Transmission of blood-borne pathogens in US dental health care settings

2016 Update

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ABSTRACT

Background. During the past decade, investigators have reported transmissions of blood-borne pathogens (BBPs) in dental settings. In this article, the authors describe these transmissions and examine the lapses in infection prevention on the basis of available information.

Methods. The authors reviewed the literature from 2003 through 2015 to identify reports of the transmission of BBPs in dental settings and related lapses in infection prevention efforts, as well as to identify reports of known or suspected health care–associated BBP infections submitted by state health departments to the Centers for Disease Control and Prevention.

Results. The authors identified 3 published reports whose investigators described the transmission of hepatitis B virus and hepatitis C virus. In 2 of these reports, the investigators described single-transmission events (from 1 patient to another) in outpatient oral surgery practices. The authors of the third report described the possible transmission of hepatitis B virus to 3 patients and 2 dental health care personnel in a large temporary dental clinic. The authors identified lapses in infection prevention practices that occurred during 2 of the investigations; however, the investigators were not always able to link a specific lapse to a transmission event. Examples of lapses included the failure to heat-sterilize handpieces between patients, a lack of training for volunteers on BBPs, and the use of a combination of unsafe injection practices.

Conclusions. The authors found that reports describing the transmission of BBPs in dental settings since 2003 were rare. Failure to adhere to Centers for Disease Control and Prevention recommendations for infection control in dental settings likely led to disease transmission in these cases.

Practical Implications. The existence of these reports emphasizes the need to improve dental health care personnel's understanding of the basic principles and implementation of standard precautions through the use of checklists, policies, and practices.

Key Words. Infection control; infection prevention; dentistry; blood-borne pathogens; hepatitis B virus; hepatitis C virus; human immunodeficiency virus; health care–associated infection; standard precautions.

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Transmissions of blood-borne pathogens (BBPs) in a dental health care setting have rarely been reported, particularly since routine hepatitis B virus (HBV) vaccination of dental health care personnel (DHCP) and universal precautions were recommended (1982 and 1987, respectively).[1-5] BBPs of primary concern include HBV, hepatitis C virus (HCV), and human immunodeficiency virus (HIV). In 1996, the Centers for Disease Control and Prevention (CDC) expanded the concept of universal precautions and changed the term to "standard precautions."[6] Standard precautions integrate and expand the elements of universal precautions into a standard of care designed to protect health care personnel (HCP) and patients from pathogens that can be spread by means of blood or any other body fluid, excretion, or secretion, except sweat and tears. The Occupational Safety and Health Administration standard regarding BBPs focuses on protecting HCP from BBPs and retains the term "universal precautions."[7]

We identified 3 reports describing transmissions of HBV and HCV in dental settings,[8-10] all of which were published after the release of the CDC's *Guidelines for Infection Control in Dental Health-Care Settings—2003*.[3] We examined these reports and noted the lapses in infection prevention on the basis of the available information. We considered whether the transmissions had resulted from the failure to adequately implement existing CDC recommendations for infection

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prevention and control and whether additional recommendations were needed.

METHODS

In 2012, the authors (J.L.C., S.K.G., J.A.H.) began a literature review to identify published reports of confirmed transmissions of BBPs in US dental settings since 2003. We defined transmissions as those situations for which the results of the epidemiologic investigation confirmed or identified a strong epidemiologic and molecular link between cases; we defined cases as people with acute viral hepatitis who visited the same dental clinic as other people who had acute or chronic viral hepatitis infection.[11,12] We conducted literature searches using Ovid MEDLINE, Web of Science, Cochrane Library, and the National Guideline Clearinghouse. Search terms included "disease transmission," "surveillance," "dental," "dentistry," "oral health," "infection control," "infection prevention," "blood-borne pathogens," "hepatitis B virus" or "HBV," "hepatitis C virus" or "HCV," "human immunodeficiency virus" or "HIV," "occupational exposure," "breaches," "health care-associated infections" or "HAIs," and "compliance." We limited searches to articles published in English from January 2003 through November 2015, and we excluded editorials, expert opinions, and general reviews.

