Chapter 2: Guidelines for Infection Control in Dental Health Care Settings

4 CE Hours - Mandatory

By: Elite Staff

Learning objectives

- Establish the process of educating and protecting dental health care personnel.
- Explain the prevention of transmission of blood-borne pathogens.
- Discuss the concerns of hand hygiene.
- Identify protection against spatter by use of personal protective equipment.
- Learn how to avoid the risk of contact dermatitis and latex hypersensitivity.

- Emphasize the importance of sterilization and disinfection of patient-care items.
- List the special considerations that should be taken with dental handpieces, waterlines, water quality, biofilm, radiology, oral surgical procedures and dental laboratories.
- Review Section 1005 California Minimum Standards for Infection Control.

Introduction

Infection control and health care epidemiology is the discipline concerned with preventing the spread of infections within the health care setting. As such, it is a practical (rather than an academic) subdiscipline of epidemiology. It is an essential (though often underrecognized and undersupported) part of the infrastructure of health care. Infection control and hospital epidemiology are akin to public health practice, practiced within the confines of a particular health care delivery system rather than directed at society as a whole.

Infection control concerns itself both with prevention (hand hygiene/hand-washing, cleaning/disinfection/sterilization, vaccination, surveillance) and with investigation and management of a demonstrated or suspected spread of infection within a particular health care setting (e.g., outbreak investigation). It is on this basis that the common title being adopted within health care is “infection prevention and control.”

This course consolidates recommendations for preventing and controlling infectious diseases and managing personnel health and safety concerns related to infection control in dental settings. It:

- Updates and revises previous CDC recommendations regarding infection control in dental settings.
- Incorporates relevant infection control measures from other CDC guidelines.
- Discusses concerns not addressed in previous recommendations for dentistry. These updates and additional topics include:
  - Application of standard precautions rather than universal precautions.
  - Work restrictions for health care personnel (HCP) infected with or occupationally exposed to infectious diseases.
  - Management of occupational exposures to blood-borne pathogens, including post-exposure prophylaxis (PEP) for work exposures to hepatitis B virus (HBV), hepatitis C virus (HCV); and human immunodeficiency virus (HIV).
  - Selection and use of devices with features designed to prevent sharps injury.
  - Hand-hygiene products and surgical hand antisepsis.
  - Contact dermatitis and latex hypersensitivity.
  - Sterilization of unwrapped instruments.
  - Dental water-quality concerns (e.g., dental unit waterline biofilms; delivery of water of acceptable biological quality for patient care; usefulness of flushing waterlines; use of sterile irrigating solutions).
  - Oral surgical procedures; handling of community boilwater advisories.
  - Dental radiology.
  - Aseptic technique for parenteral medications.
  - Preprocedural mouth rinsing for patients.
  - Oral surgical procedures.
  - Laser/electrosurgery plumes.
  - Tuberculosis (TB).
  - Creutzfeldt-Jakob disease (CJD) and other prion-related diseases.
  - Infection control program evaluation.
  - Research considerations.

These guidelines were developed by CDC staff members in collaboration with other authorities on infection control. Draft documents were reviewed by other federal agencies and professional organizations from the fields of dental health care, public health and hospital epidemiology and infection control. A Federal Register notice elicited public comments that were considered in the decision-making process. Existing guidelines and published research pertinent to dental infection control principles and practices were reviewed. Wherever possible, recommendations are based on data from well-designed scientific studies. However, only a limited number of studies have characterized risk factors and the effectiveness of prevention measures for infections associated with dental health care practices.

Some infection control practices routinely used by health care practitioners cannot be rigorously examined for ethical or logistical reasons. In the absence of scientific evidence for such practices, certain recommendations are based on strong theoretical rationale, suggestive evidence or opinions of respected authorities based on clinical experience, descriptive studies or committee reports. In addition, some recommendations are derived from federal regulations. No recommendations are offered for practices for which insufficient scientific evidence or lack of consensus supporting their effectiveness exists.
Background

In the United States, an estimated 9 million persons work in health care professions, including approximately 168,000 dentists, 112,000 registered dental hygienists, 218,000 dental assistants and 53,000 dental laboratory technicians. In this report, dental health care personnel (DHCP) refers to all paid and unpaid personnel in the dental health care setting who might be occupationally exposed to infectious materials, including body substances and contaminated supplies, equipment, environmental surfaces, water, or air. Dental health care personnel includes dentists, dental hygienists, dental assistants, dental laboratory technicians (in-office and commercial), students and trainees, contractual personnel and other persons not directly involved in patient care but potentially exposed to infectious agents (e.g., administrative, clerical, housekeeping, maintenance or volunteer personnel).

Recommendations in this report are designed to prevent or reduce potential for disease transmission from patient to dental health care personnel, from dental workers to patient, and from patient to patient. Although these guidelines focus mainly on outpatient, ambulatory dental health care settings, the recommended infection control practices are applicable to all settings in which dental treatment is provided. Dental patients and workers can be exposed to pathogenic microorganisms including cytomegalovirus (CMV), HBV, HCV, herpes simplex virus types 1 and 2, HIV, Mycobacterium tuberculosis, staphylococci, streptococci and other viruses and bacteria that colonize or infect the oral cavity and respiratory tract. These organisms can be transmitted in dental settings through:

- Direct contact with blood, oral fluids or other patient materials.
- Indirect contact with contaminated objects (e.g., instruments, equipment or environmental surfaces).
- 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).
- Inhalation of airborne microorganisms that can remain suspended in the air for long periods.

Infection through any of these routes requires that all of the following conditions be present:

- A pathogenic organism of sufficient virulence and in adequate numbers to cause disease.
- A reservoir or source that allows the pathogen to survive and multiply (e.g., blood).
- A mode of transmission from the source to the host.
- A portal of entry through which the pathogen can enter the host.
- A susceptible host (i.e., one who is not immune).

Occurrence of these events provides the chain of infection. Effective infection control strategies prevent disease transmission by interrupting one or more links in the chain.

Previous CDC recommendations regarding infection control for dentistry focused primarily on the risk of transmission of blood-borne pathogens among dental care personnel and patients and use of universal precautions to reduce that risk. Universal precautions were based on the concept that all blood and body fluids that might be contaminated with blood should be treated as infectious because patients with blood-borne infections can be asymptomatic or unaware they are infected. Preventive practices used to reduce blood exposures, particularly percutaneous exposures, include:

- Careful handling of sharp instruments.
- Use of rubber dams to minimize blood spattering.
- Hand washing.
- Use of protective barriers (e.g., gloves, masks, protective eyewear and gowns).

The relevance of universal precautions to other aspects of disease transmission was recognized, and in 1996, CDC expanded the concept and changed the term to standard precautions. Standard precautions integrate and expand the elements of universal precautions into a standard of care designed to protect health care personnel and patients from pathogens that can be spread by blood or any other body fluid, excretion or secretion.

Standard precautions apply to contact with:

- Blood.
- All body fluids, secretions and excretions (except sweat), regardless of whether they contain blood.
- Nonintact 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.

In addition to standard precautions, other measures (e.g., expanded or transmission-based precautions) might be necessary to prevent potential spread of certain diseases (e.g., TB, influenza and varicella) that are transmitted through airborne, droplet or contact transmission (e.g., sneezing, coughing and contact with skin). When acutely ill with these diseases, patients do not usually seek routine dental outpatient care. Nonetheless, a general understanding of precautions for diseases transmitted by all routes is critical because:

- Some dental health workers are hospital-based or work part-time in hospital settings.
- Patients infected with these diseases might seek urgent treatment at outpatient dental offices.
- Dental workers might become infected with these diseases.

Necessary transmission-based precautions might include patient placement (e.g., isolation), adequate room ventilation, respiratory protection (e.g., N-95 masks) for workers, or postponement of nonemergency dental procedures.

Dental health care personnel should be familiar also with the hierarchy of controls that categorizes and prioritizes prevention strategies. For blood-borne pathogens, engineering controls that eliminate or isolate the hazard (e.g., puncture-resistant sharps containers or needle retraction devices) are the primary strategies for protecting dental workers and patients. Where engineering controls are not available or appropriate, work-practice controls that result in safer behaviors (e.g., one-hand needle recappping or not using fingers for cheek retraction while using sharp instruments or suturing), and use of personal protective equipment (PPE) (e.g., protective eyewear, gloves and mask) can prevent exposure. In addition, administrative controls (e.g., policies, procedures and enforcement measures targeted at reducing the risk of exposure to infectious persons) are a priority for certain pathogens (e.g., M. tuberculosis), particularly those spread by airborne or droplet routes.

Dental practices should develop a written infection control program to prevent or reduce the risk of disease transmission. Such a program should include establishment and implementation of policies, procedures and practices (in conjunction with selection and use of technologies and products) to prevent work-related injuries and illnesses among dental care workers as well as health care-associated infections among patients. The program should embody principles of infection control and occupational health, reflect current science and adhere to relevant federal, state and local regulations and statutes. An infection control coordinator (e.g., dentist or other dental health worker) knowledgeable or willing to be trained should be assigned responsibility for coordinating the program. The effectiveness of the infection control program should be evaluated on a day-to-day basis and over time to help ensure that policies, procedures and practices are useful, efficient, and successful.
Although the infection control coordinator remains responsible for overall management of the program, creating and maintaining a safe work environment ultimately requires the commitment and accountability of all dental workers. This course is designed to provide guidance to workers for preventing disease transmission in dental health care settings, for promoting a safe working environment and for assisting dental practices in developing and implementing infection control programs. These programs should be followed in addition to practices and procedures for worker protection required by the Occupational Safety and Health Administration’s (OSHA) standards for occupational exposure to blood-borne pathogens, including instituting controls to protect employees from exposure to blood or other potentially infectious materials (OPIM), and requiring implementation of a written exposure-control plan, annual employee training, HBV vaccinations and post-exposure follow-up. Interpretations and enforcement procedures are available to help dental workers apply this OSHA standard in practice. Also, manufacturers’ Material Safety Data Sheets (MSDS) should be consulted regarding correct procedures for handling or working with hazardous chemicals.

**Definitions of terms used in this section**

“Standard precautions” are a group of infection prevention practices that apply to all patients, regardless of suspected or confirmed infection status, in any setting in which healthcare is delivered. These include: hand hygiene, use of gloves, gown, mask, eye protection, or face shield, depending on the anticipated exposure, and safe handling of sharps. Standard precautions shall be used for care of all patients regardless of their diagnoses or personal infectious status.

“Critical items” confer a high risk for infection if they are contaminated with any microorganism. These include all instruments, devices, and other items used to penetrate soft tissue or bone.

“Semi-critical items” are instruments, devices and other items that are not used to penetrate soft tissue or bone, but contact oral mucous membranes, non-intact skin or other potentially infectious materials (OPIM).

“Non-critical items” are instruments, devices, equipment, and surfaces that come in contact with soil, debris, saliva, blood, OPIM and intact skin, but not oral mucous membranes.

“Low-level disinfection” is the least effective disinfection process. It kills some bacteria, some viruses and fungi, but does not kill bacterial spores or mycobacterium tuberculosis var bovis, a laboratory test organism used to classify the strength of disinfectant chemicals.

“Intermediate-level disinfection” kills mycobacterium tuberculosis var bovis indicating that many human pathogens are also killed. This process does not necessarily kill spores.

“High-level disinfection” kills some, but not necessarily all bacterial spores. This process kills mycobacterium tuberculosis var bovis, bacteria, fungi, and viruses.

“Germinicide” is a chemical agent that can be used to disinfect items and surfaces based on the level of contamination.

“Sterilization” is a validated process used to render a product free of all forms of viable microorganisms.

“Cleaning” is the removal of visible soil (e.g., organic and inorganic material) debris and OPIM from objects and surfaces and shall be accomplished manually or mechanically using water with detergents or enzymatic products.

“Personal Protective Equipment” (PPE) is specialized clothing or equipment worn or used for protection against a hazard. PPE items may include, but are not limited to, gloves, masks, respiratory devices, protective eyewear and protective attire which are intended to prevent exposure to blood, body fluids, OPIM, and chemicals used for infection control. General work attire such as uniforms, scrubs, pants and shirts, are not considered to be PPE.

“Other Potentially Infectious Materials” (OPIM) means any one of the following:

A. Human body fluids such as saliva in dental procedures and any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids.

B. Any unfixed tissue or organ (other than intact skin) from a human (living or dead).

C. Any of the following, if known or reasonably likely to contain or be infected with human immunodeficiency virus (HIV), hepatitis B virus (HBV), or hepatitis C virus (HCV):
   1. Cell, tissue, or organ cultures from humans or experimental animals;
   2. Blood, organs, or other tissues from experimental animals; or culture medium or other solutions.

“Dental Healthcare Personnel” (DHCP), are all paid and non-paid personnel in the dental healthcare setting who might be occupationally exposed to infectious materials, including body substances and contaminated supplies, equipment, environmental surfaces, water, or air. DHCP includes dentists, dental hygienists, dental assistants, dental laboratory technicians (in-office and commercial), students and trainees, contractual personnel, and other persons not directly involved in patient care but potentially exposed to infectious agents (e.g., administrative, clerical, housekeeping, maintenance, or volunteer personnel).

All DHCP shall comply with infection control precautions and enforce the following minimum precautions to protect patients and DHCP and to minimize the transmission of pathogens in health care settings as mandated by the California Division of Occupational Safety and Health (Cal/OSHA).

1. Standard precautions shall be practiced in the care of all patients.

2. A written protocol shall be developed, maintained, and periodically updated for proper instrument processing, operatory cleanliness, and management of injuries. The protocol shall be made available to all DHCP at the dental office.

