

Hepatitis C Virus Infections from Unsafe Injection Practices at an Endoscopy Clinic in Las Vegas, Nevada, 2007–2008

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Background. In January 2008, 3 persons with acute hepatitis C who all underwent endoscopy at a single facility in Nevada were identified.

Method. We reviewed clinical and laboratory data from initially detected cases of acute hepatitis C and reviewed infection control practices at the clinic where case patients underwent endoscopy. Persons who underwent procedures on days when the case patients underwent endoscopy were tested for hepatitis C virus (HCV) infection and other bloodborne pathogens. Quasispecies analysis determined the relatedness of HCV in persons infected.

Results. In addition to the 3 initial cases, 5 additional cases of clinic-acquired HCV infection were identified from 2 procedure dates included in this initial field investigation. Quasispecies analysis revealed 2 distinct clusters of clinic-acquired HCV infections and a source patient related to each cluster, suggesting separate transmission events. Of 49 HCV-susceptible persons whose procedures followed that of the source patient on 25 July 2007, 1 (2%) was HCV infected. Among 38 HCV-susceptible persons whose procedures followed that of another source patient on 21 September 2007, 7 (18%) were HCV infected. Reuse of syringes on single patients in conjunction with use of single-use propofol vials for multiple patients was observed during normal clinic operations.

Conclusions. Patient-to-patient transmission of HCV likely resulted from contamination of single-use medication vials that were used for multiple patients during anesthesia administration. The resulting public health notification of ~50,000 persons was the largest of its kind in United States health care. This investigation highlighted breaches in aseptic technique, deficiencies in oversight of outpatient settings, and difficulties in detecting and investigating such outbreaks.

With an estimated 4.1 million persons infected [1], hepatitis C virus (HCV) is the most common blood-borne infection and a major cause of chronic liver disease and hepatocellular carcinoma in the United States [2, 3]. Although transmission of viral hepatitis in health care settings has been considered uncommon, a growing number of outbreaks in nonhospital settings has

been recognized in recent years [4]. Most of these outbreaks have been attributed to unsafe injection practices [4–6].

We report the initial field investigation of HCV infections among persons who had undergone procedures at an ambulatory specialty clinic. The long-standing practice of reusing syringes for single patients in conjunction with using single-use medication vials for multiple patients led to patient-to-patient transmission of HCV. This resulted in a public health notification that advised nearly 50,000 persons of their potential exposure and their need to be screened for HCV and other bloodborne pathogens.

METHODS

In January 2008, the Nevada State Health Division contacted the Centers for Disease Control and Prevention

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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after the Southern Nevada Health District detected an increase in acute hepatitis C cases. In Nevada, health care providers are required to report cases of acute hepatitis C to the health department within 24 h after diagnosis. Three persons had been diagnosed during a 5-week period starting in October 2007, and all had symptom onset within 35–90 days after undergoing endoscopy at the same ambulatory clinic.

Case finding and laboratory testing. Clinical histories from 3 initially identified cases were obtained through patient interviews and review of medical records. Blood specimens were obtained to confirm HCV infection and to test for hepatitis B virus (HBV) and human immunodeficiency virus (HIV). Clinic records of persons who underwent endoscopy on the same days as the initially identified case patients (25 July 2007 and 21 September 2007) were reviewed, and those persons were directly advised (by mail and telephone) to undergo screening for antibodies to HCV (anti-HCV), as well as HBV and HIV. These tests were performed at the Nevada State Public Health Laboratory or at a local commercial laboratory using recommended standardized testing methods [7].

A patient was considered susceptible to HCV infection if there was no documented evidence in clinic records that he or she had a history of HCV infection prior to his or her procedure. Laboratory-confirmed HCV infection was defined as the presence of HCV RNA identified by reverse-transcriptase polymerase chain reaction or a confirmed positive result of anti-HCV testing [7]. A person was considered to have acute hepatitis C if he or she had laboratory-confirmed HCV infection and had an acute illness with discrete onset of symptoms (eg, nausea, anorexia, fever, malaise, or abdominal pain) and jaundice or elevated serum aminotransferase levels. Individuals were considered HBV infected if they tested positive for hepatitis B surface antigen and were considered HIV infected if they tested positive for antibodies to HIV.

