Principles and Techniques of Disinfection

Chapter 20
Learning Objectives
Lesson 20.1: Principles and Techniques of Disinfection

1. Pronounce, define, and spell the key terms.
2. Discuss environmental infection control of clinical contact surfaces, including the following:
   - Explain why dental treatment room surfaces need barriers or disinfection.
   - Describe two methods to deal with surface contamination.
   - Demonstrate how to place and remove surface barriers.
   - Describe the CDC guidelines for disinfecting clinical contact surfaces.
   - List the types of surfaces in the dental office that are typically covered with barriers.
3. Name types of items that are single-use only and types of items that are single-use or reusable.
Learning Objectives
Lesson 20.1: Principles and Techniques of Disinfection (Cont.)

4. Discuss precleaning and disinfection, including the following:
   - Explain the process of precleaning contaminated dental instruments.
   - Explain the difference between disinfection and sterilization.
   - Explain the difference between a disinfectant and an antiseptic.
   - Name the government agency that is responsible for registering disinfectants.
   - Explain the precautions that should be taken when chemical sterilants/disinfectants are used.
   - Identify chemical products used for intermediate-level and low-level surface disinfection, and explain the advantages and disadvantages of each.
   - Demonstrate the process of cleaning and disinfecting a treatment room.
5. Discuss how use of a high-volume evacuation system reduces contamination of the dental team and clinical surfaces.
6. Describe the CDC guidelines for disinfecting housekeeping surfaces.
7. Discuss green infection control measures that can be taken in the dental office.
Introduction

- During patient treatment, surfaces in equipment and treatment rooms are likely to become contaminated with saliva or by aerosol containing blood, saliva, or both.
- Laboratory studies have shown that microorganisms may survive on environmental surfaces for varying periods.
- Assume that if a surface has had contact with saliva, blood, or other potentially infectious materials, it contains live microorganisms.
Environmental Infection Control

- The Centers for Disease Control and Prevention (CDC) *Guidelines for Infection Control in Dental Healthcare Settings*—2003 divide environmental surfaces into clinical contact surfaces and housekeeping surfaces.
- Housekeeping surfaces include floors, walls, and sinks.
  - Because they have a much lower risk of disease transmission, cleaning and decontamination are not as rigorous as that for clinical areas and patient treatment items.
Cleaning and Disinfecting Considerations

- Amount of direct patient contact
- Type and frequency of hand contact
- Potential amount of contamination by aerosol and spray
- Other sources of microorganisms (e.g., dust, soil, and water)
Clinical Contact Surfaces

- Can be directly contaminated either by spray or spatter generated during dental procedures or by contact with dental professional’s gloved hands
- Current infection control guidelines of the Office Safety and Asepsis Procedures Research Foundation (OSAP) recommend that clinical surfaces be classified and maintained under three categories:
  - Touch
  - Transfer
  - Splash, spatter, and droplet
Clinical Contact Surfaces (Cont.)

- **Touch surfaces** are directly touched and contaminated during treatment procedures
  - Include handles of dental lights, controls of dental units, chair switches, chairside computers, pens, telephones, containers of dental materials, and drawer handles
- **Transfer surfaces** are not directly touched but often are touched with contaminated instruments
  - Include instrument trays and handpiece holders
- **Splash, spatter, and droplet surfaces** do not actually come into contact with the members of the dental team or the contaminated instruments or supplies
  - Countertops are a major example
Clinical Surfaces
Surface Contamination

- There are two methods of dealing with surface contamination:
  - Surface barriers
  - Precleaning and disinfecting surfaces between patients
Surface Barriers

- Wide variety of surface barriers available today
- Should be resistant to fluids to keep microorganisms in saliva, blood, or other liquids from soaking through to the surface underneath
- Some plastic bags are designed in the shape of items such as the dental chair, air-water syringe, hoses, pens, and light handles
- Plastic barrier tape is frequently used to protect smooth surfaces (e.g., touch pads on equipment, electrical switches on chairs, and x-ray equipment)
  - Aluminum foil can also be used because it is easily formed around any shape
Water on a Fluid-Resistant Material

Courtesy Crosstex, Hauppauge, NY.
Tube Socks

Courtesy Certol, Commerce City, CO.
Single-Use (Disposable) Items

- Used on only one patient and then discarded, so they help reduce the chance for patient-to-patient contamination
- Single-use items are often made of plastic or less expensive metals, and they are not intended to withstand cleaning, disinfection, or sterilization
- Never process (clean, disinfect/sterilize) single-use items for use on another patient
Single-Use (Disposable) Items (Cont.)

