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Preventing Disease Transmission from Operatory Surfaces

A Peer-Reviewed Publication

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Educational Objectives

This article will review the principles of surface disinfection, including which surfaces should be disinfected, how to choose a disinfectant, and how this important infection control practice should be performed. Upon completion of this course, the dental professional will be able to:

1. Know the potential routes of transmission of microorganisms in the dental office
2. Know when and how barriers and disinfectants should be used for environmental surfaces
3. Know the difference between one-step and two-step disinfectants, and appropriate protocols to use for these
4. Consider the chemical properties, kill time, cleaning ability, compatibility, and toxicity of surface disinfectants.

Abstract

Patients and dental personnel are exposed to a variety of pathogenic microorganisms in the dental office. Potential routes of transmission include direct contact with body fluids and tissues, indirect contact with contaminated surfaces, and inhalation. Standard precautions must be followed to help prevent disease transmission. As an integral part of any infection control protocol, all environmental surfaces must be appropriately managed using barrier protection and surface disinfectants. In selecting an appropriate cleaning and disinfecting protocol, consideration should be given to chemical properties, kill time, cleaning ability, compatibility with the surface to be disinfected, contamination, and toxicity.

Introduction

Numerous microorganisms are found in the oral cavity, including cytomegalovirus (CMV), hepatitis B virus (HBV), hepatitis C virus (HCV), herpes simplex virus types 1 and 2, HIV, *Mycobacterium tuberculosis*, multiple species of *staphylococci* and *streptococci*, and numerous other viruses and bacteria that colonize the mouth and/or nasal and respiratory passages.[1] Both patients and dental personnel are exposed to a variety of pathogenic microorganisms during the delivery of dental treatment.[1] This microbial contamination can lead to infection, which can ultimately result in the development of a disease. Organisms can be disseminated directly and indirectly throughout the dental operatory during the delivery of dental care. Potential routes of transmission include:

1. Direct contact with blood, oral fluids (including saliva), other body fluids, or other patient materials
2. Indirect contact with contaminated objects including instruments, equipment, or environmental surfaces
3. Contact of eyes, nose, mouth, and/or mucous membranes with droplets/spatter containing microorganisms generated from infected persons when they cough, sneeze, or talk
4. Inhalation of airborne microorganisms that can remain suspended in the air for long periods of time[1]

Reducing the degree of contamination lessens the probability of disease transmission. All dental practitioners should incorporate recommended Centers for Disease Control and Prevention (CDC) and Occupational Safety and Health Administration (OSHA) infection control guidelines into their daily practice and implement Standard Precautions for every patient contact regardless of the presence or absence of infectious disease.[1]

Standard Precautions were updated in 2007 to include three new elements: respiratory hygiene/cough etiquette, safe injection practices, and use of masks for insertion of catheters or spinal/epidural injections.[2,3] The principles of standard precautions can be found at www.cdc.gov/ncidod/dhqp/pdf/isolation2007.pdf and www.cdc.gov/ncidod/dhqp/gl_isolation_standard.html.[2,3]

It is important that the clinician assumes that every person is potentially infected or colonized with an organism that could be transmitted in the healthcare setting and follows standard precautions during the delivery of health care.

While Standard Precautions effectively reduce the risk of infection from direct contact with blood, body fluids and spray/spatter, indirect contact with contaminated environmental surfaces and patient care items such as instruments, devices, and equipment also poses a risk. Infection control practices must be in place to reduce both direct and indirect routes of transmission, including environmental surfaces.

Disinfection of Environmental Surfaces

Disinfection of environmental surfaces has been an essential component of Universal Precautions, which emerged to become known as Standard Precautions, since the publication of the OSHA Bloodborne Pathogens Standard in 1991 and CDC infection control guidelines in 1986, 1993, and most recently 2003.[1,4,5,6] Contamination of environmental surface(s) or equipment that does not directly contact the patient, such as light handles, dental unit components, and drawer knobs, can serve as a reservoir for microbial dissemination to dental staff, subsequent patients, instruments/devices/equipment, and other environmental surfaces. The potential for disease transmission is well documented, and reduction of any source of contamination is recommended.[1-6] The most recently published Guidelines for Infection Control in Dental Health-Care Settings – 2003,[1] from the CDC, reinforces the need for managing dental environmental surfaces and should serve as the standard for clinicians to follow regarding surface disinfection.

How Important Is Surface Disinfection?

Universal/Standard Precautions have been generally accepted and practiced throughout the dental profession and were remarkably successful in preventing the transmission of bloodborne pathogens (BBP) in the dental office.[1,2,5,6] Tranmission of HIV in the dental office was reported in one office in Florida,[7] but no other dental office transmis-

sion of BBP was reported until 2007. However, in May 2007, Redd et al. published Patient-to-Patient Transmission of Hepatitis B Virus Associated With Oral Surgery.[8] This study conclusively documented patient-to-patient transmission of HBV, associated with extraction of teeth in an outpatient oral surgery office on the same day, 161 minutes apart.[8] DNA analyses of the viruses from both the probable source and index patients were found to be identical, conclusively linking the two cases.[8] The investigation found that all dentists and staff members were following recommended infection control protocols. The exact mechanism of the transmission could not be determined; however, cross contamination of a clinical contact (environmental) surface was thought to be possible.[8] The transmission of HBV occurred because the chain of infection remained intact, allowing the pathogen (HBV) to come into contact with a susceptible host. This case clearly documents the need to properly clean and disinfect all clinical contact (environmental) surfaces after every patient. The CDC estimates that there are approximately 1.25 million chronic carriers of HBV in the United States.[9]

