Sterilization and disinfection

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- **Sterilization** is a process that destroys all microorganisms including bacterial spores and viruses. Sterilization cannot be proved except by culturing.
- **Disinfection** is a process that reduces the number of pathogenic microorganisms, but not necessarily bacterial spores, from inanimate objects or skin, to a level which is not harmful to health.
- **Cleaning** is a process that removes foreign material (e.g. soil, organic material, micro-organisms) from an object.
- **Antiseptics**: Chemical disinfectants which can be safely applied to skin and mucus membrane.
- The level of decontamination should be such that there is no risk for infection when using the equipment.
- **The choice of the method depends of a number of factors,** including type of material of object, number and type of organisms involved and risk of infection to patients or staff.
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- **Physical agents include:**
- **1-Heat**
- **A) Dry heat**: it is only suitable for items able to withstand high temperatures. Dry heat kill microorganisms by causing destructive oxidation of essential cell constituents.
- **1-Hot air oven**: At 160 °C for 1 hour or 180 ° C for 30 minutes, it is a method of choice for sterilization of glassware such as assembled all glass syringes, test tubes, petri dishes, pipettes and flasks, metal instruments such as forceps, scissors, swabs and scalpel.
- **2- Flaming**: is done to loops and straight-wires, forceps tips and the neck of flask in microbiology labs. Leaving the loop in the flame of a Bunsen burner until it glows red ensures that any infectious agent gets inactivated. This is commonly used for small metal or glass objects, but not for large objects.

- 3-**Incineration:** At >1000 ° C is used for the disposal of human tissues, surgical dressings and other clinical contaminated waste.
- **4**- **Red heat**: inoculating wires, loops and point of forceps are sterilized by holding them in the flame of Bunsen burner until they are red.

- **B) Moist heat:** Moist heat causes denaturation and coagulation of proteins.

1. **Autoclave:** the most effective method and commonly used, sterilization by steam under pressure (autoclaving) is suitable for culture media and aqueous solutions, dressing material, achieved at 15 (psi) pressure, 121°C in 15-20 minutes, kill all microorganisms including spores.
2. **Boiling**: at 100 ° C for 5 min. will kill vegetative organisms, but not spores.

3. **Tyndallization**: repeated heating at low temperatures (90-100C for 30 min. on 3 consecutive days or 60 ° C for 1 hour for 5 days. first exposure to steam kills vegetative bacteria and any spore present being in a favourable medium, will germinate and will be killed on subsequent occasion.
4. **Pasteurization**: 63 ° C for 30 min. or 72° C for 20 sec. is used in food industry to eliminate vegetative pathogenic microorganisms that can be transmitted in milk and other dairy products (mycobacrteria, Salmonella, Brucella).

- **2- Radiation**
- **Ionizing Radiation Sterilization:** Gamma rays and X rays are very penetrating and are commonly used for sterilization of disposable medical equipment, such as syringes, needles, cannulas and IV sets.
- **Non Ionizing Radiation Sterilization:** Ultraviolet light irradiation (UV, from a germicidal lamp) is useful only for sterilization of surfaces and some transparent objects. Many objects that are transparent to visible light absorb UV, glass for example completely absorbs all UV light. UV irradiation is routinely used to sterilize the interiors of biological safety cabinets .

- **3- Filtration**: Fluids that would be damaged by heat (such as those containing proteins like large molecule drug products) irradiation or chemical sterilization, can be only sterilized by Microfiltration using membrane filters, This method is commonly used for heat labile pharmaceuticals and protein solutions in medicinal drug processing, antibiotic solutions, blood products.
- Usually, a filter with pore size 0.2 µm (microfiltration) will effectively remove microorganisms. In the processing of Biologics, viruses must be removed or inactivated. Nanofilters with a smaller pore size of 20 -50 nm (nanofiltration) are used.

- **Chemical sterilization**
- Chemicals are also used for sterilization. Although heating provides the most reliable way to rid objects of all transmissible agents, it is not always appropriate, because it will damage heat-sensitive materials such as biological materials, fiber optics, electronics, and many plastics. Low temperature gas sterilizers function by exposing the articles to be sterilized to high concentrations (typically 5 - 10%) of very reactive gases (alkylating agents such as ethylene oxide, and oxidizing agents such as hydrogen peroxide and ozone).
- The chemicals used as sterilants are designed to destroy a wide range of pathogens.

- Ethylene oxide gas is commonly used to sterilize objects sensitive to temperatures greater than 60 °C and / or radiation such as plastics, optics and electric.
- Alcohols: methyl alcohol, ethanol, isopropyl alcohol (60-70% in water) for skin, clinical thermometer, cabinets, incubators.
- Aldehydes, formaldehyde: to preserve anatomical specimen, sterilizing incubators and heat sensitive catheters.
- Gluteraldehyde: effective against bacteria, virus and fungi effective against plastic, metals and rubber
- Ethylene oxide: is used for single use heat sensitive, medical devices like prosthetic heart valves and plastic catheters.

- **Disinfection**

  The Use of Chemical Agents in Control

A. Phenolics-laboratory and hospital disinfectants; act by denaturing proteins and disrupting cell membranes
B. Alcohols-widely used disinfectants and antiseptics; will not kill endospores; act by denaturing proteins and possibly by dissolving membrane lipids
C. Halogens-widely used antiseptics and disinfectants; iodine acts by oxidizing cell constituents and iodinating cell proteins; chlorine acts primarily by oxidizing cell constituents
D. Heavy metals-effective but usually toxic; act by combining with proteins and inactivating them

E. Quaternary ammonium compounds-cationic detergents used as disinfectants for food utensils and small instruments, and because of low toxicity, as antiseptics for skin; act by disrupting biological membranes and possibly by denaturing proteins

F. Aldehydes-reactive molecules that can be used as chemical sterilants; may irritate the skin; act by combining with nucleic acids and proteins and inactivating them lizing gases (e.g., ethylene oxide, betapropiolactone)-can be used to sterilize heat-sensitive materials such as plastic petri dishes and disposable syringes; act by combining with proteins and inactivating them; recently, vapor-phase hydrogen peroxide has been used to decontaminate biological safety cabinets .


Thank you