- In most areas, contaminated disposable items that are not sharps and are not soaked or caked with blood may be discarded with the regular office trash.
- There is no need to discard these items in a medical waste or biohazard container.
- State and local regulations may vary, so always consult the regulatory agency for your area.
Precleaning and Disinfection

- Although no cases of cross-infection have been linked to dental treatment room surfaces, cleaning and disinfection of these surfaces are important components of an effective infection control program.
- In addition, the OSHA Blood-Borne Pathogens Standard requires that contaminated work surfaces be disinfected between patient visits.
Precleaning

- **Precleaning** means to clean before disinfecting
- All contaminated surfaces must be precleaned before they can be disinfected
- Even if there is no visible blood on a surface, it must be precleaned because even a thin layer of saliva on the surface can decrease the effectiveness of the disinfectant
- Precleaning reduces the number of microbes and removes blood and saliva (also called *bioburden*)
Precleaning (Cont.)

- These techniques are most effective when used on contaminated surfaces that are smooth and easily accessible for cleaning.
- Always wear utility gloves, mask, protective eyewear, and protective clothing when precleaning and disinfecting.
- Surfaces that are irregular or textured are difficult or impossible to clean, thereby making them difficult to disinfect as well.
- Regular soap and water may be used to preclean, but it is more efficient to select a disinfectant that can be used to clean as well as disinfect.
Disinfection

- Intended to kill disease-producing microorganisms that remain on the surface after precleaning
- Spores are not killed during disinfecting procedures
- Do not confuse disinfection with sterilization
- Sterilization is a process in which all forms of life are destroyed
Disinfectants

- Chemicals that are applied to inanimate surfaces (e.g., countertops and dental equipment)
- Antiseptics are antimicrobial agents that are applied to living tissue
- Disinfectants and antiseptics should never be used interchangeably because tissue toxicity and damage to equipment can result
Disinfectants (Cont.)

- Disinfectants are chemicals that destroy or inactivate most species of pathogenic (disease-causing) microorganisms.
- In dentistry, only those products that are EPA-registered hospital disinfectants with tuberculocidal (kills the tuberculosis bacteria) claims should be used to disinfect dental treatment areas.
- *Mycobacterium tuberculosis* is highly resistant to disinfectants, and if a disinfectant will inactivate *M. tuberculosis* it will most certainly inactivate the less resistant microbial families (e.g., bacteria, viruses, and most fungi) on the treated surface.
Ideal Surface Disinfectant

- An ideal surface disinfectant would:
  - Rapidly kill a broad spectrum of bacteria
  - Have residual activity and minimal toxicity
  - Not damage the surfaces to be treated
  - Be odorless and inexpensive
  - Work on surfaces with remaining bioburden
  - Be simple to use

- No single disinfectant product on the market today meets all these criteria

- When selecting a surface disinfectant, you must carefully consider the advantages and disadvantages of various products
Disinfectant Precautions

- Follow manufacturers’ recommendations for:
  - Mixing and diluting
  - Application technique
  - Shelf life
  - Activated use life
  - All safety warnings
# Disinfecting/Sterilizing Chemicals

