

Microbiology – Lecture 3

Sterilization

TEAM 437

Red: important

Green : doctor notes

Black : original slides

Grey: extra information



In this link, you will find any corrections or notes unmentioned in the team's work. Please check the link below [frequently](#).

https://docs.google.com/presentation/d/1yIQt3G8UDFG6xYMRhXkTk-dS54NeTfhJaPe_y0M-kjk/edit?usp=sharing



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 medical applications of different disinfections and antiseptics.**

Definition and sterilization methods



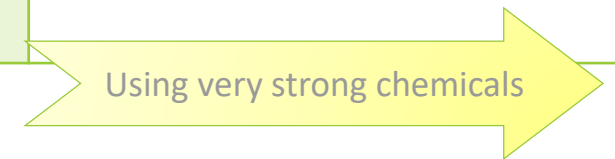
Term	Definition
Sterilization	complete killing of all forms of microorganisms, including bacterial spores
Disinfection	killing or removing of harmful vegetative microorganisms.
Disinfectant	chemical substance used to achieve disinfection used on inanimate objects. Toxic to humans.
Antiseptic	disinfectant that can be safely used on living tissues

Methods of Sterilization



Physical methods	<ul style="list-style-type: none"> • Heat (dry heat & moist heat), most important and should be used whenever possible. • U.V. Light, (ultra violet) • Ionizing Radiation • Filtration
Chemical method; used for heat sensitive equipment.	<ul style="list-style-type: none"> • Ethylene Oxide • Gluteraldehyde

Using very strong chemicals





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
High-level disinfectants Kill all including spores	Used for items involved in invasive procedures but NOT withstand sterilization (critical)	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	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)	Hospital surfaces	Quaternary ammonium compounds



PHYSICAL METHODS

COMMON HEAT METHODS

1. Dry heat

Dry Heat- kills microorganisms by destroying their **oxidative processes**. At temperature of 160C for 1 hour.

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



2. Moist heat

Uses **hot water**. Moist heat kills microorganisms by **denaturation proteins**.

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

standard sterilization method in hospitals.

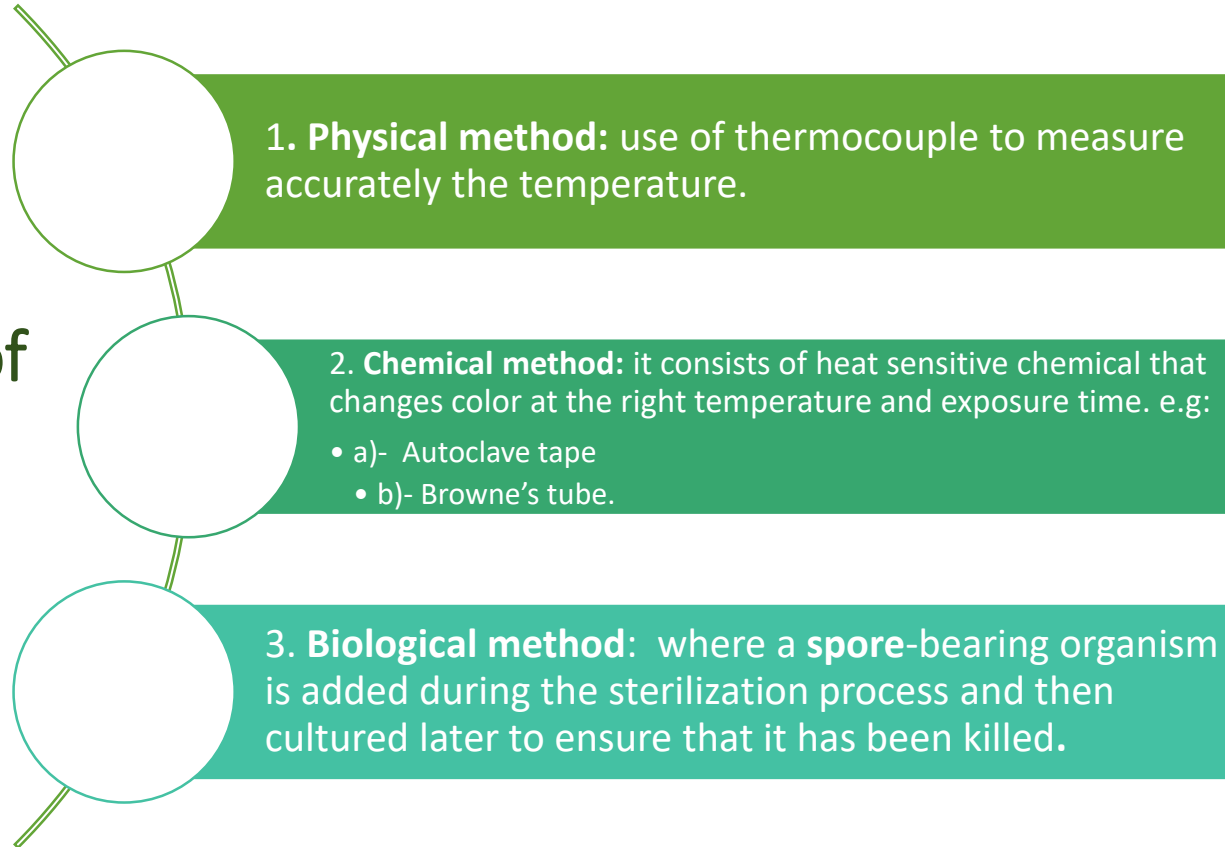
The equipment is called Autoclave and it works under the same principle as the pressure cooker where **water boils at increased atmosphere pressure i.e. because of increase pressure the boiling point of water is >100 °C.**

