Sterilization & Disinfection

Prof. Hanan Habib & Dr. AbdulAziz Al-khataff

College Of Medicine-KSU

Objectives

1~ Define the terms sterilization, disinfectant and antiseptic.

2~ Classify the different methods of sterilization (physical and chemical methods).

3~ Know and realizes that heat is the most important method of sterilization and its application in medical practice.

Objectives-cont.

4~ Know dry heat as applied in hot air Oven and moist heat as applied in autoclaves.

5~ Know the principles of Autoclave function and monitoring methods of sterilization .

6~ Know the importance of non heat sterilization methods and their use for sterilization of heat sensitive objects.

Objectives-cont.

7~Know the difference between antiseptics and disinfectants.

8~ Know types and scope of function of the disinfectants and antiseptics and factors affecting their functions.

9~ Know the medical applications of different disinfections and antiseptics.

Definitions

- **Sterilization:** complete killing of all forms of microorganisms, including bacterial **spores**
- **Disinfection:** killing or removing of harmful vegetative microorganisms.
- **Disinfectant:** chemical substance used to achieve disinfection.
- **Antiseptic:** disinfectant that can be safely used on living tissues.

Methods of Sterilization

1. **Physical methods:**
   - Heat (dry heat & moist heat)
   - U.V. Light
   - Ionizing Radiation
   - Filtration
2. **Chemical method**: (used for heat sensitive equipments)
   - Ethylene Oxide
   - Gluteraldehyde .

PHYSICAL METHODS

HEAT : Most important should be used whenever possible , types:

A-**Dry heat** at temperature of 160˚C for one hour

B- **Moist heat** eg. Autoclave

at 121 or 134 C for 10 or 15 minutes

Sterilization by Heat
Common methods
Dry Heat

- Dry Heat- kills microorganisms by destroying their oxidative processes.
  - Simplest method is exposing item to be sterilized to the naked flame e.g. Bunsen burner- for sterilizing bacteriological loops, knives, blades.
  - **Hot air oven expose items to 160 ° C for 1 hour.**
- Has electric element in chamber as source of heat plus a fan to circulate air for even distribution of heat in chamber. Oven without fan is dangerous. Used for items that are lacking water such as:

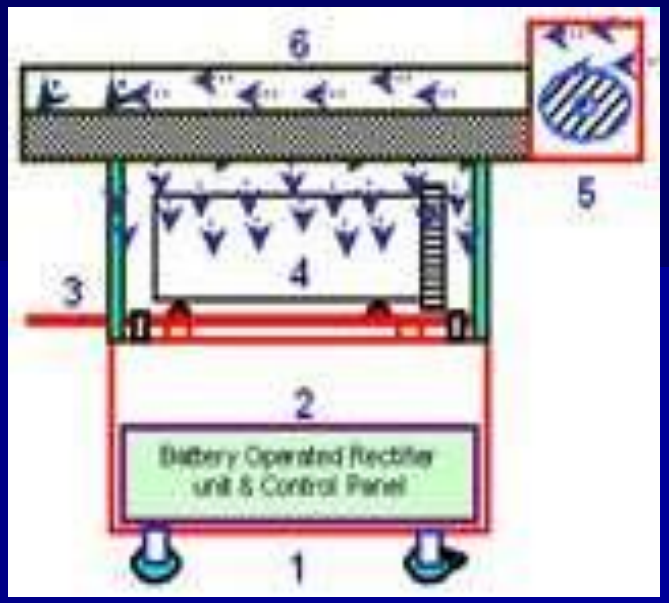
-Metals

-Glassware

-Ointment / Oils/ Waxes /Powder

Moist Heat

- Uses hot water. Moist heat kills microorganisms by denaturating proteins.
- Autoclaving – standard sterilization method in hospitals.
- The equipment is called Autoclave and it works under the same principle as the pressure cooker where water boils at increased atmosphere pressure i.e. because of increase pressure the boiling point of water is >100 ° C.
- The autoclave is a tough double walled chamber in which air is replaced by pure saturated steam under pressure.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Battery Operated Rectifier unit & Control Panel
1

- The air in the chamber is evacuated and filled with saturated steam. The chamber is closed tightly the steam keeps on filling into it and the pressure gradually increases. The items to be sterilized get completely surrounded by saturated steam (moist heat) which on contact with the surface of material to be sterilized condenses to release its latent heat of condensation which adds to already raised temperature of steam so that eventually all the microorganisms in what ever form are killed.
- The usual temperature achieved is 121 ° C , exposure time of only 15 minutes (or 134 C for 10 minutes).

