2nd year Medical Students

Sterilization and disinfection

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ILOs

- Definition of sterilization and disinfection
- Understanding Different methods used
- Differentiating between methods for both
- Understanding differences between antiseptics and disinfectants
- Factors influencing efficacy of different methods
- Importance of hand washing

Sterilization and disinfection

- **Sterilization:**
- **Is** a process that kills all forms of microbial life, including bacterial spores i.e nearly a 100% killing.
- **Disinfection**

The reduction of pathogenic organisms to a level at which they no longer constitute a risk.

- **Antisepsis**
- Term used to describe disinfection when applied to a living tissue such as a wound or skin

- What do you know?

Methods

1 - Heat

- -Dry
- -Moist

2 - Radiation

- -U.V. rays
- -Ionizing radiation
- -I.R. rays

3 - Filtration

4 - Chemical agents

HEAT

- The only method that is both reliable and widely applicable
- temperatures above 100°C to ensure that bacterial spores are killed.
- Shorter applications of lower temperatures, such as in pasteurization can effectively remove specific infection hazards (Milk,Juice).

Dry Heat

- **Most common method**
- Dry Heat kills microorganisms by destroying their oxidative processes.

1. Red heat:

The item to be sterilized is directly held in the flame and heated till it becomes red hot.
Application :- Bunsen burner used for sterilizing bacteriological loops, knives, blades

2. Flaming:

killing of organisms present on the surface of slides, mouth of culture tubes, …

- **3- Incineration:**

- Is the most common method of treating infectious waste e.g hospital wastes.
- Hazardous material is literally burned to ashes at temperatures of 870° to 980°C.
- Incineration is the safest method to ensure that no infective materials remain in samples or containers when disposed.

- 4- Oven:
- Dry heat ovens are used to sterilize items such as glassware, or powders i.e water free objects
- 160-170C for 1-2 hrs

Moist heat

- Steam is non-toxic and non-corrosive, but for effective sterilization it must be:

1 -Saturated: which means that it holds all the water it can in the form of a transparent vapour.

2 -Dry, which means that it does not contain water droplets.

- When dry saturated steam meets a cooler surface it condenses into a small volume of water and liberates the latent heat of vaporization.

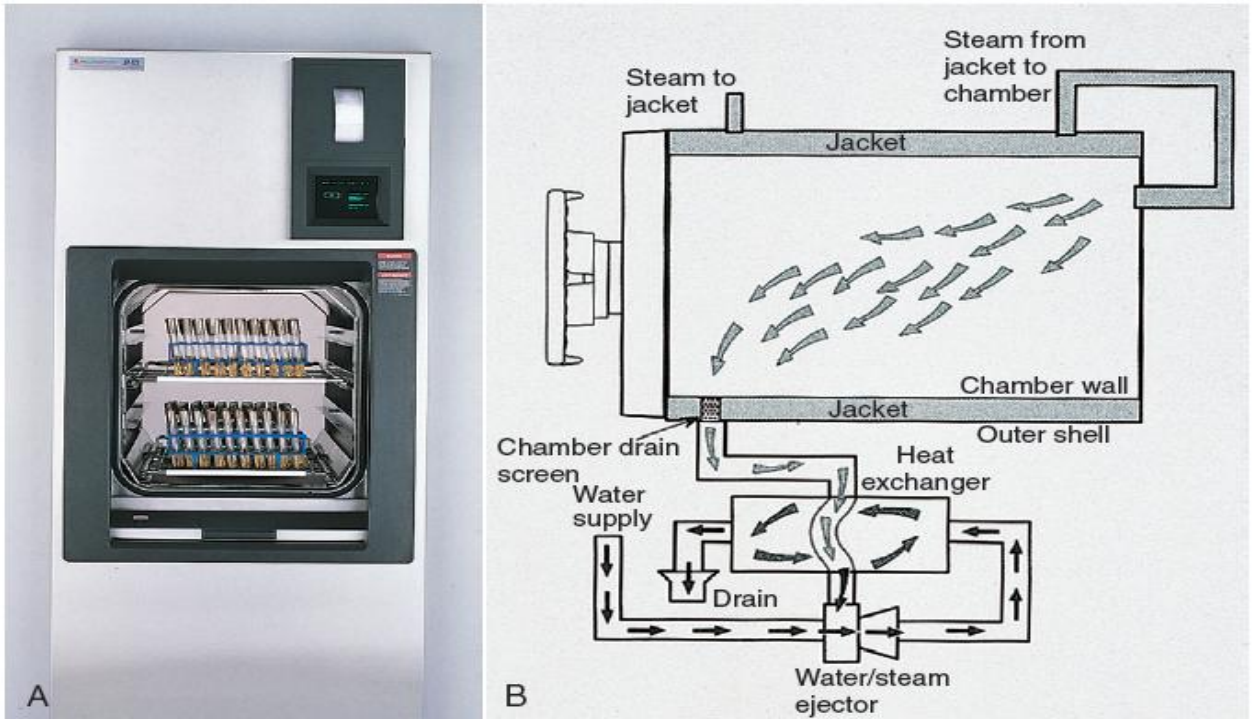
Moist heat :

