

Microbiology

team 436



MEDICINE
KING SAUD UNIVERSITY

MICROBIOLOGY

Lecture : Sterilization and disinfection

IMPORTANT.
DOCTORS NOTES.
EXTRA INFORMATION.

Objectives :

- 1- Define the terms sterilization, disinfectant and antiseptic. **3**
- 2- Classify the different methods of sterilization (physical and chemical methods). **4**
- 3- Know and realizes that **heat is the most important method** of sterilization and its application in medical practice. **5**
- 4- Know dry heat as applied in hot air Oven and moist heat as applied in autoclaves. **7**
- 5- Know the principles of Autoclave function and monitoring methods of sterilization .**6-9**
- 6- Know the importance of non heat sterilization methods and their use for sterilization of heat sensitive objects. **13-15**
- 7-Know the difference between antiseptics and disinfectants. **16**
- 8- Know types and scope of function of the disinfectants and antiseptics and factors affecting their functions. **16**
- 9- Know the medical applications of different disinfections and antiseptics. **16**

Definition

Sterilization:

complete killing of all forms of microorganisms, including bacterial **spores**.

Disinfection:

killing or removing of harmful vegetative microorganisms.

Disinfectant:

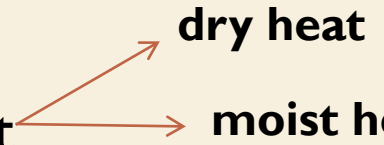
chemical substance used to achieve disinfection.

Antiseptic:

disinfectant that can be safely used on living tissues.

Methods of Sterilization

Physical methods:

1. Heat 
 - dry heat
 - moist heat
2. U.V. Light
3. Ionizing Radiation
4. Filtration

Chemical method:

(used for heat sensitive equipments)

1. Ethylene Oxide
2. Gluteraldehyde

Simplest methods is to sterilize by naked flame

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. Autoclave at 121 or 134 C for 10 or 15 minutes

PHYSICAL METHODS : Sterilization by Heat (Common methods)

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



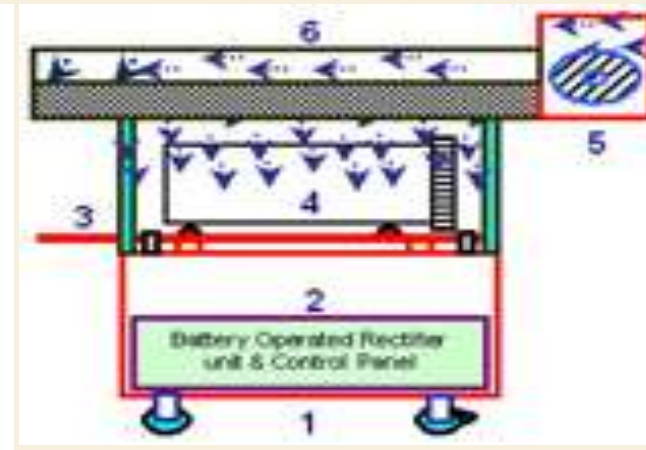
B) Moist Heat very important

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

Autoclaving – standard sterilization method in **hospitals (standard method)** .

The equipment is called **Autoclave** and it works under the same principle as the pressure cooker (قدر الضغط) where **water boils** at increased atmosphere pressure i.e. because of **increase pressure** the boiling point of water is **$>100^{\circ} \text{C}$** .

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



من الضروري إن
الأدوات اللي تستخدم
بالمستشفيات تكون
معقمة حتى لا تنتقل
الأمراض بين
المرضى لذا يستخدم
autoclave جهاز ال
لأن فاعليته قوية ويقتل
spores حتى ال

B) Moist Heat

يخرج الهواء
خارج الجهاز

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)**.

ممکن یختلف من
جهاز لجهاز

Advantages of Autoclave

1. Temp. > 100 C therefore **spores killed**.
2. Condensation of steam **generates extra heat**.
3. 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 accurately the temperature.

2. **Chemical method:** it consists of heat sensitive chemical that changes color at the right temperature and exposure time.

- e.g.
- a)- Autoclave tape
 - 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.