3. A copy of this regulation shall be conspicuously posted in each dental office.

**Personal protective equipment**

All DHCP shall wear surgical facemasks in combination with either chin length plastic face shields or protective eyewear whenever there is potential for aerosol spray, splashing or spattering of the following: droplet nuclei, blood, chemical or germincidial agents or OPIM. Chemical-resistant utility gloves and appropriate, task specific PPE shall be worn when handling hazardous chemicals. After each patient treatment, masks shall be changed and disposed. After each treatment, face shields and protective eyewear shall be cleaned, disinfected, or disposed.

Protective attire shall be worn for disinfection, sterilization, and housekeeping procedures involving the use of germicides or handling contaminated items. All DHCP shall wear reusable or disposable protective attire whenever there is a potential for aerosol spray, splashing or spattering of blood, OPIM, or chemicals and germincidal
agents. Protective attire must be changed daily or between patients if they should become moist or visibly soiled. All PPE used during patient care shall be removed when leaving laboratories or areas of patient care activities. Reusable gowns shall be laundered in accordance with Cal/OSHA Bloodborne Pathogens Standards (Title 8, Cal. Code Regs., section 5193.)

Hand hygiene

All DHCP shall thoroughly wash their hands with soap and water at the start and end of each workday. DHCP shall 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. Hands shall be thoroughly dried before donning gloves in order to prevent promotion of bacterial growth and washed again immediately after glove removal. A DHCP shall refrain from providing direct patient care if hand conditions are present that may render DHCP or patients more susceptible to opportunistic infection or exposure.

All DHCP who have exudative lesions or weeping dermatitis of the hand shall refrain from all direct patient care and from handling patient care equipment until the condition resolves.

Gloves

(8) Medical exam gloves shall be worn whenever there is contact with mucous membranes, blood, OPIM, and during all pre-clinical, clinical, post-clinical, and laboratory procedures. When processing contaminated sharp instruments, needles, and devices, DHCP shall wear heavy-duty utility gloves to prevent puncture wounds. Gloves must be discarded when torn or punctured, upon completion of treatment, and before leaving laboratories or areas of patient care activities. All DHCP shall perform hand hygiene procedures before donning gloves and after removing and discarding gloves. Gloves shall not be washed before or after use.

Needle and sharps safety

Needles shall be recapped only by using the scoop technique or a protective device. Needles shall not be bent or broken for the purpose of disposal. Disposable needles, syringes, scalpels, or other sharp items and instruments shall be placed into sharps containers for disposal as close as possible to the point of use according to all applicable local, state, and federal regulations.

Sterilization and disinfection

All germicides must be used in accordance with intended use and label instructions. Cleaning must precede any disinfection or sterilization process. Products used to clean items or surfaces prior to disinfection procedures shall be used according to all label instructions. Critical instruments, items and devices shall be discarded or pre-cleaned, packaged or wrapped and sterilized after each use. Methods of sterilization shall include steam under pressure (autoclaving), chemical vapor, and dry heat. If a critical item is heat-sensitive, it shall, at minimum, be processed with high-level disinfection and packaged or wrapped upon completion of the disinfection process. These instruments, items, and devices, shall remain sealed and stored in a manner so as to prevent contamination, and shall be labeled with the date of sterilization and the specific sterilizer used if more than one sterilizer is utilized in the facility.

Semi-critical instruments, items, and devices shall be pre-cleaned, packaged or wrapped and sterilized after each use. Methods of sterilization include steam under pressure (autoclaving), chemical vapor and dry heat. If a semi-critical item is heat sensitive, it shall, at minimum, be processed with high level disinfection and packaged or wrapped upon completion of the disinfection process. These packages or containers shall remain sealed and shall be stored in a manner so as to prevent contamination, and shall be labeled with the date of sterilization.

Irrigation

Sterile coolants/irrigants shall be used for surgical procedures involving soft tissue or bone. Sterile coolants/irrigants must be delivered using a sterile delivery system.

Facilities

If non-critical items or surfaces likely to be contaminated are manufactured in a manner preventing cleaning and disinfection, they shall be protected with disposable impervious barriers. Disposable barriers shall be changed when visibly soiled or damaged and between patients.

Clean and disinfect all clinical contact surfaces that are not protected by impervious barriers using a California Environmental Protection Agency (Cal/EPA) registered, hospital grade low- to intermediate-level germicide after each patient. The low-level disinfectants used shall be labeled effective against HBV and HIV. Use disinfectants in accordance with the manufacturer’s instructions. Clean all housekeeping surfaces (e.g. floors, walls, sinks) with a detergent and water or a Cal/EPA registered, hospital grade disinfectant. Products used to clean items or surfaces prior to disinfection procedures shall be approved by the manufacturer.
be clearly labeled and DHCP shall follow all material safety data sheet (MSDS) handling and storage instructions. Dental unit water lines shall be anti-retractive. At the beginning of each workday, dental unit lines and devices shall be purged with air or flushed with water for at least two (2) minutes prior to attaching handpieces, scalers, air water syringe tips, or other devices. The dental unit lines and devices shall be flushed between each patient for a minimum of twenty (20) seconds. Contaminated solid waste shall be disposed of according to applicable local, state, and federal environmental standards.

### Lab areas

Splash shields and equipment guards shall be used on dental laboratory lathes. Fresh pumice and a sterilized or new rag-wheel shall be used for each patient. Devices used to polish, trim, or adjust contaminated intraoral devices shall be disinfected or sterilized, properly packaged or wrapped and labeled with the date and the specific sterilizer used if more than one sterilizer is utilized in the facility. If packaging is compromised, the instruments shall be recleaned, packaged in new wrap, and sterilized again. Sterilized items will be stored in a manner so as to prevent contamination.

All intraoral items such as impressions, bite registrations, prosthetic and orthodontic appliances shall be cleaned and disinfected with an intermediate-level disinfectant before manipulation in the laboratory and before placement in the patient’s mouth. Such items shall be thoroughly rinsed prior to placement in the patient’s mouth.

The Dental Board of California and Dental Hygiene Committee of California shall review this regulation annually and establish a consensus.

### Personnel health elements of an infection control program

A protective health component for dental health care personnel is an integral part of a dental practice infection control program. The objectives are to educate workers about the principles of infection control, identify work-related infection risks, institute preventive measures and ensure prompt exposure management and medical follow-up. Coordination between the dental practice’s infection control coordinator and other qualified health care professionals is necessary to provide dental workers with appropriate services. Dental programs in institutional settings, (e.g., hospitals, health centers and educational institutions) can coordinate with departments that provide personnel health services.

However, 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 workers are placed at risk for exposure. Referral arrangements can be made with qualified health care professionals in an occupational health program of a hospital, with educational institutions or with health care facilities that offer personnel health services.

### Education and training

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 should 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 workers (e.g., techniques to prevent cross-contamination or instrument sterilization). For dental workers who perform tasks or procedures likely to result in occupational exposure to infectious agents, training should include:

- A description of their exposure risks.
- Review of prevention strategies and infection control policies and procedures.
- Discussion regarding how to manage work-related illness and injuries, including post-exposure prophylaxis.
- Review of work restrictions for an exposure or infection.

Inclusion of dental workers with minimal exposure risks (e.g., administrative employees) in education and training programs might enhance facility-wide understanding of infection control principles and the importance of the program. Educational materials should be appropriate in content and vocabulary for each person’s educational level, literacy and language, as well as be consistent with existing federal, state and local regulations.

### Immunization programs

Dental workers are at risk for exposure to, and possible infection with, infectious organisms. Immunizations substantially reduce both the number of workers susceptible to these diseases and the potential for disease transmission to other workers and patients. Thus, immunizations are an essential part of prevention and infection control programs for dental health care personnel, and a comprehensive immunization policy should be implemented for all dental health care facilities. The Advisory Committee on Immunization Practices (ACIP) provides national guidelines for immunization of health care personnel, which includes dental workers.

Dental practice immunization policies should incorporate current state and federal regulations as well as recommendations from the U.S. Public Health Service and professional organizations.

On the basis of documented health care-associated transmission, health care workers 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 health care personnel be vaccinated or have documented immunity to these diseases. ACIP does not recommend routine immunization of workers 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 workers with special conditions (e.g., pregnancy, HIV infection or diabetes).

Immunization of workers before they are placed at risk for exposure remains the most efficient and effective use of vaccines in health care settings. Some educational institutions and infection control programs provide immunization schedules for students and workers. OSHA requires that employers make hepatitis B vaccination available to all employees who have potential contact with blood or OPIM. Employers

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**REVIEW OF SCIENCE RELATED TO DENTAL INFECTION CONTROL**

- Immunization of workers before they are placed at risk for exposure remains the most efficient and effective use of vaccines in health care settings. Some educational institutions and infection control programs provide immunization schedules for students and workers. OSHA requires that employers make hepatitis B vaccination available to all employees who have potential contact with blood or OPIM. Employers
are also required to follow CDC recommendations for vaccinations, evaluation and follow-up procedures. Nonpatient 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. Dental workers unable or unwilling to be vaccinated as required or recommended should be educated regarding their exposure risks, infection control policies and procedures for the facility, and the management of work-related illness and work restrictions (if appropriate) for exposed or infected workers.

**Exposure prevention and post-exposure management**

Avoiding exposure to blood and OPIM, as well as protection by immunization, remain primary strategies for reducing occupationally acquired infections, but occupational exposures can still occur. A combination of standard precautions, engineering, work practice and administrative controls is the best means to minimize occupational exposures. 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 health care personnel. Written policies and procedures should be consistent with federal, state and local requirements addressing education and training, post-exposure management and exposure reporting.

Dental health personnel who have contact with patients can also be exposed to persons with infectious TB, and should have a baseline tuberculin skin test (TST), preferably by using a two-step test at the beginning of employment. Thus, if an unprotected occupational exposure occurs, TST conversions can be distinguished from positive TST results caused by previous exposures. The facility’s level of TB risk will determine the need for routine follow-up TSTs.

**Medical conditions, work-related illness and work restrictions**

Dental workers are responsible for monitoring their own health status. Those who have acute or chronic medical conditions that render them susceptible to opportunistic infection should discuss with their personal physicians or other qualified authority whether the condition might affect their ability to safely perform their duties.

However, under certain circumstances, health care facility managers might need to exclude dental health personnel from work or patient contact to prevent further transmission of infection. Decisions concerning work restrictions are based on the mode of transmission and the period of infectivity of the disease (Table 1). Exclusion policies should:

- Be written.
- Include a statement of authority that defines who can exclude dental workers (e.g., personal physicians).
- Be clearly communicated through education and training.

Policies should also encourage workers to report illnesses or exposures without jeopardizing wages, benefits or job status. With increasing concerns regarding blood-borne pathogens and introduction of universal precautions, use of latex gloves among health care workers has increased markedly. Increased use of these gloves has been accompanied by increased reports of allergic reactions to natural rubber latex among workers and patients, as well as increased reports of irritant and allergic contact dermatitis from frequent and repeated use of hand-hygiene products, exposure to chemicals and glove use.

Dental health workers should be familiar with the signs and symptoms of latex sensitivity. A physician should evaluate workers exhibiting symptoms of latex allergy, because further exposure could result in a serious allergic reaction. A diagnosis is made through medical history, physical examination and diagnostic tests. Procedures should be in place for minimizing latex-related health problems among DHCP and patients while protecting them from infectious materials. These procedures should include:

- Reducing exposures to latex-containing materials by using appropriate work practices.
- Training and educating dental workers on monitoring symptoms.
- Substituting nonlatex products where appropriate.

**Maintenance of records, data management and confidentiality**

The health status of dental workers can be monitored by maintaining records of work-related medical evaluations, screening tests, immunizations, exposures and post-exposure management. Such records must be kept in accordance with all applicable state and federal laws. Examples of laws that might apply include the Privacy Rule of the Health Insurance Portability and Accountability Act (HIPAA) of 1996, 45 CFR 160 and 164, and the OSHA Occupational Exposure to Blood-borne Pathogens; Final Rule 29 CFR 1910. 1030(h)(1)(i–iv).

The HIPAA Privacy Rule applies to covered entities, including certain defined health providers, health care clearinghouses and health plans. OSHA requires employers to ensure that certain information contained in employee medical records is:

- Kept confidential.
- Not disclosed or reported without the employee’s express written consent to any person within or outside the workplace except as required by the OSHA standard.
- Maintained by the employer for at least the duration of employment plus 30 years.

Dental practices that coordinate their infection control program with off-site providers might consult OSHA’s blood-borne pathogen standard and employee access to medical and exposure records standard, as well as other applicable local, state and federal laws, to determine a location for storing health records.

**Preventing transmission of blood-borne pathogens**

Although transmission of blood-borne pathogens (e.g., HBV, HCV and HIV) in dental health care settings can have serious consequences, such transmission is rare. Exposure to infected blood can result in transmission from patient to dental workers, from workers to patients, and from one patient to another. The opportunity for transmission is greatest from patients to dental workers, who frequently encounter patient blood and blood-contaminated saliva during dental procedures.

Since 1992, no HIV transmission from dental care personnel to patients has been reported, and the last HBV transmission from dental workers to patients was reported in 1987. HCV transmission from workers to patients has not been reported. The majority of dental care workers infected with a blood-borne virus do not pose a risk to patients because they do not perform activities meeting the necessary conditions for transmission. For workers to pose a risk for blood-borne virus transmission to patients, the worker must:

- Be viremic, i.e., have infectious virus circulating in the bloodstream.
- Be injured or have a condition (e.g., weeping dermatitis) that allows direct exposure to their blood or other infectious body fluids.
Reports published during 1970-1987 describe nine clusters in which dental care workers to patients is considered limited, precise risks. Although the potential for transmission of blood-borne infections from retires. Vaccination rates remain high among young dentists and as older unchanged. Infection rates can be expected to decline further as vaccination rates remain high among young dentists and as older dentists with lower vaccination rates and higher rates of infection retire.

