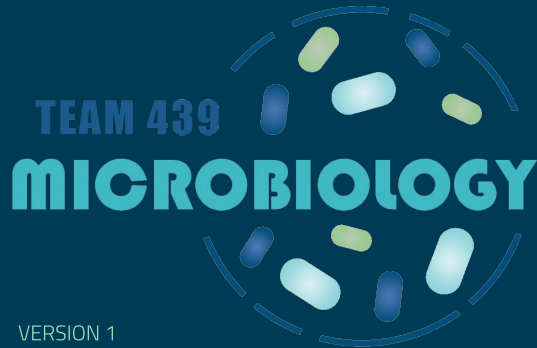


Sterilization and Disinfection



Objectives

- ❖ Define the terms sterilization, disinfectant and antiseptic
- ❖ Classify the different methods of sterilization (physical and chemical methods)
- ❖ Know and realize that heat is the most important method of sterilization and its application in medical practice
- ❖ Know dry heat as applied in hot air oven and moist heat as applied in autoclaves
- ❖ Know the principles of autoclave function and monitoring methods of sterilization
- ❖ Know the importance of non-heat sterilization methods and their use for sterilization of heat sensitive objects
- ❖ Know the difference between antiseptics and disinfectants
- ❖ Know types and scope of function of disinfectants and antiseptics and factors affecting their functions
- ❖ Know the applications of different disinfectants and antiseptics in medical practice

Colour index:

- **Red: Important .**
- Grey: Extra info & explanation.
- **Purple: only in girl's slides.**
- **Green: Only in boy's slides.**
-

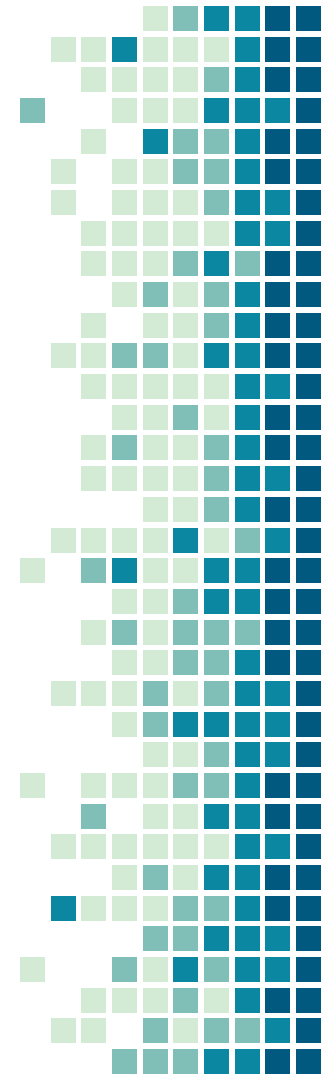
Any future corrections
will be in the editing
file, so please check it
frequently.

Scan the code
Or click [here](#)



Definitions


- ❖ **Sterilization:** Complete killing of all forms of microorganisms **including spores.**
- ❖ **Disinfection:** Killing/removing harmful vegetative microorganisms. **(kills everything except spores).**
- ❖ **Disinfectant:** Chemical substance used on inanimate objects (e.g scalpel, knife), and it is toxic to human.
- ❖ **Antiseptic:** disinfectant (less toxic), that can be safely used on living tissue.

