Effective Use of Surface Disinfectants

Infection prevention guidelines and recommended protocols can be confusing, especially regarding the use of surface disinfectants. Since incorrect use of surface disinfectants can lead to an infectious disease transmission in a health-care or other facility, it is important that all employees understand the science as well as the regulations behind environmental asepsis.

This paper will discuss the scientific principles regarding pathogenic (disease-causing) microorganisms, their role in infectious disease transmission, and methods of preventing disease transmission resulting from contact with environmental surfaces.

Introduction to Infection Control/Prevention

Pathogenic microorganisms cause infectious diseases, or infections. These microorganisms may be bacteria, viruses, parasites, protozoa, or fungi. Microorganisms enter into the body in various ways, called routes of transmission. The four key routes of transmission are direct contact, indirect contact, droplet, and airborne. Table 1 gives examples of each.

Table 1

Route of Transmission	Entry into the Body	Examples of Infectious Disease
Airborne	Inhalation or aerosol	Measles, TB, chicken pox
Direct	Person to person contact	Hepatitis, HIV
Droplet	Spray or spatter	Influenza
Indirect	Contact with contaminated surface or instrument	Hepatitis, HIV

Although pathogenic microorganisms are capable of causing infectious diseases, there are additional factors that control whether a disease transmission will occur. Often referred to as the “chain of infection,” all of the factors must be present for a disease transmission to take place. These factors include a reservoir for the pathogens to live and multiply, such as mucous membranes, the bloodstream,

or environmental surfaces. Another needed factor is a mode of transmission, a way for pathogens to be transported from the reservoir to the body, such as inhaling droplets, contacting blood or mucous membranes with contaminated hands, or a puncture or cut from a contaminated instrument or item.

In addition to a mode of transmission, a portal of entry into the body must be present. This depends on the type of pathogen. For example, a bloodborne pathogen such as hepatitis or HIV must have a portal or entry point into the bloodstream, such as through a cut or break in the skin. Some viruses, such as influenza, enter the body by inhalation of droplets. A final factor in the disease transmission process is a host or person who is susceptible or has no immunity to the pathogen.

Pathogenic Microorganisms

Some of the more common pathogenic microorganisms are bacteria. The most commonly encountered bacteria in ambulatory health care and other settings, such as child care facilities, are staph, strep, MRSA, and less frequently, tuberculosis. Other common microorganisms are viruses, such as herpes, influenza, hepatitis B and C, and the common cold.

Environmental Infection Prevention Protocols

In the interest of public safety, rules and guidelines have been implemented that serve to prevent the spread of infectious diseases. OSHA promulgated rules to protect employees in the Bloodborne Pathogens Standard.[i] The Centers for Disease Control and Prevention (CDC) has issued numerous sets of guidelines for infection control in health-care and other settings that are designed to protect patients, and to protect the public in other settings, such as schools, child care, salons, etc.

The OSHA Bloodborne Pathogens Standard, finalized in 1991, came about because of concerns for employee exposure to HIV/AIDS and hepatitis in the workplace. It sets forth rules that must be followed by both employers and employees to minimize the risk of exposure to infectious diseases that are

spread by exposure to blood and other body fluids. In addition to the risks of an infectious disease transmission from not following these protocols, employers can be subject to citations and fines for non-compliance.

The CDC has published numerous sets of guidelines on infection prevention in health-care facilities and other settings. Table 2 lists many of these guidelines. While the CDC is not a regulatory agency, it is the entity that is recognized in the U.S. and around the world for establishing the prevailing standards of care for infectious disease outbreak prevention. Employers cannot be cited or fined for lack of compliance with CDC guidelines, however, if non-compliance causes an infectious disease outbreak, public health agencies can close facilities and regulatory boards can initiate disciplinary actions against health-care professionals.