Although the potential for transmission of blood-borne infections from dental care workers to patients is considered limited, precise risks have not been quantified by carefully designed epidemiologic studies. Reports published during 1970-1987 describe nine clusters in which nature and frequency of contact with blood and body fluids through percutaneous or permucosal routes of exposure. The risk of infection after exposure to a blood-borne virus is influenced by inoculum size, route of exposure and susceptibility of the exposed health care personnel. The majority of attention has been placed on the blood-borne pathogens HBV, HCV and HIV, and these pathogens present different levels of risk to dental care workers.

Hepatitis B virus

HBV is a well-recognized occupational risk for health care workers. HBV is transmitted by percutaneous or mucosal exposure to blood or body fluids of a person with either acute or chronic HBV infection. Persons infected with HBV can transmit the virus for as long as they are HBsAg-positive. The risk of HBV transmission is highly related to the HBeAg status of the source person. In studies of health care personnel who sustained injuries from needles contaminated with blood containing HBV, the risk of developing clinical hepatitis if the blood was positive for both HBsAg and HBeAg was 22 percent to 31 percent; the risk of developing serologic evidence of HBV infection was 37–62 percent. By comparison, the risk of developing clinical hepatitis from a needle contaminated with HBsAg-positive, HBeAg-negative blood was 1–6 percent, and the risk of developing serologic evidence of HBV infection, 23–37 percent.

Blood contains the greatest proportion of HBV infectious particle titers of all body fluids and is the most critical vehicle of transmission in the health care setting. HBsAg is also found in multiple other body fluids, including breast milk, bile, cerebrospinal fluid, feces, nasopharyngeal washings, saliva, semen, sweat and synovial fluid. However, the majority of body fluids are not efficient vehicles for transmission because they contain low quantities of infectious HBV, despite the presence of HBsAg. The concentration of HBsAg in body fluids can be 100-1,000 times greater than the concentration of infectious HBV particles.

Although percutaneous injuries are among the most efficient modes of HBV transmission, these exposures probably account for only a minority of HBV infections among health care workers. In multiple investigations of nosocomial hepatitis B outbreaks, the majority of infected health care workers could not recall an overt percutaneous injury, although in certain studies, approximately one-third of infected workers recalled caring for a patient who was HBsAg-positive. In addition, HBV has been demonstrated to survive in dried blood at room temperature on environmental surfaces for one week. Thus, HBV infections that occur in workers with no history of nonoccupational exposure or occupational percutaneous injury might have resulted from direct or indirect blood or body fluid exposures that inoculated HBV into cutaneous scratches, abrasions, burns, other lesions or on mucosal surfaces. The potential for HBV transmission through contact with environmental surfaces has been demonstrated in investigations of HBV outbreaks among patients and health care personnel in hemodialysis units.

Since the early 1980s, occupational infections among health workers have declined because of vaccine use and adherence to universal precautions. Among U. S. dentists, more than 90 percent have been vaccinated, and serologic evidence of past HBV infection decreased from prevaccine levels of 14 percent in 1972, to approximately 9 percent in 1992. During 1993–2001, levels remained relatively unchanged. Infection rates can be expected to decline further as vaccination rates remain high among young dentists and as older dentists with lower vaccination rates and higher rates of infection retire.

Patients were thought to be infected with HBV through treatment by an infected dental worker. However, transmission of HBV from dentist to patient has not been reported since 1987, possibly reflecting such factors as:

- Adoption of universal precautions.
- Routine glove use.
- Increased levels of immunity as a result of hepatitis B vaccination of dental care workers.
- Implementation of the 1991 OSHA blood-borne pathogen standard.
- Incomplete ascertainment and reporting.

Standard precautions are strategies used to reduce the risk of infection from exposure to blood, all body fluids and secretions (except sweat), non-intact skin and mucous membranes.

Only one case of patient-to-patient transmission of HBV in the dental setting has been documented (CDC, unpublished data, 2003). In this case, appropriate office infection control procedures were being followed, and the exact mechanism of transmission was undetermined.

Because of the high risk of HBV infection to health care and dental workers who perform tasks that might involve contact with blood, blood-contaminated body substances, other body fluids or sharps, such workers should be vaccinated. Vaccination can protect both dental care workers and patients from HBV infection and, whenever possible, should be completed when dentists or other dental staff are in training and before they have contact with blood.

Prevaccination serological testing for previous infection is not indicated, although it can be cost-effective where prevalence of infection is expected to be high in a group of potential vaccinees (e.g., persons who have emigrated from areas with high rates of HBV infection). Dental workers should be tested for anti-HBs 1-2 months after completion of the three-dose vaccination series. Those who do not develop an adequate antibody response (i.e., anti-HBs less than 10 mIU/mL) to the primary vaccine series should complete a second three-dose vaccine series or be evaluated to determine if they are HBsAg-positive. Revaccinated persons should be retested for anti-HBs at the completion of the second vaccine series. Approximately half of nonresponders to the primary series will respond to a second three-dose series. If no antibody response occurs after the second series, testing for HBsAg should be performed.

Persons who prove to be HBsAg-positive should be counseled regarding how to prevent HBV transmission to others and regarding the need for medical evaluation. Nonresponders to vaccination who are HBsAg-negative should be considered susceptible to HBV infection and should be counseled regarding precautions to prevent HBV infection and the need to obtain HBIG prophylaxis for any known or probable parenteral exposure to HBsAg-positive blood.

Vaccine-induced antibodies decline gradually over time, and 60 percent of persons who initially respond to vaccination will lose detectable antibodies over 12 years. Even so, immunity continues to prevent clinical disease or detectable viral infection. Booster doses of vaccine and periodic serologic testing to monitor antibody concentrations after completion of the vaccine series are not necessary for vaccine responders.
Hepatitis D virus

An estimated 4 percent of persons with acute HBV infection are also infected with hepatitis delta virus (HDV). Discovered in 1977, HDV is a defective blood-borne virus requiring the presence of HBV to replicate. Patients co-infected 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.

Hepatitis C virus

Hepatitis C virus appears not to be transmitted efficiently through occupational exposures to blood. Follow-up studies of HCP exposed to HCV-infected blood through percutaneous or other sharps injuries have determined a low incidence of seroconversion (mean: 1.8 percent; range, 0 percent-7 percent). One study determined transmission occurred from hollow-bore needles but not other sharps. Although these studies have not documented seroconversion associated with mucous membrane or nonintact skin exposure, at least two cases of HCV transmission from a blood splash to the conjunctiva and one case of simultaneous transmission of HCV and HIV after nonintact skin exposure have been reported.

Data are insufficient to estimate the occupational risk of HCV infection among health care workers, but the majority of studies indicate the prevalence of HCV infection among dentists, surgeons and hospital-based workers is similar to that among the general population, approximately 1-2 percent. 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. No studies of transmission from HCV-infected dental workers 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 percent.

Human immunodeficiency virus

In the United States, 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 health care workers, but none among dental care workers, after occupational exposure to a known HIV-infected source. Transmission of HIV to six patients of a single dentist with AIDS has been reported, but the mode of transmission could not be determined. As of Sept. 30, 1993, CDC had information regarding test results of more than 22,000 patients of 63 HIV-infected health care workers, including 33 dentists or dental students. No additional cases of transmission were documented. Prospective studies worldwide indicate the average risk of HIV infection after a single percutaneous exposure to HIV-infected blood is 0.3 percent (range: 0.2-0.5 percent). After an exposure of mucous membranes in the eye, nose or mouth, the risk is approximately 0.1 percent. The precise risk of transmission after skin exposure remains unknown, but is believed to be even smaller than that for mucous membrane exposure.

Certain factors affect the risk of HIV transmission after an occupational exposure. Laboratory studies have determined that 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. In a retrospective case-control study of health care personnel, 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.

Exposure prevention methods

Avoiding occupational exposures to blood is the primary way to prevent transmission of HBV, HCV and HIV, to workers in health care settings. Exposures occur through percutaneous injury (e.g., a needlestick or cut with a sharp object), as well as through contact between potentially infectious blood, tissues or other body fluids and mucous membranes of the eye, nose, mouth or nonintact skin (e.g., exposed skin that is chapped, abraded or shows signs of dermatitis).

Observational studies and surveys indicate that percutaneous injuries among general dentists and oral surgeons occur less frequently than among general and orthopedic surgeons and have decreased in frequency since the mid-1980s. This decline has been attributed to safer work practices, safer instrumentation or design, and continued dental care workers education. Percutaneous injuries among DHCP usually:

- Occur outside the patient’s mouth, thereby posing less risk for recontact with patient tissues.
- Involve limited amounts of blood.
- Are caused by burs, syringe needles, laboratory knives and other sharp instruments.

Injuries among oral surgeons might occur more frequently during fracture reductions using wires. Experience, as measured by years in practice, does not appear to affect the risk of injury among general dentists or oral surgeons.

The majority of exposures in dentistry are preventable, and methods to reduce the risk of blood contacts have included use of standard precautions, use of devices with features engineered to prevent sharp injuries and modifications of work practices. These approaches might have contributed to the decrease in percutaneous injuries among dentists during recent years. However, needlesticks and other blood contacts continue to occur, which is a concern because percutaneous injuries pose the greatest risk of transmission.

Exposure prevention methods prevent transmission of HBV, HCV and HIV. Standard precautions include use of personal protective equipment (e.g., gloves, masks, protective eyewear or face shield, and gowns) intended to prevent skin and mucous membrane exposures. Other protective equipment (e.g., finger guards while suturing) might also reduce injuries during dental procedures.

Engineering controls are the primary method to reduce exposures to blood and OPIM from sharp instruments and needles. These controls are frequently technology-based and often incorporate safer designs of instruments and devices (e.g., self-sheathing anesthetic needles and dental units designed to shield burs in handpieces) to reduce percutaneous injuries.

Work-practice controls establish practices to protect dental workers whose responsibilities include handling, using, assembling or processing sharp devices (e.g., needles, scalers, laboratory utility knives, burs, explorers and endodontic files) or sharps disposal.
containers. Work-practice controls can include removing burs before disassembling the handpiece from the dental unit, restricting use of fingers in tissue retraction or palpation during suturing and administration of anesthesia and minimizing potentially uncontrolled movements of such instruments as scalers or laboratory knives.

As indicated, needles are a substantial source of percutaneous injury in dental practice, and engineering and work-practice controls for needle handling are of particular importance. In 2001, revisions to OSHA's blood-borne pathogens standard as mandated by the Needlestick Safety and Prevention Act of 2000 became effective. These revisions clarify the need for employers to consider safer needle devices as they become available and to involve employees directly responsible for patient care (e.g., dentists, hygienists and dental assistants) in identifying and choosing such devices. Safer versions of sharp devices used in hospital settings have become available (e.g., blunt suture needles, phlebotomy devices and butterfly needles), and their impact on reducing injuries has been documented. Aspirating anesthetic syringes that incorporate safety features have been developed for dental procedures, but the low injury rates in dentistry limit assessment of their effect on reducing injuries among dental care workers.

Work-practice controls for needles and other sharps include placing used disposable syringes and needles, scalpel blades and other sharp items in appropriate puncture-resistant containers located as close as feasible to where the items were used. In addition, used needles should never be recapped or otherwise manipulated by using both hands or any other technique that involves directing the point of a needle toward any part of the body. A one-handed scoop technique, a mechanical device designed for holding the needle cap to facilitate one-handed recapping, or an engineered sharps injury protection device (e.g., needles with resheathing mechanisms) should be employed for recapping needles between uses and before disposal. Dental care workers should never bend or break needles before disposal because this practice requires unnecessary manipulation. Before attempting to remove needles from nondisposable aspirating syringes, they should recap them to prevent injuries. For procedures involving multiple injections with a single needle, the practitioner should recap the needle between injections by using a one-handed technique or use a device with a needle-resheathing mechanism. Passing a syringe with an unsheathed needle should be avoided because of the potential for injury.

Additional information for developing a safety program and for identifying and evaluating safer dental devices is available at:
- [http://www.cdc.gov/oralhealth/infectioncontrol/forms.htm](http://www.cdc.gov/oralhealth/infectioncontrol/forms.htm) (forms for screening and evaluating safer dental devices).
- [http://www.cdc.gov/niOSH/topics/bhp](http://www.cdc.gov/niOSH/topics/bhp) (state legislation on needlestick safety).

### Post-exposure management and prophylaxis

Post-exposure management is an integral component of a complete program to prevent infection after an occupational exposure to blood. During dental procedures, saliva is predictably contaminated with blood. Even when blood is not visible, it can still be present in limited quantities and therefore is considered a potentially infectious material by OSHA. A qualified health care professional should evaluate any occupational exposure incident to blood or OPIM, including saliva, regardless of whether blood is visible, in dental settings.

Dental practices and laboratories should establish written, comprehensive programs that include hepatitis B vaccination and post-exposure management protocols that:

- Describe the types of contact with blood or OPIM that can place dental care workers at risk for infection.
- Describe procedures for promptly reporting and evaluating such exposures.
- Identify a health care professional who is qualified to provide counseling and perform all medical evaluations and procedures in accordance with current recommendations of the U. S. Public Health Service (PHS), including prophylaxis with chemotherapeutic drugs when indicated.

Dental workers, including students, who might reasonably be considered at risk for occupational exposure to blood or OPIM should be taught strategies to prevent contact with blood or OPIM and the principles of post-exposure management, including prophylaxis options, as part of their job orientation and training. Educational programs for dental workers and students should emphasize reporting all exposures to blood or OPIM as soon as possible, because certain interventions have to be initiated promptly to be effective.

Policies should be consistent with the practices and procedures for worker protection required by OSHA and with current Public Health Service recommendations for managing occupational exposures to blood.

After an occupational blood exposure, first aid should be administered as necessary. Puncture wounds and other injuries to the skin should be washed with soap and water; mucous membranes should be flushed with water. No evidence exists that using antiseptics for wound care or expressing fluid by squeezing the wound further reduces the risk of blood-borne pathogen transmission; however, use of antiseptics is not contraindicated. The application of caustic agents (e.g., bleach) or the injection of antiseptics or disinfectants into the wound is not recommended. Exposed workers should immediately report the exposure to the infection control coordinator or other designated person, who should initiate referral to the qualified health care professional and complete necessary reports.

