

A LARGE NOSOCOMIAL OUTBREAK OF HEPATITIS C AND HEPATITIS B AMONG PATIENTS RECEIVING PAIN REMEDIATION TREATMENTS

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ABSTRACT

BACKGROUND AND OBJECTIVE: In August 2002, the Oklahoma State Department of Health received a report of six patients with unexplained hepatitis C virus (HCV) infection treated in the same pain remediation clinic. We investigated the outbreak's extent and etiology.

DESIGN, SETTING, AND PARTICIPANTS: We conducted a retrospective cohort study of clinic patients, including a serologic survey, interviews of infected patients, and reviews of medical records and staff infection control practices. Patients received outpatient pain remediation treatments one afternoon a week in a clinic within a hospital. Cases were defined as HCV or hepatitis B virus (HBV) infections among patients who reported no prior diagnosis or risk factors for disease or reported previous risk factors but had evidence of acute infection.

RESULTS: Of 908 patients, 795 (87.6%) were tested, and

71 HCV-infected patients (8.9%) and 31 HBV-infected patients (3.9%) met the case definition. Multiple HCV genotypes were identified. Significantly higher HCV infection rates were found among individuals treated after an HCV-infected patient during the same visit (adjusted odds ratio [AOR], 6.2; 95% confidence interval [CI]₉₅, 2.4–15.8); a similar association was observed for HBV (AOR, 2.9; CI₉₅, 1.3–6.5). Review of staff practices revealed the nurse anesthetist had been using the same syringe–needle to sequentially administer sedation medications to every treated patient each clinic day.

CONCLUSIONS: Reuse of needles–syringes was the mechanism for patient-to-patient transmission of HCV and HBV in this large nosocomial outbreak. Further education and stricter oversight of infection control practices may prevent future outbreaks (*Infect Control Hosp Epidemiol* 2004;25:576-583).

Reuse of syringes and needles, a violation of accepted infection control procedures, is capable of transmitting blood-borne pathogens such as hepatitis viruses and has long been identified as a dangerous practice.¹⁻⁷ Transmission of hepatitis C virus (HCV)⁸⁻¹² and hepatitis B virus (HBV)¹³⁻¹⁷ among patients in healthcare settings other than hemodialysis units has been infrequently reported and has generally involved contamination of equipment or parenterally administered medications. Unsafe injection practices and other failures to use appropriate aseptic technique have been associated with several recently reported healthcare-related outbreaks of HCV and HBV infections in the United States.¹⁸

In early August 2002, the Oklahoma State Department of Health received a report of a cluster of six patients with unexplained HCV infections, all of whom had been treated for pain in the same hospital outpatient clinic. The clinic, which was opened in April 1999, was operated by a board-certified anesthesiologist and a certified registered nurse anesthetist who were contractors assisted by hospital staff nurses. Patients were seen one

afternoon every week in an outpatient clinic where they received pain management procedures such as epidural injections and nerve root blocks. Because of this cluster of HCV infections, the clinic was closed in August 2002, and we launched an investigation to determine the extent and etiology of the outbreak. This article provides detailed information about our investigation of this outbreak, which was briefly reported previously.¹⁸

METHODS

Laboratory Testing and Case Definitions

Letters were sent to all clinic patients notifying them that they might have been exposed to HCV during pain management treatments and offering to test them for HCV and HBV at no charge. Although some patients arranged to be tested through their private physicians, most were tested by the hospital and one of its commercial reference laboratories. Tests for HCV included antibody to HCV (anti-HCV) using an enzyme immunoassay (ORTHO HCV Version 3.0 ELISA, Ortho-Clinical Diagnostics, Raritan, NJ) with positive results confirmed by either a supple-

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mental anti-HCV recombinant immunoblot assay (RIBA) (Chiron RIBA HCV 3.0 SIA, Chiron Corp., Emeryville, CA) or a quantitative reverse transcriptase–polymerase chain reaction (PCR) assay for HCV RNA (Hepatitis C Viral RNA, Quantitative Real-Time PCR, Quest Diagnostics, Teterboro, NJ). Genotyping of HCV RNA–positive specimens was performed using a line-probe assay (Hepatitis C Viral RNA, Genotype, Quest Diagnostics).

