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Subject: **Epi-Aid Trip Report (2008-019): Investigation of acute hepatitis C among patients who underwent procedures at Clinic A: Nevada 2007**

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Background

On January 2, 2008, the Nevada State Health Division (NSHD) contacted CDC regarding surveillance reports received by Southern Nevada Health District's (SNHD) regarding two persons recently diagnosed with acute hepatitis C. A third person with acute hepatitis C was reported the following day. SNHD typically confirms 0-4 cases of acute hepatitis C per year. The three case-persons had a common link—all had received procedures at the same endoscopy clinic (Clinic A) within 35-90 days of illness onset. A description of these three cases follows:

- *Case 1*. A person presented on October 24, 2007 with weight loss, dark urine and scleral icterus. The patient had an elevated alanine aminotransferase (ALT) of 552 units/L and was negative for IgM antibodies to hepatitis A virus (anti-HAV) and IgM antibodies to hepatitis B core antigen (ani-HBc). Antibodies to hepatitis C virus

(anti-HCV) were positive and HCV RNA level was 5.5 million IU/ml via polymerase chain reaction (PCR). The patient denied common risk factors for hepatitis C within the previous 6 months, such as injection drug use (IDU), and sexual or other contact with a hepatitis C virus-infected person, but did report having had a colonoscopy at Clinic A on July 25, 2007.

- *Case 2.* A person with no significant past medical history presented on November 9, 2007 with a one-week history of jaundice, anorexia, dark urine and right upper quadrant pain. On November 12, 2007 the patient had an ALT of 560 units/L and was negative for IgM anti-HAV and IgM anti-HBc. At that time, the patient tested positive for anti-HCV and had an HCV RNA PCR level of 7.5 million IU/ml. The patient denied having any common risk factors for HCV infection, but did report a dental cleaning done within 6 months of the diagnosis. The patient reported having had a colonscopy on September 20, 2007 and upper endoscopy on September 21, 2007 at Clinic A.
- *Case 3.* A person presented on November 29, 2007 with dark urine and abdominal pain and had an ALT of 1070 units/L. On December 20, 2007, the patient tested negative for IgM anti-HAV and IgM anti-HBc, but positive for anti-HCV. The patient had an HCV RNA PCR level of 5.9 million IU/ml. The patient denied having any risk factors for acute HCV infection, but had a colonoscopy done at Clinic A on September 21, 2007.

As a result of the increase in reported cases and the potential for a common exposure, SNHD requested CDC's assistance with the investigation. EIS officers from the Division of Viral Hepatitis (DVH) and the Division of Healthcare Quality Promotion (DHQP) departed for Clark County, Nevada on January 9, 2008.

The subsequent investigation also revealed three more cases (Cases 4-6), as described below.

Objectives

1) To interview and collect specimens from identified hepatitis C patients for phylogenetic analysis at CDC
2) To investigate infection control procedures at Clinic A, especially use of multi-dose vials, reuse of single-use vials and reprocessing of endoscopes
3) To advise and assist the local and state health departments in appropriate medical chart abstraction, related data collection, and notification and testing procedures for other patients who were potentially exposed at the clinic in question.

Methods

Case Definitions

Acute hepatitis: Acute illness with discrete onset of symptoms (nausea, anorexia, fever, malaise or abdominal pain) and jaundice or elevated serum aminotransferase levels.

Acute hepatitis C: Acute hepatitis and alanine aminotransferase (ALT) more than seven times upper limit of normal (>7xULN), and IgM anti-HAV negative and anti-HCV-positive by EIA and RIBA or with an appropriate signal-to cutoff ratio for a given assay or HCV RNA-positive.

Clinic-associated acute hepatitis C case: Person who had a procedure at Clinic A in July 2007 through December 2007 who was diagnosed with acute hepatitis C within 6

months of the procedure date and does not have other significant risk factors for HCV infection.

Review of Incident Cases

The diagnosis of clinic-associated acute hepatitis C was confirmed in the three known incident cases by laboratory test results and interviews with the three case patients. Descriptions of the procedures, including timing, instrumentation, staff involvement, medications and complications were obtained from procedure records at Clinic A. Additionally, past medical history, surgical history, laboratory data and risk factors for hepatitis were obtained from the case-patients' medical charts. Blood specimens were sent to CDC for HCV molecular testing by PCR. Genotyping was determined by the NS5B region by PCR and analysis of the hypervariable region 1 (HVR1) was used to determine genetic relatedness among case patients, the methodologies for which have been previously described [1].

Review of Infection Control Practices

The personnel roster, layout of the clinic and the patient flow during procedures were reviewed with the nurse manager. An entire endoscopic procedure was observed, starting from intravenous (IV) catheter placement to endoscopic reprocessing. Additionally, each anesthetist and nurse involved in the care of incident cases, were observed and/or interviewed regarding their infection control practices.