We defined a case of clinic-acquired HCV infection as acute hepatitis C or laboratory-confirmed HCV infection occurring in a susceptible person who had undergone an endoscopy procedure at the clinic on 25 July 2007 or 21 September 2007.

Analysis of HCV sequences. Blood specimens from persons with clinic-acquired HCV infection and potential source cases were sent to the Centers for Disease Control and Prevention for HCV molecular testing. The subgenotype was determined from a 300-nucleotide NS5B coding region of the HCV genome. The genetic relatedness among case patients and potential source isolates was determined by analysis of HCV quasiespecies (the population of related HCV variants that occur within HCV-infected individuals) by sequencing a segment amplified from the E1–hypervariable region 1 (HVR1) of the HCV genome (291 nucleotides in length) using methods previously described [8]. The E1-HVR1 quasiespecies sequences from the patients' specimens were compared with each other

and with sequences from randomly selected HCV-infected individuals from the Third National Health and Nutrition Examination Survey (NHANES III), a representative sample of the noninstitutionalized civilian population of the United States [9].

Review of infection control practices. Several procedures, which included placement of the intravenous catheter, administration of anesthesia, endoscopy, endoscope reprocessing, and postprocedure care, were observed. All available staff directly involved in patient care were observed and interviewed. Blood specimens from staff members who had direct contact with patients were screened for HCV, HBV, and HIV infection by antibody testing.

Case-control analysis. We compared features of persons with clinic-acquired HCV infection (cases) with those of persons who were susceptible to infection but did not have clinic-acquired HCV infection (controls) for persons who underwent their procedures on the September date. All analyses were conducted using SPSS, version 15.0 (SPSS). Comparisons of categorical variables were made using the χ^2 test, and comparisons of continuous variables were made using Student's *t* test for normally distributed variables and the Mann-Whitney *U* test for nonparametric variables.

Ethics consideration. The investigation was a public health response to a disease outbreak and therefore did not require review by an institutional review board. Oral or written consent for blood testing was obtained from all patients and staff members.

RESULTS

Case finding and quasiespecies analysis. A total of 126 persons underwent endoscopy on 25 July 2007 and 21 September 2007, the dates when the 3 original case patients underwent their procedures (Figure 1). Four persons from the July date and 2 persons from the September date were known to be infected with HCV prior to their procedures and were considered potential source patients. Among the 59 susceptible persons who underwent their procedure on the July date, 49 (83%) underwent anti-HCV screening at least 8 months after their potential exposure. One met our case definition of clinic-acquired HCV infection. Among the 61 susceptible persons who had their procedure on the September date, 51 (84%) patients underwent anti-HCV screening at least 5 months after their potential exposure. Seven patients met our case definition of clinic-acquired HCV infection. None of the patients was found to be infected with HBV or HIV. Laboratory results from the remaining persons potentially exposed on the July or September date were not available because they died from causes unrelated to hepatitis (3 persons), declined to be tested, or declined to report their results. None of the 38 staff evaluated tested positive for HCV, HIV, or HBV infection.

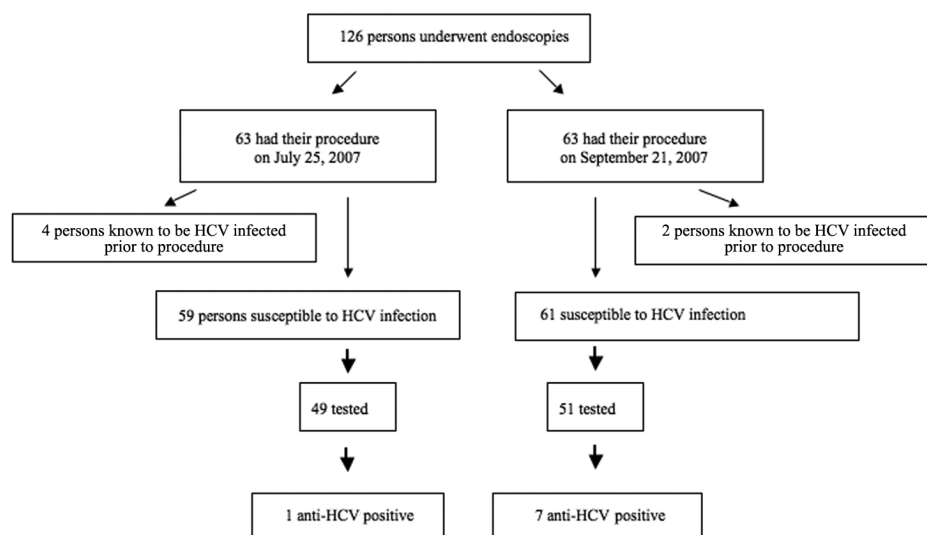


Figure 1. Patients who underwent endoscopy procedures on 25 July 2007 and 21 September 2007, by hepatitis C virus (HCV) status and screening results, Nevada, 2007. Anti-HCV positive, tested positive for antibodies to HCV.