Table 2

CDC Guidelines and Recommendations
Guideline for Hand Hygiene in Health-Care Settings - 2002
Guidelines for Environmental Infection Control in Health-Care Facilities - 2003
Guidelines for Infection Control in Dental Health-Care Settings - 2003
Influenza Vaccination of Health-Care Personnel - 2006
Guideline for Disinfection and Sterilization in Health-Care Facilities - 2008
Guidelines for the Prevention and Control of Norovirus and Gastroenteritis Outbreaks in Health-Care Settings, 2011
Note: this is not an all-inclusive list of CDC infection prevention guidelines. More information is available at www.cdc.gov

In addition to OSHA standards and CDC guidelines, some dental and other ambulatory care facilities must also follow standards from the Joint Commission on Accreditation of Health Care Organizations,[ii] known as JCAHO. Any facility that receives federal funding, such as public health clinics, must be accredited through JCAHO, including its standards for infection control/prevention. State health

departments also have rules that apply to childcare centers, tattoo and body piercing facilities, as well as hair and nail salons.

Application of Standards and Guidelines – Personal Protective Equipment

There are many facets to applying and complying with infection prevention standards and guidelines. One of the basic tenets of both the Bloodborne Pathogens Standard and CDC guidelines is the concept of "standard precautions." Formerly called "universal precautions," this is the protocol that should be followed at all times when there is potential for exposure to bloodborne or other infectious diseases. It means that the same protective measures will be followed in every situation where there is potential risk of exposure. Standard precautions do not take into consideration a health history or the fact that an individual may be known and deemed to be free of any potentially infectious diseases or conditions. It is assumed that everyone with whom a worker comes into contact is potentially infectious for HIV/AIDS, hepatitis, or other infectious diseases.

According to the OSHA Bloodborne Pathogens standard, appropriate personal protective equipment (PPE) must be worn when there is potential for exposure to blood or other potentially infectious materials (OPIM), including amniotic fluid, cerebrospinal fluid, pericardial fluid, peritoneal fluid, pleural fluid, saliva in dental procedures, semen, synovial fluid, vaginal secretions, any body fluid that is visibly contaminated with blood, and any body fluids where it is difficult to differentiate between body fluids. PPE includes exam gloves when in contact with body fluids, mucous membranes, or items that have been in contact with body fluids or mucous membranes. Facemasks (respiratory protection), safety glasses/goggles (eye protection), and protective clothing are required when there is potential for splash or spatter of blood or OPIM. These are also recommended in the CDC guidelines and JCAHO standards.

Application of Standards and Guidelines – Environmental Asepsis

Another critical element in infection control/prevention is environmental asepsis or prevention of cross contamination and disease transmission from equipment or other surfaces in a facility through indirect contact or droplet infection. Disinfectants play a key role in prevention of disease transmission; however, much confusion surrounds the selection and use of disinfectants. The following discussion aims to clarify the confusion and assist in achieving better results when using surface disinfectants.

Barriers vs. Surface Disinfectants

In dentistry and other facilities, barriers such as plastics are often used on equipment that is frequently touched with contaminated hands and may be hard to clean and disinfect. These items might include headrests on dental chairs, light handles and switches, digital X-ray sensors, intraoral camera wands, curing light wands, and others. If the barrier has remained intact during treatment and is removed without touching the item's surface with contaminated gloves, there is no need to clean and disinfect the surface before replacing the barrier. But many dental health-care professionals do it as an additional precaution. There are some environmental issues with using barriers, since most are plastics that take a very long time to degrade in a landfill. The use of barriers must be analyzed to determine the balance between disposal issues, protecting equipment, and achieving efficiency in asepsis protocols.