Because multiple factors contribute to the risk of infection after an occupational exposure to blood, the following information should be included in the exposure report, recorded in the exposed person’s confidential medical record and provided to the qualified health care professional:

- Date and time of exposure.
- Details of the procedure being performed, including where and how the exposure occurred and whether the exposure involved a sharp device, the type and brand of device, and how and when during its handling the exposure occurred.
- Details of the exposure, including its severity and the type and amount of fluid or material.
  - For a percutaneous injury, severity might be measured by the depth of the wound, gauge of the needle and whether fluid was injected.
  - For a skin or mucous membrane exposure, the estimated volume of material, duration of contact and the condition of the skin (e.g., chapped, abraded or intact) should be noted.
  - Details regarding whether the source material was known to contain HIV or other blood-borne pathogens.
  - If the source was infected with HIV, the stage of disease, history of antiretroviral therapy and viral load, if known.
- Details regarding the exposed person (e.g., hepatitis B vaccination and vaccine-response status).
- Details regarding counseling, post-exposure management and follow-up.

Each occupational exposure should be evaluated individually for its potential to transmit HBV, HCV and HIV, based on the following:

- The type and amount of body substance involved.
- The type of exposure (e.g., percutaneous injury, mucous membrane or nonintact skin exposure, or bites resulting in blood exposure to either person involved).
- The infection status of the source.
- The susceptibility of the exposed person.
All of these factors should be considered in assessing the risk for infection and the need for further follow-up (e.g. post-exposure prophylaxis, or PEP).

During 1990-1998, the Public Health Service published guidelines for PEP and other management of health care worker exposures to HBV, HCV or HIV. In 2001, these recommendations were updated and consolidated into one set of Public Health Service guidelines.

### Hand hygiene

Hand hygiene (e.g., hand-washing, hand antisepsis or surgical-hand antisepsis) substantially reduces potential pathogens on the hands and is considered the single most critical measure for reducing the risk of transmitting organisms to patients and health care personnel. Hospital-based studies have demonstrated that noncompliance with hand hygiene practices is associated with health care-associated infections and the spread of multiresistant organisms. Noncompliance also has been a major contributor to outbreaks. The prevalence of health care-associated infections decreases as adherence of health care workers to recommended hand hygiene measures improves.

The microbial flora of the skin, first described in 1938, consist of transient and resident microorganisms. Transient flora, which colonize the superficial layers of the skin, are easier to remove by routine hand-washing. They are often acquired by workers during direct contact with patients or contaminated environmental surfaces; these organisms are most frequently associated with health care-associated infections. Resident flora attached to deeper layers of the skin are more resistant to removal and less likely to be associated with such infections.

The preferred method for hand hygiene depends on the type of procedure, the degree of contamination and the desired persistence of antimicrobial action on the skin. For routine dental examinations and nonsurgical procedures, hand-washing and hand antisepsis is achieved by using either a plain or antimicrobial soap and water. If the hands are not visibly soiled, an alcohol-based hand rub is adequate.

### Selection of antiseptic agents

Selecting the most appropriate antiseptic agent for hand hygiene requires consideration of multiple factors. Essential performance characteristics of a product (e.g., the spectrum and persistence of activity and whether or not the agent is fast acting) should be determined before selecting a product. Delivery system, cost per use, reliable vendor support and supply are also considerations. Because worker acceptance is a major factor regarding compliance with recommended hand hygiene protocols, considering their needs is critical and should include possible chemical allergies, skin integrity after repeated use, compatibility with lotions used and offensive agent ingredients (e.g., scent). Discussing specific preparations or ingredients used for hand antisepsis is beyond the scope of this report. Health care workers should choose from commercially available health care worker hand washes when selecting agents for hand antisepsis or surgical hand antisepsis.

### Storage and dispensing of hand-care products

Hand-washing products, including plain (i.e., 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. Store and dispense products according to manufacturers’ directions.

### Lotions

The primary defense against infection and transmission of pathogens is healthy, unbroken skin. Frequent hand-washing with soaps and antiseptic agents can cause chronic irritant contact dermatitis among workers. Damage to the skin changes skin flora, resulting in more frequent colonization by staphylococci and gram-negative bacteria. The potential of detergents to cause skin irritation varies considerably, but can be reduced by adding emollients. Lotions are often recommended to ease the dryness resulting from frequent hand-washing and to prevent dermatitis from glove use. However, petroleum-based lotion formulations can weaken latex gloves and increase permeability. For that reason, lotions that contain petroleum or other oil emollients should only be used at the end of the work day. Dental practitioners should obtain information from lotion manufacturers regarding interaction between lotions, gloves, dental materials and antimicrobial products.

### Fingernails and artificial nails

Although the relationship between fingernail length and wound infection is unknown, keeping nails short is considered key because the majority of flora on the hands are found under and around the fingernails. Fingernails should be short enough to allow dental workers...
to thoroughly clean underneath them and prevent glove tears. Sharp nail edges or broken nails are also 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 nonwearers, both before and after hand-washing. In addition, artificial fingernails or extenders have been epidemiologically implicated in multiple outbreaks involving fungal and bacterial infections in hospital intensive-care units and operating rooms. Freshly applied nail polish on natural nails does not increase the microbial load from periungual skin if fingernails are short; however, chipped nail polish can harbor added bacteria.

Jewelry

Studies have demonstrated that skin underneath rings is more heavily colonized than comparable areas of skin on fingers without rings. In a study of intensive-care nurses, multivariable analysis determined rings were the only substantial risk factor for carriage of gram-negative bacilli and Staphylococcus aureus, and the concentration of organisms correlated with the number of rings worn. However, two other studies demonstrated that mean bacterial colony counts on hands after hand-washing were similar among persons wearing rings and those not wearing rings. Whether wearing rings increases the likelihood of transmitting a pathogen is unknown; further studies are needed to establish whether rings result in higher transmission of pathogens in health care settings. However, rings and decorative nail jewelry can make donning gloves more difficult and cause gloves to tear more readily. Thus, jewelry should not interfere with glove use (e.g., impair ability to wear the correct-sized glove or alter glove integrity).

Personal protective equipment

PPE is designed to protect the skin and the mucous membranes of the eyes, nose and mouth of dental care workers from exposure to blood or OPIM. Use of rotary dental and surgical instruments (e.g., handpieces or 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 on the floor, nearby operatory surfaces, dental care workers or the patient. The spray also might contain certain aerosols (i.e., particles of respirable size, less than 10 μm). Aerosols can remain airborne for extended periods and can be inhaled. However, they should not be confused with the large-particle spatter that makes up the bulk of the spray from handpieces and ultrasonic scalers. Appropriate work practices, including use of dental dams and high-velocity air evacuation, should minimize dissemination of droplets, spatter and aerosols.

Protective clothing

Protective clothing and equipment (e.g., gowns, lab coats, gloves, masks and protective eyewear or face shield) should be worn to prevent contamination of street clothing and to protect the skin of dental workers from exposures to blood and body substances. Uniforms/scrubs are not considered personal protective equipment when anticipating spatter of blood or body fluids. OSHA blood-borne pathogens standard requires sleeves to be long enough to protect the forearms when the gown is worn as personal protective equipment (i.e., when spatter and spray of blood, saliva or OPIM to the forearms is anticipated). Dental personnel should change protective clothing when it becomes visibly soiled and as soon as feasible if penetrated by blood or other potentially infectious fluids. All protective clothing should be removed before leaving the work area.

Gloves and gloving

DHCP wear gloves to prevent contamination of their hands when touching mucous membranes, blood, saliva or OPIM, and also to reduce the likelihood that microorganisms present on the workers’ hands will be transmitted to patients during surgical or other patient-care procedures. Medical gloves, both patient examination and surgeon’s gloves, are manufactured as single-use disposable items that should be used for only one patient, then discarded. Gloves should be changed between patients and when torn or punctured.

Wearing gloves does not eliminate the need for hand-washing. Hand hygiene should be performed immediately before donning gloves. Gloves can have small, unapparent defects or can be torn during use, and hands can become contaminated during glove removal. These circumstances increase the risk of operative wound contamination and exposure of the worker’s hands to microorganisms from patients. FDA regulates the medical glove industry, which includes gloves marketed as sterile surgeon’s and sterile or nonsterile patient examination gloves. General-purpose utility gloves are also used in dental health care settings but are not regulated by FDA because they are not promoted for medical use. More rigorous standards are applied to surgeon’s gloves than to examination gloves. FDA has identified acceptable quality levels (e.g., maximum defects allowed) for glove manufacturers, but even intact gloves eventually fail with exposure to mechanical (e.g., sharps, fingernails or jewelry) and chemical (e.g., dimethy-acrylates) hazards and over time. These variables can be controlled, ultimately optimizing glove performance, by:

- Maintaining short fingernails.
- Minimizing or eliminating hand jewelry.
- Using engineering and work-practice controls to avoid injuries with sharps.

Sterile surgeon’s gloves and double-gloving during oral surgical procedures

Certain limited studies have determined no difference in postoperative infection rates after routine tooth extractions when surgeons wore either sterile or nonsterile gloves. However, wearing sterile surgeon’s gloves during surgical procedures is supported by a strong theoretical rationale. Sterile gloves minimize transmission of microorganisms from the hands of surgical dental care personnel to patients and prevent contamination of the hands of the workers with the patient’s blood and body fluids. In addition, sterile surgeon’s gloves are more rigorously regulated by FDA and therefore, might provide an increased level of protection for the provider if exposure to blood is likely.

Although the effectiveness of wearing two pairs of gloves in preventing disease transmission has not been demonstrated, the majority of studies among health care workers have demonstrated a lower frequency of inner glove perforation and visible blood on the surgeon’s hands when double gloves are worn. In one study evaluating double gloves during oral surgical and dental hygiene procedures, the perforation of outer latex gloves was greater during longer procedures
(i.e., more than 45 minutes), with the highest rate (10 percent) of perforation occurring during oral surgery procedures. Based on these studies, double-gloving might provide additional protection from occupational blood contact. Double-gloving does not appear to substantially reduce either manual dexterity or tactile sensitivity. Additional protection might also be provided by specialty products (e.g., orthopedic surgical gloves and glove liners).

**Contact dermatitis and latex hypersensitivity**

Occupationally related contact dermatitis can develop from frequent and repeated use of hand hygiene products, exposure to chemicals, and glove use. Contact dermatitis is classified as either irritant or allergic. Irritant contact dermatitis is common, nonallergic and develops as dry, itchy, irritated areas on the skin around the area of contact. By comparison, allergic contact dermatitis (type IV hypersensitivity) can result from exposure to accelerators and other chemicals used in the manufacture of rubber gloves (e.g., natural rubber latex, nitrile and neoprene), as well as from other chemicals found in the dental practice setting (e.g., methacrylates and glutaraldehyde). Allergic contact dermatitis often manifests as a rash beginning hours after contact and, similar to irritant dermatitis, is usually confined to the area of contact.

Latex allergy (type I hypersensitivity to latex proteins) can be a more serious systemic allergic reaction, usually beginning within minutes of exposure, but sometimes occurring hours later and producing varied symptoms. More common reactions include runny nose, sneezing, itchy eyes, scratchy throat, hives and itchy, burning skin sensations. More severe symptoms include asthma marked by difficult breathing, coughing spells and wheezing; cardiovascular and gastrointestinal ailments; and in rare cases, anaphylaxis and death. The American Dental Association (ADA) began investigating the prevalence of type I latex hypersensitivity among dental care personnel at the ADA annual meeting in 1994. In 1994 and 1995, approximately 2,000 dentists, hygienists and assistants volunteered for skin-prick testing. Data demonstrated that 6.2 percent of those tested were positive for type I latex hypersensitivity. Data from the subsequent five years of this ongoing cross-sectional study indicated a decline in prevalence from 8.5 percent to 4.3 percent. This downward trend is similar to that reported by other studies and might be related to use of latex gloves with lower allergen content.

Natural rubber latex proteins responsible for latex allergy are attached to glove powder. When powdered latex gloves are worn, more latex protein reaches the skin. In addition, when powdered latex gloves are donned or removed, latex protein/powder particles become aerosolized and can be inhaled, contacting mucous membranes. As a result, allergic patients and dental workers can experience cutaneous, respiratory and conjunctival symptoms related to latex protein exposure. Dental care workers can become sensitized to latex protein with repeated exposure. Work areas where only powder-free, low-allergen latex gloves are used demonstrate low or undetectable amounts of latex allergy-causing proteins and fewer symptoms among workers related to natural rubber latex allergy. Because of the role of glove powder in exposure to latex protein, NIOSH recommends that if latex gloves are chosen, workers should be provided with reduced protein, powder-free gloves. Nonlatex (e.g., nitrile or vinyl) powder-free and low-protein gloves are also available. Although rare, potentially life-threatening anaphylactic reactions to latex can occur, and dental practices should be appropriately equipped and have procedures in place to respond to such emergencies.

Dental care personnel and dental patients with 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. Dental patients with histories of latex allergy can be at risk from dental products (e.g., prophylaxis cups, rubber dams, orthodontic elastics and medication vials). Any latex-containing devices that cannot be removed from the treatment environment should be adequately covered or isolated. Persons might also be allergic to chemicals used in the manufacture of natural rubber latex and synthetic rubber gloves, as well as metals, plastics or other materials used in dental care.

