



California Dental Board Approved: Infection Control
(2 Units)

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Answer Sheet: California Dental Board Approved: Infection Control

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Author

Dr. Vicki Cohn, chosen as one of Hudson Valley's Top Dentists in 2008, 2009 and 2010, provides a full range of dental care including cosmetic dentistry and veneers, implant reconstruction, endodontics, periodontics and orthodontics using Invisalign treatment and TMJ Therapy for sore and damaged joints and muscles. She practices in Chatham, NY.

Dr. Cohn graduated from Simmons College in Boston, earning a BS in Chemistry and Art. She is graduate of the State University of New York (SUNY) at Buffalo School of Dental Medicine. While in dental school, she participated in the Minors Program in Fixed Prosthodontics at SUNY and the Dr. G.H. Leak Memorial Cancer Fellowship Program at the prestigious Roswell Park Cancer Institute in Buffalo. Dr. Cohn received many other awards and scholarships while in Dental School. Dr. Cohn completed her general practice residency at Strong Memorial Hospital in Rochester, NY.

Dr. Cohn is constantly updating and honing her skills and knowledge by participating in programs at advanced training centers throughout the country, including the prestigious Dawson Academy, Dental Education Laboratories, Nova Southeastern University and Boston University. Dr. Cohn is also a participating member of The American Dental Association, the American Association of Endodontists, The Seattle Study Club, the Capital District Continuum of Advanced Dental Education and the Third District Dental Society.

Dr. Cohn is dedicated to using advanced technologies to provide superlative care for her patients. She performs all procedures, including fillings, crowns, cosmetic dentistry, implants, periodontal plastic surgery, bridges and root canals using microsurgical techniques and tools including surgical telescopic glasses and a high-powered surgical microscope. At the same time, she believes in using non-surgical treatment alternatives whenever appropriate. Most importantly, she is dedicated to keeping her patients comfortable and relaxed.

Dr. Cohn is applying her vast knowledge and skill in caring for her patients to a wider audience, by providing continuing education to dental professionals.

Objectives

Upon completion of this course, the learner will be able to:

- Describe the chain of infection and detail the routes of transmission for disease causing microorganisms.
- Describe an infection control program and the hierarchy of controls to prevent transmission of infection.
- Identify strategies to prevent occupational exposures to blood and body fluids.
- Define Standard Precautions and discuss its application in the dental office.
- Identify methods to ensure that patient care items and environmental surfaces are safe for use.
- Describe the most commonly used sterilization methods, and list the pros and cons of each.

The Importance of Infection Control in Dentistry

Despite the gains that have been made since the 1860s when Joseph Lister and Louis Pasteur identified infectious organisms and infection control practices to minimize their impact, today's healthcare environments persist in containing threats from infectious agents. Unlike the photo below, today's dental professionals must be alert to the potential for the transmission of pathogens in the dental healthcare setting.



Ravel, Edouard John E., 1847-1920, *Beim Zahnartz*, 1882.
Photo Courtesy of National Institute of Medicine.

According to the Bureau of Labor Statistics **Outlook Handbook 2010-2011**, there were approximately 142,000 dentists working in the US in 2008; dental hygienists held approximately 174,100 jobs (due to multiple job holdings, the number of jobs exceed the number of hygienists) and dental assistants held about 295,3000 jobs in 2008. The employment prospects for dentists are good, with an increase of 16% expected by 2018. For dental hygienists and for dental assistants, employment is expected to grow by 36% by 2018.

Both dental professionals and patients can be exposed to pathogens when contact with saliva, blood and airborne secretions. This can come from direct contact with patients and/or contaminated equipment (CDC, 2003). Dental professionals live and work in a time that demands competent, thorough, modern infection control procedures. With all the media attention given to the rise of new infectious agents and treatment resistant organisms, patients too are concerned about the sterile procedures used in the dental office. Following recommended infection control procedures can prevent transmission of infectious organisms among patients and dental health care personnel.

Prevention of exposure to pathogens and the spread of disease during routine dental care is the focus of this course. Dental professionals must understand the recommended infection control measures to be confident in their own daily practice. Much of the information in this course is based on the Center for Disease Control and Prevention (CDC) 2003 *Guideline for Infection Control in the Dental Health-Care Setting* (the complete citation appears in the reference section of this course).

In the State of California, dental professionals must meet the requirements of the state's laws and regulations. Title 16, Professional and Vocational Regulations, Division 10, Dental Board of California, Chapter 1, Section 1005 identifies Minimum Standards for Infection Control applicable to all dental licensees. This course includes those minimum Standards.

According to California Rules and Regulations, Section 1017, Dentists and Dental Auxiliaries are required to complete a minimum of 80% of their required units for license renewal in Category I subjects including two units of continuing education in infection control and two units in the California Dental Practice Act, and no more than 20% of their required units in Category II

subjects. The mandatory units will count toward the total units required to renew a license, however, failure to complete the mandatory courses will result in non-renewal of a license. This course was submitted to, and approved by, the Dental Board of California. Successful completion of this course will fulfill the mandatory requirement for two units of continuing education in infection control.

The Chain of Infection

The **Chain of Infection** is a basic component of understanding the prevention and control of infection that most healthcare workers recall from their early days of training. It is a critical concept in infection control that is worth reviewing:

The **pathogen** is the micro-organism that causes infection such as bacteria, viruses, fungi and parasites. There must be an adequate number of pathogens to cause disease.

The **reservoir** is the place where micro-organisms live, such as in humans, animals, soils, food, plants, air or water. In the dental workplace, the most common reservoirs are humans, water and dental equipment. The reservoir must meet the needs of the pathogen in order to survive and multiply.

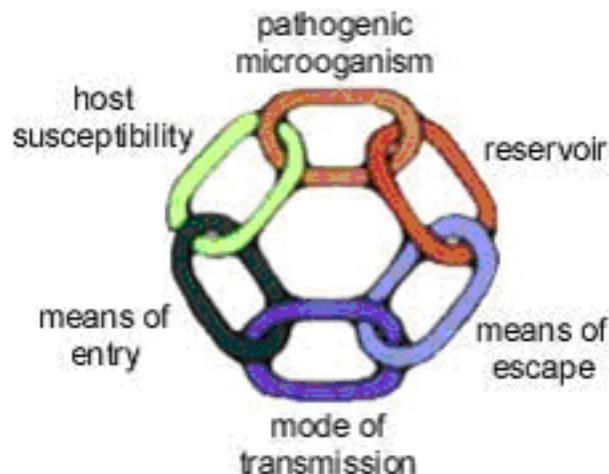
The **means of exit** are how the micro-organism leaves the reservoir.

The **method of transmission** is how the pathogen moves from place to place.

The **means of entry** is how the microorganism enters the host.

The **susceptible host** is the person who may become infected. The host cannot have immunity to the pathogen such as may occur through previous infection with the pathogen or through immunization.

The occurrence and presence of all these factors and events is considered the "chain of infection". In the healthcare setting, all of these factors come into play in the spread and the control of infection. Effective infection control strategies prevent disease transmission by interrupting one or more links in the chain of infection (CDC, 2003.)



Common **modes of transmission** of pathogens in the healthcare setting include:

- Direct contact of intact or non-intact skin with blood or body fluids or other potentially infectious material.
- Indirect contact with contaminated instruments or environmental surfaces.
- Contact of mucous membranes of the eyes, nose or mouth with droplets or spatter containing pathogens that are generated through dental handpiece and water/air syringe aerosols, coughing, sneezing or talking from an infected person and propelled a short distance.
- Inhalation of airborne microorganisms that remain suspended in the air.

Dental patients and dental professionals may be exposed to a variety of disease-causing microorganisms that are present in the mouth and respiratory tract. These organisms may be transmitted in dental settings through several routes, including:

- Intact or non-intact skin.
- Contact with a contaminated object (e.g., instruments, operatory equipment, or environmental surfaces).
- Contact with mucous membranes of the eyes, nose, or mouth with droplets (e.g., spatter) containing microorganisms generated (e.g., dental procedural splatter, coughing, sneezing, talking) from an infected person and propelled a short distance.

Inhalation of airborne microorganisms that can remain suspended in the air for long periods of time (e.g. aerosols from dental handpieces and air/water syringes).

These organisms can be transmitted in dental settings through:

1. Direct contact with blood, oral fluids, or other patient materials;
2. Indirect contact with contaminated objects (e.g., instruments, equipment, or environmental surfaces);
3. Contact of conjunctival, nasal, or oral mucosa with droplets (e.g., spatter) containing microorganisms generated from an infected person and propelled a short distance (e.g., by coughing, sneezing, or talking); and
4. Inhalation of airborne microorganisms that can remain suspended in the air for long periods.

Types of Microorganisms & Chemical Disinfectant Resistance

The following chart of microorganisms is organized from most difficult to kill on surfaces or instruments to least difficult to kill.

		Examples
Most Resistant	BACTERIAL SPORES	<i>Bacillus subtilis</i> <i>Clostridium sporogenes</i>
	MYCOBACTERIA	<i>Mycobacterium tuberculosis</i> ; <i>M. bovis</i>
	NONLIPID OR SMALL VIRUSES	Poliovirus Coxsackievirus Rhinovirus
	FUNGI	<i>Trichophyton</i> sp. <i>Cryptococcus</i> sp. <i>Candida</i> sp.
Least Resistant	VEGETATIVE BACTERIA	<i>Pseudomonas aeruginosa</i> <i>Staphylococcus aureus</i> <i>Salmonella choleraesuis</i>
	LIPID OR MEDIUM-SIZE VIRUSES	Herpes simplex virus Cytomegalovirus Respiratory syncytial virus Hepatitis B virus Human Immunodeficiency virus

Strategies and Controls that Limit Exposure to Infection

More than 8 million US health care workers may be exposed to blood or other body fluids through the following types of contact (NIOSH, 2004):

- Percutaneous injuries (injuries through the skin) with contaminated sharp instruments such as needles, explorers, scalers and scalpels (82%).
- Contact with mucous membranes of the eyes, nose, or mouth (14%).
- Exposure of broken or abraded skin (3%).
- Human bites (1%) Up to 800,000 percutaneous injuries may occur annually among all U.S. healthcare workers (both hospital-based workers and those in other health care settings).

After percutaneous injury with a contaminated sharp instrument, the average risk of infection is 0.3% for HIV and ranges from 6% to 30% for hepatitis B (NIOSH, 2004).

Avoiding exposure is the best method for the prevention of occupational exposure to bloodborne pathogens. There are a number of different preventive practices that dental professionals can utilize to protect themselves and their patients from the threat of exposure.

Dental professionals need to become familiar with the hierarchy of controls that categorize and prioritize prevention strategies. The hierarchy of safety and health controls include (CDC, 2004a):

- Legal and regulatory controls.
- Administrative and Training controls.
- Engineering controls.
- Work practice controls.

Legal and Regulatory controls are those instituted by federal, state and local laws. Federal laws include those of the Occupational Safety and Health Administration (OSHA) Occupational Safety and Health Act of 1970, General Duty Clause requires that each employer:

1. Shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to employees;
2. Shall comply with occupational safety and health standards promulgated under this Act. And each employee shall comply with occupational safety and health standards and all rules, regulations, and orders issued pursuant to this Act which are applicable to his own actions and conduct.

In 1991 OSHA promulgated the Occupational Exposure to Bloodborne Pathogens Standard. This standard was designed to protect millions of healthcare workers and related occupations from the risk of exposure to bloodborne pathogens, such as the Human Immunodeficiency Virus (HIV) and the Hepatitis B Virus (HBV).

Legal and Regulatory controls also include the component of the Dental Practice Act in California that requires dental professionals to utilize proper infection control procedures. The failure to do so can include charges of professional misconduct.

Administrative and training controls include policies, procedures, and enforcement measures to prevent exposure to disease-causing organisms. Each healthcare facility must provide such administrative control to their employees, outlining the policies and procedures related to any issue in the occupational setting in which the employee is to utilize proper infection control practices. The training of employees regarding infection control issues are also a component of administrative controls, as each facility determines the need for training.

Each dental office should have a written plan for an **Infection Control Program** that includes elements to protect personnel.

The objectives are to educate dental professionals regarding the principles of infection control, identify work-related infection risks, institute preventive measures, and ensure prompt exposure management and medical follow-up. Elements of the plan should include:

- Education programs for staff members - Personnel are more likely to comply with an Infection Control Program and Exposure Control Plan if they understand its rationale. Clearly written policies, procedures, and guidelines can help ensure consistency, efficiency, and effective coordination of activities. Personnel subject to occupational exposure are mandated receive infection control training on initial assignment, when new tasks or procedures affect their occupational exposure, and at a minimum, annually.

Education and training should be appropriate to the assigned duties of specific dental professional (e.g., techniques to prevent cross-contamination or instrument sterilization). For dental professionals who perform tasks or procedures likely to result in occupational exposure to infectious agents, training should include:

1. A description of their exposure risks;
2. Review of prevention strategies and infection-control policies and procedures;
3. Discussion regarding how to manage work-related illness and injuries, including PEP (Post Exposure Prophylaxis); and
4. Review of work restrictions for the exposure or infection.

Inclusion of dental staff with minimal exposure risks (e.g., administrative employees) in education and training programs will enhance facility wide understanding of infection control principles and the importance of the program (CDC, 2003).

- Immunization plan of vaccines for preventable diseases - Immunizations are an essential part of prevention and infection control programs for dental professionals, and a comprehensive immunization policy should be implemented for all dental health care facilities. Immunizations substantially reduce both the number of dental professionals susceptible to vaccine preventable diseases and the potential for disease transmission to other healthcare professionals and patients. Thus, The Advisory Committee on Immunization Practices (ACIP) provides national guidelines for immunization of healthcare providers, which includes dental providers (See Appendix A).

On the basis of documented healthcare associated transmission, healthcare providers are considered to be at substantial risk for acquiring or transmitting hepatitis B, influenza, measles, mumps, rubella, and varicella. All of these diseases are vaccine-preventable. ACIP recommends that all HCP be vaccinated or have documented immunity to these diseases. ACIP does not recommend routine immunization of healthcare providers against TB (i.e., inoculation with bacille Calmette-Guérin vaccine) or hepatitis A. No vaccine exists for HCV. ACIP guidelines also provide recommendations regarding immunization of healthcare providers with special conditions (e.g., pregnancy, HIV infection, or diabetes) (CDC, 1997).

