

# Sterilization & Disinfection

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# 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.

- 5~ Know dry heat as applied in hot air oven and moist heat as applied in autoclaves.
- 7~ Know the principles of autoclave function and monitoring methods of sterilization .
- 8~ Know the importance of non heat sterilization methods and their use for sterilization of heat sensitive objects.

# Objectives-cont.

9~ Know the difference between antiseptics and disinfectants.

10~ Classify the disinfectants and antiseptics and know factors affecting their functions.

11~ Know different applications for 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 minute

# 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

- May be done under either negative or positive pressure. 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.



# Sterilization by Heat

## Common methods

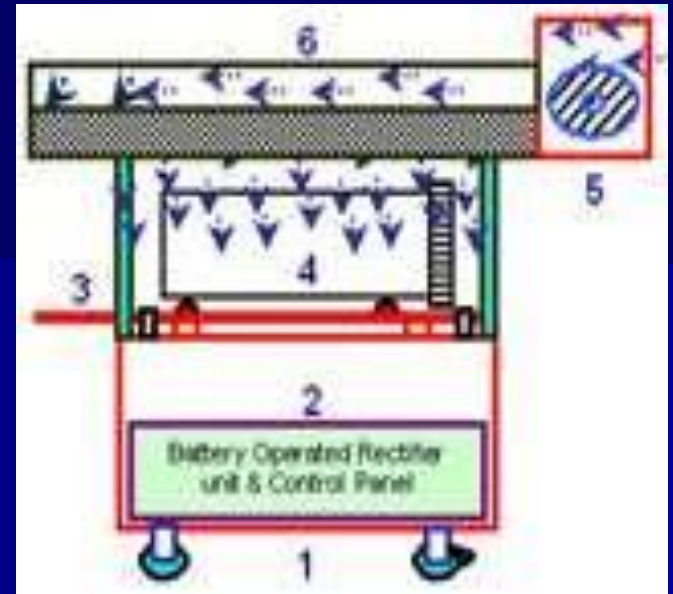
### Dry Heat

- 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 **denaturing 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.



# 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.*

- 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 mins** .

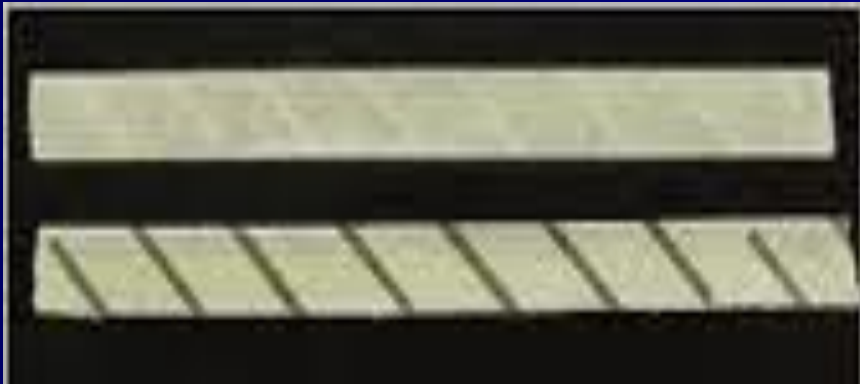
# Monitoring of Autoclaves

- **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

# 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 mins. If *Mycobacterium tuberculosis* or **spores** present then immersion period **2-3 hours**.

# 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..

# Disinfectants / Antiseptics

Disinfectant	GPC	Activity against		TB	Inactivated by		Corrosive Action
		GNB	Spores		Protein	Soap	
Phenolics Sudol	++	++	-	+	±	-	+
Izal	++	++	-	-	±	-	-
Soluble Phenolic* e.g. clearsol	++	++	-	+	±	-	± to +
Chlorine compound	++	++	++	+	++	-	(buffered $\Phi$ ++ or ± Solution)
Lodophor	++	++	+ (Slow)	+	+	-	-
<u>Chlorhexidine</u> (Hibitane)	++	+	-	-	-	-	-
70° alcohol	++	++	-	±	++	-	-
Formaldehyde	++	++	++ (slow)	++	+	-	++
<u>Glutaraldehyde</u> (Cidex)	++	++	++	++	±	-	+

# 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.  
**Hypochlorites** and **Gluteraldehyde** are more active against **hepatitis viruses** than most other disinfectants.

# Hospital disinfection methods

## Article

- Floors, walls
- Surfaces tables

## Skin

- Surgeons' hands
- 
- Patient skin

## Endoscopes

- 
- 

## Thermometers

## Disinfectant

Phenolics fluids 1-2%  
Hypochlorite, Alcohol

Chlorhexidine, Iodine  
alcohol

70% Alcohol, Iodine

Gluteraldehyde 2%

(Cidex), subatmospheric  
steam

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.