Testing for markers of HBV infection included total and IgM antibody to hepatitis B core antigen (anti-HBc), hepatitis B surface antigen (HBsAg), and antibody to HBsAg (anti-HBs) using commercially available assays. Although human immunodeficiency virus testing was performed, it is not discussed in this article because only one previously diagnosed patient tested positive.

Patients who tested positive for anti-HCV (confirmed by RIBA or PCR) were considered infected with HCV. Patients who tested positive for IgM anti-HBc or total anti-HBc in combination with either HBsAg or anti-HBs were considered infected with HBV. Patients who tested negative for serologic markers of HCV and HBV infection were considered uninfected. Patients with HCV or HBV infections were considered cases if they either (1) did not report a history of hepatitis, injection-drug use, or receipt of blood products before 1992 (1972 for HBV) or (2) reported previous risk factors but had evidence of acute infection (alanine aminotransferase level greater than 2.5 times the upper limit of normal or jaundice) within 2 to 26 weeks of visiting the clinic. Infected patients who reported a history of disease or reported a risk factor history and did not have evidence of acute infection were considered to have prior infections.

Data Collection

We reviewed pain clinic charts, nursing admission medical histories, and laboratory test results. From pain clinic charts we obtained demographic information, dates and times of visits, procedure summaries, type and dose of medications administered, and identified attending healthcare professionals. Self-reported medical histories of HCV- and HBV-positive patients, including symptoms, history of hepatitis, and lifetime history of risk factors, were obtained from nursing admission assessment sheets and follow-up telephone interviews.

Review of Staff Infection Control Practices and Staff Testing

A review of staff infection control practices was conducted, including private interviews with the attending physician, the certified registered nurse anesthetist, and several staff nurses. Self-report and peer review were used to evaluate individual infection control techniques of clinic staff and general treatment procedures. Additionally, the clinic staff was tested for HCV and HBV.

Retrospective Cohort Study

To evaluate possible risk factors for acquiring infection at the clinic, we performed a retrospective cohort study of patients classified as not previously infected (ie,

case-patients and uninfected patients). We compared infection rates among exposed and unexposed clinic patients for several factors of interest including the number of times a patient visited the clinic and the number of times a patient was exposed to HCV- or HBV-infected patients in the clinic. Statistical analysis was performed using Epi-Info (version 6; Centers for Disease Control and Prevention, Atlanta, GA) and SAS (version 8; SAS Institute, Inc., Cary, NC) software and included chi-square tests (Fisher's exact test if any expected cell value was less than 5) for dichotomous variables,¹⁹ *t* tests as well as chi-square test for trend²⁰ for continuous and categorical variables, and logistic regression for assessment of associations after controlling for potential confounders such as gender, age, and number of clinic visits. Relative risks (RRs) and adjusted odds ratios (ORs) were used to evaluate the magnitude and direction of associations and 95% confidence intervals (CI₉₅) and *P* values of less than .05 were used to determine statistical significance.

RESULTS

Identification of Cases

Serologic testing for HCV and HBV infections (most of which was conducted from August through October 2002) was completed for 795 (87.6%) of 908 patients treated since the clinic opened in April 1999. The median age of tested patients was 53 years (range, 16 to 93 years). These patients had made a median of 2 visits (range, 1 to 17 visits) to the clinic. The 113 untested patients included 74 patients who could not be contacted or did not respond to requests for testing, 9 patients who refused testing, and 30 patients who had died. Hepatitis was not listed on any of the 29 available death certificates reviewed. Tested patients were similar to untested patients regarding gender and age but attended the clinic significantly more often (data not shown).

Of the 795 patients tested, 86 (10.8%) were infected with HCV and 71 (82.6%) with clinic visit dates from April 12, 1999, through July 22, 2002, met the case definition (HCV attack rate, 9.1%) (Table 1). Forty had evidence of acute infection, including 32 (80.0%) who reported jaundice (Fig. 1). Among 63 genotyped case-patients, nearly three-fourth were genotype 1a; 12.7% had indeterminate results (Table 1).

A total of 42 (5.3%) of the patients tested were infected with HBV and 31 (73.8%) with clinic visit dates from July 19, 1999, through August 5, 2002, met the case definition (HBV attack rate, 4.0%). Thirteen had evidence of acute infection, including 11 (84.6%) who reported jaundice (Table 2).

