

# Environmental Infection Prevention and Control



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- **Iowa Dental Professionals:** This course complies with the Iowa Dental Board for recertification in the area of infection control standards, as established by the Centers for Disease Control and Prevention (CDC).

**Conflict of Interest Disclosure Statement**

- Dr. Terézhalmy has done consulting work for Procter & Gamble and has served on the dentalcare.com Advisory Board. He has no relevant financial relationships to disclose.
- Dr. Huber is a member of the dentalcare.com Advisory Board and has no relevant financial relationships to disclose.

**Introduction**

Environmental Infection Prevention and Control continuing education course presents essential elements of environmental infection prevention and control in oral healthcare settings with emphasis on meeting basic expectations for safe care.

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## Overview

There are few data clearly showing causality with respect to environmental opportunistic organisms and healthcare associated infections (HAIs); however, air, water, and fomites in healthcare settings serve as reservoirs for many pathogens. This course presents evidence-based strategies related to air quality-, water quality-, and fomite-related infection prevention and control measures, which when consistently implemented, are effective in preventing HAIs and meet basic expectations for safe care.

## Learning Objectives

**Upon completion of this course, the dental professional should be able to:**

- Discuss issues related to the criteria for determining the strength of evidence for environmental sources of infection.

## Introduction

Pathogenic organisms are present primarily in moist organic environments, but some can persist under dry conditions. In healthcare settings they can be detected in **air** and **water**, and on **fomites**. Evidence that some environmental pathogens cause healthcare-associated infections (HAIs) prompted the Centers for Disease Control and Prevention (CDC) to publish guidelines for environmental infection control in healthcare facilities.<sup>1</sup> Elements of these guidelines were incorporated into the Guidelines for Infection Control in Dental Health-Care Settings - 2003.<sup>2</sup>

The strength of evidence for an environmental source of infectious agents that shows causality of a HAI is predicated on eight criteria (Box A).<sup>1</sup>

#### Box A. Criteria for Determining the Strength of Evidence for Environmental Sources of Infection.

1. Organism must be able to survive in air or water, or on fomites.
2. Organism can be cultured from in-use air, water, or fomites.
3. Organism can proliferate in air or water, or on fomites.
4. Acquisition of infection cannot be explained by any other recognized modes of transmission.
5. Retrospective case-control studies show an association between exposure to air, water, or fomites and infection.
6. Prospective case-control studies show an association between exposure to air, water, or fomites and infection.
7. Prospective studies allocating exposure to air, water, or fomites to a subset of patients show an association between exposure and infection.
8. Decontamination of air, water, or fomites results in elimination of infection transmission.

When considering air, water, or fomites as the source of pathogens in HAIs, one must understand the “chain of infection.”<sup>1,2</sup> Requisites for the transmission of pathogenic organisms from an environmental source to people include (1) a source of infectious agents, i.e., contaminated air, water or fomites; (2) a susceptible host exposed to an adequate number of sufficiently virulent microorganisms; and (3) a mechanism to transfer or mode of transmission of pathogens from the source to the host.

The risk of acquiring environmentally related HAIs is greatest among immunocompromised individuals. Immunocompromised individuals are those patients and healthcare personnel (HCP) whose immune mechanisms are deficient because of hereditary or acquired immunologic disorders, chronic diseases, or immunosuppressive therapy.<sup>1</sup> A subset of these patients, those with an absolute neutrophil count of  $\leq 500$  cells/mL has the greatest risk of HAIs.<sup>1</sup>

#### Air

**Aerosols** are airborne particles generated both by humans and from environmental sources that may contain viable pathogens.<sup>1</sup> **Droplets** greater than 5  $\mu\text{m}$  are generated when a person coughs or sneezes, or when water is converted to a fine mist by medical/dental devices such as high-speed handpieces and ultrasonic instruments).<sup>1</sup> Droplets may contain infectious pathogens, but they tend to quickly settle out from air so that any risk of disease transmission is generally limited to within 3 feet of the source.<sup>1</sup>

While pathogens in droplets are transmitted primarily by inhalation of droplets in close proximity to the source, transmission may also result from physical transfer of pathogens from a source contaminated with aerosols that have settled out from the air.<sup>1</sup> Common pathogens spread by droplets include the influenza virus, rhinovirus, adenovirus, respiratory syncytial virus, and gram-positive cocci (e.g., *Staphylococcus aureus* and group A beta-hemolytic *streptococci*).<sup>1,2</sup>

**Droplet nuclei** are the residuals of droplets that, while suspended in air, dried out and produced particles ranging in size from 1-5 µm.<sup>1</sup> Droplet nuclei can be transported beyond 3 feet of the source and remain suspended in air indefinitely in a dry, cool atmosphere.<sup>1</sup> Pathogens can be transmitted by inhalation of droplet nuclei or contact with contaminated objects.<sup>1</sup> Common pathogens spread by droplet nuclei include *M. tuberculosis* (MTB), and the *varicella zoster* and measles viruses.<sup>1</sup>

