35	0.6
Massachusetts	37	0.6	174	2.6	228	3.4	249	3.7	424	6.2
Michigan	76	0.8	74	0.7	78	0.8	83	0.8	107	1.1
Minnesota	32	0.6	47	0.9	40	0.7	37	0.7	51	0.9
Mississippi	U	U	U	U	U	U	U	U	U	U
Missouri	4	0.1	6	0.1	6	0.1	8	0.1	24	0.4
Montana	9	0.9	16	1.6	13	1.3	15	1.5	20	1.9
Nebraska	3	0.2	2	0.1	2	0.1	8	0.4	2	0.1
Nevada	12	0.4	9	0.3	6	0.2	12	0.4	16	0.5
New Hampshire	U	U	U	U	U	U	U	U	U	U
New Jersey	71	0.8	106	1.2	113	1.3	130	1.5	122	1.4
New Mexico	21	1.0	12	0.6	16	0.8	40	1.9	18	0.9
New York	93	0.5	131	0.7	126	0.6	121	0.6	179	0.9

**Table 4.1 (cont'd). Reported cases of acute hepatitis C, nationally and by state or jurisdiction — United States, 2012-2016**

State	2012		2013		2014		2015		2016	
	No.	Rate*	No.	Rate*	No.	Rate*	No.	Rate*	No.	Rate*
North Carolina	63	0.6	79	0.8	111	1.1	144	1.4	82	0.8
North Dakota	0	0.0	4	0.6	0	0.0	0	0.0	1	0.1
Ohio	7	0.1	116	1.0	105	0.9	122	1.1	187	1.6
Oklahoma	80	2.1	40	1.0	45	1.2	35	0.9	32	0.8
Oregon	37	0.9	14	0.4	15	0.4	13	0.3	19	0.5
Pennsylvania	66	0.5	81	0.6	69	0.5	129	1.0	225	1.8
Rhode Island	U	U	U	U	U	U	U	U	U	U
South Carolina	1	0.0	0	0.0	4	0.1	5	0.1	10	0.2
South Dakota	U	U	U	U	U	U	U	U	20	2.3
Tennessee	129	2.0	98	1.5	123	1.9	173	2.6	150	2.3
Texas	44	0.2	28	0.1	47	0.2	48	0.2	40	0.1
Utah	17	0.6	11	0.4	38	1.3	30	1.0	76	2.5
Vermont	6	1.0	3	0.5	4	0.6	1	0.2	5	0.8
Virginia	76	0.9	41	0.5	54	0.6	52	0.6	43	0.5
Washington	54	0.8	63	0.9	82	1.2	63	0.9	62	0.9
West Virginia	55	3.0	58	3.1	62	3.4	63	3.4	94	5.1
Wisconsin	26	0.5	40	0.7	49	0.9	64	1.1	103	1.8
Wyoming	U	U	U	U	U	U	U	U	U	U
<b>Total</b>	<b>1778</b>	<b>0.6</b>	<b>2138</b>	<b>0.7</b>	<b>2194</b>	<b>0.7</b>	<b>2436</b>	<b>0.8</b>	<b>2967</b>	<b>1.0</b>

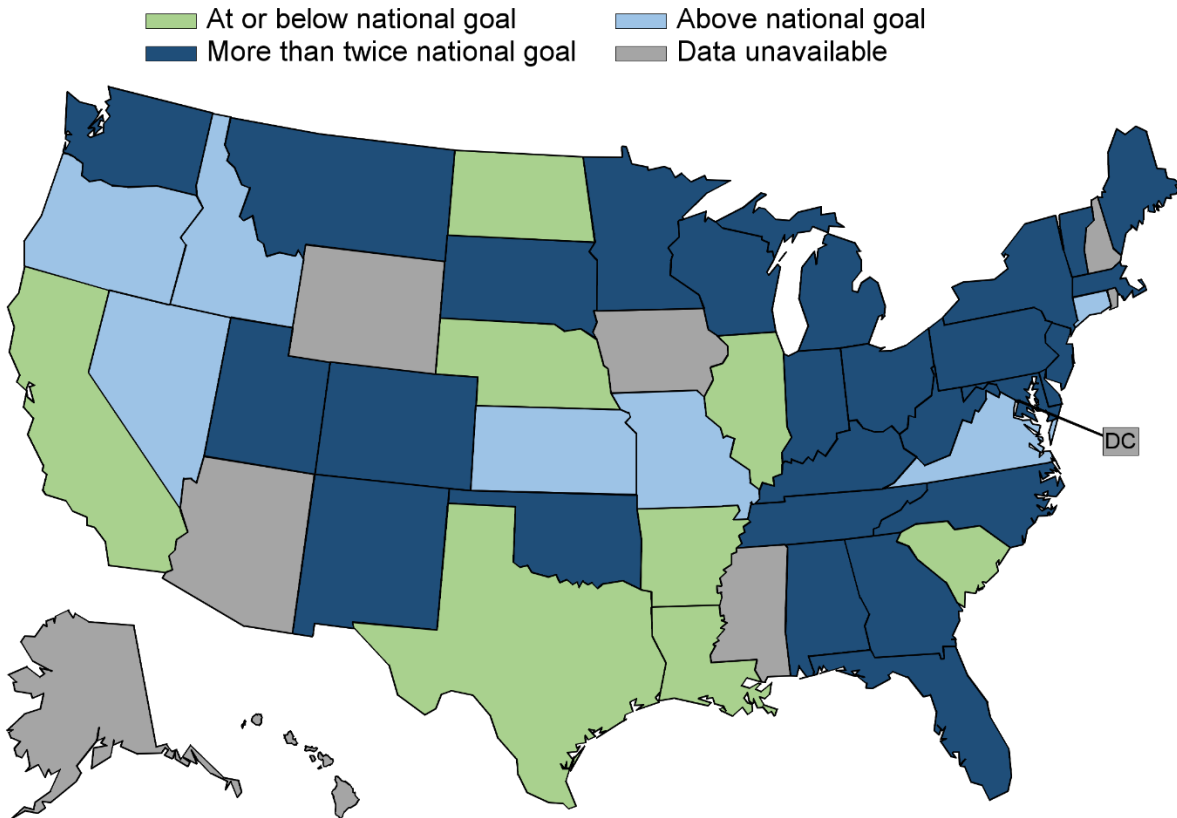
Source: CDC, National Notifiable Diseases Surveillance System.

\*Rate per 100,000 population.

U=No data available for reporting.

- The number of acute hepatitis C cases reported in the United States increased 20.2% from 2012 through 2013 (1,778 cases to 2,138 cases), increased 2.6% (to 2,194 cases) from 2013 through 2014, and increased 11.0% (to 2,436 cases) from 2014 through 2015. Compared with 2015, cases of acute HCV increased 21.8% (to 2,967 cases) in 2016.
- From 2015 through 2016, the national rate of acute cases of hepatitis C increased from 0.8 to 1.0 cases per 100,000 population.
- By state, 2016 rates of acute hepatitis C ranged from no cases reported in Arkansas to 6.2 cases per 100,000 population in Massachusetts.
- Of the 42 reporting states, 8 states (Florida, Indiana, Massachusetts, New Jersey, New York, Ohio, Pennsylvania, and Tennessee) accounted for 56.3% of the acute hepatitis C cases reported in 2016.

Map 4.1 State Acute Hepatitis C Incidence Compared to Healthy People 2020 National Goal\*  
United States, 2016



Source: CDC, National Notifiable Diseases Surveillance System (NNDSS)

\*National goal: 0.25 cases/100,000 population

- Of the 42 reporting states, the following 8 (25%) met the *Healthy People 2020* (<https://www.healthypeople.gov/>) goal of reducing hepatitis C incidence to  $\leq 0.25$  cases/100,000 population: Arkansas, California, Illinois, Louisiana, Nebraska, North Dakota, South Carolina, and Texas.
- The incidence of acute hepatitis C was above the *Healthy People 2020* goals for 34 of the 42 reporting states: Alabama, Colorado, Connecticut, Delaware, Florida, Georgia, Idaho, Indiana, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nevada, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, South Dakota, Tennessee, Utah, Vermont, Virginia, Washington, West Virginia, and Wisconsin.
- Of the 34 states with rates above the *Healthy People 2020* goals, 27 states (Alabama, Colorado, Delaware, Florida, Georgia, Indiana, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Montana, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Dakota, Tennessee, Utah, Vermont, Washington, West Virginia, and Wisconsin) had rates of acute hepatitis C that were more than twice the national goal.

