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Recommendations for Prevention and Control of Hepatitis C Virus (HCV) Infection and HCV-Related Chronic Disease

The following article includes excerpts from the MMWR article with the above title (1998;47[No. RR-19]:1-38). The full article contains patient education information not included here. If you would like to receive a copy of the entire MMWR article, you may call the Office of Epidemiology at 804/786-6261 or visit the Centers for Disease Control and Prevention web site at http://www.cdc.gov.

Introduction

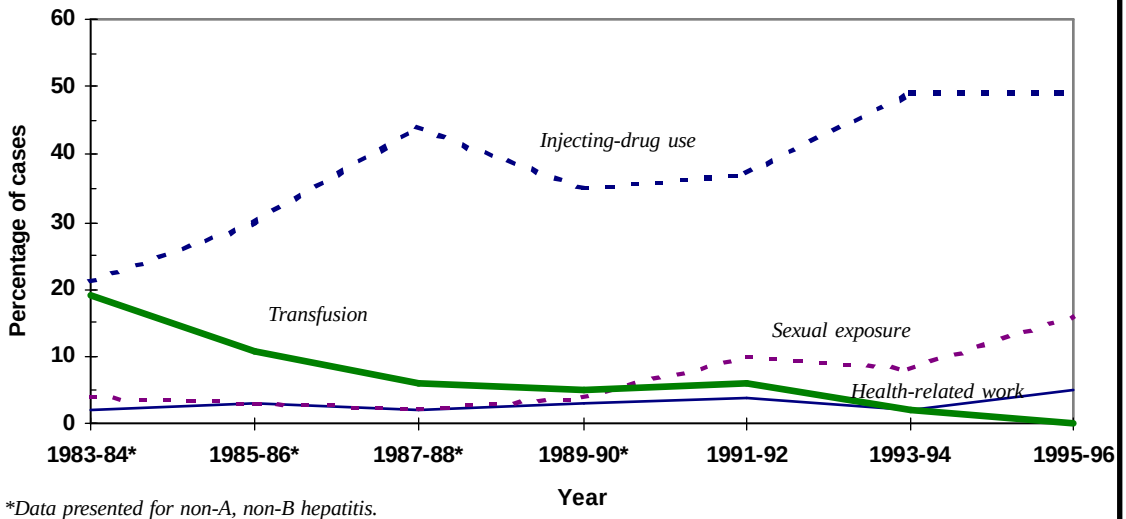
Hepatitis C virus (HCV) infection is the most common chronic bloodborne infection in the United States. Centers for Disease Control and Prevention (CDC) staff estimate that during the 1980s, an average of 230,000 new infections occurred each year. Although since 1989 the annual number of new infections has declined by >80% to 36,000 by 1996, an estimated 3.9 million (1.8%) Americans have been infected with HCV. Most of these persons are chronically infected and might not be aware of their infection because they are not clinically ill. Infected persons serve as a source of transmission to others and are at risk for chronic liver disease or other HCV-related chronic diseases during the first two or more decades following initial infection.

Chronic liver disease is the tenth leading cause of death among adults in the United States, and accounts for approximately 25,000 deaths annually, or approximately 1% of all deaths. Population-based studies indicate that 40% of chronic liver disease is HCV-related, resulting in an estimated 8,000-10,000 deaths each year. Current estimates of medical and work-loss costs of HCV-related acute and chronic liver disease are >$600 million annually, and HCV-associated end-stage liver disease is the most frequent indication for liver transplantation among adults. Because most HCV-infected persons are aged 30-49 years, the number of deaths attributable to HCV-related chronic liver disease could increase substantially during the next 10-20 years as this group of infected persons reaches ages at which complications from chronic liver disease typically occur.

HCV is transmitted primarily through large or repeated direct percutaneous exposures to blood. In the United States, the relative importance of the two most common exposures associated with transmission of HCV, blood transfusion and injecting-drug use, has changed over time (Figure 1). Blood transfusion, which accounted for a substantial proportion of HCV infections acquired >10 years ago, rarely accounts for recently acquired infections. In contrast, injecting-drug use consistently has accounted for a substantial proportion of HCV infections and currently accounts for 60% of HCV transmission in the United States.

Reducing the burden of HCV infection and HCV-related disease in the United States requires implementation of primary prevention activities to reduce the risk for contracting HCV infection and secondary prevention activities to reduce the risk for liver and other chronic diseases in HCV-infected persons. The recommendations contained in this re-

Figure 1. Reported cases of acute hepatitis C by selected risk factors, United States, 1983-1996



**Data presented for non-A, non-B hepatitis.*
Source: Centers for Disease Control and Prevention.

port were developed by reviewing currently available data and are based on the opinions of experts. These recommendations provide broad guidelines for a) the prevention of transmission of HCV; b) the identification, counseling, and testing of persons at risk for HCV infection; and c) the appropriate medical evaluation and management of HCV-infected persons.

Epidemiology

Demographic Characteristics

HCV infection occurs among persons of all ages, but the highest incidence of acute hepatitis C is found among persons aged 20-39 years, and males predominate slightly. African Americans and whites have similar incidence of acute disease; persons of Hispanic ethnicity have higher rates. In the general population, the highest prevalence rates of HCV infection are found among persons aged 30-49 years and among males. Unlike the racial/ethnic pattern of acute disease, African Americans have a substantially higher prevalence of HCV infection than do whites.

Table 1. Estimated average prevalence of hepatitis C virus (HCV) infection in the United States by various characteristics and estimated prevalence of persons with these characteristics in the population

Characteristic	HCV-infection prevalence		Prevalence of persons with characteristic, %
	%	(range, %)	
Persons with hemophilia treated with products made before 1987	87	(74-90)	<0.01
Injecting-drug users			
current	79	(72-86)	0.5
history of prior use	No Data		5
Persons with abnormal alanine aminotransferase levels	15	(10-18)	5
Chronic hemodialysis patients	10	(0-64)	0.1
Persons with multiple sex partners (lifetime)			
≥50	9	(6-16)	4
10-49	3	(3-4)	22
2-9	2	(1-2)	52
Persons reporting a history of sexually transmitted diseases	6	(1-10)	17
Persons receiving blood transfusions before 1990	6	(5-9)	6
Infants born to infected mothers	5	(0-25)	0.1
Men who have sex with men	4	(2-18)	5
General population	1.8	(1.5-2.3)	NA*
Health-care workers	1	(1-2)	9
Pregnant women	1	--	1.5
Military personnel	0.3	(0.2-0.4)	0.5
Volunteer blood donors	0.16	--	5

**Not applicable.*

Transmission Modes

Most risk factors associated with transmission of HCV in the United States were identified in case-control studies conducted during 1978-1986. These risk factors included blood transfusion, injecting-drug use, employment in patient care or clinical laboratory work, exposure to a sex partner or household member who has had a history of hepatitis, exposure to multiple sex partners, and low socioeconomic level.

