**Subject microbiology OTT 1 Part 1**

**Microbiology** is the branch of science that deals with the study of microorganisms—very small living organisms that cannot be seen with the naked eye and can only be observed under a microscope.

**Example:**
The study of **bacteria** such as *Lactobacillus*, which is used in making curd, is an example of microbiology.

**Introduction to Microorganisms**

Microorganisms are very tiny living organisms that cannot be seen with the naked eye. They are so small that we need a microscope to see them. Microorganisms are found everywhere around us—in air, water, soil, plants, animals, and even inside the human body.

Although microorganisms are very small, they play a very important role in our daily life. Some microorganisms are helpful and are used in making food like curd, bread, and cheese. They also help in digestion and protect our body from harmful germs. However, some microorganisms are harmful and can cause diseases such as flu, cholera, tuberculosis, and malaria.

Microorganisms include bacteria, viruses, fungi, protozoa, and algae. Each type has different shapes, sizes, and functions. Studying microorganisms helps us understand how diseases spread, how food is preserved, and how nature stays balanced.

In short, microorganisms may be tiny, but their impact on life is very big.

**Classification of Bacteria (Student-Friendly)**

Bacteria can be classified in different ways based on their **shape**, **cell wall**, **oxygen requirement**, and **nutrition**.

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## 1. Classification Based on Shape

1. **Cocci (Singular: Coccus)**
   - Shape: Round or spherical
   - Example: *Staphylococcus*
2. **Bacilli (Singular: Bacillus)**
   - Shape: Rod-shaped
   - Example: *Escherichia coli (E. coli)*
3. **Spirilla**
   - Shape: Spiral or corkscrew-shaped
   - Example: *Spirillum*
4. **Vibrios**
   - Shape: Comma-shaped
   - Example: *Vibrio cholerae*

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## 2. Classification Based on Cell Wall (Gram Staining)

1. **Gram-Positive Bacteria**
   - Thick cell wall
   - Stain purple in Gram staining
   - Example: *Streptococcus*
2. **Gram-Negative Bacteria**
   - Thin cell wall
   - Stain pink/red in Gram staining
   - Example: *E. coli*

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## 3. Classification Based on Oxygen Requirement

1. **Aerobic Bacteria**
   - Need oxygen to survive

- Example: *Mycobacterium tuberculosis*

2. **Anaerobic Bacteria**
   - Do not need oxygen
   - Example: *Clostridium*

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**4. Classification Based on Mode of Nutrition**

1. **Autotrophic Bacteria**
   - Make their own food
   - Example: Cyanobacteria
2. **Heterotrophic Bacteria**
   - Depend on other organisms for food
   - Example: *Salmonella*

**Characteristics of Rickettsia (Student-Friendly)**

**Rickettsia** are very small bacteria that cause diseases in humans and animals. They have some unique characteristics that make them different from other bacteria.

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**Main Characteristics of Rickettsia**

1. **Very Small Size**
   - Rickettsia are extremely small and can only be seen under a microscope.
2. **Obligate Intracellular Parasites**
   - They can survive and multiply **only inside living host cells**.
3. **Bacterial Nature**
   - They are true bacteria and contain both **DNA and RNA**.
4. **Gram-Negative**
   - Rickettsia are **Gram-negative bacteria** with a thin cell wall.
5. **Cannot Live Outside Host**

    - They cannot grow on ordinary culture media like other bacteria.
6. **Transmitted by Arthropods**
    - Spread through insects such as **ticks, lice, fleas, and mites**.
7. **Cause Serious Diseases**
    - They cause diseases like **typhus**, **Rocky Mountain spotted fever**, and **scrub typhus**.
8. **Energy Dependent on Host**
    - They depend on host cells for energy, similar to viruses.

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**Example**

- *Rickettsia prowazekii* – causes **epidemic typhus**

**Transmission and Diseases Caused by *Rickettsia***

**Rickettsia** are small, obligate intracellular bacteria that cause a group of infections known as **rickettsial diseases**. These diseases are mainly transmitted to humans through **arthropod vectors**.