1- Autoclave: (steam under pressure)

Moist heat at temp. more than 100^{o}C

- An autoclave is essentially a large pressure cooker.
- causes the irreversible denaturation of enzymes and structural proteins.
- The most commonly used steam sterilizer in the microbiology laboratory is the gravity displacement type (Figure)

- Steam enters at the top of the sterilizing chamber
- because steam is lighter than air, it displaces the air in the chamber and forces it out the bottom through the drain vent.
- Items such as media, liquids, and instruments are usually autoclaved for 15 minutes at 121°C.



Monitoring of autoclaves:

Chemical- it consists of heat sensitive chemical that changes color at the right temperature and exposure time.

Autoclave tape

Browne's tube.

Biological – where a spore-bearing organism is added during the sterilization process and then cultured later to ensure that it has been killed. These biological indicators contain Bacillus stearothermophilus spores.

Moist heat

- 2- Moist heat at temp. of100^{o}C
- Boiling at 100°C for 15 minutes, which kills vegetative bacteria on glasswares, forceps scalpels…
- 3- Moist heat at temp. less than 100^{o}C
- Pasteurization :
- Pasteurizing at 63°C for 30 minutes or 72°C for 15 seconds, which kills food pathogens without damaging the nutritional value or flavor

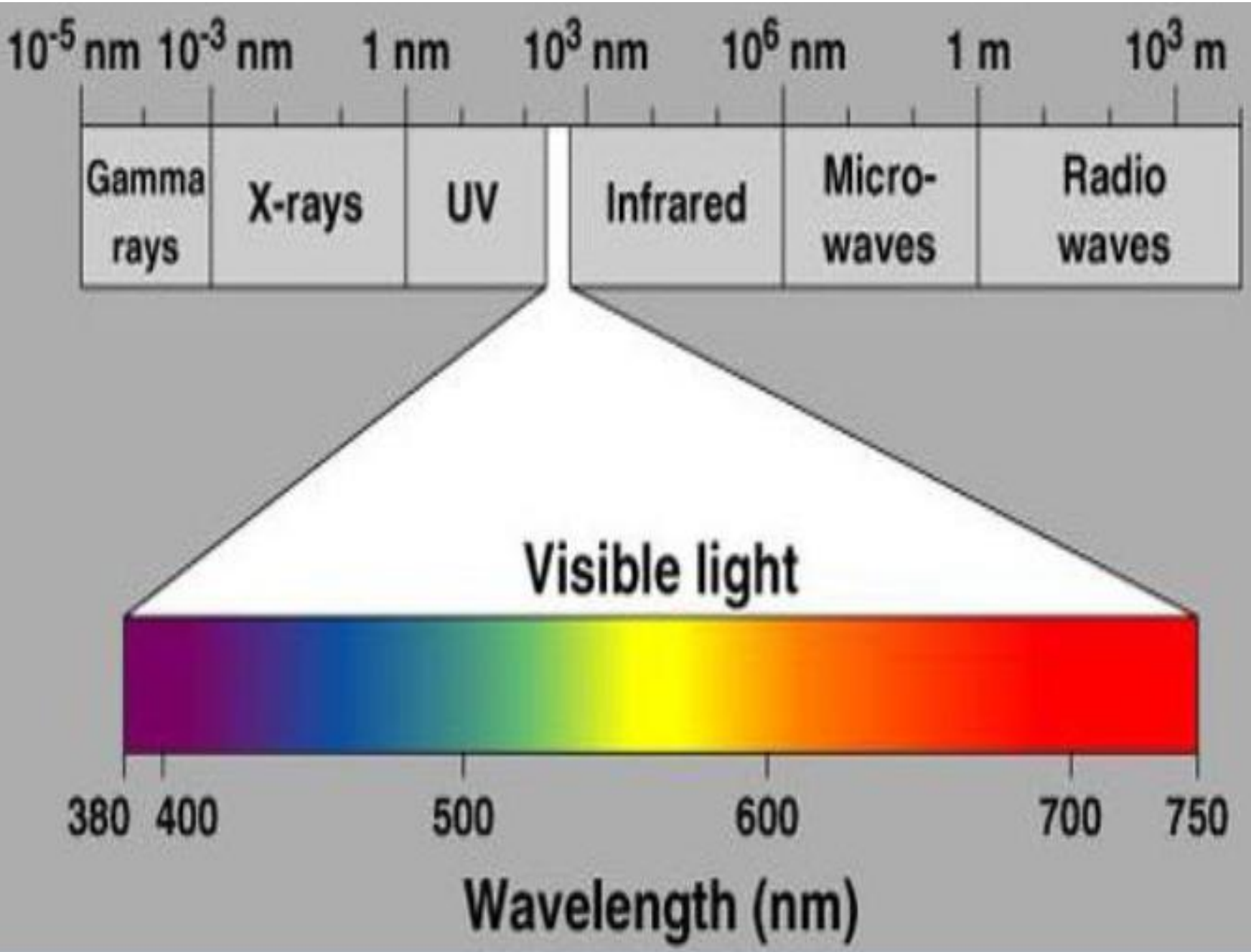
2- Radiation

A- Ionizing radiation:

- The ionizing radiation is composed of short wavelength and high-energy gamma rays.

- Its energy is sufficient to detach electrons from atoms or molecules

- Ionizing radiation is used for sterilizing disposables such as plastic syringes, catheters, or gloves before use.


10^{-5} nm
10^{-3} nm
1 nm
10^{3} nm
10^{6} nm
1 m
10^{3} m
Gamma rays
X-rays
UV
Infrared
Micro-waves
Radio waves
Visible light
380
400
500
600
700
750
Wavelength (nm)

Radiation

B. (UV) light (disinfectant)

- UV rays are long wavelength and low energy.
- They do not penetrate well, and organisms must have direct surface exposure, such as the working surface of a BSC, for this form of disinfection to work.

3- Filtration

➢ Mechanism

mechanically removes microorganisms by passage of a liquid or gas through a screen like material with small pores. May be done under either negative or positive pressure.

➢ Application