Transfusions and Transplants. Currently, HCV is rarely transmitted by blood transfusion. During 1985-1990, cases of transfusion-associated non-A, non-B hepatitis declined by >50% because of screening policies that excluded donors with human immunodeficiency virus (HIV) infection and donors with surrogate markers for non-A, non-B hepatitis. By 1990, risk for transfusion-associated HCV infection was approximately 1.5% per recipient or approximately 0.02% per unit transfused. During May 1990, routine testing of donors for evidence of HCV infection was initiated, and during July 1992, more sensitive multiantigen testing was implemented, reducing further the risk for infection to 0.001% per unit transfused.

Receipt of clotting factor concentrates prepared from plasma pools posed a high risk for HCV infection until effective procedures to inactivate viruses, including HCV, were introduced during 1985 (Factor VIII) and 1987 (Factor IX). Persons with hemophilia who were treated with products before inactivation of those products have prevalence rates of HCV infection as high as 90% (Table 1). Although plasma derivatives (e.g., albumin and immune globulin [IG] for intramuscular [IM] administration) have not been associated with transmission of HCV infection in the United States, intravenous (IV) IG that was not virally inactivated was the source of one outbreak of hepatitis C during 1993-1994. Since December 1994, all IG products, IV and IM, commercially available in the United States must undergo an inactivation procedure or be negative for HCV RNA (ribonucleic acid) before release.

Transplantation of organs (e.g., heart, kidney, or liver) from infectious donors to the organ recipient also carried a high risk for transmitting HCV infection before donor screening. Limited studies of recipients of transplanted tissue have implicated transmission of HCV only from nonirradiated bone tissue of unscreened donors. As with blood-donor screening, use of anti-HCV-negative organ and tissue donors has virtually eliminated risks for HCV transmission from transplantation.

Injecting and Other Illegal Drug Use. Although the number of cases of acute hepatitis C among injecting-drug users has declined dramatically since 1989, both incidence and prevalence of HCV infection remain high in this group. Injecting-drug use currently accounts for most HCV transmission in the United States, and has accounted for a substantial proportion of HCV infections during past decades. Many persons with chronic HCV infection might have acquired their infection 20-30 years ago as a result of limited or occasional illegal drug injecting. Injecting-drug use leads to HCV transmission in a manner similar to that for other bloodborne pathogens (i.e., through transfer of HCV-infected blood by sharing syringes and needles either directly or through contamination of drug preparation equipment). However, HCV infection is acquired more rapidly after initiation of injecting than other viral infections (i.e., hepatitis B virus [HBV] and HIV), and rates of HCV infection among young injecting-drug users are four times higher than rates of HIV infection. After 5 years of injecting, as many as 90% of users are infected with HCV. More rapid acquisition of HCV infection compared with other viral infections among injecting-drug users is likely caused by high prevalence

of chronic HCV infection among injecting-drug users, which results in a greater likelihood of exposure to an HCV-infected person.

Nosocomial and Occupational Exposures. Nosocomial transmission of HCV is possible if infection-control techniques or disinfection procedures are inadequate and contaminated equipment is shared among patients. Although reports from other countries do document nosocomial HCV transmission, such transmission rarely has been reported in the United States, other than in chronic hemodialysis settings. Prevalence of antibody to HCV (anti-HCV) positivity among chronic hemodialysis patients averages 10%, with some centers reporting rates >60%. Both incidence and prevalence studies have documented an association between anti-HCV positivity and increasing years on dialysis, independent of blood transfusion. These studies, as well as investigations of dialysis-associated outbreaks of hepatitis C, indicate that HCV transmission might occur among patients in a hemodialysis center because of incorrect implementation of infection-control practices, particularly sharing of medication vials and supplies.

Health-care, emergency medical (e.g., emergency medical technicians and paramedics), and public safety workers (e.g., fire-service, law-enforcement, and correctional facility personnel) who have exposure to blood in the workplace are at risk for being infected with bloodborne pathogens. However, prevalence of HCV infection among health-care workers, including orthopedic, general, and oral surgeons, is no greater than the general population, averaging 1%-2%, and is 10 times lower than that for HBV infection. In a single study that evaluated risk factors for infection, a history of unintentional needle-stick injury was the only occupational risk factor independently associated with HCV infection.

The average incidence of anti-HCV seroconversion after unintentional needle sticks or sharps exposures from an HCV-positive source is 1.8% (range: 0%-7%), with one study reporting that transmission occurred only from hollow-bore needles compared with other sharps. A study from Japan reported an incidence of HCV infection of 10% based on detection of HCV RNA by reverse transcriptase polymerase chain reaction (RT-PCR). Although no incidence studies have documented transmission associated with mucous membrane or nonintact skin exposures, transmission of HCV from blood splashes to the conjunctiva have been described.

The risk for HCV transmission from an infected health-care worker to patients appears to be very low. One published report exists of such transmission during performance of exposure-prone invasive procedures. That report, from Spain, described HCV transmission from a cardiothoracic surgeon to five patients, but did not identify factors that might have contributed to transmission. Although factors (e.g., virus titer) might be related to transmission of HCV, no methods exist currently that can reliably determine infectivity, nor do data exist to determine threshold concentration of virus required for transmission.

Percutaneous Exposures in Other Settings. In other countries, HCV infection has been associated with folk medicine practices, tattooing, body piercing, and commercial barbering. However, in the United States, case-control studies have reported no association between HCV infection and these types of exposures. In addition, of patients with acute hepatitis C who were identified in CDC's sentinel counties viral hepatitis surveillance system during the past 15 years and who denied a history of injecting-drug use, only 1% reported a history of tattooing or ear piercing, and none reported a history of acupuncture. Among injecting-drug users, frequency of tattooing and ear piercing also was uncommon.

Although any percutaneous exposure has the potential for transferring infectious blood and potentially transmitting bloodborne pathogens, no data exist in the United States indicating that persons with exposures to tattooing and body piercing alone are at increased risk for HCV infection. Further studies are needed to determine if these types of exposures and settings in which they occur (e.g.,

Reporting Hepatitis C in Virginia

Cases of acute hepatitis C should be reported to the local health department by physicians and persons in charge of medical facilities. The health department applies the following CDC criteria to determine whether the reported case meets the surveillance definition for acute illness.

Clinical case definition: an acute illness with a) discrete onset of symptoms and b) jaundice or elevated serum aminotransferase levels

Laboratory criteria:

1. Serum aminotransferases (ALT, AST) >2.5 times the upper limit of normal, and
2. IgM anti-HAV negative, and
3. IgM anti-HBc negative (if done) or HbsAg negative, and
4. Anti-HCV positive, verified by a supplemental test

Comments:

1. Persons who have chronic hepatitis or persons identified as anti-HCV positive should not be reported as having acute viral hepatitis unless they have evidence of an acute illness compatible with viral hepatitis.

2. Available serologic tests for anti-HCV do not distinguish between acute and chronic infection. Thus, other causes of acute hepatitis should be excluded for anti-HCV positive patients who have an acute illness compatible with viral hepatitis.

correctional institutions, unregulated commercial establishments), are risk factors for HCV infection in the United States.