The mean age of the 8 persons with clinic-acquired HCV infection was 54 years, and the median age was 57 years (range, 37–73 years). Five (63%) were women. Six (75%) had acute hepatitis C with symptom onset between late October 2007 and November 2007, which was 35–90 days after undergoing procedures at the clinic. Four required hospitalization to receive supportive care for viral hepatitis.

Seven persons with clinic-acquired HCV infection had HCV genotype 1a, on the basis of analysis of the NS5b region. HCV RNA could not be amplified from 1 person with clinic-acquired HCV infection from the September date. On each of the 2 procedure dates, a person known to be previously infected with HCV genotype 1a and who underwent endoscopy prior to the procedures of all known patients with clinic-acquired HCV infection was identified as the potential source case. E1-HVR1 quasiespecies analysis confirmed each as the source of 2 distinct clusters—a July cluster and a September cluster (Figure 2). The maximum HCV quasiespecies sequence identity was 98.6% between the patient with clinic-acquired HCV infection and the potential source patient from July. The range of the maximum sequence identities was 98.3%–100% between the 6 patients with clinic-acquired HCV infection and the potential source patient from September. The maximum identities were <90% between the 2 clusters and 5 NHANES III participants.

Phylogenetic analysis revealed significant intermixing between quasiespecies from patients with clinic-acquired HCV infection and from the potential source patient from both the July and September clusters (Figure 2). An especially complex pattern of intermixing was found among quasiespecies from the September cluster; the potential source contains 2 branches of quasiespecies, with one branch intermixing quasiespecies from

the potential source and from all 6 clinic-acquired cases of HCV infection. The range of sequence identity between all quasiespecies in this branch was 94.2%–100%. Such intermixing was not found between NHANES III participants (Figure 2).

According to start times recorded in each person's clinic record, the source patient from July was the first person to undergo endoscopy on that date and the source patient from September was the 19th person to undergo endoscopy on that date (Figure 3). There were 2 procedure rooms, but room numbers identifying where individual patients underwent their procedures were not documented. Additionally, some procedure start times overlapped, even though the same staff was presumably in attendance. Among 59 persons whose procedure followed that of the source patient from July, 49 susceptible persons were tested, and 1 (2%) had clinic-acquired HCV infection. On that date, 6 susceptible persons who had procedure start times that were between those of the source patient and the person with clinic-acquired infection tested negative for anti-HCV. Among the 43 persons whose procedure followed that of the source patient from September, 38 susceptible persons were tested, and 7 (18%) had clinic-acquired HCV infection. Procedure start times for 4 of the case patients with clinic-acquired HCV infection were 6–40 min after the start of the source patient's procedure. The other 3 case patients with clinic-acquired HCV infection from that date had procedure start times ~2–3.5 h after the start of the source patient's procedure and followed the procedures of 8 persons who tested negative for anti-HCV. Three persons whose procedure start times were between those of the last known persons to have been infected on that date were not tested or did not have their results reported.