OSHA requires that employers make hepatitis B vaccination available to all employees who have potential contact with blood or other potentially infectious material (OPIM). Employers are also required to follow CDC recommendations for vaccinations, evaluation, and follow-up procedures. Non-patient care staff (e.g., administrative or housekeeping) might be included, depending on their potential risk of coming into contact with blood or OPIM. Employers are also required to ensure that employees who decline to accept hepatitis B vaccination sign an appropriate declination statement (CDC, 2003) to be kept on file.

- Medical condition management and work-related illnesses and restrictions

Dental programs in institutional settings, (e.g., hospitals, health centers, and educational institutions) can coordinate with departments that provide personnel health services. The majority of dental practices are in ambulatory, private settings that do not have licensed medical staff and facilities to provide complete on-site health service programs. In such settings, the infection-control coordinator should establish programs that arrange for site-specific infection control services from external health care facilities and providers before dental health care personnel are placed at risk for exposure. Referral arrangements can be made with qualified healthcare professionals in an occupational health program of a hospital, with educational institutions, or with healthcare facilities that offer personnel health services.

This is particularly needed in the case of occupational exposure to bloodborne pathogens (post-exposure prophylaxis will be discussed later in this course).

- Maintenance of health records in accordance with all applicable state and federal laws.
- Exposure prevention and post exposure management, with follow-up of staff exposed to infectious organisms or potentially harmful materials - Despite the hierarchy of controls in the avoiding exposure to blood and OPIM, occupational exposures can still occur. Written policies and procedures to facilitate prompt reporting, evaluation, counseling, treatment,

and medical follow-up of all occupational exposures should be available to all dental professionals. Written policies and procedures should be consistent with federal, state, and local requirements addressing education and training, post exposure management, and exposure reporting.

The CDC has guidelines for the post-exposure management of occupational exposure to blood and OPIM (CDC, 2005). These guidelines can be found at <http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5409a1.htm>.

The infection control program should identify an infection control coordinator (a dentist or other dental health care professional) knowledgeable or willing to be trained who is assigned responsibility for coordinating the program. The effectiveness of the infection control program should be evaluated on a regular basis.

It is important to remember that some training controls are also a legal control, for example, this course is a legislated requirement for dental professionals in the state of California.

Engineering controls eliminate, isolate or reduce exposure to a threat such as a pathogenic organism or physical hazard through the use or substitution of engineered machinery or equipment. Such controls are often technology based, incorporating a safer design to necessary equipment.

Examples include needleless syringes, needle recapping devices, N2O2 scavenging devices, sharps disposal containers, positive pressure ventilation patient rooms, dilution ventilation, high-efficiency particulate air (HEPA) filtration, ultraviolet lights, ventilation systems, sound-dampening materials to reduce noise levels, safety interlocks, and radiation shielding. Well designed engineering controls eliminate human error. The dental professional has greater protection from the hazard because it is either eliminated or reduced through no additional effort on the part of the healthcare worker.

Where engineering controls are not available or appropriate, **work practice controls** must be used. Work practice controls result in safer behavior that is aimed at reducing the risk of exposure by changing the way a task is performed. Examples include using instruments rather than fingers to retract or palpate tissue during suturing and administration of anesthesia, not passing an unsheathed needle to another healthcare provider. The utilization of barriers such as personal protective equipment (PPE) when coming in contact with potentially infectious materials is also a work practice control (this will be explained in detail later in this course).

Hand Hygiene

Probably the most common work practice control related to infection control is hand hygiene. Certainly, hand hygiene is often identified as the single most effective intervention to prevent the spread of infection. In 2002 the recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force published new hand hygiene guidelines (CDC, 2002).

The hands are the most common mode of pathogen transmission. Good hand hygiene can prevent the spread of healthcare related infections. Good hand hygiene can reduce the spread of antibiotic resistance in healthcare settings and the likelihood of healthcare associated infections.

Hand hygiene is a general term that applies to either handwashing, antiseptic handwash, alcohol-based handrub, or surgical hand hygiene/antisepsis.

Handwashing - Washing hands with plain soap and water.

Antiseptic handwash - Washing hands with water and soap or other detergents containing an antiseptic agent such as triclosan or chlorhexidine.

Alcohol-based handrub - Rubbing hands with a waterless agent containing 60%-95% ethanol or isopropanol alcohol containing preparation is referred to as an alcohol rub. an alcohol-containing preparation. These agents are a recent addition to the dental guidelines and have become more frequently used in the US to improve compliance with handwashing in hospitals. In most dental practices, sinks are readily available and the need for alcohol preparations is not as great, but if placed strategically, can aid in hand hygiene compliance.

Surgical antiseptis refers to an antiseptic handwash or alcohol-based handrub (If using an alcohol-based handrub the hands should first be washed with soap and water) performed preoperatively by surgical personnel to eliminate microorganisms on hands. Antiseptic preparations for surgical hand hygiene should have persistent (long-lasting) antimicrobial activity.

The CDC (2003) recommends that hands be cleaned:

- When they are visibly dirty;
- After touching contaminated objects with bare hands; and
- Before and after patient treatment, that is, before glove placement and immediately after glove removal.



Plain soap is good for reducing bacterial counts, but antimicrobial soap is better and alcohol-based handrubs are the best, providing activity that prevents or inhibits survival of microorganisms after the product is applied.

Alcohol handrubs have a rapid and effective antimicrobial action when applied to the skin but must contain other ingredients, such as chlorhexidine or triclosan, to achieve persistent (long-lasting) activity. When combined with emollients, or skin softeners, they can improve skin condition. In hospital settings, they are often more accessible than sinks.

However, alcohol is not a good cleaning agent, so these products cannot be used if hands are visibly soiled. Because of their flammable nature, they must be stored away from high temperatures or flames. In addition, there is some concern that hand softeners and glove

powders might build up on the hands after repeated use. Hands should be washed occasionally with soap and water. Hand lotions can prevent skin dryness associated with hand washing. However, it's important to consider the compatibility of lotion and antiseptic products and the effect of petroleum or other oil emollients on the integrity of gloves when selecting and using them.

Short nails allow thorough cleaning of nails and may reduce premature glove tearing. Artificial nails can harbor pathogens-thus, their use should be avoided.

During surgical procedures, hand or arm jewelry can harbor microorganisms or increase risk of glove failure. If worn during non-surgical procedures, hand or arm jewelry can affect glove placement, fit, or durability.

Keeping nails short is considered key because the majority of flora on the hands are found under and around the fingernails. **Such hygiene is considered the single most critical measure for reducing the risk of transmitting organisms to patients and health care personnel.**

Dental care workers should wash their hands thoroughly (for a minimum duration of 15 seconds) with an antimicrobial handwash at the beginning of the day, between patients, that is, before and after patient treatment (before glove placement and after glove removal), whenever hands are visibly soiled or after touching contaminated objects with bare hands.

Wash after removing gloves and before touching anything. Healthcare workers shall also wash contaminated or visibly soiled hands with soap and water and put on new gloves before treating each patient. If hands are not visibly soiled or contaminated an alcohol based hand rub may be used as an alternative to soap and water.

Alcohol hand rubs are rapidly germicidal when applied to the skin but should include such antiseptics as chlorhexidine, quaternary ammonium compounds, octenidine, or triclosan to achieve persistent activity. Alcohol-based hand rubs should contain 60%-95% ethanol or isopropanol and should not be used in the presence of visible soiled or organic material. If using an alcohol-based hand rub, apply adequate amount to palm of one hand and rub hands together, covering all surfaces of the hands and fingers, until hands are dry. Follow manufacturer's recommendations regarding the volume of product to use. If hands feel dry after rubbing them together for 10-15 seconds, an insufficient volume of product likely was applied. The drying effect of alcohol can be reduced or eliminated by adding 1%-3% glycerol or other skin-conditioning agents.

The 2003 CDC Guidelines for Infection Control in Dental Settings identified:

Table 2. Hand-hygiene methods and indications

Method	Agent	Purpose	Duration (minimum)	Indication*
Routine handwash	Water and nonantimicrobial soap (e.g., plain soap †)	Remove soiled and transient microorganisms	15 seconds§	Before and after treating each patient (e.g., before glove placement and after glove removal). After barehanded touching of inanimate objects likely to be contaminated by blood or saliva.
Antiseptic handwash	Water and antimicrobial soap (e.g., chlorhexidine, iodine and iodophors, chloroxylenol [PCMX], triclosan)	Remove or destroy transient microorganisms and reduce resident flora	15 seconds§	Before leaving the dental operator or the dental laboratory. When visibly soiled.¶
Antiseptic hand rub	Alcohol-based hand rub¶	Remove or destroy transient microorganisms and reduce resident flora	Rub hands until the agent is dry¶	Before regloving after removing gloves that are torn, cut, or punctured.
Surgical antisepsis	Water and antimicrobial soap (e.g., chlorhexidine, iodine and iodophors, chloroxylenol [PCMX], triclosan)	Remove or destroy transient microorganisms and reduce resident flora (persistent effect)	Follow manufacturer instructions for surgical hand-scrub product with persistent activity¶**	Before donning sterile surgeon's gloves for surgical procedures††
	Water and non-antimicrobial soap (e.g., plain soap†) followed by an alcohol-based surgical hand-scrub product with persistent activity			

* (7-9, 11,13, 113, 120-123, 125, 126, 136-138).

† Pathogenic organisms have been found on or around bar soap during and after use (139). Use of liquid soap with hands-free dispensing controls is preferable.

§Time reported as effective in removing the most transient flora from the skin. For most procedures, a vigorous rubbing together of all surfaces of premoistened lathers hands and fingers for ≥ 15 seconds, followed by rinsing under a stream of cool or tepid water is recommended (9,120, 123, 140, 141). Hands should always be dried thoroughly before donning gloves.

¶ Alcohol-based hand rubs should contain 60% - 95% ethanol or isopropanol and should not be used in the presence of visible soil or organic material. If using an alcohol-based hand rub, apply adequate amount to palm of one hand and rub hands together, covering all surfaces of the hands and fingers, until hands are dry. Follow manufacturer's recommendations regarding the volume of product to use. If hands feel dry after rubbing them together for 10 - 15 seconds, in insufficient volume of product likely was applied. The drying effect of alcohol can be reduced or eliminated by adding 1% - 3% glycerol or other skin-conditioning agents (123).

** After application of alcohol-based surgical hand-scrub product with persistent activity as recommended, allow hands and forearms to dry thoroughly and immediately don sterile surgeon's gloves (144, 145). Follow manufacturer instructions (122, 123, 137, 146).

†† Before beginning surgical hand scrub, remove all arm jewelry and any hand jewelry that may make donning gloves more difficult, cause gloves to tear more readily (142, 143), or interfere with glove usage (e.g., ability to wear the correct-sized glove or altered glove integrity).

Hand Washing Considerations

- Handwashing products, including plain (non-antimicrobial) soap and antiseptic products, can become contaminated or support the growth of microorganisms. Liquid products should be stored in closed containers and dispensed from either disposable containers or containers that are washed and dried thoroughly before refilling. Soap should not be added to a partially empty dispenser, because this practice of topping off might lead to bacterial contamination.
- Take your time while washing hands. Wash hands thoroughly, making sure to work the soap between the webs of the fingers, cleaning the tips of the fingers around fingernails, and rubbing the backs of the hands and the thumbs.
- Do not use scrubbing brushes on hands because they can cause abrasions to the skin.
- For injuries to the skin, no evidence exists that using antiseptics for wound care or expressing fluid by squeezing the wound further reduces the risk of bloodborne pathogen transmission, however use of antiseptics is not contraindicated.
- The application of caustic agents like bleach or the injection of antiseptics or disinfectants into the wound is not recommended.
- Remember to use disinfectant on the handles of the sink and the pump of the soap container after every patient.
- Dampness under gloves can cause irritation. Dry hands thoroughly with disposable paper towels.
- Any member of the dental team who has an exudative lesion or weeping dermatitis shall refrain from all direct patient care and from handling patient care equipment until the condition resolves.

Standard Precautions

Previous CDC recommendations on infection control for dentistry in 1986 and 1993 focused on the use of Universal Precautions to prevent transmission of bloodborne pathogens. Universal Precautions were based on the concept that all blood and certain body fluids should be treated as infectious because it is impossible to know who may be carrying a bloodborne virus. Thus, Universal Precautions should apply to all patients (CDC, 2004a, OSHA, 2003).

The relevance of Universal Precautions applied to other potentially infectious materials was recognized, and in 1996, CDC replaced Universal Precautions with **Standard Precautions**.

Standard Precautions integrate and expand Universal Precautions. Standard precautions:

- Apply to all patients.
- Integrate and expand Universal Precautions to include organisms spread by blood and also:
 - Body fluids, secretions, and excretions except sweat, whether or not they contain blood;
 - Non-intact (broken) skin;
 - Mucous membranes.

Saliva has always been considered a potentially infectious material in dental infection control; thus, no operational difference exists in clinical dental practice between Universal Precautions and Standard Precautions.

Note: OSHA retains the use of the term "Universal Precautions" because they are concerned primarily with transmission of bloodborne pathogens.

Personal Protective Equipment

The use of **personal protective equipment** (PPE) is a work practice control used in standard precautions. PPE include gloves, gowns, masks, goggles, face shields (CDC, 2004a).

Personal protective equipment (PPE), or barrier precautions, are a major component of Standard Precautions. Use of rotary dental and surgical instruments (e.g., handpieces, ultrasonic scalers) and air-water syringes creates a visible spray that contains primarily large-particle droplets of water, saliva, blood, microorganisms, and other debris. This spatter travels only a short distance and settles out quickly, landing either on the floor, operatory surfaces, dental health care personnel (DHCP), or the patient.

PPE is essential to protect the skin and the mucous membranes of DHCP from exposure to infectious or potentially infectious materials. PPE should be worn whenever there is potential for contact with spray or spatter and should be removed when leaving treatment areas. Decisions about the use of PPE are determined by the type of interaction the dental professional has with the patient (CDC, 2004a).

Gloves

Gloves are worn for three reasons:

- To minimize the risk of health care personnel acquiring infections from patients.
- To prevent pathogenic organisms from being transmitted from health care personnel to patients.
- To reduce contamination of health care personnel's hands by organisms that can be transmitted from one patient to another.