Taking thorough health histories for both patients and dental workers, followed by avoidance of contact with potential allergens, can minimize the possibility of adverse reactions. Certain common predisposing conditions for latex allergy include previous history of allergies, a history of spina bifida, urogenital anomalies or allergies to avocados, kiwis, nuts or bananas. The following precautions should be considered to ensure safe treatment for patients who have possible or documented latex allergy:

- Be aware that latent allergens in the ambient air can cause respiratory or anaphylactic symptoms among persons with latex hypersensitivity. Patients with latex allergy can be scheduled for the first appointment of the day to minimize their inadvertent exposure to airborne latex particles.

- Communicate with other dental workers regarding patients with latex allergy (e.g., by oral instructions, written protocols and posted signage) to prevent them from bringing latex-containing materials into the treatment area.

- Frequently clean all working areas contaminated with latex powder or dust.

- Have emergency treatment kits with latex-free products available at all times.

- If latex-related complications occur during or after a procedure, manage the reaction and seek emergency assistance as indicated. Follow current medical emergency response recommendations for management of anaphylaxis.

**Sterilization and disinfection of patient-care items**

Patient-care items (dental instruments, devices and equipment) are categorized as critical, semicritical or noncritical, depending on the potential risk for infection associated with their intended use (Table 1). Critical items used to penetrate soft tissue or bone have the greatest risk of transmitting infection and should be sterilized by heat. Semicritical items touch mucous membranes or nonintact skin and have a lower risk of transmission; because the majority of semicritical items in dentistry are heat-tolerant, they also should be sterilized by using heat. If a semicritical item is heat-sensitive, it should, at a minimum, be processed with high-level disinfection.

Noncritical patient-care items pose the least risk of transmission of infection, contacting only intact skin, which can serve as an effective barrier to microorganisms. In the majority of cases, cleaning, or if visibly soiled, cleaning followed by disinfection with an EPA-registered hospital disinfectant is adequate. When the item is visibly contaminated with blood or OPIM, an EPA-registered hospital disinfectant with a tuberculocidal claim (i.e., intermediate-level disinfectant) should be used. Cleaning or disinfection of certain noncritical patient-care items can be difficult or damage the surfaces; therefore, use of disposable barrier protection of these surfaces might be a preferred alternative.

FDA-cleared sterilant/high-level disinfectants and EPA registered disinfectants must have clear label claims for intended use, and manufacturer instructions for use must be followed.
or sterilization, instruments should be handled as though contaminated. To minimize bacterial contamination during cleaning and rinsing, surfaces should be rinsed with water to remove chemical or detergent residue. Splashing the disinfection or sterilization process can interfere with microbial inactivation and compromise patient safety. After cleaning, instruments should be rinsed to remove debris, as well as organic and inorganic matter. If visible debris is not removed, it will interfere with microbial inactivation and can compromise the disinfection or sterilization process. Automated cleaning equipment (e.g., ultrasonic cleaner or washer-disinfector) does not require presoaking or scrubbing of instruments and can increase productivity, improve cleaning effectiveness and decrease worker exposure to blood and body fluids. Thus, using automated equipment can be safer and more efficient than manually cleaning contaminated instruments.

TABLE 1. Infection control categories of patient-care instruments

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
<th>Dental instrument/item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical</td>
<td>Penetrates soft tissue, contacts bone, enters into or contacts the bloodstream or other normally sterile tissue.</td>
<td>Surgical instruments, periodontal scalers, scalpel blades, surgical dental burs.</td>
</tr>
<tr>
<td>Semi-critical</td>
<td>Contacts mucous membranes or nonintact skin; will not penetrate soft tissue, contact bone, enter into or contact the bloodstream or other normally sterile tissue.</td>
<td>Dental mouth mirror, amalgam condenser, reusable dental impression trays, dental handpieces*.</td>
</tr>
<tr>
<td>Non-critical</td>
<td>Contacts intact skin.</td>
<td>Radiograph head/cone, blood pressure cuff, facebow, pulse oximeter.</td>
</tr>
</tbody>
</table>

* Although dental handpieces are considered a semicritical item, they should always be heat-sterilized between uses and not high-level disinfected. See dental handpieces and other devices attached to air or waterlines for detailed information.

Transporting and processing contaminated critical and semi-critical patient-care items

Dental workers can be exposed to microorganisms on contaminated instruments and devices through percutaneous injury, contact with nonintact skin on the hands or contact with mucous membranes of the eyes, nose or mouth. Contaminated instruments should be handled carefully to prevent exposure to sharp instruments that can cause a percutaneous injury. Instruments should be placed in an appropriate container at the point of use to prevent percutaneous injuries during transport to the instrument processing area.

Instrument processing area

Dental workers should process all instruments in a designated central processing area to more easily control quality and ensure safety. The central processing area should be divided into sections for:

- Receiving, cleaning and decontamination.
- Preparation and packaging.
- Sterilization.
- Storage.

Ideally, walls or partitions should separate the sections to control traffic flow and contain contaminants generated during processing. When physical separation of these sections cannot be achieved, adequate spatial separation might be satisfactory if the dental workers who process instruments are trained in work practices to prevent contamination of clean areas. Space should be adequate for the volume of work anticipated and the items to be stored.

Receiving, cleaning and decontamination

Reusable instruments, supplies and equipment should be received, sorted, cleaned and decontaminated in one section of the processing area. Cleaning should precede all disinfection and sterilization processes; it should involve removal of debris, as well as organic and inorganic contamination. Removal of debris and contamination is achieved either by scrubbing with a surfactant, detergent and water, or by an automated process (e.g., ultrasonic cleaner or washer-disinfector) using chemical agents. If visible debris, whether inorganic or organic matter, is not removed, it will interfere with microbial inactivation and can compromise the disinfection or sterilization process. After cleaning, instruments should be rinsed with water to remove chemical or detergent residue. Splashing should be minimized during cleaning and rinsing. Before final disinfection or sterilization, instruments should be handled as though contaminated.

Considerations in selecting cleaning methods and equipment include:

- Efficacy of the method, process and equipment.
- Compatibility with items to be cleaned.
- Occupational health and exposure risks.

Use of automated cleaning equipment (e.g., ultrasonic cleaner or washer-disinfector) does not require presoaking or scrubbing of instruments and can increase productivity, improve cleaning effectiveness and decrease worker exposure to blood and body fluids. Thus, using automated equipment can be safer and more efficient than manually cleaning contaminated instruments.

If manual cleaning is not performed immediately, placing instruments in a puncture-resistant container and soaking them with detergent, a disinfectant/detergent or an enzymatic cleaner will prevent drying of
patient material and make cleaning easier and less time-consuming. Use of a liquid chemical sterilant/high-level disinfectant (e.g., glutaraldehyde) as a holding solution is not recommended.

Using work-practice controls (e.g., a long-handled brush) to keep the scrubbing hand away from sharp instruments is recommended. To avoid injury from sharp instruments, workers should wear puncture-resistant, heavy-duty utility gloves when handling or manually cleaning contaminated instruments and devices. Employees should not reach into trays or containers holding sharp instruments that cannot be seen (e.g., sinks filled with soapy water in which sharp instruments have been placed). Work-practice controls should include use of a strainer-type basket to hold instruments and forceps to remove the items. Because splashing is likely to occur, a mask, protective eyewear or face shield, and gown or jacket should be worn.

**Preparation and packaging**

In another section of the processing area, cleaned instruments and other dental supplies should be inspected, assembled into sets or trays, and wrapped, packaged or placed into container systems for sterilization. Hinged instruments should be processed open and unlocked. An internal chemical indicator should be placed in every package. In addition, an external chemical indicator (e.g., chemical indicator tape) should be used when the internal indicator cannot be seen from outside the package. For unwrapped loads, at a minimum, an internal chemical indicator should be placed in the tray or cassette with items to be sterilized (see Sterilization of unwrapped instruments). Dental practices should refer to the manufacturer’s instructions regarding use and correct placement of chemical indicators (see Sterilization monitoring). Critical and semicritical instruments that will be stored should be wrapped or placed in containers (e.g., cassettes or organizing trays) designed to maintain sterility during storage.

Packaging materials (e.g., wraps or container systems) allow penetration of the sterilization agent and maintain sterility of the processed item after sterilization. Materials for maintaining sterility of instruments during transport and storage include wrapped perforated instrument cassettes, peel pouches of plastic or paper and sterilization wraps (woven and nonwoven). Packaging materials should be designed for the type of sterilization process being used.

**Sterilization**

The sterilization section of the processing area should include the sterilizers and related supplies, with adequate space for loading, unloading and cool down. The area can also include incubators for analyzing spore tests and enclosed storage for sterile items and disposable (single-use) items. Manufacturer and local building code specifications will determine placement and room ventilation requirements.

**Sterilization procedures** – Heat-tolerant dental instruments usually are sterilized by:
- Steam under pressure (autoclaving).
- Dry heat.
- Unsaturated chemical vapor.

All sterilization should be performed by using medical sterilization equipment cleared by FDA. The sterilization times, temperatures and other operating parameters recommended by the manufacturer of the equipment used, as well as instructions for correct use of containers, wraps and chemical or biological indicators, should always be followed.

Items to be sterilized should be arranged to permit free circulation of the sterilizing agent (e.g., steam, chemical vapor or dry heat); manufacturer’s instructions for loading the sterilizer should be followed. Instrument packs should be allowed to dry inside the sterilizer chamber before removing and handling. Packs should not be touched until they are cool and dry because hot packs act as wicks, absorbing moisture, and hence, bacteria from hands. The ability of equipment to attain physical parameters required to achieve sterilization should be monitored by mechanical, chemical and biological indicators. Sterilizers vary in their types of indicators and their ability to provide readings on the mechanical or physical parameters of the sterilization process (e.g., time, temperature and pressure). Consult with the sterilizer manufacturer regarding selection and use of indicators.

**Steam sterilization** – Among sterilization methods, steam sterilization, which is dependable and economical, is the most widely used for wrapped and unwrapped critical and semicritical items that are not sensitive to heat and moisture. Steam sterilization requires exposure of each item to direct steam contact at a required temperature and pressure for a specified time needed to kill microorganisms. Two basic types of steam sterilizers are the gravity displacement and the high-speed prevacuum sterilizer.

The majority of tabletop sterilizers used in a dental practice are gravity displacement sterilizers, although prevacuum sterilizers are becoming more widely available. In gravity displacement sterilizers, the sterilizer chamber can result in cool air pockets and items not being sterilized.

Prevacuum sterilizers are fitted with a pump to create a vacuum in the chamber and ensure air removal from the sterilizing chamber before the chamber is pressurized with steam. Relative to gravity displacement, this procedure allows faster and more positive steam penetration throughout the entire load. Prevacuum sterilizers should be tested periodically for adequate air removal, as recommended by the manufacturer. Air not removed from the chamber will interfere with steam contact. If a sterilizer fails the air removal test, it should not be used until inspected by sterilizer maintenance personnel and it passes the test. Manufacturer’s instructions, with specific details regarding operation and user maintenance information, should be followed.

**Unsaturated chemical-vapor sterilization** – Unsaturated chemical-vapor sterilization involves heating a chemical solution of primarily alcohol with 0.23 percent formaldehyde in a closed pressurized chamber. Unsaturated chemical vapor sterilization of carbon steel instruments (e.g., dental burs) causes less corrosion than steam sterilization because of the low level of water present during the cycle. Instruments should be dry before sterilizing. State and local authorities should be consulted for hazardous waste disposal requirements for the sterilizing solution.

**Dry-heat sterilization** – Dry heat is used to sterilize materials that might be damaged by moist heat (e.g., burs and certain orthodontic instruments). Although dry heat has the advantages of low operating cost and being noncorrosive, it is a prolonged process and the high temperatures required are not suitable for certain patient-care items and devices. Dry-heat sterilizers used in dentistry include static-air and forced-air types:
- The static-air type is commonly called an oven-type sterilizer. Heating coils in the bottom or sides of the unit cause hot air to rise inside the chamber through natural convection.
• The forced-air type is also known as a rapid heat-transfer sterilizer. Heated air is circulated throughout the chamber at a high velocity, permitting more rapid transfer of energy from the air to the instruments, thereby reducing the time needed for sterilization.

**Sterilization of unwrapped instruments** – An unwrapped cycle (sometimes called flash sterilization) is a method for sterilizing unwrapped patient-care items for immediate use. The time required for unwrapped sterilization cycles depends on the type of sterilizer and the type of item (i.e., porous or nonporous) to be sterilized. The unwrapped cycle in tabletop sterilizers is preprogrammed by the manufacturer to a specific time and temperature setting and can include a drying phase at the end to produce a dry instrument with much of the heat dissipated. If the drying phase requirements are unclear, the operation manual or manufacturer of the sterilizer should be consulted. If the unwrapped sterilization cycle in a steam sterilizer does not include a drying phase or has only a minimal drying phase, items retrieved from the sterilizer will be hot and wet, making aseptic transport to the point of use more difficult. For dry-heat and chemical-vapor sterilizers, a drying phase is not required.

Unwrapped sterilization should be used only under certain conditions:
- Thorough cleaning and drying of instruments precedes the unwrapped sterilization cycle.
- Mechanical monitors are checked and chemical indicators used for each cycle.
- Care is taken to avoid thermal injury to dental care personnel or patients.
- Items are transported aseptically to the point of use to maintain sterility.

Because all implantable devices should be quarantined after sterilization until the results of biological monitoring are known, unwrapped or flash sterilization of implantable items is not recommended.

Critical instruments sterilized unwrapped should be transferred immediately by using aseptic technique, from the sterilizer to the actual point of use. Critical instruments should not be stored unwrapped. Semicritical instruments that are sterilized unwrapped on a tray or in a container system should be used immediately or within a short time. When sterile items are open to the air, they will eventually become contaminated. Storage, even temporary, of unwrapped semicritical instruments is discouraged because it permits exposure to dust, airborne organisms and other unnecessary contamination before use on a patient. A carefully written protocol for minimizing the risk of contaminating unwrapped instruments should be prepared and followed.

