Sterilization in Operative Dentistry

The process of keeping instruments clean and disposing of potential infection sources is known as dental sterilization. Dental professionals are exposed to a wide variety of microorganisms in the blood and saliva of patients, making infection control procedures important. The common goal of infection control is to eliminate or reduce the number of microbes being transferred from one person to another.

Deposition of organisms in the tissues and their growth resulting in a host reaction is called an infection. The number of organisms required to cause infection is termed the infective dose.

Factors affecting infective dose are:

- Virulence of the organism
- Susceptibility of the host
- Age, drug therapy, or pre-existing disease

Spread of infection: Microorganisms can spread from one person to another via **direct contact** (by touching soft tissues or teeth of patients), **indirect contact** (injuries with contaminated sharp instruments, needlestick injuries, or contact with contaminated equipment and surfaces), and **droplet infection** (by large particle droplets spatter which is transmitted by close contact).

Cleaning: It is the process that physically removes contamination but does not necessarily destroy microorganisms. It is a prerequisite before decontamination by disinfection or sterilization of instruments

Disinfection: It is the process of using an agent that destroys germs or other harmful microbes or inactivates them, usually referred to as chemicals that kill the growing forms (vegetative forms) but not the resistant spores of bacteria.

Antisepsis: It is the destruction of pathogenic microorganisms existing in their vegetative state on living tissue.
Sterilization: Sterilization involves any process, physical or chemical, that will destroy all forms of life, including bacteria, fungi, spores, and viruses.

Classification of sterilization
- **Physical Methods**
- **Chemical Methods**
- **Combination of both**

Physical methods include (Moist heat, Dry heat, Filtration, and Radiation) while **Chemical methods** include chemical liquids (Alcohols, Aldehydes, Halogens, and Phenols).

The infection control program in minimum dental offices includes:

1- Sterilization of instruments
2- Comprehensive medical history
3- Hepatitis B vaccine to prevent any cross infection
4- Antiseptic and mouthwash
5- Disposal face mask
6- Gloves and over-gloves
7- Protective eyewear (eye class)
8- Protective gown
9- Head cups
10- Rubber dam
11- Surface cleaning and cover tray
12- Needle and sharp instrument safety



Dental instrument classification:
Centers for Disease Control and Prevention (CDC) classified the instrument into critical, semi-critical, and noncritical, depending on the potential risk of infection during the use of these instruments.

Category	Definitions	Dental instrument or item	Type of sterilization
Critical	Penetrate soft tissue, contact bone, enters into or contacts the blood stream	Surgical instruments, periodontal scalers, scalpel blades, surgical dental burs.	HEAT STERILIZE between uses or use sterile single-use, DISPOSABLE devices
Semicritical	Contact mucous membranes or non intact skin, will not penetrate tissue, contact bone, enter into or contact blood stream.	Dental mouth mirror, amalgam condenser, reusable dental impression trays, dental handpieces	HEAT STERILIZE or HIGH-LEVEL DISINFECT
Noncritical	Contact intact skin	Radiograph head\cone, blood pressure cuff, facebow	Clean and disinfect using a LOW TO INTERMEDIATE LEVEL DISINFECTANT

Stages for instrument sterilization:

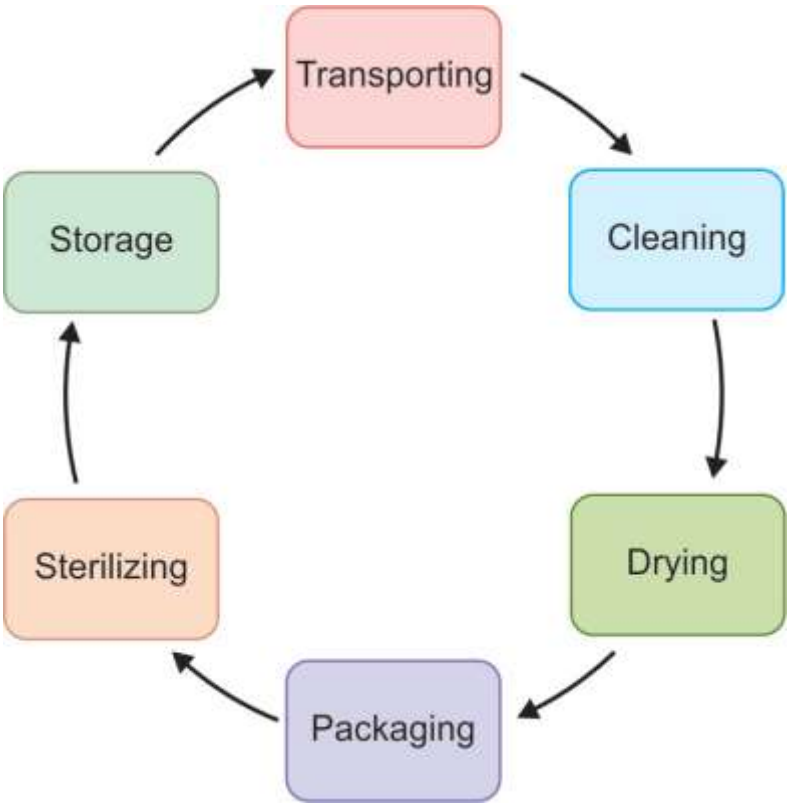
Instrument processing for sterilization is the collection of procedures that prepare the contaminated instruments for reuse. For a complete sterilization process, instruments should be processed correctly and carefully.

