Sterilization and Disinfection processes in health setting

Sterilization describes a process that destroys or eliminates all forms of microbial life and is carried out in health-care facilities by physical or chemical methods. Steam under pressure, dry heat, Ethylene oxide gas, hydrogen peroxide gas plasma, and liquid chemicals are the principal sterilizing agents used in health-care facilities.

Disinfection **and disinfectants** describes a process that eliminates many or all pathogenic microorganisms, except bacterial spores, on inanimate objects. In health-care settings, equipment are usually disinfected by using a single or a combination of disinfectants such as; hydrogen peroxide, peracetic acid, alcohols, chlorine, chlorine compounds, formaldehyde, glutaraldehyde, iodophors, phenolics, and quaternary ammonium compounds.

Factors influencing efficacy of disinfectants and sterilizers includes;

1. **Prior cleaning of the object**; Cleaning is the removal of foreign material (e.g., soil, and organic material) from objects and is normally accomplished using water with detergents or enzymatic products. Thorough cleaning is required before high-level disinfection and sterilization because inorganic and organic materials that remain on the surfaces of instruments interfere with the effectiveness of these processes.
2. **Organic and inorganic load present**; Organic matter in the form of serum, blood, pus, or fecal or lubricant material can interfere with the antimicrobial activity of disinfectants the larger the number of microbes, the more time a germicide needs to destroy all of them
3. **Type and level of microbial contamination**; Intrinsic resistance mechanisms in microorganisms to disinfectants vary more so with spore formers. Spores are resistant to disinfectants because the spore coat and cortex act as a barrier,
4. **Concentration of and exposure time to the germicide**; the more concentrated the disinfectant is, the greater the efficacy and the shorter time necessary to achieve microbial killing. Items must be exposed to the germicide for the appropriate minimum contact time.
5. **Physical nature of the object**; Medical instruments with multiple pieces must be disassembled and equipment such as endoscopes that have crevices, joints, and channels are more difficult to disinfect than are flat- surface equipment because penetration of the disinfectant of all parts of the equipment is more difficult
6. **Presence of biofilms;** Microorganisms may be protected from disinfectants by production of thick masses of cells and extracellular materials, or biofilms. Biofilms are microbial communities that are tightly attached to surfaces and cannot be easily removed. The larger the number of microbes, the more time a germicide needs to destroy all of them
7. **Temperature and pH of the disinfection process**; Several physical and chemical factors also influence disinfectant procedures: temperature, pH, relative humidity, and water hardness
8. **Relative humidity** of the sterilization process (e.g., ethylene oxide).

The primary techniques applicable in sterilization of medical devices

Several methods can be used to sterilize medical devices in hospital setting and these may include;

1. Steam sterilization
2. Radiation sterilization,
3. Dry heat sterilization,
4. Sterilization by filtration
5. Gas sterilization (such as ethylene oxide sterilization)
6. Vapor sterilization
7. Liquid sterilization.

The choice for sterilization methods; the choice of sterilization technique to be used in a medical equipment primarily depend on the materials used. Examples;

1. **Biologic materials**: Nearly all devices that contain biologic materials such as culture media will require sterilization by filtration for the biological component of the device.
2. **Cost effectiveness**: The most inexpensive and popular method of sterilization is steam under pressure by autoclaving Devices made with metals, or other materials compatible with steam sterilization can be sterilized using autoclaves.
3. **Heat sensitivity:** In all materials that are heat sensitive, use of ethylene oxide gas sterilization is recommended.
4. **Cold sterilization preference:** Radiation is more effective and preferred for cold type of sterilization especially in culture media rooms. However, radiation is more expensive, harder to outsource.

Sterilization Type	Compatible Materials	Pros	Cons
Steam/Autoclave	• Withstand at least 121°C • Humidity resistant	• Inexpensive & non-toxic • Easy to outsource • Easy bulk processing • In-house hospital access	• Bad for heat or humidity sensitive materials • Lengthy processing time with drying cycle
Radiation	• Withstand around 25 megarads of radiation exposure	• Great for heat-sensitive materials • Non-toxic and sterilizes solid, liquid, and gas products • Fast	• Not for biologics • Breaks down materials faster • No hospital inhouse access • Expensive • Harder to outsource
Dry Heat	• Withstand at least 170°C • Thermoset plastics • Metals	• Inexpensive • Easy bulk processing • Non-toxic • In-house hospital access	• Few materials can withstand dry heat temperatures • Bad for electronics, biologics, thermoplastics
Filtration	• Useful for liquid products	• Great for biologics • Easy to outsource • Easy bulk processing	• Expensive • Time-consuming • Not useful for solid products
Gas/EtO	• Heat-sensitive materials • Electronics	• Inexpensive • Easy to outsource • Easy bulk processing • In-house hospital access	• Leaves chemical residues (see EtO Residual Testing) • Expensive • Lengthy processing time
Vapor	• Heat and moisture tolerant materials	• Fast process • In-house hospital access • Non-toxic	• Bad for heat sensitive or moisture-sensitive materials • Bad for electronics
Liquid	• Withstand submersion into abrasive liquid chemicals	• Fast process • Inexpensive	• Abrasive to materials • Surface-level sterilization • Chemical disposal is difficult