In addition, we reviewed published summaries from CDC's Division of Viral Hepatitis, which is part of the National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, of suspected health care–associated hepatitis transmissions reported by state and local health departments from 1998 to 2014.[11,12] HBV and HCV infections are reportable conditions in all states. Surveillance case report forms for viral hepatitis infections request information about potential behavioral risks, such as sexual contact and injection drug use, a history of working in a health care setting, and a history of receiving medical and dental treatment during the likely exposure period. State and local health departments investigate patients who do not report behavioral risk factors to determine potential sources of transmission. Although it is not mandatory for health departments to report suspected health care–associated hepatitis cases to the CDC, health departments can request that the CDC provide consultation and laboratory assistance to complete these investigations.

RESULTS

By searching the literature and reviewing reports to the CDC of transmission events from 2003 to 2015, we identified 3 episodes of BBP transmission in US dental settings (Table 1[8-10]). In 2 episodes,[8,10] investigators confirmed a single instance of patient-to-patient transmission of either HBV or HCV. Both single-transmission episodes of BBPs occurred in outpatient oral surgery practices. In a third episode,[9] investigators identified acute HBV infection in 3 patients and 2 DHCP who were volunteers and not involved directly in the delivery of clinical care (Box 1[3]). We did not identify any transmissions of HIV among dental patients or DHCP during our search.

In 2002, a state health department conducted an epidemiologic investigation of a person who had an acute HBV infection (Table 1).[8] This index patient (that is, the first case or instance of a patient who came to the attention of health authorities) had no identified risk of developing infection, but the patient reported having recently had oral surgery involving intravenous (IV) sedation and undergone the extraction of 7 teeth. A retrospective investigation of the treating oral surgery practice revealed that another patient (the source patient), who had been seen earlier on the same day as the index patient, was listed on the state's reportable disease registry for HBV. Documentation showed that at the time the source patient had 3 teeth extracted under IV general anesthesia, she also had chronic hepatitis B and had tested positive for hepatitis e antigen with a high viral load. The findings of molecular genetic testing confirmed the transmission of HBV between this source patient and the index patient. During the investigation, office staff members reported that they had followed standard infection prevention and control practices. All staff members had been vaccinated, and none of them had HBV. The investigators only could speculate that the virus had been spread via an environmental surface that remained contaminated with blood, despite the staff members' reportedly good cleaning practices. Furthermore, the fact that a substantial prevalence of previous vaccination (64%) among the patients who were treated after the source patient may have limited the potential for additional HBV transmissions.

In 2013, another single transmission of a BBP—this time involving HCV—from 1 oral surgery patient to another occurred[10] (Table 1). The case was initially reported to state public health officials as a potential health care–associated HCV infection when a regular blood donor screened positive for HCV infection during a routine blood donation. All of the patient's previous blood donations, including 1 that had occurred in April 2012, had tested negative for HCV. The patient did not report having any typical risk factors for HCV infection, but the patient had undergone oral

ABBREVIATION KEY. **ADA:** American Dental Association. **BBPs:** Blood-borne pathogens. **CDC:** Centers for Disease Control and Prevention. **DHCP:** Dental health care personnel. **HAI:** Health care–associated infection. **HBV:** Hepatitis B virus. **HCP:** Health care personnel. **HCV:** Hepatitis C virus. **HIV:** Human immunodeficiency virus. **IV:** Intravenous. **TB:** Tuberculosis.

TABLE 1

Published reports of transmission of blood-borne pathogens in dental health care settings, 2003 to 2015.