Case Finding

We sought to identify potential source patients and additional clinic-associated cases of acute hepatitis C or HCV infection. The procedure records of persons who preceded known clinic-associated case-patients on the days they had procedures were reviewed for evidence of past HCV infection. Additionally, names of patients who had a procedure on the same days that clinic-associated case-patients had procedures were compiled and cross-matched against (a) SNHD's database containing HCV commercial laboratory results and (b) SNHD's hepatitis C public health surveillance records. After receiving verbal informed consent, we also obtained health histories on all staff that have contact with patients and sent blood specimens to CDC for bloodborne infection screening.

Results

Description of Clinic A Practices, Staff and Procedures

According to interviews with clinic staff, Clinic A was a freestanding, private endoscopy clinic that primarily performs upper endoscopies and colonoscopies, and occasionally places gastrostomy tubes and esophageal pH probes. Clinic A has performed procedures for ~18 years and moved to its current site within the past 4 years. Although considered a separate facility, they shared staff with an affiliated gastroenterology clinic. There were 9 physicians, 4 certified registered nurse anesthetists (CRNA), 10 registered nurses (RNs), 9 technicians and 2 licensed practical nurses (LPNs) who engaged in patient care. The clinic performed ~50-60 procedures a day, 5 days a week.

The layout of the clinic consisted of a small waiting area, 4 patient bays separated by curtains where pre- and post-procedure assessments took place, a preparation room where IV catheters were placed and 2 procedure rooms (Figure 1). In between the

procedure rooms, there was a room where reprocessing of the endoscopes took place. A room off of the reprocessing room is where clean endoscopes were kept. A utility room was present behind a closed door next to the IV preparation room.

From observations of clinic staff, each morning, an RN opened a combination lock in order to access keys to open the medication cabinet. One cabinet contained propofol, lidocaine and saline. This cabinet remained open throughout the day. CRNAs were given vials of propofol and a bottle of lidocaine each morning. Fentanyl, meperidine or midazolam, which are kept in a separate lockbox, were used for sedation if the patient could not tolerate propofol and were distributed just before sedation occurs. The contents of the lockbox were checked each morning.

From observations at the facilities, at the start of each procedure, patients changed into gowns and were escorted to a bay area. They were then called back into the preparation room. In the room, IVs were usually placed by RNs or CRNAs. The patients then moved to the procedure room where CRNAs and technicians interviewed and positioned the patient in the procedure room. An RN recorded patient vital signs and findings while in the procedure room. Technicians then brought an endoscope from the clean room into the procedure room. After gowning and gloving, a clinician entered the room and performed endoscopy after an anesthetic (usually propofol) had taken effect on the patient. After the procedure, the patient was brought back to the patient bay for post-procedure assessment and recovery. IV fluids were available, but, according to staff interviews and chart reviews, rarely needed to be administered after the procedure. Clinic A did not have authorization to conduct any blood testing, including fingerstick glucose monitoring.

Review of Infection Control Practices

Observations of Work Environment

Clinic A generally appeared clean and well organized. There was a separation between clean and contaminated equipment areas. Puncture-resistant sharps containers were conveniently located where IVs were inserted or parenteral medications delivered. Sharps containers were never overflowing during the observation period; at the end of the day, these were disposed of in the utility area.

Sinks and hand sanitizers were located throughout the Clinic. However, on multiple occasions, staff were observed not performing proper or adequate hand hygiene between patients. Additionally, anesthetists did not always wear gloves when they administered IV medications. Such improper infection control practices were pointed out to staff and administrators soon after breaches were noted.

Injection Practices

Before placing IVs, RNs or CRNAs generally wore gloves, but one CRNA was observed not to do so. They cleansed the patient's skin with alcohol. They did not have safety-locking needles, but most disposed of needles into proper receptacles. However, one CRNA was observed moving about the room with an uncapped needle. RNs flushed the IVs with 1-2 ccs of saline obtained from 20cc vials after placement of the IVs. They usually did not wipe the stopper with alcohol. CRNAs generally did not report using saline flushes after IV insertions since they immediately administered sedation.

We observed and inquired about preparation and administration of sedation over several days. At the start of the day, each CRNA was given one 30cc multi-dose vial of lidocaine and several vials of 200mg/20cc or 500mg/50cc single-use propofol. Using a

new syringe and needle each time, a CRNA would prefill multiple 10cc syringes with 1cc of lidocaine, recap the needles, and store them in a drawer. The syringes were neither labelled with their contents nor dated. If syringes with lidocaine drawn from previous days were still in the drawer, they would be used. At the start of a case, a CRNA would draw 9ccs of propofol using a syringe containing lidocaine and administer this to the patient.