هذي الطرق للتأكد من فعالية ال
autoclaves
و مو شرط نتأكد كل يوم ممكن
نتأكد كل 3 شهور



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**

- ✓ quite common especially in domestic circumstances.

✓ Pasteurization of the milk to prevent diseases like :

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

Other physical methods

Radiation

U.V. 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. 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.**

Serum is sterilized
by filtration



Moist heat

الشريط قبل عملية التعقيم تكون عليه خطوط بيضاء وبعد التعقيم خطوط سوداء غير متقطعة تدل على أن جميع الأدوات عقت بشكل صحيح

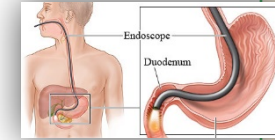
الأنابيب تكون حمراء قبل عملية التعقيم وإذا تمت عملية التعقيم بنجاح يصير لونها أخضر

filtration

ممكن يحطون فلاتر في المكيفات لترشيح الهواء من بعض أنواع البكتيريا



Chemical Methods:



Used for **heat sensitive** equipments. e.g. plastics and lensed endoscopes.

Simple
disinfectants / antiseptic

alcohol,

phenolics,

chlorhexidine,

Strong

chemical substances may be used to achieve sterilization (**kill spores**)

Activated alkaline
Gluteraldehyde 2%

(يستخدم في عيادات المناظير)
وهو أسهل من Ethylene oxide

Ethylene oxide
(inactivates
microorganisms by
alkylates DNA molecules)

Most disinfectant **doesn't** achieve full sterilize
EXEPT glutaraldehyde 2% can achieve full sterilize

HIV & hepatitis B/C
virus

من أخطر الكائنات التي
ممكن تنتقل من مريض لآخر
عند استخدام نفس المنظّر

Immerse item (endoscopes) in solution (Gluteraldehyde) for:

[^](غمّر)

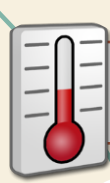
1- HIV or hepatitis B/C > about 20 m.

2- Mycobacterium tuberculosis or spores > immersion period 2-3 h.

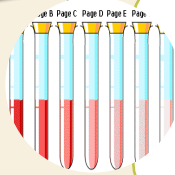
Ethylene oxide may cause **explosion** if used **pure**, so it is:

- 1- mixed with an inert gas.
- 2- Requires high humidity (50- 60%).
- 3- Temperature : 55-60°C
- 4- exposure period 4-6 hours.

FACTORS INFLUENCING ACTIVITY OF DISINFECTANTS



1-Activity directly proportional to **temperature**.



2-Directly proportional to **concentration** up to a point – optimum (الأمثل) concentration. After this level no advantage in further increases in concentration.

إذا ما كان في التركيز المطلوب لن يكون ذا

عشان كذا ما احط المطهر على الجهاز عطلول . لا! لازم

اغسله قبل

فائدة

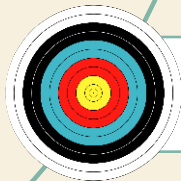
3- it is **inactivated** by: **A**-Dirt. **B**-Organic matter (Proteins, Pus, Blood, Mucus; Feces). **C**-Non organic (Cork (فلين), Hard water, Some plastics).

بعض المطهرات تحتاج تكون في أوعية معينة (فلين/بلاستيك/زجاج..))



4- **Time**: Disinfectants need time to work (explosion).

Range of action means (affects what type of bacteria?)



5- **Range of Action**: Disinfectants not equally effective against the whole spectrum of microbes.

e.g. **Chlorhexidine**: less active against (-Gram) bacteria than (+Gram) cocci.

Hypochlorite & Gluteraldehyde: more active against hepatitis viruses than most other disinfectants.