Autoclaving and how it works



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Monitoring of Autoclaves



Spore test is a biological indicator

This is autoclave tape; it will have NO black stripes before sterilization.

Black stripes AFTER sterilization



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.

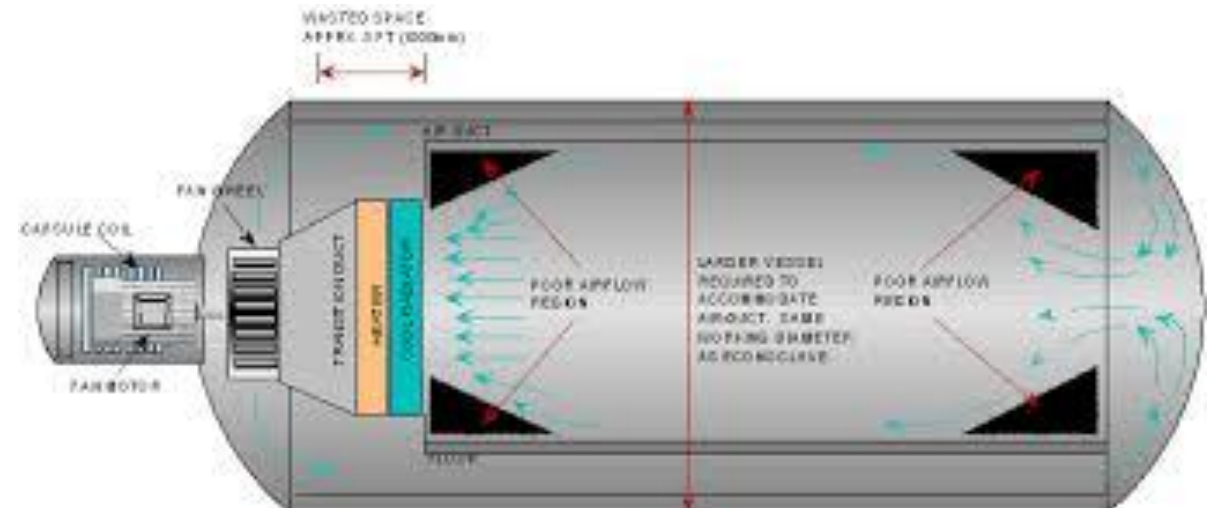
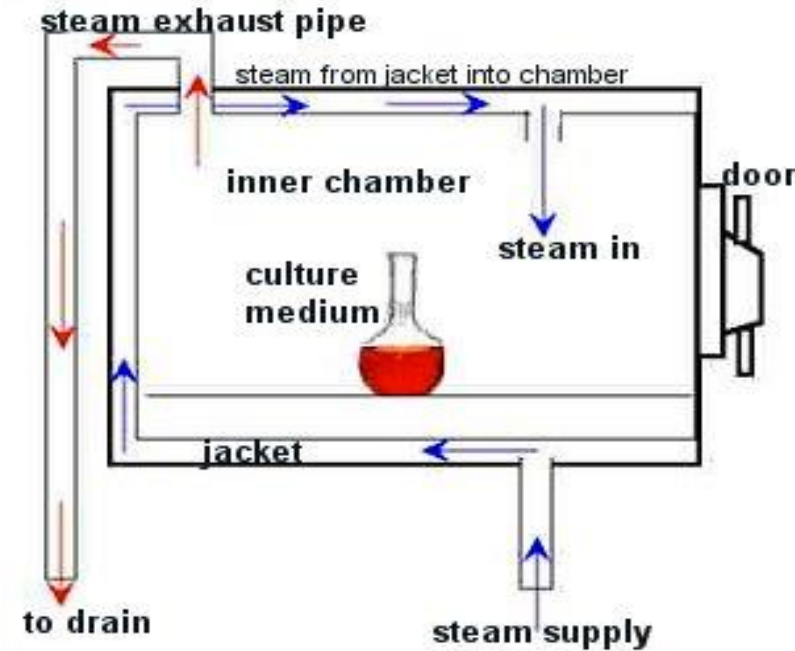
Note: for all invasive procedures at operating room or clinics, autoclavable equipments should be used.



