

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.

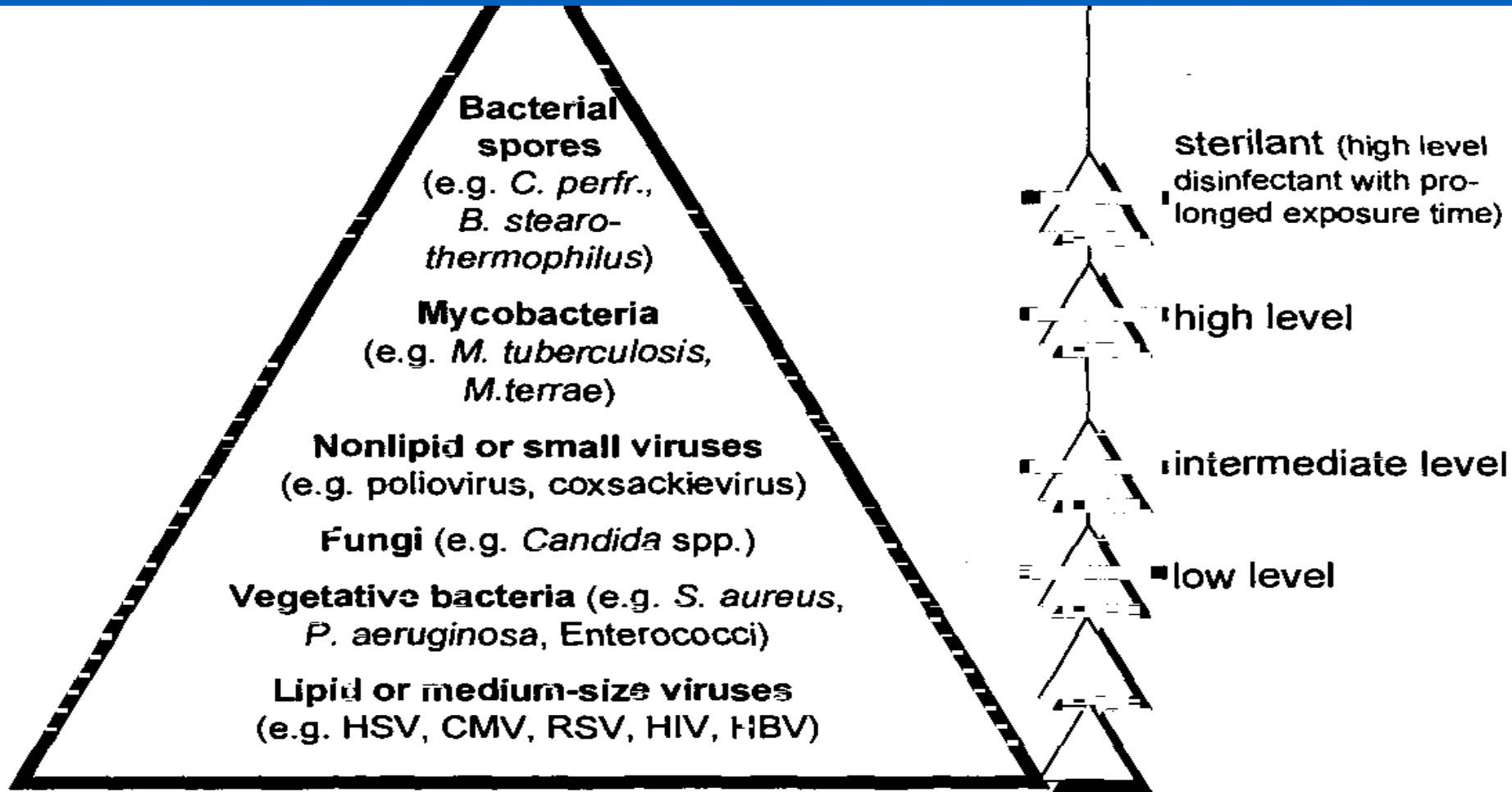
Definitions

- **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.

1-Sterilization Monitor by physical, chemical or biological)	A-Physical	Heat	Dry Metals,Glassware,Ointment / Oils/ Waxes/Powder	160°C /60 mints
		Moist heat		121° C /15 mints or 134° C /10 mints
		Pasteurization For milk		74°C for 3-5 seconds or 62°C /30 mints
		UV Light	TB lab	254 nm waves
		Ionizing Radiation	sterilization of disposable	X- rays, gamma rays & cosmic rays
	B-Chemical (heat sensitive)	Ethylene Oxide (gas)	endoscopes	55-60°C /4-6 hours.
		Gluteraldehyde (Aldehydes)	Endoscopes anesthetic tubes	2% 20 mints –TB 2 hrs
		Filtration	For sera and antibiotics	0.22-0.24 µm pores
	2-Disinfectant	Phenolics fluids	Surfaces Surgical and neonal units	1-2%
Gluteraldehyde		surfaces	2%	
Alchole		Surfaces/thermometer		
3-Antiseptic	Chlorhexidine	skin	0.5%	
	Iodine (halogens)	skin	10%	
	Alchole	skin	70%	