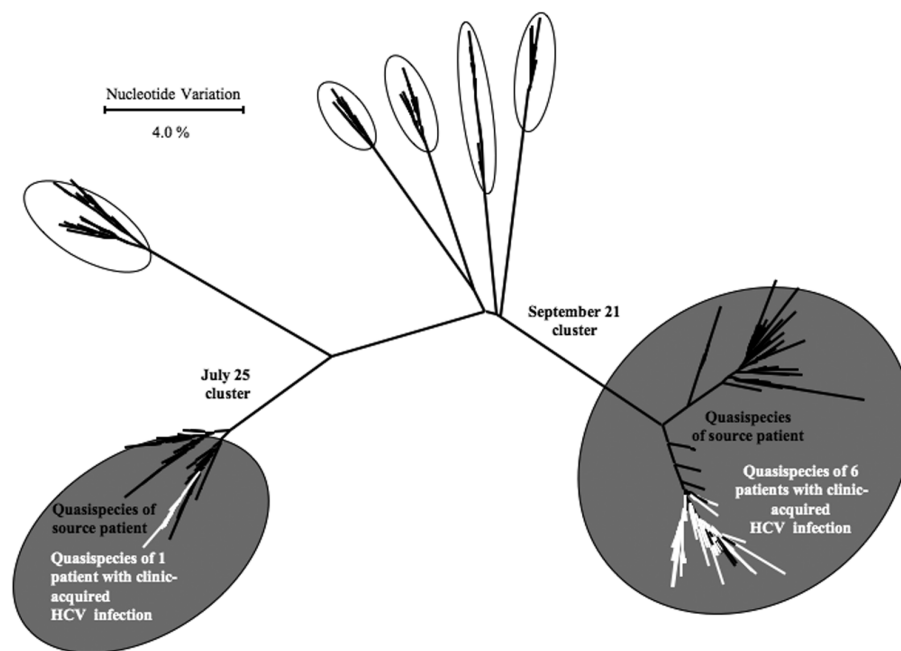


Figure 2. Phylogenetic tree of hepatitis C virus (HCV) E1–hypervariable region 1 (HVR1) sequences (quasispecies) from 7 patients with clinic-acquired HCV infection and 2 source patients (1 each) from the July and September clusters, compared with 5 selected Third National Health and Nutrition Examination participants (NHANES III), Nevada, 2007. The gray-shaded ovals represent source patients (*black tips*) and patients with clinic-acquired HCV infection (*white tips*). The unshaded ovals represent NHANES III participants.

Observation of infection control procedures. The sedative propofol was the primary medication used to induce anesthesia. During the investigation, an anesthetist was directly observed placing a new needle on the same syringe that had been used to administer initial sedation to a patient. This syringe was then used to withdraw additional propofol from an open propofol

vial for the same patient. According to the anesthetist, if the patient did not require more sedation, the needle and syringe would be disposed, but the open vial could be used on subsequent patients. As soon as these improper practices were observed, we advised the clinic to stop these practices and educated their staff about the associated risks. Another anes-

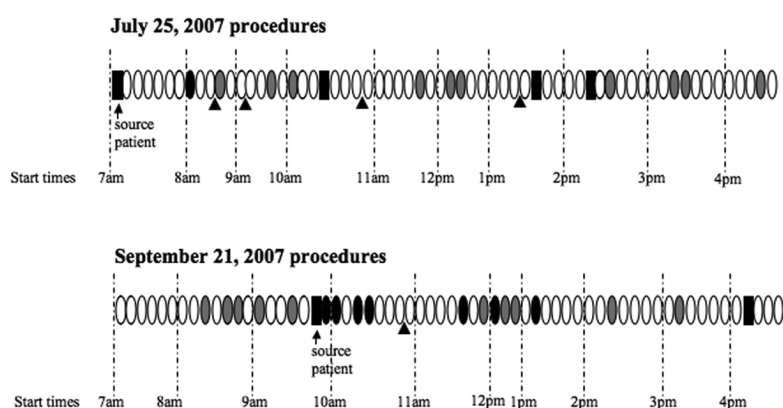


Figure 3. Chronological order (based on start times from clinic records) of patients who underwent endoscopy and their hepatitis C virus (HCV) status (susceptible to HCV or previously infected with HCV) before their procedure and the results of HCV screening conducted for the investigation, by date of procedure, Nevada, 2007. Note that the source patient was determined by quasispecies analysis. A blackened triangle indicates that the same procedure start time was recorded for the 2 patients noted above it. *Blackened rectangle*, Previously infected with HCV prior to procedure. *Unblackened (white) oval*, Susceptible to HCV and tested negative for antibodies to HCV at screening. *Blackened oval*, Susceptible to HCV and tested positive for antibodies to HCV at screening (ie, clinic-acquired HCV infection). *Gray oval*, Susceptible to HCV and did not undergo screening for antibodies to HCV or the results of screening were unknown.

thetist who was no longer working at the clinic but who was interviewed by telephone reported this same practice of reusing syringes on single patients when withdrawing medications from single-use vials that were then used for multiple patients. Clinic procedural logs indicated that 500-mg vials of propofol had been used on the July and September dates investigated. On those dates, the mean and median amount of propofol used was 154 mg and 150 mg, respectively (range, 100–400 mg).