**Table 4.2. Select clinical characteristics of acute hepatitis C cases\* reported in the United States, 2016**

Clinical characteristic	Availability of valid data <sup>†</sup> for clinical characteristic		Cases with clinical characteristic <sup>§</sup>	
	No.	%	No.	%
<b>Jaundice</b>	2,380	80.2	1,054	44.3
<b>Hospitalized for acute hepatitis C</b>	1,993	67.2	923	46.3
<b>Died from acute hepatitis C</b>	1,687	56.9	52	3.1

Source: CDC, National Notifiable Diseases Surveillance System.

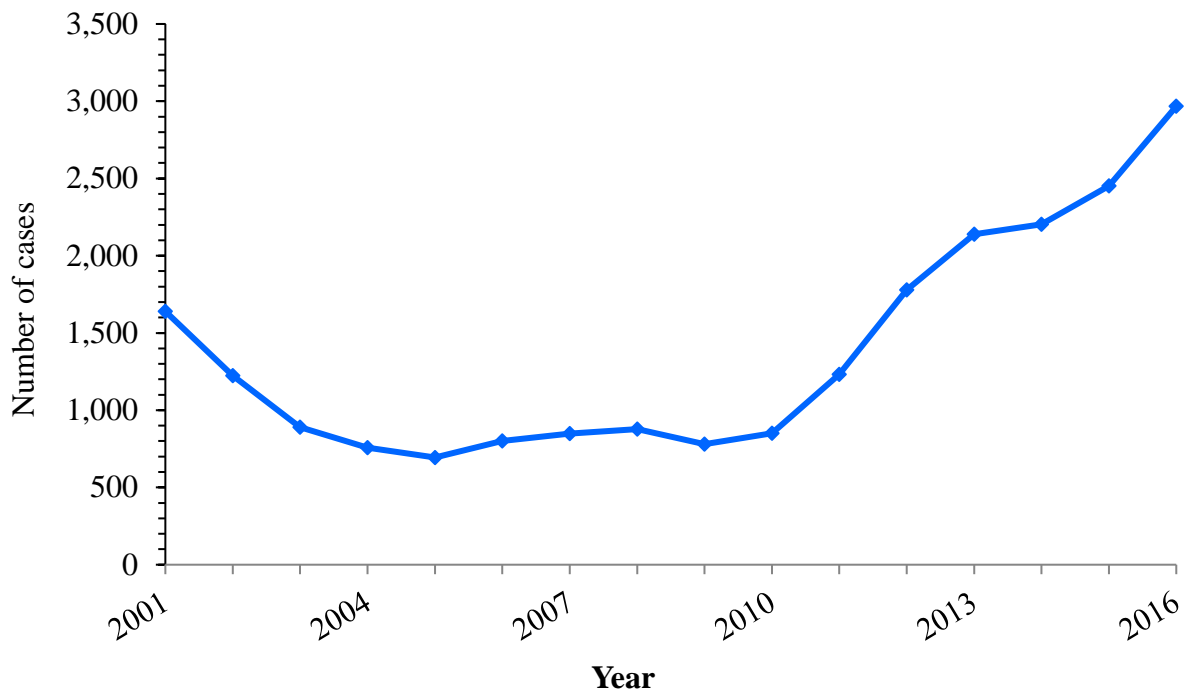
\*A total of 2,967 acute hepatitis C cases were reported during 2016.

<sup>†</sup>Case reports for which questions regarding clinical characteristics were answered with “yes” or “no.” Reports with any other response were excluded.

<sup>§</sup>Numbers and percentages represent only those case reports for which data regarding clinical characteristics were available; numbers likely are underestimates.

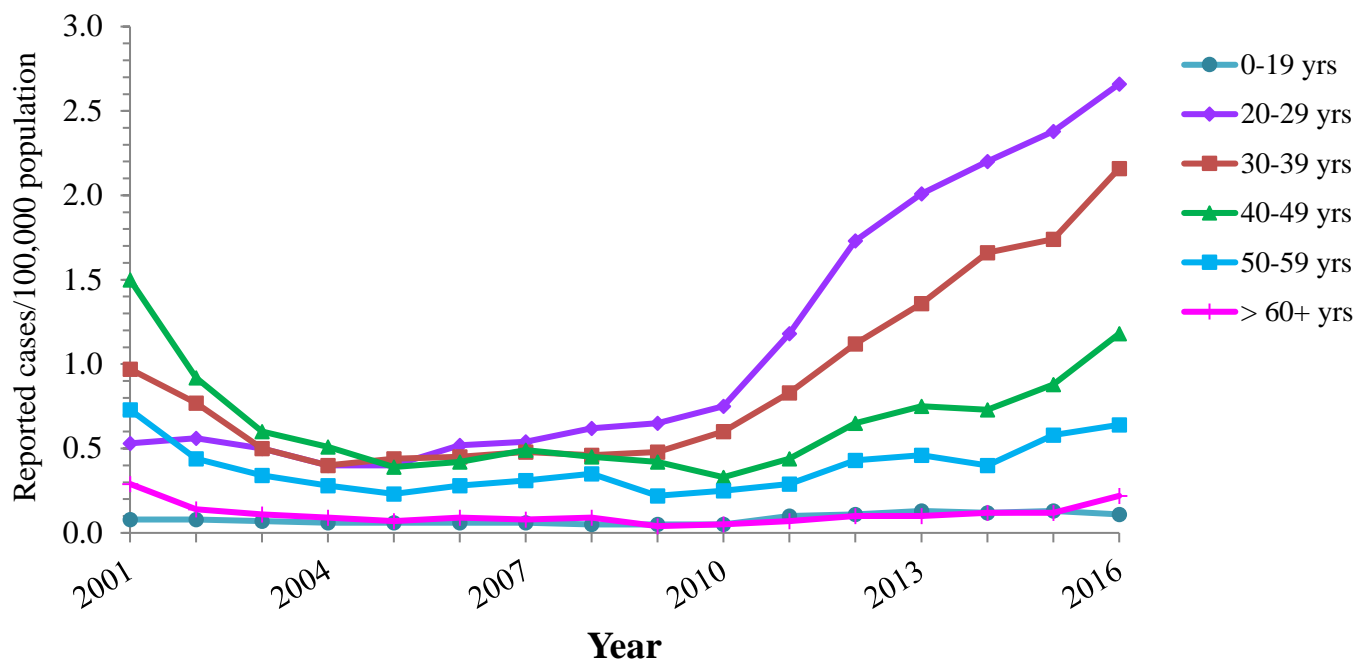
- Of the 2,967 acute hepatitis C case reports received during 2016, 80.2% included information regarding whether the patient had jaundice, 67.2% included information regarding hospitalization caused by hepatitis C, and 56.9% included information on death from hepatitis C. (Note: more severe cases are likely to be ascertained and reported.)
- Jaundice was reported for 1,054 (44.3%) of the 2,380 acute hepatitis C case reports that included information about jaundice.
- Hospitalization as the result of hepatitis C was reported for 923 (46.3%) of the 1,993 acute hepatitis C case reports that included information about hospitalization.
- Death from hepatitis C was reported for 52 (3.1%) of the 1,687 acute hepatitis C case-reports that included information about death.

**Figure 4.1. Reported number of acute hepatitis C cases — United States, 2001–2016**



Source: CDC, National Notifiable Diseases Surveillance System.

- The number of reported acute hepatitis C cases declined 48.2%, from 1,640 in 2001 to 850 in 2010. The rate then increased 3.5 fold to 2,967 cases in 2016. From 2015 through 2016, the number of acute HCV cases increased 21.8% (from 2,436 to 2,967 cases).