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## Transmission of Rickettsia

Rickettsial infections are **not spread directly from person to person**. They are transmitted through the bite or contamination of skin by infected vectors:

**Common Modes of Transmission**

- **Ticks** □ – Most common vector
- **Lice** □
- **Fleas** □
- **Mites**

**How Transmission Occurs**

- Bite of an infected arthropod
- Scratching the bite site, allowing infected feces to enter the skin
- Crushing an infected louse or flea on broken skin

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## Diseases Caused by Rickettsia

Rickettsial diseases are classified into groups:

**1. Typhus Group**

| Disease | Causative Agent | Vector |
|---|---|---|
| **Epidemic Typhus** | *Rickettsia prowazekii* | Body louse |
| **Endemic (Murine) Typhus** | *Rickettsia typhi* | Fleas |

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**2. Spotted Fever Group**

| Disease | Causative Agent | Vector |
|---|---|---|
| **Rocky Mountain Spotted Fever** | *Rickettsia rickettsii* | Ticks |
| **Indian Tick Typhus** | *Rickettsia conorii* | Ticks |

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**3. Scrub Typhus**

| Disease | Causative Agent | Vector |
|---|---|---|
| **Scrub Typhus** | *Orientia tsutsugamushi* | Mites (chiggers) |

## Common Symptoms

- High fever
- Severe headache
- Rash (often appears after fever)
- Muscle pain
- Chills and weakness

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## Prevention

- Avoid tick-infested areas
- Use insect repellents
- Wear protective clothing
- Maintain personal hygiene to prevent lice infestation

**Prevention and Control of Rickettsial Diseases**

Rickettsial diseases are transmitted by arthropod vectors such as **ticks, lice, fleas, and mites**. Prevention and control mainly focus on **vector control, personal protection, and early treatment**.

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## Prevention of Rickettsial Diseases

### 1. Vector Control

- Control **ticks, lice, fleas, and mites** in the environment
- Use **insecticides** in homes, animal shelters, and surroundings
- Proper disposal of waste to reduce breeding sites

### 2. Personal Protective Measures

- Wear **long-sleeved clothes** and long trousers in endemic areas

- Use **insect repellents** (e.g., DEET) on exposed skin
- Avoid sitting or sleeping on bare ground in endemic areas
- Maintain **personal hygiene** to prevent lice infestation

### 3. Environmental Measures

- Keep surroundings clean and dry
- Control rodents which act as reservoirs
- Proper housing and sanitation

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## Control of Rickettsial Diseases

### 1. Early Diagnosis and Treatment

- Prompt treatment with **antibiotics (Doxycycline)** reduces complications and mortality
- Early treatment prevents severe disease

### 2. Surveillance and Case Reporting

- Early detection and reporting of cases
- Monitoring of outbreaks in endemic areas

### 3. Health Education

- Educate people about **modes of transmission and prevention**
- Awareness programs for travelers and rural populations

### 4. Isolation

- Isolation is **not usually required** as person-to-person transmission does not occur

### Characteristics of *Chlamydiae*

**Chlamydiae** are a group of **small, obligate intracellular bacteria** that cause various human and animal diseases.

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## Key Characteristics of Chlamydiae

### 1. General Characteristics

- **Gram-negative–like bacteria** (do not stain well with Gram stain)
- **Obligate intracellular parasites** (cannot grow outside living cells)
- **Very small in size**
- Contain **DNA and RNA**
- Have a **cell wall**, but **lack muramic acid**
- Unable to synthesize **ATP** → known as **energy parasites**

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### 2. Unique Developmental Cycle

Chlamydiae show a **two-form life cycle**:

1. **Elementary Body (EB)**
    - Small, dense, infectious form
    - Extracellular
    - Attaches to and enters host cells
2. **Reticulate Body (RB)**
    - Larger, metabolically active form
    - Intracellular and non-infectious
    - Multiplies by binary fission inside host cells

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### 3. Growth and Cultivation

- Cannot be grown on artificial media

- Grown in:
  - Tissue culture
  - Chick embryo
  - Experimental animals

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**4. Antigenic Structure**

- Possess **group-specific and species-specific antigens**
- Detected by serological tests

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**5. Sensitivity**

- Sensitive to **tetracyclines and macrolides**
- Resistant to antibiotics acting on cell wall (e.g., penicillin – ineffective)

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**6. Diseases Caused**

- *Chlamydia trachomatis*:
  - Trachoma
  - Urethritis
  - Cervicitis
  - Lymphogranuloma venereum
- *Chlamydia pneumoniae*: Atypical pneumonia
- *Chlamydia psittaci*: Psittacosis

**Treatment, Prevention, and Control of *Chlamydiae* Infections**

*Chlamydiae* are obligate intracellular bacteria, so their management focuses on **appropriate antibiotics, early detection, and preventive measures**.