No significant infection control breaches were identified during our observations of the endoscopy procedure itself. Biopsy needles were designated for single-use and were disposed of accordingly. Endoscopes were reprocessed according to manufacturer's instructions, and review of available daily logs indicated no problems with reprocessing of endoscopes on the dates that clinic-acquired cases were identified. Different endoscopes were used for the source patient and the patient with clinic-acquired infection on the July date. The same endoscopes were used for 3 persons with clinic-acquired infection on the September date, but there was sufficient time (>35 min) between those cases for adequate reprocessing, and a different endoscope was used for the source patient.

Case-control analysis. Case patients (7 persons) and control patients (31 persons) were similar with respect to sex, mean age, type of procedure performed, indication for procedure, and whether a biopsy was performed (Table 1). Case patients and control patients were equally likely to have anesthesia administered by anesthetist 1 or anesthetist 2, who were the only ones to administer anesthesia on the September date. The same proportion of case and control patients underwent colonoscopy (86% and 65%, respectively), with the remainder in each category undergoing upper endoscopy. Case and control patients received similar amounts of propofol during the procedures. However, patients with HCV infection who underwent procedures subsequent to the source patient had their procedures

closer in time to those of the source patient than did 31 control patients who did not become HCV infected (Table 1).

DISCUSSION

We documented 2 separate HCV transmission events that resulted in 8 patients acquiring infection during procedures at a single endoscopy clinic. Persons with clinic-acquired HCV infection were epidemiologically linked by endoscopy dates, and HCV quasispecies analysis showed a high degree of relatedness among viruses isolated from patients with procedures on the same day. Transmission likely resulted from contamination of single-use medication vials that were then used for multiple patients during the administration of anesthesia.

Many health care-associated outbreaks, including the one described here, resulted from reuse of syringes and/or needles in conjunction with use of shared medication vials [10–17]. Reports of these outbreaks should prompt providers to review their practices and those of their staff. They should understand that there is a risk of bloodborne pathogen transmission when devices and medications are shared among patients, even in the absence of visible blood on objects [18, 19]. It is unlikely that transmission occurred during endoscopy. In one study that attributed HCV transmission directly to colonoscopy, biopsies were found to be an independent risk factor for infection, and inadequate disinfection of endoscopes was documented [20]. Neither of these findings was apparent from our investigation.

It is possible that some persons who we defined as being susceptible to HCV infection were infected prior to their procedure but were unaware of their infection status. However, with the exception of one person who did not have virus isolated, all those with clinic-acquired HCV infection had virus genetically related to each other and to that of the source patients. Cases may have been missed because not enough time

Table 1. Demographic and Procedural Characteristics among Case Patients with Clinic-Associated Hepatitis C Virus (HCV) Infection, Compared with Control Patients, Nevada, 2007

Characteristic	Case patients (n = 7)	Control patients ^a (n = 31)	P
Female sex	5 (71)	19 (61)	.25
Age, mean years	52.3	53.8	.83
Time from start of source patient's procedure to start of susceptible patients' procedures, mean min	80	230	<.01
Colonoscopy	6 (86)	20 (65)	.40
Biopsy performed	5 (71)	15 (48)	.41
Indication for endoscopy screening	1 (14)	7 (23)	.63
≥2 Doses of propofol administered	7 (100)	28 (90)	.95
Amount of propofol administered during procedure, mean mg	151	173	.06

NOTE. Data are no. (%) of patients, unless otherwise indicated.

^a Patients who underwent an endoscopy after the source patient on the September date and who tested negative for HCV infection.

elapsed from exposure to development of antibodies to HCV. Most persons were screened at least 5 months after potential exposure, and those who were screened <6 months after exposure were asked to undergo HCV RNA testing or repeat antibody testing. It remains unclear why some susceptible persons became infected during their procedures while others did not. Persons with clinic-associated HCV infection underwent procedures closer in time to that of the source patient, compared with uninfected persons. These persons may have been exposed to higher viral loads, which became diluted over time. Alternatively, multiple propofol vials may have been open at once, and the contaminated vials were only used for persons who became infected. Additionally, the order in which persons underwent their procedures may not have been accurately recorded, and room numbers identifying where persons underwent their procedures were not documented. These factors limited our ability to trace how transmission might have been perpetuated. Unidentified host factors also may have played a role in why some susceptible persons became infected while others did not.