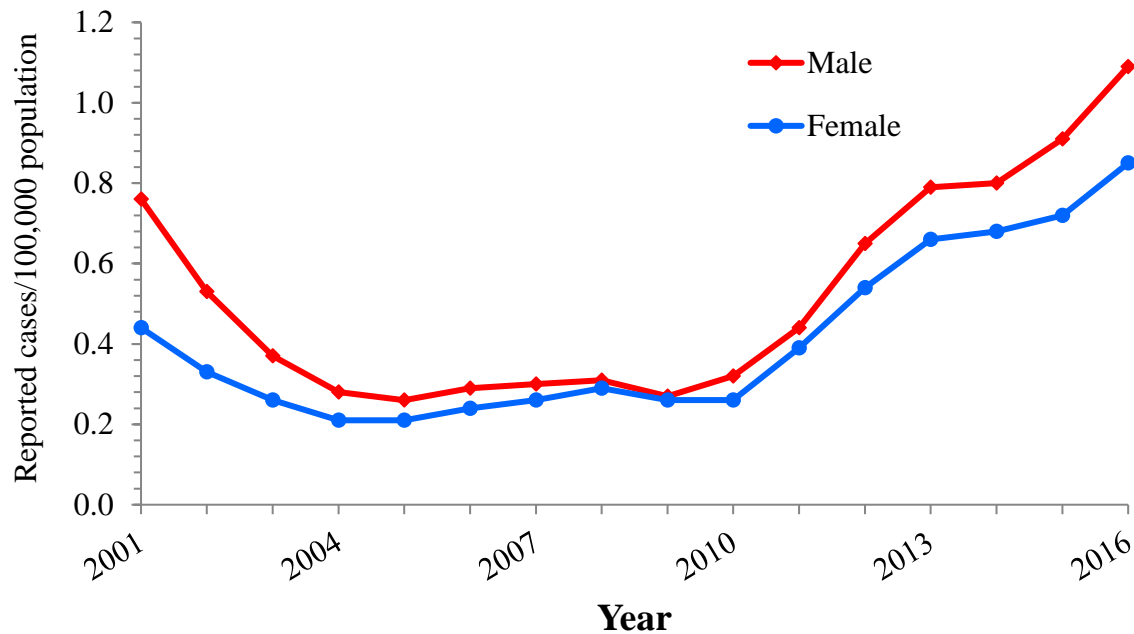
**Figure 4.2. Incidence of acute hepatitis C, by age group — United States, 2001–2016**

Source: CDC, National Notifiable Diseases Surveillance System.

- From 2001 through 2003, incidence rates for reported acute hepatitis C decreased among all age groups except for persons aged 0–19 years; rates remained stable among all age groups from 2003 through 2005. From 2005 through 2016, persons aged 20–29 experienced annual increases and persons aged 30–59 generally experienced increases with occasional downward fluctuations.
- From 2005 through 2016, the largest increases in the rate of acute hepatitis C were among persons aged 20–29 years (from 0.4 cases per 100,000 population in 2005 to 2.7 cases per 100,000 population in 2016) and persons aged 30–39 years (from 0.4 cases per 100,000 population in 2005 to 2.2 cases per 100,000 population in 2016).
- In 2016, among all age groups, persons aged 20–29 years had the highest rate (2.7 cases per 100,000 population) and persons aged 0–19 years had the lowest rate (0.1 cases per 100,000 population) of acute hepatitis C.
- From 2015 through 2016, incidence rates for reported acute hepatitis C increased for all age groups, except for persons aged 0–19 years. The largest increases were among persons aged 40–49 years (33.3%) from 0.9 cases per 100,000 to 1.2 cases per 100,000; persons aged 30–39 years (29.4%) from 1.7 cases per 100,000 to 2.2 cases per 100,000; and persons aged 20–29 years (12.5%) from 2.4 cases per 100,000 to 2.7 cases per 100,000 population.

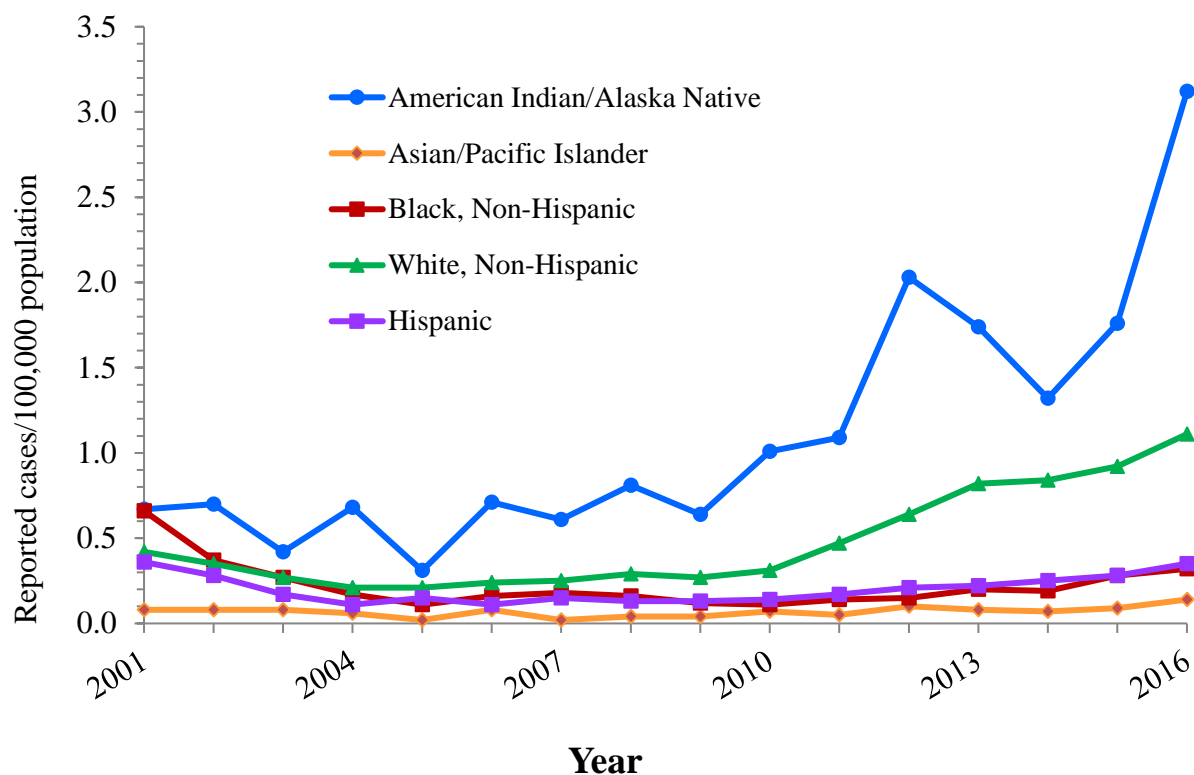


**Figure 4.3. Incidence of acute hepatitis C, by sex — United States, 2001-2016**



Source: CDC, National Notifiable Diseases Surveillance System.

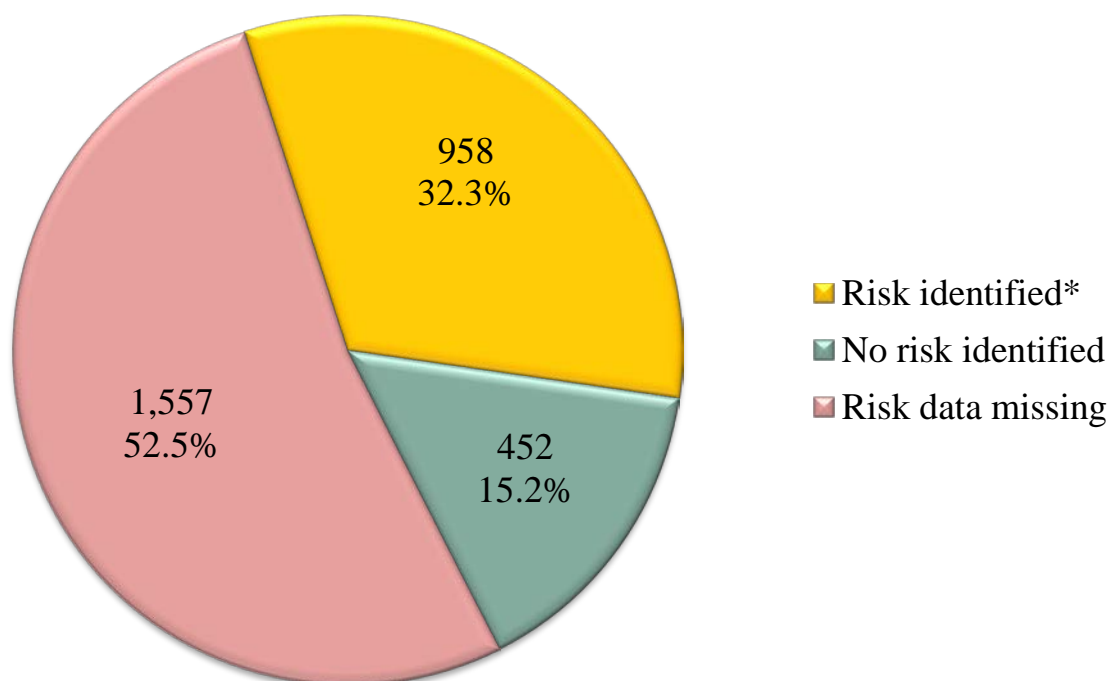
- From 2001 through 2005, reported acute hepatitis C declined for males and females while remaining higher for males than for females.
- From 2005 through 2010, the incidence of reported acute hepatitis C rates remained fairly stable and similar for both males and females.
- From 2010 through 2016, rates of acute hepatitis C increased 3-fold among both males and females.
- In 2016, rates among males and females were 1.1 and 0.9 cases per 100,000 population, respectively.