Wearing gloves does not eliminate or replace the need for hand washing. Hand hygiene should be performed immediately prior to putting on and after removal of gloves. Gloves might have small holes or tears that are not noticeable, or hands can become contaminated as gloves are removed. Such circumstances increase the risk of contamination and exposure of the dental professional's hands to microorganisms from patients.

For the protection of the dental professional and patients, gloves must always be worn when contact with blood, saliva, and mucous membranes are possible. Do not touch your face, nose, or mouth with contaminated gloves.

Gloves should be removed after patient care and hands should be immediately washed. Hands should also be washed before putting gloves on.

Surgical or examination gloves should not be washed before use, nor should they be washed, disinfected, or sterilized for reuse. Washing of gloves can cause a condition known as "wicking," or penetration of liquids through undetected holes in the gloves. These circumstances may increase the risk of contamination and exposure of the dental professional's hands to

microorganisms from patients. Disinfecting agents, oils, certain oil-based lotions, and heat treatments such as autoclaving may result in deterioration of gloves.

Gloves are used when touching blood, body fluids, secretions, excretions, contaminated items, for touching mucus membranes and non-intact skin. Washing hands thoroughly with antimicrobial soaps can disinfect the hands, but will not make them sterile. Medical exam gloves shall be worn whenever there is a potential for contact with mucous membranes, blood or OPIM.

Properly fitting gloves should be snug but not restrictive, and should cover the cuffs of a long sleeved gown. Gloves must be discarded upon completion of treatment and before leaving laboratories or areas of patient care activities. Healthcare workers must perform hand hygiene procedures after removing and discarding gloves. Wash hands after each use.

For most dental procedures, single- use non-sterile rubber gloves are acceptable. It is recommended that sterile surgical gloves be worn for surgical extractions and more invasive procedures. The FDA strictly regulates the production of sterile gloves, so their use should limit contamination of the surgical site.

The chemicals in disinfectants can cause defects in the material of latex gloves, so it is better to use heavy utility gloves when using or mixing chemicals. Do not use petroleum or oil-based lotions before donning gloves because it can damage the gloves and reduce their effectiveness. Using lotions to reduce dryness of the hands should only be used at the end of the work day. Store gloves according to manufacturer's directions to assure the longest shelf life.

If gloves are torn, cut, or punctured they must be changed as soon as it is safely possible. Wash hands thoroughly and replace the gloves before continuing with the procedure. Sharp nail edges or broken nails are likely to increase glove failure. Long artificial or natural nails can make donning gloves more difficult and can cause gloves to tear more readily. Hand carriage of gram-negative organisms has been determined to be greater among wearers of artificial nails than among non-wearers, both before and after hand washing.

Healthcare providers should cover any cuts with a bandage; use an antibacterial ointment underneath, if indicated. Slip one layer of gauze between the bandage and the glove to help control moisture or to protect the cut from being contaminated by the powder on the glove's interior.

Inexpensive plastic gloves used for handling food can be put over the gloves during treatment to enter data in charts or to retrieve an item out of a drawer. These gloves may not be used alone as a hand barrier or for intraoral patient care.

For oral surgery, the effectiveness of wearing two pairs of gloves to prevent disease transmission has not been demonstrated, but the majority of studies among health care personnel and dental health care personnel have demonstrated a lower frequency of inner glove perforation and visible blood on the surgeon's hands. Double gloving does not appear to substantially reduce either manual dexterity or tactile sensitivity.

The use of latex gloves and other latex products can cause reactions among dental health professionals. Three types of reactions can occur in persons using latex products (NIOSH, 1997):

- Irritant contact dermatitis.
- Allergic contact dermatitis (delayed hypersensitivity).
- Latex allergy.

The most common reaction to latex products is **irritant contact dermatitis** -- the development of dry, itchy, irritated areas on the skin, usually the hands. This reaction is caused by skin irritation from using gloves and possibly by exposure to other workplace products and chemicals. The reaction can also result from repeated hand washing and drying, incomplete hand drying, use of cleaners and sanitizers, and exposure to powders added to the gloves. Irritant contact dermatitis is not a true allergy (NIOSH, 1997).

Allergic contact dermatitis (Type IV delayed hypersensitivity, also sometimes called **chemical sensitivity dermatitis**) results from exposure to chemicals added to latex during harvesting, processing, or manufacturing. These chemicals can cause skin reactions similar to those caused by poison ivy. As with poison ivy, the rash usually begins 24 to 48 hours after contact and may progress to oozing skin blisters or spread away from the area of skin touched by the latex (NIOSH, 1997).

Latex allergy (immediate hypersensitivity) can be a more serious reaction to latex than irritant contact dermatitis or allergic contact dermatitis. Certain proteins in latex may cause sensitization (positive blood or skin test, with or without symptoms). Although the amount of exposure needed to cause sensitization or symptoms is not known, exposures at even very low levels can trigger allergic reactions in some sensitized individuals (NIOSH, 1997).

- Latex allergy is a Type I or an immediate hypersensitivity reaction to the proteins found in natural rubber latex. These proteins can attach to the powder in gloves which, in turn, causes more latex protein to reach the skin. This reaction is generally a more severe and immediate systemic reaction than contact dermatitis. Common reactions include runny nose, itchy eyes, hives, and burning skin sensations. More severe reactions are characterized by breathing difficulty and, rarely, anaphylaxis (shock) or death.

Reactions usually begin within minutes of exposure to latex, but they can occur hours later and can produce various symptoms. Mild reactions to latex involve skin redness, hives, or itching. More severe reactions may involve respiratory symptoms such as runny nose, sneezing, itchy eyes, scratchy throat, and asthma (difficult breathing, coughing spells, and wheezing). Rarely, shock may occur; but a life-threatening reaction is seldom the first sign of latex allergy. Such reactions are similar to those seen in some allergic persons after a bee sting (NIOSH, 1997).

Repeated exposure to latex increases chances of an allergic episode. Most dental professionals wear gloves 8 to 10 hours daily, 4 to 5 days a week. Histories of allergies, asthma, and eczema have been linked to latex glove reactions. A physician should treat any dermatitis and the dental professional should not be exposed to the latex until the condition is completely healed. Some dermatitis problems may result from moisture accumulating under gloves. Cotton glove liners are available to provide a barrier between the skin and the latex. Dental professionals who exhibit skin rash, itching, or wheezing should seek the care of a physician for diagnosis.

Patients with spina bifida are particularly vulnerable to life-threatening latex reactions. Patients who have undergone repeated surgery with prolonged contact with rubber tubes or post-surgical drains, and those with history of other allergies are most likely to have reactions to rubber gloves or the rubber dam. For these patients it would be advisable to wear a non-latex glove (vinyl or nitrile).

Other recommendations can minimize the risk of contact dermatitis, hypersensitivity and latex allergy:

- Educate dental professionals about reactions associated with frequent hand hygiene and glove use.

- Staff that have dermatologic problems should get a diagnosis from a qualified medical provider before making changes in gloves or hand hygiene agents.
- Screen patients and dental workers for latex allergy in medical histories.
- Dental professionals and dental patients with a latex allergy should not have direct contact with latex-containing materials and should be in a latex-safe environment with all latex-containing products removed from their vicinity. Note that many bib clips are made with latex.
- Have both dental and medical emergency latex-free products available at all times.

Protective Clothing

Dental professionals should wear long-sleeved disposable or reusable gowns, lab coats, or uniforms that cover skin and personal clothing likely to become soiled with blood, saliva, or infectious material when spatter and spray of blood, saliva, or other potentially infectious material to the forearms might occur.

Protective clothing should be changed when it becomes visibly soiled or as soon as possible if penetrated by blood or other potentially infectious fluids.

All protective clothing should be removed before leaving patient care or laboratory areas.

Gowns are used during procedures and patient care activities when contact of clothing/exposed skin with blood or OPIM is expected or likely. The garment should be fluid-resistant, high-necked, and provide coverage to the knees.

Gowns should be changed between patients when they are visibly soiled or moist or at a minimum, daily. Protective attire must be removed when leaving laboratories or areas of patient care activities and placed in laundry or disposal bags after use. These protective garments should not be worn outside the office.

Wash uniforms in hot soapy water and bleach. Reusable gowns must be laundered in accordance with Cal-DOSH Bloodborne Pathogens Standards, Title 8, Cal. Code of Regs. section 5193. Machine dry at least at 100°F. A cost analysis will reveal the most economical protective apparel choice for the office. Compare the costs of bulk purchases of disposable gowns and disposal requirements with the purchase and installation of a washer and dryer or medical laundry service.

Masks/Face Shields/Protective Eyewear

Wear surgical masks in combination with either chin-length plastic face shields or protective eyewear to protect the face, mouth, and nasal cavity when spatter of blood or OPIM or when splashing of blood or OPIM and other body fluids is expected.

Masks should be well constructed. The pleated, soft type of mask has a higher filtration than the cup style. A tight seal at the bridge of the nose will minimize eyewear fogging. Use a mask with at least a filtration of 95% of particles 3 to 5 microns in diameter.

Microbes pass more easily through moisture, so masks should be changed when they become wet or visibly soiled. Masks must be changed after each patient, and even during patient treatment when applicable. Some professionals change masks after an hour of use. Be careful not to touch the mask with soiled gloves if it is to be reused.

Face shields must be cleaned, and if visibly soiled, cleaned and disinfected after each patient.

Wear protective eyewear to shield the eyes from spatter of contaminated material. Goggle-type wrap around styles or face shields are recommended. Face shields used during air-abrasion deflects aluminum oxide particles from the lenses of magnifying eyewear. Protective eyewear also reminds the health care worker not to touch their eyes during procedures and when mixing chemicals. After each patient, protective eyewear must be cleaned; and if visibly soiled, cleaned and disinfected.

The patient may also wear protective eyewear. Some offices use sunglasses to reduce the glare of the overhead light and to protect the patient's eyes from spatter. Disinfect patient eyewear after each use.

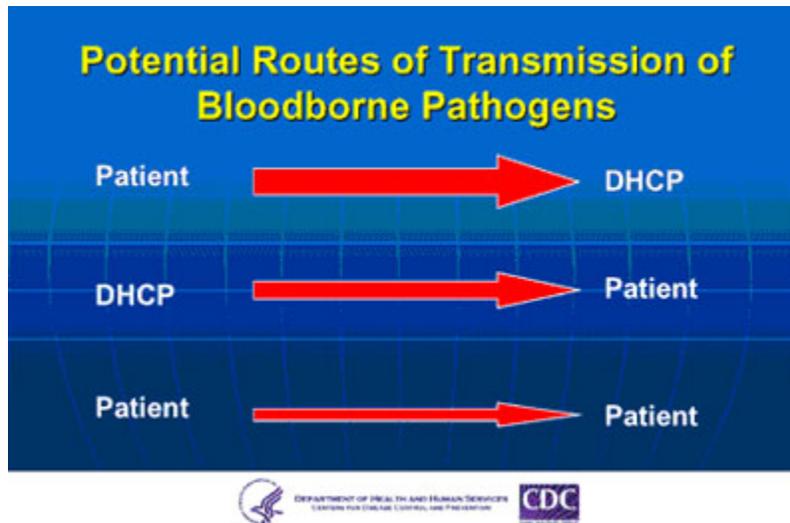


Photo Courtesy of the Indian Health Service/U.S. Department of Health and Human Services, 2000.

Preventing Transmission of Bloodborne Pathogens

Bloodborne viruses such as hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV) are of concern to dental health care professionals (DHCP). These viruses:

- Can be transmitted to patients and DHCP in healthcare settings.
- Can produce chronic infection.
- Are often carried by persons unaware of their infection.



Transmission of bloodborne pathogens may occur from patient to DHCP, from DHCP to patient, and from patient to patient. Because DHCP frequently are exposed to blood and blood-contaminated saliva during dental procedures, they are at greater risk of infection by a bloodborne pathogen than are patients.

The risk of infection with a bloodborne virus is largely determined by:

- Its prevalence, or frequency, in the patient population.
- The risk of transmission after an exposure to blood (risk varies by type of virus).
- The type and frequency of blood contacts. If health care personnel are frequently exposed to blood, especially if they are working with sharp objects such as needles, their risk of exposure to a bloodborne virus is higher than if they rarely come into contact with blood.

Characteristics of Percutaneous Injuries Among DHCP

According to the CDC (2003), available information indicates that percutaneous injuries among dentists declined from an average rate of 11 injuries per year in 1987 to <3 injuries per year in 1993.

In general, most injuries among general dentists were caused by burs, followed by syringe needles and other sharp instruments. Injuries most often occur while the dentist's hands are outside the patient's mouth. Most injuries involve small, rather than large, amounts of blood.

The frequency of percutaneous injuries among oral surgeons is similar to that reported among U.S. dentists. Injuries among oral surgeons may occur more frequently during procedures using surgical wire, such as during fracture reductions.

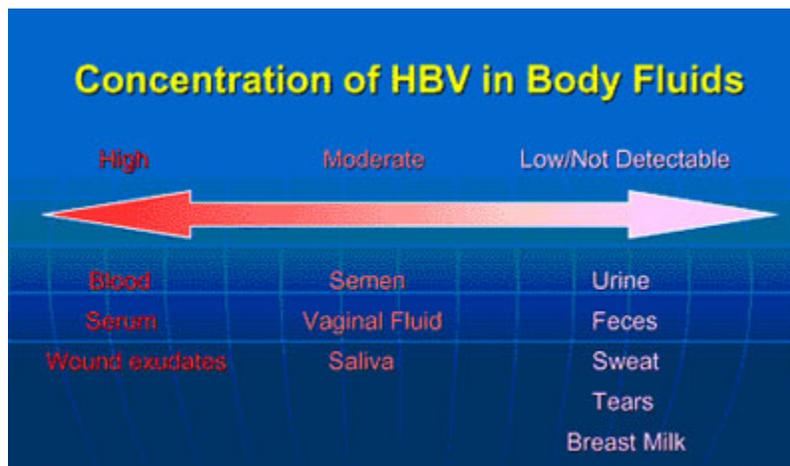
Average Risk of Bloodborne Virus Transmission after Needlestick (CDC, 2003)	
Source	Risk
HBV	
HBsAg+ and HBeAg+	22.0%-31.0% clinical hepatitis; 37%-62% serological evidence of HBV infection.
HBsAg+ and HBeAg-	1.0%-6.0% clinical hepatitis; 23%-37% serological evidence of HBV infection
HCV	1.8% (0%-7% range)
HIV	0.3% (0.2%-0.5% range)

The average risk of transmission after a single needlestick from an infected patient by type of bloodborne virus varies greatly by type of virus.