How does it 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 what ever form are killed.

The usual temperature achieved is **121 ° C**, exposure time of only **15 minutes** (or **134 C for 10 minutes**).





In short pasteurization :

Is the most effective way to sterilize.
-it requires high temperature and high pressure.
-it does the work at short time.

Moist heat: Other Applications

A) 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**)

62°C for 30 minutes. (**Conventional method**).

Why do we pasteurize foods?

To prevent transmission of zoonotic diseases to humans, like :

- Typhoid fever
- Brucellosis
- Tuberculosis
- Q fever

B) Boiling

quite common especially in domestic circumstances.

C) Steam Sterilizers

For babies' bottles.



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.*

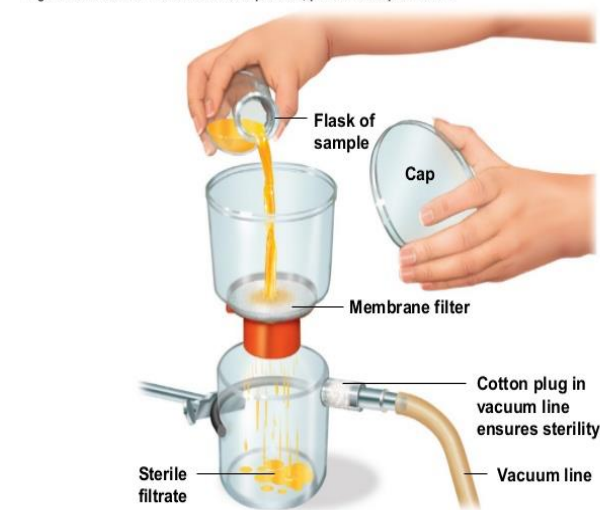




Other Physical Methods: Filtration

- 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.