**Figure 4.4. Incidence of acute hepatitis C, by race/ethnicity — United States, 2001–2016**

Source: CDC, National Notifiable Diseases Surveillance System.

- From 2002 through 2016, the incidence rate of acute hepatitis C for American Indians/Alaska Natives remained high relative to other racial/ethnic groups. The largest rate increase for this racial/ethnic group occurred from 2015 through 2016 (from 1.8 cases per 100,000 population to 3.1 cases per 100,000 population).
- From 2015 through 2016, the incidence rate of acute hepatitis C increased among all racial/ethnic groups.
- In 2016, the incidence rate per 100,000 population of acute hepatitis C was 3.1 for American Indians/Alaska Natives, 1.1 for non-Hispanic Whites, 0.4 for Hispanics, 0.3 for non-Hispanic Blacks, and 0.1 for Asians/Pacific Islanders.

**Figure 4.5. Availability of information on risk exposures/behaviors associated with acute hepatitis C — United States, 2016**

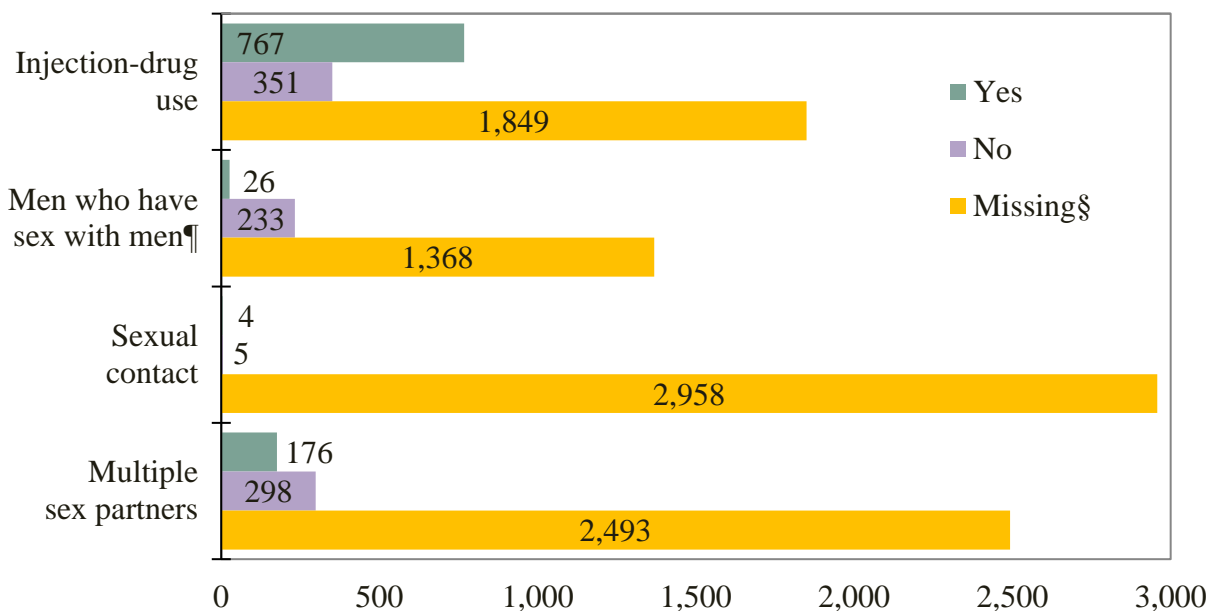


Source: CDC, National Notifiable Diseases Surveillance System.

\*Includes case reports indicating the presence of at least one of the following risks 2 weeks to 6 months prior to onset of acute, symptomatic hepatitis C: 1) using injection drugs; 2) having sexual contact with suspected/confirmed hepatitis C patient; 3) being a man who has sex with men; 4) having multiple sex partners concurrently; 5) having household contact with suspected/confirmed hepatitis C patient; 6) having had occupational exposure to blood; 7) being a hemodialysis patient; 8) having received a blood transfusion; 9) having sustained a percutaneous injury; and 10) having undergone surgery.

- Of the 2,967 case reports of acute hepatitis C received by CDC during 2016, a total of 1,557 (52.5%) did not include a response (i.e., a “yes” or “no” response to any of the questions about risk exposures and behaviors) to enable assessment of risk exposures or behaviors.
- Of 1,410 case reports that contained risk exposure/behavior information:
  - 452 (32.1%) indicated no risk exposure/behavior for acute hepatitis C and
  - 958 (67.9%) indicated at least one risk exposure/behavior for acute hepatitis C during the 2 weeks to 6 months prior to illness onset.

Figure 4.6a. Acute hepatitis C reports\*, by risk exposure/behavior† — United States, 2016



Source: CDC, National Notifiable Diseases Surveillance System.

\*A total of 2,967 case reports of acute hepatitis C were received in 2016.

† More than one risk exposure/behavior may be indicated on each case report.

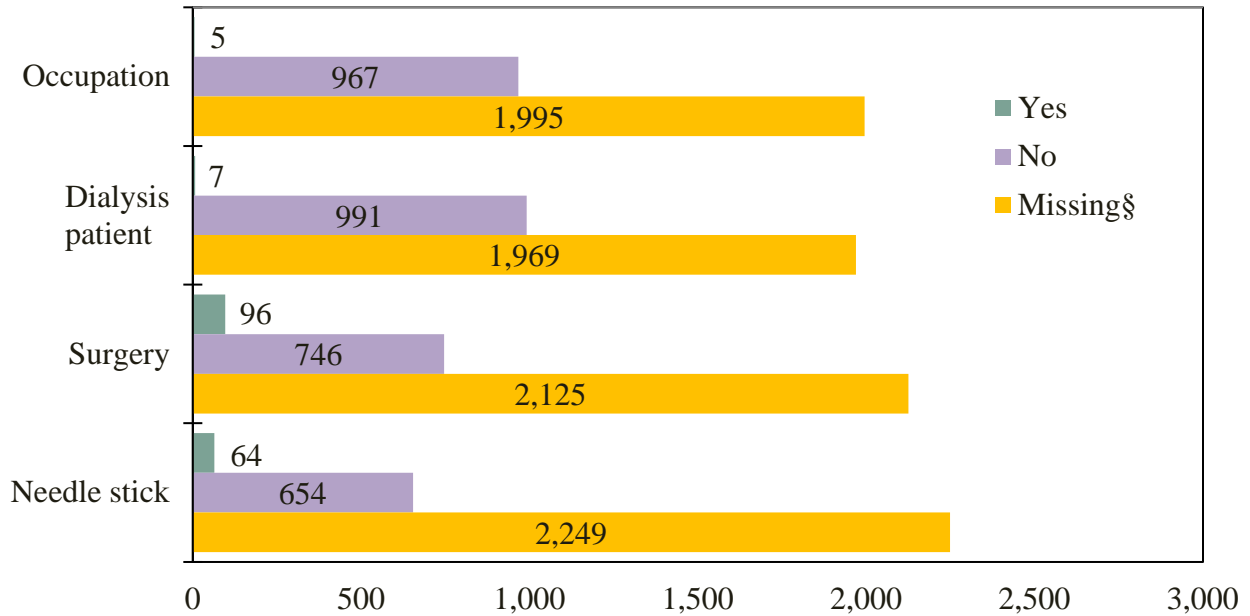
§No risk data reported.

¶A total of 1,627 acute hepatitis C cases were reported among males in 2016.

Figure 4.6a presents reported risk exposures/behaviors for acute hepatitis C during the incubation period, 2 weeks to 6 months prior to onset of symptoms.