Selection and Use of Surface Disinfectants

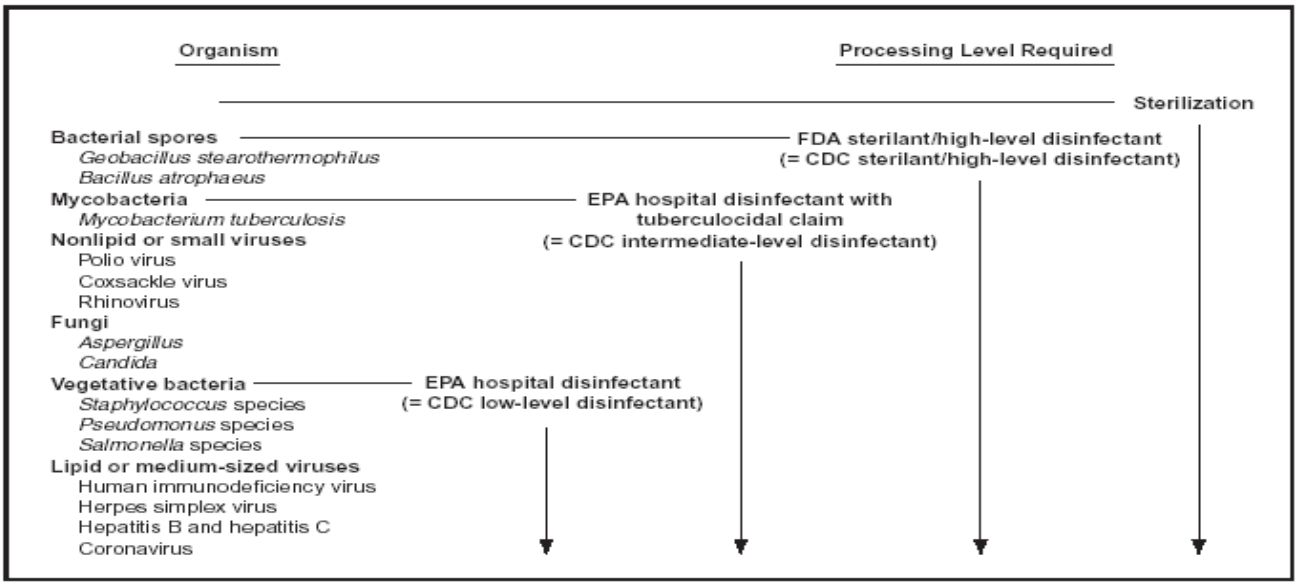
The CDC guidelines recommend selecting surface disinfectants based on the disinfectant's effectiveness against various microorganisms. Additional criteria include whether the surface is a clinical contact surface directly contacted during the delivery of care, or a housekeeping surface that has not been directly touched. For clinical contact surfaces where there is likely to be blood present, an intermediate level, hospital-grade, tuberculocidal disinfectant is recommended. Where there is not likely to be blood present, a low-level disinfectant (not labeled as tuberculocidal) may be utilized.

In dental treatment rooms it is assumed that there will be some blood present on environmental surfaces when operative or preventive procedures have been performed. Therefore the generally accepted standard is to utilize a tuberculocidal disinfectant. To simplify the process, many products are classified as cleaner/disinfectants, which is another important characteristic when making product selections. This means that the one product can be used for both pre-cleaning and disinfecting.

In addition, the CDC guidelines and OSHA Bloodborne Pathogens Standard recommend the use of EPA-registered, hospital-grade disinfectants, whose manufacturers must provide data to the EPA that proves the efficacy of the product against any pathogens listed on the product label. If a product does not make a label claim that it is tuberculocidal, it may not be appropriate to be used in health-care settings, but may be appropriate in other settings. Products can be searched in the EPA database at www.epa.gov/pesticides/antimicrobials/chemregindex.hem.

Figure 1 illustrates the resistance of microorganisms to various disinfecting chemicals.