Review of Staff Infection Control Practices and Staff Testing

Interviews with the certified registered nurse anesthetist and clinic staff nurses revealed that the certified registered nurse anesthetist's routine practice was to prepare a single needle and syringe at the beginning of each clinic session for each of three sedation medications (midazolam,

TABLE 1
RESULTS OF HEPATITIS C VIRUS TESTING FOR 795 PAIN CLINIC PATIENTS IN OKLAHOMA DURING 2002*

No. of cases	71 (82.6%)
Evidence of acute infection†	
Yes	40 (56.3%)
No	31 (43.7%)
Genotype (n = 63)	
1a	46 (73.0%)
2b	5 (7.9%)
3a	4 (6.4%)
Indeterminate	8 (12.7%)
No. of prior infections	15 (17.4%)
Evidence of previous infection	
Previously diagnosed	10 (66.7%)
Strong risk factors	5 (33.3%)
Genotype (n = 13)	
1a	7 (53.8%)
2b	3 (23.1%)
1b	1 (7.7%)
3a	1 (7.7%)
Indeterminate	1 (7.7%)

*Eighty-six patients (10.8%) were infected with hepatitis C virus. Eleven clinic patients were co-infected with hepatitis C virus and hepatitis B virus.

†Included self-reported jaundice or laboratory evidence of an elevated alanine aminotransferase level (> 2.5 times the upper limit of normal).

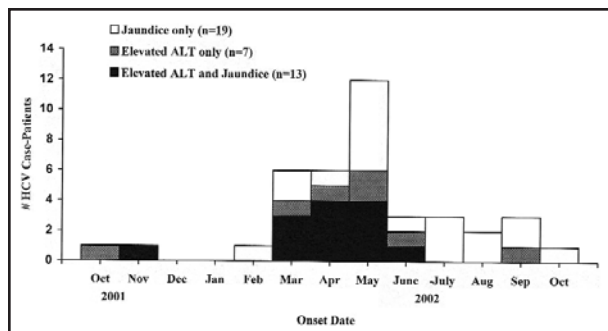


FIGURE 1. Onset of evidence of acute hepatitis C virus (HCV) infection among HCV case-patients (n = 39). Forty (56.3%) of the 71 case-patients infected with HCV self-reported jaundice or had laboratory evidence of an elevated alanine aminotransferase (ALT) level (> 2.5 times the upper limit of normal); however, 1 patient could not recall the month of onset. For patients with an elevated ALT level and jaundice, the date of the laboratory report of an elevated ALT level was used as the date of onset.

fantanyl, and propofol) and to use these three syringes and needles to administer these medications sequentially to all patients treated in an individual clinic session, through a heparin lock attached directly to an intravenous cannula. The certified registered nurse anesthetist reported that he employed this unsafe injection practice because he believed the heparin lock provided a sterile field.

In March 2002, a staff nurse lodged a verbal complaint about the certified registered nurse anesthetist's reuse of needles with an immediate supervisor, but this complaint was not formalized in writing or investigated. A

TABLE 2
RESULTS OF HEPATITIS B VIRUS TESTING FOR 795 PAIN CLINIC PATIENTS IN OKLAHOMA DURING 2002*

No. of cases	31 (73.8%)
Evidence of acute infection†	
Yes	13 (41.9%)
No	18 (58.1%)
HBV test panel results	
IgM anti-HBc	2
IgM anti-HBc and anti-HBs	9
Total anti-HBc and anti-HBs	18
Total anti-HBc and HBsAg	2
No. of prior infections	11 (26.2%)
Evidence of previous infection	
Previously diagnosed	8 (72.7%)
Strong risk factors	3 (27.3%)
HBV test panel results	
IgM anti-HBc‡	2
IgM anti-HBc and anti-HBs‡	2
Total anti-HBc and anti-HBs	6
Total anti-HBc and HBsAg	1

HBV = hepatitis B virus; anti-HBs = antibody to hepatitis B surface antigen; anti-HBc = antibody to hepatitis B core antigen; HBsAg = hepatitis B surface antigen.

*Forty-two patients (5.3%) were infected with HBV. Eleven clinic patients were co-infected with hepatitis C virus and HBV.

†Included self-reported jaundice or laboratory evidence of an elevated alanine aminotransferase level (> 2.5 times the upper limit of normal).