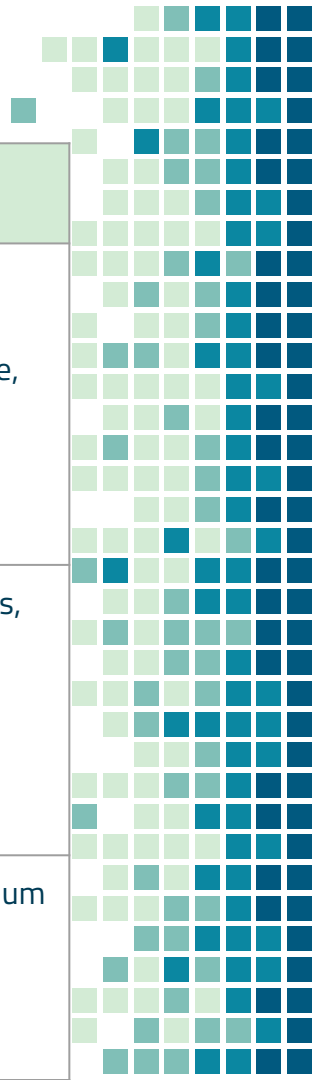


Sterilization By chemical or physical or biological method	Physical	Heat		Dry heat metals, glassware, ointment, oils, waxes, powder	160°C/60 mins
				Moist heat (faster than heat)	121°C/15 mins or 134°C/10 mins
				Milk pasteurization	74°C for 3-5 sec or 62°C/30 mins
		Radiation	UV	TB lab	254 nm waves
			Ionizing radiation	Sterilization of disposable stuff	Gama rays, x rays, cosmic rays
		Filtration		For sera & antibiotics	0.22-2.24 µm pores
	Chemical	Ethylene oxide		Endoscopes	55-60°C 4-6 hrs
		Glutaraldehyde		Endoscopes & anesthetic tubes	2% 20mins TB 2 hrs
Disinfectant	Phenolic fluids e.g. Dettol		Surgical surfaces & neonatal units	1-2%	
	Glutaraldehyde		Surfaces	2%	
	Alcohol		Surfaces/thermometer		
Antiseptic	Chlorhexidine		Skin	0.5%	
	Iodine (halogens)		Skin	10%	
	Alcohol		Skin	70%	