1- **Presoaking**: Place loose instruments in a holding solution (neutral pH detergents/water) for 30 minutes. It facilitates the cleaning process by preventing the debris from drying to reduce the chances of contamination.
2- **Cleaning**: Clean instruments in an ultrasonic cleaner (preferred), instrument washer, or by hand while wearing proper protection. Ultrasonic cleaners are the safest and most efficient ways to clean instruments; ultrasonic cleaning is 9 times more effective than hand cleaning, and it provides fast and thorough cleaning without damage to instruments.



3- **Packaging**: Place instruments in a sealed package or pouch unless you're going to use them immediately after sterilization
4- **Sterilization**: Sterilize instruments using steam autoclaving, dry-heat, or chemical vapor machines.

5- **Drying or cooling**: Store Instruments in a Dry, Protected Area



Methods of sterilization

There are four accepted methods of sterilization:

1. **Steam pressure sterilization (autoclave)**
2. **Chemical vapor pressure sterilization (chemi-clave)**
3. **Dry heat sterilization (dryclave)**
4. **Ethylene oxide sterilization**

1. **STEAM PRESSURE STERILIZATION (AUTOCLAVING)**

Sterilization with steam under pressure is performed in a steam autoclave. It involves heating water to generate steam in a closed chamber resulting in moist heat that rapidly kills microorganisms. For a light load of instruments, the time required at 250° F (121° C) is a minimum of 15 minutes at 15 psi pressure.

Time for wrapped instruments can be reduced to 3 to 10 minutes if the temperature is raised to approximately 273° F (134° C) to give 20 psi of pressure. The time required for the sterilizer to reach the correct temperature is not included.

Instruments that are sterilized by using an autoclave are Handpieces, orthodontic pliers, impression trays, and surgical instruments

Advantages of autoclaves:

1- Autoclaving is the most rapid and effective method for sterilizing cloth surgical packs and towel packs.
2- The instruments can be wrapped before sterilization
3- Good penetration on all surfaces.
4- Easily monitored and short procedure time

Disadvantages of autoclaves:

1- Items sensitive to elevated temperature cannot be autoclaved.
2- Autoclaving tends to rust carbon steel instruments and burs.
3- Steam appears to corrode the steel neck and shank portions of some diamond instruments and carbide burs.
4- Dulling of unprotected cutting edges.

2. CHEMICAL VAPOR PRESSURE STERILIZATION (CHEMICLAVING)

Sterilization by chemical vapor under pressure is performed in a Chemi-clave. **Formaldehyde** and **alcohol** formulation is heated in a closed chamber, producing hot vapours that kill microorganisms. The temperature, pressure, and time required for the completion of one cycle are 270°F (132°C) at 20 psi for 30 minutes.

Instruments that are sterilized by using chemi-clave are:

- Periodontal, restorative and endodontic instruments
- Carbon steel and other corrosion-sensitive burs and pliers

Advantages of Chemi-claves:

1- Carbon steel and other corrosion-sensitive burs, instruments, and pliers are said to be sterilized without rust or corrosion.

Disadvantages of Chemi-claves:

1- Items sensitive to elevated temperature will be damaged.
2- Instruments must be lightly packaged in bags obtained from the sterilizer manufacturer.
3- Towels and heavy cloth wrappings of surgical instruments may not be penetrated to provide sterilization.

3. DRY HEAT STERILIZATION (hot air ovens):

Dry heat utilizes the hot air, which has very little or no water vapours in it, to sterilize the instruments. Hot air oven utilizes radiating dry heat for sterilization as this type of energy does not penetrate materials easily. So, long periods of exposure to high temperatures are usually required.