‡Four IgM anti-HBc-positive patients were each tested more than 12 months after their most recent clinic visit and each reported a prior diagnosis of HBV, previous risk factors (injection-drug use or receipt of blood products before 1972), or both.

formal complaint was lodged in June 2002, following a verbal complaint by a second nurse. The certified registered nurse anesthetist and clinic staff nurses reported that the certified registered nurse anesthetist began using new syringes and needles to administer each medication to each patient on June 17, 2002, when notified of the formal complaint concerning his technique.

There was no evidence that any other clinic staff practiced improper infection control techniques. Multi-dose vials were not carried over from one clinic day to another. Saline and heparin were aliquotted into individual syringes at the beginning of each clinic day and were maintained in a room separate from the patient treatment areas. No additional equipment that could have served as a source of transmission was identified. With the exception of one staff nurse who was also a clinic patient and met the case definition for HCV infection, clinic staff tested negative for HCV and HBV infections.

Retrospective Cohort Study

There were no differences in HCV infection rates by mean age (data not shown) or gender (Table 3). Higher HCV infection rates were associated with more frequent clinic visits (Table 3). The risk of infection increased significantly when patients were treated immediately after or anytime after a patient infected with HCV during the same clinic session (Table 3); these relation-

TABLE 3
ASSESSMENT OF POTENTIAL RISK FACTORS FOR HEPATITIS C VIRUS INFECTION AMONG PAIN CLINIC PATIENTS IN OKLAHOMA DURING 2002

Risk Factor	No. of Case-Patients	No. of Uninfected Patients	RR (CI₉₅)	P	Adjusted OR* (CI₉₅)
Gender					
Male	28	247	1.2 (0.8–1.9)	.49	
Female	43	453			
No. of clinic visits					
> 1	58	421	2.8 (1.6–5.0)	< .001	
1	13	288			
Treated anytime after an anti-HCV–positive patient during the same clinic session					
Ever	66	383	9.7 (4.0–23.9)	< .001	6.2 (2.4–15.8)
Never	5	326			
Treated immediately after an anti-HCV–positive patient					
Ever	54	103	12.6 (7.5–21.1)	< .001	14.0 (7.5–26.2)
Never	17	606			
Total no. of visits treated anytime after an anti-HCV–positive patient during the same clinic session					
0	5	326	1.00		
1	24	258	5.6 (2.2–14.6)	< .001	
2	27	92	15.0 (5.9–38.0)	< .001	
≥ 3	15	33	20.7 (7.9–54.3)	< .001	
				< .001†	

HCV = hepatitis C virus; RR = relative risk; CI₉₅ = 95% confidence interval; OR = odds ratio; anti-HCV = antibody to hepatitis C virus.

*Derived from multivariate analysis.

†Chi-square test for linear trend.

ships remained after multivariate modeling adjusting for age, gender, and number of clinic visits (Table 3). There was also a significant dose–response relationship between the HCV infection rate and the number of clinic visits during which a patient was treated anytime after a patient infected with HCV. Compared with patients never treated after a patient infected with HCV, the risk increased 6-fold for those treated anytime after an infected patient on 1 day, 15-fold for those treated anytime after an infected patient on 2 days, and 21-fold for those treated anytime after an infected patient on 3 or more days (Table 3).

Higher HCV genotype 1a infection rates were also significantly associated with being treated immediately after (RR, 13.1; CI₉₅, 7.3 to 23.4; $P < .001$) or anytime after (RR, 10.5; CI₉₅, 3.8 to 28.9; $P < .001$) a patient infected with HCV genotype 1a during the same clinic session. Similarly, although there were only 5 HCV case-patients with genotype 2b, higher HCV genotype 2b infection rates were significantly associated with being treated immediately after (RR, 312.5; CI₉₅, 38.8 to 2,500.0; $P < .001$) or anytime after (RR, 65.8; CI₉₅, 7.5 to 588.2; $P < .001$) a patient infected with HCV genotype 2b during the same clinic session. Higher HCV genotype 3a infection rates were not associated with being treated after a patient with HCV genotype 3a (data not shown).

Clustering of three or more sequentially treated

patients infected with HCV genotype 1a occurred on seven clinic dates. Clustering of two patients infected with HCV genotype 1a and at least one patient with an indeterminate or unknown genotype treated sequentially occurred on an additional three clinic dates. During 2 days, nine patients with HCV genotype 1a were treated in close sequence (Table 4). Clustering of two or more sequentially treated patients infected with HCV genotype 2b occurred on three clinic dates. Although patients infected with HCV genotype 3a were never treated sequentially in the clinic, there were two clinic dates during which two patients infected with HCV genotype 3a were treated. On one of these dates, the two patients infected with genotype 3a were separated in treatment order by one patient infected with HCV genotype 1a.