FIGURE. Decreasing order of resistance of microorganisms to germicidal chemicals

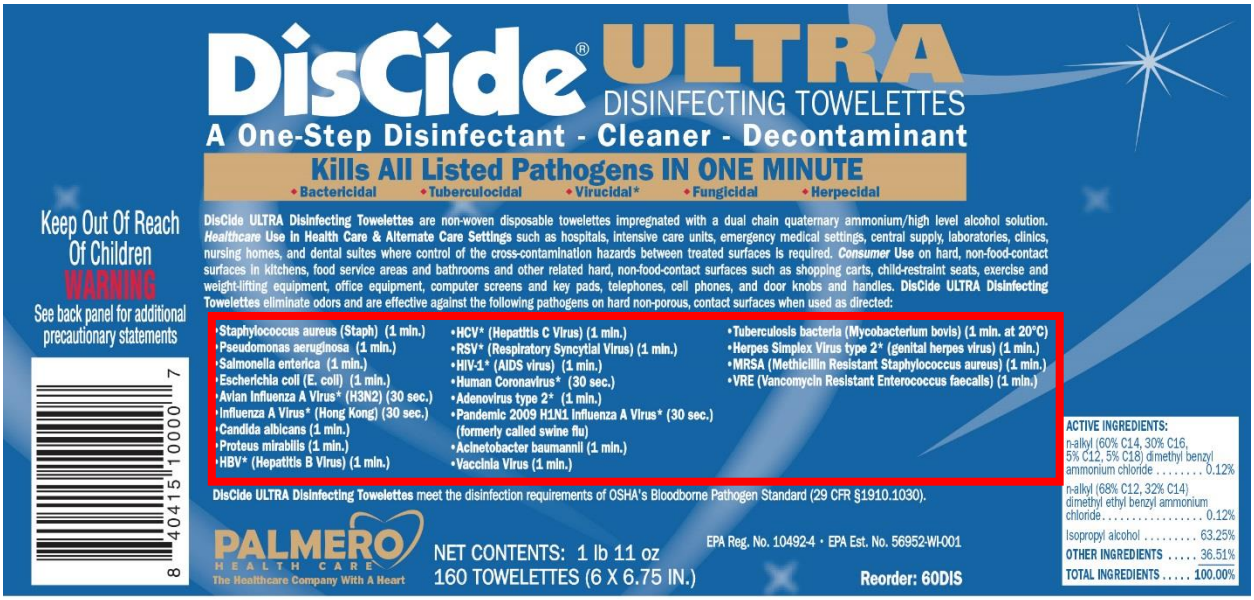


Source: Adapted from Bond WW, Ott BJ, Franke K, McCracken JE. Effective use of liquid chemical germicides on medical devices; instrument design problems. In: Block SS, ed. Disinfection, sterilization and preservation. 4th ed. Philadelphia, PA: Lea & Gebiger, 1991:1100.

When reading labels on surface disinfectants, it is important not only to note whether the product claims to be a tuberculocidal disinfectant, but also the other microorganisms listed on the label. Labels

typically state on the front of the product that it is tuberculocidal, bactericidal, virucidal, and fungicidal. The label should specify the microorganisms that the product is effective against. Some labels make it easier to identify the microorganisms and their kill time versus other labels. Figure 2 shows an example of a product label that lists the microorganisms and kill times visibly, making it readily available without searching the entire label for the information.

Figure 2



It is extremely important for the end users of disinfecting products to do their due diligence when selecting surface disinfectants. The first step is to be sure that the correct disinfectant is being used to get the desired results, in other words, matching the disinfectant to the task. It is also critical to confirm that the disinfectant being used has passed the testing criteria with the Environmental Protection Agency (EPA). In some instances, products may be distributed that have not passed the testing criteria. This information is easily accessible from the EPA website. The link for information regarding hospital grade and tuberculocidal disinfectants is www.epa.gov/oppad001/atp-product-list.pdf. The link for information regarding disinfectants for use against Ebola Virus is www.epa/opp001/list-l-ebola-

virus.html. The EPA is an excellent resource for validating the effectiveness of products, and to reinforce that the product being used meets the OSHA and CDC criteria for both employee and patient safety.

Applying Surface Disinfectants

From the early days of compliance with the Bloodborne Pathogens Standard and the 1993 CDC Guidelines for Infection Control in Dentistry, health-care professionals were advised to use a spray-wipe-spray method to clean and disinfect surfaces. The first spray and subsequent wipe was for pre-cleaning a surface to remove blood and other debris that might prevent the solution from penetrating onto the surface to be disinfected. The second spray application was the disinfecting procedure. After many years of utilizing this protocol, dental health-care workers began to develop respiratory problems from continuous exposure to these products, and the CDC no longer recommends the spray-wipe-spray technique.[iii,iv]

In addition, OSHA, in conjunction with the National Institute for Safety and Health (NIOSH), has recently published an info sheet and poster that explain the potential hazards to workers who use cleaning and disinfecting chemicals.[v,vi] The 2003 CDC guidelines recommend that surfaces be cleaned, then disinfected. This can easily be accomplished by wiping surfaces twice with a disinfectant. The first wipe is for pre-cleaning and the second for disinfecting. However, a new wipe must be used for each step.