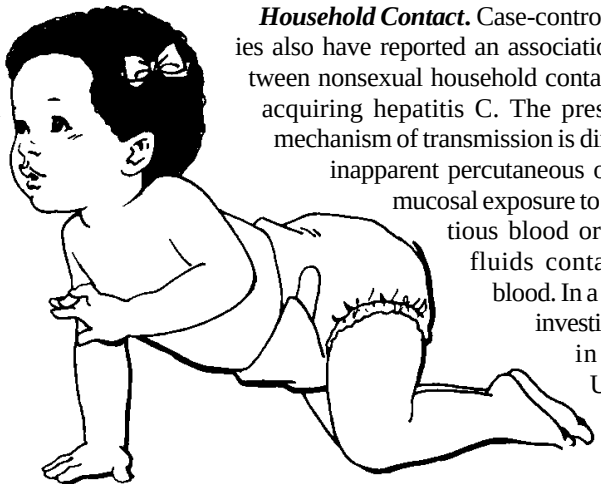
Sexual Activity. Case-control studies have reported an association between exposure to a sex contact with a history of hepatitis or exposure to multiple sex partners and acquiring hepatitis C. In addition, 15%-20% of patients with acute hepatitis C who have been reported to CDC's sentinel counties surveillance system, have a history of sexual exposure in the absence of other risk factors. Two thirds of these have an anti-HCV-positive sex partner, and one third reported >2 partners in the 6 months before illness.

In contrast, a low prevalence of HCV infection has been reported by studies of long-term spouses of patients with chronic HCV infection who had no other risk factors for infection. Five of these studies have been conducted in the United States, involving 30-85 partners each, in which average prevalence of HCV infection was 1.5% (range: 0% to 4.4%). Among partners of persons with hemophilia coinfected with HCV and HIV, two studies have reported an average prevalence of HCV infection of 3%. One additional study evaluated potential transmission of HCV between sexually transmitted disease (STD) clinic patients who denied percutaneous risk factors and their steady partners. Prevalence of HCV infection among male patients with an anti-HCV-positive female partner (7%) was no different than that among males with a negative female partner (8%). However, female patients with an anti-HCV-positive partner were almost fourfold more likely to have HCV infection than females with a negative male partner (10% versus 3%, respectively). These data indicate that, similar to other bloodborne viruses, sexual transmission of HCV from males to females might be more efficient than from females to males.

Among persons with evidence of high-risk sexual practices (e.g., patients attending STD clinics and female prostitutes) who denied a history of injecting-drug use, prevalence of anti-HCV has been found to average 6% (range: 1%-10%). Specific factors associated with anti-HCV positivity for both heterosexuals and men who have sex with men (MSM) included greater numbers of sex partners, a history of prior STDs, and failure to use a condom. However, the number of partners associated with infection risk varied among studies, ranging from >1 partner in the previous month to >50 in the previous year. In studies of other populations, the number of partners associated with HCV infection also varied, ranging from >2 partners in the 6 months before illness for persons with acute hepatitis C, to ≥5 partners/year for HCV-infected volunteer blood donors, to ≥10 lifetime partners for HCV-infected persons in the general population.

Only one study has documented an association between HCV infection and MSM activity, and at least in STD clinic settings, the prevalence rate of HCV infection among MSM generally has been similar to that of heterosexuals. Because sexual transmission of bloodborne viruses is recognized to be more efficient among MSM compared with heterosexual men and women, why HCV infection rates are not substantially higher among MSM compared with heterosexuals is unclear. This observation and the low prevalence of HCV infection observed among long-term spouses of persons with chronic HCV infection have raised doubts regarding the importance of sexual activity in transmission of HCV. Unacknowledged percutaneous risk factors (i.e., illegal injecting-drug use) might contribute to increased risk for HCV infection among persons with high-risk sexual practices.

Although considerable inconsistencies exist among studies, data indicate overall that sexual transmission of HCV appears to occur, but that the virus is inefficiently spread through this manner. More data are needed to determine the risk for, and factors related to, transmission of HCV between long-term steady partners as well as among persons with high-risk sexual practices, including whether other STDs promote transmission of HCV by influencing viral load or modifying mucosal barriers.



Household Contact. Case-control studies also have reported an association between nonsexual household contact and acquiring hepatitis C. The presumed mechanism of transmission is direct or inapparent percutaneous or permucosal exposure to infectious blood or body fluids containing blood. In a recent investigation in the United States,

an HCV-infected mother transmitted HCV to her hemophilic child during performance of home infusion therapy, presumably when she had an unintentional needle stick and subsequently used the contaminated needle in the child.

Although prevalence of HCV infection among nonsexual household contacts of persons with chronic HCV infection in the United States is unknown, HCV transmission to such contacts is probably uncommon. In studies from other countries of nonsexual household contacts of patients with chronic hepatitis C, average anti-HCV prevalence was 4%. Although infected contacts in these studies reported no other commonly recognized risk factors for hepatitis C, most of these studies were done in countries where exposures commonly experienced in the past from contaminated equipment used in traditional and nontraditional medical procedures might have contributed to clustering of HCV infections in families.

Perinatal. The average rate of HCV infection among infants born to HCV-positive, HIV-negative women is 5%-6% (range: 0%-25%), based on detection of anti-HCV and HCV RNA, respectively. The average infection rate for infants born to women coinfected with HCV and HIV is higher, 14% (range: 5%-36%) and 17%, based on detection of anti-HCV and HCV RNA, respectively. The only factor consistently found to be associated with transmission has been the presence of HCV RNA in the mother at the time of birth. Although two studies of infants born to HCV-positive, HIV-negative women reported an association with titer of HCV RNA, each study reported a different level of HCV RNA related to transmission. Studies of HCV/HIV-coinfected women more consistently have indicated an association between virus titer and transmission of HCV.

Data regarding the relationship between delivery mode and HCV transmission are limited and presently indicate no difference in infection rates between infants delivered vaginally compared with cesarean-delivered infants. The transmission of HCV infection through breast milk has not been documented. In the studies that have evaluated breastfeeding in infants born to HCV-infected women, average rate of infection was 4% in both breastfed and bottle-fed infants.

Diagnostic criteria for perinatal HCV infection have not been established. Various anti-HCV patterns have been observed in both infected and uninfected infants of anti-HCV-positive mothers. Passively acquired maternal antibody might persist for months, but probably not for >12 months. HCV RNA can be detected as early as 1 to 2 months.

Persons with No Recognized Source for Their Infection. Recent studies have demonstrated that injecting-drug use currently accounts for 60% of HCV transmission in the United States. Although the role of sexual activity in transmission of HCV remains unclear, ≤20% of persons with HCV infection report sexual exposures (i.e., exposure to an infected sexual partner or to multiple partners) in the absence of percutaneous risk factors. Other known exposures (occupational, hemodialysis, household, perinatal) together account for approximately 10% of infections. Thus, a potential risk factor can be identified for approximately 90% of persons with HCV infection. In the remaining 10%, no recognized source of infection can be identified, although most persons in this category are associated with low socioeconomic level. Although low socioeconomic level has been associated with several infectious diseases and might be a surrogate for high-risk exposures, its nonspecific nature makes targeting prevention measures difficult.