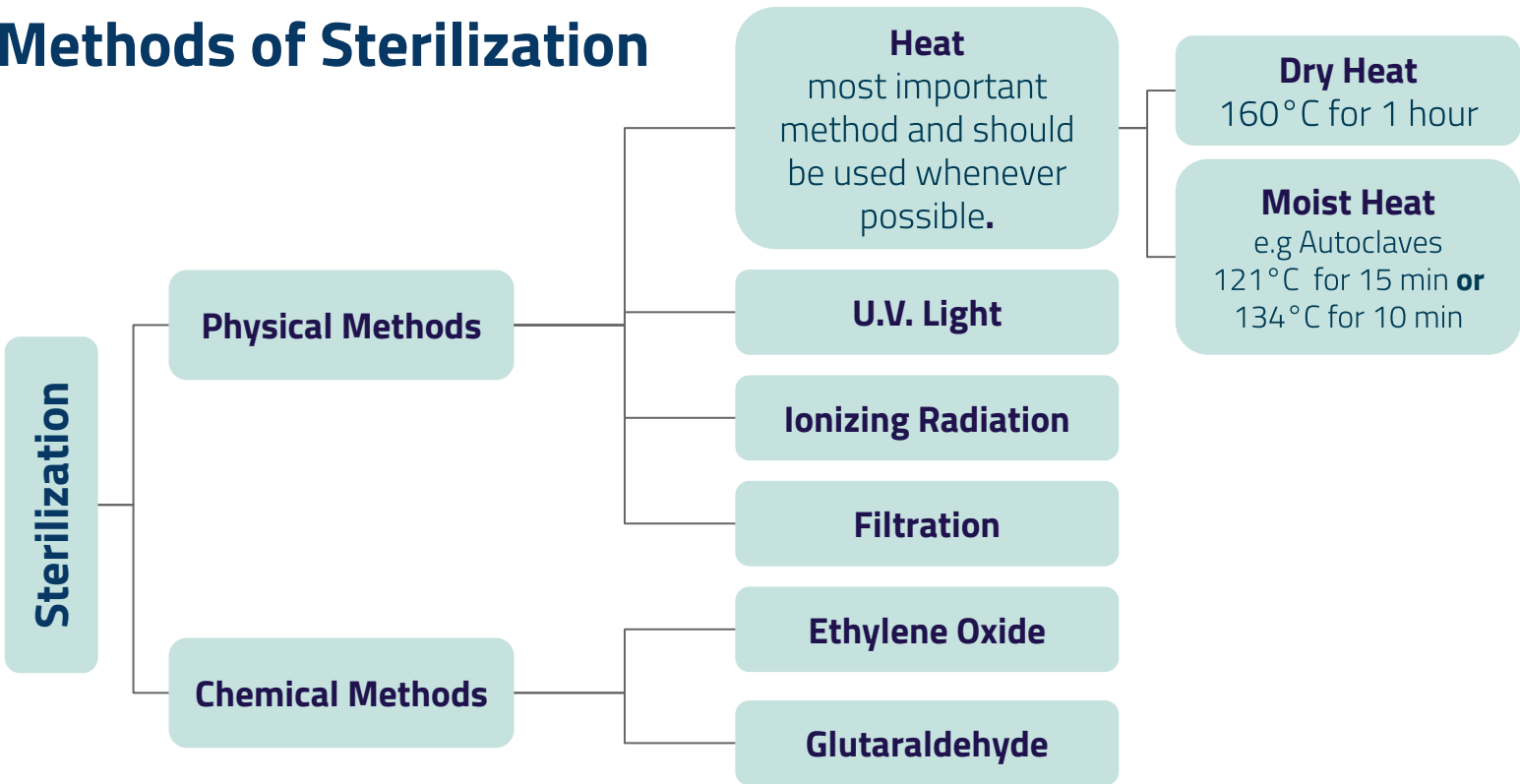
Levels of Disinfectants

Only found in boy's slides

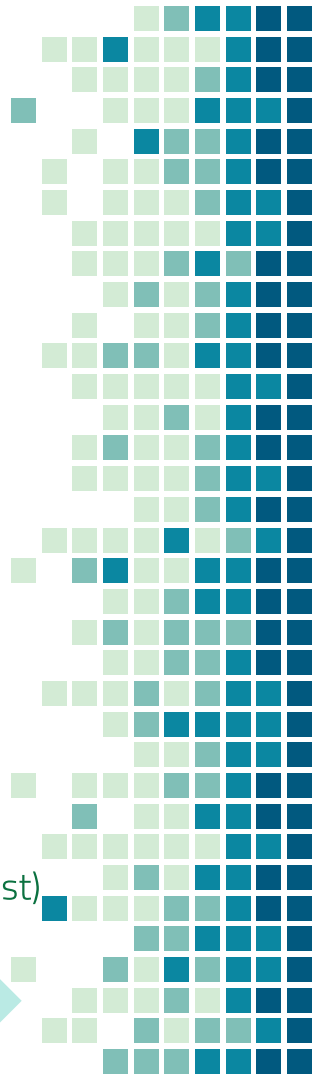
Level	Uses	Application	Examples
<p>High-level disinfectants</p> <p>-Kill all microorganisms + spores</p> <p>(Some strong disinfectants are capable of sterilization if the concentration is high)</p>	<p>Used for critical instruments, items involved in invasive procedures (a device that enters normally sterile tissue)</p>	<p>Endoscopes, Surgical instruments</p> 	<p>Moist heat, Glutaraldehyde, Hydrogen peroxide, Chlorine dioxide, Formaldehyde, Peracetic acid</p>
<p>Intermediate Level</p> <p>-Kill all microorganisms including mycobacterium (TB), non-enveloped viruses, fungi, & bacteria</p>	<p>Used on semi-critical instruments, for cleaning surfaces or instruments without bacterial spores and highly resilient organisms</p>	<p>Laryngoscopes, anesthesia breathing circuits</p>	<p>Phenol compounds, Alcohol, Iodophor</p>
<p>Low-level disinfectants</p> <p>-Kill enveloped viruses and bacteria</p>	<p>Used to treat non-critical instruments, not penetrating into mucosal surfaces or sterile tissue</p>	<p>Hospital surfaces</p>	<p>Quaternary ammonium compounds</p>