Lasers and electrosurgical units release **laser plumes** or **surgical smoke** containing gases, tissue debris, and aerosolized infectious agents such as the human papilloma virus, HIV, coagulase-negative *Streptococcus*, *Corynebacterium spp.*, and *Neisseria spp.*<sup>1,2</sup> Although the presence of pathogens in laser plumes or surgical smoke may not cause disease if the normal mode of transmission is not airborne, laser plumes and surgical smoke are considered potential health hazards.<sup>1,2</sup>

The presence of **aerosolized allergens**, derived primarily from latex gloves, carpeting, and cloth furnishings, must also be considered.<sup>1,2</sup> Exposure to aerosolized allergens can cause urticaria, asthma, allergic rhinitis, conjunctivitis, angioedema, and rarely anaphylaxis. Because cornstarch/latex protein particles become airborne during donning, use, and removal of gloves; in 2016 the FDA banned all powdered surgeon's gloves because of unreasonable and substantial risk of allergic reactions.<sup>3</sup>

### Air Quality-related Infection Prevention and Control

Standard heating, ventilation, and air conditioning (HVAC) systems in healthcare facilities are designed to maintain air temperature and humidity at comfortable levels for HCP and patients; to control odors; to remove contaminated air; to facilitate air-handling requirements to protect susceptible HCP and patients from airborne pathogens and allergens; and to minimize the risk of healthcare-related reactions to aerosolized allergens.<sup>1</sup>

Malfunction of any component of the HVAC systems (e.g., outside air intake; filters;

dehumidifiers; heating and cooling equipment; fans; ductwork; air exhaust or out-takes; registers; and diffusers or grilles) can contribute to unacceptable indoor air quality and the spread of healthcare-associated airborne pathogens and aerosolized allergens. Recommendations to maintain acceptable indoor air quality in healthcare settings are summarized in Table 1.<sup>1,2</sup>

Areas in healthcare settings that require special ventilation include: (1) operating rooms (ORs), (2) protective environment (PE) rooms, and (3) airborne infection isolation rooms (AIIRs).<sup>1</sup> However, community-based oral healthcare facilities typically do not maintain areas that require special ventilation (e.g., ORs, PE rooms, and AIIRs).<sup>2</sup>

### Water

**Moist environments** and **aqueous solutions** serve as reservoirs for waterborne pathogens. Under favorable conditions (i.e., warm temperature and a source of nutrients) many microorganisms actively proliferate; or remain for long periods in highly stable, noninfectious forms. From a contaminated water source, pathogens can be transmitted by direct contact with water, ingestion or aspiration of water, indirect-contact transmission (e.g., improperly reprocessed devices), and inhalation of aerosols.<sup>1</sup>

Direct contact with contaminated water, ingestion of contaminated water, and indirect-contact transmission are commonly associated with infections caused by *Pseudomonas aeruginosa* and other gram-negative bacteria, and nontuberculous mycobacteria (NTM) commonly found in potable water.<sup>1,2</sup> Aspiration of water or water aerosols generated from water sources contaminated with *Legionella spp.* often serve as the vehicle for introducing *Legionellae* into the respiratory tract.<sup>1,2</sup>

### Water Quality-related Infection Prevention and Control

The Environmental Protection Agency (EPA), the American Public Health Association (APHA), and the American Water Works Association (AWWA) have set a limit of 500 CFU/mL for aerobic, heterotrophic, mesophilic bacteria

**Table 1. Recommendations to Maintain Acceptable Indoor Air Quality in Healthcare Settings.**

1. Heating, ventilation, and air conditioning systems
  - a. Follow the American Institute of Architects (AIA) guidelines as the minimum standards where state or local regulations are not in place for the design, construction, and renovation of healthcare facilities.
  - b. Monitor HVAC systems in accordance with engineers' and manufactures' recommendations to ensure optimal performance for removal of particulates and eliminate excess moisture.
2. Laser plumes and surgical smoke
  - a. In settings where laser plumes or surgical smoke are generated, wear appropriate personal protective equipment, including N95 or N100 respirators, to minimize exposure.
  - b. Use central wall suction units with in-line filters to evacuate minimal laser plumes.
  - c. Use mechanical smoke evacuation system with a high-efficiency filter to manage the generation of large amounts of laser plume when ablating tissue infected with the human papilloma virus.
3. Latex-related aerosol contamination
  - a. Use low-protein latex gloves; or, preferably, latex free gloves.

in drinking water.<sup>1,2</sup> Treated municipal water enters healthcare facilities via the water main and is distributed throughout the buildings by a network of pipes. To minimize potential stagnation, pipe-runs should be as short as practical and they should be insulated.<sup>1</sup>