Clinical Features and Natural History

Acute HCV Infection

Persons with acute HCV infection typically are either asymptomatic or have a mild clinical illness; 60%-70% have no discernible symptoms; 20%-30% might have jaundice; and 10%-20% might have nonspecific symptoms (e.g., anorexia, malaise, or abdominal pain). Clinical illness in patients with acute hepatitis C who seek medical care is similar to that of other types of viral hepatitis, and serologic testing is necessary to determine the etiology of hepatitis in an individual patient. In ≤20% of these patients, onset of symptoms might precede anti-HCV seroconversion. Average time period from exposure to symptom onset is 6-7 weeks, whereas average time period from exposure to seroconversion is 8-9 weeks. Anti-HCV can be detected in 80% of patients within 15 weeks of exposure, in ≥90% within 5 months after exposure, and in ≥97% by 6 months after exposure. Rarely, seroconversion might be delayed until 9 months after exposure.

The course of acute hepatitis C is variable, although elevations in serum alanine aminotransferase (ALT) levels, often in a fluctuating pattern, are its most characteristic feature. Normalization of ALT levels might occur and suggests full recovery, but this is frequently followed by ALT elevations that indicate progression to chronic disease. Fulminant hepatic failure following acute hepatitis C is rare.

Chronic HCV Infection

After acute infection, 15%-25% of persons appear to resolve their infection without sequelae as defined by sustained absence of HCV RNA in serum and normalization of ALT levels. Chronic HCV infection develops in most persons (75%-85%), with persistent or fluctuating ALT elevations indicating active liver disease developing in 60%-70% of chronically infected persons. In the remaining 30%-40% of chronically infected persons, ALT levels are normal. No clinical or epidemiologic features among patients with acute infection have been found to be predictive of either persistent infection or chronic liver disease. Moreover, various ALT patterns have been observed in these patients during follow-up, and patients might have prolonged periods (≥12 months) of normal ALT activity even though they have histologic-confirmed chronic hepatitis. Thus, a single ALT determination cannot be used to exclude ongoing hepatic injury, and long-term follow-up of patients with HCV infection is required to determine their clinical outcome or prognosis.

The course of chronic liver disease is usually insidious, progressing at a slow rate without symptoms or physical signs in the majority of patients during the first two or more decades after infection. Frequently, chronic hepatitis C is not recognized until asymptomatic persons are identified as HCV-positive during blood-donor screening, or elevated ALT levels are detected during routine physical examinations. Most studies have reported

that cirrhosis develops in 10%-20% of persons with chronic hepatitis C over a period of 20-30 years, and hepatocellular carcinoma (HCC) in 1%-5%, with striking geographic variations in rates of this disease. However, when cirrhosis is established, the rate of development of HCC might be as high as 1%-4% per year. In contrast, a study of >200 women 17 years after they received HCV-contaminated Rh factor IG reported that only 2.4% had evidence of cirrhosis and none had died. Thus, longer term follow-up studies are needed to assess lifetime consequences of chronic hepatitis C, particularly among those who acquired their infection at young ages.

Although factors predicting severity of liver disease have not been well-defined, recent data indicate that increased alcohol intake, being aged >40 years at infection, and being male are associated with more severe liver disease. In particular, among persons with alcoholic liver disease and HCV infection, liver disease progresses more rapidly; among those with cirrhosis, a higher risk for development of HCC exists. Furthermore, even intake of moderate amounts (>10 g/day) of alcohol in patients with chronic hepatitis C might enhance disease progression. More severe liver injury observed in persons with alcoholic liver disease and HCV infection possibly is attributable to alcohol-induced enhancement of viral replication or increased susceptibility of cells to viral injury. In addition, persons who have chronic liver disease are at an increased risk for fulminant hepatitis A.

Extrahepatic manifestations of chronic HCV infection are considered to be of immunologic origin and include cryoglobulinemia, membranoproliferative glomerulonephritis, and porphyria cutanea tarda. Other extrahepatic conditions have been reported, but definitive associations of these conditions with HCV infection have not been established. These include seronegative arthritis, Sjögren syndrome, autoimmune thyroiditis, lichen planus, Mooren corneal ulcers, idiopathic pulmonary fibrosis (Hamman-Rich syndrome), polyarteritis nodosa, aplastic anemia, and B-cell lymphomas.

Primary Prevention Recommendations

Primary prevention activities can reduce or eliminate potential risk for HCV transmission from a) blood, blood components, and plasma derivatives; b) high-risk activities such as injecting-drug use and sex with multiple partners; and c) percutaneous exposures to blood in health care and other settings. Immunization against HCV is not available; therefore, identifying persons at risk but not infected with HCV provides opportunity for counseling on how to reduce their risk for becoming infected.

Blood, Plasma Derivatives, Organs, Tissues, and Semen

Current practices that exclude blood, plasma, organ, tissue, or semen donors determined to be at increased risk for HCV by history or who have serologic markers for HCV infection must be maintained to prevent HCV transmission from transfusions and transplants. Viral inactivation of clotting factor concentrates and other products derived from human plasma, including IG products, also must be continued, and all plasma-derived products that do not undergo viral inactivation should be HCV RNA negative by RT-PCR before release.

High-Risk Drug and Sexual Practices

Health-care professionals in all patient care settings routinely should obtain a history that inquires about use of illegal drugs (injecting and noninjecting) and evidence of high-risk sexual practices (e.g., multiple sex partners or a history of STDs). Primary prevention of illegal drug injecting will eliminate the greatest risk factor for HCV infection in the United States. Although consistent data are lacking regarding the extent to which sexual activity contributes to HCV transmission, persons having multiple sex partners are at risk for STDs (e.g., HIV, HBV, syphilis, gonorrhea, and chlamydia). Counseling and education to prevent initiation of drug-injecting or high-risk sexual practices is important, especially for adolescents. Persons who inject drugs or who are at risk for STDs should be counseled regarding what they can do to minimize their risk for becoming infected or of transmitting infectious agents to others, including need for vaccination against hepatitis B. Injecting and noninjecting illegal drug users and sexually active MSM also should be vaccinated against hepatitis A.

Based on the findings of multiple studies, syringe and needle-exchange programs can be an effective part of a comprehensive strategy to reduce the incidence of bloodborne virus transmission and do not encourage the use of illegal drugs. Therefore, to reduce the risk for HCV infection among injecting-drug users, local communities can consider implementing syringe and needle-exchange programs.

Percutaneous Exposures to Blood in Health Care and Other Settings

Health-Care Settings

Health-care, emergency medical, and public safety workers should be educated regarding risk for and prevention of bloodborne infections, including the need to be vaccinated against hepatitis B. Standard barrier precautions and engineering controls should be implemented to prevent exposure to blood. Protocols should be in place for reporting and follow-up of percutaneous or permucosal exposures to blood or body fluids that contain blood.

Health-care professionals responsible for overseeing patients receiving home infusion therapy should ensure that patients and their families (or caregivers) are informed of potential risk for infection with bloodborne pathogens, and should assess their ability to use adequate infection-control practices consistently. Patients and families should receive training with a standardized curriculum that includes appropriate infection-control procedures, and these procedures should be evaluated regularly through home visits.

Currently, no recommendations exist to restrict professional activities of health-care workers with HCV infection. As recommended for all health-care workers, those who are HCV-positive should follow strict aseptic technique and standard precautions, including appropriate use of hand washing, protective barriers, and care in the use and disposal of needles and other sharp instruments.