The emergence and propagation of antimicrobial resistance is another significant factor that raises the importance of adherence to Standard Precautions, especially hand hygiene and disinfection of environmental surfaces. The development of antimicrobial resistance is directly attributable to natural biological changes (mutation), the indiscriminate and inappropriate use of antibiotics (overuse of Rx for viral infections, improper dosing, and poor adherence), noncompliance with infection control practices, and the use of antibiotics in food products (overuse in cattle, chickens, and pigs).[10-12] Penicillin-resistant *Streptococcus pneumonia*, vancomycin-resistant *enterococci*, methicillin-resistant *Staphylococcus aureus* (MRSA), multidrug-resistant *salmonellae*, and multidrug-resistant *Mycobacterium tuberculosis* have all been reported in a wide range of clinical conditions and especially hospital-acquired (nosocomial) infections.[10-11]

One of the most worrisome organisms is MRSA, with transmission associated with hospitals and medical care delivery facilities.[11,13-15] MRSA infection occurs either as a result of direct contact with an infected person or indirect contact with a contaminated surface, instrument, or device.[10-13] The primary mode of transmission is human hands, especially healthcare workers' (HCW) hands, that may become contaminated by contact with infected or colonized patients.[10-13] If proper hand hygiene is not performed, these organisms can be spread HCW-to-patient, patient-to-HCW, patient-to-patient, and HCW/patient-device/surface throughout the facility.[10-13] This transmission could be prevented if the chain-of-infection were broken by the performance of hand hygiene and proper disinfection of environmental surfaces with an EPA-registered disinfectant. This fundamental breech of infection control has been a major contributor to the increase and dissemination of MRSA and other resistant organisms in healthcare settings. Clinicians, both medical and dental, must practice Standard Precautions with every patient contact.

Environmental Surfaces: Clinical Contact vs. Housekeeping

Environmental surfaces in the dental office are basically divided into either clinical contact surfaces or housekeeping surfaces based on the degree and type of contamination to which the surface is exposed. A clinical contact surface is defined as any surface that is touched by contaminated hands, aerosol, instruments, devices, or other items in the course of providing dental care. Examples of clinical contact surfaces are shown in Figure 1. Any other surfaces such as floors and walls are defined as Housekeeping Surfaces. The management of these surfaces as recommended by the CDC is outlined in Table 1.[1]

Figure 1. Clinical contact surfaces in the operatory[1]

- Light handles
- Switches
- Radiology equipment
- Includes digital sensors
- Chairside computers, mouse and keyboards
- Drawer handles, doorknobs
- Reusable containers of dental materials
- Faucet handles
- Countertops, mobile carts/cabinets
- Pens, pencils
- Telephones, intercom

Adapted from CDC 2003 Guidelines

Environmental Surfaces: Barriers vs. Disinfection

The use of barrier protection or chemical disinfection is largely a matter of practicality and personal choice. Both are effective in reducing contamination, and each has advantages and disadvantages as well as specific indications (Table 1).

Barriers

Barrier protection includes clear plastic wrap, bags, sheets, tubing, and plastic-backed paper or other materials impervious to moisture. Their utilization on surfaces and equipment can prevent contamination of clinical contact surfaces. They are most effective for difficult-to-clean and smaller surfaces. Barriers are single-use and must be discarded after every patient contact. After removing the barrier, examine the surface to make sure it did not become soiled. The surface

needs to be cleaned and disinfected between patients only if contamination is evident. However, at the end of each day every clinical contact surface must be cleaned and then disinfected with an EPA-registered disinfectant.[1]

Disinfection

The other option is to clean and disinfect clinical contact surfaces with an EPA-registered hospital disinfectant after every patient contact. In the 2003 Guidelines,[1] the CDC has expanded the list of agents acceptable for surface disinfection from the previous 1993 Guidelines[4] (Table 2). A low-level disinfectant with an HIV/HBV claim or an intermediate-level disinfectant (tuberculocidal claim) may be used on any clinical contact surface not visibly contaminated with blood. Intermediate-level disinfectant should be used when the surface is visibly contaminated with blood or other potentially infectious material (OPIM). Although low-level agents may be used under certain circumstances, there is little if any cost differential between low- and intermediate-level products. More importantly, the intermediate-level chemicals can be used regardless of the presence or absence of blood. Conversely, a low-level disinfectant cannot be used on a surface with visible blood contamination, requiring the purchase of both the low-level and the intermediate-level products.