Thereafter, the techniques of the CRNAs varied, particularly in regard to the manner in which propofol was administered to patients who required additional sedation during an endoscopy procedure. CRNA 1 was observed placing a new needle on the same syringe that had been used to administer initial sedation to a patient. This syringe then was used to withdraw additional propofol from an open propofol vial for the same patient. When questioned, the CRNA indicated that reuse of syringes in this manner for an individual patient was his routine practice and reflected what clinic staff had instructed him to do. According to an interview with the CRNA, if the patient did not require more sedation, the CRNA disposed of the needle and syringe, but kept the remainder of the propofol vial in order to use it for the next patient. CRNA 2 was observed using several new syringes to withdraw propofol in addition to the syringe that contained the lidocaine and propofol. These additional syringes filled with propofol were then available if the patient required additional sedation. CRNA 2 disposed of partially used syringes, but kept the unused ones for subsequent patients. CRNA 2 also reported having been instructed to reuse syringes to administer multiple doses of propofol to an individual patient, but did not do so. CRNA 3 was observed drawing additional doses of propofol for an individual patient with a new needle and syringe as needed. CRNA 3 reused propofol single use vials between patients after wiping the stopper with alcohol and used a new needle and syringe each time. CRNA 4 no longer worked at the Clinic and had moved out of state. By phone conversation, CRNA 4 reported a practice similar to CRNA 1. CRNA 4 would reuse a syringe to access propofol if a patient required additional sedation. The CRNA would discard the syringe at the end of the case, but would use the remainder of the propofol vial on subsequent patients.

CRNAs tended to remain in the same procedure room, except during lunch time (usually ~11:30am) when they changed rooms to cover for another CRNA. The medications were supposed to stay in the original room, and that was observed. No formal sign-out as to what was contained in used syringes and vials occurred between CRNAs. At the end of the day, partially used propofol vials were discarded and unused ones placed back into the cabinet. Unused prefilled syringes of lidocaine that were not marked with their contents or date remained in the medication drawers.

Endoscope reprocessing

Staff reported that the clinic owned 18 endoscopes; 6 used for upper endoscopies and 12 used for colonscopies. The individual endoscope number used during a particular procedure was recorded on the nursing chart. Upon completion of endoscopy, the endoscope was passed to the medical technician, who was gowned, gloved and masked. The distal portion of the endoscope was immediately placed in a container of cleaning detergent, which was kept at the bedside and changed between patients. The detergent solution was sucked through the tubing to flush the endoscope and clear the channel. The biopsy equipment was disposable and thrown out at the end of the procedure.

The endoscope was then taken into the adjacent Reprocessing Room (Figure 1). First, a leak check was performed using a handheld manometer. If the endoscope passed

the leak test, the technician then performed manual cleaning of the endoscope. All caps were removed from the endoscope and placed in a detergent solution. Then, the endoscope was submerged in a mixture of water and enzymatic cleaning solution. The air and biopsy ports were brushed clean using disposable brushes, which were thrown out after each use; also, a disposable brush was used to wipe the external surface of the endoscope. A pump was then attached, which has a set timer that pumped the enzymatic solution through the endoscope channels for one minute. When this process was completed, the endoscope and caps were then transferred to a water bath, where the endoscope was again submerged and the pump pushed water through the channels for one minute. The water and enzymatic cleaning baths were changed after every two endoscopes; however, the directions for use on the detergent bottle state that fresh detergent should be used for each endoscope or set of instruments and that the dilute detergent solution was to be discarded after each use.

After these manual cleaning steps were completed, the endoscope and caps were transferred to an automated reprocessor, which used a glutaraldehyde solution, to perform high-level disinfection. The clinic owned two reprocessors and each machine was capable of holding and reprocessing two endoscopes in the same basin, simultaneously. There was no record of which endoscopes were disinfected by which machine and in which order. Automated reprocessing was a timed process that pumped the glutaraldehyde solution over and through the ports of the endoscope. When the high-level disinfection was completed, the machine alarmed to notify the technician to inject a syringe containing 70% isopropyl alcohol and another syringe containing air for the final drying cycle. The disinfecting and drying cycles took approximately 17 minutes from start to finish, not including the manual cleaning steps. The technician then removed the endoscope from the machine, used compressed air to further dry the open ports, and then took it into the adjoining Equipment Supply Room (Figure 1) where it was hung in a cabinet to complete the drying process and await its next use. Colonoscopes were hung on one side of the closet and endoscopes on the other side. The endoscopes were not tagged and the reprocessing was not logged, but the staff claimed to be able to recognize that only endoscopes that have undergone complete reprocessing are to be hung in the clean supply room.

According to staff interviews, each morning, a maintenance test was performed on the automated reprocessor to make sure that the machine and the glutaraldehyde solution still met the necessary standards for high-level disinfection. A strip tested the chemical concentration of the glutaraldehyde reservoir in the machine. The solution was replaced when the test strip indicated the solution did not meet the necessary standards. Clinic staff stated that normally the glutaraldehyde solution lasted for 14 days, but because they do so many procedures, they would change the fluid more frequently. The daily review also involved checking the water flow, air flow, level of disinfectant, and temperature of the disinfectant. Review of the daily logs for September 2007, indicated there were no problems with either automated reprocessor machine in the two days before and after the case patients received their procedures. According to records, the glutaraldehyde solution was changed on September 10, 17 and 25 in both machines. In July 2007, the clinic had only one of the newer reprocessors and was also using an older model machine for reprocessing. Logs from the older machine were not available, but review of logs for the newer reprocessor that was used for the month of July demonstrated no problems in the two days immediately before and after one of the case

patients received their procedure (July 25). The glutaraldehyde solution solution had been changed on July 2 and 30.