STUDY	SETTING (YEAR REPORTED)	PATHOGEN (HEALTH CARE–ASSOCIATED INFECTIONS)	NO. OF PEOPLE NOTIFIED FOR BLOOD-BORNE PATHOGENS SCREENING	DENTAL TREATMENT PROVIDED	REPORTED ANESTHETIC	KNOWN OR SUSPECTED MODE OF TRANSMISSION	COMMENTS
Redd and Colleagues,[8] 2007	Oral surgeon's practice (2002)	HBV* (1)	27	Index patient†: 7 extractions, intravenous sedation	Intravenous methohexital, diazepam, dexamethasone, fentanyl, droperidol, local lidocaine, and nasal oxygen	The investigators speculated that a lapse in cleaning environmental surfaces had occurred after the source patient was treated, leaving an area contaminated with blood, which resulted in cross-contamination.	This is the first documented case, to our knowledge, of patient-to-patient transmission of a blood-borne pathogen in a dental setting in the United States. The source patient had chronic hepatitis B with high viral load at the time of the surgery. A high prevalence of hepatitis B vaccination (self-reported) among patients may have limited additional transmission. The office staff members followed standard infection prevention and control practices, and all staff members had been previously vaccinated and were negative for HBV. Medications were kept in multidose medication vials in a separate medication room. The physical layout of the office, strict one-way flow of needles from the clean area, careful record keeping for controlled substances and multidose medication vials, and lack of observed improper procedures suggested that unsafe injection practices was not a likely mode of transmission.
				Source patient: 3 extractions, intravenous general anesthesia	Intravenous methohexital, diazepam, dexamethasone, fentanyl, droperidol, succinylcholine, intramuscular methylprednisolone acetate, local lidocaine, and nasal oxygen		

* HBV: Hepatitis B virus.
† Index patient: The first case or instance of a patient who came to the attention of health authorities.
‡ The index patient who had undergone extractions and received dental prophylaxis and the index patient who had undergone extractions were lost to follow-up.
§ DHCP: Dental health care personnel.
¶ HCV: Hepatitis C virus.

surgical procedures during multiple dental appointments at a single dental practice within the 3 months before testing positive for HCV. Investigators found multiple lapses of infection prevention and control practices, including but not limited to having dental assistants on staff who did not have appropriate certification and who determined dosage and administered IV sedation medication, improper dating and storage of multidose medication vials, use of single-dose medication vials for more than 1 patient, and a lack of autoclave monitoring and maintenance. Molecular testing conducted by CDC staff members compared HCV specimens from the index patient with another clinic patient who was known to be infected with HCV and who had undergone an oral surgical procedure on the same day as the index patient. These test results showed close molecular identity, which indicated a likely transmission between the 2 patients. Although the investigators identified multiple lapses in infection prevention practices, they concluded that it was possible that DHCP may have reused needles, syringes, or both to enter medication vials and then subsequently used one of those medication vials when treating another patient.[10] This unsafe injection practice, which contaminates the contents of the medication vial, has been associated with the

TABLE 1 (CONTINUED)