There were no differences in HBV infection rates by mean age (data not shown) or number of clinic visits, but males had significantly higher HBV infection rates than did females (Table 5). The risk of acquiring HBV infection was significantly associated with being treated immediately after or anytime after a patient infected with HBV (based on any combination of markers) or, more specifically, after an HBsAg-positive patient during the same clinic session (Table 5). These relationships remained after multivariate modeling adjusting for age, gender, and number of clinic visits (Table 5). There was

TABLE 4
CLUSTERING OF PAIN CLINIC PATIENTS INFECTED WITH HEPATITIS C VIRUS IN OKLAHOMA DURING 2002

Date of Clinic Visit*	Order†	Genotype	
2/25/2002 (n = 24)	11	1a	
	12	1a	
	13	1a	
	14	1a	
	15	1a	
	16	1a	
	17	1a	
	18	1a	
	19	1a	
	20	2b	
	21	Indeterminate	
	22	‡	
	23	‡	
	24	1a	
	3/11/2002 (n = 21)	3	2b
		4	1a
		5	1a
		6	1a
		7	‡
		8	1a
		9	1a
		10	1a
		11	1a
		12	1a
13		1a	
14		Indeterminate	
15		1a	
16		‡	
17		Indeterminate	
18		1a	
19		‡	
20		1a	

*The date patients visited the clinic to receive pain management treatments.

†The sequential order in which patients were treated that day.

‡Patient was not tested or was negative for antibody to hepatitis C virus or antibody to hepatitis B core antigen.

Note. Ten patients treated on February 25, 2002, were also treated on March 11, 2002.

also a significant dose-response relationship between HBV infection rates and the number of clinic visits during which a patient was treated anytime after a patient infected with HBV. Compared with patients never treated after a patient infected with HBV, the risk increased 3-fold for those treated anytime after an infected patient on 1 day, 4-fold for those treated anytime after an infected patient on 2 days, and 10-fold for those treated anytime after an infected patient on 3 or more days (Table 5). Clustering of three sequentially treated patients infected with HBV occurred on three clinic dates. On two clinic dates, four

patients infected with HBV were treated after an HBsAg-positive patient (Table 6).

Amplification of HCV infections among patients receiving treatment in the clinic appeared to occur as patient-to-patient transmission spread the virus in the patient population. Figure 2 displays the proportion of patients treated in the clinic each month who met the case definition for HCV infection. The prevalence of HCV case-patients began to increase in May 2001, appeared to peak in February to March 2002, and returned to baseline in July 2002. The attack rate of HCV infections among patients treated in the clinic from May 2001 through June 10, 2002, was 16.6%. The attack rate prior to this period was 2.6%, and the attack rate after this period was 4.9%. The outbreak appeared to end when the certified registered nurse anesthetist discontinued reusing syringes and needles on June 17, 2002. All HCV and HBV case-patients treated in the clinic after this date were also treated before this date and clustering of HCV and HBV case-patients was not observed after this date.

DISCUSSION

We identified 71 cases of HCV and 31 cases of HBV infection among patients undergoing pain remediation treatments in an outpatient clinic in Oklahoma. Our results suggest that infection was likely transmitted from patient to patient when a syringe and the attached needle, contaminated by the blood of an infected patient during the administration of anesthesia, were reused on subsequent patients. Failure of a certified registered nurse anesthetist to follow basic principles of infection control, inadequate oversight of clinic staff by the attending physician, delays in responding to staff complaints, and the difficulty of identifying acute cases of HCV all contributed to the outbreak's magnitude and prolonged duration.

Administering intravenous anesthesia provides many opportunities for contamination of medical equipment, supplies, and multidose medication vials if strict aseptic technique and appropriate injection practices are not applied.²¹ Lapses in aseptic technique by anesthesiologists or certified registered nurse anesthetists have been implicated in previous reports of transmission of bacterial and viral pathogens.^{18,22-24} Savings of drugs, supplies, and time have been cited as reasons for reuse of syringes during administration of anesthesia medications among anesthesiologists.^{2,5,25-27} Drug-abusing healthcare workers may also serve as sources of provider-to-patient transmission of blood-borne infections.²⁸

The certified registered nurse anesthetist involved in this outbreak reported routinely reusing needles and syringes during a period of several years while administering anesthesia medications directly into intravenous solution bags or portals on tubing in surgical settings. He continued reusing needles and syringes when he began working in the pain clinic. He reported that he was unaware that this inappropriate injection practice may have placed patients at risk of blood-borne infections.