The glutaraldehyde solution instructions state that the solution should be maintained with a pH between 6.0 to 7.0 and a minimum recommended concentration (MRC) of 1.5% gluteraldehyde. The expiration date was 28 days after the solution was first put into use or when the MRC drops below 1.5%, whichever came first. The clinic logs indicated that the recommended daily tests were performed.

There was no distinction or difference between reprocessing of the endoscopes and colonoscopes. Biopsy equipment for both endoscopes was disposable and both types of endoscopes were compatible with the same reprocessing equipment. There were diagrams of the reprocessing steps hung on the wall in the reprocessing room and, according to interviews with administrator, technicians were trained by an assigned mentor, until it was felt that they understood and completed the steps correctly and independently.

Clinic-Associated HCV Cases and Potential Sources Patients

Three additional cases of clinic-associated acute hepatitis C were identified.

● *Case 4* was identified as a patient who noticed light stools on October 29, 2007, which was followed by dark urine, jaundice, abdominal pain, nausea, vomiting and anorexia. The person was hospitalized on November 6, 2007. Initial blood results at that time were negative for anti-HAV, IgM anti-HBc and anti-HCV. However, the patient was positive for enzyme immunoassays (EIA) anti-HCV on testing 9 days later, with a high signal-to-cut-off ratio (4.3). The patient denied any significant risk factors for HCV within the past 6 months. The patient reported undergoing procedures at Clinic A on September 19, 2007 and September 21, 2007, dates which were confirmed in the procedure records.

● *Case 5* was a patient who became symptomatic with nausea, vomiting, anorexia and jaundice on October 22, 2007 and was hospitalized on November 6, 2007. The patient's ALT was 1165 units/L, and was positive for anti-HCV and anti-HAV, negative for anti-HBc. On subsequent testing, the patient was IgM anti-HAV- negative and HCV RNA was >50 million IU/ml. Hospital records indicated having had a colonscopy and an upper endoscopy at Clinic A; Clinic records verify that these tests were done on September 21, 2007 and September 28, 2007, respectively.

● *Case 6* was identified by physician report. The patient was a individual who was diagnosed with laboratory-confirmed acute hepatitis C on October 18, 2007. The patient had a colonscopy on September 21, 2007. Details regarding the timing of symptoms and clinical course are pending.

The six confirmed clinic-associated case-patients ranged in age from 37 to 72 years and had onset of symptoms between October 24, 2007 and November 29, 2007 (Figure 2). Five case-patients – cases 2, 3, 4, 5 and 6 – all had procedures done on September 21, 2007, with details as follows. Intravenous lines for these five case-patients were inserted by three different RNs. Anesthesia was provided by either CRNA 1 (cases 2 and 3) or CRNA 4 (cases 4, 5, and 6) (Table 1). All case-patients from September 21st received multiple doses of propofol during their procedures. We could not determine if the CRNAs changed rooms or used previously drawn medications since the procedure room numbers were not recorded in the chart. Four case-patients had colonoscopies and one had an upper endoscopy; records indicated that the same

endoscope was used on two of the patients. Two of the five case-patients had a biopsy as part of their procedure. Case-patients 2, 4 and 5 also had procedures done on September 20, 2007, September 19, 2007 and September 28, 2007, respectively. Thus far, there have been no other acute hepatitis C cases identified on those days.

Two potential source patients with chronic HCV infection were identified from medical chart reviews of patients who preceded the incident cases on July 25, 2007 and September 21, 2007 (Table 2). Both of these potential source patients with chronic HCV infection had HCV genotype 1, as did the case-patients. A blood sample from the person who had their procedure on September 21, 2007 has not yet been analyzed and a blood sample from the person who had their procedure on July 25, 2007 has not yet been obtained. None of the staff members tested positive for HCV (or current HBV) infection.

Molecular Laboratory Results

Samples from five of six clinic-associated case-patients were available for molecular testing by PCR. All were genotype 1a as determined by analysis of the NS5b region (Figure 3). Four of four persons who had procedures on September 21, 2007 had HVR1 regions that were identical or nearly identical (Figure 4). The sequence from the case-patient who had their procedure on July 25, 2007 differed from the September 21, 2007 cluster of patients.

Testing for Other Bloodborne Pathogens

Specimens from five of six patients with incident HCV infection were sent to CDC for HBV and HIV testing. Four of five showed no evidence of HBV infection by antibodies to hepatitis B core antigen (anti-HBc) testing, and one showed evidence of previous infection (total anti-HBc-positive, IgM anti-HBc-negative) but was not chronically infected (hepatitis B surface antigen negative). None were infected with HIV based on anti-HIV testing.

