CRCST SELF-STUDY LESSON PLAN
Lesson No. CRCST 175 (Technical Continuing Education - TCE)

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3M Health Care

Sterilization in Dental Settings: Tools to Achieve and Provide Optimal Standard of Care

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LEARNING OBJECTIVES
1. Understand the meaning of "chain of infection"
2. Discuss key concepts related to device reprocessing in dental clinics
3. Describe steam sterilization monitoring tools

Sterilization within a dental clinic poses different challenges than those faced in a hospital setting. Challenges include smaller instruments, which can harbor residue; smaller sterilizer chambers; and the storage of sterile items in small cabinets and drawers. This lesson offers an overview of the numerous techniques dental professionals need to be aware of when implementing infection prevention strategies in their dental clinics - specifically those related to the sterilization of critical devices.

Objective 1: Understanding the meaning of "chain of infection"

Infections occur daily, ranging from small colds or the flu to more complex pathogens that infect millions of people. Although some pathogens cause just a minor hiccup within the immune system, others can be rather complex; however, for a person to be infected initially, a series of events must occur. These events are often described as the "chain of infection." For dental health care providers (DHCP), understanding the chain of infection and the standard precautions needed to reduce risk is critical for reducing patient-to-patient disease transmission, as well as keeping the practitioner safe.

For a person to become infected, a transmission must occur. An infection takes place when a pathogen leaves the reservoir or host through a portal of exit. This must be followed by a mode of transmission, which enables the pathogen to enter through a portal of entry of a susceptible host.

There are four different modes of transmission that could place the patient at risk of contracting disease. These include direct contact with blood, tissues or bodily fluids; indirect contact with contaminated objects; droplet contact with mucous membranes, eyes, nose or mouth through aerosol generation by an infected individual; or inhalation of airborne microorganisms. If just one of the elements is removed

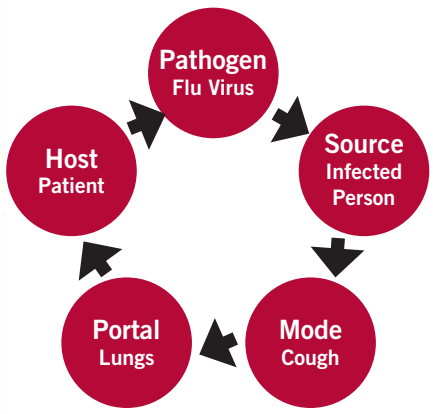

Figure 1: Example Chain of Infection

within the singular process, the chain of infection is broken. That is why it is so important to always investigate how infections are transmitted to the patient. Failure to ensure all necessary steps have been taken to clean and sterilize reusable dental instruments increases the risk of disease transmission.

Protocols for early detection and management of risk related to the dental appointment include several standard precautions. Some of them include hand hygiene and personal protective equipment (PPE), as well as dental unit water quality. This lesson focuses on the sterilization and disinfection of patient care items and devices.[1]

Objective 2: Discuss key concepts related to device reprocessing in dental clinics

Device reprocessing is a major component of safe care and involves multiple steps that must be performed correctly. In order to determine how to properly reprocess devices, instruments are divided into three categories based on their expected use. These categories are critical, semi-critical and non-critical:

- Critical items are devices that enter sterile tissue or the vascular system. Critical items must be sterilized. Examples of critical items include:
  - » Surgical instruments;
  - » Implants;
  - » Needles; and
  - » Dental items such as drills and periodontal instruments.

- Semi-critical item are devices that touch mucous membranes or nonintact skin. Semi-critical items must be high-level disinfected or sterilized. Examples of semi-critical items include:
  - » Anesthesia equipment;
  - » Laryngoscopes;
  - » Syringes; and
  - » Dental items such as curing lights and impression trays.

- Non-critical items come in contact with intact skin but not mucous membranes. Non-critical items need low-or intermediate level disinfection. Non-critical items include:
  - » Thermometers and stethoscopes; and
  - » Dental items such as light handles, X-ray equipment and chairside computers.

Most items used in dentistry are either critical or semi-critical.

Cleaning is defined as the removal of visible and non-visible soil. This is achieved using enzymatic cleaners and detergents. Enzymes break down the soil while the detergents remove the soil from the surface of the instrument. After manual cleaning, devices are usually placed inside a washer-disinfector or an ultrasonic cleaner following manufacturer's instructions for use (IFU).

After cleaning, microbial contamination on the instrument surface has been reduced; however, the instruments may still pose a risk to patients and clinicians.

Disinfection is the process that deactivates microorganisms to certain safety levels. Disinfection is less lethal than sterilization and does not kill all bacterial spores. While disinfection is appropriate for items that touch intact skin, it is not appropriate for critical items like reusable instruments.

The highest level of safety is provided by sterilization, which inactivates all microorganisms, including bacterial spores. To minimize patient-to-patient disease transmission, sterilization of critical items is required.

Steam sterilization in dental offices

Most dental offices rely on table-top steam sterilizers. Every method of sterilization has critical variables that are necessary to achieve an effective sterilization process. For steam sterilization, those variables are time, temperature, and the presence of saturated steam. If any one of these variables is missing, then the cycle will not be effective, and the devices may not be sterile.