In chronic hemodialysis settings, intensive efforts must be made to educate new staff and reeducate existing staff regarding hemodialysis-specific infection-control practices that prevent transmission of HCV and other bloodborne pathogens. Hemodialysis-center precautions are more stringent than standard precautions. Standard precautions require use of gloves only when touching blood, body fluids, secretions, excretions, or contaminated items. In contrast, hemodialysis-center precautions require glove use whenever patients or hemodialysis equipment is touched. Standard precautions do not restrict use of supplies, instruments, and medications to a single patient; hemodialysis-center precautions specify that none of these

items be shared among any patients. Thus, appropriate use of hemodialysis-center precautions should prevent transmission of HCV among chronic hemodialysis patients, and isolation of HCV-positive patients is not necessary or recommended.

Other Settings

Persons who are considering tattooing or body piercing should be informed of potential risks of acquiring infection with bloodborne and other pathogens through these procedures. These procedures might be a source of infection if equipment is not sterile or if the artist or piercer does not follow other proper infection-control procedures (e.g., washing hands, using latex gloves, and cleaning and disinfecting surfaces).

Secondary Prevention Recommendations

Secondary prevention activities can reduce risks for chronic disease by identifying HCV-infected persons through diagnostic testing and by providing appropriate medical management and antiviral therapy. Because of the number of persons with chronic HCV infection, identification of these persons must be a major focus of current prevention programs. Identification of persons at risk for HCV infection provides opportunity for testing to determine their infection status, medical evaluation to determine their disease status if infected, and antiviral therapy, if appropriate. Identification also provides infected persons opportunity to obtain information concerning how they can prevent further harm to their liver and prevent transmitting HCV to others.

Persons for Whom Routine HCV Testing Is Recommended

Testing should be offered routinely to persons most likely to be infected with HCV who might require medical management, and testing should be accompanied by appropriate counseling and medical follow-up. In addition, persons who wish to know or are concerned about their HCV-infection status should be provided the opportunity for counseling, testing, and appropriate follow-up.

- Persons who ever injected illegal drugs, including those who injected once or a few times many years ago and do not consider themselves as drug users;
- Persons with selected medical conditions including:
  – persons who received clotting factor concentrates produced before 1987
  – persons who were ever on chronic hemodialysis
  – persons with persistently abnormal ALT levels (above the upper limit of normal on at least two occasions)
  – persons with other evidence of liver disease identified by abnormal serum aspartate aminotransferase (AST) levels;
- Persons who received blood or blood components from donors who subsequently tested positive for anti-HCV using a licensed multiantigen assay: These persons should be notified according to guidelines issued by the Food and Drug Administration (FDA) (http://www.fda.gov/cber/gdlns/gmphcv.txt).
- Persons who received a transfusion of blood or blood components (including platelets, red cells, washed cells, and fresh frozen plasma) or a solid-organ transplant (e.g., heart, lung, kidney, or liver) before July 1992;
- Health-care, emergency medical, and public safety workers after needle sticks, sharps, or mucosal exposures to HCV-positive blood: Individual institutions should establish policies and procedures for HCV testing of persons after percutaneous or permucosal exposures to blood and ensure that all personnel are familiar with these policies and procedures. Health-care professionals who provide care to persons exposed to HCV in the occupational setting should be knowledgeable regarding the risk for HCV infection and appropriate counseling, testing, and medical follow-up. IG and antiviral agents are not recommended for postexposure prophylaxis of hepatitis C. Limited data indicate that antiviral therapy might be beneficial when started early in the course of HCV infection, but no guidelines exist for administration of therapy during the acute phase of infection. When HCV infection is identified early, the individual should be referred for medical management to a specialist knowledgeable in this area.
- Children born to HCV-positive women: IG and antiviral agents are not recommended for postexposure prophylaxis of infants born to HCV-positive women. Testing of infants for anti-HCV should be performed no sooner than age 12 months, when passively transferred maternal anti-HCV declines below detectable levels. If earlier diagnosis of HCV infection is desired, RT-PCR for HCV RNA may be performed at or after the infant's first well-child visit at age 1-2 months. Umbilical cord blood should not be used for diagnosis of perinatal HCV infection because cord blood can be contaminated by maternal blood. If positive for either anti-HCV or HCV RNA, children should be evaluated for the presence or development of liver disease, and those children with persistently elevated ALT levels should be referred to a specialist for medical management.

Persons for Whom Routine HCV Testing is Not Recommended

For the following persons, routine HCV testing is not recommended unless they have risk factors for infection.

- Health care, emergency medical, and public safety workers
- Pregnant women
- Household (nonsexual) contacts of HCV-positive persons

Persons for Whom Routine HCV Testing is of Uncertain Need

- Recipients of transplanted tissue: The risk for HCV transmission from transplanted tissue (e.g., corneal, musculoskeletal, skin, ova, or sperm) appears to be rare.
- Intranasal cocaine and other noninjecting illegal drug users: Currently, the strength of the association between intranasal cocaine use and HCV infection does not support routine testing based solely on this risk factor.
- Persons with a history of tattooing or body piercing: Because no data exist in the United States documenting that persons with a history of such exposures as tattooing and body piercing are at increased risk for HCV infection, routine testing is not recommended based on these exposures alone. In settings having a high proportion of HCV-infected persons and where tattooing and body piercing might be performed in an unregulated manner (e.g., correctional institutions), these types of exposures might be a risk factor for HCV infection.
- Persons with a history of multiple sex partners or STDs: Insufficient data exist to recommend routine testing based on these histories alone.
- Long-term steady sex partners of HCV-positive persons: HCV-positive persons with long-term steady partners do not need to change their sexual practices. Persons with HCV infection should discuss with their partner the need for counseling and testing. If the partner chooses to be tested and tests negative, the couple should be informed of available data regarding risk for HCV transmission by sexual activity to assist them in making decisions about precautions. If the partner tests positive, appropriate counseling and evaluation for the presence or development of liver disease should be provided.

Testing for HCV Infection

Consent for testing should be obtained in a manner consistent with that for other medical care and services provided in the same setting, and should include measures to prevent unwanted disclosure of test results to others. Persons should be provided with information regarding