Discussion

Our investigation identified six cases of acute hepatitis C in persons who underwent procedures at Clinic A between 35-90 days before the onset of their illness. None of the case-patients had significant risk factors for HCV infection within the typical incubation period (15-160 days prior to the onset of symptoms) and five of the cases had procedures on the same day (September 21, 2007). The genetic relatedness of the viruses from case patients who had procedures on September 21, 2007 supports the epidemiologic findings and points to a common source of infection. The lack of genetic relatedness to the patient seen in July 2007 suggests a separate transmission incident. Observation of anesthesia administration practices indicated that some staff routinely reused syringes during individual procedures to withdraw anesthesia from single-use propofol vials that were inappropriately used to provide medication for multiple patients. Similar practices have previously been implicated in the transmission of bloodborne pathogens [2-7].

HCV is primarily transmitted through percutaneous or mucosal contact with an infected person's blood. Most (60-70%) persons acutely infected are not symptomatic or have non-specific symptoms. The remainder may have classic signs of hepatitis, such as

jaundice (20-30%), or non-specific symptoms, such as anorexia, fatigue and abdominal pain (10-20%) Regardless of whether or not they have symptoms in the acute period, approximately 70% of those infected will remain chronically infected. Among those chronically infected, 10-20% will develop cirrhosis over a 20-30 year period [8].

In the United States, transmission of HCV in healthcare settings is thought to be uncommon and is primarily recognized in the context of outbreaks [6]. During the last decade, most healthcare-associated outbreaks of HCV have involved patient-to-patient transmission and were attributed to unsafe injection practices. There have been numerous reports implicating the reuse of syringes and needles and/or the mishandling of medication vials [2-7]. In some instances, syringes and/or needles used on HCV-infected patients have been directly reused on other patients [3]. Alternatively, indirect contamination of a shared medication vial or container of flush solution has been described; this can occur when a syringe that was used on HCV-infected patients is re-used for that patient [2, 6, 9]. Backflow that occurs while injecting the patient or from removal of the needle can contaminate the syringe. If the contaminated syringe is used to withdraw medication from a vial or container that will be used for subsequent patients, these patients are placed at risk of infection. The practice of reusing syringes during a procedure to access shared propofol was observed, and interviews suggested it was a common practice at Clinic A. This was considered the most likely mode of transmission in clinic A.

Occasionally, patient-to-patient HCV transmission has been attributed to inadequate cleaning or disinfection of patient equipment [10, 11], but we consider this mechanism less likely in the context of our investigation. In clinic A, endoscope reprocessing procedures were generally followed, except that enzymatic cleaning solution was used on more than one endoscope. Manual cleaning with brushes to remove biofilms and high-level disinfection, which are considered most important for reducing potential bloodborne pathogen transmission, were judged adequate. However, because record-keeping was lacking in some respects, we could not determine whether endoscopes had been processed at the same time or by the same machine (this was not recorded in the charts). We also noted that on September 21, 2007, patient records indicated that two of the case-patients had procedures performed with one particular endoscope, although clinic staff attributed this to a clerical error. In addition, in one report, endoscopic biopsies were found to be an independent risk factor for HCV infection [11], (though deficiencies in the handling of parenteral medications were also noted). In our investigation, only three of six clinic-associated case-patients had a biopsy done, and the needle used was reported to be a single-use disposable item.

Transmission of HCV from infected staff has occasionally been reported and typically involved diversion of narcotics such as fentanyl [6]. This route of transmission appears unlikely in the clinic A setting given that no staff members have tested positive for HCV infection and propofol is not a commonly abused medication.

Actions and Recommendations

Given the findings of this ongoing investigation, we took the following actions and made the following recommendations.

Clinic A: Infection Control Practices

As we observed and interviewed individual staff members, we pointed out best practices in infection control.

1. **Injection safety**: We reviewed with the Clinic A staff the following: never reuse needles or syringes when drawing medications; never pool medications from individual vials; never use single-use vials for multiple patients; never recap needles; and immediately dispose of sharps in appropriate containers. Improper practices were promptly brought to the attention of staff (e.g., syringe reuse by CRNA 1 was immediately corrected after it was recognized).
2. **Hand hygiene**: We informed staff of the need to wash their hands or use hand sanitizer before providing injections, after blood contamination, and between patients; and to wear gloves for procedures that might involve contact with blood and to change gloves between patients.
3. **Patient-care equipment**: We instructed staff that the use of a batch of reprocessing detergent solution must be restricted to only one endoscope.