- Of the 1,118 case reports that contained information about injection-drug use, 68.6% (n=767) indicated use of injection drugs.
- Of the 259 case reports from males that included information about sexual preferences/practices, 10.0% (n=26) indicated sex with another man.
- Of the 9 case reports that had information about sexual contact, 44.4% (n=4) indicated sexual contact with a person with confirmed or suspected hepatitis C.
- Of the 474 case reports that had information about number of sex partners, 37.1% (n=176) indicated having  $\geq 2$  sex partners.

**Figure 4.6b. Acute hepatitis C reports\*, by risk exposure/behavior† — United States, 2016**



Source: CDC, National Notifiable Diseases Surveillance System.

\*A total of 2,967 case reports of acute hepatitis C were received in 2016.

†More than one risk exposure/behavior may be indicated on each case report.

§No risk data reported.

Figure 4.6b presents reported risk exposures/behaviors for acute hepatitis C during the incubation period, 2 weeks to 6 months prior to onset of symptoms.

- Of the 972 case reports that included information about occupational exposures, 0.5% (n=5) indicated employment in a medical, dental, or other field involving contact with human blood.
- Of the 998 case reports that included information about receipt of dialysis or a kidney transplant, 0.7% (n=7) indicated patient receipt of dialysis or a kidney transplant.
- Of the 842 case reports that included information about surgery, 11.4% (n=96) indicated having surgery.
- Of the 718 case reports that included information about needle sticks, 8.9% (n=64) indicated having an accidental needle stick/puncture.

## Chronic Hepatitis C

In 2016, a total of 148,932 case reports of chronic hepatitis C were reported to CDC from 42 states (Table 4.3). Based on 2003-2010 data from national health surveys adjusted for underreporting, approximately 3.5 million persons were infected with HCV (17).

### 2016 CSTE/CDC Case Definition (NNDSS)

#### Clinical Description

No available evidence of clinical and relevant laboratory information indicative of acute infection (refer to the criteria for classification Table VII-B in CSTE position statement 15-ID-03). Most hepatitis C virus (HCV)-infected persons are asymptomatic; however, many have chronic liver disease, which can range from mild to severe.

#### Laboratory Criteria

- A positive test for antibodies to hepatitis C virus (anti-HCV)
- Hepatitis C virus detection test:
  - Nucleic acid test (NAT) for HCV RNA positive (including qualitative, quantitative or genotype testing)
  - A positive test indicating presence of hepatitis C viral antigen(s) (HCV antigen)\*

\* When and if a test for HCV antigen(s) is approved by FDA and available.

#### Criteria to Distinguish a New Case from an Existing Case

- A new chronic case is an incident chronic hepatitis C case that meets the case criteria for chronic hepatitis C and has not previously been reported. A confirmed acute case may not be reported as a probable chronic case (i.e., HCV antibody positive, but with an unknown HCV RNA NAT or antigen status).
- States and territories may choose to track resolved hepatitis C cases in which spontaneous clearance of infection or sustained viral response to treatment are suspected to have occurred before national notification or are known to have occurred after national notification as a confirmed or probable case to CDC.

**Table 4.3. Number of newly reported case\* reports<sup>†</sup> of confirmed chronic hepatitis C submitted by states and jurisdictions, 2016**

<b>State/Jurisdiction</b>	<b>No. chronic hepatitis C case reports submitted<sup>†</sup></b>
Alabama	N
Alaska	754
Arizona	U
Arkansas	0
California <sup>§</sup>	697
Colorado	2,917
Connecticut	1,631
Delaware	1,328
District of Columbia	U
Florida	17,724
Georgia	7,086
Hawaii	U
Idaho	895
Illinois	5,568
Indiana	U
Iowa	734
Kansas	1,205
Kentucky	44
Louisiana	3,534
Maine	494
Maryland	4,367
Massachusetts	4,609
Michigan	5,178
Minnesota	1,420
Mississippi	N
Missouri	5,068
Montana	1,026
Nebraska	801
Nevada	4
New Hampshire	10
New Jersey	8,006
New Mexico	1,205

Table 4.3 (cont'd). Number of newly reported case\* reports<sup>†</sup> of confirmed chronic hepatitis C submitted by states and jurisdictions, 2016

State/Jurisdiction	No. chronic hepatitis C case reports submitted <sup>†</sup>
New York	8,985
North Carolina	N
North Dakota	701
Ohio	14,272
Oklahoma	543
Oregon	3,541
Pennsylvania	13,029
Rhode Island	U
South Carolina	3,121
South Dakota	483
Tennessee	10,632
Texas	N
Utah	1,221
Vermont	723
Virginia	5,150
Washington	4,294
West Virginia	3,106
Wisconsin	2,347
Wyoming	479
<b>Total</b>	<b>148,932</b>

Source: CDC, National Notifiable Diseases Surveillance System

\*For case definition, see <https://wwwn.cdc.gov/nndss/conditions/hepatitis-c-chronic/case-definition/2016/>

<sup>†</sup>Reports may not reflect unique cases.

<sup>§</sup>Cases reported by California through NNDSS were all from San Francisco County. Differences in the number of cases in this table and table 4.4 are because NNDSS and CDC's Secure Access Management System (SAMS) have different data close-out dates by which all annual data must be submitted.

N=Not Reportable, chronic hepatitis C is not reportable in the listed state.

U= No data available for reporting.

- In 2016, a total of 42 states notified CDC of 148,932 cases of chronic hepatitis C.
- Eleven states (Florida, Georgia, Illinois, Michigan, Missouri, New Jersey, New York, Ohio, Pennsylvania, Tennessee, and Virginia) accounted for 67.6% of the chronic hepatitis C case reports submitted through NNDSS in 2016.
- In 2016, the largest number of reports of chronic hepatitis C was received from Florida (n=17,724 or 11.9%).



**Table 4.4. Reported cases of chronic hepatitis C, by demographic characteristics and laboratory tests — Enhanced Viral Hepatitis Surveillance Sites, 2013-2016**

Category	FL	MA	MI	NYS*	Phil	SF	WA	Total
	No.	No.	No.	No.	No.	No.	No.	No.
	% <sup>†</sup>	%	%	%	%	%	%	%
<b>Sex</b>								
<b>Female</b>	18,034	8,002	9,495	9,554	2,198	1,540	6,839	55,662
	40.2%	38.6%	36.5%	38.4%	34.2%	28.2%	38.3%	38.1%
<b>Male</b>	26,740	12,628	16,439	15,141	4,145	3,879	10,733	89,705
	59.5%	61.0%	63.2%	60.9%	64.6%	71.0%	60.1%	61.3%
<b>Unknown /missing</b>	135	83	66	171	75	42	284	856
	0.3%	0.4%	0.3%	0.7%	1.2%	0.8%	1.6%	0.6%
<b>Race/ethnicity</b>								
<b>American Indian/ Alaska Native, NH<sup>§</sup></b>	81	49	214	117	6	30	121	618
	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	0.0%	0.0%
<b>Asian/Pacific Islander, NH</b>	104	308	140	290	52	205	131	1,230
	0.2%	1.5%	0.5%	1.2%	0.8%	3.8%	0.7%	0.8%
<b>Black, NH</b>	1,796	816	4,476	2,187	793	851	399	11,318
	4.0%	3.9%	17.2%	8.8%	12.4%	15.6%	2.2%	7.7%
<b>White, NH</b>	13,714	8,552	12,296	11,525	783	1,919	4,366	53,155
	30.5%	41.3%	47.3%	46.3%	12.2%	35.1%	24.5%	36.4%
<b>Hispanic</b>	1,744	1,144	472	1,513	320	378	343	5,914
	3.9%	5.5%	1.8%	6.1%	5.0%	6.9%	1.9%	4.0%
<b>Other, NH</b>	544	637	290	383	33	35	122	2,044
	1.2%	3.1%	1.1%	1.5%	0.5%	0.6%	0.7%	1.4%
<b>Unknown /missing</b>	26,926	9,207	8,112	8,851	4,431	2,043	12,374	71,944
	60.0%	44.5%	31.2%	35.6%	69.0%	37.4%	69.3%	49.2%
<b>Age group, years</b>								
<b>0-14</b>	95	145	96	47	26	1	49	459
	0.2%	0.7%	0.4%	0.2%	0.4%	0.0%	0.3%	0.3%
<b>15-24</b>	3,901	2,755	2,053	2,880	255	133	1,315	13,292
	8.7%	13.3%	7.9%	11.6%	4.0%	2.4%	7.4%	9.1%
<b>25-39</b>	12,605	7,714	6,334	7,228	1,341	958	4,045	40,225
	28.1%	37.2%	24.4%	29.1%	20.9%	17.5%	22.7%	27.5%
<b>40-54</b>	10,846	4,923	5,908	5,912	1,847	1,629	5,241	36,306
	24.2%	23.8%	22.7%	23.8%	28.8%	29.8%	29.4%	24.8%
<b>55+</b>	17,441	5,156	11,600	8,747	2,947	2,695	7,192	55,778
	38.8%	24.9%	44.6%	35.2%	45.9%	49.3%	40.3%	38.1%
<b>Unknown/missing</b>	21	20	9	52	2	45	14	163
	0.0%	0.1%	0.0%	0.2%	0.0%	0.8%	0.1%	0.1%