In addition to stagnation, the production of aerosols and wet surfaces also facilitate the multiplication and dispersal of waterborne pathogens. Measures to prevent the spread of waterborne pathogens include hand hygiene, glove use, barrier precautions, and eliminating/minimizing contamination at point-of-use fixtures.<sup>1,2</sup> Infection prevention strategies related to hand hygiene and the use of personal protective equipment are presented elsewhere.<sup>4,5</sup>

**Universal point-of-use fixtures** for water in healthcare facilities include sinks, faucets, toilets,

and eye-wash stations.<sup>1,2</sup> The potential for these fixtures to serve as a reservoir for pathogenic organisms has long been recognized. Sinks, faucets, and toilets should be cleaned and disinfect on a regular basis using an EPA-registered product (see section on Fomite-related Infection Prevention and Control). Eyewash stations should be flushed weekly with sterile water.

**Special point-of-use fixtures** include high-speed handpieces, sonic and ultrasonic scalers, and air-water syringes. These devices are connected to a water source by dental unit waterlines (DUWLs), which consist of small-bore plastic tubing. The presence of biofilms of waterborne bacteria (e.g., *Legionella spp.*, *Pseudomonas aeruginosa*, and NTM) in DUWLs has been confirmed.<sup>1,2</sup> Strategies to maintain acceptable water quality in oral healthcare settings are summarized in Table 2.<sup>1,2</sup>

**Table 2. Recommendations to Maintain Acceptable Water Quality in Oral Healthcare Settings.<sup>1,2</sup>**

1. Dental unit water lines.
  - a. Use water that meets nationally recognized standards for drinking water (i.e., <500 CFU/mL) for routine dental treatment.
  - b. Take precautions to prevent waterborne contamination of DUWLs and instruments.
    - i. Consult with dental water-line manufacturers to (1) determine suitable methods and equipment to obtain the recommended water quality; and (2) determine appropriate methods for monitoring the water to ensure quality is maintained.
    - ii. After each patient, discharge water and air for a minimum of 20-30 seconds from all devices (e.g., handpieces, ultrasonic scalers, and air-water syringe) connected to the dental water system.
2. Boil-water advisory.
  - a. Do not deliver water to the patient through dental equipment/instruments (e.g., handpieces, ultrasonic scalers, and air-water syringe) connected to the public water system.
  - b. Do not use water from the public water system for patient rinsing or handwashing.
    - i. Use bottled water for patient rinsing.
    - ii. If hands are not visibly soiled, use an alcohol-based hand-rub.
    - iii. If the hands are visibly soiled use bottled water and soap or antiseptic towelettes.
  - c. When boil-water advisory is cancelled.
    - i. Follow guidelines provided by the local water system authority regarding adequate flushing of waterlines.
    - ii. If no guidelines are provided, flush DUWLs and faucets for 1-5 minutes before using water for patient care.
    - iii. Disinfect DUWLs according to dental unit manufacturer's recommendations.
3. Water quality for oral surgical procedures.
  - a. Use specifically designed point-of-use devices (e.g., bulb syringe, single-use disposable products, and sterilizable tubing) for the delivery of sterile irrigating fluids.

## Fomites

The classification for medical and surgical instruments as critical, semicritical, and noncritical is predicated on their potential to transmit infection if the items are contaminated prior to use.<sup>1</sup> The CDC expanded the original classification by adding fomites, i.e., environmental surfaces that generally do not come in direct contact with patients, but may serve as a reservoir for pathogens.<sup>1,2</sup> Factors that influence the number and types of microorganisms on environmental surfaces are presented in Box B.<sup>1</sup>

In comparison to air and water, environmental surfaces carry the least risk of disease transmission in healthcare settings. When implicated, the transmission of pathogenic organisms from the source to the host is primarily through indirect means such as via hand transfer.<sup>1</sup> Infection prevention strategies related to hand hygiene and glove use with special reference to the oral healthcare setting are discussed elsewhere.<sup>4,5</sup>

### Fomite-related Infection Prevention and Control

Fomite or environmental surfaces can be conveniently divided into two major categories: (1) clinical contact surfaces such as dental units, x-ray machines, equipment knobs and controls; and (2) housekeeping surfaces.<sup>1,2</sup> Housekeeping surfaces can be further subdivided into (1) those with frequent hand contact such as doorknobs, light switches, walls around toilets; and (2) those with minimal hand

contact such as floors, ceilings, window sills, blinds, curtains.<sup>1,2</sup>

Strategies for cleaning and disinfecting environmental surfaces take into account (1) the potential for direct patient contact; (2) the degree and frequency of hand contact; and (3) the likelihood that the surface will be contaminated with blood and other potentially infectious material (OPIM) or pathogens from environmental sources such as soil, dust, and water.<sup>1,2</sup>

**Cleaning** is the first step in disinfection. It is a form of decontamination that renders the environmental surface safe to handle or use by removing organic matter, salts, and visible soil, all of which interfere with microbial inactivation.<sup>1,2</sup> The physical action of scrubbing with a detergent and rinsing with water removes large amount of microorganisms from surfaces.<sup>1</sup> A **detergent**, often referred to as soap, is composed of both hydrophilic and lipophilic parts and possesses cleaning action.