Time is one critical variable that rarely changes. For the most part, it is not of great concern, unless time controls are manual, which is rare in most sterilizers today.

Temperature may be affected by several factors, including calibration of the temperature sensors, how loads are distributed inside the chamber, how many pouches and cassettes are loaded, and what the packs contain; the heavier the pack, the higher the temperature variation may be. If temperature is lower than the one specified on the cycle, sterilization failures may occur.

Table-top sterilizers typically generate their own steam using water from an on-board reservoir (this is known as saturated steam). Steam quality begins with the water used to generate the steam - the better the water, the greater the chances of having good steam quality. The water used to fill the reservoir should

comply with the requirements outlined in the manufacturer's manual for the steam sterilizer.

The sterilization cycles usually begin with the removal of air inside the chamber and from pouches and cassettes. Different sterilizers use different methods to remove residual air. There are two major categories: gravity displacement and dynamic air removal.

Gravity air displacement occurs when steam enters the top of the chamber and displaces air from top to bottom.

Dynamic air removal has two subcategories: pre-vacuum and steam flush pressure pulse (SFPP).

- Pre-vacuum systems generate a series of vacuum pulses to pull out air. This process is repeated several times.
- SFPP systems rely on a series of positive pressure steam pulses followed by gravity flushes. The chamber pressure never drops below atmospheric pressure.

Today, the most common method of steam sterilization in the dental setting is dynamic air removal; in particular, SFPP. It is important to know the cycle type on the sterilizer as this affects which monitoring tools can be used, but more importantly, the ability to process instruments per the manufacturer's IFU.

Following decontamination, both instruments and cassettes should be inspected for potential residue or water. While preparing pouches and cassettes, an internal chemical indicator should be placed inside each package. Both pouches and cassettes should also be labeled with the content name, date, the sterilizer and cycle number, and the person responsible for preparing the item. If more than one sterilizer is used in the same clinic, the sterilizer should be numbered for easy identification. Item labeling should be detailed enough to execute a recall, should it ever be necessary.

Once inspected and packaged, items are ready to be loaded into the sterilizer. When loading the sterilizer, consider the following precautions:

- Avoid overloading the chamber;
- Leave at least 1" of space between pouches and cassettes; and
- If peel pouches are used, make sure each pouch is loaded on its side, with the plastic side facing the paper side of the next pouch.

After the cycle has completed, it is important to wait for the pouches and cassettes to cool down before storage. Packs can be extremely hot and storing hot instruments can facilitate condensation, which may result in packages becoming wet; this results in a contaminated package in the storage area.

Objective 3: Describe steam sterilization monitoring tools

Sterilization is a rather unique process as success cannot be observed directly; therefore, assurance is needed that the cycle went as expected to reduce the risk that patients are exposed to non-sterile instruments. There are several monitoring tools that, when used in the right fashion and frequency, will provide the information needed for safe load release.

When looking to implement instrument reprocessing and sterilization strategies, multiple guidelines have been developed for successful execution. The American National Standards Institute and the Association for the Advancement of Medical Instrumentation's ANSI/AAMI ST79:2017 *Comprehensive guide to steam sterilization and sterility assurance in health care facilities* have developed standards for successful sterilization. This standard provides an in-depth overview of the key elements of reprocessing devices.

These recommendations emphasize the importance of a thorough quality control program, including the use of sterilization monitoring tools at a specified frequency. The tools listed below are part of the infection prevention strategy and are the cornerstone of a successful instrument reprocessing quality management system:

- Physical monitors;
- Chemical indicators (CIs); and
- Biological indicators (BIs).

Physical monitors record the parameters of temperature, pressure and time inside the steam sterilizer by means of printer tape or digital display. This information can be used later to identify the root cause of cycle failures, such as positive BIs or wet packs.

CIs are used to monitor the presence or attainment of one or more of the parameters required for a satisfactory sterilization process or used in specific tests of sterilization equipment. There are three main categories:

- External CIs, also known as Type 1: According to ANSI/AAMI ST79: 2017, these should be used outside every package (unless the internal CI is visible). They indicate if the pack has been exposed to steam by providing a visual change of color.
- Air removal test, also known as Type 2 or Bowie-Dick Test: This is used to assess the ability of the pre-vac steam sterilizers to remove air. ANSI/AAMI ST79: 2017 recommends testing the sterilizers every day with a Bowie-Dick test pack.
- Internal CIs, also known as Type 3, 4, 5 and 6: As the name implies, these are placed inside each pouch or cassette to assist with the detection

of potential sterilization failures, by monitoring one or more critical variables. ANSI/AAMI ST79: 2017 recommends the preferred use of a Type 5 or Type 6 internal CI.

BIs are sterilization process monitoring devices that provide a direct measure of lethality, which is related to the ability of the cycle to inactivate microorganisms including bacterial spores. BIs contain viable bacterial spores. For steam sterilization, BIs contain *Geobacillus stearothermophilus*, which is highly resistant to the sterilization process. The rationale behind the use of BIs is that if these bacterial spores are inactivated, there is a high probability that any less-resistant bacteria on cleaned instruments would be inactivated.