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
<th>Examples</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sterilant*</td>
<td>Destroys all microorganisms, including high numbers of bacterial spores</td>
<td>Glutaraldehyde, glutaraldehyde phenate, hydrogen peroxide, hydrogen peroxide with peracetic acid, peracetic acid</td>
<td>Heat-sensitive reusable items: immersion only</td>
</tr>
<tr>
<td>High-level disinfectant*</td>
<td>Destroys all microorganisms, but not necessarily high numbers of bacterial spores</td>
<td>Glutaraldehyde, glutaraldehyde phenate, hydrogen peroxide, hydrogen peroxide with peracetic acid, peracetic acid, orthophthalaldehyde</td>
<td>Heat-sensitive reusable items: immersion only</td>
</tr>
<tr>
<td>Intermediate-level disinfectant</td>
<td>Destroys vegetative bacteria, most fungi, and most viruses; inactivates <em>Mycobacterium tuberculosis</em> var. <em>bovis</em> (is tuberculocidal)</td>
<td>EPA-registered hospital disinfectant† with label claim of tuberculocidal activity (e.g., chlorine-based products, phenolics, iodophors, hydrogen peroxide, quaternary ammonium compounds with alcohol, bromides)</td>
<td>Clinical contact surfaces; noncritical surfaces with visible blood</td>
</tr>
<tr>
<td>Low-level disinfectant</td>
<td>Destroys vegetative bacteria, some fungi, and some viruses; does not inactivate <em>M. tuberculosis</em> var. <em>bovis</em> (is not tuberculocidal)</td>
<td>EPA-registered hospital disinfectant with no label claim of tuberculocidal activity (e.g., quaternary ammonium compounds)</td>
<td>Housekeeping surfaces (e.g., floors, walls); noncritical surfaces without visible blood; clinical contact surfaces‡</td>
</tr>
</tbody>
</table>

*Some, but not all, of these products can serve as high-level disinfectants and sterilants depending on the immersion time used.

†A hospital disinfectant is one that has been shown to kill *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Salmonella choleraesuis*.

‡The Centers for Disease Control and Prevention indicates that low-level disinfectants can be used on clinical contact surfaces if the product has a label claim of killing human immunodeficiency virus (HIV) and hepatitis B virus (HEV) in addition to being an EPA-registered hospital disinfectant.

Iodophors

- EPA-registered intermediate-level hospital disinfectants with tuberculocidal action
  - Because iodophors contain iodine, they may corrode or discolor certain metals and may temporarily cause reddish or yellow stains on clothing and other surfaces
Synthetic Phenol Compounds

- EPA-registered intermediate-level hospital disinfectants with broad-spectrum disinfecting action
- Phenols can be used on metal, glass, rubber, or plastic
- May also be used as a holding solution for instruments; however, phenols leave a residual film on treated surfaces
- Synthetic phenol compound is prepared daily
Synthetic Phenol Disinfectant

Courtesy Certol, Commerce City, CO.
Sodium Hypochlorite

- Sodium hypochlorite (household bleach) is a fast-acting, economical, and broad-spectrum intermediate-level disinfectant (1:100 dilution for surface decontamination)
  - Bleach solution is unstable, must be prepared daily, has a strong odor, and is corrosive to some metals, destructive to fabrics, and irritating to the eyes and skin; it may eventually cause plastic chair covers to crack
Alcohol

- Alcohols are not effective in the presence of blood and saliva
- Evaporate quickly and are damaging to certain materials such as plastics and vinyl
- Not recommended as a surface disinfectant by several agencies
Immersion Disinfectants

- Some chemicals on the market can be used for sterilization or high-level disinfection
- When used as sterilants, they destroy all microbial life, including bacterial endospores
- Depending on the type, time for sterilization can range from 6 hours to 30 hours
- At weaker dilutions or with shorter contact time, these chemicals provide high-level disinfection, inactivating all microorganisms except endospores
- Most of these chemicals are toxic and can irritate the eyes, skin, and lungs
- PPE must be worn when these chemicals are used
Covered Instrument Tray