There are three levels of **disinfection** for instruments and environmental surfaces that do not require sterility for safe use: high-level, intermediate level, and low-level.<sup>1</sup> The rationale for this strategy is that microorganisms can usually be grouped according to their natural resistance to a spectrum of disinfectants (Table 3).<sup>1</sup> **Disinfectants** are **germicidal chemicals** that have been approved for use on environmental surfaces based on efficacy against specific microorganisms.

#### Box B. Factors Affecting the Number and Types of Microorganisms on Environmental Surfaces.

1. Number of people in the environment.
2. Amount of activity.
3. Amount of moisture.
4. Presence of material capable of supporting microbial growth.
5. Rate at which organisms suspended in air are removed.
6. Type of surface orientation (i.e., horizontal or vertical).

**Table 3. Levels of Disinfection by Type of Microorganism.**

Disinfection level	Bacteria			Fungi	Viruses	
	Vegetative	Tubercle bacillus	Spores		Lipid and medium size	Nonlipid and small size
High	+	+	±	+	+	+
Intermediate	+	+	-	+	+	±
Low	+	-	-	±	+	±

**High-level disinfectants** such as glutaraldehyde, peracetic acid, and hydrogen peroxide are regulated exclusively by the FDA.<sup>1</sup> They inactivate all vegetative bacteria, mycobacteria, viruses, fungi; and, with extended exposure times, they are capable of killing high numbers bacterial spores. Indications for the use of high-level disinfectants are specified in their labels; for example, “use as immersion disinfectant for heat-sensitive instruments.” Their use on environmental surfaces is inappropriate.<sup>1,2</sup>

**Intermediate-level disinfectants** such as sodium hypochlorite, alcohols, some phenolics, and some iodophors are regulated exclusively by the EPA.<sup>1,6</sup> These products labeled as “tuberculocidal hospital disinfectants” inactivate MBT, which is more resistant to disinfectants than ordinary vegetative bacteria, fungi, or viruses (with or without lipid envelopes).<sup>1</sup> Intermediate-level disinfectants, with the exception of sodium hypochlorite, have no sporicidal activity.

**Low-level disinfectants** such as quaternary ammonium compounds, some phenolics, some iodophors are also regulated exclusively by the EPA.<sup>1,6</sup> They inactivate vegetative bacteria, fungi, enveloped viruses (e.g., HIV, HBV, influenza virus), and some non-enveloped viruses such as adenoviruses.<sup>1</sup> Products labeled “hospital disinfectants” have passed efficacy tests for activity against *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Salmonella cholerae*.<sup>1</sup>

The recent SARS-CoV-2 virus pandemic has heightened the focus on environmental surfaces as reservoir for pathogens, with the introduction of a new categorization of products that have qualified under EPA’s emerging viral pathogens program for use against SARS-CoV-2.<sup>7,8</sup>

### Cleaning and Disinfection Strategies for Clinical Contact Surfaces

**Barrier protection** on clinical contact surfaces are useful, especially if the surfaces are frequently touched by gloved hands during the delivery of patientcare or are difficult to clean. Suitable barrier protection includes impervious-backed paper, aluminum foil, and plastic or fluid-resistant covers.<sup>1,2</sup> Barrier protections are to be removed and discarded after each patient while still wearing gloves.<sup>1</sup> If a surface is visibly soiled, clean and disinfect; otherwise, after degloving and performing hand hygiene, place clean barriers before the next patient is seated.

If barriers are not used and the surface is not visibly soiled, first clean then disinfect with an **EPA-Listed product that qualifies under EPA’s emerging viral pathogens program for use against SARS-CoV-2.**<sup>7,8</sup> If the surface is visibly soiled, first clean then disinfected with an EPA-Listed product that qualifies under EPA’s emerging viral pathogens program for use against SARS-CoV-2.<sup>7,8</sup>

### Cleaning and Disinfection Strategies for Housekeeping Surfaces

Housekeeping surfaces with frequent hand contact such as doorknobs, chair arms, hangers,

and anything else that people may come in contact with should be cleaned on a regular basis.<sup>1,9</sup> Horizontal surfaces in routine patient-care areas with infrequent hand contact such as windowsills, and hard-surface floors require cleaning on a regular basis and when soiled or spills occur. Extraordinary cleaning and decontamination of floors in healthcare settings is unwarranted.<sup>1</sup> Cleaning the walls, blinds, and window curtains is recommended when they are visibly soiled.<sup>1</sup>