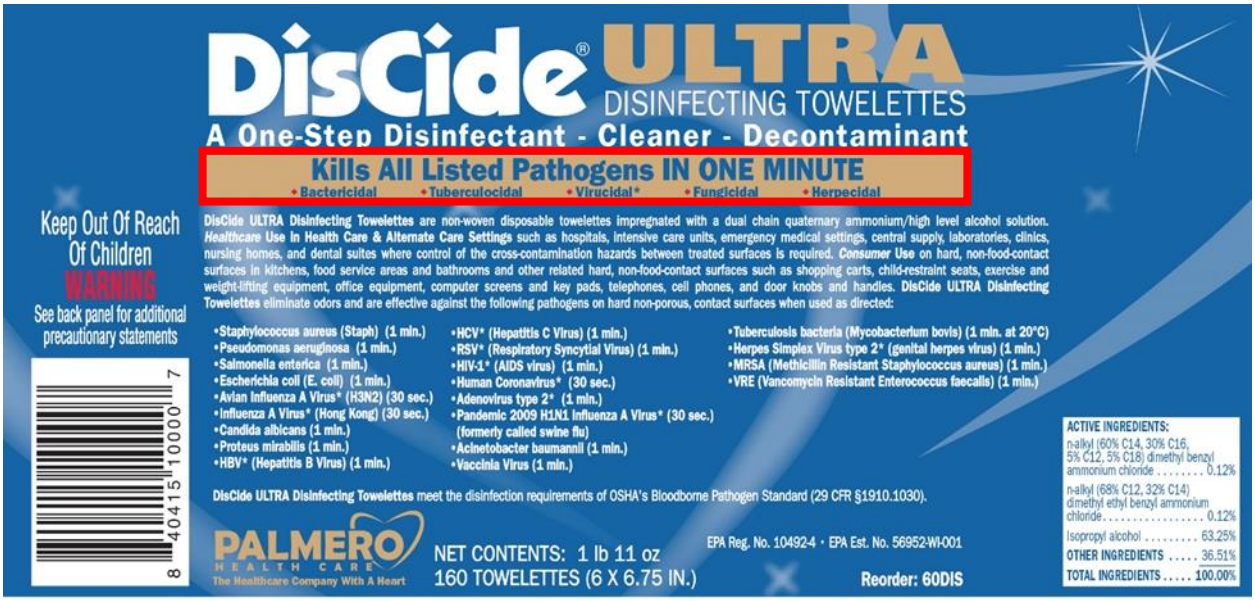
It is important to note that if a disinfectant wipe is the product of choice, ensure that it has been tested for efficacy in that format, just as a spray product has been tested for efficacy when applied from the spray bottle. Sometimes health-care personnel will use a spray disinfectant inappropriately, as in they pour the solution over gauze squares in a container to make their own wipes. This is considered an off-label use of the product and it has not been tested for efficacy in this manner. Not only is there the possibility of putting patients at risk, there is potential for liability and/or regulatory citations if there happens to be an infectious disease outbreak and disinfectants were not being utilized properly. Gauze

should be saturated with disinfectant at the time of use and not stored in containers since the fibers in the gauze can inactivate the disinfectant through chemical reactions and/or the fibers binding up the active ingredients.

Instructions for Use of Disinfectants

The disinfectant label has a great deal of important information beyond the list of microorganisms the product is effective against. The application instructions are included on the label, as well as the contact time necessary for the product to be effective against certain microorganisms. Most disinfectants have a contact time between 1 minute and 10 minutes. But users must be aware of the kill time for TB, which is usually (but not always) longer than 1 minute. The kill time for some viruses, such as HIV, may be one minute, but the TB kill time may be 3 to 10 minutes, depending on the product.

The appropriate contact time to be used in health-care settings is the listed TB kill time for a product. This means that after cleaning a surface and reapplying the disinfectant, the surface must remain wet (though not drenched) with the product for the appropriate time listed on the label. Health-care professionals and workers using surface disinfectants are rightly concerned with the efficiency of using various products and in many cases make product choices based on the shortest contact time listed. Always consult the product label and instructions for use and for information regarding application and contact times. Figure 3 illustrates contact times as listed on a product label.