Table 1: General Recommendations for Environmental Surfaces[1]

Clinical Contact Surfaces
Use surface barriers to protect clinical contact surfaces, particularly difficult to clean or damaged surfaces
Switches on dental chairs/units, etc.
Change surface barriers between patients
At the end of the day clean and disinfect with an EPA-registered hospital disinfectant with:
A low-level product with HIV and HBV label claims or an intermediate-level product with tuberculocidal activity if not visibly contaminated with blood
Use an intermediate-level disinfectant if visibly contaminated with blood
AND
Clean and disinfect clinical contact surfaces that are not barrier-protected, between patients, using an EPA-registered hospital disinfectant:
Use a low-level product with HIV and HBV label claims or an intermediate-level product with tuberculocidal activity at the end of the day if not visibly contaminated with blood
Use an intermediate-level disinfectant if visibly contaminated with blood.
Follow the manufacturers' instructions for correct use
Use gloves, mask, eye protection, clinical gown
Do not use a high-level disinfectant or liquid sterilant
Housekeeping Surfaces (floors, walls, sinks, etc.)
Clean with detergent and water or an EPA-registered hospital disinfectant/detergent on a routine basis
Clean mops and cloths after use and allow drying before reuse; or use single-use, disposable mop heads or cloths.
Prepare fresh cleaning or EPA-registered disinfecting solutions daily and as instructed by the manufacturer.
Clean walls, blinds, and window curtains in patient-care areas when they are visibly dusty or soiled
Do not use a high-level disinfectant or liquid sterilant

Another significant change in the 2003 Guidelines is that only EPA-registered agents should be used to disinfect clinical contact surfaces. As household bleach is not EPA-registered for this purpose, diluted bleach should not be used. Additionally, the use of liquid chemical sterilants/high-level disinfectants (such as gluteraldehyde and related chemicals) for disinfecting environmental surfaces is not recommended.[1]

Clean It First!

Before disinfection can occur, the clinical contact surface(s) must be free of organic matter, salts, and visible soils. The presence of these materials may chemically react with the disinfectant, causing inactivation, or may isolate or sequester the active agent so that it cannot directly contact or interact with the microorganism.[1,16] If a surface is not cleaned first, disinfection cannot be assured. Removal of all visible blood and inorganic and organic matter can be as critical as the germicidal activity of the disinfecting agent, and all clinical contact surfaces should be pre-cleaned; cleaned with an absorbent material before the disinfectant is applied.[1,16] Any surface that cannot be cleaned adequately should be protected with a barrier.[1] A disinfectant that contains a detergent has the obvious advantage of providing the clinician with a cleaner/disinfectant in one formulation. This reduces the number of items in the office inventory, is more convenient, and usually decreases cost. Alcohol is a very poor cleaner, and the higher the percentage of alcohol in a product, the less effective the cleaning of the surface to which it is applied. Given their inherent inability to effectively clean and remove bioburden, solutions containing a high concentration of alcohol should be used in a two-step process, and should only be used after first cleaning the surface with a detergent.

Cleaning and Disinfecting Clinical Contact Surfaces: One-step vs. Two-step Disinfectant Products

Chemical germicides are divided into two types: one-step and two-step.[16] One-step disinfectants contain a detergent that cleans and disinfects hard surfaces in *one* operation.[16] Pre-cleaning of the contaminated surface is not required unless it is heavily soiled, which is an unusual occurrence in the dental office. One-step germicides both clean and introduce the biologically active disinfectant and require a minimum contact time for a specific agent to ensure antimicrobial activity. Two-step germicides require *separate* cleaning and disinfection operations under all conditions.[16] A two-step process, commonly referred to as spray-wipe-spray, is recommended when a two-step product is employed. First, the surface must be cleaned with a detergent.[1,16] This application phase is followed by a wipe that physically removes bioburden or other debris that might interfere with disinfection.[1,16] Once cleaned, the surface can be disinfected.[1,16] A second spray, this time with an EPA-registered liquid chemical germicide, is applied to the surface.[1,16] This must remain in contact with the surface for the

contact time stated on the disinfectant's label.[1] The one-step and two-step disinfectant processes are outlined in Table 2.

Table 2: Cleaning and Disinfecting Clinical Contact Surfaces: One-step vs. Two-step Disinfectant Products

Process	One-step Disinfectant	Two-step Disinfectant
Spray	—	Apply detergent to clinical contact surfaces
Wipe	—	Physically clean clinical contact surfaces
Spray	Apply detergent to clinical contact surfaces, Physically clean clinical contact surfaces and Apply EPA-registered liquid chemical disinfectant	Apply EPA-registered liquid chemical disinfectant
Wait	Disinfect clinical contact surfaces Contact time for a specific agent to ensure antimicrobial activity Allow to dry	Disinfect clinical contact surfaces Contact time for a specific agent to ensure antimicrobial activity Allow to dry

Advantages of a one-step product are obvious – one application of disinfectant vs. two saves considerable time and uses less product. However, any heavily contaminated surfaces should be cleaned and disinfected using the two-step process.

Surface disinfectants were recently evaluated by the American Dental Association (ADA) and the results were published in the Professional Products Review (PPR).[16] One-step vs. two-step classification, and the bactericidal and tuberculocidal contact time in minutes and effectiveness of selected products are found in Table 3.[16]

Table 3: Hard Surface Bactericidal and Tuberculocidal Test Results[16]

	Tuberculocidal		Bactericidal	
	Contact Time	Effective	Contact Time	Effective
One-Step Products				
Birex SE	10	Yes	10	Yes
DisCide ULTRA	1	Yes	1	Yes
Two-Step Products				
Asepticare TB + II	6	Yes	3	Yes
CaviCide Spray	5	No	3	No
GC Spray-Cide	6	Yes	3	Yes
Lysol Brand I.C. Disinfectant Cleaner	10	No	10	Yes
Lysol Brand II I.C. Disinfectant Spray	10	Yes	10	Yes
MicroStat 2	5	Yes	5	Yes
Sporicidin Disinfectant Solution and Spray	10	Yes	3	Yes

Adapted from Table 1, ADA Professional Product Review, vol. 21, issue 13.