Housekeeping surfaces should be cleaned with soap and water or a detergent/disinfectant.<sup>1,2</sup> The methods and frequency of cleaning should be determined by policy.<sup>2</sup> Cost, safety, product-surface compatibility, and acceptability by staff are the main criteria for selecting an agent. The manufacturers' instructions for product use should be followed.<sup>1</sup> Consult the products' safety data sheets (SDS) to determine precautions to be taken during product use. Personal protective equipment (PPE) used during cleaning and housekeeping procedures should be appropriate for the task.<sup>5</sup>

### **Cleaning and Disinfection Strategies for Spills**

There is no evidence that bloodborne pathogens such as HBV, HCV, HIV and OPIM have been transmitted from a housekeeping surface such as floors, walls, or countertops. Nonetheless, cleaning and disinfection of contaminated areas are sound infection prevention practices.<sup>1,2</sup> In patient-care areas, manage small spills by removing visible organic matter with absorbent material such as disposable paper towels; discard it into a leak-proof properly labeled container; and then, disinfect the area.<sup>1,2</sup>

Household bleach, 1:10 v/v dilution, is effective ("unregistered use") depending on the amount of organic material; however, OSHA regulations require the use of an EPA-List D low-level disinfectant (i.e., hospital disinfectant with HIV and HBV claims); or an EPA-List E intermediate-level disinfectant (i.e., hospital disinfectant with tuberculocidal, HIV, and HBV claims); or an EPA-List B intermediate-level disinfectant (i.e., hospital disinfectant with tuberculocidal claim).<sup>1,6</sup> PPE used during the cleaning and

decontamination procedures should be appropriate for the task.<sup>5</sup>

### **Carpeting and Cloth Furnishings**

Carpets and cloth furnishings harbor a diverse microbial population and allergens and should be vacuumed regularly; although, the bacterial and allergen burden is reduced only temporarily. Despite evidence of microbial growth and persistence, there is little evidence that carpets and cloth furnishings influence the rate of HAIs and there are no recommendations against their use in general patient-care areas. However, avoiding their use in areas where spills are likely to occur is prudent. Decontaminating carpets and cloth furnishings is difficult.<sup>1,2</sup>

### **Flowers and Plants in Patient-care Areas**

There is minimal evidence that plants in general patient-care areas pose an increased risk of HAIs in immunocompetent patients. Nonetheless, the following precautions should be implemented: (1) limit plant care to staff with no direct patient contact; (2) wear gloves when handling plants; (3) wash hands after handling plants; (4) change vase-water every 2 days and discharge water into a sink outside the immediate patient-care area; (5) clean and disinfect vases after use; and (6) potted plants, and fresh-cut and dry flowers should be excluded from areas where immunocompromised patients are treated.<sup>1</sup>

### **Pest Control**

Insect habitats are characterized by warmth, moisture, and availability of food. Although, insects carry a wide variety of pathogenic organisms on their surfaces and in their guts, the presence of insects in healthcare facilities is not likely to contribute substantially to the rate of HAIs. Pest control should focus on eliminating food sources, indoor habitats, and other conditions that attract pests, and apply pesticides as needed. A pest-control specialist can implement a regular insect-control program that is tailored to the needs of the setting and use approved chemicals and/or physical methods.<sup>1</sup>

### **Contaminated Laundry**

OSHA defines contaminated laundry as "laundry which has been soiled with blood or OPIM" and

includes towels, personal clothing, uniforms, scrub suits, gowns, and drapes for surgical procedures. Although contaminated textiles and fabrics in healthcare facilities can be a source of substantial numbers of pathogenic organisms, reports of HAIs linked to contaminated fabrics are so few in number that the overall risk of disease transmission during the laundry process is negligible.<sup>1</sup>

OSHA regulations prohibit home laundering of items considered PPE; however, experts disagree whether this regulation extends to uniforms and scrub suits that are not contaminated with blood or OPIM. Such items presumably do not differ appreciably from street clothes in the degree of bioburden and home laundering would remove the level of soil adequately. However, in response to the recent SARS-CoV-2 virus pandemic, the ADA recommends office attire such as scrubs be changed between street clothes upon entry and exit and not be taken home.<sup>9</sup> Clearly, employers must launder workers' personal protective garments or uniforms contaminated with blood or OPIM (Table 4).<sup>1</sup>

### Disposable Surgical Gowns and Drapes

Disposable, single use gowns and drapes, regardless of the material used to manufacture them, must be resistant to liquid and microbial penetration and registered with the FDA. Repellency and pore size of the fabric contribute to gown performance, but performance capability can also be influenced by the item's design and construction. When selecting a barrier product, the repellency level and the type of barrier should be compatible with the exposure expected. CDC offers no recommendations regarding the use of disposable fabrics and textiles versus durable goods.<sup>1</sup>

### Service Animals

Title III of the Americans with Disabilities Act (ADA) of 1990 mandates that persons with disabilities accompanied by service animals be allowed access with their service animals into places of public accommodation. There is no evidence that animals pose a significant risk of transmitting infection in healthcare facilities. Therefore, a person with disability may be accompanied by a service animal unless

the animal's presence or behavior requires a fundamental alteration in the nature of a service to be provided or is a direct threat to other persons.