**Other sterilization methods** – Heat-sensitive critical and semicritical instruments and devices can be sterilized by immersing them in liquid chemical germicides registered by FDA as sterils. When using a liquid chemical germicide for sterilization, certain post-sterilization procedures are essential. Items need to be:
- Rinsed with sterile water after removal to remove toxic or irritating residues.
- Handled using sterile gloves and dried with sterile towels.
- Delivered to the point of use in an aseptic manner.

If an instrument is stored before use, the instrument should not be considered sterile and should be sterilized again just before use. In addition, the sterilization process with liquid chemical sterilants cannot be verified with biological indicators.

Because of these limitations and because liquid chemical sterilants can require approximately 12 hours of complete immersion, they are almost never used to sterilize instruments. Rather, these chemicals are more often used for high-level disinfection. Shorter immersion times (12-90 minutes) are used to achieve high-level disinfection of semicritical instruments or items. These powerful, sporicidal chemicals (e.g., glutaraldehyde, peracetic acid and hydrogen peroxide) are highly toxic. Manufacturer instructions (e.g., regarding dilution, immersion time and temperature) and safety precautions for using chemical sterilants/high-level disinfectants must be followed precisely.

These chemicals should not be used for applications other than those indicated in their label instructions. Misapplications include use as an environmental surface disinfectant or instrument-holding solution.

When using appropriate precautions (e.g., closed containers to limit vapor release, chemically resistant gloves and aprons, goggles and face shields), glutaraldehyde-based products can be used without tissue irritation or adverse health effects. However, dermatologic, eye irritation, respiratory effects and skin sensitization have been reported. Because of their lack of chemical resistance to glutaraldehydes, medical gloves are not an effective barrier. Other factors might apply (e.g., room exhaust ventilation or air exchanges/hour) to ensure workers’ safety. For all of these reasons, using heat-sensitive semicritical items that must be processed with liquid chemical germicides is discouraged; heat-tolerant or disposable alternatives are available for the majority of such items.

Low-temperature sterilization with ethylene oxide gas (ETO) has been used extensively in larger health care facilities. Its primary advantage is the ability to sterilize heat- and moisture-sensitive patient-care items with reduced deleterious effects. However, extended sterilization times of 10-48 hours and potential hazards to patients and workers requiring stringent health and safety requirements make this method impractical for private-practice settings. Handpieces cannot be effectively sterilized with this method because of decreased penetration of ETO gas flow through a small lumen.

Other types of low-temperature sterilization (e.g., hydrogen peroxide gas plasma) exist but are not yet practical for dental offices. Bead sterilizers have been used in dentistry to sterilize small metallic instruments (e.g., endodontic files). FDA has determined that a risk of infection exists with these devices because of their potential failure to sterilize dental instruments and has required their commercial distribution cease unless the manufacturer files a premarket approval application. If a bead sterilizer is employed, DHCP assume the risk of employing a dental device FDA has deemed neither safe nor effective.

**Sterilization monitoring** – Monitoring of sterilization procedures should include a combination of process parameters, including mechanical, chemical and biological. These parameters evaluate both the sterilizing conditions and the procedure’s effectiveness.

Mechanical techniques for monitoring sterilization include assessing cycle time, temperature and pressure by observing the gauges or displays on the sterilizer and noting these parameters for each load. Some tabletop sterilizers have recording devices that print out these parameters. Correct readings do not ensure sterilization, but incorrect readings can be the first indication of a problem with the sterilization cycle.

Chemical indicators, internal and external, use sensitive chemicals to assess physical conditions (e.g., time and temperature) during the sterilization process. Although chemical indicators do not prove sterilization has been achieved, they allow detection of certain equipment malfunctions, and they can help identify procedural errors. External indicators applied to the outside of a package (e.g., chemical indicator tape or special markings) change color rapidly when a specific parameter is reached, and they verify that the package has been exposed to the sterilization process. Internal chemical indicators should be used inside each package to ensure the sterilizing agent has penetrated the packaging material and actually reached the instruments inside. A single-parameter internal chemical indicator provides information regarding only one sterilization parameter (e.g., time or temperature). Multiparameter internal chemical indicators are designed to react to more than two parameters (e.g., time and temperature; or time, temperature and the presence of steam) and can provide a more reliable indication that sterilization conditions have been
met. Multiparameter internal indicators are available only for steam sterilizers (i.e., autoclaves).

Because chemical indicator test results are received when the sterilization cycle is complete, they can provide an early indication of a problem and where in the process the problem might exist. 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 (BIs) (i.e., spore tests) are the most accepted method for monitoring the sterilization process because they assess it directly by killing known highly resistant microorganisms (e.g., Geobacillus or Bacillus species), rather than merely testing the physical and chemical conditions necessary for sterilization. Because spores used in BIs are more resistant and present in greater numbers than the common microbial contaminants found on patient-care equipment, an inactivated BI indicates other potential pathogens in the load have been killed.

Correct functioning of sterilization cycles should be verified for each sterilizer by the periodic use (at least weekly) of BIs. Every load containing implantable devices should be monitored with such indicators, and the items quarantined until BI results are known. However, in an emergency, placing implantable items in quarantine until spore tests are known to be negative might be impossible.

Manufacturer’s directions should determine the placement and location of BI in the sterilizer. A control BI, from the same lot as the test indicator and not processed through the sterilizer, should be incubated with the test BI; the control BI should yield positive results for bacterial growth.

In-office biological monitoring is available; mail-in sterilization monitoring services (e.g., from private companies or dental schools) can also be used to test both the BI and the control. Although some dental care personnel have expressed concern that delays caused by mailing specimens might cause false negatives, studies have determined that mail delays have no substantial effect on final test results.

Procedures to follow in the event of a positive spore test have been developed. If the mechanical (e.g., time, temperature and pressure) and chemical (i.e., internal or external) indicators demonstrate that the sterilizer is functioning correctly, a single positive spore test probably does not indicate sterilizer malfunction. Items other than implantable devices do not necessarily need to be recalled; however, the spore test should be repeated immediately after correctly loading the sterilizer and using the same cycle that produced the failure. The sterilizer should be removed from service, and all records reviewed of chemical and mechanical monitoring since the last negative BI test.

Also, sterilizer operating procedures should be reviewed, including packaging, loading and spore testing, with all persons who work with the sterilizer to determine whether operator error could be responsible. Overloading, failure to provide adequate package separation and incorrect or excessive packaging material are all common reasons for a positive BI in the absence of mechanical failure of the sterilizer unit. A second monitored sterilizer in the office can be used, or a loaner from a sales or repair company obtained, to minimize office disruption while waiting for the repeat BI.

If the repeat test is negative and chemical and mechanical monitoring indicates adequate processing, the sterilizer can be put back into service. If the repeat BI test is positive, and packaging, loading and operating procedures have been confirmed as performing correctly, the sterilizer should remain out of service until it has been inspected, repaired and rechallenged with BI tests in three consecutive empty chamber sterilization cycles. When possible, items from suspect loads dating back to the last negative BI should be recalled, rewrapped and resterilized.

A more conservative approach has been recommended in which any positive spore test is assumed to represent sterilizer malfunction and requires that all materials processed in that sterilizer, dating from the sterilization cycle having the last negative biologic indicator to the next cycle indicating satisfactory biologic indicator results, should be considered nonsterile and retrieved, if possible, and reprocessed or held in quarantine until the results of the repeat BI are known. This approach is considered conservative because the margin of safety in steam sterilization is sufficient enough that infection risk associated with items in a load indicating spore growth is minimal, particularly if the item was properly cleaned and the temperature was achieved (e.g., as demonstrated by acceptable chemical indicator or temperature chart). Published studies are not available that document disease transmission through a nonretrieved surgical instrument after a steam sterilization cycle with a positive biological indicator. This more conservative approach should always be used for sterilization methods other than steam (e.g., dry heat, unsaturated chemical vapor, ETO or hydrogen peroxide gas plasma).

Results of biological monitoring should be recorded and sterilization monitoring records (i.e., mechanical, chemical and biological) retained long enough to comply with state and local regulations. Such records are a component of an overall dental infection control program (See program evaluation).

Storage of sterilized items and clean dental supplies

The storage area should contain enclosed storage for sterile items and disposable (single-use) items. Storage practices for wrapped sterilized instruments can be either date- or event-related. Packages containing sterile supplies should be inspected before use to verify barrier integrity and dryness.

Although some health care facilities continue to date every sterilized package and use shelf-life practices, other facilities have switched to event-related practices. This approach recognizes that the product should remain sterile indefinitely unless an event causes it to become contaminated (e.g., torn or wet packaging). Even for event-related packaging, minimally, the date of sterilization should be placed on the package, and if multiple sterilizers are used in the facility, the sterilizer used should be indicated on the outside of the packaging material to facilitate the retrieval of processed items in the event of a sterilization failure. If packaging is compromised, the instruments should be reclaned, packaged in new wrap and sterilized again.

Clean supplies and instruments should be stored in closed or covered cabinets, if possible. Dental supplies and instruments should not be stored under sinks or in other locations where they might become wet.

Environmental infection control

In the dental operatory, environmental surfaces (i.e., a surface or equipment that does not contact patients directly) can become contaminated during patient care. Certain surfaces, especially ones touched frequently (e.g., light handles, unit switches and drawer knobs) can serve as reservoirs of microbial contamination, although they have not been associated directly with transmission of infection to either dental workers or patients. Transfer of microorganisms from contaminated environmental surfaces to patients occurs primarily through dental care personnel hand contact. When these surfaces are touched, microbial agents can be transferred to instruments, other environmental surfaces or to the nose, mouth or eyes of workers or patients. Although hand hygiene is key to minimizing this transferal,
barrier protection or cleaning and disinfecting of environmental surfaces also protects against health care-associated infections.

Environmental surfaces can be divided into clinical contact surfaces and housekeeping surfaces. Because housekeeping surfaces (e.g., floors, walls and sinks) have limited risk of disease transmission, they can be decontaminated with less rigorous methods than those used on dental patient-care items and clinical contact surfaces. Strategies for cleaning and disinfecting surfaces in patient-care areas should consider the following:

- Potential for direct patient contact.
- Degree and frequency of hand contact.
- Potential contamination of the surface with body substances or environmental sources of microorganisms (e.g., soil, dust or water).

### Clinical contact surfaces

Clinical contact surfaces can be directly contaminated from patient materials by direct spray or spatter generated either during dental procedures or by contact with dental care personnel’s gloved hands. These surfaces can subsequently contaminate other instruments, devices, hands or gloves. Examples of such surfaces include:

- Light handles.
- Switches.
- Dental radiograph equipment.
- Dental chair-side computers.
- Reusable containers of dental materials.
- Drawer handles.
- Faucet handles.
- Countertops.
- Pens.
- Telephones.
- Doorknobs.

Barrier protection of surfaces and equipment can prevent contamination of clinical contact surfaces, but is particularly effective for those that are difficult to clean. Barriers include clear plastic wrap, bags, sheets, tubing and plastic-backed paper or other materials impervious to moisture. Because such coverings can become contaminated, they should be removed and discarded between patients while dental workers are still gloved. After removing the barrier, examine the surface to make sure it did not become soiled inadvertently. The surface needs to be cleaned and disinfected only if contamination is evident. Otherwise, after removing gloves and performing hand hygiene, dental workers should place clean barriers on these surfaces before the next patient. If barriers are not used, surfaces should be cleaned and disinfected between patients by using an EPA-registered hospital disinfectant with an HIV, HBV claim (i.e., low-level disinfectant) or a tuberculocidal claim (i.e., intermediate-level disinfectant). Intermediate-level disinfectant should be used when the surface is visibly contaminated with blood or OPIM. Also, general cleaning and disinfection are recommended for clinical contact surfaces, dental unit surfaces and countertops at the end of daily work activities and are required if surfaces have become contaminated since their last cleaning. To facilitate daily cleaning, treatment areas should be kept free of unnecessary equipment and supplies.

Manufacturers of dental devices and equipment should provide information regarding material compatibility with liquid chemical germicides, whether equipment can be safely immersed for cleaning, and how it should be decontaminated if service is required. Because of the risks associated with exposure to chemical disinfectants and contaminated surfaces, dental workers who perform environmental cleaning and disinfection should wear gloves and other protective equipment to prevent occupational exposure to infectious agents and hazardous chemicals. Chemical- and puncture-resistant utility gloves offer more protection than patient examination gloves when using hazardous chemicals.

### Housekeeping surfaces

Evidence does not support that housekeeping surfaces (e.g., floors, walls and sinks) pose a risk for disease transmission in dental health care settings. Actual physical removal of microorganisms and soil by wiping or scrubbing is probably as critical, if not more so, than any antimicrobial effect provided by the agent used. The majority of housekeeping surfaces need to be cleaned only with a detergent and water or an EPA-registered hospital disinfectant/detergent, depending on the nature of the surface and the type and degree of contamination. Schedules and methods vary according to the area (e.g., dental operatory, laboratory, bathrooms or reception rooms), surface and amount and type of contamination.

Floors should be cleaned regularly, and spills should be cleaned up promptly. An EPA-registered hospital disinfectant/detergent designed for general housekeeping purposes should be used in patient-care areas if uncertainty exists regarding the nature of the soil on the surface (e.g., blood or body fluid contamination versus routine dust or dirt). Unless contamination is reasonably anticipated or apparent, cleaning or disinfecting walls, window drapes and other vertical surfaces is unnecessary. However, when housekeeping surfaces are visibly contaminated by blood or OPIM, prompt removal and surface disinfection is appropriate infection control practice and required by OSHA.

Part of the cleaning strategy is to minimize contamination of cleaning solutions and cleaning tools (e.g., mop heads or cleaning cloths). Mops and cloths should be cleaned after use and allowed to dry before re-use, or single-use, disposable mop heads and cloths should be used to avoid spreading contamination.