Although this investigation confirmed a link between HCV infections in persons who had procedures on only 2 days, these unsafe injection practices were in place at the clinic for at least 4 years, according to staff interviews. As a result, Southern Nevada Health District notified ~50,000 persons who were potentially exposed to unsafe practices at this clinic during this period and recommended that they undergo HCV, HBV, and HIV testing. Although the initial field investigation described here occurred during a 10-day period, local health authorities continued their investigation and response to its findings for several months, at a cost of almost \$500,000 above their routine operating expenses. In addition to these direct costs, the situation created a reported loss of confidence in health care providers to deliver safe care [21]. However, the findings of the outbreak also increased local and national awareness of injection safety among practitioners and patients and contributed to changes in the inspection process of ambulatory surgical centers nationwide [19].

The true scope of the problem of health care–related HCV transmission may not be fully recognized. It is difficult to detect when an infection is acquired and to link cases to a common source because (1) 60%–70% of acute HCV infections are asymptomatic [22]; (2) there is no laboratory test that can distinguish acute from chronic infection, although viremia associated with an increase in alanine aminotransferase levels prior to antibody detection may indicate acute HCV infection; and (3) there is a long incubation period (mean, 4–12 weeks; range, 2–24 weeks) among symptomatic persons. In the outbreak described, the unusual number of persons with symptomatic infection within a short period of time alerted public health officials to a possible common source.

The investigation and conclusions reached are subject to unavoidable limitations. The field investigation occurred during a 10-day period 5 months after the initial transmission events occurred, so observations and interviews were potentially subject to changed practices and recall bias, respectively. However, the reuse of syringes and the use of single-use vials for multiple patients were directly observed, even after the clinic became aware of possible HCV transmission between patients.

The HCV infections and health care resources expended during the investigation and patient notifications could have been prevented. States have different mechanisms for infection control oversight and regulation, but ambulatory surgical centers and other outpatient clinics have not traditionally received the same scrutiny as have hospitals [23, 24]. Since 2007, recommendations for preventing health care–related transmission of infectious agents specifically include safe injection practices as part of standard precautions [18]. Specifically, syringes should not be reused when withdrawing medications for an individual patient or multiple patients. Single-use vials should never be used for multiple patients, and the use of multidose vials for multiple patients should be avoided. In 2007, the Nevada state licensing bureau performed an inspection of the clinic; however, observations of procedures and formal assessments of infection control practices and injection safety were not components of the inspection process at that time. A new survey tool focusing on infection control and observation of procedures has since been incorporated into the survey process for all ambulatory surgical centers certified by the Centers for Medicare and Medicaid Services. Additionally, the Centers for Medicare and Medicaid Services has updated several ambulatory surgical center health and safety standards, including requirements that these facilities maintain infection control programs based on nationally recognized guidelines and that these programs be directed by appropriately trained health care professionals. Improvements in oversight, including increased licensing, accreditation, and inspection requirements, may help to improve adherence to recommended practices. Ultimately, however, it remains the responsibility of all health care providers and facilities to ensure basic safe care practices and to maintain patient safety as their top priority.

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Potential conflicts of interest. All authors: no conflicts.

References

1. Armstrong GL, Wasley A, Simard EP, McQuillan GM, Kuhnert WL, Alter MJ. The prevalence of hepatitis C virus infection in the United States, 1999 through 2002. *Ann Intern Med* 2006; 144:705–14.
2. Bell BP, Manos MM, Zaman A, et al. The epidemiology of newly diagnosed chronic liver disease in gastroenterology practices in the