SNHD

1. **Case finding and epidemiologic studies**:
    a. Clinic A staff's routine mishandling of injection equipment and single-use medication vials represented practices that have been previously implicated in bloodborne pathogen transmission. Such practices warrant patient notification advising testing for HCV, HBV and HIV [12]. Since the clinic had been operating in its current structure and format for 4 years and it was not possible to determine which individual patients might have been exposed to contaminated vials or equipment, a general notification advising testing for patients who underwent procedures over the entire 4 year period was discussed and agreed upon.
    b. Clinic records of persons who had procedures on the days that one or more acute hepatitis C cases were identified (July 25, 2007 and September 21, 2007) were reviewed by CDC and the results were entered into a database which was provided to SNHD. We discussed and recommended the use of these data in the context of analytic epidemiologic studies to further elucidate patterns of infection and identify risk factors for infection. To the extent possible, efforts should be made to insure the highest degree of overall ascertainment of HCV infection status (i.e., acute HCV infection, previous HCV infection, HCV-uninfected) for this subset of patients.
    c. CDC recommends and offers to perform HCV genotyping and RNA sequencing on all specimens that test positive for anti-HCV for persons who had procedures on July 25, 2007 or September 21, 2007 in order to identify potential source patients and further elucidate patterns of transmission.
    d. Where feasible, CDC is available to perform HCV genotyping and RNA sequencing on specimens that test positive for anti-HCV to assist SNHD with the investigation of additional clusters of infections that might be identified as a result of the patient notification and testing.
    e. We recommended that reviews of infection control practices at other affiliated endoscopy clinics should be considered and patient notification decisions be made based on those findings.

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Figure 1: Layout of Clinic A

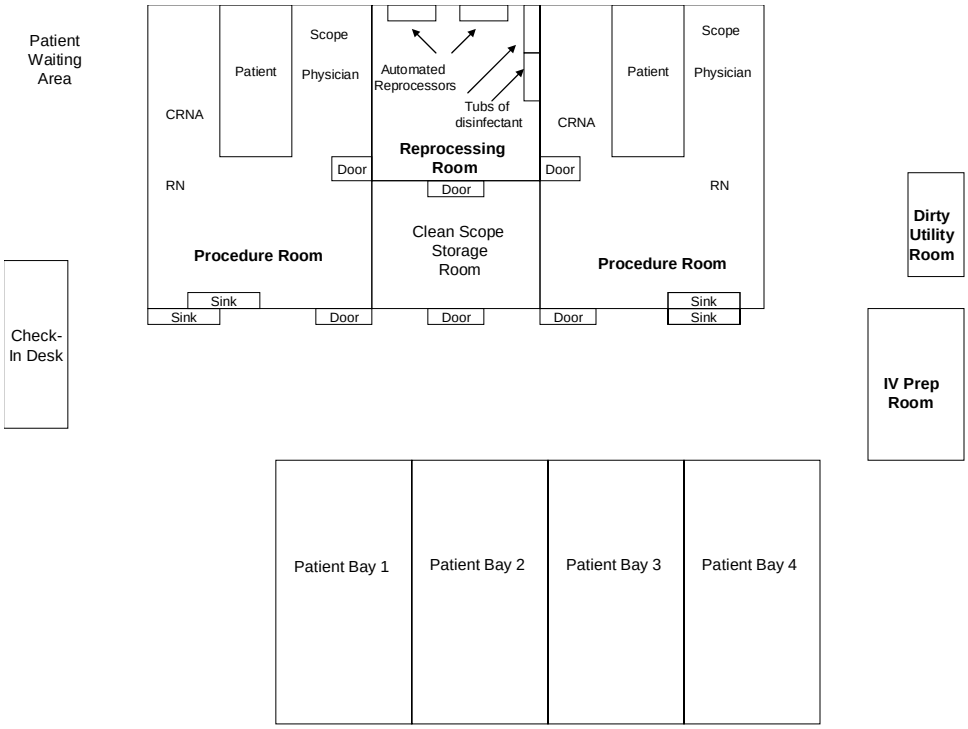


Figure 2. Acute hepatitis C in persons who underwent endoscopies at Clinic A, by date of procedure and onset of symptoms: Nevada 2007

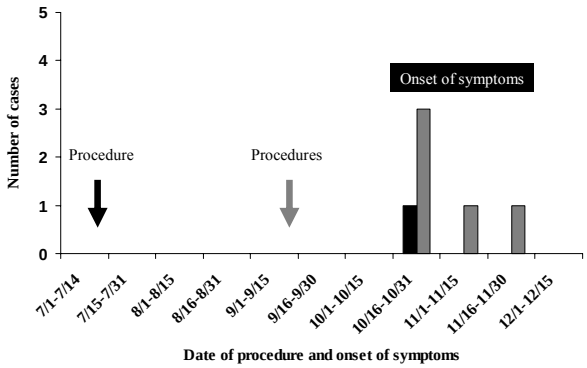


Table 1. Characteristics of procedures, staff involvement and anesthesia administered for incident case of acute hepatitis C:
Clinic A, Nevada 2007