A "direct threat" is defined as a significant risk to the health or safety of others that cannot be mitigated or eliminated by modifying policies, practices, or procedures. If a patient must be separated from his or her service animal, (1) the patient must make arrangements for the supervision and care of the animal during the period of separation and (2) the healthcare provider must make appropriate arrangements to address the patient's needs in the absence of the service animal.<sup>1</sup>

### Waste Management and Hazard Communication

Most solid waste generated in oral healthcare settings is **non-hazardous solid waste**, a subset of municipal **solid waste**.<sup>10</sup> Standard methods of collecting, storing, transporting, and disposing such wastes are regulated by state or local jurisdictions. It is of import to note that municipal solid waste regulations often include mandatory requirements for recycling certain materials (e.g., newspapers, cardboards, plastics, glass containers, aluminum cans, etc.).

A small percentage of solid waste generated in oral healthcare settings is **hazardous solid waste**. A subset of hazardous solid waste is **regulated medical waste**. The federal OSHA and its counterpart state agencies are responsible for developing and enforcing rules related to regulated medical waste. The rules are based on anticipated risks of exposure to blood and OPIM and relate to workers' health and safety. A review of **regulated medical waste management** is presented elsewhere.<sup>11</sup>

Hazardous solid waste also includes hazardous waste and universal waste. **Hazardous waste** includes chemical agents used or generated in the workplace, which pose a hazard to human health or to the environment when handled improperly. **Universal waste** includes hazardous waste batteries, pesticides, mercury-containing equipment, and fluorescent lamps. A review of **hazardous and universal waste management** is presented elsewhere.<sup>12</sup>

**Table 4. Recommendations for Contaminated Laundry.<sup>1</sup>**

1. Routine handling of contaminated laundry
  - a. Handle contaminated textiles and fabrics with minimum agitation to avoid contamination of air, environmental surfaces, and persons.
  - b. Bag or otherwise contain contaminated textiles or fabrics at point of use.
    - i. Use leak-proof containment for textiles and fabrics contaminated with blood or OPIM.
    - ii. Identify bags or containers for contaminated textiles with labels, color coding, or other alternative means of hazard communication.
2. Laundry facility and equipment
  - a. The laundry facility in a healthcare setting should be designed for efficiency in providing hygienically clean textiles, fabrics, and apparel for patients and staff.
  - b. Laundry area should have a handwashing facility readily available to workers
  - c. Laundry workers should wear PPE
  - d. Laundry equipment must be used and maintained according to manufacturers' instructions
3. Laundry process
  - a. If hot-water laundry cycles are used, wash with detergent in water  $\geq 160^{\circ}\text{F}$  ( $\geq 71^{\circ}\text{C}$ ) for  $\geq 25$  minutes
  - b. Choose chemicals suitable for low-temperature washing at proper use concentration if low-temperature ( $< 160^{\circ}\text{F}$  [ $< 71^{\circ}\text{C}$ ]) laundry cycles are used
  - c. Do not leave damp textiles or fabrics in machines overnight
  - d. Package, transport, and store clean textiles and fabrics by methods that will ensure their cleanliness and protect them from dust and soil during inter-facility loading, transport, and unloading.
4. Special laundry situations
  - a. Some textiles, surgical drapes, and gowns must be sterilized before use
    - i. Require steam autoclaving after laundering
  - b. Dry cleaning should be reserved for those circumstances in which fabrics cannot be safely cleaned with water and detergent.
    - i. Dry cleaning alone is relatively ineffective in reducing the number of bacteria and viruses on contaminated linen.

The federal OSHA and its counterpart state agencies are also responsible for developing and enforcing rules for **hazardous chemicals** as they relate to workers' health and safety. These rules are predicated on anticipated risks of exposure to chemicals in the workplace and the need to communicate this information to workers based on the principle of "right to know." A review of **hazard communication compliance** in oral healthcare settings is presented elsewhere.<sup>13</sup>

### Basic Expectations for Safe Care

In 2016, the CDC published a Summary of Infection Prevention Practices in Dental Settings: Basic Expectations for Safe Care, which includes an Infection Prevention Checklist (Appendix A).<sup>14</sup> Section I: Policies and Practices addresses basic expectations for safe care related to institutional infection prevention practices. Section II: Direct Observation of Personnel and Patient-care Practices addresses basic expectations related to personnel infection prevention practices.

