Sterilization and disinfection

-Important -Extra -Notes

-In boy's slides -In girl's slides

In this link, you will find any correction or notes unmentioned in the team's work. Please check the link below Frequently.
https://docs.google.com/document/d/1WvdeC1atp7J-ZKWOUSukSLsEcosjZ0AqV4z2VcH2TA0/edit?usp=sharing

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MICROBIOLOGY TEAM 438

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.
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.
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.

Doctor's note:

- ★ Sterilization : Killing everything including the spores, and Disinfection: killing everything except the spores.
- ★ Disinfectants: is the chemical substance.
  - If you increase the concentration or the time of disinfectants It's will be high-level (critical) which means (Sterilization).
- ★ Sterilization and disinfection are the processes and disinfectants are the chemical substances that you use it.
- ★ There are 3 level of disinfectants:
  - High-Level (critical).
  - Intermediate-Level (semi-critical).
  - Low-Level (non-critical).
- ★ Antiseptic used for human, and it's one of the disinfectants.
  - All antiseptic is a disinfectant, والعكس غير صحيح.
- ★ "In heat sterilization when you use the moist heat, you can go for a shorter period of time."
  - لأن فيه رطوبة والرطوبة تزيد الحرارة وبرضو فيه ضغط، ف عشان كذا تحتاج درجة حرارة ووقت أقل من الدراي هييت.
  - "it's very useful because it's very quick and you need less temperature."
- ★ For pasteurization, you need less temperature and if you increase the temp. you might reach to less time.
  - Pasteurization = درجة الغليان تقريباً
- ★ The UV light used in the TB labs, and it kills all the microbes.
- ★ Radiation = تستخدم للتخلص من النفايات
- ★ Endoscopes are a high-level disinfectant.
- ★ Glutaraldehyde is the same as formaldehyde.
- ★ Filtration is one method of sterilization.

Definitions:

Sterilization:

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Complete killing of all forms of microorganisms including bacterial spores

(Killing everything including spores).

Disinfection:

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killing or removing of harmful vegetative microorganisms.

(Killing everything except spores).

Disinfectant:

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chemical substance used on inanimate objects. Toxic to human .

Antiseptic:

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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 (it's faster than 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	gamma rays, X-rays & cosmic rays
	B-Chemical (heat sensitive)	Ethylene Oxide (gas)	Endoscopes	55-60°C / 4-6 hours.
		Glutaraldehyde(Aldehydes) (same as Formaldehyde)	Endoscopes anesthetic tubes	2% 20 mints - TB 2 hrs
		Filtration	For sera and antibiotics	0,22-0,24 µm pores
2-Disinfectant		Phenolics fluids E.g. dettol	Surfaces surgical and neonal units	1-2%
		Gluteraldehyde	Surfaces	2%
		Alcohole	Surfaces/thermometer	
3-Antiseptic		Chlorhexidine	Skin	0,5%
		Iodine (halogens)	Skin	10%
		Alcohole	Skin	70%

Levels of disinfectants

This slide only found in boy's slides.

Level	uses	application	example
High-level disinfectants Kill all including spores. *some of disinfectants if u increase the concentration or the time, it will reach to sterilization .. CRITICAL.	Used for items involved in invasive procedures but NOT withstand sterilization (**critical**) *Critical هو الي ممكن يلامس الدم وال mucus.	Endoscopes, Surgical instruments	Moist heat Gluteraldehyde Hydrogen peroxide Chlorine dioxide Formaldehyde Peracetic acid
Intermediate-level disinfectants Kill all including mycobacterium non-enveloped viruses fungus and bacteria , "Kill every thing EXCEPT spores".	Used for cleaning surface or instruments without bacterial spores and highly resilient organism (semicritical)	Laryngoscopes, Anesthesia breathing circuits...etc	Phenol compounds Alcohol Iodophor
Low-level disinfectants Enveloped viruses and bacteria	Used to treat noncritical instruments and devices, not penetrating into mucosa surfaces or sterile tissues (noncritical) * ما يلامس الدم وال mucus.	Hospital surfaces	Quaternary ammonium compounds

Methods of Sterilization

1.Physical methods:

Heat (dry heat & moist heat)
UV (ultra violet) Light
Ionizing Radiation
Filtration