**Table 4.4 (cont'd). Reported cases of chronic hepatitis C, by demographic characteristics and laboratory tests — Enhanced Viral Hepatitis Surveillance Sites, 2013-2016**

Category	FL	MA	MI	NYS	Phil	SF	WA	Total
	No.	No.	No.	No.	No.	No.	No.	No.
	%	%	%	%	%	%	%	%
<b>Hepatitis C laboratory testing<sup>†</sup></b>								
<b>Anti-HCV+</b>	28,145	14,800	15,689	17,458	3,957	3,137	8,889	92,075
	62.7%	71.5%	60.3%	70.2%	61.7%	57.4%	49.8%	63.0%
<b>HCV RNA+</b>	33,059	15,900	10,689	18,461	6,067	4,006	11,378	99,560
	73.6%	76.8%	41.1%	74.2%	94.5%	73.4%	63.7%	68.1%
<b>Total no. cases</b>	44,909	20,713	26,000	24,866	6,418	5,461	17,856	146,223
<b>2013-2016 Est. population total**</b>	20,259,003	6,761,108	9,914,094	11,238,360	1,562,194	856,404	6,333,530	56,924,692
<b>Rate per 100,000 population</b>	221.7	306.4	262.3	221.3	410.8	637.7	281.9	256.9

Source: CDC, Enhanced Viral Hepatitis Surveillance Sites.

Abbreviations: FL, Florida; MA, Massachusetts; MI, Michigan; NYS, New York State; Phil, Philadelphia; SF, San Francisco; WA, Washington State; HBV: Hepatitis B Virus; IgM anti-HBc (Anti-Hepatitis B core IgM); NAT: HBV nucleic acid testing.

Percentages may not sum to 100% due to rounding.

\*New York City was not included in the case count for New York State, therefore cases and population estimates from New York excluded those who resided in New York City.

†The denominator used to calculate proportions was the total number of cases reported for each site.

§NH: Non-Hispanic

¶Cases can be reported with more than one laboratory test result.

\*\*Population estimates for the United States: <https://wonder.cdc.gov/bridged-race-population.html>

HCV: Hepatitis C virus; Anti-HCV: Hepatitis C Antibody; HCV RNA: Ribonucleic acid.

- From 2013 through 2016, a total of 146,223 cases of chronic hepatitis C were reported by the seven funded sites.
- Among the 146,223 cases of chronic hepatitis C:
  - 61.3% were among males;
  - 61.4% were among persons aged 15–54 years;
  - 36.4% were among persons identifying as white, non-Hispanic;
  - 63.0% tested anti-HCV-positive; and
  - 68.1% tested HCV RNA-positive.
- By site, the proportion of chronic hepatitis C cases among males ranged from 59.5% in Florida to 71.0% in San Francisco. Similarly, the proportion of chronic hepatitis C cases among persons identifying as white, non-Hispanic ranged from 12.2% in Philadelphia to 47.3% in Michigan.

**Table 4.5. Number and rate\* of hepatitis C-related deaths<sup>†</sup>, by demographic characteristic and year — United States, 2012-2016**

Demographic characteristic		2012		2013		2014		2015		2016	
		No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Age Group (years) <sup>§</sup>	0–34	158	0.11	121	0.08	162	0.11	196	0.13	165	0.11
	35–44	622	1.54	573	1.42	552	1.36	597	1.47	536	1.32
	45–54	4,749	10.73	4,344	9.93	4,118	9.48	3,676	8.51	3,038	7.10
	55–64	9,235	23.93	9,899	25.18	9,999	24.95	9,702	23.73	9,032	21.78
	65–74	2,515	10.49	3,004	11.91	3,390	12.84	4,023	14.60	4,086	14.27
	≥75	1,369	7.15	1,425	7.31	1,433	7.22	1,434	7.10	1,292	6.27
Race/ethnicity <sup>¶</sup>	White, NH (non-Hispanic)	11,839	4.35	12,219	4.40	12,455	4.46	12,355	4.38	11,422	3.97
	Black, NH	3,232	7.81	3,520	8.35	3,540	8.12	3,606	8.14	3,365	7.42
	Hispanic	2,668	7.19	2,699	6.91	2,767	6.81	2,699	6.40	2,482	5.69
	Asian/Pacific Islander	472	3.15	495	3.09	438	2.56	445	2.49	405	2.14
	American Indian/Alaskan Native	313	11.81	324	12.22	317	11.20	367	12.95	312	10.75
Sex	Male	13,300	7.31	13,745	7.40	13,998	7.39	14,095	7.31	12,863	6.52
	Female	5,350	2.77	5,623	2.85	5,661	2.81	5,534	2.71	5,290	2.55
<b>Overall</b>		<b>18,650</b>	<b>4.96</b>	<b>19,368</b>	<b>5.03</b>	<b>19,659</b>	<b>5.01</b>	<b>19,629</b>	<b>4.91</b>	<b>18,153</b>	<b>4.45</b>

Source: CDC, National Vital Statistics System.

\*Rates for race, sex, and overall total are age-adjusted per 100,000 U.S. standard population in 2000.

<sup>†</sup>Cause of death is defined as the underlying cause of death or one of the multiple causes of death and is based on the International Classification of Diseases, 10th Revision (ICD-10) codes B17.1, and B18.2 (hepatitis C).

<sup>§</sup>Two deaths in 2012, two deaths in 2013, five deaths in 2014, one death in 2015, and four deaths in 2016 are not represented under the age category due to missing age data.

<sup>¶</sup>The race/ethnicity category was added starting in 2010 to incorporate bridged race categories. 126 deaths in 2012, 111 deaths in 2013, 142 deaths in 2014, 157 deaths in 2015, and 167 deaths in 2016 are not represented under the race/ethnicity category due to missing data.

- As determined by death-certificate information, of the three types of viral hepatitis (hepatitis A, hepatitis B, and hepatitis C), hepatitis C was listed most often as the underlying or contributing cause of death (n=18,153) and had the highest hepatitis-related mortality rate in 2016, at 4.5 deaths/100,000 population.
- The overall hepatitis C-related mortality rate remained steady from 2012 through 2014 (5.0 deaths/100,000 population); it then declined to 4.9 deaths/100,000 in 2015 and declined even further to 4.5 deaths/100,000 in 2016.
- In 2016, persons aged 55–64 years had the highest hepatitis C-related mortality rate (21.8 deaths/100,000 population) compared with other age groups, accounting for 49.8% of hepatitis C-related deaths in 2016.
- In 2016, American Indians/Alaska Natives had the highest hepatitis C-related mortality rate compared with other racial/ethnic populations, at 10.8 deaths/100,000 population. Non-Hispanic whites accounted for 63.5% of the 17,986 hepatitis C-related deaths that included race/ethnicity information in 2016.
- In 2016, the hepatitis C-related mortality rate for males was approximately 2.6 times the rate for females. From 2015 through 2016, the rate for males declined from 7.3 deaths/100,000 to 6.5

deaths/100,000 population.

## DISCUSSION

National surveillance data for viral hepatitis provide essential information for identifying patterns and trends in viral hepatitis. These data can help public health entities 1) estimate the health burden of hepatitis A, hepatitis B, and hepatitis C at national, state, and local levels; 2) identify clusters of disease indicating a possible viral hepatitis outbreak; 3) identify those populations for whom public health intervention is needed; and 4) evaluate intervention efforts. National rates for acute hepatitis A and B have been published since 1966, and national rates for acute hepatitis C (formerly non-A, non-B) have been published since 1992. Changes in risk exposures and behaviors have resulted in major changes in the epidemiology of these diseases, while implementation of expanded and improved public health strategies more effectively address prevention, detection, and treatment by targeting at-risk populations such as PWIDs.