Methods of Sterilization



Boy's slides | Disinfectant level: arranged from most resilient (strongest) > to least resilient (weakest)



Physical Methods

Note: Moist heat requires less time compared to dry heat

Dry heat

مثل الفرن

Kills microorganisms by destroying their **oxidative processes**

Source of heat = electric chamber

Has a fan to circulate the air for even distribution of heat. (an oven without a fan is dangerous)

Used for items **lacking water** such as:
1-Metals 2-Glassware
3-Ointment/oils/waxes/powder

Simplest method is exposing the item to be sterilized to a naked flame. E.g **Bunsen burner** for sterilizing bacteriological loops, knives, blades

Moist heat

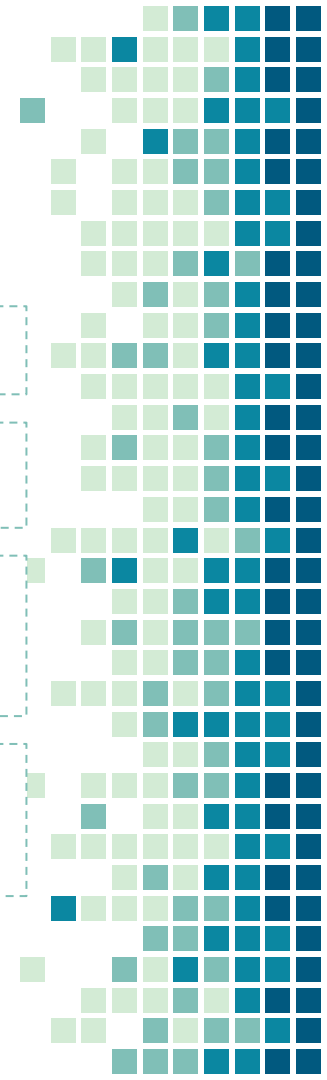
مثل قدر الضغط

Kills microorganisms by **denaturing proteins**

E.g **Autoclave**: standard sterilization method in hospitals.

It works by boiling water at increased atmospheric pressure (due to \uparrow pressure water boils $>100^{\circ}\text{C}$)

The autoclave is a tough double walled chamber in which air is replaced by pure saturated steam under pressure



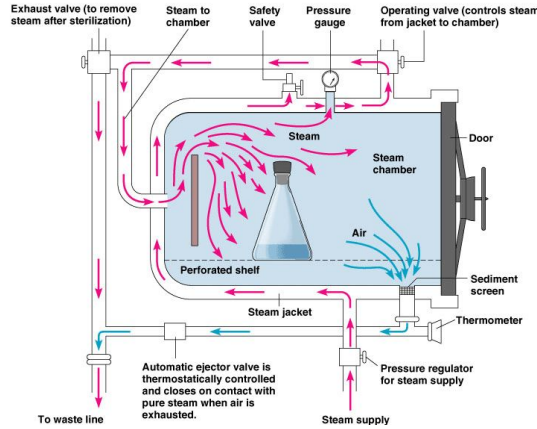
How Autoclaves Work?

The air in the chamber is evacuated and saturated steam enters.

The chamber is closed tightly and the steam continues to enter.