Courtesy Zirc Company, Buffalo, MN.
Glutaraldehyde Immersion Disinfectant

- Classified as a high-level disinfectant/sterilant; can also be used as a liquid sterilant when immersion time is greatly increased
- Useful for plastics and other items that cannot withstand heat sterilization
- Very toxic and should be handled carefully to avoid the fumes
- Glutaraldehyde-treated instruments should never be used on patients without first being thoroughly rinsed with water
- Prolonged contact of certain types of instruments with glutaraldehyde solutions can lead to discoloration and corrosion of the instruments’ surfaces and cutting edges
Chlorine Dioxide Immersion Disinfectant

- Chlorine dioxide is an effective, rapid-acting environmental surface disinfectant (3 minutes) or chemical sterilant (6 hours)
- Chlorine dioxide does not readily penetrate organic debris and must be used with a separate cleaner
- Chlorine dioxide must be prepared fresh daily, it must be used with good ventilation, and it is corrosive to aluminum containers
Ortho-Phthalaldehyde Immersion Disinfectant (OPA)

- Classified as a high-level disinfectant
- OPA is effective in achieving high-level disinfection within 12 minutes at room temperature
- More expensive than glutaraldehydes but may be a good alternative for individuals with a sensitivity to glutaraldehydes
- It has very little odor and does not require activation or mixing
Ortho-Phthalaldehyde Disadvantages

- Costly
- Can be used only half as long as most glutaraldehydes in dentistry
- May stain skin and fabrics
- Plastics turn a blue-green color where proteins have not been removed
- Would require more than 30 hours to secure sterilization
Evacuator System

- High-volume evacuation reduces the risk of saliva escaping from patients’ mouths
- Regular cleanings help tubes and pipes flow easier
  - Clean by flushing with detergent or water
- Periodically clean the traps
Housekeeping Surfaces

- No scientific evidence showing that housekeeping surfaces (e.g., floors, walls, and sinks) pose a risk for disease transmission in dental healthcare settings.
- Majority of housekeeping surfaces need to be cleaned only with a detergent and water or an EPA-registered hospital disinfectant/detergent.
- However, used solutions of detergents or disinfectants—especially if prepared in dirty containers, stored for long periods of time, or prepared incorrectly—may be reservoirs for microorganisms.
- Make fresh cleaning solution each day; discard any remaining solution and let the container dry to minimize bacterial contamination.
Carpeting and Cloth Furnishings

- Carpeting is more difficult to clean than is nonporous hard-surface flooring, and it cannot be reliably disinfected, especially after contamination with blood and other body substances.
- Studies have documented the presence of bacteria and fungi in carpeting.
- Cloth furnishings pose similar contamination risks in areas where direct patient care is performed and where contaminated materials are handled.
- CDC guideline: Avoid using carpeting and cloth-upholstered furnishings in dental operatories, laboratories, and instrument processing areas.
Spills of Blood and Body Substances

- The majority of blood contamination in dentistry results from spatter and the use of rotary or ultrasonic instruments.
- No scientific evidence shows that HIV, HBV, or HCV has been transmitted from a housekeeping surface.
- OSHA requires that blood spills and other body fluids be removed and the surfaces disinfected.
- CDC guideline: Clean spills of blood or other potentially infectious materials and decontaminate the surface with an EPA-registered hospital disinfectant with low-level to intermediate activity, depending on the size of the spill and the surface porosity.
Greener Infection Control

- Protecting the environment has become an important part of our personal lives and in our homes
- That responsibility extends to the provision of dental care
- Many of the infection control products and procedures we must use to protect our patients and ourselves have a negative impact on the environment
Greener Infection Control (Cont.)

- By altering a process or a material, it is possible to minimize a potentially negative impact on the environment.
- For example, using disinfectant wipes instead of spraying disinfectants could reduce the amount of chemicals in the air.
- Going greener requires thoughtful planning, research, and experimentation.
Greener Infection Control (Cont.)

- **Paper**
  - Digital patient records could have a significant impact on the amount of paper that is used.

- **Radiology**
  - Digital radiology is rapidly becoming state-of-the-art.

- **Personal protective attire**
  - Protective barriers present a challenge in the attempt to go greener; some are recyclable.

- **Surface barriers and precleaning/disinfection**
  - Involves the use of chemicals and PPE.
Questions?