Advantages of Autoclave

- Temp. > 100 C therefore spores killed.
- Condensation of steam generates extra heat.
- The condensation also allows the steam to penetrate rapidly into porous materials.
- *Note: for all invasive procedures at operating room or clinics, autoclavable equipments should be used.*

Monitoring of Autoclaves

- 1. **Physical method:** use of thermocouple to measure accurately the temperature.
- 2. **Chemical method:** it consists of heat sensitive chemical that changes color at the right temperature and exposure time.
- e.g. a)- Autoclave tape
- b)- Browne's tube.
- 3. **Biological method**: where a **spore**-bearing organism is added during the sterilization process and then cultured later to ensure that it has been killed.


Sterile Surgical
Pack

Spore test
(biological indicator)

Moist heat: Other Applications

Pasteurization

- Used heat at temperatures sufficient to inactivate harmful organism in milk. The temperatures of sterilization is not achieved .
- Temperature may be 74° C, for 3-5 seconds. (Flash methods or 62° C for 30 minutes. (Conventional method).

Boiling – quite common especially in domestic circumstances.

Pasteurization of milk

To prevent diseases like :

- Typhoid fever
- Brucellosis
- Tuberculosis
- Q fever

Other physical methods : Radiation

- **U.V. light**
  - Has limited sterilizing power because of poor penetration into most materials. Generally used in irradiation of air in certain areas such as operating rooms and tuberculosis labs.
- **Ionizing radiation-**
  - e.g. Gamma radiation: has greater energy than U.V. light, therefore more effective. Used mainly in industrial facilities e.g. sterilization of disposable plastic syringes, gloves, specimens containers and Petri dishes.

Other physical methods : Filtration

- Use of membrane filter .Example ; ***membrane filter*** made of cellulose acetate. Generally removes most bacteria but viruses and some small bacteria e.g. *Chlamydia* & *Mycoplasma* may pass through. Thus filtration does not technically sterilize items but is adequate for circumstances under which is used.
- Main use: for heat labile substances e.g. sera, antibiotics.

Chemical Methods

- Some strong chemical substances may be used to achieve sterilization (kill spores) e.g. Gluteraldehyde and Ethylene oxide. Used for heat sensitive equipments.
- Disinfectants /Antiseptics

eg. phenolics, chlorhexidine, alcohol, etc..

Sterilization by Chemical Methods

Useful for **heat sensitive materials** e.g. plastics and lensed endoscopes).

1. **Ethylene Oxide Chamber**

Ethylene oxide alkylates DNA molecules and thereby inactivates microorganisms.

Ethylene oxide may cause explosion if used pure so it is mixed with an inert gas .Requires high humidity (50-60%) .Temperature : 55-60° C and exposure period 4-6 hours.

2. **Activated alkaline Gluteraldehyde 2%**

Immerse item in solution for about 20 minutes. If *Mycobacterium tuberculosis* or spores present then immersion period 2-3 hours.

Factors influencing activity of disinfectants

- 1. Activity directly proportional to temperature.
- 2. Directly proportional to concentration up to a point – optimum concentration. After this level no advantage in further increases in concentration.

Factors influencing activity of disinfectants

- 3. Disinfectants may be inactivated by :
  - Dirt
  - Organic matter : Proteins, Pus, Blood, Mucus and Feces.
  - Non organic: Cork, Hard water and Some plastics.
- 4. Time : Disinfectants need time to work.
- 5. Range of Action : Disinfectants not equally effective against the whole spectrum of microbes. e.g. Chlorhexidine less active against Gram negative bacteria than Gram positive cocci.

  Hypochlorite and Gluteraldehyde are more active against hepatitis viruses than most other disinfectants.

Disinfectants /Antiseptics

Disinfectants/ Antiseptics	GPC	Activity against		TB	Inactivated by		Corrosive Action
		GNB	Spores		Protein	Soap	
Phenolics Sudol	++	++	–	+	±	–	+
Izal	++	++	–	–	±	–	–
Soluble Phenolic* e.g. clearsol	++	++	–	+	±	–	± to +
Chlorine compound	++	++	++	+	++	–	(buffered Φ++ or ± Solution)
Lodophor	++	++	+ (Slow)	+	+	–	–
Chlorhexidine (Hibitane)	++	+	–	–	–	–	–
70° alcohol	++	++	–	±	++	–	–
Formaldehyde	++	++	++ (slow)	++	+	–	++
Glutaraldehyde (Cidex)	++	++	++	++	±	–	+

Hospital disinfection methods

Article	Disinfectant
Floors, walls	Phenolics fluids 1-2%
Surfaces tables	Hypochlorite, Alcohol
Skin	
Surgeons' hands	Chlorhexidine, Iodine alcohol
Patient skin	70% Alcohol, Iodine
Endoscopes	Gluteraldehyde 2% (Cidex), sub-atmospheric steam
Thermometers	70% Alcohol

Important points

- Any instrument or item used for sterile body site should be sterile.
- Any instrument or item used for non-sterile body site can be disinfected.
- Hand washing is the most important to prevent hospital acquired infection.