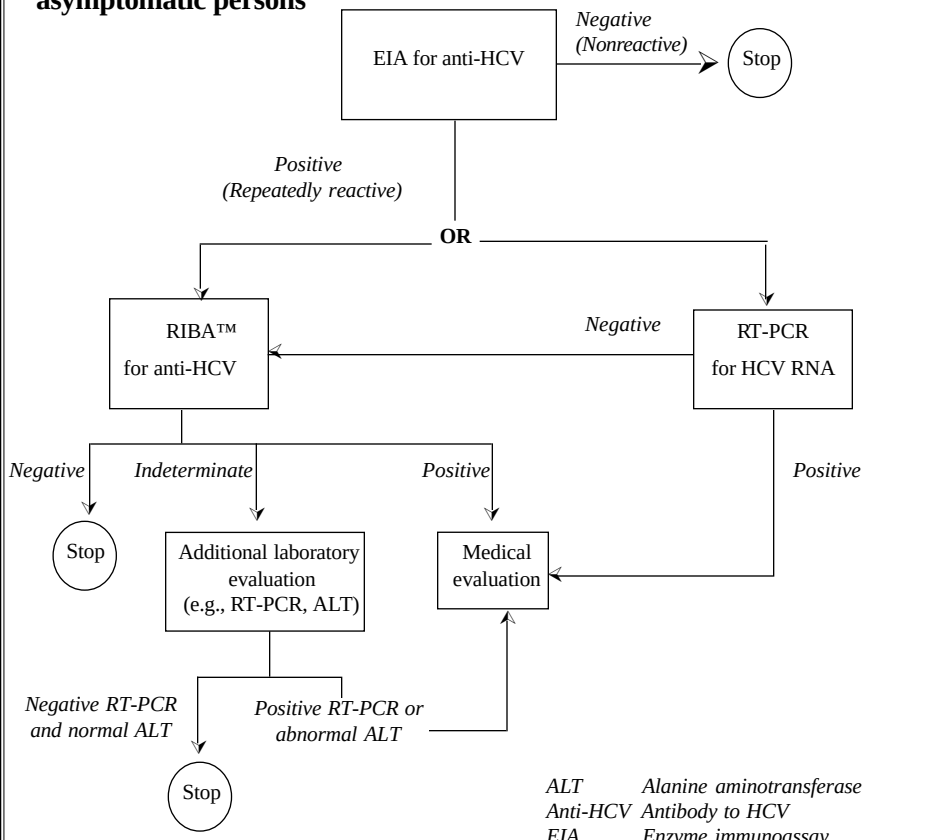
- exposures associated with the transmission of HCV, including behaviors or exposures that might have occurred infrequently or many years ago;
- the test procedures and the meaning of test results;
- the nature of hepatitis C and chronic liver disease;
- the benefits of detecting infection early;
- available medical treatment; and
- potential adverse consequences of testing positive, including disrupted personal relationships and possible discriminatory action (e.g., loss of employment, insurance, and educational opportunities).

Comprehensive information regarding hepatitis C should be provided before testing; however, this might not be practical when HCV testing is performed as part of a clinical work-up or when testing for anti-HCV is required. In these cases, persons should be informed that a) testing for HCV infection will be performed, b) individual results will be kept confidential, and c) appropriate counseling and referral will be offered if results are positive.

The diagnosis of HCV infection can be made by detecting either anti-HCV or HCV RNA (Table 2). Anti-HCV is recommended for routine testing of asymptomatic persons. Testing should include enzyme immunoassay (EIA) and followup of positive EIA results with a supplemental test that is more specific (i.e., recombinant immunoblot assay [RIBA™]) (Figure 1). Supplemental anti-HCV testing confirms the presence of anti-HCV and can be performed on the same serum sample collected for the EIA (i.e., routine serology). Anti-HCV tests do not distinguish between acute, chronic or resolved infection.

Supplemental test results might be reported as positive, negative, or indeterminate. An anti-HCV-positive person is defined as one whose serologic results are EIA-test-positive and supplemental-test-positive. Persons with a negative EIA test result or a positive EIA and a negative supplemental test result are considered uninfected, unless other evidence exists to indicate HCV infection (e.g., abnormal ALT levels in immunocompromised persons or persons with no other etiology for their liver disease). Indeterminate supplemental test results have been observed in recently infected persons who are in the process of seroconversion, as well as in persons chronically infected with HCV. Indeterminate anti-HCV

Figure 1. Hepatitis C virus (HCV) infection testing algorithm for asymptomatic persons



ALT Alanine aminotransferase
Anti-HCV Antibody to HCV
EIA Enzyme immunoassay
RIBA™ Recombinant immunoblot assay
RT-PCR Reverse transcriptase polymerase chain reaction

Table 2. Tests for hepatitis C virus (HCV) infection

Test/Type	Application	Comments
Hepatitis C virus antibody (anti-HCV)		
• EIA (enzyme immunoassay) • Supplemental assay (i.e., recombinant immunoblot assay [RIBA™])	• Indicates past or present infection, but does not differentiate between acute, chronic or resolved infection • All positive EIA results should be verified with a supplemental assay	• Sensitivity ≥97% • EIA alone has low-positive predictive value in low-prevalence populations
HCV RNA (hepatitis C virus ribonucleic acid) **Qualitative tests*†**		
• Reverse transcriptase polymerase chain reaction (RT-PCR) amplification of HCV RNA by in-house or commercial assays (e.g., Amplicor HCV™)	• Detect presence of circulating HCV RNA • Monitor patients on antiviral therapy	• Detect virus as early as 1-2 weeks after exposure • Detection of HCV RNA during course of infection might be intermittent; a single negative RT-PCR is not conclusive • False-positive and false-negative results might occur
Quantitative tests*†		
• RT-PCR amplification of HCV RNA by in-house or commercial assays (e.g., Amplicor HCV Monitor™) • Branched chain DNA§ (bDNA) assays (e.g., Quantiplex™ HCV RNA Assay)	• Determine concentration of HCV RNA • Might be useful for assessing the likelihood of response to antiviral therapy	• Less sensitive than qualitative RT-PCR • Should not be used as a primary test to confirm or exclude diagnosis of HCV infection or to determine treatment endpoint
Genotype*†		
• Several methodologies available (e.g., hybridization, sequencing)	• Group isolates of HCV based on genetic differences, into 6 genotypes and >90 subcultures • With new therapies, length of treatment might vary based on genotype	• Genotype 1 (subtypes 1a and 1b) most common in United States and associated with lower response to antiviral therapy • Genotyping might be warranted among persons with chronic hepatitis C who are being considered for antiviral therapy
Serotype*		
• EIA based on immunoreactivity to synthetic peptides (e.g., Murex HCV Serotyping 1-6 Assay)	• No clinical utility	• Cannot distinguish between subtypes • Dual infections often observed

**Currently not U.S. Food and Drug Administration approved; lack standardization.*
†Samples require special handling (e.g., serum must be separated within 2-4 hours of collection and stored frozen [-20°C or -70°C]; frozen samples should be shipped on dry ice).
§Deoxyribonucleic acid.

results also might indicate a false-positive result, particularly in those persons at low risk for HCV infection. Confirmation or exclusion of HCV infection in a person with indeterminate anti-HCV supplemental test results should be made on the basis of further laboratory testing, which might include repeating the anti-HCV in two or more months or testing for HCV RNA and ALT level.