Level	uses	application	example
<p>High-level disinfectants</p> <p>Kill all including spores</p>	<p>Used for items involved in invasive procedures but NOT withstand sterilization (critical)</p>	<p>Endoscopes, Surgical instruments</p>	<p>Moist heat Gluteraldehyde Hydrogen peroxide Chlorine dioxide Formaldehyde Peracetic acid</p>
<p>Intermediate-level disinfectants</p> <p>Kill all including mycobacterium non-enveloped viruses fungus and bacteria</p>	<p>Used for cleaning surface or instruments without bacterial spores and highly resilient organism (semicritical)</p>	<p>Laryngoscopes, Anesthesia breathing circuits...etc</p>	<p>Phenol compounds Alcohol Iodophor</p>
<p>Low-level disinfectants</p> <p>Enveloped viruses and bacteria</p>	<p>Used to treat noncritical instruments and devices, not penetrating into mucosa surfaces or sterile tissues (noncritical)</p>	<p>Hospital surfaces</p>	<p>Quaternary ammonium compounds</p>

Disinfectant Level



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.

A. 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

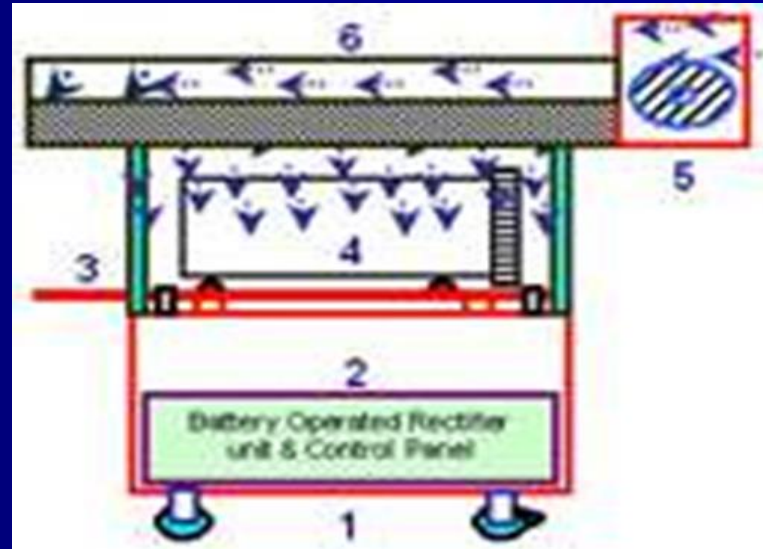


B. Moist Heat

- 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

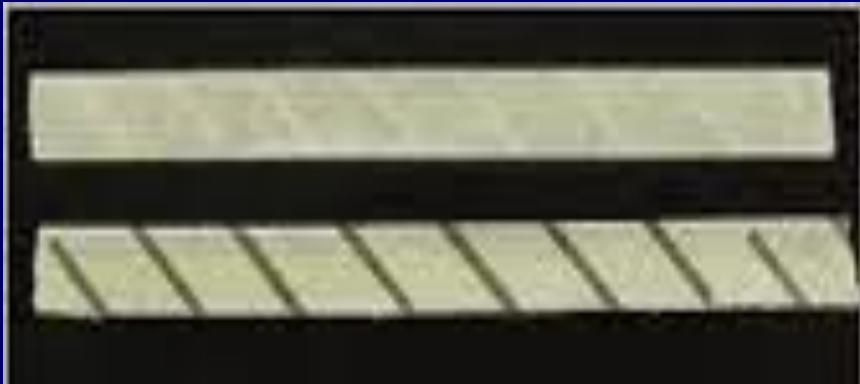
- Temp. $> 100\text{ C}$, spores killed.
- Condensation of steam generates extra heat.
- The condensation also allows the steam to penetrate rapidly into porous materials.
- *Note: for all invasive procedures at operating room or clinics, autoclavable equipments should be used.*

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.

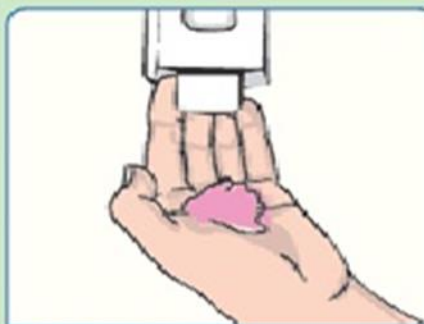
Soap, Water and common sense are yet the best antiseptics

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	
Phenolics Sudol	++	++	-	+	±	-	+
Izal	++	++	-	-	±	-	-
Soluble Phenolic* e.g. clearsol	++	++	-	+	±	-	± to +
Chlorine compound	++	++	++	+	++	-	(buffered Φ ++ or ± Solution)
Lodophor	++	++	+ (Slow)	+	+	-	-
<u>Chlorhexidine</u> (Hibitane)	++	+	-	-	-	-	-
70° alcohol	++	++	-	±	++	-	-
Formaldehyde	++	++	++ (slow)	++	+	-	++
<u>Gluteraldehyde</u> (Cidex)	++	++	++	++	±	-	+

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.