- United States: results from population-based surveillance. *Am J Gastroenterol* **2008**; 103:2727–36.
3. El-Serag HB. Hepatocellular carcinoma and hepatitis C in the United States. *Hepatology* **2002**; 36(Suppl 1):S74–83.
 4. Thompson ND, Perz JF, Moorman AC, Holmberg SD. Nonhospital health care-associated hepatitis B and C virus transmission: United States, 1998–2008. *Ann Intern Med* **2009**; 150:33–9.
 5. Alter MJ. Healthcare should not be a vehicle for transmission of hepatitis C virus. *J Hepatol* **2008**; 48:2–4.
 6. Williams IT, Perz JF, Bell BP. Viral hepatitis transmission in ambulatory health care settings. *Clin Infect Dis* **2004**; 38:1592–8.
 7. Centers for Disease Control and Prevention. Guidelines for laboratory testing and result reporting of antibody to hepatitis C virus. *MMWR Recomm Rep* **2003**; 52(RR-3):1–13, 15.
 8. Ramachandran S, Xia GL, Ganova-Raeva LM, Nainan OV, Khudyakov Y. End-point limiting-dilution real-time PCR assay for evaluation of hepatitis C virus quasispecies in serum: performance under optimal and suboptimal conditions. *J Virol Methods* **2008**; 151:217–24.
 9. Ezzati TM, Massey JT, Waksberg J, Chu A, Maurer KR. Sample design: Third National Health and Nutrition Examination Survey. *Vital Health Stat* **1992**; 113:1–35.
 10. Centers for Disease Control and Prevention. Acute hepatitis C virus infections attributed to unsafe injection practices at an endoscopy clinic—Nevada, 2007. *MMWR Morb Mortal Wkly Rep* **2008**; 57:513–7.
 11. Bruguera M, Saiz JC, Franco S, et al. Outbreak of nosocomial hepatitis C virus infection resolved by genetic analysis of HCV RNA. *J Clin Microbiol* **2002**; 40:4363–6.
 12. Krause G, Trepka MJ, Whisenhunt RS, et al. Nosocomial transmission of hepatitis C virus associated with the use of multidose saline vials. *Infect Control Hosp Epidemiol* **2003**; 24:122–7.
 13. Comstock RD, Mallonee S, Fox JL, et al. A large nosocomial outbreak of hepatitis C and hepatitis B among patients receiving pain remediation treatments. *Infect Control Hosp Epidemiol* **2004**; 25:576–83.
 14. Macedo de Oliveira A, White KL, Leschinsky DP, et al. An outbreak of hepatitis C virus infections among outpatients at a hematology/oncology clinic. *Ann Intern Med* **2005**; 142:898–902.
 15. Patel PR, Larson AK, Castel AD, et al. Hepatitis C virus infections from a contaminated radiopharmaceutical used in myocardial perfusion studies. *JAMA* **2006**; 296:2005–11.
 16. Centers for Disease Control and Prevention. Transmission of hepatitis B and C viruses in outpatient settings—New York, Oklahoma, and Nebraska, 2000–2002. *Morb Mortal Wkly Rep* **2003**; 52:901–6.
 17. Lagging LM, Aneman C, Nenonen N, et al. Nosocomial transmission of HCV in a cardiology ward during the window phase of infection: an epidemiological and molecular investigation. *Scand J Infect Dis* **2002**; 34:580–2.
 18. Siegel J, Rhinehart E, Jackson M, Chiarello L; Healthcare Infection Control Practices Advisory Committee. 2007 Guideline for isolation precautions: preventing transmission of infectious agents in healthcare settings. Atlanta: US Department of Health and Human Services, Centers for Disease Control and Prevention, **2007**. Available at: <http://www.cdc.gov/hicpac/pdf/isolation/Isolation2007.pdf>. Accessed 16 June 2010.
 19. Perz JF, Thompson ND, Schaefer MK, Patel PR. US outbreak investigations highlight the need for safe injection practices and basic infection control. *Clin Liver Dis* **2010**; 14:137–51.
 20. Bronowicki JP, Venard V, Botte C, et al. Patient-to-patient transmission of hepatitis C virus during colonoscopy. *N Engl J Med* **1997**; 337:237–40.
 21. Allen M. Poll finds ill feelings on health care. *Las Vegas Sun*, 27 May **2008**. Available at: <http://www.lasvegassun.com/news/2008/may/27/poll-finds-ill-feelings-health-care/>. Accessed 16 June 2010.
 22. Centers for Disease Control and Prevention. Recommendations for prevention and control of hepatitis C virus (HCV) infection and HCV-related chronic disease. *MMWR Morb Mortal Wkly Rep* **1998**; 47(RR-19):1–39.
 23. Lapetina EM, Armstrong EM. Preventing errors in the outpatient setting: a tale of three states. *Health Aff (Millwood)* **2002**; 21:26–39.
 24. Jarvis WR. Infection control and changing health-care delivery systems. *Emerg Infect Dis* **2001**; 7:170–3.