Sections I.11 and I.12 reflect basic expectations for safe care related to institutional compliance with environmental infection prevention and control and dental unit water quality, respectively. Sections II.7 and II.8 reflect basic expectations for safe care related to personnel and patient-care practices compliance with and competence in executing environmental infection prevention and control measures and dental unit water quality requirements, respectively.

### Summary

Current guidelines acknowledge that while the healthcare environment contains a diverse population of microorganisms, it is rarely implicated in disease transmission; and implementation of environmental infection prevention and control measures on the rates of HAIs are not readily measurable. However, the strength of available evidence affirms that infection prevention and control strategies, when consistently implemented, are effective in preventing or minimizing HAIs.

## Course Test Preview

To receive Continuing Education credit for this course, you must complete the online test. Please go to: [www.dentalcare.com/en-us/professional-education/ce-courses/ce363/test](http://www.dentalcare.com/en-us/professional-education/ce-courses/ce363/test)

1. **In healthcare settings, pathogenic organisms are least likely to be detected \_\_\_\_\_.**
  - A. in air
  - B. in water
  - C. on fomites
  - D. primarily under dry conditions
2. **Which of the following statements is NOT a requisite for the transmission of pathogenic organisms from an environmental source to people?**
  - A. There must be a source of infectious agents, i.e., contaminated air, water or fomites.
  - B. There must be a susceptible host exposed to an adequate number of sufficiently virulent microorganisms.
  - C. There must be a mechanism to transfer or mode of transmission of pathogens from the source to the host.
  - D. A subset of immunocompromised patients, those with an absolute lymphocyte count of  $\leq 500$  cells/mL has the greatest risk of HAIs.
3. **All the following statements are correct with respect to droplets EXCEPT which one? Droplets \_\_\_\_\_.**
  - A. are particles of moisture greater than  $5\mu$
  - B. can contain infectious pathogens
  - C. can be transported over a long distance, i.e., beyond 3 feet of the source
  - D. are instrumental in spreading the influenza virus
4. **All the following statements related to laser plumes or surgical smoke, and aerosolized allergens are correct EXCEPT which one?**
  - A. Lasers and electrosurgical units release laser plumes or surgical smoke containing gases, tissue debris, and aerosolized infectious agents.
  - B. The presence of pathogens in laser plumes or surgical smoke will predictably cause disease.
  - C. Exposure to aerosolized allergens can cause urticaria, asthma, allergic rhinitis, conjunctivitis, angioedema, and rarely anaphylaxis.
  - D. The FDA banned all powdered surgeon's gloves because of unreasonable and substantial risk of allergic reactions.
5. **Typically, which of the following areas in healthcare settings is not equipped with special ventilation?**
  - A. Operating rooms.
  - B. Protective environment rooms.
  - C. Airborne infection isolation rooms.
  - D. Community-based oral healthcare facilities.
6. **Which of the following modes are likely to serve as a vehicle for the transmission for *Legionella spp.* from a contaminated water source?**
  - A. Ingestion of water.
  - B. Aspiration of water or inhalation of aerosols.
  - C. Direct contact with water.
  - D. Indirect-contact transmission (e.g., from an improperly reprocessed device).

7. **Measures to prevent the spread of waterborne pathogens include all of the following EXCEPT which one?**
- A. Pipe runs from the water main as long as practical.
  - B. Hand hygiene and glove use.
  - C. Barrier precautions.
  - D. Eliminating or minimizing contamination at point-of-use fixtures.
8. **The presence of biofilms of waterborne bacteria (e.g., *Legionella spp.* and *Pseudomonas aeruginosa*) in dental unit waterlines has been confirmed.**
- A. True
  - B. False
9. **All the following statements relative to boil-water advisory are correct EXCEPT which one? While the boil-water advisory is in effect \_\_\_\_\_.**
- A. use bottled water for patient rinsing
  - B. if hands are visibly soiled, use an alcohol-based handrub
  - C. do not deliver water to the patient through point-of-use fixtures from the public water system
  - D. do not use water from the public water system for handwashing
10. **All the following are specifically designed point-of-use devices to ensure water quality when performing oral surgical procedures for the delivery of sterile irrigating fluid EXCEPT which one?**
- A. Bulb syringe.
  - B. Single-use disposable products.
  - C. Air-water syringe.
  - D. Sterilizable tubing.
11. **An essential first step to ensure the success of the disinfection process on fomites is the physical action of scrubbing with a detergent and rinsing with water, which removes large amounts of microorganisms from surfaces.**
- A. True
  - B. False
12. **All the following statements are correct in relation to intermediate-level disinfectants EXCEPT which one? Intermediate-level disinfectants \_\_\_\_\_.**
- A. are regulated exclusively by the FDA
  - B. inactivate *Mycobacterium tuberculosis*, which is substantially more resistant to chemical germicides than ordinary vegetative bacteria, fungi, and viruses (with or without lipid envelops)
  - C. except for sodium hypochlorite, have no demonstrable sporicidal activity
  - D. are labeled as "tuberculocidal hospital disinfectants"
13. **If barriers are not used, regardless of the surface condition, i.e., visibly soiled or not, first clean the surface then disinfect with an EPA-Listed product that qualifies under EPA's emerging viral pathogens program for use against SARS-CoV-2.**
- A. True
  - B. False