The pressure rises

Pic is For Clarification Only

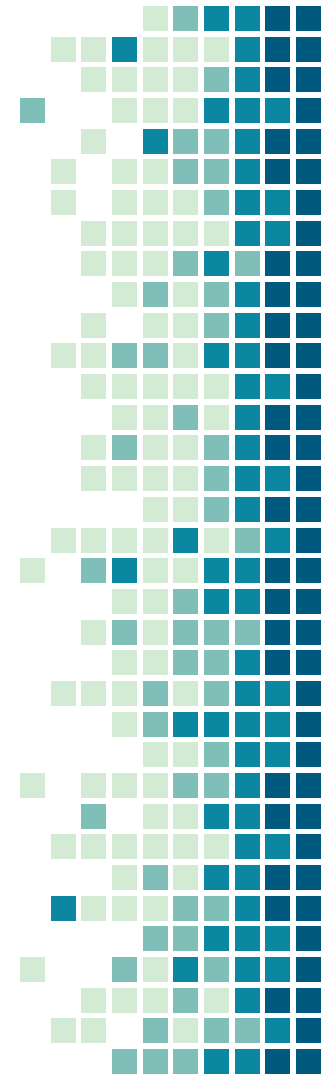


The items to be sterilized get completely surrounded by steam (moist heat).

Eventually all microorganisms in whatever form are killed.

Which adds to the already raised temperature of the steam.

The surface of the material condenses to release its latent heat of condensation.



Autoclaves

1

Physical method: use of thermocouple to measure the temperature.

Monitoring Autoclaves

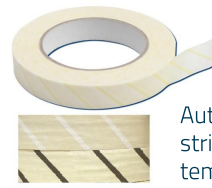
2

Chemical method: it consists of a heat sensitive chemical that changes color at the right temperature and exposure time. E.g **a)** Autoclave tape (commonly used) **b)** Browne's tube

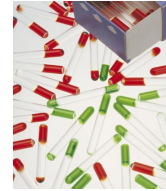
3

Biological method: where a **spore-bearing** organism is added during the sterilization process and then cultured later to ensure that it has been killed.

فيه 3 طرق لقياس أداء Autoclaves ، رقم 1 باستعمال جهاز يقيس الحرارة جوا، رقم 2 باستعمال شريط أو أنابيب يتغير لونها اذا كان التعقيم صحيح والجهاز شغال زين، اما الطريقة الثالثة انهم يحطون سبورز جوا الجهاز وبعدها يطلعونها و يسوون لها cell culture باللاب، اذا ماصار نمو للكلتشر معناها السبورز ماتت والجهاز شغال زي الفل، اما اذا نمت الكلتشر وعاشت يعني فيه شي غلط ولازم يشوفون لهم صرفه.



Autoclave tape: The black stripes show that the target temp has been achieved





Browne's tube: The tubes change from red to green after target temp is achieved

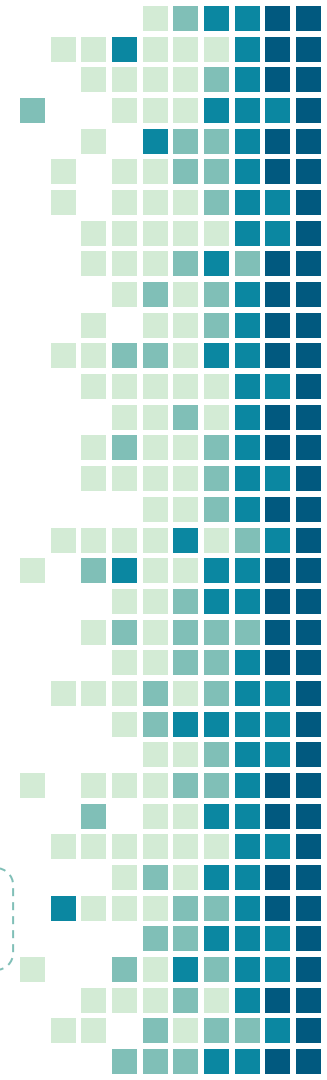
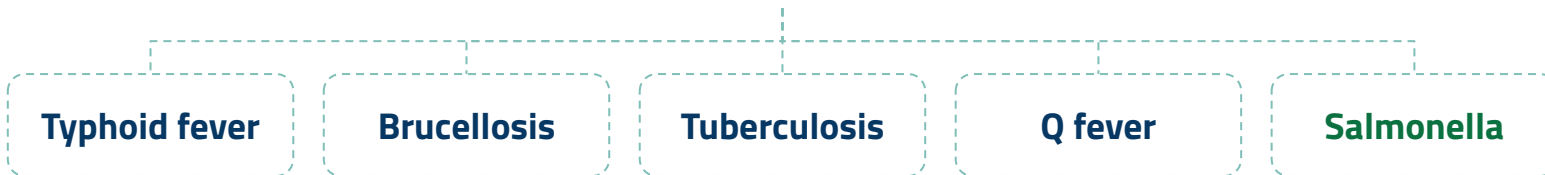
Advantages of Autoclaves