Cost, safety, product-surface compatibility and acceptability by housekeepers can be key criteria for selecting a cleaning agent or an EPA-registered hospital disinfectant/detergent. Protective equipment used during cleaning and housekeeping procedures should be appropriate to the task.

Another reservoir for microorganisms can be solutions of detergents or disinfectants, especially if prepared in dirty containers, stored for long periods of time or prepared incorrectly. Manufacturers’ instructions for preparation and use should be followed. Making fresh cleaning solution each day, discarding any remaining solution and allowing the container to dry will minimize bacterial contamination. Preferred cleaning methods produce minimal mists and aerosols or dispersion of dust in patient care areas.
Cleaning and disinfection strategies for blood spills

The majority of blood contamination events in dentistry result from spatter during dental procedures using rotary or ultrasonic instrumentation. Although no evidence supports that HBV, HCV or HIV has been transmitted from a housekeeping surface, prompt removal and surface disinfection of an area contaminated by either blood or OPIM are appropriate infection control practices and required by OSHA.

Strategies for decontaminating spills of blood and other body fluids differ by setting and volume of the spill. Blood spills on either clinical contact or housekeeping surfaces should be contained and managed as quickly as possible to reduce the risk of contact by patients and workers. The person assigned to clean the spill should wear gloves and other protective equipment as needed. Visible organic material should be removed with absorbent material (e.g., disposable paper towels discarded in a leak-proof, appropriately labeled container). Nonporous surfaces should be cleaned and then decontaminated with either an EPA-registered hospital disinfectant effective against HBV and HIV or an EPA-registered hospital disinfectant with a tuberculocidal claim (i.e., intermediate-level disinfectant). If sodium hypochlorite is chosen, an EPA-registered sodium hypochlorite product is preferred. However, if such products are unavailable, a 1:100 dilution of sodium hypochlorite (e.g., approximately ¼ cup of 5.25 percent household chlorine bleach to 1 gallon of water) is an inexpensive and effective disinfecting agent.

Carpeting and cloth furnishings

Carpeting is more difficult to clean than nonporous hard surface flooring, and it cannot be reliably disinfected, especially after spills of blood and body substances. Studies have documented the presence of diverse microbial populations, primarily bacteria and fungi, in carpeting. Cloth furnishings pose similar contamination risks in areas of direct patient care and places where contaminated materials are managed (e.g., dental operatory, laboratory, or instrument processing areas). For these reasons, use of carpeted flooring and fabric-upholstered furnishings in these areas should be avoided.

Nonregulated and regulated medical waste

Studies have compared microbial load and diversity of microorganisms in residential waste with waste from multiple health care settings. General waste from hospitals or other health care facilities (e.g., dental practices or clinical/research laboratories) is no more infective than residential waste. The majority of soiled items in dental offices are general medical waste, and thus can be disposed of with ordinary waste. Examples include used gloves, masks, gowns, lightly soiled gauze or cotton rolls, and environmental barriers (e.g., plastic sheets or bags) used to cover equipment during treatment.

Although any item that has had contact with blood, exudates or secretions might be infective, treating all such waste as infective is neither necessary nor practical. Infectious waste that carries a substantial risk of causing infection during handling and disposal is regulated medical waste. A complete definition of regulated waste is included in OSHA’s blood-borne pathogens standard. Regulated medical waste is only a limited subset of waste: 9-15 percent of total waste in hospitals and 1-2 percent of total waste in dental offices.

Regulated medical waste requires special storage, handling, neutralization and disposal and is covered by federal, state and local rules and regulations. Examples of regulated waste found in dental-practice settings are solid waste soaked or saturated with blood or saliva (e.g., gauze saturated with blood after surgery), extracted teeth, surgically removed hard and soft tissues, and contaminated sharp items (e.g., needles, scalpel blades and wires). Regulated medical waste requires careful containment for treatment or disposal. A single leak-resistant biohazard bag is usually adequate for containment of nonsharp regulated medical waste, provided the bag is sturdy and the waste can be discarded without contaminating the bag’s exterior. Exterior contamination or puncturing of the bag requires placement in a second biohazard bag. All bags should be securely closed for disposal. Puncture-resistant containers with a biohazard label, located at the point of use (i.e., sharps containers), are used as containment for scalp blades, needles, syringes and unused sterile sharps.

Dental health care facilities should dispose of medical waste regularly to avoid accumulation. Any facility generating regulated medical waste should have a plan for its management that complies with federal, state and local regulations to ensure health and environmental safety.

Discharging blood or other body fluids to sanitary sewers or septic tanks

All containers with blood or saliva (e.g., suctioned fluids) can be inactivated in accordance with state-approved treatment technologies, or the contents can be carefully poured down a utility sink, drain or toilet. Appropriate protective equipment (e.g., gloves, gown, mask and protective eyewear) should be worn when performing this task. No evidence exists that blood-borne diseases have been transmitted from contact with raw or treated sewage. Multiple blood-borne pathogens, particularly viruses, are not stable in the environment for long periods, and the discharge of limited quantities of blood and other body fluids into the sanitary sewer is considered a safe method for disposing of these waste materials. State and local regulations vary and dictate whether blood or other body fluids require pretreatment or if they can be discharged into the sanitary sewer and in what volume.

Dental unit waterlines, biofilm, and water quality

Studies have demonstrated that dental unit waterlines (i.e., narrow-bore plastic tubing that carries water to the high-speed handpiece, air/water syringe and ultrasonic scaler) can become colonized with microorganisms, including bacteria, fungi and protozoa. Protected by a polysaccharide slime layer known as a glycocalyx, these microorganisms colonize and replicate on the interior surfaces of the waterline tubing and form a biofilm, which serves as a reservoir that can amplify the number of free-floating (i.e., planktonic) microorganisms in water used for dental treatment. Although oral flora and human pathogens (e.g., Pseudomonas aeruginosa, Legionella species, and nontuberculous Mycobacterium species), have been isolated from dental water systems, the majority of organisms recovered from dental waterlines are common heterotrophic water bacteria. These exhibit limited pathogenic potential for immuno-competent persons.
Dental unit water quality

Research has demonstrated that microbial counts can reach 200,000 colony-forming units (CFU)/mL within five days after installation of new dental unit waterlines, and levels of microbial contamination 106 CFU/mL of dental unit water have been documented. These counts can occur because dental unit waterline factors (e.g., system design, flow rates and materials) promote both bacterial growth and development of biofilm.

Although no epidemiologic evidence indicates a public health problem, the presence of substantial numbers of pathogens in dental unit waterlines generates concern. Exposing patients or dental workers to water of uncertain microbiological quality, despite the lack of documented adverse health effects, is inconsistent with accepted infection control principles. Thus, in 1995, ADA addressed the dental water concern by asking manufacturers to provide equipment with the ability to deliver treatment water with less than 200 CFU/mL of unfiltered output from waterlines. This threshold was based on the quality assurance standard established for dialysate fluid, to ensure that fluid delivery systems in hemodialysis units have not been colonized by indigenous waterborne organisms.

Standards also exist for safe drinking water quality as established by EPA, the American Public Health Association (APHA) and the American Water Works Association (AWWA); they have set limits for heterotrophic bacteria of less than 500 CFU/mL of drinking water. Thus, the number of bacteria in water used as a coolant/irrigant for nonsurgical dental procedures should be as low as reasonably achievable and, at a minimum, less than 500 CFU/mL, the regulatory standard for safe drinking water established by EPA and APHA/ AWWA.

SPECIAL CONSIDERATIONS

Dental handpieces and other devices attached to air and waterlines

Multiple semicritical dental devices that touch mucous membranes are attached to the air or waterlines of the dental unit. Among these devices are high- and low-speed handpieces, prophylaxis angles, ultrasonic and sonic scaling tips, air abrasion devices and air and water syringe tips. Although no epidemiologic evidence implicates these instruments in disease transmission, studies of high-speed handpieces using dye expulsion have confirmed the potential for retracting oral fluids into internal compartments of the device. This determination indicates that retained patient material can be expelled intraorally during subsequent uses. Studies using laboratory models also indicate the possibility for retention of viral DNA and viable virus inside both high-speed handpieces and prophylaxis angles. The potential for contamination of the internal surfaces of other devices (e.g., low-speed handpieces and ultrasonic scalers), has not been studied, but restricted physical access limits their cleaning. Accordingly, any dental device connected to the dental air/water system that enters the patient’s mouth should be run to discharge water, air or a combination for a minimum of 20-30 seconds after each patient. This procedure is intended to help physically flush out patient material that might have entered the turbine and air and waterlines.

Heat methods can sterilize dental handpieces and other intraoral devices attached to air or waterlines. For processing any dental device that can be removed from the dental unit air or waterlines, neither surface disinfection nor immersion in chemical germicides is an acceptable method. Ethylene oxide gas cannot adequately sterilize internal components of handpieces. In clinical evaluations of high-speed handpieces, cleaning and lubrication were the most critical factors in determining performance and durability. Manufacturer’s instructions for cleaning, lubrication and sterilization should be followed closely to ensure both the effectiveness of the process and the longevity of handpieces.

Some components of dental instruments are permanently attached to dental unit waterlines, and although they do not enter the patient’s oral cavity, they are likely to become contaminated with oral fluids during treatment procedures. Such components (e.g., handles or dental unit attachments of saliva ejectors, high-speed air evacuators and air/water syringes) should be covered with impervious barriers that are changed after each use. If the item becomes visibly contaminated during use, dental care personnel should clean and disinfect with an EPA-registered hospital disinfectant (intermediate-level) before use on the next patient.

Saliva ejectors

Backflow from low-volume saliva ejectors occurs when the pressure in the patient’s mouth is less than that in the evacuator. Studies have reported that backflow in low-volume suction lines can occur, and microorganisms can be present in the lines retracted into the patient’s mouth when a seal around the saliva ejector is created (e.g., by a patient closing their lips around the tip of the ejector, creating a partial vacuum). This backflow can be a potential source of cross-contamination; occurrence is variable because the quality of the seal formed varies between patients.

Furthermore, studies have demonstrated that gravity pulls fluid back toward the patient’s mouth whenever a length of the suction tubing holding the tip is positioned above the patient’s mouth, or during simultaneous use of other evacuation (high-volume) equipment. Although no adverse health effects associated with the saliva ejector have been reported, practitioners should be aware that in certain situations, backflow could occur when using a saliva ejector.

Dental radiology

When taking radiographs, the potential to cross-contaminate equipment and environmental surfaces with blood or saliva is high if aseptic technique is not practiced. Gloves should be worn when taking radiographs and handling contaminated film packets. Other protective equipment (e.g., mask, protective eyewear and gowns) should be used if spattering of blood or other body fluids is likely. Heat-tolerant versions of intraoral radiograph accessories are available, and these semicritical items (e.g., film-holding and positioning devices) should be heat-sterilized before patient use.

After exposure of the radiograph and before glove removal, the film should be dried with disposable gauze or a paper towel to remove blood or excess saliva and placed in a container (e.g., disposable cup) for transport to the developing area. Alternatively, if FDA-cleared film barrier pouches are used, the film packets should be carefully removed from the pouch to avoid contamination of the outside film packet and placed in the clean container for transport to the developing area. Various methods have been recommended for aseptic transport of exposed films to the developing area, and for removing the outer film packet before exposing and developing the film. Other information regarding dental radiography infection control is available.
Oral surgical procedures

The oral cavity is colonized with numerous microorganisms. Oral surgical procedures present an opportunity for entry of microorganisms (i.e., exogenous and endogenous) into the vascular system and other normally sterile areas of the oral cavity (e.g., bone or subcutaneous tissue); therefore, an increased potential exists for localized or systemic infection. Oral surgical procedures involve the incision, excision or reflection of tissue that exposes the normally sterile areas of the oral cavity. Examples include biopsy, periodontal surgery, apical surgery, implant surgery and surgical extractions of teeth (e.g., removal of erupted or nonerupted tooth requiring elevation of mucoperiosteal flap, removal of bone or section of tooth, and suturing if needed) (see “Hand hygiene, PPE, single-use or disposable devices,” and “Dental unit water quality”).

Handling of biopsy specimens

To protect persons handling and transporting biopsy specimens, each specimen must be placed in a sturdy, leak-proof container with a secure lid for transportation. 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 an impervious bag. The container must be labeled with the biohazard symbol during storage, transport, shipment and disposal.

Handling of extracted teeth disposal

Extracted teeth that are being discarded are subject to the containerization and labeling provisions outlined by OSHA’s blood-borne pathogens standard. OSHA considers extracted teeth to be potentially infectious material that should be disposed in medical waste containers. Extracted teeth sent to a dental laboratory for shade or size comparisons should be cleaned, surface-disinfected with an EPA-registered hospital disinfectant with intermediate-level activity (i.e., tuberculosis claim), and transported in a manner consistent with OSHA regulations. However, extracted teeth can be returned to patients on request, at which time provisions of the standard no longer apply. Extracted teeth containing dental amalgam should not be placed in a medical waste container that uses incineration for final disposal. Commercial metal recycling companies also might accept extracted teeth with metal restorations, including amalgam. State and local regulations should be consulted regarding disposal of the amalgam.

M. tuberculosis

Patients infected with M. tuberculosis occasionally seek urgent dental treatment at outpatient dental settings. Understanding the pathogenesis of the development of TB will help dental care workers determine how to manage such patients.

M. tuberculosis is a bacterium carried in airborne infective 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 two to 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.

Any dental worker with a persistent cough (i.e., lasting more than three weeks), especially in the presence of other signs or symptoms compatible with active TB (e.g., weight loss, night sweats, fatigue, bloody sputum, anorexia or fever), should be evaluated promptly. The person should not return to the workplace until a diagnosis of TB has been excluded or he or she is on therapy and has been determined noninfectious by a physician.