How to Choose Disinfectants

Which chemical germicide should be used in the dental office? To make an informed choice, the clinician must understand some basic facts about the regulation and testing of disinfectants.[1] In the U.S., two agencies regulate disinfectants: the Environmental Protection Agency (EPA) and the Food and Drug Administration (FDA).[1,16] All liquid chemical disinfectants used on noncritical surfaces are regulated by the EPA.[1,16] Any high-level disinfectants and sterilants are regulated by the FDA (Table 4).[1,16]

The CDC's 1993 Guidelines called for the use of EPA-registered hospital disinfectants with tuberculocidal activity on clinical contact surfaces;[6] however as stated above, the 2003 Guidelines state that a low-level disinfectant with an HIV, HBV claim may be used for clinical contact surfaces not visibly contaminated with blood.[1,16] The CDC and the FDA classify disinfectants differently than the EPA does. CDC/FDA designates any EPA-registered hospital disinfectant without a tuberculocidal claim as a low-level disinfectant and any EPA-registered hospital disinfectant with a tuberculocidal claim as an intermediate-level disinfectant (Table 4).[1,16-21]

The EPA registers environmental surface disinfectants based on the manufacturer's microbiological activity claims when registering its disinfectant and does not use the terms intermediate-level or low-level disinfectants as used in CDC guidelines.[1,16-21] In order for a product to be labeled as an EPA hospital disinfectant, it must pass Association of Official Analytical Chemists (AOAC) effectiveness tests against three target organisms:

1. *Salmonella choleraesuis* for effectiveness against gram-negative bacteria
2. *Staphylococcus aureus* for effectiveness against gram-positive bacteria
3. *Pseudomonas aeruginosa* for effectiveness against a primarily nosocomial pathogen[16-21]

For a variety of indications and special conditions, manufacturers might also test specifically against organisms of known concern in healthcare practices such as HIV, HBV, hepatitis C virus (HCV), and herpes, which could then be put into label claims.[17-21]

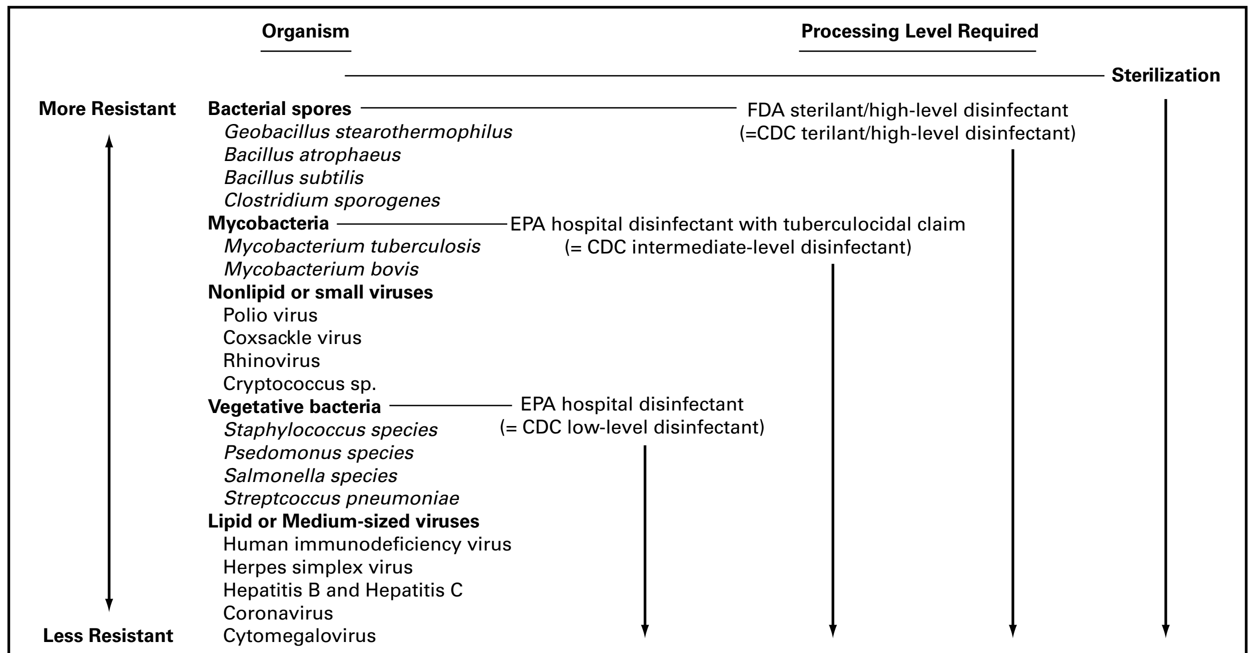
Clearly, each specific product must be carefully evaluated before use. (Table 5) A listing of disinfectants registered with the EPA, according to their efficacy against certain bloodborne/body fluid pathogens, can be found at http://www.epa.gov/oppad001/chemregindex.htm. Additionally, the Organization for Safety and Asepsis Procedures (OSAP) has produced an updated surface disinfectant reference chart that clinicians may find helpful.[22]

Organism Efficacy

It is important to select a disinfectant that is biologically active against a broad spectrum of microorganisms including not only the bloodborne pathogens (HIV, HBV, HCV), but other viruses, bacteria, and fungi (Figure 2). While the bloodborne pathogens and emerging resistant organisms such as