STUDY	SETTING (YEAR REPORTED)	PATHOGEN (HEALTH CARE–ASSOCIATED INFECTIONS)	NO. OF PEOPLE NOTIFIED FOR BLOOD-BORNE PATHOGENS SCREENING	DENTAL TREATMENT PROVIDED	REPORTED ANESTHETIC	KNOWN OR SUSPECTED MODE OF TRANSMISSION	COMMENTS
Radcliffe and Colleagues,[9] 2013	Free dental clinic conducted in a school gymnasium (2009)	HBV (5)	> 1,500	Index patient[†] 1: extractions, dental prophylaxis Index patient 2: extractions, restorations Index patient 3: extractions	Local anesthetic with lidocaine (index patient 2)[‡]	Multiple procedural and infection prevention and control breaches were identified during retrospective investigation (for example, outer surfaces of dental handpieces were reportedly cleaned with disinfectant wipes and used on patients without being heat-sterilized, instruments were sterilized unwrapped, and some patients were allowed to carry their partially used anesthetic carpules in the metal syringes on a tray to other stations if needed for later reuse); however, sparse documentation did not provide evidence to link specific breaches with infection.	Of the 5 cases, 3 were patients and 2 were DHCP[§] who were not involved in patient-care delivery but were potentially exposed to infectious agents. One member of the DHCP team set up supplies and performed maintenance on both clean and dirty equipment such as air compressors and did report exposure to blood during this clinic and also had an exposure at another temporary dental clinic 1 month earlier. The other DHCP escorted patients from the dental triage section to the waiting area of the treatment section and did not report exposure to blood at this clinic. Neither DHCP had received the HBV vaccine nor had they received infection control training in preparation for working in the clinic.
				Potential source patient with known hepatitis B surface antigen positivity: extractions 2 other potential source patients: restorative procedures	Local anesthetic with lidocaine		
Bradley, 2015[10]	Oral surgeon's practice (2013)	HCV[¶] (1)	5,810	Index patient[†]: tooth extraction, bone graft, and implant placement with intravenous sedation	Intravenous propofol, midazolam, dexamethasone, metoclopramide, local lidocaine, and nasal oxygen and nitrous oxide	Multiple lapses in infection prevention and control were found, most notably related to administration of intravenous sedation medications by unsupervised, unlicensed, and untrained dental assistants. Other possible routes of transmission included improperly sterilized dental equipment or environmental contamination; however, contaminated medication vials used on more than 1 patient was a likely mode of transmission.	To our knowledge, this is the first documented case of patient-to-patient transmission of HCV in a dental setting in the United States. No other cases of blood-borne infections were identified that could be attributed definitively to transmission among patients at this oral surgery clinic.
				Source patient: multiple extractions with intravenous sedation	Intravenous propofol, ketamine, diazepam, dexamethasone, local lidocaine, and nasal oxygen and nitrous oxide. Morphine administered by unknown route.		

transmission of BBPs in a variety of health care settings.[13,14] The investigators did not identify any other cases of blood-borne infections that could be linked definitively to transmission among patients at this oral surgery clinic.

In 2009, investigators from the local and state health departments identified an outbreak of 5 acute HBV infections at a 2-day portable dental clinic[9] (Table 1). Set up in a gymnasium, the dental clinic was staffed by 750 volunteers, and more than 1,100 adults received dental

BOX 1

Definition of dental health care personnel.*

"DHCP† include dentists, dental hygienists, dental assistants, dental laboratory technicians (in-office and commercial), students and trainees, contract personnel, and other persons not directly involved in patient care but potentially exposed to infectious agents (e.g., administrative, clerical, housekeeping, maintenance or volunteer personnel)."

* Source: Kohn and colleagues.[3]
† DHCP: Dental health care personnel.

treatment. The 5 acute HBV infections included 3 patients and 2 DHCP who were not involved directly with patient care. All 3 patients had undergone extractions; 1 of the patients also had received restorations and another patient also received a dental prophylaxis. None of the 3 patients shared a treatment provider. One of the cases involved a member of the DHCP team at the clinic whose role was to maintain the dental equipment. The DHCP reported that, while wearing gloves, he had handled a blood-contaminated air compressor. He also reported having had frequent episodes of nose-blowing and had wiped sweat from his brow without removing his gloves. He also reported that he had worked at a similar clinic 2 weeks previously. When working at that clinic, he did not wear a mask or protective eyewear, and, while handling a full suction container, he had been splashed in the face by blood-contaminated saliva. The second case involving DHCP was a person who had directed patients from triage to the treatment waiting area. This person did not report having had any contact with blood. None of the 5 people who had acute HBV infections had reported having any behavioral risk factors for HBV, such as a recent history of injection drug use or multiple sex partners. By reviewing the state's HBV registry, the case investigators revealed 3 possible source patients (that is, patients who had positive serologic tests for hepatitis B surface antigens before they had visited the portable dental clinic). Serologic specimens were not available from these patients to conduct viral sequencing or to make comparisons with the outbreak cases.