ANSI/AAMI ST79: 2017 recommends monitoring with a BI weekly, preferably daily. Additionally, any sterilization loads containing implantable devices should be monitored with a BI and the load quarantined until the result is available. Consult with the sterilizer and BI manufacturers to ensure the BI is suitable for the table-top sterilizer cycle(s) being tested.

The two main formats for BIs are spore strips and self-contained BIs.

- Self-contained BIs consist of spores on a carrier and an ampoule of growth media both contained in an outer plastic sleeve. After sterilization, the BI is activated and incubated in office at the appropriate temperature. Depending on the technology used, results are available between 24 minutes and 48 hours.
- Spore strips consisting of spores loaded onto a paper strip and protected by a paper envelope are also available; however due to the length of time required for incubation (three to seven days), this type of monitor is rarely used.

Growth of bacterial spores (a positive BI result) indicates a failure in the sterilization cycle. A negative BI result (meaning inactivation of bacterial spores) indicates a successful sterilization cycle.

The use of these monitoring tools is essential for quality assurance and patient safety.

Conclusion

A basic infection prevention program within a dental setting must include a thorough understanding of the factors affecting the chain of infection and how breaking the chain can help prevent the spread of infection.

While sterilization is a complex process, understanding the most important device reprocessing concepts and how sterilizers work will help in the implementation of a successful sterility assurance program. The use of sterilization monitoring tools recommended by professional organizations and governmental agencies is essential for complying with infection prevention protocols.

RESOURCES

1. Centers for Disease Control and Prevention. Summary of infection prevention practices in dental settings. 2016.

2. ANSI/AAMI ST79:2017 *Comprehensive guide to steam sterilization and sterility assurance in health care facilities.*

3. Organization for Safety Asepsis and Prevention/DentaQuest Partnership. *Best Practices for infection control in dental clinics during the COVID-19 pandemic*. 2019.

4. Centers for Disease Control and Prevention. *Infection Prevention Checklist for Dental Settings*. 2016.

5. Centers for Disease Control and Prevention. *Guidelines for Infection Control in Dental Health Care Settings*. 2003.

CRCST Self-Study Lesson Plan Quiz - Sterilization in Dental Settings: Tools to Achieve and Provide Optimal Standard of Care

Lesson No. CRCST 175 (Technical Continuing Education - TCE) • Lesson expires November 2023

1. What is the term used to describe a series of conditions that must exist for infections to occur?
a. Chain of disease
b. Chance of infection
c. Chain of infection
d. None of the above

2. Which are considered the modes of transmission for infections?
a. Direct contact with blood
b. Droplet contact with mucous membranes
c. Indirect contact with contaminated objects
d. All the above

3. Which of the following elements would need to be eliminated to break the chain of infection?
a. Packaging of cleaned instruments
b. The use of enzymes
c. Mode of transmission
d. All the above

4. What is an example of a critical instrument?
a. Dental X-ray equipment
b. Light handles
c. Periodontal instruments
d. Chair side computer

5. What is the final reprocessing step for a critical instrument?
a. High-level disinfection
b. Sterilization
c. Low-level sterilization
d. Ultrasonic cleaning

6. In order to determine how to properly reprocess devices, instruments are divided into how many categories, based on their expected use?
a. Two
b. Five
c. Four
d. Three

7. What is the definition of a critical instrument?
a. A device that enters sterile tissue or the vascular system of a patient
b. A device that comes in contact with mucosal membrane or non-intact skin
c. A device that comes in contact with intact skin
d. A device that is decontaminated with enzymatic cleaners

8. Sterilization is defined as:
a. The removal of bacteria and virus
b. The inactivation of microorganisms, including bacterial spores
c. The removal of visual soil and blood
d. The ability to inactivate chemical indicators

9. What are the critical variables for steam sterilization to be effective?
a. Time
b. Saturated steam
c. Temperature
d. All of above

10. When loading packs into the sterilizers, a good practice would be:
a. Placing all peel packs flat
b. Checking the placement of physical monitors
c. Avoiding overloading the chamber
d. All the above

11. What type of internal chemical indicator is recommended in ANSI/AAMI ST79: 2017?
a. Type 3
b. Type 4
c. Type 5 and 6
d. Type 6

12. What type of chemical indicator is used to assess the vacuum system on pre-vac sterilizers?
a. Type 1
b. Type 2
c. Type 3
d. Type 4

13. For steam sterilization to be effective, which of the following needs to be removed from the chamber and packaged load items at the beginning of the cycle?
a. Air
b. Water
c. Steam
d. Pressure

14. Which type of monitoring tool ensures that the sterilizer is working to kill all viable microorganisms, including bacterial spores?
a. Bowie-Dick test
b. Biological indicator
c. Chemical indicator
d. Physical monitor

15. Which type of chemical indicator is located on the outside of the package, indicating it was exposed to steam?
a. Internal chemical indicators
b. Sterilizer test indicators
c. Bowie-Dick Test
d. External chemical indicators

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