For instance, the risk of HBV transmission after a percutaneous exposure (e.g., needlestick) to HBV-infected blood varies from 1%-62%, depending on the hepatitis B e-antigen (HBeAg) status of the source patient. If the source patient's blood is positive for HBeAg (a marker of increased infectivity), the risk of transmission can be as high as 62%. If the patient's blood is hepatitis B surface antigen (HBsAg) positive but HBeAg negative, the risk varies from 1%-37%.

The average risk of HCV transmission after a percutaneous exposure to HCV-infected blood is 1.8%.

The average risk of HIV infection after a percutaneous exposure to HIV-infected blood is 0.3%. To put this in perspective, 1 in 3 needlesticks from an HBeAg+ source patient would result in infection compared to only 1 in 300 needlesticks from an HIV-infected patient.



As mentioned earlier, one factor to consider in assessing the risk of infection is the type of body substances to which DHCP are exposed. This slide shows the concentration of HBV in various body fluids. On the left, in red, are the fluids with the highest concentration of virus.

Moving from the left to the right side, the concentration decreases. Blood, for instance, has a higher virus concentration than urine or sweat. Saliva alone, without blood, has a moderate concentration of virus.

Transmission of bloodborne pathogens (e.g., HBV, HCV, and HIV) in dental health care settings is rare, any incidence of exposure can have serious consequences. Exposure to infected blood can result in transmission from patient to dental professional and from dental professional to patient, and from one patient to another. The opportunity for transmission is greatest from patient to dental professionals, who frequently encounter patient blood and blood-contaminated saliva during dental procedures.

No transmission of HIV from dental professionals to patient has been reported since 1992 (CDC, 2003). The last HBV transmission from dental professional to patients was reported in 1987. No transmission of HCV from dental professional to patient has been reported.

The majority of dental professionals infected with a bloodborne virus do not pose a risk to patients because they do not perform activities meeting the necessary conditions for transmission. For dental professionals to pose a risk for bloodborne virus transmission to patients, the dental professional must (CDC, 2003):

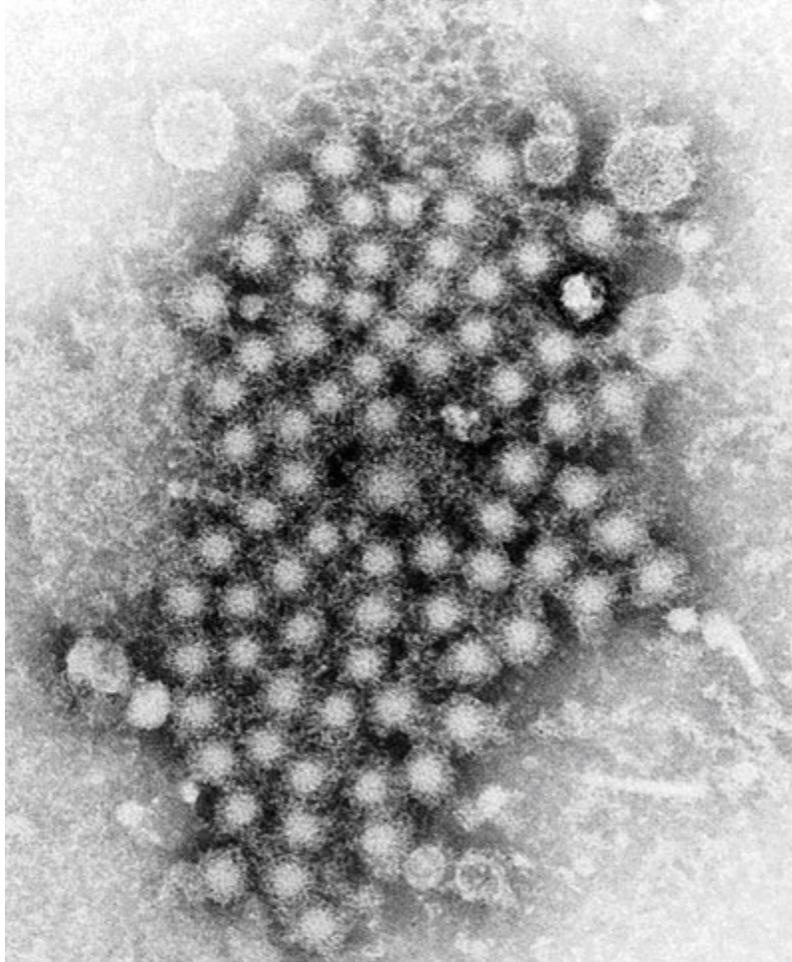
1. Be viremic (i.e., have infectious virus circulating in the bloodstream);
2. Be injured or have a condition (e.g., weeping dermatitis) that allows direct exposure to their blood or other infectious body fluids; and
3. Enable their blood or infectious body fluid to gain direct access to a patient's wound, traumatized tissue, mucous membranes, or similar portal of entry.

Although an infected dental professional might be viremic, unless the second and third conditions are also met, transmission cannot occur.

The risk of occupational exposure to bloodborne viruses by the dental professional, from patients, is largely determined by the viral prevalence in the patient population and the nature and frequency of contact with blood and body fluids through percutaneous or permucosal routes of exposure (CDC, 2003). The risk of infection after exposure to a bloodborne virus is influenced by (CDC, 2003):

- Inoculum size,
- Route of exposure, and
- Susceptibility of the exposed dental professional.

Hepatitis



Transmission electron micrograph (TEM) revealed numerous hepatitis virions, of an unknown strain of the organism.
Photo courtesy of CDC.

Hepatitis A virus is spread from person to person through fecal-oral transmission. This occurs when something is put in the oral cavity that has been contaminated with stool. It can be spread through contaminated food or water or through sexual contact. Most infections result from contact with a household member or sex partner who has hepatitis A (CDC, 2009).

Hepatitis A can be prevented through washing hands, particularly after using the bathroom, changing a diaper, and before preparing or eating food (CDC, 2009).

Two products are used to prevent hepatitis A virus infection: immune globulin and hepatitis A vaccine (CDC, 2009).

Immune globulin is a preparation of antibodies that can be given before exposure for short-term protection against hepatitis A and for persons who have already been exposed to hepatitis A virus. Immune globulin must be given within 2 weeks after exposure to hepatitis A virus for maximum protection.

Hepatitis A vaccine has been licensed in the United States for use in persons 12 months of age and older. The vaccine is recommended (before exposure to hepatitis A virus) for persons who are more likely to get hepatitis A virus infection or are more likely to get seriously ill if they do get

hepatitis A. The vaccines currently licensed in the United States are HAVRIX® (manufactured by GlaxoSmithKline) and VAQTA® (manufactured by Merck & Co., Inc). Health care workers, including dental professionals are not at increased risk for hepatitis A. It is not recommended that health care workers receive the hepatitis A vaccine (CDC, 2009).

Hepatitis B is caused by a virus that attacks the liver. The virus, which is called hepatitis B virus (HBV), can cause lifelong infection, cirrhosis (scarring) of the liver, liver cancer, liver failure, and death. Hepatitis B can be acute, chronic or perinatal (CDC, 2009a).

Disease Burden from viral Hepatitis B in the United States (CDC, 2010)

	Hepatitis B					
	2008	2007	2006	2005	2004	2003
No. of Acute Clinical Cases Reported	4,033	4,519	4,758	5,494	6,212	7,526
Estimated No. of Acute Clinical Cases	12,000	13,000	13,000	15,000	17,000	21,000
Estimated No. of New Infections (current)	38,000	43,000	46,000	53,000	60,000	73,000
Percent Ever Infected	4.3% - 5.6%					
Number of Persons Living with Chronic Infection	800,000 - 1.4 million persons					
Annual Number of Chronic Liver Disease Deaths associated with Viral Hepatitis	3,000					

HBV is transmitted through activities that involve percutaneous or mucosal contact with infectious blood or body fluids (e.g., semen, saliva), including (CDC, 2009a):

- Sex with an infected partner
- Injection drug use that involves sharing needles, syringes, or drug-preparation equipment
- Birth to an infected mother
- Contact with blood or open sores of an infected person
- Needle sticks or sharp instrument exposures
- Sharing items such as razors or toothbrushes with an infected person

HBV is not spread through food or water, sharing eating utensils, breastfeeding, hugging, kissing, hand holding, coughing, or sneezing (CDC, 2009a).

HBV can survive outside the body at least 7 days and still be capable of causing infection (CDC, 2009a).

The presence of signs and symptoms related to HBV varies by age. Most children under age 5 years and newly infected immunosuppressed adults are asymptomatic, whereas 30%–50% of persons aged ≥5 years have initial signs and symptoms. When present, signs and symptoms can include (CDC, 2009a):

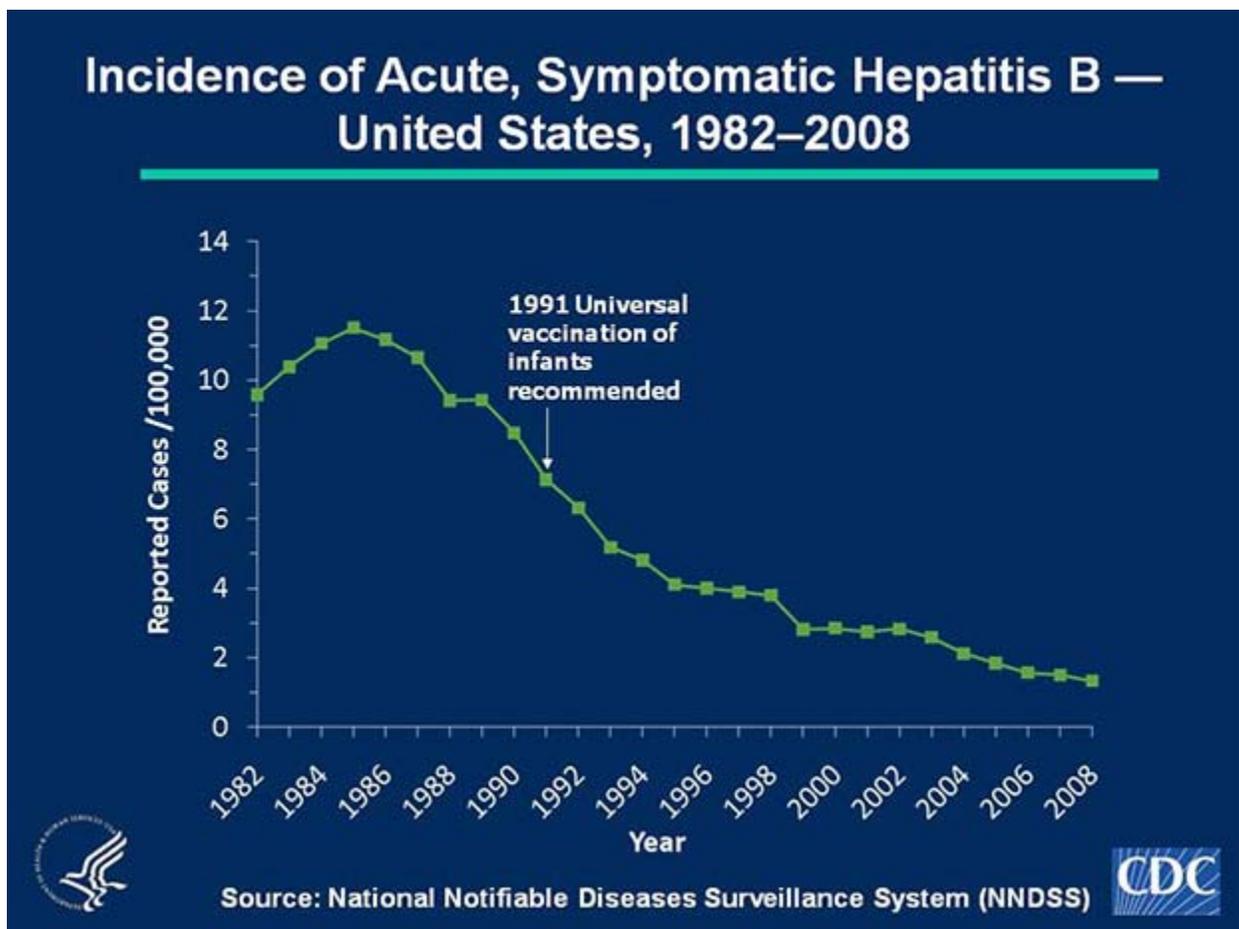
- Fever
- Fatigue
- Loss of appetite
- Nausea

- Vomiting
- Abdominal pain
- Dark urine
- Clay-colored bowel movements
- Joint pain
- Jaunice

Persons with chronic HBV infection might be asymptomatic, have no evidence of liver disease, or have a spectrum of disease ranging from chronic hepatitis to cirrhosis or hepatocellular carcinoma, a type of liver cancer (CDC, 2009a).

Healthcare personnel who have received **hepatitis B vaccine** and developed immunity to the virus are at virtually no risk for infection. For a susceptible person, the risk from a single needlestick or cut exposure to HBV-infected blood ranges from 6-30% and depends on the hepatitis B e antigen (HBeAg) status of the source individual.

Hepatitis B surface antigen (HBsAg)-positive individuals who are HBeAg positive have more virus in their blood and are more likely to transmit HBV than those who are HBeAg negative (CDC, 2003a). Hepatitis B vaccine is the most effective means of preventing HBV infection and its consequences (Mast, et al., 2005). The annual number of occupational infections has decreased 95% since hepatitis B vaccine became available in 1982, from >10,000 in 1983 to <400 in 2001 (CDC, 2003a).



Both OSHA regulations and CDC recommendations state that hepatitis B vaccine should be made available to all dental workers who are exposed to blood or other potentially infectious materials.