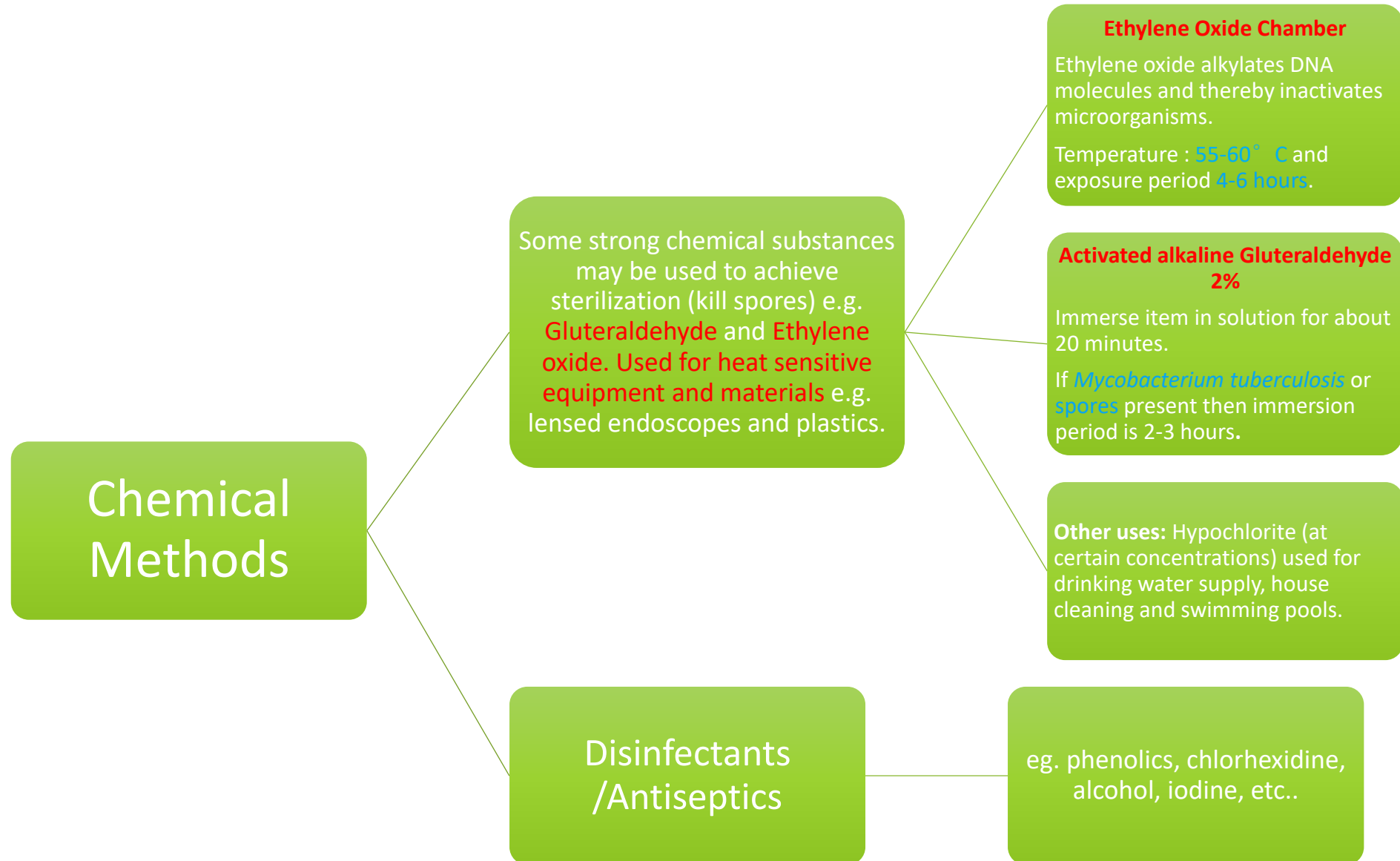
Figure 7.4 Filter sterilization with a disposable, presterilized plastic unit.



Chemical Methods



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Chemical Methods

Some strong chemical substances may be used to achieve sterilization (kill spores) e.g. **Gluteraldehyde** and **Ethylene oxide**. Used for **heat sensitive equipment and materials** e.g. lensed endoscopes and plastics.

Ethylene Oxide Chamber
Ethylene oxide alkylates DNA molecules and thereby inactivates microorganisms.
Temperature : **55-60° C** and exposure period **4-6 hours**.

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.

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

Disinfectants /Antiseptics

eg. phenolics, chlorhexidine, alcohol, iodine, etc..

Note; Clorox is a tamer type of hypochlorite



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.

3. Disinfectants may be inactivated by:

- A) Dirt
- B) Organic matter: Proteins, Pus, Blood, Mucus and Feces.
- C) 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.



Note; it must be clean before disinfecting



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 \pm Solution)
Lodophor	++	++	+ (Slow)	+	+	-	-
<u>Chlorhexidine (Hibitane)</u>	++	+	-	-	-	-	-
70° alcohol	++	++	-	±	++	-	-
Formaldehyde	++	++	++ (slow)	++	+	-	++
<u>Gluteraldehyde (Cidex)</u>	++	++	++	++	±	-	+



Hospital Disinfection Methods

Article:

Floors, walls

Disinfectant:

- Phenolics fluids 1-2%

Surfaces tables

- Hypochlorite, Alcohol

Skin:

Surgeons' hands

- Chlorhexidine, Iodine alcohol

Patient's skin

- 70% Alcohol, Iodine

Endoscopes

- Gluteraldehyde 2% (Cidex), sub-atmospheric steam

Thermometers

- 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**.