The results of the investigation[9] revealed several breaches of infection prevention practices that could have resulted in the exposure of patients, staff, and environmental surfaces to HBV and other BBPs. For example, reports indicated that the outer surfaces of dental handpieces had been cleaned with disinfectant wipes but were returned to service without being heat-sterilized before being used on other patients, that used instruments had been sterilized unwrapped, and that some patients had been allowed to carry their partially used anesthetic cartridges in the metal dental cartridge syringes on a tray to other stations if the anesthetic might have been needed for later reuse. Patient treatment chairs and portable dental units were in close proximity, and DHCP performed oral surgical procedures in treatment areas lacking physical barriers, such as curtains.

In addition, the results of the investigation[9] revealed that volunteers who were not involved in patient care did not receive training about BBPs, and no one had verified their histories of having received the hepatitis B vaccination, even though the volunteers could potentially be exposed to blood. It was assumed that the licensed dentists and dental students who volunteered already received the HBV vaccination and training in preventing the transmission of BBPs. The clinic did have a policy for needlestick reporting and follow-up; however, written policies including training in and oversight for infection prevention and control were lacking. Written information about individual patient procedures and providers was limited. Despite the identification of breaches related to infection prevention and control during the clinic, it was not possible to retrospectively link specific practices to the transmission of HBV in this outbreak. Laboratory results from the patients' HBV gene sequences showed that all were genotype D and that a partial gene sequence was identical in all cases; this finding provides limited evidence that these 5 outbreak cases could have been exposed to blood from a common source.

DISCUSSION

Infection prevention recommendations are designed to prevent or reduce the potential for disease transmission from patient to DHCP, from DHCP to patient, and from patient to patient. Patient-to-patient transmission of BBP can occur when lapses in basic infection prevention practices allow patients who are infected with HBV or HCV to serve as an indirect source of pathogens for disease transmission to other patients. For example, in a dental setting, DHCP should appropriately clean, disinfect, or heat-sterilize instruments and equipment before using them on another patient.[3,21] In addition, DHCP should barrier-protect or clean and disinfect environmental surfaces, including the light handle, chair controls, computer mouse, or keyboard, between patients.[3,21] Paying strict attention to aseptic technique when handling and administering parenteral medications, such as IV or intramuscular injections, can prevent the contamination of supplies used for injections, including medication vials, containers, needles, syringes, and IV tubing.[3,15] Finally, because contaminated hands can cause health care–associated infections (HAIs), proper use of gloves and performing correct hand hygiene is critical.[3,16,21]

HBV and HCV transmission as a result of unsafe injection practices is well documented in US health care settings.[11,12,17-19] As a result of these transmissions, recommendations for safe injection practices are now basic elements of standard precautions[15,20] (Box 2[21]).

BOX 2

Safe injection practices for dental health care settings.*

- Prepare injections using aseptic technique in a clean area.
- Disinfect the rubber septum on a medication vial with alcohol before piercing.
- Do not use needles or syringes† for more than 1 patient (this includes manufactured prefilled syringes and other devices such as insulin pens).
- Enter medication containers (single-dose and multidose vials, ampules, and bags) with a new needle and new syringe, even when obtaining additional doses for the same patient.
- Use single-dose vials for parenteral medications when possible.
- Do not use single-dose medication vials, ampules, and bags or bottles of IV‡ solution for more than 1 patient.
- Do not combine the leftover contents of single-dose vials for later use.
- Apply the following guidelines if using multidose vials:
  - Dedicate multidose vials to a single patient whenever possible.
  - If multidose vials will be used for more than 1 patient, restrict the multidose vial to a centralized medication area and do not allow it to enter the immediate patient treatment area (for example, dental operatory) to prevent inadvertent contamination.
  - If a multidose vial enters the immediate patient treatment area, ensure that it is dedicated for single-patient use and discarded immediately after use.
  - Date multidose vials when first opened, and discard the vial within 28 days, unless the manufacturer specifies a shorter or longer date for an opened vial.
- Do not use fluid infusion or administration sets (for example, IV bags, tubings, and connections) for more than 1 patient.