TABLE 5
ASSESSMENT OF POTENTIAL RISK FACTORS FOR HEPATITIS B VIRUS INFECTION AMONG PAIN CLINIC PATIENTS IN OKLAHOMA DURING 2002

Risk Factor	No. of Case-Patients	No. of Uninfected Patients	RR (CI₉₅)	P	Adjusted OR* (CI₉₅)
Gender					
Male	17	257	2.2 (1.1–4.4)	.021	
Female	14	485			
No. of clinic visits					
> 1	21	457	1.3 (0.6–2.8)	.44	
1	10	294			
Treated anytime after an HBV [†] -positive patient during the same clinic session					
Ever	20	260	3.3 (1.6–6.7)	< .001	2.9 (1.3–6.5)
Never	11	491			
Treated immediately after an HBV [†] -positive patient					
Ever	11	60	5.5 (2.8–11.0)	< .001	6.4 (2.7–15.3)
Never	20	691			
Treated anytime after an HBsAg-positive patient during the same clinic session					
Ever	9	27	8.5 (4.2–17.0)	< .001	10.5 (4.2–26.5)
Never	22	721			
Total no. of visits treated anytime after an HBV [†] -positive patient during the same clinic session					
0	11	491	1.00		
1	12	201	2.6 (1.2–5.7)	.017	
2	5	48	4.3 (1.6–11.9)	.013	
≥ 3	3	11	9.8 (3.1–31.2)	.005	
				< .001 [‡]	

HBV = hepatitis B virus; RR = relative risk; CI₉₅ = 95% confidence interval; OR = odds ratio; HBsAg = hepatitis B surface antigen.

*Derived from multivariate analysis.

[†]Defined as positive for antibody to hepatitis B core antigen in combination with HBsAg or antibody to hepatitis B surface antigen (see METHODS).

[‡]Chi-square test for linear trend.

Once he was notified that a formal complaint concerning his technique had been filed with the facility's infection control committee, he began using new syringes and needles to administer each medication to each patient. Following the brief report of this outbreak investigation, the Oklahoma Board of Nursing revoked the certified registered nurse anesthetist's license and imposed a monetary fine.¹⁸ The American Association of Nurse Anesthetists condemned the practice of reusing needles or syringes²⁹; they sent mailings to members and students, nurse anesthesia school program directors, and hospital administrators reminding them that needles and syringes should not be reused. However, continued targeted educational efforts are recommended.

The major limitation of our study was the potential for misclassification of patients. Because there is currently no assay to distinguish newly acquired from previous HCV infection and most individuals infected with HCV have mild or no signs or symptoms,³⁰ it was difficult to differentiate between cases and patients with prior infections. Information about symptoms of jaundice and prior risk factors was collected during follow-up interviews with

the patients and thus could have been subject to recall bias. Because most patients were treated in the clinic on two or three different dates, it was difficult to definitively identify which patients served as sources of infection on which dates. Genotype 1a, the most common HCV genotype in this outbreak, is the most common HCV genotype in the United States,³¹ and we were limited in our ability to directly compare HCV isolates from individual patients because viral sequencing was not performed.

We were particularly limited in our ability to correctly classify the source of HBV infection for patients who did not have serologic evidence of acute infection because 61.9% of the patients infected with HBV were tested more than 6 months after their last clinic visit (45.2% were tested more than 12 months after their last clinic visit). An additional source of potential misclassification arose from the 113 untested clinic patients. A total of 16 case-patients (5 with HCV and 11 with HBV) were never treated in the clinic after a patient known to be infected. However, 3 of the 5 HCV case-patients who were never exposed to an anti-HCV-positive patient and 7 of the 11 HBV case-patients who were never exposed to an HBV-