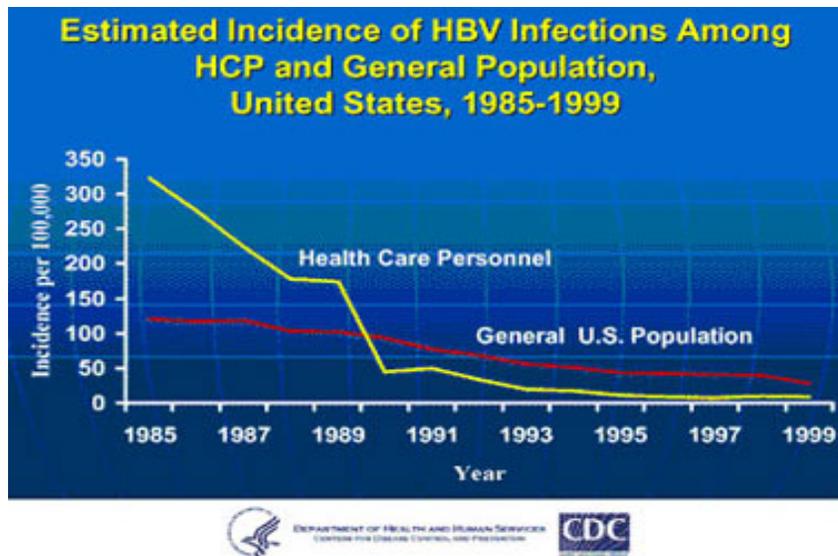
Employers should provide easy access to a qualified health care professional who can administer the vaccine and provide appropriate follow-up testing.

Post-vaccination testing for antibody to hepatitis B surface antigen (anti-HBs) response is indicated for DHCP who have blood or patient contact and are at ongoing risk for injuries with sharp instruments or needle sticks. Post-vaccination testing should be completed one to two months after the 3rd vaccine dose. Knowledge of antibody response should guide appropriate post exposure prophylaxis (PEP).

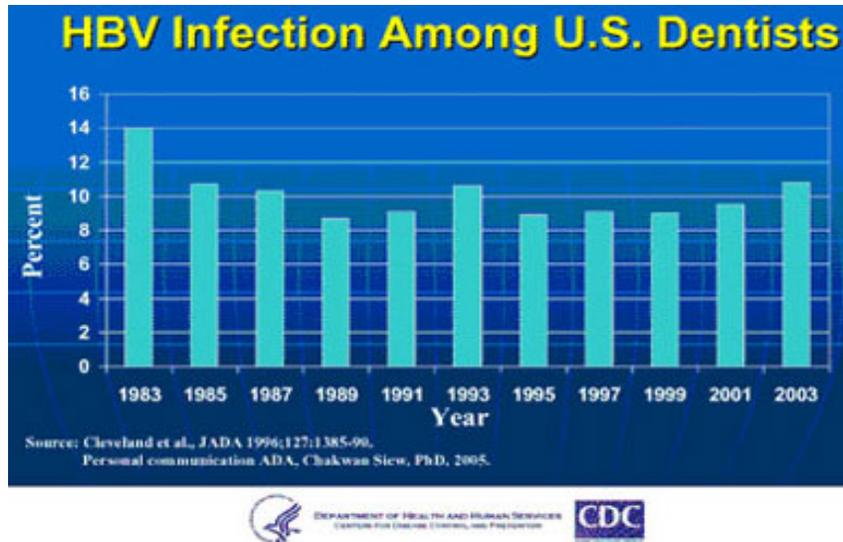
The HBV vaccine is recommended for (CDC, 2003a):

- All infants;
- All children 0-18 years of age who have not been previously vaccinated;
- People of any age whose behavior or their profession puts them at risk for HBV infection.

The greatest concentration of HBV in an infected patient's mouth is in the gingival sulcus. Inflammation may be present in this area due to gingivitis. Probing or scaling will result in easy, profuse bleeding. The dental hygienist is at high risk for infection because of the bleeding associated with routine prophylaxis. Other risky procedures include packing cord for crown impressions, oral surgery, needle sticks, injuries from contaminated sharps, blood and saliva contamination of cuts and cracks on the skin, and spraying of blood and saliva onto mucous membranes.



Occupational exposures of healthcare providers (HCP) to HBV have been declining, as evidenced by this graph that shows the decline in the incidence of HBV infections in health care personnel as compared to that in the general population between the years of 1985 and 1999. In the early to mid 1980s, health care personnel had a much higher incidence of HBV infection than the general population, but through the years, with the 1987 publication of Universal Precaution guidelines and the 1991 OSHA requirement that employers provide HBV vaccination to healthcare personnel, the incidence has dropped below that of the general population.



Among U.S. dentists, evidence of past HBV infection decreased from pre-vaccine levels of 14% in 1972 to ~9% in 1989. Since then, levels have remained relatively unchanged. This is because the prevalence (proportion) of HBV infection among all dentists should gradually decrease as older dentists (who are more likely to be infected and unvaccinated than younger dentists) retire (CDC, 2003).

Since the early 1970s, nine clusters involving more than 300 cases of HBV transmission from infected dentists and oral surgeons to patients have been reported (CDC, 2003). Eight dentists tested for hepatitis B e-antigen were positive.

Since 1987, however, no cases of DHCP-to-patient transmission of HBV have been reported, probably the result of increased use of Universal or Standard Precautions and increased use of the hepatitis B vaccine (CDC, 2003).

In 2003, the first and only case of patient-to-patient transmission of HBV in a dental office was reported. A later investigation of office procedures indicated that proper infection control precautions were being followed and the exact mechanism of transmission could not be identified (CDC, 2003).

Hepatitis C is a liver disease caused by the hepatitis C virus (HCV), which is found in the blood of persons who have this disease.

Although only 849 cases of confirmed acute Hepatitis C were reported in the United States in 2007, CDC estimates that approximately 17,000 new HCV infections occurred that year, after adjusting for asymptomatic infection and underreporting. Persons newly infected with HCV are usually asymptomatic, so acute Hepatitis C is rarely identified or reported. Approximately 3.2 million persons in the United States have chronic HCV infection. Infection is most prevalent among those born during 1945–1965, the majority of whom were likely infected during the 1970s and 1980s when rates were highest (CDC, 2010c).

Approximately 15%–25% of persons clear the virus from their bodies without treatment and do not develop chronic infection; the reasons for this are not well known; however, HCV infection becomes chronic in approximately 75%–85% of cases (CDC, 2010c).

The following persons are at known to be at increased risk for HCV infection (CDC, 2010c):

- Current or former injection drug users, including those who injected only once many years ago
- Recipients of clotting factor concentrates made before 1987, when more advanced methods for manufacturing those products were developed
- Recipients of blood transfusions or solid organ transplants before July 1992, when better testing of blood donors became available
- Chronic hemodialysis patients
- Persons with known exposures to HCV, such as
 - health care workers after needlesticks involving HCV-positive blood
 - recipients of blood or organs from a donor who tested HCV-positive
- Persons with HIV infection
- Children born to HCV-positive mothers.

Of every 100 persons infected with HCV about (CDC, 2010c):

- 75–85 will go on to develop chronic infection
- 60–70 will go on to develop chronic liver disease
- 5–20 will go on to develop cirrhosis over a period of 20–30 years
- 1–5 will die from the consequences of chronic infection (liver cancer or cirrhosis)

Hepatitis C is a leading indication for liver transplants (CDC, 2010c). According to the CDC, person at risk for HCV infection might also be at risk for infection with hepatitis B virus (HBV) or HIV.

The CDC reported that estimates of the occupational risk of HCV infection among healthcare providers is unknown, but the majority of studies indicate the prevalence of HCV infection among dentists, surgeons, and hospital-based healthcare providers is similar to that among the general population, approximately 1%--2% (CDC, 2003). In a study that evaluated risk factors for infection, a history of unintentional needlesticks was the only occupational risk factor independently associated with HCV infection (CDC, 2003).

HCV appears not to be efficiently transmitted through occupational exposures. Transmission of HCV generally has been associated with hollow-bore needles and not other sharp instruments.

Although studies have not documented transmission associated with mucous membrane or non-intact skin exposure, at least two cases of transmission of HCV from a blood splash to the conjunctiva of the eye have been reported (CDC, 2003).

In 2003, there was a report of simultaneous transmission of HIV and HCV from a nursing home patient to a health care worker. This transmission is thought to have occurred through a non-intact skin exposure. The investigation concluded that consistent use of barrier precautions might have prevented this transmission (CDC, 2003).

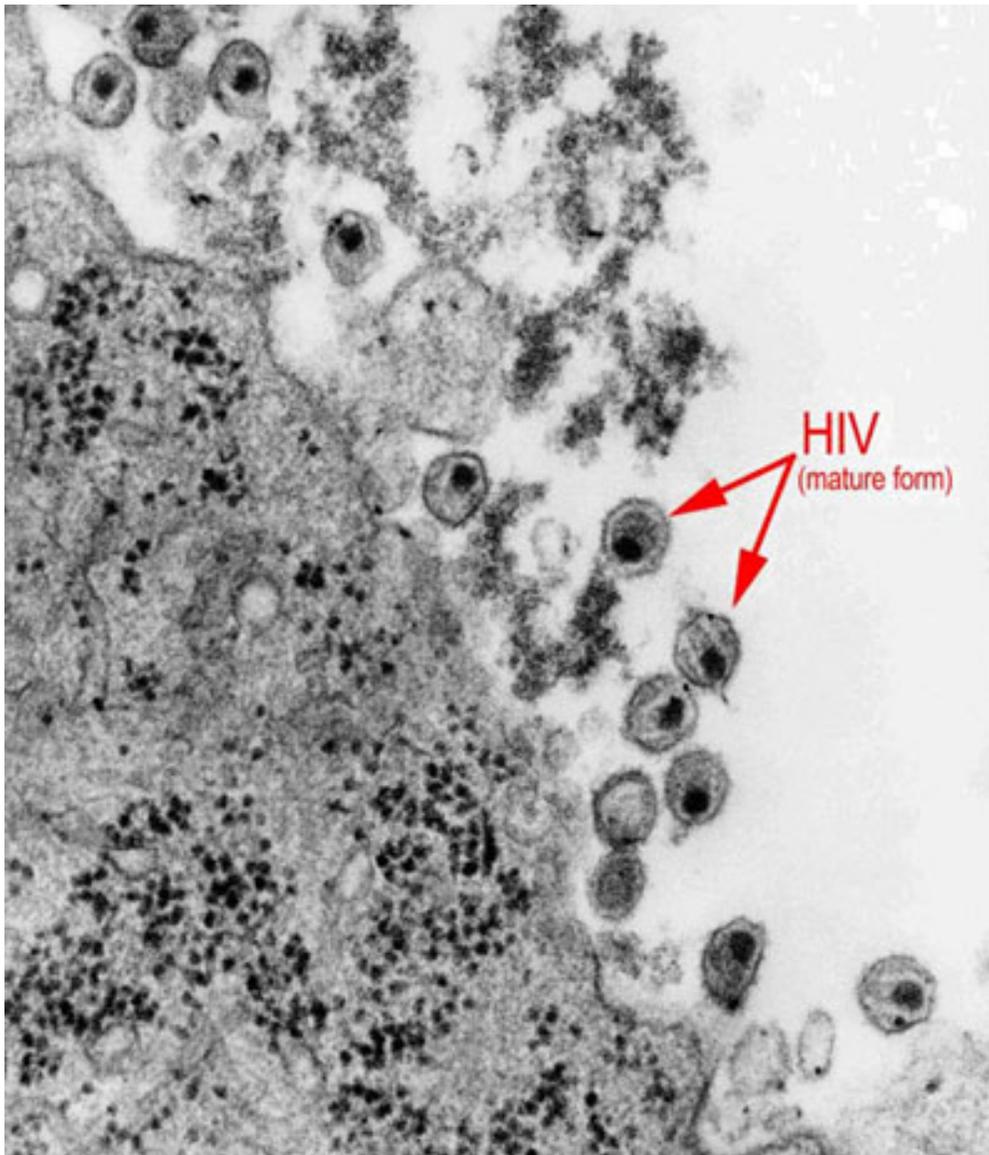
No studies of transmission from HCV-infected dental professionals to patients have been reported, and the risk for such transmission appears limited. Multiple reports have been published describing transmission from HCV-infected surgeons, which apparently occurred during performance of invasive procedures; the overall risk for infection averaged 0.17% (CDC, 2003). There have been no reports of an HCV transmission from an infected DHCP to a patient or of patient-to-patient transmission of HCV in a dental health care setting.

Based on this information, the risk of HCV transmission in dentistry appears very low.

An estimated 4% of persons with acute HBV infection are also infected with **hepatitis Delta virus (HDV)**. Discovered in 1977, HDV is a defective bloodborne virus requiring the presence of HBV to replicate. Patients coinfecting with HBV and HDV have substantially higher mortality rates than those infected with HBV alone. Because HDV infection is dependent on HBV for replication, immunization to prevent HBV infection, through either pre- or post-exposure prophylaxis, can also prevent HDV infection (CDC, 2003).

HIV/AIDS

The human immunodeficiency virus (HIV) is the virus that can lead to AIDS. HIV transmission can occur when blood, semen, pre-seminal fluid, vaginal fluid, or breast milk from an infected person enters the body of an uninfected person (CDC, 2010d).



This highly magnified transmission electron micrographic (TEM) image revealed the presence of mature forms of the human immunodeficiency virus (HIV) in a tissue sample under investigation. Photo courtesy of CDC.

HIV can enter the body through a vein (e.g., injection drug use), the lining of the anus or rectum, the lining of the vagina and/or cervix, the opening to the penis, the mouth, other mucous membranes (e.g., eyes or inside of the nose), or cuts and sores. Intact, healthy skin is an excellent barrier against HIV and other viruses and bacteria (CDC, 2010d).

These are the most common ways that HIV is transmitted from one person to another (CDC, 2010d):

- By having sex (anal, vaginal, or oral) with an HIV-infected person;
- By sharing needles or injection equipment with an injecting drug user who is infected with HIV; or
- From HIV-infected women to their babies before or during birth, or through breast-feeding after birth.

HIV also can be transmitted through receipt of infected blood or blood clotting factors. However, since 1985, all donated blood in the United States has been tested for HIV. Therefore, the risk of infection through transfusion of blood or blood products is extremely low. The U.S. blood supply is considered to be among the safest in the world (CDC, 2010d).

Despite the tremendous public health education efforts at HIV prevention, the number of people with HIV infection continue to grow, with approximately 56,000 newly diagnosed HIV infections in the US annually (CDC, 2010a).

