Sterilization, Disinfection and Biosafety

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Learning Objectives

- Define Sterilization and disinfection
- Identify the different types or methods of sterilization
- Recognize the biosafety in operation theaters and hospitals
- Recognize the standard microbiological practices
- Define procedures used by laboratories to protect workers and others from infection
- List the types of infectious waste.
**Sterilization**

- **Sterilization**
  - The killing or removal of all form of microbial life including spores.
  - Sterilization of instruments, drugs and supplies is important for the prevention of infection.

- **Disinfection**
  - Is reducing the number of bacteria to a level low enough that disease is unlikely to occur
  - It a is less lethal process than sterilization.
Types of sterilization

**Chemical methods**
- Mild
- Potent

**Physical methods**
- Filtration
- Radiation
- Heat
  - Non-ionizing
  - Dry heat
    - Read heat (direct flaming)
  - Moist heat
    - Autoclaving above 100°C
    - At a temperature of 100°C
    - At a temperature below 100°C
- ionizing
  - Infra-red radiation
  - Hot air oven
  - Tyndallization
  - Boiling at 100°C
Physical methods

• **Heat**

1. **Dry heat**

a) **Red heat:** heating of platinum loop, points of forceps, needles and mouth of culture tubes.
Physical methods

b) Hot air oven: Temperature of 160 °C for 1 hour is employed. Hot air oven is the best method for sterilizing dry glassware, forceps, scalpels...other steel & dental &surgical instruments, powders, fat, greases.
Physical methods

c) Infra-red radiation: the source employed is an electrically heat element, a temperature of 180° C can be attained. Used for glassware.
Physical methods

- **d) Incineration:** This is an excellent method of destroying materials such as contaminated cloth, animal carcasses and pathological materials.
Physical methods

2. Moist heat

• Kills microorganisms by *coagulating* their proteins.
• Moist heat sterilization is carried out with following methods:
  ✷ Temp below 100°C: Pasteurization
  ✷ Temperature at 100°C: Boiling and Tyndallization
  ✷ Steam under pressure: Autoclave
Physical methods

Pasteurization

• Process of killing of pathogens in the milk but does not sterilize it.
• Milk is heated at 63°C for 30 mins.
  (HOLDER METHOD)
• At 72°C for 15-20 Sec. Rapid cooling to 13°C
  (FLASH PROCESS)
Physical methods

At a temperature of 100°C

• **Boiling:** Kills vegetative forms of bacterial pathogens.

• **Tyndallization:** Steaming at 100°C for 30min for 3 successive days. For media containing sugar and gelatin.
Physical methods

At a temperature above 100°C

- Stem under pressure- Autoclave
- Sterilization is carried out under pressure at 121° for 15 mints.
- This is the usual method of sterilizing bacteriological media, surgical instruments, towels, dressing, gloves,..etc
Physical methods

- **Radiation** act on nucleic acid
- Non-ionizing radiation.
- Ionizing Radiation
- **Non-ionizing radiation** here the radiation not very penetrating
  - Direct **sun light** (contain natural U/V light) kill vegetative organisms, but spores are much more resistant.
  - **Ultra violet light** (U/V light) commonly used to sterilize the air in the hospital operating rooms (theaters), bacteriological hood. It has no effect on under surfaces.
Physical methods
Physical methods

- Ionizing radiation: Gamma rays, X-rays.

It has effect on under surfaces. Used in commercial purpose to sterile high quantity of pre packed material e.g. disposable syringe, catheter, petri dish ….etc.
Physical methods

• **FILTRATION**

• Used for Liquid suspension that could be damage by heat e.g. serum, vaccines, sugars, antibiotics, toxins and enzymes.

• Most filters in use contains cellulose acetate or nitrocellulose, compressed asbestos fibers

• Example is **Seitz filter**.

• Pores size are vary and can often filter viruses.

• Filtration accelerated by vacuum system.
Chemical methods

- It kill or stop growing of microorganisms

- Act on lipid content of cell membrane, on nucleic acid, denaturation of protein it either bactericidal or bacteriostatic

  1. potent: called disinfectant (e.g. Phenol group & Chlorine)

  2. Mild: called Antiseptics (e.g. Chlorhexiden)
Chemical methods

• **Iodine**: used in surgery to sterile skin pre-operation
<table>
<thead>
<tr>
<th>Material</th>
<th>Method</th>
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<tbody>
<tr>
<td>Inoculating wires &amp; Loops</td>
<td>RedHeat</td>
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<tr>
<td>Glassware—Syringes, petridishes, test tubes, Flasks</td>
<td>Hot air oven</td>
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<tr>
<td>, Universal container, Oily fluids, powders</td>
<td>Ethylene Oxide / Gamma irradiation</td>
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<tr>
<td>Disposable syringes &amp; other disposable items</td>
<td>Autoclaving</td>
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<tr>
<td>Culture Media</td>
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<tr>
<td>Culture Media containing serum, eggs</td>
<td>Tyndallization</td>
</tr>
<tr>
<td>Toxins, sera, sugars, antibiotic solutions</td>
<td>Filtration</td>
</tr>
<tr>
<td>Milk, Milk products</td>
<td>Pasteurization</td>
</tr>
<tr>
<td>Cystoscope &amp; Endoscopes</td>
<td>Glutaraldehyde</td>
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<tr>
<td>Operation Theatre (Fumigation)</td>
<td>Formaldeh</td>
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<tr>
<td>Skin</td>
<td>Tincture iodine, 70% ethenol, savlon</td>
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<td>Aprons, gloves, catheters, surgical instruments except sharps</td>
<td>Autoclaving</td>
</tr>
<tr>
<td>Sharp instruments</td>
<td></td>
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<tr>
<td>Rubber, plastic &amp; polythene tubes</td>
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</table>
Biosafety in operation theater
hospital and lab
Care of the self and surroundings in operation theatres