Other pertinent information regarding the use of disinfectants is to be aware that mixing different chemistries (products or formulas) together can alter the effectiveness of a product. This could be two entirely different products from different manufacturers, or products from the same manufacturer. Even within the same product family the spray formula may differ in its composition from the wipe formula. Although it seems logical to assume that both products under the same brand name are the same, they may not be. Mixing chemistries or formulas can cause staining or a film on surfaces or hazardous chemical reactions, making the products ineffective. Therefore it is important to know when researching products if the same formulation is used for the entire product line. Some products, such as DisCide, have the same formula for spray and wipes. Again, always consult the label and instructions for use of disinfectant products.

When changing from one type or brand of disinfectant to another, all surfaces should be thoroughly cleaned with soap and water to remove any residue left from the previous disinfectant. If surfaces are not cleaned prior to using a different product, staining and film build-up can occur, as well as unpleasant odors from the reaction of the different products.

The Cost Factor

As stated previously, health-care and other facilities have legitimate concerns regarding the costs associated with infection control protocols. Not only is the cost of the product itself a factor, so is the time required for the product to be effective, which affects turnaround of treatment rooms or other areas that need to be cleaned and disinfected between patients. Obviously the shorter the contact time required for a product to be effective, the shorter the turnaround time. The dispensing method – liquid/spray bottle or wipe – for the product may affect the turnaround time as well. For example, using pre-moistened wipes requires less time to clean and disinfect surfaces than dispensing solution from a spray bottle onto a gauze or paper towel. If the wipes are more efficient to use, then their higher cost is offset by shorter cleanup time and the ability to serve more patients in the same amount of time.

Environmental Safety and Surface Disinfectants

The safety issues regarding spraying surface disinfectants were discussed earlier in this article. Other issues affecting the environment for workers using surface disinfectants include the possibility for skin irritation, especially to the hands, when not using the recommended (and OSHA-required) PPE. This will vary from product to product and will be included on the label or Safety Data Sheet (SDS). Some products recommend the use of utility gloves, while others recommend the use of exam gloves. Still others do not recommend hand protection, which applies only to exposure to the product. Since the products are used on contaminated surfaces, gloves must still be worn to protect workers from any microbial contamination on equipment or surfaces.

Although not recommended, if a spray disinfectant is used, workers should always wear respiratory protection (face mask) and eye protection (safety glasses or goggles) to prevent inhalation or splashing of solution into the eyes, nose, or mouth. Keep in mind that although a worker spraying surface

disinfectant may be wearing the appropriate PPE, other workers may not be, and patients or clients certainly will not be, and they can be exposed to these chemicals as well.

Over time, disinfecting solutions can build up on surfaces. Equipment and counter tops should be cleaned with soap and water regularly to remove this build up. In addition, disinfectants with a high alcohol content can cause drying and cracking of equipment, especially to upholstery on dental chairs. There are products on the market to protect upholstery, such as TopCat Chair Guard, which can be applied to chairs, and protective barriers can also be used on chairs.

Summary

As required by the OSHA Bloodborne Pathogens standard, written protocols must be developed for each work setting for cleaning and disinfecting contaminated surfaces and equipment. The protocols should be easy to follow, and each employee must be aware of the protocols. Part of the protocol should be a list of criteria for selecting the most appropriate product(s), depending on the work setting, and the microorganisms that may be present on surfaces and/or equipment. All employees should be trained on the disinfecting and other patient or client safety protocols, as well as other workplace or engineering controls to protect them from disease transmission while doing their jobs. Training updates should take place whenever there is a breach in the protocol to prevent it from recurring, and on an annual basis, as required by OSHA.

Disinfectant use plays a critical role in the control if infectious diseases. Great care should be taken when selecting products to ensure the safety of workers, patients, and clients.

[i] Occupational Health and Safety Administration, 29 CFR 1910.1030, Bloodborne Pathogen Standard, Dec. 6, 1991

[ii] Joint Commission on Accreditation of Health Care Organizations, 2015, Standards for Ambulatory Care
[iii] Centers for Disease Control and Prevention, Guidelines for Infection Control in Dental Health-Care Settings, 2003
[iv] Occupational and Environmental Medicine. 2011 Dec;68(12):914-9
[v] Occupational Safety and Health Administration, https://www.osha.gov/Publications/OSHA3512.pdf

[vi] Occupational Health and Safety Administration, https://www.osha.gov/Publications/3511-CleanChemPoster.pdf