At the end of 2007, the estimated number of persons living with a diagnosis of HIV infection in the 37 states and 5 U.S. dependent areas with confidential name-based HIV infection reporting was 599,819. In the 37 states only, this included 577,452 adults and adolescents, and 2,919 children under age 13 years (CDC, 2010b).

The cumulative estimated number of AIDS diagnoses through 2008 in the United States and dependent areas was 1,106,391. Of these, 1,073,128 were diagnosed in the 50 states and the District of Columbia and 33,262 were diagnosed in the dependent areas. In the 50 states and the District of Columbia, 851,974 cumulative AIDS diagnoses were among adult and adolescent males, 211,804 were among adult and adolescent females, and 9,349 were among children under age 13 years (CDC, 2010b).

The cumulative estimated number of deaths of persons with an AIDS diagnosis in the United States and dependent areas, through 2007, was 597,499 (CDC, 2010b).

According to the CDC, during the mid-to-late 1990s, advances in treatment slowed the progression of HIV infection to AIDS and led to dramatic decreases in deaths among persons with AIDS. The decrease in the estimated number of deaths of persons with AIDS continued, but the number of AIDS cases diagnosed during that same period increased (CDC, 2007). The reasons for the increase in the number of AIDS diagnoses are unclear but may be due to increased emphasis on testing; the fact that more people are living with HIV and thus are experiencing the development of AIDS; and technical issues in the statistical process used in estimating the number of AIDS diagnoses (CDC, 2007).

In the US, the risk of HIV transmission in dental settings is extremely low. As of December 2001, a total of 57 cases of HIV seroconversion had been documented among all healthcare providers, but none among dental professionals, after occupational exposure to a known HIV-infected source (CDC, 2003).

Prospective studies worldwide indicate the average risk of HIV infection after a single percutaneous exposure to HIV-infected blood is 0.3% (range: 0.2%–0.5%) (CDC, 2003). After an

exposure of mucous membranes in the eye, nose, or mouth, the risk is approximately 0.1% (CDC, 2003). The precise risk of transmission after skin exposure remains unknown but is believed to be even smaller than that for mucous membrane exposure.

The CDC reported that certain factors affect the risk of HIV transmission after an occupational exposure. Laboratory studies have determined if needles that pass through latex gloves are solid rather than hollow-bore, or are of small gauge (e.g., anesthetic needles commonly used in dentistry), they transfer less blood (CDC, 2003). In a retrospective case-control study of healthcare providers, an increased risk for HIV infection was associated with exposure to a relatively large volume of blood, as indicated by a deep injury with a device that was visibly contaminated with the patient's blood, or a procedure that involved a needle placed in a vein or artery. The risk was also increased if the exposure was to blood from patients with terminal illnesses, possibly reflecting the higher titer of HIV in late-stage AIDS (CDC, 2003).

Health Care Workers with Documented and Possible Occupationally Acquired HIV/AIDS
CDC Database as of December 2002

	Documented	Possible
Dental Worker	0	6 *
Nurse	24	35
Lab Tech, clinical	16	17
Physician, nonsurgical	6	12
Lab Tech, nonclinical	3	—
Other	8	69
Total	57	139

* 3 dentists, 1 oral surgeon, 2 dental assistants



As of December 2002, there were no DHCP among the 57 U.S. HCP with documented HIV transmission following a specific exposure to a known HIV-infected source (CDC, 2003).

CDC also has received reports of 139 other HCP considered to have possible occupational HIV transmission; of these, only 6 were DHCP. For each of the 139 persons, no other risk for infection could be identified during follow-up investigation (CDC, 2003).

Each of the 6 DHCP reported a history of occupational percutaneous or mucous membrane exposure to blood or body fluids in the dental setting, but HIV transmission could not be linked to a specific exposure.

Several factors affect the risk of HIV transmission after an occupational exposure. In a study of health care personnel who had percutaneous exposure to HIV-infected blood (Cardo, et. al, 1997), an increased risk for HIV infection was associated with exposure to a relatively large quantity of blood as indicated by deep injury, visible blood on the device, or a procedure involving a needle placed in an artery or vein.

The risk was also increased if the exposure was to blood from patients with terminal illness, possibly reflecting the higher titer of HIV in late-stage AIDS.

Post-exposure Management Program

Despite our best efforts, blood exposures will likely continue to occur. Post-exposure management remains an important component of a complete program to prevent infection following exposure to blood. Elements of an effective post-exposure management program include:

- Policies and procedures that clearly state how to manage exposures.
- Education of dental health care personnel in prevention strategies (including evaluation of safety devices), principles of post-exposure management, the importance of prompt reporting, and PEP efficacy and toxicity.
- Resources for rapid access to clinical care, post-exposure prophylaxis, as well as testing of both source patients and exposed health care personnel (preferably with a rapid HIV test).

Except for institutional settings, coordination with off-site infection control or occupational health services likely will be necessary. A health care professional who is qualified to manage, counsel, and provide medical follow-up should be selected before staff are placed at risk. Ensure that this person is familiar with the dental application of risk assessment and management.

The key elements of post-exposure management include wound management and exposure reporting.

The evaluating health care professional should assess the risk of infection by examining the type and severity of exposure, the bloodborne status of the source person, and the susceptibility (immune status) of the exposed person. All of these factors should be considered in assessing the risk of infection and the need for further follow-up (e.g., PEP).

The CDC has issued updated guidelines for postexposure prophylaxis for occupational exposure to HIV (CDC, 2005). They can be accessed at <http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5409a1.htm>.

HIV Transmission from Dental Professionals to Patients

According to the CDC (2003), transmission of HIV from infected healthcare providers to patients has been documented in only one practice. Investigation of the patients of a Florida dentist with AIDS strongly suggested that HIV was transmitted during dental care to 6 of approximately 1,100 patients tested. As of September 30, 1993, CDC had information regarding test results of >22,000 patients of 63 HIV-infected healthcare providers, including 33 dentists or dental students. No additional cases of transmission were documented (CDC, 2003).

Sterilization and Disinfection of Patient Care Items

Definitions

Cleaning involves the physical removal of organic matter to reduce microbial growth prior to the reduction and/or destruction of microbes through the sterilization or disinfection process. Organic matter may interfere with the action of antiseptics, disinfectants and sterilants by preventing adequate penetration. Soap and water with friction is the standard. Cleaning is the basic first step in all decontamination processes.

Sterilization involves the **removal or destruction** of all microorganisms and their spores.

Disinfection involves the **reduction** in number and type of microorganisms -

- High-level includes pasteurization or use of glutaraldehyde. All life is destroyed except spores. Items that touch mucous membranes should receive high-level disinfection i.e. flexible endoscopes, laryngoscopes and other similar instruments.
- Intermediate level hospital-grade disinfectant - an Environmental Protection Agency (EPA) approved Tuberculocidal cleaner/disinfectant. Items that touch mucous membranes or skin that is not intact should receive intermediate- level disinfection i.e. thermometers, hydrotherapy tanks.
- Low-level sanitizers reduce bacteria to what is considered a "safe level". Items that touch intact skin should receive low - level disinfection i.e. stethoscopes, beds, whirlpools, and equipment which are non-invasive to patients.

Antisepsis is the **inhibition** of microorganism's growth on living tissue such as skin preparation before vascular line insertion or other invasive procedure. Alcohol, chlorhexidine, and Iodophors, i.e., betadine are most frequently used solution for antisepsis. Germicidal chemicals used for antisepsis are not generally adequate for decontaminating environmental surfaces. There are three categories of patient-care items depending on their intended use and the potential risk of disease transmission.

Critical items penetrate soft tissue or contact bone, the bloodstream, or other normally sterile tissues of the mouth. They have the highest risk of transmitting infection and should be heat-sterilized between patient uses. Alternatively, use sterile, single-use disposable devices. Examples include surgical instruments, periodontal scalers, periodontal probes, scalpel blades and surgical dental burs.

Semi-critical items contact only mucous membranes and do not penetrate soft tissues. As such, they have a lower risk of transmission. Examples of these are mirrors, amalgam condensers, impression trays and x-ray aiming devices,

Because most items in this category are heat-tolerant, they should be heat sterilized between patient uses. For heat-sensitive instruments, high-level disinfection is appropriate.

Dental handpieces are a special case. Even though they do not penetrate soft tissue, it is difficult for chemical germicides to reach the internal parts of handpieces. For this reason, they should be heat sterilized using a steam autoclave or chemical vapor sterilizer.

Noncritical instruments and devices only contact intact skin, which serves as an effective barrier to microorganisms.

These items carry such a low risk of transmitting infections that they usually require only cleaning and low-level disinfection. If using a low-level disinfectant, according to OSHA, it must have a label claim for killing HIV and HBV. However, if an item is visibly bloody, it should be cleaned and disinfected using an intermediate-level disinfectant before use on another patient. Examples of instruments in this category include X-ray head/cones, facebows, pulse oximeters, and blood pressure cuffs.

Instrument Processing Area

Most instrument cleaning, disinfecting, and sterilization should occur in a designated central processing area to control both quality and personnel safety.

To prevent cross-contamination, the instrument processing area should be physically or spatially divided into regions for cleaning, packaging, sterilization, and storage.

- In the cleaning area, reusable contaminated instruments are received, sorted, and cleaned.
- The packaging area is for inspecting, assembling, and packaging clean instruments in preparation for final sterilization.
- The sterilization and storage area contains the sterilizers and related supplies, incubators for analyzing spore tests (if performed in office-although some states require using a testing service), and can contain enclosed storage for sterile items and disposable (single-use) items.

Cleaning

As noted above in the definitions, cleaning is the first step in a decontamination process.

Automated or mechanical cleaning equipment, such as ultrasonic cleaners, instrument washers, and washer-disinfectors, are commonly used to clean dental instruments. Automated cleaners increase the efficiency of the cleaning process and reduce the handling of sharp instruments. After cleaning, instruments should be rinsed with water to remove chemical or detergent residue.

If **manual cleaning** is necessary, soak instruments in a rigid container filled with detergent, disinfectant/detergent, or an enzymatic cleaner. This step prevents drying of patient material and makes cleaning easier and less time consuming.

- Do not use high-level disinfectants/sterilants (e.g., glutaraldehyde) as instrument-holding solutions.
- To avoid injury from sharp instruments, personnel should wear puncture-resistant, heavy-duty, utility gloves (i.e., not patient care gloves) when handling or manually cleaning contaminated instruments and devices. To protect against splashes, a facemask, eye protection or face shield, and a gown or jacket should be worn.

Preparation and Packaging

After thorough cleaning and drying of instruments, critical and semi-critical instruments that will be stored before use should be wrapped or placed into container systems prior to heat sterilization. This step protects items from contamination after the sterilization cycle and during storage.

Open or unlock hinged instruments so that all surfaces are exposed.

Place a chemical indicator inside each wrapped package. If the indicator cannot be seen from the outside, place another indicator (e.g., indicator tape) on the outside of the package.

Always wear heavy-duty, puncture-resistant utility gloves while inspecting and packaging instruments.

Heat-Based Sterilization

There are three types of heat sterilization methods commonly used in dentistry.

1. **Steam under pressure** (autoclaving). There are two types of tabletop steam autoclaves:
 - In most commonly used gravity displacement sterilizers, steam enters the chamber and unsaturated air is forced out of the chamber through a vent in the chamber wall.
 - In contrast, pre-vacuum sterilizers are fitted with a vacuum pump to create a vacuum in the chamber and ensure air removal from the sterilizing chamber and load **before** the chamber is pressurized with steam. This method improves the speed and efficiency of the sterilization process.
2. **Dry heat sterilizers** are either static air (convection or FDA-approved oven type) or forced air (rapid heat-transfer).
3. **Unsaturated chemical vapor** sterilizers use a proprietary formula of alcohol/formaldehyde.

With all of these methods, always use FDA-approved devices and closely follow the manufacturer's instructions for proper use.

Liquid Chemical Sterilant/Disinfectant

Heat-sensitive instruments can be sterilized or high-level disinfected by soaking them in a liquid chemical germicide cleared by the FDA. However, exposure to these powerful and toxic chemicals can be harmful to DHCP and patients if the manufacturer's instructions for use and safety precautions are not followed precisely. For these reasons, CDC encourages the use of heat-tolerant or disposable alternatives.

Sterilization Monitoring - Types of Indicators

Proper monitoring of sterilization procedures should include a combination of process indicators, including the following:

- **Mechanical**-involves assessment of cycle time, temperature, and pressure by observing the gauges or displays on the sterilizer.
- **Chemical**-uses sensitive chemicals that change color when a given parameter is reached (e.g., heat-sensitive external tape, internal chemical indicator strip).
- **Biological**-this method is the most valid method for monitoring the sterilization process because it assesses the process directly. It does so by using the most heat-resistant microorganisms and not by using indicators that only test the physical and chemical conditions necessary for sterilization.

Mechanical and chemical indicators should be assessed with each load. If either mechanical indicators or internal or external chemical indicators indicate inadequate processing, items in the load should not be used until reprocessed.

Biological indicators should be assessed at least once a week.

Storage of Sterile and Clean Items and Supplies

DHCP have a choice about how they maintain their instrument storage area - either date- or event-related shelf-life practices. In date-related packing, every sterilized package is expiration-dated and the instruments are used on a "first in, first out" basis. In event-related practice, the

contents of a sterilized package should remain sterile indefinitely unless some event, for example, torn or wet packaging material, causes it to become potentially contaminated. It is still useful to place the date of sterilization and identify the sterilizer used if multiple sterilizers are utilized in the office. In case of sterilization failure, this information would facilitate retrieval of processed items.

- Examine each package. If it is damaged in any way, items should be re-cleaned, re-wrapped, and re-sterilized. Even if an event-related approach is used, all packages should be labeled with the date of sterilization and which sterilizer was used, should a sterilization failure occur.
- Store all sterile and clean items and supplies in dry, closed, or covered cabinets.

Environmental Infection Control

Environmental Surfaces

Environmental surfaces can become contaminated with microorganisms during patient care, although they have not been associated directly with disease transmission to patients or DHCP.

Environmental surfaces do not require decontamination procedures as stringent as those used on patient care items.