* Modified from Centers for Disease Control and Prevention.[21]
† A note about administering local dental anesthetic: When dental health care personnel use a dental cartridge syringe to administer local anesthetic, they should not use the needle or the anesthetic cartridge for more than 1 patient. They should ensure that the dental cartridge syringe is cleaned appropriately and heat-sterilized before using it with another patient.
‡ IV: Intravenous.

Investigators of the 2013 event concluded that the dental patient-to-patient transmission of HCV likely was caused by DHCP reentering medication vials with a syringe that already had been used for a patient who had a chronic HCV infection and then using the contents of those vials for an injection in another patient.[10] CDC recommends using single-dose medication vials whenever possible; if HCP must use multidose medication vials, they should dedicate the use of the vials to a single patient whenever possible. HCP should enter medication containers (single-dose and multidose medication vials, ampules, and bags) with a new needle and a new syringe, even when obtaining additional doses for the same patient. In addition, if HCP bring a multidose medication vial into an immediate patient treatment area, they should dedicate the vial for single-patient use and discard it immediately after use.[15,20,22] CDC recommendations for safe injection practices (Box 2[21]) apply not only when DHCP use parenteral medications combined with fluid infusion systems, such as for patients undergoing conscious sedation, but also when DHCP administer local anesthetic, during which they should use needles and cartridges containing local anesthetics for 1 patient only and ensure that the dental cartridge syringe is cleaned and heat-sterilized between patients.[3]

HBV and HCV can persist on environmental surfaces and devices contaminated with blood. HBV is a hardy virus that has been demonstrated to survive in dried blood at room temperature on environmental surfaces for at least 1 week.[23] In studies related to infectivity, the investigators have found that HCV can survive in the environment for up to 6 weeks on dry surfaces,[24,25] although most HCV transmissions occur through percutaneous exposure.[11,12] Strict adherence to CDC infection prevention recommendations for cleaning and disinfecting environmental surfaces and for packaging and heat-sterilizing contaminated instruments is critical in preventing the transmission of BBPs.[26,27]

In this review, we described 3 events involving the transmission of BBPs that occurred in the United States between 2001 and 2013.[8-10] To put these events in context, we offer some historical comparisons of reported transmissions of BBPs in dental settings and the implementation of infection prevention recommendations. Before 1987, 9 outbreaks of HBV occurred in dental settings (general practice and oral surgery); the number of patients infected with hepatitis ranged from 3 patients in 1 outbreak to 55 patients in another.[28] In each practice, the dentist or oral surgeon also was infected. In addition, the results of serologic surveys indicated that there were a number of asymptomatic cases, suggesting that more transmissions had occurred in some of these outbreaks than had been reported.[28] To our knowledge, since 1987, there have been no transmissions of HBV or HCV in dental settings that involved an infected dentist or oral surgeon.

The hepatitis B vaccine became commercially available in 1982. Between 1983 and 1992, there was a 74% increase (from 22% to 85%) in the frequency of self-reported vaccination among US dentists participating in health screenings sponsored by the American Dental Association (ADA).[29] Serologic evidence of past HBV infection among dentists declined from prevaccine levels of 14% in 1972 to 9% in 1992, likely reflecting increased immunization and use of standard precautions.[29] From 1993 to 2007, levels of HBV infection among dentists remained relatively unchanged (Steven Gruninger, MS, senior research fellow, Research and Laboratories, Science Institute, American Dental Association, Chicago, IL, written communication, September 2014).

The average (standard deviation) prevalence of HCV antibodies among US dentists participating in ADA health screenings from 2000 to 2005 (0.47% [0.15]) remained well below the level of the general population (1.3-1.6%), suggesting that dentists in the United States

have a low occupational risk of developing HCV infection.[30] In our review, we found no evidence of transmission of a BBP, including HCV, between an infected dentist or oral surgeon and a patient.