2. Chemical method:

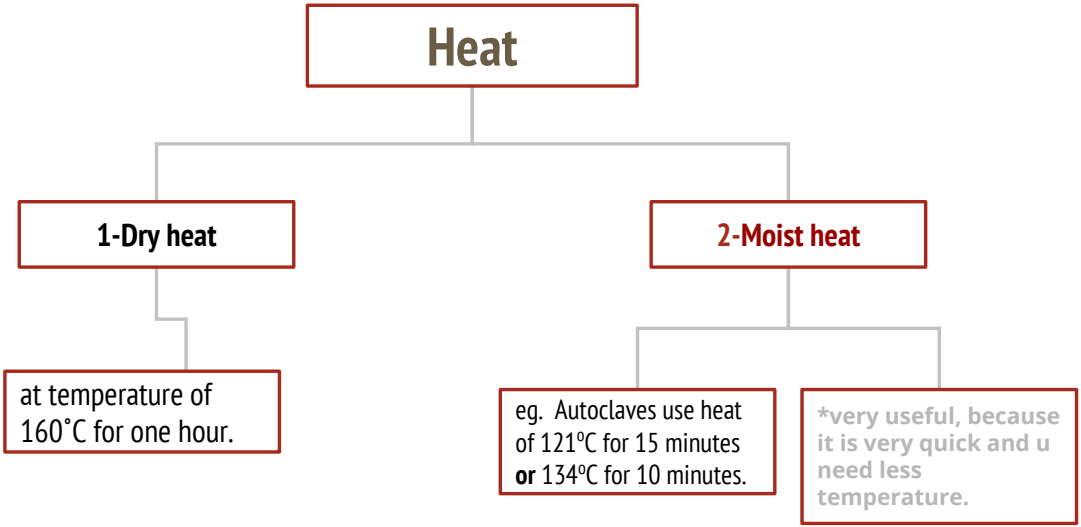
(used for heat sensitive equipments)

★ Ethylene Oxide.
★ Gluteraldehyde which is same as Formaldehyde.

- The Strongest Disinfectant level is Bacterial spores.
- And the weakest is the Viral envelope.

Physical Methods

Heat is the most important should be used whenever possible.



Physical Methods

Sterilization by Heat Common methods:

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.

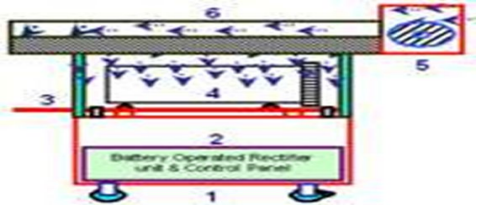
Dry Heat

- ★ 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**

Physical Methods

Sterilization by Heat Common methods

Moist Heat



Dry Heat

Physical Methods

How do autoclaves work?

- 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 whatever form are killed.
- The usual temperature achieved is 121 °C exposure time 15 minutes (or 134 C for 10 minutes).

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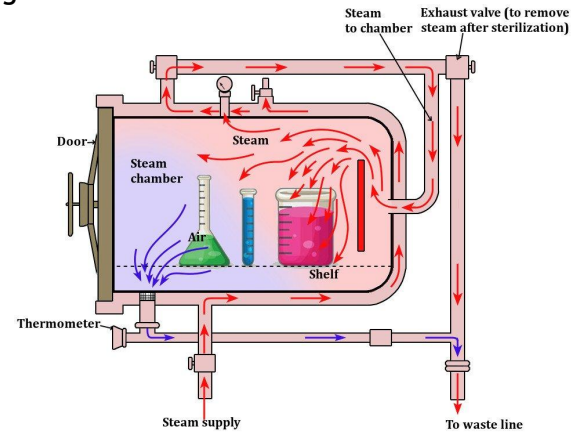
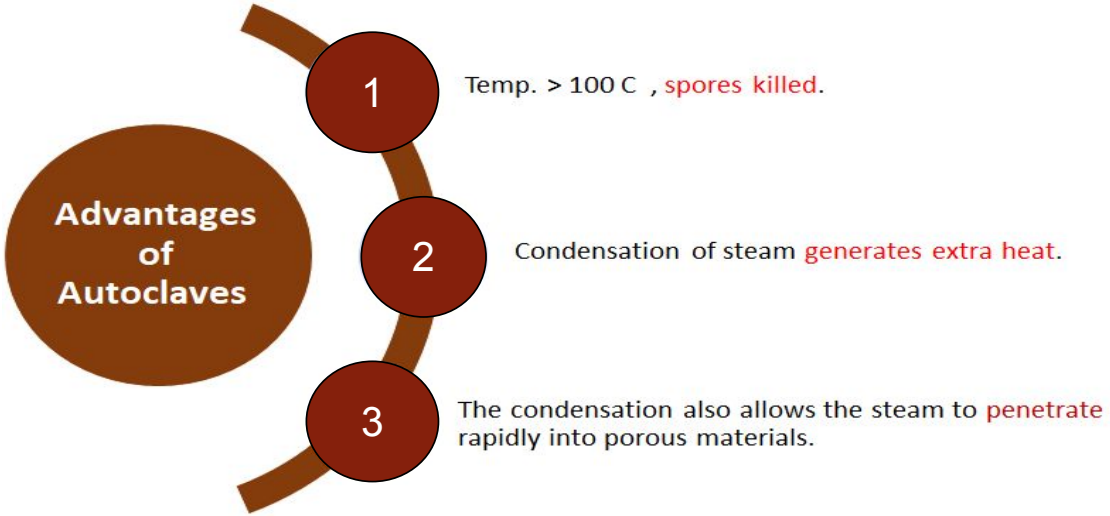