Dry heat sterilization is readily achieved at temperatures above 320° F (160° C) for 1-2 hours. The oven is electrically heated and is fitted with a fan to ensure adequate and even distribution of hot air in the chamber. It is also fitted with a thermostat that maintains the chamber air at a chosen temperature. Instruments that are sterilized by using a hot air oven are:

(Endodontic instruments, Condensers, Hand instruments, Orthodontic pliers, Surgical instruments, Burs)

Advantages of dry heat sterilization:

1- Carbon steel instruments and burs will not rust, corrode, or lose their temper or cutting edges if they are well-dried before processing.
2- Economical.
3- Easily monitored.
4- Effective and safe for sterilization of metal instruments and mirrors

Disadvantages of dry heat sterilization:

1- High temperatures may damage more heat-sensitive items, such as rubber or plastic goods.
2- Sterilization cycles are prolonged at lower temperatures.
3- Heavy loads of instruments, crowding of packs, and heavy wrapping easily defeat sterilization.
4- Hot air is a bad conductor of heat; hence it has less penetrating power.
5- Not suitable for handpieces.
6- Cannot sterilize liquids.

4. Ethylene Oxide sterilization

Ethylene oxide sterilization is the best method for sterilizing complex, heat-sensitive instruments and delicate materials like rotary handpieces. Ethylene oxide is a gas at a temperature below 100°C. It is highly explosive and inflammable. It is a highly penetrative, non-corrosive agent with a bactericidal action. It is used for the sterilization of towels, metal and plastic instruments.

Advantages of Ethylene Oxide sterilization:

1- It leaves no residue
2- Good penetration power
3- It can be used at a low temperature
4- Suited for heat-sensitive articles, for example, plastic, and rubber.

Disadvantages of Ethylene Oxide sterilization:

1- High cost of the equipment
2- Toxicity of the gas
3- Explosive and inflammable.

LIQUID STERILANTS/HIGH-LEVEL DISINFECTANTS

- Sterilants used for high-level disinfection of items for reuse are **glutaraldehydes** at 2% to 3% concentrations; it kills bacterial spores in 6-10 hours.
- Greater dilutions are not encouraged for repeated use.
- Placing wet items in disinfectant trays dilutes the solution.
- Glutaraldehydes are irritating, sensitizing to skin and respiratory passages, and can be toxic, as indicated in manufacturers' safety data sheets.
- Keep trays tightly covered in a well-vented area.
- Do not use 2% glutaraldehyde solutions to wipe counters or equipment (e.g., dental unit and chair)

CLEANING AND DISINFECTION OF DENTAL UNIT AND ENVIRONMENTAL SURFACES

- Countertops and dental unit surface that may have become contaminated with patient material should be cleaned with disposable toweling, using an appropriate cleaning agent and water as necessary.
- Surfaces then should be disinfected with a suitable chemical germicide, including phenolics, iodophors, and chlorine-containing compounds.
- A fresh solution of sodium hypochlorite (household bleach) prepared daily is an inexpensive and effective intermediate-level germicide. Concentration (1/4 cup of bleach to 1 gallon of water) is effective on environmental surfaces that have been cleaned of visible contamination. Caution should be exercised since chlorine solutions are corrosive to metals, especially aluminum

DISINFECTION OF THE DENTAL LABORATORY

- Laboratory materials and other items that have been used in the mouth (e.g., impressions, bite registrations, fixed and removable prostheses, orthodontic appliances) should be cleaned and disinfected before and after being manipulated in the laboratory, whether an on-site or remote location and before placement in the patient's mouth.

STERILISATION OF HANDPIECES: After each patient use,

,

- Run any handpiece that is connected to the dental air/water system to discharge water and/or air for at least 20 seconds
- Leave the bur in place while you clean the outside of the handpiece with detergent and warm water. Alcohol or any chemical solution should never be used as a cleaning agent as it can dehydrate spores and increase resistance to sterilization.
- Sterilize in an autoclave or by chemical methods.
- If recommended by the manufacturer, Lubricate the handpiece using lubricating spray oil into the drive airline.

Some dental instruments have components that are heat sensitive or are permanently attached to dental unit water lines. Some items may not enter the patient's oral cavity but are likely to become contaminated with oral fluids during treatment procedures, including, for example, handles or dental unit attachments of saliva ejectors, high-speed air evacuators, and air/water syringes. These components should be covered with disposable covers that are changed after each use or, if the surface permits, carefully cleaned and then treated with a chemical germicide having at least an intermediate level of activity

Disposal of waste materials:

- ✓ Blood, suctioned fluids, or other liquid waste may be poured carefully into a drain connected to a sanitary sewer system.
- ✓ Disposable needles, scalpels, or other sharp items should be placed intact into puncture-resistant containers before disposal.
- ✓ Solid waste contaminated with blood or other body fluids should be placed in sealed, sturdy impervious bags to prevent leakage of the contained