In clinical settings, use of RT-PCR to detect HCV RNA might be appropriate to confirm the diagnosis of HCV infection (e.g., in patients with abnormal ALT levels or with indeterminate supplemental anti-HCV test results) although RT-PCR assays are not currently FDA-approved. Most RT-PCR assays have a lower limit of detection of 100-1,000 viral genome copies/mL. With adequate optimization of RT-PCR assays, 75%-85% of persons who are anti-HCV-positive and >95% of persons with acute or chronic hepatitis C will test positive for HCV RNA. Some HCV-infected persons might be only intermittently HCV RNA-positive, particularly those with acute hepatitis C or with end-stage liver disease caused by hepatitis C. Detection of HCV RNA by RT-PCR in a person with an anti-HCV-positive result indicates current infection. However, absence of HCV RNA in a person with an anti-HCV-positive result based on EIA testing alone (i.e., without supplemental anti-HCV testing) cannot differentiate between resolved infection and a false-positive anti-HCV test result. In addition, because some persons with HCV infection might experience intermittent viremia, the meaning of a single negative HCV RNA result is difficult to interpret, particularly in the absence of additional clinical information. If HCV RNA is used to confirm anti-HCV results, a separate serum sample will need to be collected. To minimize false-negative results, serum must be separated from cellular components within 2-4 hours after collection, and preferably stored frozen at -20°C or -70°C. If shipping is required, frozen samples should be protected from thawing. Because of assay variability, rigorous quality assurance and control should be in place in clinical laboratories

performing this assay, and proficiency testing is recommended. If the HCV RNA result is negative, supplemental anti-HCV testing should be performed so that the anti-HCV EIA result can be interpreted before the result is reported to the patient.

Clinical Management and Treatment

HCV-positive patients should be evaluated for presence and severity of chronic liver disease. Initial evaluation for presence of disease should include multiple measurements of ALT at regular intervals, because ALT activity fluctuates in persons with chronic hepatitis C. Patients with chronic hepatitis C should be evaluated for severity of their liver disease and for possible treatment.

Antiviral therapy is recommended for patients with chronic hepatitis C who are at greatest risk for progression to cirrhosis. These persons include anti-HCV-positive patients with persistently elevated ALT levels, detectable HCV RNA, and a liver biopsy that indicates either portal or bridging fibrosis or at least moderate degrees of inflammation and necrosis.

In patients with less severe histologic changes, indications for treatment are less clear, and careful clinical follow-up might be an acceptable alternative to treatment with antiviral therapy (e.g., interferon) because progression to cirrhosis is likely to be slow, if it occurs at all. Similarly, patients with compensated cirrhosis (without jaundice, ascites, variceal hemorrhage, or encephalopathy) might not benefit from interferon therapy. Careful assessment should be made, and the risks and benefits of therapy should be thoroughly discussed with the patient.

Patients with persistently normal ALT values should not be treated with interferon outside of clinical trials because treatment might actually induce liver enzyme abnormalities. Patients with advanced cirrhosis who might be at risk for decompensation with therapy and pregnant women also should not be treated. Interferon treatment is not FDA-approved for patients aged <18 years, and more data are needed regarding treatment of persons aged <18 years or >60 years. Treatment of patients who are drinking excessive amounts of alcohol or who are injecting illegal drugs should be delayed until these behaviors have been discontinued for ≥6 months. Contraindications to treatment with interferon include major depressive illness, cytopenias, hyperthyroidism, renal transplantation, and evidence of autoimmune disease.

Most clinical trials of treatment for chronic hepatitis C have been conducted using alpha-interferon. When the recommended regimen of 3 million units administered subcutaneously 3 times/week for 12 months is used, approximately 50% of treated patients have normalization of serum ALT activity (biochemical response), and 33% have a loss of detectable HCV RNA in serum (virologic response) at the end of therapy. However, ≥50% of these patients relapse when therapy is stopped. Thus, 15%-25% have a sustained response as measured by testing for ALT and HCV RNA ≥1 years after therapy is stopped, many of whom also have histologic improvement. For patients who do not respond by the end of therapy, retreatment with a standard dose of interferon is rarely effective. Patients who have persistently abnormal ALT levels and detectable HCV RNA in serum after 3 months of interferon are unlikely to respond to treatment, and interferon treatment should be discontinued. These persons might be considered for participation in clinical trials of alternative treatments. Decreased interferon response rates (<15%) have been found in patients with higher serum HCV RNA titers and HCV genotype 1 (the most common strain of HCV in the United States); however, treatment should not be withheld based solely on these findings.

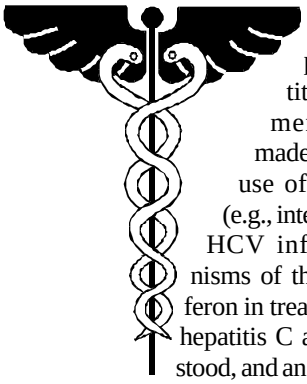
Therapy for hepatitis C is a rapidly changing area of clinical practice. Combination therapy with interferon and ribavirin, a nucleoside analogue, is now FDA-approved for treatment of chronic hepatitis C in patients who have relapsed following interferon treatment and might be approved soon for patients who have not been treated previously. Studies of patients treated with a combination of ribavirin and interferon have demonstrated a substantial increase in sustained response rates, reaching 40%-50%, compared with response rates of 15%-25% with interferon alone. However, as with interferon alone, combination therapy in patients with genotype 1 is not as successful, and sustained response rates among these patients are still <30%.

Most patients receiving interferon experience flu-like symptoms early in treatment, but these symptoms diminish with continued treatment. Later side effects include fatigue, bone marrow suppression, and neuropsychiatric effects (e.g., apathy, cognitive changes, irritability, and depression). Interferon dosage must be reduced in 10%-40% of patients and discontinued in 5%-15% because of severe side effects. Ribavirin can induce hemolytic anemia and can be problematic for patients with preexisting anemia, bone marrow suppression, or renal failure. In these patients, combination therapy should be avoided or attempts should be made to correct the anemia. Hemolytic anemia caused by ribavirin also can be life-threatening for patients with ischemic heart disease or cerebral vascular disease. Ribavirin is teratogenic, and female patients should avoid becoming pregnant during therapy.

Other treatments, including corticosteroids, ursodiol, and thymosin, have not been effective. High iron levels in the liver might reduce the efficacy of interferon. Use of iron -reduction therapy (phlebotomy or chelation) in combination with interferon has been studied, but results have been inconclusive. Because patients are becoming more interested in alternative therapies (e.g., traditional Chinese medicine, antioxidants, naturopathy, and homeopathy), physicians should be prepared to address questions regarding these topics.

Postexposure Prophylaxis and Follow-Up

Available data regarding the prevention of HCV infection with IG indicate that IG is not effective for postexposure prophylaxis of hepatitis C. No assessments have been made of postexposure use of antiviral agents (e.g., interferon) to prevent HCV infection. Mechanisms of the effect of interferon in treating patients with hepatitis C are poorly understood, and an established infection might need to be present for interferon to be an effective treatment. As of the publication of this report, interferon is FDA-approved only for treatment of chronic hepatitis C.