Advantages of Autoclaves



Note : *for all invasive procedures at operating room or clinics, autoclavable equipments should be used.*

Monitoring of Autoclaves

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.

Spore test is a 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 the milk to prevent diseases like :

- Typhoid fever
- Brucellosis
- Tuberculosis
- Q fever
- Salmonella

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.

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. Glutaraldehyde and Ethylene oxide. Used for heat sensitive equipment & material (e.g. lensed endoscope & plastics).	**Ethylene Oxide Chamber** Ethylene oxide alkylates DNA molecules & thereby inactivates microorganisms. Temperature: 55-60℃ Exposure period: 4-6 hours.
	Activated Alkaline Glutaraldehyde 2% Immerse item in solution for about 20 minutes. For Mycobacterium tuberculosis or spores, immersion period is 2-3 hours
	Other uses Hypochlorite (at certain concentrations) used for drinking water supply, house cleaning, and swimming pools.
Disinfectants/Antiseptics	E.g. phenolics, chlorhexidine, alcohol, iodine, etc…

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 increase in concentration.

3. Inactivation of disinfectants by: dirt, organic matter (proteins, pus, blood, mucus, & feces), non-organic (cork, hard water, & some plastics).

4. Time (disinfectants need time to work).

5. Range of action: disinfectants are not equally effective against the whole spectrum of microbes. E.g. chlorhexidine is less active against gram- bacteria than gram+ cocci. Hypochlorite & glutaraldehyde are more active against hepatitis virus than most other disinfectants.

Hospital disinfection methods

Article	Disinfectant
Floor, walls	Phenolic fluids 1-2%
Surfaces, tables	Hypochlorite, alcohol
Endoscopes	Glutaraldehyde 2% (Cidex), sub-atmospheric steam
Thermometers	70% alcohol
Skin: –Surgeon's hands –Patient skin	-Chlorhexidine, Iodine alcohol -70% alcohol, iodine

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.

Summary of disinfectants and antiseptics

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

Notes:

- ★ You don't have to memorise the previous table but you need to know the strong and commonly used chemicals (chlorhexidine,glutaraldehyde,alcohol,iodine)
- ★ important to know

Autoclave monitoring

Difference between objects sterilized by autoclave,hot air oven,

MCQs

Q1: What's the right temperature for Dry heat?

a)134 for 10 m. b)160 for half hour. c)160 for one hour. d)121 for 15 m.

Q2: The complete killing of all forms of microbes is?

a)Sterilization. b)disinfectants. c)disinfection. d)antiseptic.

Q3: High-level disinfectant is?

a)semi-critical. b)non-critical c)heat d)sterilization.

Q4: Filtration is one method of :

a)monitoring of Autoclave. b)semi-critical c)sterilization. d)heat.

SAQs

1- Give me the commonly used for the chemical method in the monitoring of Autoclave:

Autoclave tape

2- One of the advantages of the autoclave is?

Kill spores.

1/c 2/a 3/d 4/c

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