- Temp $>100^{\circ}\text{C}$, **spores killed.**
- Condensation of steam **generates extra heat.**
- The condensation also allows the steam to **penetrate** rapidly into porous material.

Moist Heat: Other Applications

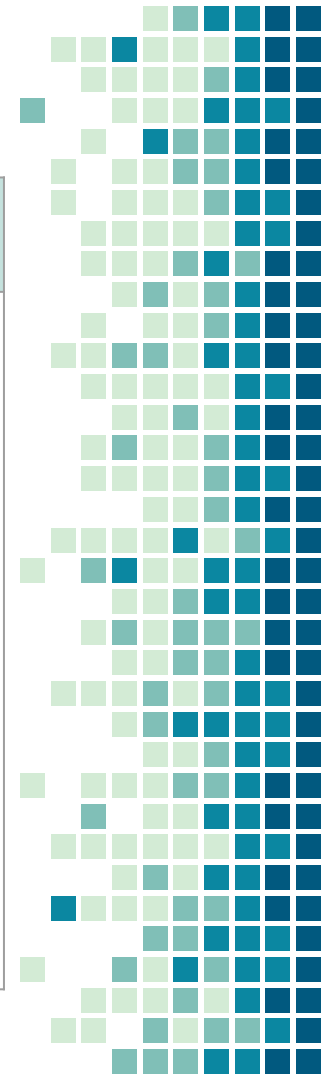
Pasteurization 	<ul style="list-style-type: none">❖ Used to heat at temperatures sufficient to inactivate harmful organisms in the milk.❖ The temperature of sterilization is not achieved❖ Temp. may be 74°C for 3-5 sec (Flash method) or 62°C for 30 min (Conventional method).
Boiling	<ul style="list-style-type: none">❖ Commonly used in domestic circumstances (houses).
Steam Sterilizers 	<ul style="list-style-type: none">❖ Used for baby bottles

Diseases that pasteurization helps to prevent



Other Physical Methods:

Radiation <small>2 types</small>	Filtration
<p>★ UV light</p> <ul style="list-style-type: none">○ Has limited sterilizing power because of poor penetration. مايقدر يخترق الأسطح○ Used in irradiation of air in certain areas (e.g operating rooms & TB labs).	<ul style="list-style-type: none">★ Use of membrane filter e.g membrane filter made up of cellulose acetate.★ Generally removes most bacteria★ But viruses and small bacteria e.g chlamydia & mycoplasma may pass through.
<p>★ Ionizing radiation</p> <ul style="list-style-type: none">○ E.g Gamma radiation.○ Has greater energy than UV, thus it is more effective.○ Used mainly in industrial facilities to sterilize (disposable plastic syringes, gloves, specimens, containers, petri dish).	<ul style="list-style-type: none">★ Doesn't technically sterilize items but is adequate for circumstances under which is used.★ Main use: for heat labile substances (substances that can be destroyed at high temp) E.g sera, antibiotics.★ Other use: AC of certain operating theaters.



Chemical Methods,

either by strong chemicals or
by disinfectants/antiseptics.



Strong Chemicals

Some strong chemical substances may be used to achieve sterilization (kill spores).