MRSA are significant issues in healthcare, fungal and other viral infections, such as influenza and SARS, are of concern in the fields of medicine and dentistry. These organisms can be transmitted onto and from environmental surfaces. Additionally, many of these infections are associated with high rates of morbidity and mortality. In order to inactivate more than just the bloodborne pathogens, a surface disinfectant with higher levels of antimicrobial activity is highly desirable to maximize the ability to disinfect surfaces. Tuberculocidal products possess these antimicrobial properties (Figure 2). To effectively

Figure 2: Decreasing Order of Resistance of Microbes to Disinfection[1]



Source: Centers for Disease Control and Prevention (CDC). Guidelines for infection control in dental health-care settings, 2003. MMWR Morb Mortal Wkly Rep.2003, Dec. 19, 2003, Vol. 52, No. RR-17, 1-68.
Appendix A Regulatory Framework for Disinfectants and Sterilants: Centers for Disease Control and Prevention (CDC). Guidelines for infection control in dental health-care settings, 2003. MMWR Morb Mortal Wkly Rep.2003, Dec. 19, 2003, Vol. 52, No. RR-17, 1-68.

Table 4: Disinfectants and Sterilants

	Sterilization (Regulated by FDA)	High-Level Disinfection (Regulated by FDA)	Intermediate-Level Disinfection (Regulated by EPA)	Low-Level Disinfection (Regulated by EPA)
Microbial Kill	All microorganisms, including spores	All microorganisms; does not kill spores	Vegetative bacteria; most fungi and viruses. Does not kill spores Tuberculocidal: inactivates *Mycobacterium bovis.*	Kills most vegetative bacteria; some fungi and viruses. Not tuberculocidal: does not inactivate *Mycobacterium bovis*
Methodology/Examples	**Heat automated:** High Temperature: Steam, dry heat, unsaturated chemical vapor Low Temperature: Ethylene oxide, plasma peroxide **Liquid immersion**: Chemical Sterilants/high level disinfectants	**Heat automated:** Washer-disinfector **Liquid immersion:** (Low Temp.): Chemical sterilants/high-level disinfectants	**Liquid contact:** EPA-registered hospital level disinfectant with tuberculocidal activity	**Liquid contact:** EPA-registered hospital level disinfectant with no claim for tuberculocidal activity. Must have label claim for HIV and HBV potency for clinical contact surfaces.
Patient-care Items	High Temperature: Heat tolerant critical and semi-critical; Low Temperature: Heat-sensitive critical and semi-critical	Heat-sensitive critical and semi-critical	Non-critical with visible blood	Non-critical without visible blood
Environmental Surfaces			Clinical contact surfaces contaminated with blood; Blood spills on housekeeping surfaces.	Clinical contact surfaces not contaminated with blood; Housekeeping surfaces.

Source: Centers for Disease Control and Prevention (CDC). Guidelines for infection control in dental health-care settings, 2003. MMWR Morb Mortal Wkly Rep.2003, Dec. 19, 2003, Vol. 52, No. RR-17, 1-68. ADA Professional Product Review, vol. 21, issue 13.

Table 5: Disinfectant Kill Times

Category and Brand	Longest time	TB	Germicidal	Fungicidal	Virucidal	Manufacturer or Distributor
Accelerated Hydrogen Peroxide						
Optim 33 TB	10 min	5 min	1 min	10 min	1 min	SciCan
Citric Acid						
Lysol IC Ready to Use Disinfectant Cleaner	10 min	10 min	10 min	10 min	10 min	Sultan Healthcare
Iodophors						
IodoFive Surface Disinfectant/Cleaner	10 min	10 min	10 min	10 min	10 min	Certol International
Phenolics (Dual) Water-Based						
Birex SE Concentrate	10 min	10 min	10 min	10 min	10 min	Biotrol International
DisCide Germicidal Foaming Cleaner	10 min	10 min	10 min	10 min	10 min	Palmero Health Care
ProSpray C-60 Conc. Surface Disinfectant	10 min	10 min	10 min	10 min	10 min	Certol International
ProSpray Surface Disinfectant Spray	10 min	10 min	10 min	10 min	10 min	Certol International
ProSpray Wipes	10 min	10 min	10 min	10 min	10 min	Certol International
Phenolics (Dual) Alcohol-Based						
DisCide Disinfectant Spray	10 min	10 min	10 min	10 min	10 min	Palmero Health Care
Quaternaries Dual or Synergized Plus Alcohol						
CaviCide Spray	3 min	3 min	3 min	3 min	2 min	TotalCare/Pinnacle/
CaviWipes	3 min	3 min	3 min	3 min	2 min	TotalCare/Pinnacle/Metrex
Cetylcide II Broad Spectrum Disinfectant	10 min	NA	10 min	10 min	10 min	Cetylite Industries
DisCide ULTRA Spray	1 min	1 min	1 min	1 min	1 min	Palmero Health Care
DisCide ULTRA Wipes	1 min	1 min	1 min	1 min	1 min	Palmero Health Care
GC Spray-Cide	10 min	6 min	10 min	5 min	10 min	GC America
Lysol IC Disinfectant Spray	10 min	10 min	10 min	10 min	10 min	Sultan Healthcare
Opti-Cide-3 Spray	3 min	3 min	3 min	3 min	3 min	Micro Scientific Industries
Sanitex Plus Spray	10 min	6 min	10 min	5 min	10 min	Crosstex International
Sanitex Plus Wipes	2 min	1 min	2 min	NA*	2 min	Crosstex International
Sani-Cloth HB Wipes	10 min	NA	10 min	10 min	10 min	PDI International
Sani-Cloth Plus Wipes	3 min	3 min	3 min	NA	3 min	PDI International
Super Sani-Cloth Wipes	2 min	1 min	2 min	NA*	2 min	PDI International
Sodium Hypochlorite						
Clorox Germicidal Spray	5 min	1 min	30 sec	5 min	1 min	Harry J. Bosworth Company
Clorox Germicidal Wipes	5 min	2 min	30 sec	5 min	1 min	Harry J. Bosworth Company
Sodium Bromide & Chlorine						
Microstat 2 Tablets	5 min	5 min	5 min	5 min	5 min	Septodont