Soap, Water and common sense
are yet the best antiseptics

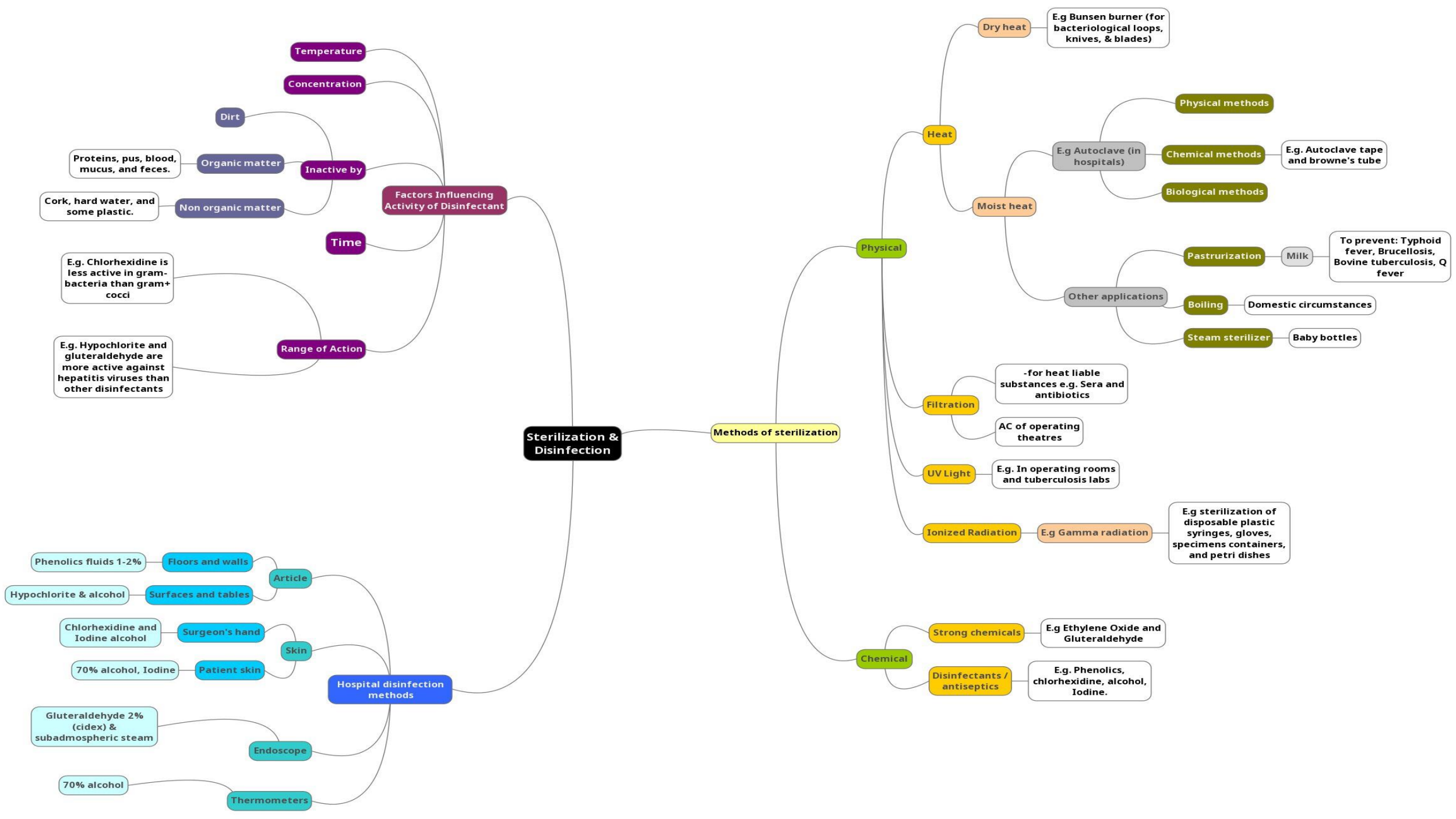
William Osler

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





Quiz and references

1- killing or removing of harmful vegetative microorganisms, is:

- A- sterilization b- disinfectant c- antiseptic d- disinfection

2- Disinfectants may be inactivated by :

- A- water b- dirt c- soap d- washing

3- Gamma radiation: has greater energy than U.V. light, therefore more effective. Used mainly in :

- A- industrial facilities b- tuberculosis labs c- Browne's tube d- Patient's skin

4- We use pasteurization to prevent the transmission of which disease?

- A- tuberculosis b- small pox c- hepatitis d- liver failure

5- Chlorhexidine less active against Gram:

- A- positive b- negative

6- 74C, for 3-5 seconds is called:

- A- frozen method b- conventional method c- flash method d- pasturized method

Answers

D

B

A

A

B

C



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لا يقوى الإنسان في الحياة على هذه الأرض من دون أن يعاونه الناس ويقفوا معه.



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