The immediate postexposure setting provides opportunity to identify persons early in the course of their HCV infection. Studies indicate that interferon treatment begun early in the course of HCV infection is associated with a higher rate of resolved infection. However, no data exist indicating that treatment begun during the acute phase of infection is

Cases of Selected Notifiable Diseases Reported in Virginia*

Disease	Total Cases Reported, September 1998						Total Cases Reported Statewide, January through September		
	State	Regions					This Year	Last Year	5 Yr Avg
		NW	N	SW	C	E			
AIDS	86	7	22	22	17	18	716	811	984
Campylobacteriosis	54	9	7	16	13	9	506	468	535
Giardiasis	46	7	18	4	13	4	298	326	251
Gonorrhea	1505	57	83	386	354	625	7009	6160	7933
Hepatitis A	10	0	5	0	4	1	163	171	139
Hepatitis B	7	1	0	1	3	2	79	95	99
Hepatitis NANB	1	0	0	0	0	1	11	23	20
HIV Infection	56	3	13	6	12	22	637	747	708
Influenza	1	0	0	0	0	1	1068	448	631
Legionellosis	0	0	0	0	0	0	16	19	12
Lyme Disease	7	2	1	3	0	1	50	46	61
Measles	0	0	0	0	0	0	2	1	2
Meningitis, Aseptic	27	3	9	7	0	8	131	173	255
Meningitis, Bacterial†	2	0	0	0	0	2	35	68	71
Meningococcal Infections	2	0	1	1	0	0	28	43	46
Mumps	1	0	0	1	0	0	6	10	20
Pertussis	9	8	0	1	0	0	19	42	38
Rabies in Animals	43	16	8	8	9	2	439	505	371
Rocky Mountain Spotted Fever	1	0	0	0	0	1	9	15	22
Rubella	0	0	0	0	0	0	0	1	1
Salmonellosis	126	22	24	23	35	22	776	760	807
Shigellosis	16	0	10	0	2	4	144	363	434
Syphilis, Early‡	32	0	2	4	8	18	319	478	820
Tuberculosis	31	2	10	5	4	10	222	254	255

Localities Reporting Animal Rabies This Month: Accomack 1 skunk; Alexandria 1 raccoon; Amherst 1 skunk; Augusta 1 raccoon; Bedford 1 raccoon, 1 skunk; Botetourt 1 raccoon; Buckingham 1 groundhog; Campbell 1 raccoon; Chesterfield 1 bat, 1 cat; Fairfax 1 bat, 1 cat, 1 fox, 3 raccoons; Fauquier 1 raccoon; Franklin County 1 skunk; Frederick 2 raccoons; Hanover 2 skunks; Nelson 1 raccoon; Page 3 raccoons, 2 skunks; Prince Edward 1 raccoon; Prince George 1 fox; Prince William 1 bat; Pulaski 1 skunk; Roanoke County 1 raccoon; Rockbridge 1 fox; Rockingham 1 horse; Spotsylvania 1 raccoon; Stafford 1 raccoon, 1 skunk; Surry 1 raccoon; Sussex 1 raccoon; Virginia Beach 1 fox.

Occupational Illnesses: Asbestosis 61; Carpal Tunnel Syndrome 37; Hearing Loss 19; Lead exposure 1; Mesothelioma 1; Pneumoconiosis 8.

*Data for 1998 are provisional. †Other than meningococcal. ‡Includes primary, secondary, and early latent.

more effective than treatment begun early during the course of chronic HCV infection. In addition, as stated previously, interferon is not FDA-approved for this indication. Determination of whether treatment of HCV infection is more beneficial in the acute phase than in the early chronic phase will require evaluation with well-designed research protocols.

Future Directions

To prevent chronic HCV infection and its sequelae, prevention of new HCV infections should be the primary objective of public health activities. Achieving this objective will require the integration of HCV prevention and surveillance activities into current public health infrastructure. In addition, several questions concerning the epidemiology of HCV infection remain, and the answers to those questions could change or modify primary prevention activities. These questions primarily concern the magnitude of the risk attributable to sexual transmission of HCV and to illegal noninjecting-drug use.

Identification of the large numbers of persons in the United States with chronic HCV infection is resource intensive. The most efficient means to achieve this identification is unknown, because the prevention effectiveness of various implementation strategies has not been evaluated. However, widespread programs to identify, counsel, and treat HCV-infected persons, combined with improvements in the efficacy of treatment, are expected to lower the morbidity and mortality from. HCV-related chronic liver disease substantially. Monitoring the progress of these activities to determine their effectiveness in achieving a reduction in HCV-related chronic disease is important.

Cases of Selected Notifiable Diseases Reported in Virginia*

Disease	Total Cases Reported, October 1998						Total Cases Reported Statewide, January through October		
	State	Regions					This Year	Last Year	5 Yr Avg
		NW	N	SW	C	E			
AIDS	92	8	8	4	35	37	808	938	1077
Campylobacteriosis	85	12	26	16	18	13	591	519	598
Giardiasis	88	15	36	2	21	14	386	367	292
Gonorrhea	618	38	70	68	225	217	7619	7122	8929
Hepatitis A	18	3	5	2	1	7	181	195	158
Hepatitis B	9	0	1	0	1	7	88	106	110
Hepatitis NANB	0	0	0	0	0	0	11	24	22
HIV Infection	60	5	15	3	16	21	697	796	795
Influenza	1	0	1	0	0	0	1069	457	650
Legionellosis	2	0	0	2	0	0	18	21	18
Lyme Disease	8	3	3	0	1	1	58	53	68
Measles	0	0	0	0	0	0	2	1	2
Meningitis, Aseptic	57	4	23	7	1	22	189	191	317
Meningitis, Bacterial†	6	2	1	0	0	3	41	75	77
Meningococcal Infections	8	2	2	2	0	2	36	48	51
Mumps	2	0	1	0	0	1	8	10	22
Pertussis	11	4	3	0	2	2	30	42	46
Rabies in Animals	51	20	8	7	7	9	490	565	427
Rocky Mountain Spotted Fever	4	0	2	0	0	2	13	19	25
Rubella	1	0	1	0	0	0	1	1	1
Salmonellosis	168	16	47	15	49	41	944	885	945
Shigellosis	32	4	20	0	2	6	176	376	480
Syphilis, Early‡	23	0	1	7	8	7	342	537	890
Tuberculosis	21	0	8	0	5	7	250	275	287

Localities Reporting Animal Rabies This Month: Amherst 1 skunk; Appomattox 1 raccoon; Augusta 1 raccoon; Campbell 2 raccoons; Charles City 1 raccoon; Chesapeake 2 foxes, 1 raccoon; Clarke 1 raccoon; Dinwiddie 1 cat; Essex 1 raccoon; Fairfax 3 raccoons; Fauquier 1 skunk; Frederick 1 skunk; Hanover 2 skunks; Henrico 1 bat, 1 raccoon; Loudoun 3 raccoons; Louisa 1 skunk; Middlesex 1 fox; Montgomery 2 skunks; Nelson 1 raccoon; Northampton 1 raccoon; Orange 1 cat, 1 raccoon; Page 2 raccoons, 1 skunk; Prince Edward 1 raccoon; Prince William 2 raccoons; Richmond County 1 skunk; Rockbridge 1 cat, 2 raccoons; Rockingham 1 cow, 1 raccoon; Spotsylvania 1 raccoon; Stafford 1 raccoon, 1 skunk; Suffolk 1 raccoon; Virginia Beach 1 raccoon; Warren 1 skunk; Washington 1 raccoon.

Occupational Illnesses: Asbestosis 20; Carpal Tunnel Syndrome 45; De Quervain's Syndrome 2; Hearing Loss 10; Lead Poisoning 3; Pneumoconiosis 9.

*Data for 1998 are provisional. †Other than meningococcal. ‡Includes primary, secondary, and early latent.

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