- Theatre dress (includes head cap, mask, apron, chapel, should be made available for all persons who are entering into the operation theatre (surgeons, anaesthetist, microbiologist team, nurses, theatre assistants & helper).
- Do not keep any material which are unnecessary for operation theatre procedures
- Operation theatre should be cleaned and fumigated as the prevailing conditions of working and work load,
Operation Theatre Safety is Responsibility Of
Everyone
Factors which influence Safety in Hospital Environment
Importance of Hand Washing

Soap
Water
Common Sense
Yet the best Antiseptic

*William Osler*
Wash hands frequently, thoroughly

Change gloves often, when appropriate
Specific Indications for Hand Hygiene

• **Before:**
  – Patient contact
  – Donning gloves when inserting a CVC
  – Inserting urinary catheters, peripheral vascular catheters, or other invasive devices that don’t require surgery

• **After:**
  – Contact with a patient’s skin
  – Contact with body fluids or excretions, non-intact skin, wound dressings
  – Removing gloves
Who is Important in prevention of Infections
Remember we are More important than many
Are Flowers Safe in the Hospital?
Why flowers are Harmful

• They carry a prominent bacteria which can cause Hospital acquired infections.

• Many Hospitals advise not to bring flowers to patients in Burns/Orthopedic wards and critical care areas.
Biosafety in microbiology lab
BIOSAFETY: Preventing lab-acquired infections

- Bacteria
- Viruses
- Fungi
- Human blood, unfixed tissue
- Human cell lines
Why Biosafety is Important?

• Laboratories recognize hazards of processing infectious agents.

• Guidelines developed to protect workers in microbiological and medical labs through engineering controls, management policies, work practices.
Biosafety levels

• Labs divided into 4 biosafety levels; protective practices increase with each
  – Biosafety Level 1 labs - work with least dangerous agents, require fewest precautions.
  – Biosafety Level 2 labs - Agents associated with human disease, generally required for any human-derived blood, bodily fluids, tissues in which infectious agent may be unknown.
  – Biosafety levels 3 labs - Agents with potential for respiratory transmission, may cause serious and potentially lethal infection.
  – Biosafety Level 4 labs - have strictest methods because dealing with agents that are most dangerous to human health.
Standard Microbiological Practices

- Wash hands before and after entering the lab
- Change gloves frequently
- Wear lab coat or apron
- Wear goggles, safety glasses to protect the eyes or full face shield to protect facial skin.
- Dispose of contaminated sharps and waste immediately after testing
Standard Microbiological Practices

- Pipetting by mouth is strictly forbidden
- Never eat, drink or smoke at the test site
- Keep food out of the laboratory/testing site refrigerator
Standard Microbiological Practices

- Keep work areas uncluttered and clean
- Disinfect work surfaces daily
- Restrict or limit access when working
- Keep supplies locked in a safe and secure area
- Keep emergency eye wash units in working order and within expiry date
Types of infectious waste

• Pathological wastes
  - Human pathological wastes tissues, organs, body parts, containers of body fluids

• All Sharps (even if not contaminated)
  □ Any article that can puncture or cut, and have been used in human patient care or treatment (e.g. needles & syringes)
Types of infectious waste

• Contaminated animal carcasses, body parts, bedding and related wastes
  • animal bedding known to have been exposed to infectious agents during research

• Materials (soil, water, or other debris) which result from the cleanup of a spill of any infectious medical waste.

• Waste contaminated by or mixed with infectious medical waste.
Protect Yourself...

• Wear latex, vinyl or rubber gloves UNDER heavy duty reusable work gloves
• Practice good hand hygiene: Wash with soap and water regularly and before break, eating, smoking, drinking, going home.
• Wear a face shield or goggles
• Wear a disposable apron if chance of contamination of clothing
• Report any “stick” or splash to Employee Health Nurse
• Ask about getting a Hepatitis B Vaccine or any other vaccines which related to your work.
Summary

- Sterilization is the killing of all forms of microbial life.
- Types of sterilization
  - Physical methods
  - Chemical methods
- Biosafety ensuring that individuals and the environment are not infected
- Infectious waste (BioMedical Waste) consists of solids, liquids, sharps, and laboratory waste that are potentially infectious or dangerous.
- With proper knowledge, planning and care, a biological exposure is avoidable.