Used for heat sensitive equipment & material
E.g lensed endoscope & plastics

1- Ethylene oxide chamber

Ethylene oxide alkylates DNA molecules & thereby inactivates microorganisms
Temp: 55-60°C
Exposure period: 4-6 hours

2- Activated Alkaline Glutaraldehyde 2%

Immerse item in solution for about 20 min. But for Mycobacterium tuberculosis or spores immersion period is 2-3 hours

3- Other Uses

Hypochlorite (at certain concentrations) used for drinking water supply, house cleaning, and swimming pools

Disinfectants/Antiseptics

E.g phenolics, chlorhexidine, alcohol, iodine...

Factors influencing activity of disinfectants

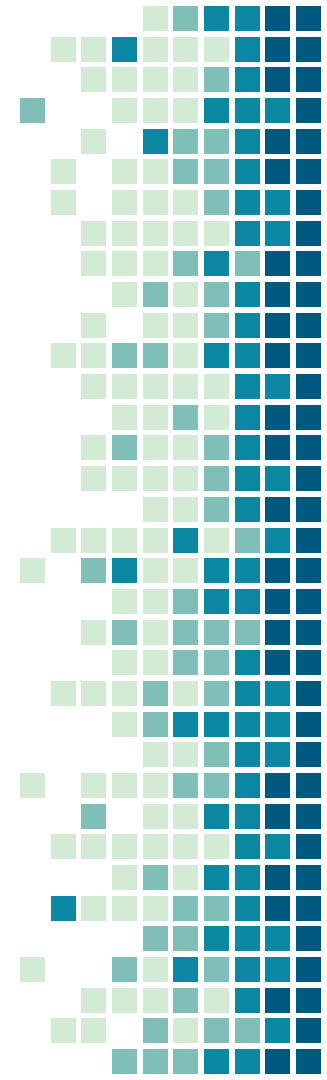
Activity is **directly proportional** to **temperature**

It is **Directly proportional** to **concentration** up to an optimum concentration (after this level there is no advantage in further increasing the concentration)

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

Time (disinfectants need time to work)

Range of action: disinfectants are not equally effective against the whole spectrum of microbes. E.g chlorhexidine is **less active against gram (-ve) than gram (+ve)** 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's skin

Chlorhexidine, Iodine
alcohol, 70% alcohol

- Any instrument or item used on **Sterile tissue** should be **Sterile.**

- Any instrument or item used for **Non-Sterile tissue** can be **Disinfected.**



Notes

- ❖ Sterilization kills everything including spores, while disinfection kills everything except spores.
- ❖ Disinfection is the **name** of the process, but disinfectant is the chemical **substance** used.
- ❖ If you increase the concentration or the time of disinfectants It's will be high-level (critical) which means (Sterilization).
- ❖ There are 3 level of disinfectants:
 - High-Level (critical).
 - Intermediate-Level (semi-critical).
 - Low-Level (non-critical).
- ❖ Antiseptic is used for human, and it's one of the disinfectants. (All antiseptics are disinfectants, but not all disinfectants are antiseptic).
- ❖ In heat sterilization when you use the moist heat, you can go for a shorter period of time because of the moist which makes it faster.
- ❖ The UV light used in the TB labs, and it kills all the microbes.



MCQs

1- Complete killing of all forms of microorganisms including spores?

- A- Sterilization
- B- Disinfectant
- C- Filtration
- D- Antiseptic

2- Dry heat uses:

- A- 60°C for 1 hour
- B- 160°C for 1 hour
- C- 160°C for 30 mins
- D- 120°C for 1 hour

3- UV is used for:

- A- Sera and antibiotics
- B- milk pasteurization
- C- TB lab
- D- Disposable stuff