Source: Data from EPA approved labels of the primary registered product
NA - missing EPA approved label claim
* effective against *Candida albicans*

disinfect a surface, the surface disinfectant must be applied to a clean surface and remain on the surface for the longest contact time of all the organisms listed on the label.

Tuberculocidal Activity

Mycobacterium tuberculosis is an airborne pathogen that rarely contaminates environmental surfaces, nor is it commonly found in the dental operatory. The organism, however, is difficult to kill. Only bacterial spores are more difficult to inactivate. Therefore, because TB is the most difficult vegetative organism to inactivate, activity of a disinfectant against TB (intermediate-level) is a good indicator of broad spectrum germicidal activity (Figure 2).[1,16] Although some organisms can survive exposure to a tuberculocidal disinfectant, most viruses inclusive of the bloodborne pathogens (HBV, HCV, HIV), fungi, and bacteria are inactivated (Figure 2).[1]

The ADA PPR recently tested the bactericidal and tuberculocidal activity of a number of intermediate-level disinfectants (Tables 3 and 6).[16] Please note that in Table 3 although CaviCide® spray failed the hard surface tuberculocidal test at 5 minutes, it passed at the 10-minute contact time.[16] In this evaluation, Lysol® I.C.™ had almost no tuberculocidal activity.[16] All testing in this evaluation was performed in the ADA laboratories, and a detailed description of the microbial methodology can be viewed at the PPR Web site at www.ada.org/goto/ppr.[16]

Whether a one-step or a two-step product, tuberculocidal (intermediate-level) disinfectants can be used in the presence or absence of blood,[1] thereby offering the clinician a wider range of use in the dental office, usually at comparable cost. Additionally, while low-level disinfectants may effectively inactivate bloodborne pathogens such as HIV and HBV,

Table 6: Intermediate-level Disinfectant Product Features According to Manufacturers[16]

Category and Brand	Ready-to-Use	Shelf-life
Citric Acid		
Lysol IC Ready to Use Disinfectant Cleaner	Yes	N/S
Phenolic		
Sporicidin Disinfectant Solution and Spray	Yes	N/S
Phenolics (Dual) Water-Based		
Birex SE Concentrate	No, mix with water	~ 1 year
Quaternaries Dual or Synergized Plus Alcohol		
AsepticareTB + II	Yes	N/S
CaviCide Spray	Yes	~ 2 years
DisCide ULTRA Spray	Yes	N/S
GC Spray-Cide	Yes	~ 2 years
Lysol IC Disinfectant Spray	Yes	N/S
Sodium Bromide & Chlorine		
Microstat 2 Tablets	No, 2-part mix	7 days, after mixed

Adapted from Table 2, ADA Professional Product Review, vol. 21, issue 13.

they are not effective against more-resistant organisms, such as cold and influenza viruses as well as other organisms, that would be inactivated with a tuberculocidal product.

The Choice Is Yours

A number of factors must be considered before choosing a chemical agent for surfaces. Clinicians should consider the agent's antimicrobial activity (low-level vs. intermediate-level, which is tuberculocidal), the surfaces to be disinfected, cost, safety, ease of use, and odor. The cleaning ability of the agent and whether a one-step or a two-step procedure would be required are important considerations. It is essential that an agent's compatibility with the surface to be cleaned is known. Using an agent that is not compatible with a surface could result in staining and damage to the surface. Roughening and pitting of the surface could occur when using an incompatible agent. This could make the surface more difficult to clean and disinfect.

Read the Label!

Most importantly, READ THE LABEL! All the information regarding the chemical composition, EPA registration, inclusion of a detergent, one-step vs. two-step product, recommended use, antimicrobial activity, and safety information should be clearly stated. Each manufacturer is responsible for providing a Material Safety Data Sheet (MSDS) that clearly states the distributor, hazardous ingredients, physical and chemical characteristics, fire and explosive data, physical hazards, health hazards, emergency first aid, special precautions, and special protection information.

How can you tell how toxic your disinfectant is? Read the label. Check if there are words on the label, such as "caution," "danger," or "warning," which are required by the EPA if chemicals are associated with toxicity. These are signal words that are required for all registered pesticide products unless the product can be categorized as Toxicity Category IV. The signal word is determined by the most severe toxicity category assigned to the five acute toxicity studies conducted on the chemical or if methanol is present at a concentration of ≥4%. The ranking of signal words from most to least severe is as follows:

§ Toxicity Category I – DANGER
  Also used for ≥4% methanol
§ Toxicity Category II – WARNING
§ Toxicity Category III – CAUTION
§ Toxicity Category IV – None Required

The precautionary statements on the label provide information on a chemical's toxicity; irritation and sensitization hazards; and treatment instructions and information to reduce potential exposure. The level of hazard is determined by acute oral, dermal, and inhalation testing measuring systemic toxicity; primary eye and skin irritation testing; and dental sensitization testing.