Filtration is the preferred method of sterilizing certain solutions, that likely to be damaged by heat e.g. IV fluids. Antibiotic solutions, vaccines, enzymes, and some culture media.

➢ Most common types:

- **Membrane Filters:** Uniform pore size. Used in industry and research. Different sizes:
- 0.22 and 0.45um Pores: Used to filter most bacteria. Don't retain spirochetes, mycoplasmas and viruses.
- 0.01 um Pores: Retain all viruses and some large proteins.

- Filtration of air is accomplished using high-efficiency particulate air (HEPA) filters designed to remove organisms larger than 0.3 μm from isolation rooms

4- Chemicals

1- Ethylene oxide

- The most common chemical sterilant is ethylene oxide (EtO)
- Used in gaseous form for sterilizing heat sensitive Objects as endoscopes and plastics
- Acts by Protein denaturation
- Flammable can explode
- Used at temperature 30-60 ^{o}C
- Bacillus subtilis as an indicator

4- Chemicals

2- 70% Ethyl alcohol (Disinfectant and antiseptic) and isopropyl alcohol

- its use is limited to the skin as an antiseptic or on thermometers and injection vial rubber.
- Denature proteins and dissolve lipid
- No effect on bacterial spores
- More effective than 99%

4- Chemicals

- 3- The halogens, especially chlorine and iodine, are frequently used as disinfectants.
- Protein denaturisation
- Chlorine is most often used in the form of sodium hypochlorite (NaHCl), the compound known as household bleach, concentration and time?
- Iodine used as antiseptic while chlorine as disinfectant

Sterilization and disinfection

- The choice of method of sterilization or disinfection depends on:

- The nature of the item to be treated
- The likely microbial contamination
- The risk of transmitting infection to patients or staff in contact with the item.

Resistance to Sterilization and disinfection

- Vegetative bacteria and viruses are more susceptible

- Bacterial spores are the most resistant, to sterilizing and disinfecting agents.

Resistance to Sterilization and disinfection

- Within different species and strains of species there may be wide variation in intrinsic resistance (structure difference, growth conditions)

- Prions: Highly resistance, use disposable instruments or incineration special chemicals and autoclave cycles e.g 121 ^{o}C for 1 hour or 134 ^{o}C > 18 minutes

The End