NNDSS, the core of viral hepatitis surveillance, was designed to enable states to notify CDC of cases of diseases deemed notifiable by CDC and CSTE. Most of these notifiable diseases are diagnosed with a single positive laboratory test. However, cases of acute and chronic hepatitis B and C do not fit this pattern, as additional information beyond a single laboratory test is required to confirm a case (53). To better count and characterize cases of viral hepatitis and estimate the burden of disease, CDC supplements NNDSS data with data obtained from select funded sites, national surveys, and vital statistics.

Data from NNDSS reveal that from 2015 through 2016, there was an increase of 44.4% in the number of reported cases of hepatitis A, a 4.5% decrease in the number of reported cases of acute hepatitis B, and a 21.8% increase in the number of reported cases of hepatitis C. CDC was alerted to two large hepatitis A outbreaks in 2016: first a large outbreak in Hawaii linked to raw scallops imported from the Philippines; and secondly, an outbreak in multiple Eastern states traced to frozen strawberries imported from Egypt (<https://www.cdc.gov/hepatitis/outbreaks/index.htm>). Such outbreaks emphasize the continued need to increase routine hepatitis A vaccination of children as well as improve coverage among at-risk adult populations. Recent vaccination recommendations for hepatitis B encompass not only adults at risk, but also universal vaccination of adults in settings in which a high proportion have risk factors and vaccination of adults requesting protection from hepatitis B without acknowledgment of a specific risk factor (30). The 22% increase in the annual number of new HCV infections in 2016 reflects the epidemics of HCV transmission associated with growing numbers of young white youth who have transitioned from oral prescription opioid abuse to injection of these opioids and heroin (16). American Indians and Alaskan Natives (AI/AN), although smaller in population size, have been disproportionately affected by the current HCV epidemic. Hepatitis C-related mortality rates in the AI/AN population has long exceeded those of other racial populations, and a marked increase in acute HCV rates from 2015 through 2016 in this group shows that transmission is a continuing concern. In 2016, after adjusting for under-ascertainment and under-reporting, the estimated numbers of cases of HAV, HBV, and HCV infections were 4,000, 20,900, and 41,200, respectively.

Chronic hepatitis infection continues to affect millions of Americans (8, 17). In 2016, a total of 14,847 reports of chronic hepatitis B and 148,932 reports of chronic hepatitis C were submitted to CDC through NNDSS. Mortality data from 2016 presented in this surveillance report show that certain socio-demographic groups are disproportionately dying with these infections,

specifically 1) persons aged  $\geq 55$  years (for hepatitis A); 2) persons aged  $\geq 55$  years of age and Asians/Pacific Islanders (for hepatitis B); and 3) persons aged 55–64 years and American Indians/Alaska Native (for hepatitis C). Mortality rates in 2016 were highest among persons infected with HCV (4.45 deaths per 100,000 population), followed by HBV (0.45 deaths per 100,000 population) and HAV (0.02 deaths per 100,000 population).

CDC and state health departments rely on surveillance data to track the incidence of acute infection, guide development and evaluation of programs and policies to prevent infection and minimize the public health impact of viral hepatitis, and monitor progress towards achieving goals established for these programs and policies. Effective systems for conducting surveillance for chronic HBV and HCV infections are critical to ensure accurate reporting of all cases and to support prevention programs that interrupt transmission of viral hepatitis and improve the health of those who are currently infected.

## REFERENCES

1. Centers for Disease Control and Prevention's (CDC) National Notifiable Diseases Surveillance System (NNDSS). <https://www.cdc.gov/nndss/>.
2. Klevens RM, Liu SJ, Roberts H, Jiles RB, Holmberg SD. Estimating acute viral hepatitis infections from nationally reported cases. *Am J Public Health*. 2014;104(3):482-7.
3. Collier MG, Khudyakov YE, Selvage D, Adams-Cameron M, Epton E, Cronquist A, et al. Outbreak of hepatitis A in the USA associated with frozen pomegranate arils imported from Turkey: an epidemiological case study. *Lancet Infect Dis*. 2014;14(10):976-81.
4. Centers for Disease Control and Prevention. Prevention of hepatitis A through active or passive immunization: recommendations of the Advisory Committee on Immunization Practices. *MMWR*. 2006;55(RR-07):1-23.
5. Klevens RM, Kruszon-Moran D, Wasley AM, Gallagher K, McQuillan GM, Kuhnert WL, et al. Seroprevalence of hepatitis A antibodies in the United States: results from the National Health and Nutrition Examination Survey. *Public Health Rep*. 2011;126(4):522-32.
6. Centers for Disease Control and Prevention. Vaccination coverage among children aged 19-35 months – United States, 2016. *MMWR*. 2017;66(43):1171-1177
7. Klevens RM, Miller JT, Iqbal KI, Thomas A, Rizzo EM, Hanson H, et al. The evolving epidemiology of hepatitis A in the United States. *Arch Intern Med* 2010; 170(20):1811-18.
8. Roberts H, Kruszon-Moran D, Ly KN, Hughes E, Iqbal K, Jiles RB, Holmberg SD. Prevalence of chronic hepatitis B virus (HBV) infection in U.S. households: National Health and Nutrition Examination Survey (NHANES), 1988-2002. *Hepatology* 2016; 63(2):388-97.
9. Kowdley KV, Wang CC, Welch S, Roberts H, Brosgart CL. Prevalence of chronic hepatitis B among foreign-born persons living in the United States by country of origin. *Hepatology* 2012;56(2):422-33.
10. LeFevre ML, on behalf of the U.S. Preventive Services Task Force. Screening for hepatitis B virus infection in nonpregnant adolescents and adults: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med*. 2014;161(1):58-66.
11. Centers for Disease Control and Prevention. Recommendations for identification and public health management of persons with chronic hepatitis B virus infection. *MMWR*. 2008;57(RR-08):1-18.
12. Spradling PR, Rupp LB, Moorman AC, Lu M, Teshale EH, Gordon SC, et al. Hepatitis B and C virus infection among 1.2 million persons with access to care: factors associated with testing and infection prevalence. *Clin Infect Dis*. 2012;55(8):1047-55.
13. Zibbell JE, Asher AK, Patel RC, Kupronis B, Iqbal K, Ward JW, Holtzman D. Increases in Acute Hepatitis C Virus Infection Related to a Growing Opioid Epidemic and Associated Injection Drug Use, 2004 to 2014. *Amer J Public Health*. 2018 Feb;108(2):175-81. doi: 10.2105/AJPH.2017.304132. Epub 2017 Dec 21.
14. Increases in Hepatitis C Virus Infection Related to Injection Drug Use Among Persons Aged  $\leq 30$  Years — Kentucky, Tennessee, Virginia, and West Virginia, 2006–2012. *MMWR*. May 8, 2015 / 64(17);453-458.
15. Centers for Disease Control and Prevention. Hepatitis C virus infection among adolescents and young adults: Massachusetts, 2002-2009. *MMWR*. 2011;60(17):537-
16. Suryaprasad AG, White JZ, Xu F, Eichler B, Hamilton J, Patel A, et al. Emerging epidemic of hepatitis C virus among young non-urban persons who inject drugs in the United States, 2006-2011. *Clin Infect Dis*. 2014;59(10):1411-19.