Summary: Disinfectants /Antiseptics

Gram positive cocci Gram negative bacilli

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

Chlorine's uses include:

- Clorox (diluted form)
- small portions are added to drinking water
- used in swimming pools (especially public ones)
- تعقيم رضاعات الأطفال

- + : effective
- ++: very effective
- : Less effective
- +: maybe
- = double negative (less effective)

^you should read all that , you are a doctor 😊 but you need to memorize only the strong Disinfectants (yellow) & daily-use Disinfectants (blue)

most of the strong disinfectants are ++ differ especially in spores

most of the daily-use disinfectants are - or =

Hospital disinfection methods

*Depends on
Hospital's
Policy

Article	Disinfectant
-Floors, walls:	Phenolics fluids 1-2%
-Surfaces tables:	Hypochlorite, Alcohol
-Endoscopes:	Gluteraldehyde 2% (Cidex)
	sub-atmospheric steam
-Thermometers:	70% Alcohol
Skin:	Antiseptics
-Surgeons' hands:	Chlorhexidine, Iodine alcohol
-Patient skin:	70% Alcohol, Iodine

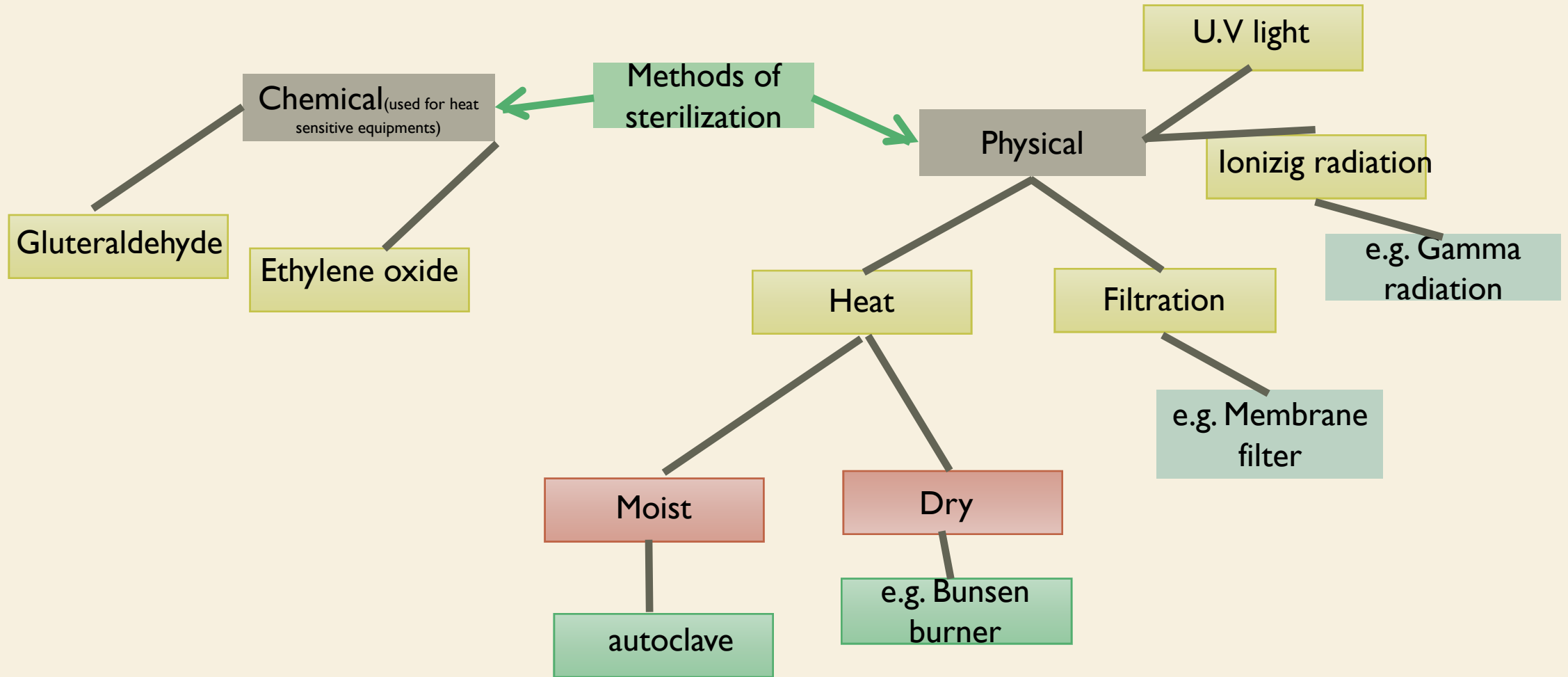
Important points

- 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.**
- Hand washing is the most important to **prevent** hospital acquired infection.

Online quiz

<https://www.onlineexambuilder.com/microbiology-l7-part2/exam-106383>

summery



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