Documented, occupationally acquired HIV infection among HCP is rare in the United States, with few confirmed cases since the late 1990s. Transmission of HIV to 6 patients of a dentist with AIDS remains the only reported transmission of HIV in a dental setting.[31,32]

Transmission of BBPs is usually of greatest concern to DHCP because of their frequent direct or indirect contact with blood or blood-contaminated saliva. Other modes of transmission, such as inhalation of infectious microorganisms, also can result in HAIs. For example, separate episodes of transmission of Legionella infection and tuberculosis (TB), respectively, also were reported from 2003 to 2015.[33,34] In 2011, an 82-year-old woman in Italy was diagnosed with Legionnaires' disease, caused by *Legionella pneumophila*, and died 2 days later.[33] The patient's only known risk of exposure for Legionella infection consisted of attending 2 dental appointments. All isolates obtained from the woman's bronchial aspirate were genetically identical to those obtained from dental unit waterline samples in her dentist's office. This incident reinforces the need to follow CDC recommendations for dental water quality.[3,21]

In 2010, investigators found that a dental hygienist who developed active pulmonary TB likely transmitted *Mycobacterium tuberculosis* to another DHCP who worked in the same practice location.[34] The newly hired hygienist worked for several months in the dental practice while she was infectious because her TB symptoms originally were misdiagnosed. This report highlights the importance of implementing a written TB infection prevention and control plan that ensures baseline screening of new hires for active or latent TB that uses a 2-step tuberculin skin test or a single blood assay for *M. tuberculosis*.[3,35,36] In addition, DHCP should be trained to recognize the signs and symptoms suggestive of active TB disease.[36]

Although the transmissions of HBV and HCV described in this report could not be definitively linked with a specific breach of infection prevention and control practices, investigators of HAIs that have occurred in other medical settings have determined that HAIs were caused by the failure of HCP to consistently practice recommended infection prevention measures and to sufficiently integrate these measures into the day-to-day management of program areas.[15] It is reasonable to assume that HAIs found in dental settings may be caused by similar lapses in compliance. In dental and medical settings, noncompliance with established guidelines has led not only to HAIs but also to burdens on resources at the state and local levels, such as the use of dedicated personnel, investigation costs, patient notification, and testing of potentially exposed patients for BBP infection.[9,37]

Our findings emphasize the importance that all DHCP, including those not involved directly in patient care but who may be exposed to infectious materials and those who use portable dental equipment, should adhere to recommended infection prevention practices. Adherence involves providing operational oversight of infection prevention practices by an infection prevention coordinator, having written infection prevention policies and procedures, training DHCP in procedures that are designed to prevent BBP transmission and infection and that are appropriate for assigned duties, ensuring that all staff members who may come into contact with blood or body fluids have received HBV vaccination, and emphasizing the use of standard precautions as the foundation for a successful infection prevention program.[3,7,9,15,38] Ongoing monitoring and routine evaluation of the infection prevention and control program are critical components for assessing compliance with recommended practices. Continuous review of the goals, activities, and practice policies should be followed by improvement activities that are realistic in expectation and, above all, effective. Table 2[3] provides examples of methods for evaluating infection prevention and control programs.

Infection prevention recommendations should be available and easily understandable so that all DHCP can routinely implement the recommendations. To accomplish these goals, CDC has developed the *Summary of Infection Prevention Practices in Dental Settings: Basic Expectations for Safe Care*.[21] This publication reflects existing evidence-based recommendations presented in CDC's *Guidelines for Infection Control in Dental Health-Care Settings—2003*[3] and other selected CDC recommendations published since 2003.[15,27,39-44] It also emphasizes the elements of standard precautions and the basic infection prevention expectations for safe care in dental settings; this publication is meant to supplement existing recommendations, not replace them. It includes a companion checklist to be used in dental practice settings to assess infection prevention policies and procedures and the adequacy of their supplies for adhering to standard precautions. Users can modify this checklist to reflect individual practice policies and procedures. In addition, infection control coordinators can use the checklist to periodically evaluate compliance with correct infection prevention practices by means of observing DHCP when they are performing their duties. We anticipate that the *Summary of Infection Prevention Practices in Dental Settings: Basic Expectations for Safe Care* and checklist can supplement existing infection prevention guidelines from the CDC, provide the basis for training and educating DHCP, and ultimately ensure the safety of both dental patients and DHCP.