4- Chlorhexidine is used for with concentration of

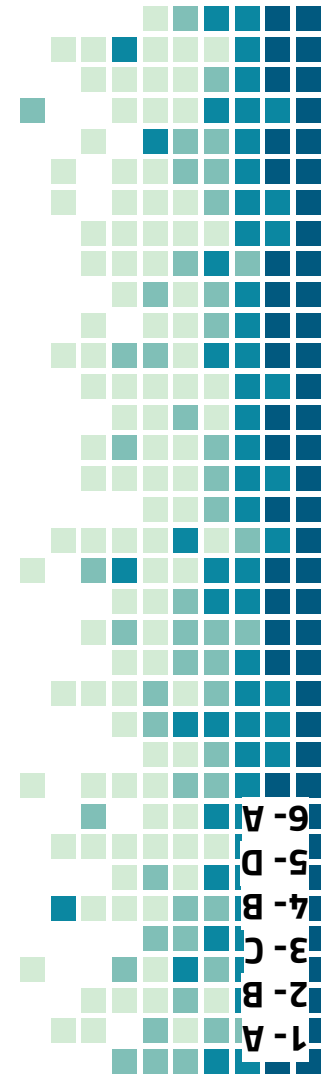
- A- Skin, 70%
- B- Skin, 0.5%
- C- Surface 0.7%
- D- Surface 0.5%

5- Milk pasteurization can be achieved with:

- A- 74°C for 3-5 sec
- B- 62°C for 30 mins
- C- 160°C for 15 mins
- D- A or B

6- Moist heat kills organisms by:

- A- Denaturation proteins
- B- Oxidative processes
- C- By spraying alcohol with heat
- D- By a fanned hot oven



1-A
2-B
3-C
4-B
5-D
6-A

MCQs

1- In the hospitals, thermometers are disinfected with?

- A- Autoclave
- B- 0.5% glutaraldehyde a
- C- 70% alcohol
- D- Iodine

2- Not an influencing factor of activity of disinfectants

- A- Temperature
- B- Time
- C- Concentration
- D- Moist & pressure

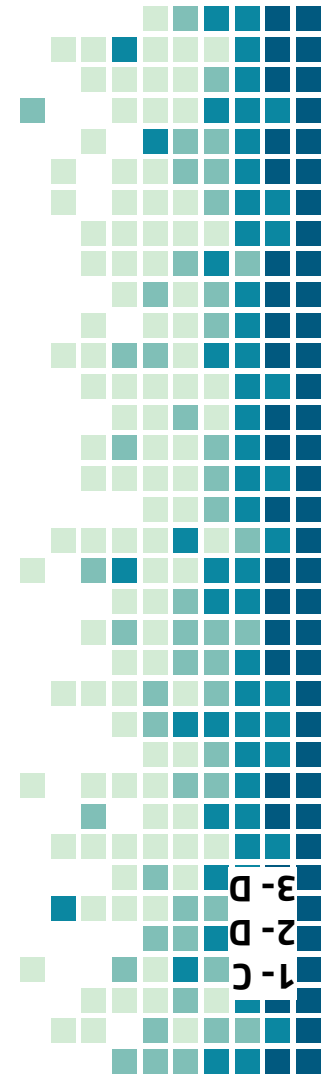
3- Hypochlorite and alcohol are used in the hospital with?

- A- Endoscopes
- B- Surgeon's hands
- C- Patient's skin
- D- Surfaces

SAQ

Q1- What are the advantages of Autoclaves?
(Slide 9)

Q2- List 3 factors that affects the activity of disinfectants. (Slide 14)



1-C
2-D
3-D

Team Leaders

- Duaa Alhumoudi
- Manee Alkhalifah

Team Members

- Sarah Alqahtani
- Sadem Alzayed
- Noura Alshathri
- Ghadah Alsuwailem
- Shahad Almezel
- Noura Alsalem
- Sumo Alzeer
- Renad Alhomaidi
- Raghad Albarrak
- Reema Alowerdi
- Abdulaziz Alderaywsh
- Sultan Alqahtani
- Faisal Alomri
- Munib Alkhateeb
- Abdulaziz Alomar
- Muhannad Alomar



Contact us through:
Microbiology439@gmail.com