TABLE 6
CLUSTERING OF PAIN CLINIC PATIENTS INFECTED WITH HEPATITIS B VIRUS IN OKLAHOMA DURING 2002

Date of Clinic Visit*	Order†	Positive HBV Test Panel Results
4/29/2002 (n =15)	9	anti-HBc, HBsAg
	10	IgM anti-HBc, anti-HBs
	11	anti-HBc, anti-HBs
	12	‡
	13	IgM anti-HBc, anti-HBs
	14	‡
5/20/2002 (n =18)	15	IgM anti-HBc, anti-HBs
	13	anti-HBc, HBsAg
	14	‡
	15	IgM anti-HBc, anti-HBs
	16	IgM anti-HBc
	17	IgM anti-HBc, anti-HBs
	18	IgM anti-HBc

HBV = hepatitis B virus; anti-HBc = antibody to hepatitis B core antigen; anti-HBs = antibody to hepatitis B surface antigen; HBsAg = hepatitis B surface antigen.

*The date patients visited the clinic to receive pain management treatments.

†The sequential order in which patients were treated that day.

‡Patient was not tested or was negative for antibody to hepatitis C virus or anti-HBc.

positive patient were treated sometime after an untested patient on at least one clinic visit. Potential sources of infection for the remaining 2 HCV case-patients and 4 HBV case-patients remain unknown. Because untested patients most often visited the clinic prior to 2001, visited significantly fewer times than did tested patients, and did not cluster in treatment order with other untested patients or with hepatitis-positive patients, we do not believe untested patients played a large role in this outbreak.

Despite the potential for some misclassification, these results support a strong cause-and-effect relationship between reuse of syringes and needles in anesthesia and HCV and HBV infections of patients in this outbreak. The strength of the associations, dose-response relationships, consistency with other studies, and the fact that it was the only biologically plausible mechanism evident all support our conclusions. Additionally, when the certified registered nurse anesthetist discontinued reusing needles and syringes, the outbreak ceased.

Although data from case-control studies and national and sentinel surveillance systems suggest that healthcare-related transmission is an uncommon source of infection in the United States,³¹⁻³³ unsafe injections have been recognized as an important source of transmission of blood-borne pathogens in the developing world,³⁴⁻³⁶ and healthcare-related outbreaks of viral hepatitis have been reported in developed countries.^{8,9,12,34,37-41}

Most patients with acute HCV or HBV infections are asymptomatic and therefore might not come to medical attention or may not be investigated by public health

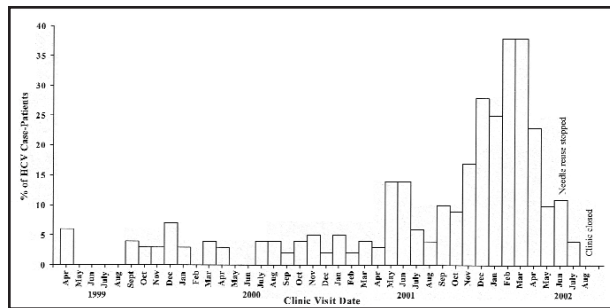


FIGURE 2. Proportion of patients treated in the pain clinic categorized as hepatitis C virus (HCV) case-patients by month of clinic visit. Because patients with HCV visited the clinic an average of 2.2 times, patients are counted more than once when their visits took place in multiple months. Reuse of needles or syringes was discontinued on June 17, 2002. The clinic was closed on August 12, 2002.

departments. This outbreak was originally identified by a local physician in a community of fewer than 100,000 who treated six of the HCV-positive pain clinic patients. This underscores the importance of collecting information on potential sources of infection from patients with acute viral hepatitis, promptly reporting acute infections to the public health department, and investigating even small clusters of unexplained acute hepatitis to determine the frequency with which healthcare-related transmission of viral hepatitis occurs. In the United States, a source for infection cannot be identified for approximately 10% to 20% of individuals newly infected with HCV or HBV.^{31,33} Healthcare-related transmission should be suspected when cases without known sources of transmission are detected among individuals who are typically at low risk for infection.¹⁸

The errors in infection control practices and oversight identified in our investigation highlight needed improvements in education and monitoring to ensure that blood-borne pathogens are not transmitted in healthcare settings. Basic infection control principles of aseptic technique and safe injection practices need to be reinforced in education and training programs. These programs should also emphasize the importance of peer review and appropriate supervision of assistants by attending physicians. Finally, each institution should have explicit mechanisms for lodging and investigating complaints of improper infection control practices, and these policies should be widely disseminated to staff, including contractors and other non-hospital staff practicing at the facility.

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