TABLE 2

Examples of methods for evaluating infection prevention programs.*

PROGRAM ELEMENT	EVALUATION ACTIVITY
Appropriate Immunizations of DHCP†	Conduct an annual review of individual personnel records to ensure up-to-date immunizations.
Education and Training	Conduct an annual review to ensure that all DHCP received training on initial employment, when new tasks or procedures affected the employee's occupational exposure, and, at a minimum, annually.
Assessment of Occupational Exposures to Infectious Agents	Report occupational exposures to infectious agents. Document the steps that occurred around the exposure and plan how such exposures can be prevented in the future.
Comprehensive Postexposure Management and Medical Follow-up Program After Occupational Exposures to Infectious Agents	Ensure that postexposure management plan is clear, complete, and available at all times to all DHCP. All staff members should understand the plan, which should include toll-free phone numbers that provide access to additional information.
Adherence to Hand Hygiene Before and After Patient Care	Observe and document circumstances of appropriate or inappropriate handwashing. Review findings in a staff meeting.
Proper Use of Personal Protective Equipment to Prevent Occupational Exposures to Infectious Agents	Observe and document the use of barrier precautions and careful handling of sharp objects. Review findings in a staff meeting.
Routine and Appropriate Sterilization of Instruments Using a Biological Monitoring System	Monitor log records of cycle and temperature strip with each sterilization load, chemical indicators, and examine results of weekly biological monitoring. Take appropriate action when failure of sterilization process is noted.
Evaluation and Implementation of Safer Medical Devices	Conduct an annual review of the exposure prevention and control plan and consider new developments in safer medical devices.
Compliance of Water in Routine Dental Procedures With Current Environmental Protection Agency Drinking Water Standards (Fewer Than 500 Colony-Forming Units of Heterotrophic Water Bacteria)	Monitor dental water quality as recommended by the equipment manufacturer, using commercial self-contained test kits or commercial water testing laboratories.
Proper Handling and Disposal of Medical Waste	Observe the safe disposal of medical waste and take measures if hazardous situations occur.
Health Care–Associated Infection	Assess the unscheduled return of patients after procedures and evaluate them for an infectious process. A trend may require formal evaluation.

* Source: Kohn and colleagues.[3] For a complete discussion of program evaluation, refer to this source.
† DHCP: Dental health care personnel.

Limitations. The transmissions of BBPs that we summarized in this review may be an underestimate of the burden of infections resulting from lapses in infection control in dental settings. For example, some investigators may not have reported or linked transmissions of BBP in dental settings with dental treatment because of the long incubation period (up to 6 months) for HBV and HCV,[23-25] the asymptomatic course of acute infection for viral hepatitis and sometimes for HIV infection,[45] and the limited resources in state and local health departments to follow up on viral hepatitis cases that involved no identified risks or that lacked data on risk factors or health care visits.[45,46] Even if a patient becomes symptomatic, the HCP might not suspect that the patient has a BBP infection, or if the patient has received a diagnosis, the HCP might not have reported the patient's infection to the health department.[45]

CONCLUSIONS

The results of our review of reported transmissions of BBPs since 2003 indicate that the transmission of BBPs in US dental settings is infrequent. This finding emphasizes the overall importance of adhering to dental infection prevention recommendations, including standard precautions, to prevent BBP transmission and the dramatic effects of vaccination against occupational HBV infection. The CDC *Guidelines for Infection Control in Dental Health-Care Settings—2003*[3] remains the standard of care for the profession. Failure among DHCP to adhere to CDC infection prevention recommendations likely led to the disease transmissions identified in these reports. These transmissions highlight the need for improved understanding of the primary principles of infection prevention and control as well as the implementation of standard precautions among DHCP, including those who are not involved directly in patient care activities. ■

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