



Sterilization & Disinfection

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Objectives

- 1- Define the terms sterilization, disinfectant and antiseptic.**
- 2- Know 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.**

Objectives , cont.

- 7~Know the differences between antiseptics and disinfectants.**
- 8~ Know the factors affecting disinfectants and antiseptics .**
- 9~ Know the scope of function and applications of different disinfections and antiseptics in clinical 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.

Methods of Sterilization

1. Physical Methods:

Heat (*moist heat & dry heat*)

U.V.(ultra violet) Light

Ionizing Radiation

Filtration

2. Chemical Methods:(used for **heat sensitive equipment**)

Ethylene oxide

Gluteraldehyde

Physical Methods: Heat

HEAT : Most important method ,should be used whenever possible, can be :

A-Dry heat : use temperature at 160°C for one hour

B- Moist heat : eg. Autoclaves, use temperature at 121 for 15 minutes or 134 C for 10 minutes.

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 ,virology 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.

Physical Methods : Filtration

Use of **membrane filter** made of cellulose acetate or other material.

Generally removes most bacteria but viruses and some small bacteria (e.g. *Chlamydia & Mycoplasma*) require smaller pore sizes.

Thus filtration does not technically sterilize the 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.



Medical applications of heat methods

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 , Oil, Waxes ,Powder



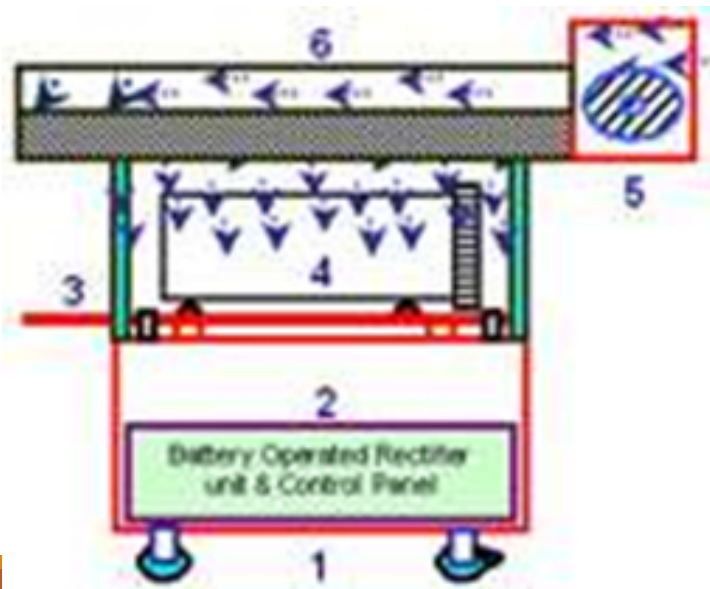
Moist Heat: Autoclave

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

Autoclaving : the 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 atmospheric pressure ,because of **increased 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.



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 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 and spores are killed.

The usual temperature achieved is **121 ° C for 15 minutes** or **134 C for 10 minutes.**

Advantages of Autoclaves

Temp > 100 C therefore **spores killed**.

Condensation of steam **generates extra heat**.

The condensation also allows the steam to **penetrate** into porous materials.

Note: Autoclavable items must be used for invasive procedures in operating room , dental equipments , and the laboratories.

Monitoring of Autoclaves

- 1. Physical method:** use thermocouple to measure accurately the temperature.
- 2. Chemical method :** use 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 : spore test**, a kit containing a spore bearing organism is added during the sterilization process ,then cultured later on to ensure that spores have 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** (including most viruses ,most vegetative bacteria and fungi). The temperatures of sterilization is not achieved . Two methods :

Flash method :Temp. used 74° C for 3-5 seconds.

Conventional method: temp. used 62° C for 30 minutes .

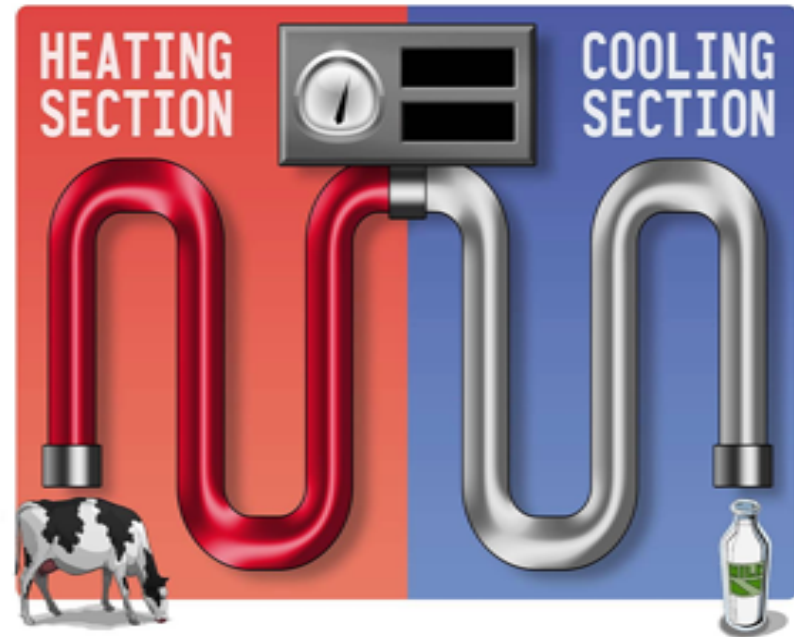
.Boiling : commonly used in domestic circumstances .Does not kill spores.

.Steam sterilizers: to sterilize babies bottles.

Pasteurization of milk

To prevent transmission of the following important zoonotic diseases to human :

- Typhoid fever
- Brucellosis
- Bovine tuberculosis
- Q fever



Steam sterilizer: babies bottles sterilizer -sample



Chemical Methods

- Use of **Disinfectants /Antiseptics**

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

- Some **strong chemical** substances may be used to achieve sterilization (**kill spores**) such as: glutaraldehyde & ethylene oxide

Strong chemicals used for heat sensitive items which are used for sterile body sites.

Sterilization by strong Chemicals

Useful for **heat sensitive materials** e.g. plastics and lensed endoscopes).

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** an optimum concentration. After this level no advantage in further increases in concentration.



Factors influencing activity of disinfectants

3. 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 are 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

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)	+	+	-	-
<u>Chlorhexidine</u> (Hibitane)	++	+	-	-	-	-	-
70° Alcohol	++	++	-	±	++	-	-
Formaldehyde	++	++	++ (slow)	++	+	-	++
<u>Glutaraldehyde</u> (Cidex)	++	++	++	++	±	-	+

Hospital disinfection methods

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

Important to remember

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**.

Reference book

Sherris Medical Microbiology, an Introduction to Infectious Diseases.

Latest edition, Kenneth Ryan and George Ray.

Publisher : McGraw Hill .