Incident Case	Date of Procedure	Start Time	Type of Procedure	Endoscope #	Biopsy?	IV start	Anesthetist	Muliple doses of propofol administerd?
Case 1	7/25/07	8:17am	Colonoscopy	155	Yes	CRNA 4	CRNA 4	No
Case 4	9/19/07	12:35pm	Upper endoscopy	136	Yes	RN 3	CRNA 4	Yes
Case 2	9/20/07	12:20pm	Colonoscopy	170	Yes	RN 5	CRNA 1	Yes
Case 5	9/21/07	9:55am	Colonoscopy	57	No	RN 2	CRNA 4	Yes
Case 3	9/21/07	10:24am	Colonoscopy	41	No	RN 1	CRNA 1	Yes
Case 6	9/21/07	10:30am	Colonscopy	57	Yes	RN 3	CRNA 4	Yes
Case 4	9/21/07	12:25am	Colonoscopy	155	No	RN 1	CRNA 4	Yes
Case 2	9/21/07	1:12pm	Upper endoscopy	70	Yes	RN 1	CRNA 1	Yes
Case 5	9/28/07	9:25am	Upper endoscopy	170	Yes	CRNA 1	CRNA 2	Yes

Table 2. Characteristics of procedures, staff involvement and anesthesia administered for potential source patients (known to be chronically infected before the procedure and preceeded known clinic associated case-patient): Clinic A, Nevada 2007

Incident Case	Date of Procedure	Start Time	Type of Procedure	Endoscope #	Biopsy?	IV start	Anesthetist	Muliple doses of propofol administerd ?
Potential source 1	7/25/07	7:05am	Upper endoscopy	301	Y	CRNA 4	CRNA 4	Yes
Potential source 2	9/21/07	9:49am	Colonscopy	170	Y	RN 3	CRNA 1	Yes