- 14. All the following statements are correct with respect to housekeeping surfaces EXCEPT which one?**
- A. Extraordinary cleaning and decontamination of floors in healthcare settings is warranted.
  - B. Cleaning the walls, blinds, and window curtains is recommended when they are visibly soiled.
  - C. Housekeeping surfaces need to be cleaned only with soap and water, alternatively, a detergent/disinfectant may be used.
  - D. The methods, thoroughness, and frequency of cleaning housekeeping surfaces and the products used are determined by healthcare facility policy.
- 15. All the following strategies for spills of blood and OPIM are acceptable according to OSHA regulations EXCEPT which one? Removing visible organic matter with absorbent material such as disposable paper towels; discard it into a leak-proof properly labeled container; and then, disinfect the area with \_\_\_\_\_.**
- A. household bleach, 1:10 v/v dilution
  - B. an EPA-List D low-level disinfectant (i.e., hospital disinfectant with HIV and HBV claims)
  - C. an EPA-List E intermediate-level disinfectant (i.e., hospital disinfectant with tuberculocidal, HIV, and HBV claims)
  - D. EPA-List B intermediate-level disinfectant (i.e., hospital disinfectant with tuberculocidal claim)
- 16. All the following statements are correct with reference to carpeting and cloth furnishings in clinical setting EXCEPT which one?**
- A. Carpeting and cloth furnishings harbor a diverse microbial population and allergens and should be vacuumed regularly; although, the bacterial and allergen burden is reduced only temporarily.
  - B. Despite evidence of microbial growth and persistence, there is little evidence that carpets and cloth furnishings influence the rate of HAIs.
  - C. There are specific recommendations against the use of carpeting and cloth furnishings in general patient-care areas.
  - D. Avoiding carpeting and cloth furnishings in areas where spills are likely to occur is prudent because fully contaminating carpets and cloth furnishings is difficult.
- 17. All the following statements are correct with reference to contaminated laundry EXCEPT which one?**
- A. OSHA defines contaminated laundry as "laundry which has been soiled with blood or OPIM."
  - B. Healthcare-associated infections linked to contaminated fabrics are so few that the overall risk of disease transmission during the laundry process is negligible.
  - C. OSHA regulations prohibit home laundering of PPE, and experts agree that this regulation extends to uniforms and scrubs not contaminated with blood and OPIM.
  - D. In response to the recent SARS-CoV-2 virus pandemic, the ADA recommends office attire, such as scrubs, be changed between street clothes upon entry and exit and not be taken home.

- 18. All the following statements are correct with reference to disposable (i.e., single use) surgical gowns, drapes, and fabrics EXCEPT which one?**
- A. Disposable (i.e., single use) surgical gowns, drapes, and fabrics must be resistant to liquids and microbial penetration.
  - B. Disposable (i.e., single use) surgical gowns, drapes, and fabrics must be registered with the FDA to demonstrate their safety and effectiveness.
  - C. The CDC offers specific recommendations regarding the use of disposable fabrics and textiles versus durable goods.
  - D. Repellency and pore size of the fabric contribute to gown performance, but performance capability can also be influenced by the item's design and construction.
- 19. Which of the following statements related to solid waste generated in oral healthcare settings is incorrect?**
- A. Solid waste generated in oral healthcare settings is a subset of municipal solid waste.
  - B. Standard methods of collecting, storing, transporting, and disposing of municipal solid wastes are regulated by state or local jurisdictions.
  - C. Municipal solid waste regulations often include mandatory requirements for recycling certain materials (e.g., newspapers, cardboards, plastics, glass containers, etc.).
  - D. Most solid waste generated in oral healthcare settings is hazardous solid waste.
- 20. All the following items related to waste management and hazard communication compliance are correct EXCEPT which one?**
- A. Regulated medical waste is a subset of hazardous solid waste.
  - B. The federal OSHA and its counterpart state agencies are responsible for developing and enforcing rules related to regulated medical waste.
  - C. Universal waste includes chemical agents used or generated in the workplace, which pose a hazard to human health or to the environment when handled improperly.
  - D. The federal OSHA and its counterpart state agencies are responsible for developing and enforcing rules for hazardous chemicals as they relate to workers' health and safety.

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## Additional Resources

- No Additional Resources Available.

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