Make certain that there is a copy of each product's MSDS on file in the office and that these are readily available to all employees. Disinfectants intended for use on clinical contact surfaces or housekeeping surfaces are regulated in interstate commerce by the Antimicrobials Division, Office of Pesticide Programs, EPA, under the authority of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) of 1947, as amended in 1996.[20] Under FIFRA, any substance or mixture of substances intended to prevent, destroy, repel, or mitigate any pest, including microorganisms, but excluding those in or on living man or animal, must be registered before sale or distribution.[20] FIFRA explicitly requires users of products to follow the labeling directions on each product; all EPA-registered product labels state under the Directions for Use heading: "It is a violation of federal law to use this product inconsistent with its labeling." [20] Clinicians must ensure that they comply with all federal and state regulations regarding these disinfectants and must obtain an MSDS from the manufacturer and always follow the manufacturer's directions for pre-cleaning, appropriate personal protective equipment, safe handling, and proper storage and disposal.

Conclusions:

- With the emergence of increasing antimicrobial resistance, adherence to all the principles of Standard Precautions, including disinfection of clinical contact surfaces, should be followed for each and every patient contact.
- Clinicians should either cover clinical contact surfaces with an appropriate barrier or disinfect with an EPA-registered liquid chemical germicide between each and every patient.
- Choose a chemical agent that satisfies all federal and state regulations.

- Follow the directions and use the longest contact time listed on the label.
- Products that clean as well as disinfect are more convenient and limit the number of chemicals in inventory.
- Products with the one-step claim may lessen the time required for surface disinfection as well as use less chemical agent when turning over an operatory.
- Products that are tuberculocidal and contain a biodegradable detergent may decrease cost and increase efficiency.
- Products that are highly compatible will cause less damage to equipment and result in less deterioration of surfaces over time.
- Read the label! Know what you are using and how to use it.

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Author Profile

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Dr. DePaola is a Professor, Department of Oncology & Diagnostic Sciences, Dental School, University of Maryland, Baltimore. He received his DDS in 1975, completed a Master's Degree in Oral Biology, is a Diplomate of the American Board of Oral Medicine and the American College of Dentists; and has a Certificate in Prosthodontics. Dr. DePaola serves as the Executive Director of Biosafety and Continuous Quality Improvement at the Dental School, and the Director for dental training for the PA-Mid-Atlantic AIDS Education and Training Center. He is an international lecturer and a served as a member of the ADA Council of Scientific Affairs from 2002-2005. Active in research, he has authored and co-authored of over 130 journal articles, book chapters, and abstracts and serves as a consultant to the American Dental Association and numerous other professional groups and private industry. Over the past 20 years, he has been awarded over 75 research and service grants, many in the field of anti-plaque chemotherapeutic agents, HIV/AIDS, management of medically compromised dental patients, rapid salivary diagnostic testing, dental unit waterlines and infection control.

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Reader Feedback

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Questions

1. Microorganisms found in the oral cavity include _________.
   a. hepatitis B virus
   b. *Mycobacterium tuberculosis*
   c. *staphylococci* and *streptococci*
   d. all of the above

2. Organisms can only be disseminated directly during the delivery of dental care.
   a. True
   b. False

3. Reducing the degree of contamination lessens the probability of disease transmission.
   a. True
   b. False

4. A case of transmission of hepatitis B virus in the dental office setting was reported by Redd et al. in _________.
   a. 2003
   b. 2005
   c. 2007
   d. none of the above

5. The clinician should assume that _________.
   a. infection control protocols are needed only for persons known to be infected
   b. every person is potentially infected or colonized with an organism, but it will not be transmitted in the healthcare setting
   c. every person is potentially infected or colonized with an organism that could be transmitted in the healthcare setting
   d. none of the above

6. Infection control practices must be in place in order to reduce transmission of microorganisms from environmental surfaces.
   a. True
   b. False

7. Environmental surfaces that must be disinfected include _________.
   a. dental unit components
   b. drawer knobs
   c. instruments/devices/equipment
   d. all of the above

8. Patient-to-patient transmission of hepatitis B associated with a patient's visit for dental treatment has been reported.
   a. True
   b. False

9. Transmission of microorganisms can be prevented if the chain-of-infection is broken.
   a. True
   b. False

10. Barrier protection ________.
    a. is most effective for difficult-to-clean and smaller surfaces
    b. can prevent contamination of clinical contact surfaces
    c. includes clear plastic wrap, bags, and plastic-backed paper
    d. all of the above

11. If barrier protection is used, it is never necessary to disinfect clinical contact surfaces.
    a. True
    b. False

12. Disinfectants used for environmental surfaces _________.
    a. can be one-step or two-step disinfectants
    b. must be EPA-registered
    c. are low-level or intermediate-level disinfectants
    d. all of the above

13. Low-level chemicals can be used regardless of the presence or absence of blood.
    a. True
    b. False

14. If not visibly contaminated with blood, an intermediate-level disinfectant can be used on clinical contact surfaces.
    a. True
    b. False

15. Housekeeping surfaces should be cleaned with_________.
    a. an FDA-regulated sterilant
    b. an EPA-registered disinfectant/detergent
    c. an FDA-registered disinfectant/detergent
    d. any of the above

