

# 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.

- 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 applications of different disinfections and antiseptics in medical practice.

# Definitions

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

# Methods of Sterilization

## 1. Physical methods:

- Heat ( dry heat & moist heat)
- UV ( ultra violet ) 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. Autoclaves use heat of 121 C for 15 minutes or 134 C for 10 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



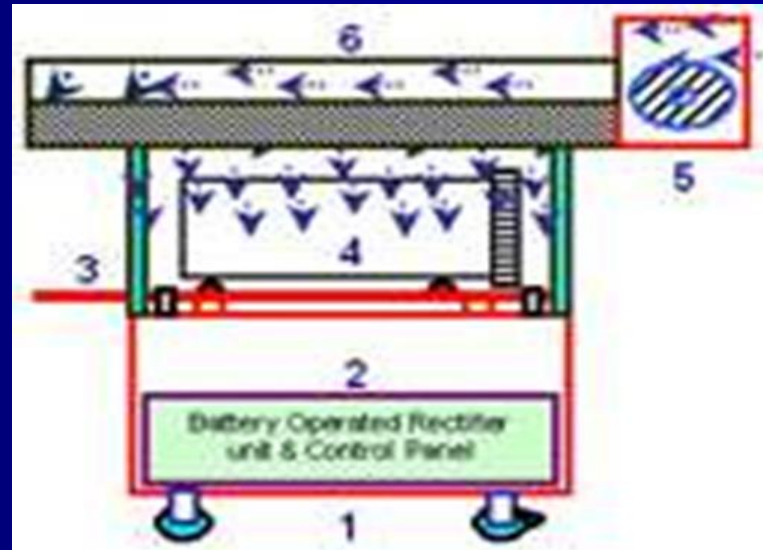


# Moist Heat

- Uses hot water. Moist heat kills microorganisms by **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.



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- 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 **15 minutes** ( or **134 C** for **10 minutes**).

# Advantages of Autoclave

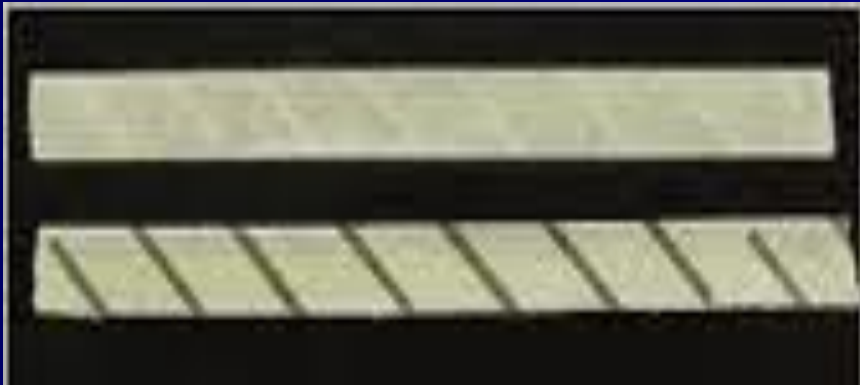
- Temp.  $> 100\text{ C}$  , spores killed.
- Condensation of steam generates extra heat.
- The condensation also allows the steam to penetrate rapidly into porous materials.
- *Note: for all invasive procedures at operating room or clinics, autoclavable equipments should be used.*

# Monitoring of Autoclaves

- **1. Physical method:** use of thermocouple to measure the temperature.
- **2. Chemical methods:** consists of heat sensitive chemical that changes color at the right temperature and exposure time.
  - e.g. a)- Autoclave tape ( commonly used)
  - 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** :commonly used in domestic circumstances .

**Steam sterilizers** :for babies bottles .



# Pasteurization of milk

To prevent the transmission of zoonotic diseases to human ,like :

- ❑ Typhoid fever
- ❑ Brucellosis
- ❑ Bovine tuberculosis
- ❑ Q fever

# Other physical methods :

## Radiation

### ■ UV 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 ( require smaller pore size) . 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. Other use: AC of certain operating theatres.



# 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, iodine , etc..

# Sterilization by Chemical Methods

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

## 1. Ethylene Oxide Chamber

Ethylene oxide alkylates DNA molecules and thereby inactivates microorganisms.

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 is 2-3 hours.

3. **Other uses:** Hypochlorite ( at certain concentrations) used for drinking water supply ,house cleaning and swimming pools.

# Factors influencing activity of disinfectants

- 1. Activity directly proportional to **temperature**.
- 2. Directly proportional to **concentration** up to an 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.



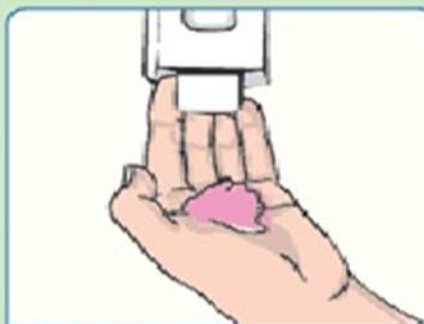
# Soap, Water and common sense are yet the best antiseptics

*William Osler*

## FIGHT GERMS BY WASHING YOUR HANDS!



**1** Wet your hands



**2** Soap



**3** Lather and scrub - 20 sec



**4** Rinse - 10 sec



**5** Turn off tap



**6** Dry your hands

### DONT FORGET TO WASH:

- between your fingers
- under your nails
- the tops of your hands

# Summary :Disinfectants & Antiseptics

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

# 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), sub-atmospheric  
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.