There are two categories of environmental surfaces:

Clinical contact surfaces have a high potential for direct contamination from patient materials either by direct spray or spatter generated during dental procedures or by contact with DHCP's gloved hand. These surfaces can later contaminate other instruments, devices, hands, or gloves.

Housekeeping surfaces do not come into contact with patients or devices used in dental procedures. Therefore, they have a limited risk of disease transmission.



Photo credit: Lt. Col. Jennifer Harte, U.S.A.F. Dental Investigation Service, Great Lakes, IL.

Some examples of clinical contact surfaces, including a light handle, countertop, bracket tray, dental chair, and door handle (shown by arrows above).

Housekeeping Surfaces



DEPARTMENT OF HEALTH AND HUMAN SERVICES
CENTERS FOR DISEASE CONTROL AND PREVENTION



Lt. Col. Jennifer Harte, U.S.A.F. Dental Investigation Service, Great Lakes, IL.

Examples of housekeeping surfaces are walls, sinks, and floors (shown by arrows).

General Cleaning Recommendations

- Use barrier precautions (e.g., heavy-duty utility gloves, masks, protective eyewear) when cleaning and disinfecting environmental surfaces.
- Physical removal of microorganisms by cleaning is as important as the disinfection process.
- Follow manufacturer's instructions for proper use of EPA-registered hospital disinfectants (such as dilution and storage).
- Do not use sterilant/high-level disinfectants on environmental surfaces.

Cleaning Clinical Contact Surfaces

Because clinical contact surfaces come into direct contact with contaminated gloves, instruments, spray or spatter, their risk of transmitting infection is greater than for housekeeping surfaces. These surfaces can subsequently contaminate other instruments, devices, hands, or gloves.

Surface barriers can be used to protect clinical contact surfaces and changed between patients. Surface barriers are particularly useful for surfaces that are hard to clean, such as switches on dental chairs. This practice will also reduce exposure to harmful chemical disinfectants.

If surface barriers cannot be used, clean and then disinfect the surface with an EPA-registered hospital disinfectant effective against HIV and HBV (low-level disinfectant). If the surface is visibly contaminated with blood or other patient material, clean and then disinfect the surface with an EPA-registered hospital disinfectant with a tuberculocidal claim (intermediate-level disinfectant).

Cleaning Housekeeping Surfaces

Housekeeping surfaces carry the least risk for transmitting infections in dental settings. On a routine basis, these surfaces should be either cleaned with soap and water or an EPA-registered detergent/hospital disinfectant.

Wet mops and cloths may become contaminated with microorganisms, so clean the mop and cloths after use and allow them to dry thoroughly before re-using.

Prepare fresh cleaning and disinfecting solutions daily and per manufacturer recommendations.

Medical Waste

There is no evidence that traditional medical waste management has contributed to increased levels of disease in the community or among health care personnel.

The majority of waste generated in a medical or dental office (~98%-99%) is not considered infectious and can be discarded in the regular trash. Examples include used gloves, masks, and lightly bloodied gauze.

Regulated medical waste includes all biohazardous waste and sharps waste. Some waste, such as used needles, extracted teeth, oral tissue specimens and gauze soaked in blood, may pose a potential risk of infection, however, and warrants special precautions during handling and disposal. Any disposable items (masks, gloves, paper covers, paper towels, gauze, surface covers, gowns, etc.) that contain recognizable blood or body fluids should be carefully handled with utility gloves and placed in a sturdy plastic red bag. Put sharps (needles and scalpel blades) in a puncture-resistant container. Anesthetic cartridges may contain aspirated blood or fluids, so they should also be disposed of in the sharps container.

In California, the law that govern the management of medical waste is the Medical Waste Management Act (MWMA). Generators of medical waste must consult with the California Department of Health Services, Medical Waste Management Program for details on how to abide by the laws.

Rules for containerizing and storing medical waste vary depending on the type of waste. The following rules apply (for complete rules see the Medical Waste Management Act):

- Medical waste must be contained separately from other waste at the point of origin in the healthcare facility. Sharps containers may be placed in biohazard bags or in containers with biohazard bags.
- Biohazardous waste must be placed in a red biohazard bag conspicuously labeled with the words "Biohazardous Waste" or with the international biohazard symbol and the word "BIOHAZARD."
- Sharps waste must be contained in a sharps container.
- Biohazardous waste that is contaminated through contact with, or having previously contained, chemo-therapeutic agents, must be segregated for storage, and, when placed in a secondary container, that container must be labeled with the words "Chemotherapy Waste", "CHEMO", or other label approved by the department on the lid and on the sides, so as to be visible from any lateral direction.
- Biohazardous waste comprised of human surgery specimens or tissues which have been fixed in formaldehyde or other fixatives, must be segregated for storage and, when placed in a secondary container, that container must be labeled with the words "Pathology Waste", "PATH", or other label approved by the department on the lid and on the sides, so as to be visible from any lateral direction.



To containerize biohazard bags, a person must do all of the following:

- The bags must be tied to prevent leakage or expulsion of contents during all future storage, handling, or transport.
- Biohazardous waste must be appropriately bagged and placed for storage, handling, or transport in a rigid container which may be disposable, reusable, or recyclable.
- Containers must be leak resistant, have tight-fitting covers, and be kept clean and in good repair.
- Containers may be of any color and must be labeled with the words "Biohazardous Waste" or with the international biohazard symbol and the word "BIOHAZARD" on the lid and on the sides so as to be visible from any lateral direction.
- Biohazardous waste must not be removed from the biohazard bag until treatment is completed.
- Biohazardous waste must not be disposed of before being treated.
- If a facility generates 20 or more pounds of biohazardous waste per month, the facility must not contain or store biohazardous or sharps waste above 0 degrees Centigrade (32 degrees Fahrenheit) at any onsite location for more than seven days without obtaining prior written approval of the enforcement agency.
- If a facility generates less than 20 pounds of biohazardous waste per month, the person must not contain or store biohazardous waste above 0 degrees Centigrade (32 degrees Fahrenheit) at any onsite location for more than 30 days.
- A facility may store biohazardous or sharps waste at or below 0 degrees Centigrade (32 degrees Fahrenheit) at an onsite location for not more than 90 days without obtaining prior written approval of the enforcement agency.
- A facility may store biohazardous or sharps waste at a permitted transfer station at or below 0 degrees Centigrade (32 degrees Fahrenheit) for not more than 30 days without obtaining prior written approval of the enforcement agency.
- A facility must not store biohazardous or sharps waste above 0 degrees Centigrade (32 degrees Fahrenheit) at any location or facility which is offsite from the generator for more than seven days before treatment.

Dental Unit Waterlines, Biofilm, and Water Quality

Dental Unit Waterlines and Biofilm

Studies have shown that colonies of microorganisms, or biofilms, can form on the inside of the small-bore plastic tubing that transports water within the dental unit to handpieces and air-water syringes. Once formed, a biofilm serves as a reservoir that may dramatically increase the number of free-floating microorganisms in water used for dental treatment.

Most organisms isolated from dental water systems originate from the public water supply and do not pose a high risk of disease for healthy persons. Although a few pathogenic organisms, such as *Legionella* spp. and *Pseudomonas* sp., have been found, adverse public health threats have not been documented.

Dental Unit Water Quality

Despite a lack of documented adverse health effects, using water of uncertain microbiological quality is inconsistent with infection control principles. Clearly, dental unit water quality (DUWQ) is a concern. Levels of contamination in water from untreated systems can exceed 1 million colony forming units per milliliter (mL) of water.

Untreated dental units cannot reliably produce water that meets drinking water standards (fewer than 500 CFU/mL of heterotrophic water bacteria). Even using source water containing <500 CFU/mL of bacteria (e.g., tap, distilled, or sterile water) in a self-contained system will not eliminate bacterial contamination in treatment water if biofilms in the water system are not controlled. Removal or inactivation of dental waterline biofilms requires use of chemical germicides.

Dental Water Quality

For routine dental treatment, meet regulatory standards for drinking water.*

* <500 CFU/mL of heterotrophic water bacteria.

For this reason, CDC recommends that water used for routine dental treatment meet regulatory standards for drinking water (fewer than 500 CFU/mL of heterotrophic water bacteria).

Available DUWL Technology

In recent years, commercial devices and procedures designed to improve the quality of water used in dental treatment have become widely available. Examples of methods shown to be effective include the following:

- Self-contained water systems combined with intermittent or continuous chemical treatment.
- In-line microfilters.
- Combinations of these treatments.
- Another alternative is to bypass the conventional dental water delivery system entirely and use either autoclavable or disposable pathways, such as sterile water delivery systems.

As with any dental equipment, always consult with the dental unit manufacturer for appropriate methods to maintain the recommended quality of dental water.

Monitoring Options

Monitoring of dental water quality may be performed using commercial self-contained test kits or commercial water-testing laboratories. In-office water-testing systems are available that work at room temperature using small paddles or plates of culture medium to reveal bacterial colonies after 72 or more hours.

Dentists should consult with the manufacturer of their dental unit or water delivery system to determine the best method for maintaining acceptable water quality (i.e., <500 CFU/mL) and the recommended frequency of monitoring.

Sterile Irrigating Solutions

During oral surgical procedures, microorganisms may enter the bloodstream and other normally sterile areas of the oral cavity (e.g., bone or subcutaneous tissue). For this reason, sterile solutions (e.g., sterile saline or sterile water) should be used as a coolant/irrigator when performing surgical procedures.

Because the tubing cannot be reliably sterilized, conventional dental units cannot reliably deliver sterile water even when equipped with independent water reservoirs. Sterile water delivery devices, such as sterile irrigating syringes, or bulb syringes should be used to deliver sterile water. Sterile water systems, such as those used with surgical handpieces, bypass the dental unit and use sterile disposable or autoclavable tubing.

Special Considerations

Dental Handpieces and Other Devices Attached to Air and Waterlines

Any removable device that is attached to the air or waterlines should be heat sterilized to ensure that internal components have been sterilized.

It is very important to follow the manufacturer's instructions for cleaning and lubrication. These protocols can ensure the effectiveness of the process and contribute to the life of the device.

Surface disinfection or liquid chemical germicide immersion are not acceptable. In addition, the use of ethylene oxide is not recommended because it cannot reliably penetrate the internal components.

Components of Devices Permanently Attached to Air and Waterlines

Some parts of dental instruments are permanently attached to dental unit waterlines. These items do not enter the patient's mouth but are likely to become contaminated with oral fluids during treatment procedures. Some examples include handles or dental unit attachments of saliva ejectors, high-volume evacuators, and air/water syringes.

These components should be covered with waterproof barriers and changed after each use.

If the item becomes visibly contaminated during use, clean and disinfect with an EPA-registered hospital disinfectant with a tuberculocidal claim (intermediate-level disinfectant) before using it with the next patient.

Saliva Ejectors

Backflow, meaning reverse flow, can occur when there is more negative pressure in the patient's mouth than in the evacuator tubing, for example, when the patient uses the saliva ejector as a straw. When this happens, material from the mouth of a previous patient might remain in the vacuum line of the saliva ejector and be aspirated into the mouth of the next patient being treated.

Although there have been no reports of any adverse health issues, patients should not be instructed to close their lips tightly around the saliva ejector tip during use.

Dental Radiology

When taking or processing radiographs:

- Wear gloves and other appropriate personal protective equipment as necessary.
- Heat sterilize heat-tolerant radiographic accessories.
- Transport and handle exposed radiographs so as to prevent cross-contamination.
- Avoid contamination of developing equipment.

Parenteral Medications

Parenteral medications are medications that are injected into the body.

Cases of disease transmission following improper administration of parenteral medications have been reported in medical settings. For this reason it is critical that DHCP handle parenteral medications safely and use special precautions to prevent infection transmission.

Precautions to prevent disease transmission associated with the use of parenteral medications include:

- Treat fluid infusion and administration sets, including IV tubings, bags, connections, needles, and syringes as single-patient, disposable.

Regarding single-dose vials:

- Do not administer to multiple patients even if the needle on the syringe is changed.
- Use single-dose instead of multidose vials whenever possible.
- Do not combine leftover contents for later use.

Single-Use (Disposable) Devices

A single-use device, also referred to as a disposable device, is intended for use on one patient. It was never intended to be cleaned, disinfected, or sterilized and used on another patient.

Single-use devices used in dentistry are usually not heat tolerant and cannot be reliably cleaned. Examples of such items include syringe needles, prophylaxis cups and brushes, and plastic orthodontic brackets.

Preprocedural Mouth Rinses

Preprocedural mouth rinsing is the use of an antimicrobial mouth rinse by the patient prior to a dental procedure. These mouth rinses can contain, for example, chlorhexidine gluconate, essential oils, and povidine-iodine.

Studies have shown that preprocedural mouth rinses can reduce the number of aerosolized bacteria, and in some cases, the number of bacteria introduced into the bloodstream. However, there is no scientific evidence that this practice can prevent clinical infections among patients or DHCP.

Although there is no harm in using preprocedural mouth rinses because of the lack of evidence that clinical infections are prevented, no recommendation is made.

Oral Surgical Procedures

The oral cavity is colonized by many types and large numbers of microorganisms. Surgical procedures present an opportunity for these microorganisms to enter the bloodstream and other normally sterile areas of the mouth. Entry of microorganisms into bone and subcutaneous tissue may increase the potential for localized or systemic infection.

CDC recommendations define oral surgical procedures as those that "involve the incision, excision, or reflection of tissue that exposes normally sterile areas of the oral cavity."

Examples include biopsy, periodontal surgery, implant surgery, apical surgery, and surgical extractions of teeth, defined as the removal of erupted or nonerupted teeth requiring elevation of mucoperiosteal flap, removal of bone, or sectioning of teeth and suturing if needed.

A higher level of infection control is warranted when performing surgical procedures and includes the following:

- Surgical handscrub using an antimicrobial agent.
- Use of sterile surgeon's gloves.
- Use of sterile irrigating solutions.
- The latter includes delivery systems that bypass the dental unit, such as sterile bulb syringes or sterile injection syringes.

Handling Biopsy Specimens

To protect the people handling and transporting biopsy specimens, each specimen must be placed in a sturdy, leakproof container with a secure lid to prevent leakage during transport.

Care should be taken when collecting the specimen to avoid contaminating the outside of the container. If the outside of the container becomes visibly contaminated, it should be cleaned and disinfected or placed in a leakproof bag.

The container also must be labeled with a biohazard symbol.