17. Edlin BR, Eckhardt BJ, Shu MA, Holmberg SD, Swan T. Toward a more accurate estimate of the prevalence of hepatitis C in the United States. *Hepatology*. 2015 Nov;62(5):1353-63.
18. Ly KN, Xing J, Klevens RM, Jiles RB, Ward JW, Holmberg SD. The increasing burden of mortality from viral hepatitis in the United States between 1999 and 2007. *Ann Intern Med*. 2012;156(4):271-8.
19. Mahajan R, Xing J, Liu SJ, Ly KN, Moorman AC, Rupp LB, et al. Mortality among persons in care with hepatitis C virus infection: the Chronic Hepatitis Cohort Study (CheCS), 2006-2010. *Clin Infect Dis*. 2014;58(8):1055-61.
20. Ly KN, Hughes EM, Jiles RB, Holmberg SD. Rising mortality associated with hepatitis C virus in the United States. *Clin Infect Dis* 2016;62:1287-1288. Available at: <https://academic.oup.com/cid/article/62/10/1287/2462772/Rising-Mortality-Associated-With-Hepatitis-C-Virus>. Accessed on January 29, 2017.
21. American Association for the Study of Liver Diseases (AASLD) and the Infectious Diseases Society of America (IDSA). Recommendations for testing, management, and treating hepatitis C. HCV testing and linkage to care. Available at: <http://www.hcvguidelines.org>.
22. Holmberg SD, Spradling PR, Moorman AC, Denniston MM. Hepatitis C in the United States. *N Engl J Med* 2013;368(20):1859-61.
23. Moyer VA, on behalf of the U.S. Preventive Services Task Force. Screening for hepatitis C virus infection in adults: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med*. 2013;159(5):349-57.
24. Centers for Disease Control and Prevention. Prevention of hepatitis A through active or passive immunization: recommendations of the Advisory Committee on Immunization Practices. *MMWR*. 1996;45(RR-15):1-30.
25. Centers for Disease Control and Prevention. Prevention of hepatitis A through active or passive immunization: recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR*. 1999;48(RR-12):1-37.
26. Centers for Disease Control and Prevention. Use of hepatitis B vaccination for adults with diabetes mellitus: recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR*. 2011;60(50):1709-11.
27. McMahon BJ, Alward WL, Hall DB, Heyward WL, Bender TR, Francis DP, et al. Acute hepatitis B virus infection: relation of age to the clinical expression of disease and subsequent development of the carrier state. *J Infect Dis*. 1985;151(4):599-603.
28. Centers for Disease Control and Prevention. A comprehensive immunization strategy to eliminate transmission of hepatitis B virus infection in the United States: recommendations of the Advisory Committee on Immunization Practices (ACIP) part 1: immunization of infants, children, and adolescents. *MMWR*. 2005;54(RR-16):1-31.
29. Centers for Disease Control and Prevention. A comprehensive immunization strategy to eliminate transmission of hepatitis B virus infection in the United States: recommendations of the Advisory Committee on Immunization Practices (ACIP) Part II: immunization of adults. *MMWR*. 2006;55(RR-16):1-33.
30. Centers for Disease Control and Prevention. Prevention of Hepatitis B Virus Infection in the United States: Recommendations of the Advisory Committee on Immunization Practices. *MMWR*. 2018; 67(1);1-31
31. Holmberg SD, Suryaprasad AG, Ward JW. Updated CDC recommendations for the management of hepatitis B virus-infected health-care providers and students. *MMWR*. 2012;61(RR03):1-12.
32. Centers for Disease Control and Prevention. Sexual transmission of hepatitis C virus among HIV-infected men who have sex with men--New York City, 2005-2010. *MMWR*.



2011;60(28):945-50.

33. Tohme RA, Holmberg SD. Is sexual contact a major mode of hepatitis C transmission? *Hepatology*. 2010;52(4):1497-505.

34. Mok J, Pembrey L, Tovo PA, Newell ML, European Paediatric Hepatitis C Virus Network. When does mother to child transmission of hepatitis C virus occur? *Arch Dis Child Fetal Neonatal Ed*. 2005;90(2):F156-60.

35. Alter MJ, Margolis HS, Krawczynski K, Judson, FN, Mares A, Alexander WJ, et al. The natural history of community-acquired hepatitis C in the United States. *N Engl J Med* 1992;327: 1899–1905.

36. Centers for Disease Control and Prevention. Testing for HCV infection: an update of guidance for clinicians and laboratorians. *MMWR*. 2013;62(18):362-5.

37. US Food and Drug Administration. FDA approves rapid test for antibodies to hepatitis C virus. News and Events. Available at: <https://wayback.archive-it.org/7993/20170112215729/http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/2010/ucm217318.htm>.

38. Denniston MM, Jiles RB, Drobeniuc J, Klevens RM, Ward JW, McQuillan GM, 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.

39. Centers for Disease Control and Prevention. Recommendations for the identification of chronic hepatitis C virus infection among persons born during 1945–1965. *MMWR*. 2012;61(RR-04):1-18.

40. Ghany MG, Nelson DR, Strader DB, Thomas DL, Seeff LB, American Association for Study of Liver Diseases. An update on treatment of genotype 1 chronic hepatitis C virus infection: 2011 practice guideline by the American Association for the Study of Liver Diseases. *Hepatology*. 2011;54(4):1433-44.

41. Casey LC, Lee WM. Hepatitis C virus therapy update 2013. *Curr Opin Gastroenterol*. 2013;29(3):243-9.

42. US Food and Drug Administration. FDA approves Sovaldi for chronic hepatitis C. Available at: <http://wayback.archive-it.org/7993/20161022101337/http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm377888.htm>. Accessed on January 29, 2017.

43. Asselah T, Marcellin P. New direct-acting antivirals' combination for the treatment of chronic hepatitis C. *Liver Int*. 2011;31(Suppl 1):68-77.

44. Lin MV, Chung R. Recent FDA approval of sofosbuvir and simeprevir: implications for current HCV treatment. *Clin Liver Dis*. 2014;3(3):65-8.

45. Medications to Treat Hepatitis C – A Timeline. Hepatitis Central. <http://www.hepatitiscentral.com/medications-to-treat-hepatitis-c-a-timeline/>.

46. FDA approves Mavyret for Hepatitis C. Available at <https://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm570038.htm>. Accessed on February 8, 2018.

47. FDA approves two hepatitis C drugs for pediatric patients. Available at <https://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm551407.htm>. Accessed on February 8, 2018.

48. AASLD/IDSA. Recommendations for testing, managing, and treating hepatitis C. Available at: <http://www.hcvguidelines.org/>. Accessed February 6, 2017.



49. National Center for Health Statistics. Mortality data. Accessed December 31, 2016. Available at: <http://www.cdc.gov/nchs/deaths.htm>.

50. World Health Organization. International Classification of Diseases, 10th Revision. Geneva: World Health Organization; 1998.

51. Klein RJ, Schoenborn CA. Age adjustment using the 2000 projected U.S. population. *Healthy People 2010 Stat Notes*. 2001(20):1-10.
52. Ko SC, Fan L, Smith EA, Fenlon N, Koneru AK, Murphy TV. Estimated Annual Perinatal Hepatitis B Virus Infections in the United States, 2000-2009. *J Pediatric Infect Dis Soc*. 2016 Jun;5(2):114-21. doi: 10.1093/jpids/piu115. Epub 2014 Dec 18.
53. Klevens RM, Miller JT, Vonderwahl C, Speers S, Alelis K, Sweet K, et al. Population-based surveillance for hepatitis C virus, United States, 2006-2007. *Emerg Infect Dis*. 2009;15(9):1499-502.

## ADDITIONAL RESOURCES

Epidemiology and Prevention of Vaccine-Preventable Diseases. The Pink Book: Course Textbook.

- Hepatitis A: <http://www.cdc.gov/vaccines/pubs/pinkbook/downloads/hepa.pdf> [PDF - 14  Pages]
- Hepatitis B: <http://www.cdc.gov/vaccines/pubs/pinkbook/downloads/hepb.pdf> [PDF - 24  Pages]


Prevention of Hepatitis A through Active or Passive Immunization: Recommendations of the Advisory Committee on Immunization Practices (ACIP):

<http://www.cdc.gov/mmwr/pdf/rr/rr5507.pdf> [PDF - 30 Pages] 

Prevention of Hepatitis B Virus Infection in the United States: Recommendations of the Advisory Committee on Immunization Practices:

<https://www.cdc.gov/mmwr/volumes/67/rr/pdfs/rr6701-H.pdf> [PDF – 36 Pages] 

Recommendations for Identification and Public Health Management of Persons with Chronic Hepatitis B Virus Infection: <http://www.cdc.gov/mmwr/pdf/rr/rr5708.pdf> [PDF - 28 Pages] 

Recommendations for Prevention and Control of Hepatitis C Virus (HCV) Infection and HCV-Related Chronic Disease: <http://www.cdc.gov/mmwr/PDF/RR/RR4719.pdf> [PDF - 54 Pages] 

2005 Guidelines for Viral Hepatitis Surveillance and Case Management:

<http://www.cdc.gov/hepatitis/PDFs/2005Guidlines-Surv-CaseMngmt.pdf> 