16. Diluted household bleach _________.
    a. is EPA-registered for clinical contact surface disinfection and can be used for disinfection
    b. is not EPA-registered for clinical contact surface disinfection but is still permissible to use for disinfection of clinical contact surfaces
    c. is not EPA-registered for clinical contact surface disinfection and should not be used for disinfection
    d. none of the above

17. Clinical contact surfaces must be free of organic matter, salts, and visible soils before disinfection can occur.
    a. True
    b. False

18. Organic materials on environmental surfaces can _________.
    a. sequester the active agent
    b. chemically react with the disinfectant
    c. physiologically react with the disinfectant
    d. a and b

19. Any surface that cannot be cleaned adequately should be _________.
    a. redesigned
    b. protected with a barrier
    c. sterilized
    d. discarded

20. A disinfectant that contains a detergent _________.
    a. reduces the number of items in the office inventory
    b. is mandatory
    c. provides the clinician with a cleaner/disinfectant in one formulation
    d. a and c

21. One-step germicides both clean and introduce the biologically active disinfectant, and require a minimum contact time for a specific agent to ensure antimicrobial activity.
    a. True
    b. False

22. The CDC/FDA designates any EPA-registered hospital disinfectant without a tuberculocidal claim as an intermediate-level disinfectant.
    a. True
    b. False

23. In order to inactivate more than just the bloodborne pathogens, _________.
    a. a surface disinfectant with higher levels of antimicrobial activity is highly desirable to minimize surface damage
    b. a surface disinfectant with low levels of antimicrobial activity is adequate if left on surfaces for five minutes
    c. a surface disinfectant with higher levels of antimicrobial activity is highly desirable to maximize the ability to disinfect surfaces
    d. a and c

24. The longest kill time required for phenolics is five minutes.
    a. True
    b. False

25. The longest kill time required for quaternaries dual or synergized quaternaries plus alcohol is thirty seconds.
    a. True
    b. False

26. TB is a good indicator of broad spectrum germicidal activity because _________.
    a. TB is the easiest vegetative organism to inactivate with an intermediate-level disinfectant
    b. TB is the most difficult vegetative organism to inactivate with an intermediate-level disinfectant
    c. TB is highly contagious
    d. none of the above

27. Whether a one-step or a two-step product, tuberculocidal (intermediate-level) disinfectants can be used in the presence or absence of blood.
    a. True
    b. False

28. When selecting a disinfectant for clinical contact surfaces, clinicians should consider _________.
    a. the agent's antimicrobial activity and the surfaces to be disinfected
    b. cost and ease of use
    c. safety and odor
    d. all of the above

29. To tell how toxic your disinfectant is, the label should be checked to see if the word _________ is on the label.
    a. caution
    b. danger
    c. warning
    d. any of the above

30. Clinicians must ensure that they comply with all federal and state regulations regarding disinfectants for clinical contact surfaces.
    a. True
    b. False

ANSWER SHEET

Preventing Disease Transmission from Operatory Surfaces

Name: ____ Title: ____ Specialty: ____

Address: ____ E-mail: ____

City: ____ State: ____ ZIP: ____ Country: ____

Telephone: Home ( ) ____ Office ( ) ____

Requirements for successful completion of the course and to obtain dental continuing education credits: 1) Read the entire course. 2) Complete all information above. 3) Complete answer sheets in either pen or pencil. 4) Mark only one answer for each question. 5) A score of 70% on this test will earn you 4 CE credits. 6) Complete the Course Evaluation below. 7) Make check payable to PennWell Corp.

Educational Objectives

1. Know the potential routes of transmission of microorganisms in the dental office
2. Know when and how barriers and disinfectants should be used for environmental surfaces
3. Know the difference between one-step and two-step disinfectants, and appropriate protocols to use for these
4. Consider the chemical properties, kill time, cleaning ability, compatibility, and toxicity of surface disinfectants.

Course Evaluation

Please evaluate this course by responding to the following statements, using a scale of Excellent = 5 to Poor = 0.

1. Were the individual course objectives met? Objective #1: Yes No Objective #3: Yes No
   Objective #2: Yes No Objective #4: Yes No

2. To what extent were the course objectives accomplished overall? 5 4 3 2 1 0

3. Please rate your personal mastery of the course objectives. 5 4 3 2 1 0

4. How would you rate the objectives and educational methods? 5 4 3 2 1 0

5. How do you rate the author's grasp of the topic? 5 4 3 2 1 0

6. Please rate the instructor's effectiveness. 5 4 3 2 1 0

7. Was the overall administration of the course effective? 5 4 3 2 1 0

8. Do you feel that the references were adequate? Yes No

9. Would you participate in a similar program on a different topic? Yes No

10. If any of the continuing education questions were unclear or ambiguous, please list them.

____

11. Was there any subject matter you found confusing? Please describe.

____

____

12. What additional continuing dental education topics would you like to see?

____

____

Mail completed answer sheet to

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2.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	17.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
3.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	18.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
4.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	19.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
5.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	20.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
6.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	21.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
7.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	22.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
8.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	23.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
9.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	24.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
10.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	25.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
11.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	26.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
12.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	27.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
13.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	28.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
14.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	29.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
15.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	30.	Ⓐ	Ⓑ	Ⓒ	Ⓓ

AGD Code 148

PLEASE PHOTOCOPY ANSWER SHEET FOR ADDITIONAL PARTICIPANTS.

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