Extracted Teeth

Extracted Teeth

- ◆ Considered regulated medical waste
 - Do not incinerate extracted teeth containing amalgam
 - Clean and disinfect before sending to lab for shade comparison
- ◆ Can be given back to patient

BIOHAZARD

Extracted teeth that are being discarded are considered infectious and should be treated as regulated medical waste.

Extracted teeth containing amalgam should not be placed in a medical waste container that uses an incinerator for final disposal. State and local regulations should be consulted regarding disposal of amalgam.

Extracted teeth used for shade comparison should be cleaned and the surface disinfected with an intermediate-level EPA-registered hospital grade disinfectant before sending to the laboratory.

If patients request their own extracted teeth, the tooth fairy wins: OSHA regulations no longer apply once the tooth has been returned to the patient. However, for the safety of others who may come into contact with the tooth, it should be cleaned and disinfected before it is returned to the patient.

Extracted teeth are occasionally collected and used for preclinical educational training.

- Extracted teeth should be cleaned of visible blood and debris and kept hydrated in tap water or saline. Be sure to use a sturdy, leakproof container if transporting and label the container with a biohazard symbol.
- Using teeth without amalgam is preferred because teeth can be safely autoclaved. If extracted teeth that contain amalgam must be used, DO NOT heat sterilize since this will produce harmful mercury vapors. Instead, immerse in 10% formalin for 2 weeks before use.
- Even though the inside of the pulp chamber is now safe to touch, CDC suggests that students use Standard Precautions, because preclinical exercises should simulate clinical practice.

Laser/Electrosurgery Plumes and Surgical Smoke

Lasers or electrosurgical units can cause thermal destruction of tissue and create a smoke by-product containing toxic gases and vapors such as benzene; dead and live cellular material (including blood fragments), and viruses.

One concern is that aerosolized infectious material, such as herpes simplex virus (HSV) and human papillomavirus (HPV) in the laser plume may contact the nasal mucosa of the laser operator and nearby DHCP.

No evidence exists that HIV or HBV have been transmitted via aerosolization and inhalation.

Until studies have fully evaluated the risk for DHCP from exposure to laser plumes and electrosurgery smoke, it might be practical to follow National Institute of Occupational Safety and Health (NIOSH) recommendations (see guidelines). Use of precautions beyond Standard Precautions is an unresolved issue in dentistry.

Dental Laboratory

Dental prostheses, such as crowns, full and partial dentures, orthodontic appliances, and items used in their fabrication are potential sources of contamination in the dental laboratory.

As such, they should be handled in a manner that protects patients and DHCP from exposure to microorganisms.

Prostheses, orthodontic appliances, and impressions should be cleaned, disinfected with an intermediate-level disinfectant, and rinsed before and after being manipulated. Wear gloves and other appropriate personal protective equipment (PPE) until disinfection has been completed.

Clean and heat sterilize heat-tolerant items used in the mouth.

Communicate specific information about disinfection procedures; personnel in both the dental office and the laboratory should ensure that the other knows what has occurred.

Transmission of Mycobacterium Tuberculosis

Persons infected with Mycobacterium tuberculosis may be seen in dental care settings.



This thin section transmission electron micrograph (TEM) depicted the ultrastructural details displayed by a number of Gram-positive Mycobacterium tuberculosis bacilli, the causative agent for tuberculosis. Photo courtesy of CDC.

M. tuberculosis is a bacterium carried in airborne droplet nuclei that can be generated when persons with pulmonary or laryngeal TB sneeze, cough, speak, or sing. These small particles (1--5 µm) can stay suspended in the air for hours. Infection occurs when a susceptible person inhales droplet nuclei containing *M. tuberculosis*, which then travel to the alveoli of the lungs. Usually within 2--12 weeks after initial infection with *M. tuberculosis*, immune response prevents further spread of the TB bacteria, although they can remain alive in the lungs for years, a condition termed latent TB infection. Persons with latent TB infection usually exhibit a reactive tuberculin skin test (TST), have no symptoms of active disease, and are not infectious. However, they can develop active disease later in life if they do not receive treatment for their latent infection.

Approximately 5% of persons who have been recently infected and not treated for latent TB infection will progress from infection to active disease during the first 1--2 years after infection; another 5% will develop active disease later in life. These means that approximately 90% of U.S. persons with latent TB infection do not progress to active TB disease. Although both latent TB infection and active TB disease are described as TB, only those with active disease are contagious and present a risk of transmission. Symptoms of active TB disease include a productive cough, night sweats, fatigue, malaise, fever, and unexplained weight loss. Certain immunocompromising medical conditions (e.g., HIV) increase the risk that TB infection will progress to active disease at a faster rate (CDC, 2003).

According to the CDC guidelines, overall, the risk borne by dental professionals for exposure to a patient with active TB disease is probably low (CDC, 2003). There has been only one case report of transmission of tuberculosis bacteria from an infected dentist to patients, reportedly transmitted by direct inoculation of extraction sites through the dentist's fingers (Smith WH, Davies D, Mason KD, Onions JP: Intraoral and pulmonary tuberculosis following dental treatment. *Lancet* 1982;1:842-4).

However, in certain cases, dental professionals or the community served by the dental facility might be at relatively high risk for exposure to TB (CDC, 2003).

In addition, tuberculin skin test conversions among DHCP are rare, even among populations of dentists at high risk for exposure to TB patients.

Periodic updates of medical histories should include questions concerning history of TB exposure, infection or (current or past) treatment for active TB, and symptoms consistent with TB.

Elective dental treatment should be deferred for any patient suspected or known to have active TB until they have been evaluated by medical personnel.

Surgical masks do not prevent inhalation of *M. tuberculosis* droplet nuclei, and therefore, standard precautions are not sufficient to prevent transmission of this organism. Recommendations for expanded precautions to prevent transmission of *M. tuberculosis* and other organisms that can be spread by airborne, droplet, or contact routes have been detailed in other guidelines.

DHCP should wear a face mask (surgical) or N-95 respirator for all patient contact. Any patient with suspected or possible infectious TB should be separated from other patients or DHCP, given a surgical mask to wear, and provided with tissues for coughing or sneezing. Refer the patient to a facility with proper TB infection control precautions for medical evaluation or urgent dental treatment. If you are in an office or facility that will provide dental treatment for patients with TB, additional precautions are necessary. Refer to CDC Guidelines for Preventing the Transmission of MTB in Health-Care Facilities. *MMWR* 1994;43(No. RR-13).

Creutzfeldt-Jakob Disease (CJD) and other Prion Diseases

Creutzfeldt-Jakob disease (CJD) belongs to a group of rapidly progressive, fatal, degenerative neurological disorders, transmissible spongiform encephalopathies (TSEs) that affect both humans and animals (CDC, 2010). These TSEs are thought to be caused by infection with an unusual pathogen called a prion. Prions are isoforms of a normal protein, capable of self-propagation although they lack nucleic acid. Prion diseases have an incubation period of years and are usually fatal within 1 year of diagnosis (CDC, 2010).

In addition to CJD, the TSEs include:

- Gerstmann-Straussler-Scheinker Syndrome;
- Fatal Familial Insomnia;
- Variant Creutzfeldt-Jakob Disease (vCJD), also known as Bovine Spongiform Encephalitis (BSE), called "mad cow disease" in animals.
- Kuru.

CJD and vCJD are transmissible diseases, but not through the air or casual contact. All known cases of acquired, iatrogenic CJD have resulted from exposure to infected central nervous tissue (e.g., brain and dura mater), pituitary, or eye tissue. Studies in experimental animals have determined that other tissues have low or no detectable infectivity. Limited experimental studies have demonstrated that scrapie (a TSE in sheep) can be transmitted to healthy hamsters and mice by exposing oral tissues to infectious homogenate. These animal models and experimental designs might not be directly applicable to human transmission and clinical dentistry, but they indicate a theoretical risk of transmitting prion diseases through perioral exposures (CDC, 2010).

According to the CDC, published reports, iatrogenic transmission of CJD has occurred in humans under three circumstances: after use of contaminated electroencephalography depth electrodes and neurosurgical equipment; after use of extracted pituitary hormones; and after implant of contaminated corneal and dura mater grafts from humans. The equipment-related cases occurred before the routine implementation of sterilization procedures used in healthcare facilities (CDC, 2010).

Per the CDC, case-control studies have found no evidence that dental procedures increase the risk of iatrogenic transmission of TSEs among humans. In these studies, CJD transmission was not associated with dental procedures (e.g., root canals or extractions), with convincing evidence of prion detection in human blood, saliva, or oral tissues, or with dental professionals becoming occupationally infected with CJD. In 2000, prions were not found in the dental pulps of eight patients with neuropathologically confirmed sporadic CJD by using electrophoresis and a Western blot technique (CDC, 2010).

Prions exhibit unusual resistance to conventional chemical and physical decontamination procedures. Because of this resistance and the invariably fatal outcome of CJD, procedures for disinfecting and sterilizing instruments potentially contaminated with the CJD prion have been controversial for years. Scientific data indicate the risk, if any, of sporadic CJD transmission during dental and oral surgical procedures is low to nil. Until additional information exists regarding the transmissibility of CJD or vCJD, special precautions in addition to standard precautions might be indicated when treating known CJD or vCJD patients; the following list of precautions is provided, by the CDC, for consideration without recommendation (CDC, 2010):

- Use single-use disposable items and equipment whenever possible.
- Consider items difficult to clean (e.g., endodontic files, broaches, and carbide and diamond burs) as single-use disposables and discard after one use.

- To minimize drying of tissues and body fluids on a device, keep the instrument moist until cleaned and decontaminated.
- Clean instruments thoroughly and steam-autoclave at 134°C for 18 minutes. This is the least stringent of sterilization methods offered by the World Health Organization.
- Do not use flash sterilization for processing instruments or devices.

Program Evaluation

Earlier in this course, a workplace infection control program was described. With its focus on preventing infection in the healthcare setting, including those that are acquired by patients and those that come from occupational exposure, knowing whether the infection control program is effective is critical.

Strategies and tools to evaluate the infection control program can include the following:

- Periodic observational assessments.
- Checklists to document procedures.
- Routine review of occupational exposures to bloodborne pathogens.
- Constructive review and feedback to staff.

Program evaluation provides an opportunity to identify and change inappropriate practices, thereby improving the effectiveness of the infection control program.

Conclusion

Eliminating or controlling the risk of exposure to disease causing organisms in the dental healthcare setting has been the focus of this course. The ethical and professional responsibility to follow current accepted scientifically based infection control practices among dental professionals is clear. It is also the legal responsibility of dental professionals in California to maintain knowledge and competence in infection control as a component of professional practice; failure to do so can result in charges of professional misconduct.

Completing a mandatory California Dental Board approved course on infection control for relicensure of dental professionals, such as this course, is also a legal responsibility.

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Course Test

1. The biofilm that can form on dental unit waterlines poses a risk in the chain of infection. Which of the elements of the chain of infection is the biofilm?
 - A. Pathogen.
 - B. Method of transmission.
 - C. Reservoir.
 - D. Means of entry.
2. Preventing the risk of exposure to pathogens by changing the procedure for a particular task, such as using gloves as a barrier while handling potentially infectious materials is known as:
 - A. A work practice control.
 - B. An administrative control.
 - C. An engineering control.
 - D. None of the above.
3. Standard Precautions include all of the following **EXCEPT**:
 - A. It is based on the concept that blood and body fluids, non-intact skin and mucous membranes are all potentially infectious.
 - B. It applies to all patients.
 - C. It encompasses the use of barrier precautions such as personal protective equipment.
 - D. It is used only for those patients with known or suspected HIV, HBV or HCV infection.
4. Which of the following can damage latex gloves?
 - A. Oil or petroleum based hand cream.
 - B. Disinfecting chemicals and antimicrobial hand wash.
 - C. A sharp instrument.
 - D. All of the above.
5. Properly diluted iodophor is rated by the EPA as a tuberculocidal disinfectant.
 - A. True.
 - B. False.
6. The majority of microorganisms found on the hands are:
 - A. On the thumbs.
 - B. Under and around the nails.
 - C. At the fingertips.
 - D. In between the fingers.
7. According to the Centers for Disease Control and Prevention, effective infection control strategies prevent disease transmission by interrupting one or more links in the chain of infection.
 - A. True.
 - B. False.

8. After percutaneous injury with a contaminated sharp instrument, the average risk of HIV infection is:
- A. 0.8%.
 - B. 30 %
 - C. 0.3%
 - D. 6%
9. High level disinfection involves the destruction of all life, including bacterial spores.
- A. True.
 - B. False.
10. The greatest concentration of the hepatitis B virus in the mouth is in:
- A. The tongue.
 - B. The anterior palate.
 - C. The gingival sulcus.
 - D. The enamel structure.
11. Surgical instruments, periodontal scalers, scalpel blades and surgical dental burs are all classified as critical items. The following is true of critical items **EXCEPT**:
- A. They have the highest risk of transmitting infection and should be heat sterilized between use.
 - B. They penetrate soft tissue or contact bone, the bloodstream, or other normally sterile tissues of the mouth.
 - C. They are biohazardous and the waste water is considered regulated medical waste.
 - D. Sterile, single-use disposable devices can be used.
12. Which of the following statements is true regarding dental unit waterlines?
- A. If municipal water is the source that enters the dental unit waterline, output will always meet dental water quality.
 - B. Flushing the waterlines at the beginning of the day sufficiently reduces the biofilm in the waterlines.
 - C. Filters commonly found in dental unit water regulators do not function as microbiological filters.
 - D. Dental unit waterlines can reliably deliver optimal water quality when used for irrigation during a surgical procedure.
13. All the following is true about regulated medical waste in California **EXCEPT**:
- A. It accounts for approximately 98-99% of waste produced in dental offices.
 - B. Includes biohazardous waste and sharps waste.
 - C. Generators of regulated medical waste must consult with the California Department of Health Services, Medical Waste Management Program.
 - D. The law in California that governs the management of medical waste is the Medical Waste Management Act (MWMA).

14. Latex allergy is:

- A. An immediate hypersensitivity reaction to the proteins in natural rubber latex.
- B. The proteins attach to the powder in the gloves.
- C. Reactions can be severe, starting with runny nose, hives, itchy eyes, burning skin sensations, difficulty breathing, anaphylactic shock and death.
- D. All of the above.