Creutzfeldt-Jakob disease and other prion diseases

Creutzfeldt-Jakob disease (CJD) belongs to a group of rapidly progressive, invariably fatal, degenerative neurological disorders, transmissible spongiform encephalopathies (TSEs) that affect both humans and animals and 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 one year of diagnosis. Among humans, TSEs include CJD, Gerstmann-Straussler-Scheinker syndrome, fatal familial insomnia, kuru and variant CJD (vCJD). Occurring in sporadic, familial and acquired (i.e., iatrogenic) forms, CJD has an annual incidence in the United States and other countries of approximately one case per million population. In approximately 85 percent of affected patients, CJD occurs as a sporadic disease with no recognizable pattern of transmission. A smaller proportion of patients (5-15 percent) experience familial CJD because of inherited mutations of the prion protein gene.

Program evaluation

The goal of a dental infection control program is to provide a safe working environment that will reduce the risk of health care-associated infections among patients and occupational exposures among workers. Medical errors are caused by faulty systems, processes and conditions that lead persons to make mistakes or fail to prevent errors being made by others. Effective program evaluation is a systematic way to ensure procedures are useful, feasible, ethical and accurate. Program evaluation is an essential organizational practice; however, such evaluation is not practiced consistently across program areas, nor is it sufficiently well-integrated into the day-to-day management of the majority of programs.

A successful infection control program depends on developing standard operating procedures, evaluating practices, routinely documenting adverse outcomes (e.g., occupational exposures to blood) and work-related illnesses in dental workers, and monitoring health care-associated infections in patients. Strategies and tools to evaluate the infection control program can include periodic observational assessments, checklists to document procedures and routine review of occupational exposures to blood-borne pathogens. Evaluation offers an opportunity to improve the effectiveness of both the infection control program and dental practice protocols. If deficiencies or problems in the implementation of infection control procedures are identified, further evaluation is needed to eliminate the problems. Examples of infection control program evaluation activities are provided on (Table 2).
Investigate the applicability of other types of sterilization

Study the effect of alcohol-based hand-hygiene products on

Develop devices with passive safety features to prevent

Develop animal models to determine the risk of transmitting

Laboratory-based research

- Develop animal models to determine the risk of transmitting organisms through inhalation of contaminated aerosols (e.g., influenza) produced from rotary dental instruments.
- Conduct studies to determine the effectiveness of gloves (i.e., material compatibility and duration of use).
- Develop devices with passive safety features to prevent percutaneous injuries.
- Study the effect of alcohol-based hand-hygiene products on retention of latex proteins and other dental allergens (e.g., methyl methacrylate, glutaraldehyde, thiurams) on the hands of workers after latex glove use.
- Investigate the applicability of other types of sterilization procedures (e.g., hydrogen peroxide gas plasma) in dentistry. Encourage manufacturers to determine optimal methods and frequency for testing dental-unit waterlines and maintaining dental-unit water-quality standards.
- Determine the potential for internal contamination of low-speed handpieces, including the motor, and other devices connected to dental air and water supplies, as well as more efficient ways to clean, lubricate, and sterilize handpieces and other devices attached to air or waterlines.
- Investigate the infectivity of oral tissues in Creutzfeldt-Jakob disease (CJD) or variant CJD patients.
- Determine the most effective methods to disinfect dental impression materials.
- Investigate the viability of pathogenic organisms on dental materials (e.g., impression materials, acrylic resin, or gypsum materials) and dental laboratory equipment.

Infection control research considerations

Although the number of published studies concerning dental infection control has increased in recent years, questions regarding infection control practices and their effectiveness remain unanswered. Multiple concerns were identified by the working group for this report, as well as by others during the public comment period. This list is not exhaustive and does not represent a CDC research agenda, but rather is an effort to identify certain concerns, stimulate discussion, and provide direction for determining future action by clinical, basic science and epidemiologic investigators, as well as health and professional organizations, clinicians and policy makers.

Education and promotion

- Design strategies to communicate, to the public and providers, the risk of disease transmission in dentistry.
- Promote use of protocols for recommended postexposure management and follow-up.
- Educate and train dental health care personnel (DHCP) to screen and evaluate safer dental devices by using tested design and performance criteria.

Laboratory-based research

- Appropriate immunization of dental health care personnel (DHCP).
- Assessment of occupational exposures to infectious agents.
- Comprehensive postexposure management plan and medical follow-up program after occupational exposures to infectious agents.
- Adherence to hand hygiene before and after patient care.
- Proper use of personal protective equipment to prevent occupational exposures to infectious agents.

TABLE 2. Examples of methods for evaluating infection control programs

<table>
<thead>
<tr>
<th>Program element</th>
<th>Evaluation activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appropriate immunization of dental health care personnel (DHCP).</td>
<td>Conduct annual review of personnel records to ensure up-to-date immunizations.</td>
</tr>
<tr>
<td>Assessment of occupational exposures to infectious agents.</td>
<td>Report occupational exposures to infectious agents. Document the steps occurred around the exposure and plan how such exposure can be prevented in the future.</td>
</tr>
<tr>
<td>Comprehensive postexposure management plan and medical follow-up program after occupational exposures to infectious agents.</td>
<td>Ensure the postexposure management plan is clear, complete, and available at all times to all DHCP. All staff should understand the plan, which should include toll-free phone numbers for access to additional information.</td>
</tr>
<tr>
<td>Adherence to hand hygiene before and after patient care.</td>
<td>Observe and document circumstances of appropriate or inappropriate handwashing. Review findings in a staff meeting.</td>
</tr>
<tr>
<td>Proper use of personal protective equipment to prevent occupational exposures to infectious agents.</td>
<td>Observe and document the use of barrier precautions and careful handling of sharps. Review findings in a staff meeting.</td>
</tr>
<tr>
<td>Routine and appropriate sterilization of instruments using a biologic monitoring system.</td>
<td>Monitor paper log of steam cycle and temperature strip with each sterilization load, and examine results of weekly biologic monitoring. Take appropriate action when failure of sterilization process is noted.</td>
</tr>
<tr>
<td>Evaluation and implementation of safer medical devices.</td>
<td>Conduct an annual review of the exposure control plan and consider new developments in safer medical devices.</td>
</tr>
<tr>
<td>Compliance of water in routine dental procedures with current U.S. Environmental Protection Agency drinking water standards (fewer than 500 CFU of heterotrophic water bacteria).</td>
<td>Monitor dental water quality as recommended by the equipment manufacturer, using commercial self-contained test kits, or commercial water-testing laboratories.</td>
</tr>
<tr>
<td>Proper handling and disposal of medical waste.</td>
<td>Observe the safe disposal of regulated and nonregulated medical waste and take preventive measures if hazardous situations occur.</td>
</tr>
<tr>
<td>Health care–associated infections.</td>
<td>Assess the unscheduled return of patients after procedures and evaluate them for an infectious process. A trend might require formal evaluation.</td>
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</table>
Clinical and population-based epidemiologic research and development

- Continue to characterize the epidemiology of blood contacts, particularly percutaneous injuries, and the effectiveness of prevention measures.
- Further assess the effectiveness of double gloving in preventing blood contact during routine and surgical dental procedures.
- Continue to assess the stress placed on gloves during dental procedures and the potential for developing defects during different procedures.
- Develop methods for evaluating the effectiveness and cost-effectiveness of infection control interventions.
- Determine how infection control guidelines affect the knowledge, attitudes, and practices of dental workers.

Selected definitions

**Alcohol-based hand rub** – An alcohol-containing preparation designed for reducing the number of viable microorganisms on the hands.

**Antiseptic** – A germicide used on skin or living tissue for the purpose of inhibiting or destroying microorganisms (e.g., alcohols, chlorhexidine, chlorine, hexachlorophene, iodine, chloroxylenol [PCMX], quaternary ammonium compounds, and triclosan).

**Bead sterilizer** – A device using glass beads 1.2–1.5 mm diameter and temperatures 217°C–232°C for brief exposures (e.g., 45 seconds) to inactivate microorganisms. (This term is actually a misnomer because it has not been cleared by the Food and Drug Administration [FDA] as a sterilizer.)

**Bioburden** – Microbiological load (i.e., number of viable organisms in or on an object or surface) or organic material on a surface or object before decontamination, or sterilization. Also known as bioload or microbial load.

**Colony-forming unit (CFU)** – The minimum number (i.e., tens of millions) of separable cells on the surface of or in semisolid agar medium that give rise to a visible colony of progeny. CFUs can consist of pairs, chains, clusters, or as single cells and are often expressed as colony-forming units per milliliter (CFUs/mL).

**DHCP** – Dental health care personnel/professionals (DHCP) include dentists, dental hygienists, dental assistants, dental laboratory technicians (in-office and commercial), students and trainees, contractual personnel, and other persons not directly involved in patient care but potentially exposed to infectious agents (e.g., administrative, clerical, housekeeping, maintenance, or volunteer personnel). Working in a dental health care facility.

**Dental treatment water** – Nonsterile water used during dental treatment, including irrigation of nonsurgical operative sites and cooling of high-speed rotary and ultrasonic instruments.

**Droplet nuclei** – Particles <5 μm in diameter formed by dehydration of airborne droplets containing microorganisms that can remain suspended in the air for long periods of time.

**Endotoxin** – The lipopolysaccharide of gram-negative bacteria, the toxic character of which resides in the lipid protein. Endotoxins can produce pyrogenic reactions in persons exposed to their bacterial component.

**HCP** – Health care personnel/professionals include doctors, nurses, radiologist, laboratory technicians, pharmacists, assistants, (in-office and commercial), students and trainees, contractual personnel, and other persons not directly involved in patient care but potentially exposed to infectious agents (e.g., administrative, clerical, housekeeping, maintenance, or volunteer personnel) working in a health care facility.

**HCW** – Health care worker includes anyone working in a health care facility of any kind whenever there is potential contact for spattering of blood or OPIM.

**Hepatitis B immune globulin (HBIG)** – Product used for prophylaxis against HBV infection. HBIG is prepared from plasma containing high titer of Hepatitis B surface antibody (anti-HBs) and provides protection for 3–6 mos.

**Hepatitis B surface antigen (HBsAg)** – Serologic marker on the surface of HBV detected in high levels during acute or chronic hepatitis. The body normally produces antibodies to surface antigen as a normal immune response to infection.

**Hepatitis B e-antigen (HBeAg)** – Secreted product of the nucleocapsid gene of HBV found in serum during acute and chronic HBV infection. Presence indicates that the virus is replicating and serves as a marker of increased infectivity.

**Hepatitis B surface antibody (anti-HBs)** – Protective antibody against HBsAg. Presence in the blood can indicate past infection with, and immunity to, HBV, or immune response from hepatitis B vaccine.

**Heterotrophic bacteria** – Those bacteria requiring an organic carbon source for growth (i.e., deriving energy and carbon from organic compounds).

**Iatrogenic** – Induced inadvertently by HCP, medical (including dental) treatment, or diagnostic procedures. Used particularly in reference to an infectious disease or other complication of treatment.

**Nosocomial** – Infection acquired in a hospital as a result of medical care.

**OPIM** – Other potentially infectious materials. OPIM is an OSHA term that refers to: 1.) Body fluids including semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures; any body fluid visibly contaminated with blood; and all body fluids in situations where differentiating between body fluids is difficult or impossible; 2.) Any unfixed tissue or organ (other than intact skin) from a human (living or dead); and 3.) HIV-containing cell or tissue cultures, organ cultures; HIV- or HBV-containing culture medium or other solutions; and blood, organs, or other tissues from experimental animals infected with HIV or HBV.

**Prion** – Protein particle lacking nucleic acid that has been implicated as the cause of certain neurodegenerative diseases (e.g., scrapie, CJD, and bovine spongiform encephalopathy [BSE]).

**Retraction** – Entry of oral fluids and microorganisms into waterlines through negative water pressure.

**Seroconversion** – The change of a serological test from negative to positive indicating the development of antibodies in response to infection or immunization.
Sterile – Free from all living microorganisms; usually described as a probability (e.g., the probability of a surviving microorganism being 1 in 1 million).

Sterilization – Use of a physical or chemical procedure to destroy all microorganisms including substantial numbers of resistant bacterial spores.

Conclusion
Dental health care professionals are at risk everyday, but here we have seen many infection control practices a dentist, his staff and his patients can take to reduce those risks. By taking the sterilization precautions, developing a written plan for the key elements of an infection control process, maintaining the necessary records, evaluating the plan on a routine basis and making changes to keep the processes up-to-date, the goal of minimizing the risk of disease transmission in the dental office can be met.

References
### Final Examination Questions

Select the best answer for each question and mark your answers on the Final Examination Answer Sheet found on page 69,
or for faster service complete your test online at Dental.EliteCME.com.

<table>
<thead>
<tr>
<th>Question</th>
<th>True</th>
<th>False</th>
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<tbody>
<tr>
<td>1. Avoiding exposure to blood and OPIM as well as protection by immunization remain primary strategies for reducing occupationally acquired infections, but occupational exposures can still occur.</td>
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<td></td>
<td>○ True</td>
<td>○ False</td>
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<tr>
<td>2. Standard precautions are strategies used to reduce the risk of infection from exposure to blood, all body fluids and secretions (except sweat), non-intact skin and mucous membranes.</td>
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<td></td>
<td>○ True</td>
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<tr>
<td>3. There is evidence that shows using antiseptics for wound care or expressing fluid by squeezing the wound further reduces the risk of blood-borne pathogen transmission.</td>
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<td></td>
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<tr>
<td>4. Dental devices that are connected to the dental water system and that enter the patient’s mouth (e.g., handpieces, ultrasonic scalers or air/water syringes) should be operated to discharge water and air for a minimum of 5-10 seconds after each patient.</td>
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<tr>
<td></td>
<td>○ True</td>
<td>○ False</td>
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<tr>
<td>5. Sterilization is the use of a chemical procedure to destroy all microorganisms, including substantial numbers of resistant bacterial spores.</td>
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<td></td>
<td>○ True</td>
<td>○ False</td>
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