Figure 3: HCV Genotyping by NS5b Region

Note: NVC numbers correspond to clinic-associated case-persons

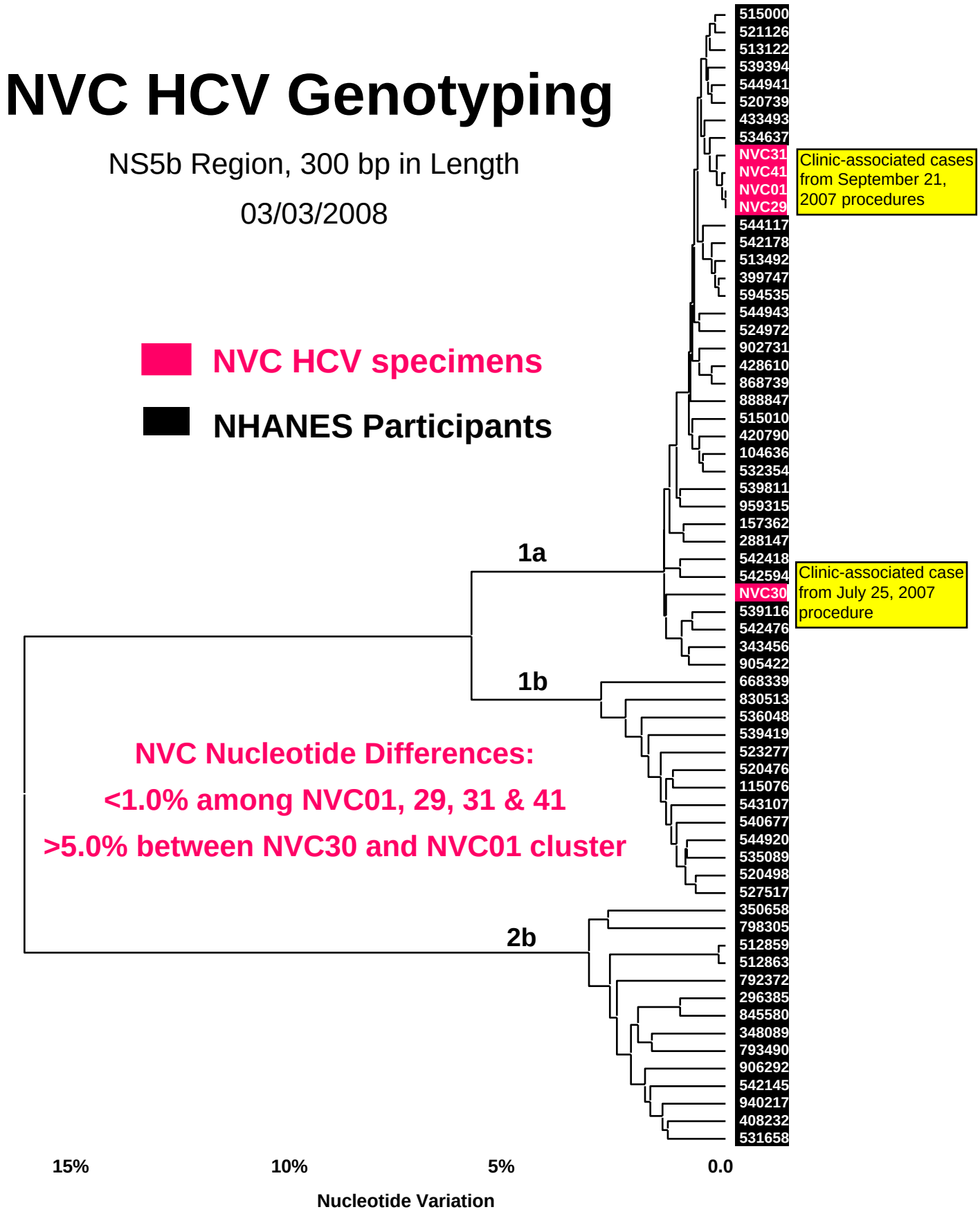


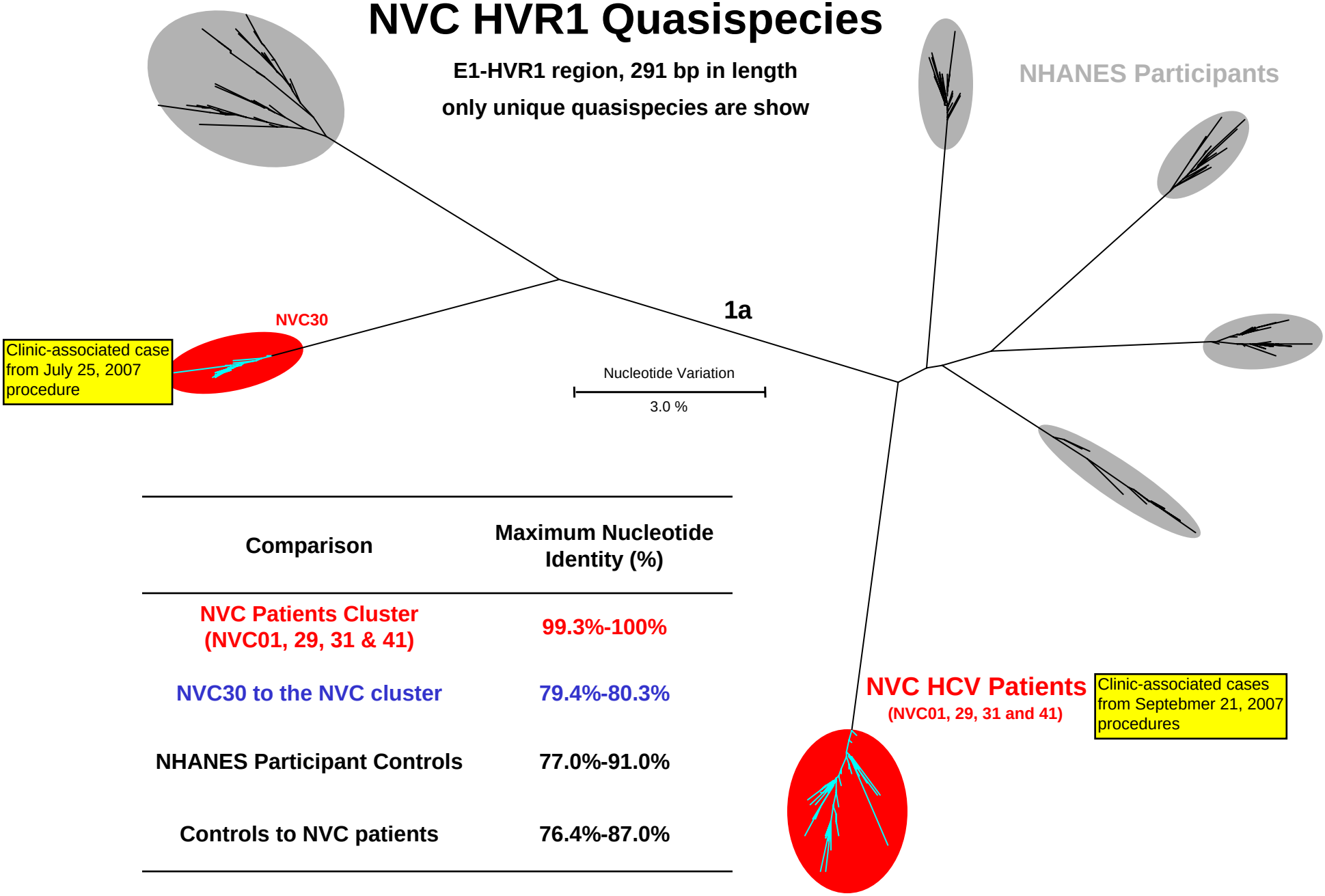
Figure 4. Quasispecies analysis by HVR1 region for clinic-associated case-persons

Note: NVC numbers correspond to clinic-associated case-persons

NVC HVR1 Quasispecies

E1-HVR1 region, 291 bp in length

only unique quasispecies are show



Comparison	Maximum Nucleotide Identity (%)
NVC Patients Cluster (NVC01, 29, 31 & 41)	99.3%-100%
NVC30 to the NVC cluster	79.4%-80.3%
NHANES Participant Controls	77.0%-91.0%
Controls to NVC patients	76.4%-87.0%