## 1. Treatment of Chlamydial Infections

### Drugs of Choice

- **Azithromycin** (single dose)
- **Doxycycline** (7–14 days)

### Alternative Drugs

- **Erythromycin**
- **Clarithromycin**
- **Levofloxacin** (in some cases)

### Important Points

- **Penicillin is ineffective** (due to lack of typical cell wall)
- Sexual partners should be **treated simultaneously**
- Early treatment prevents complications like infertility and chronic infection

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## 2. Prevention of Chlamydial Infections

### Personal Preventive Measures

- Practice **safe sex** (use of condoms)
- Avoid multiple sexual partners
- Maintain **personal hygiene**
- Avoid sharing personal items (towels, eye cosmetics)

### Maternal & Neonatal Prevention

- Screening and treatment of **pregnant women**
- Proper eye care of newborns to prevent **inclusion conjunctivitis**

## 3. Control of Chlamydial Infections

### Public Health Measures

- **Early diagnosis and screening**, especially in sexually active individuals
- **Contact tracing** and treatment of partners
- Health education about **modes of transmission**
- Reporting and surveillance of cases

### Environmental & Community Control

- Improvement in **sanitation and living conditions**
- Control of overcrowding (important for trachoma)

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## Vaccine

- ✕**No effective vaccine available** against chlamydial infections

### Spirochetes characteristics

**Spirochetes** are a unique group of bacteria with distinctive features. Their characteristics include:

1. **Shape and Structure**:
   - They are **helical or spiral-shaped** bacteria.
   - They are **flexible**, not rigid like many other bacteria.
   - Their spiral shape allows them to move in a corkscrew-like fashion.
2. **Motility**:
   - Spirochetes move using **axial filaments (endoflagella)**, which are located **between the cell membrane and outer sheath**.

- This movement enables them to **penetrate viscous environments** like mucus or connective tissue.

3. **Gram Stain Properties**:
   - Most spirochetes are **Gram-negative**, meaning they have a thin peptidoglycan layer and an outer membrane.
   - They often **do not stain well** with the Gram stain; special stains like **silver stain, Giemsa, or dark-field microscopy** are used.
4. **Size**:
   - They are **thin and long**, usually **0.1–0.5 µm in diameter** and **5–250 µm in length**, depending on the species.
5. **Cell Envelope**:
   - They have a **double membrane**: an inner cytoplasmic membrane and an outer sheath.
   - The outer sheath can help **evade host immune responses**.
6. **Oxygen Requirement**:
   - Varies by species:
     - **Aerobic**: Some require oxygen.
     - **Microaerophilic or anaerobic**: Many prefer low oxygen or no oxygen environments.
7. **Pathogenicity**:
   - Some spirochetes are **pathogenic** to humans, causing diseases like:
     - **Treponema pallidum** → syphilis
     - **Borrelia burgdorferi** → Lyme disease
     - **Leptospira spp.** → leptospirosis
   - Others are **commensal** in the human mouth and gut.
8. **Reproduction**:
   - They reproduce **by binary fission** like other bacteria.
9. **Culture Requirements**:
   - Many spirochetes are **difficult to culture in the lab**, requiring special media or host organisms.
10. **Unique Features**:

- Their **corkscrew motility** allows them to **move through viscous fluids and host tissues**, which is essential for their pathogenicity.

If you want, I can also make a **very simple table summarizing these characteristics** for easy memorization for exams. It will be super concise and clear.

**1. What is Transmission?**

Transmission refers to the way infectious agents (like viruses, bacteria, or parasites) spread from one person, animal, or object to another. Understanding transmission is key to preventing the spread of diseases.

**Types of Transmission:**

1. **Direct Transmission:** Immediate transfer from one person to another (e.g., touching, kissing, sexual contact).
2. **Indirect Transmission:** Spread via contaminated objects (fomites), air, water, or vectors (like mosquitoes).
3. **Droplet Transmission:** Spread through large respiratory droplets (coughing, sneezing).
4. **Airborne Transmission:** Small particles remain suspended in the air and infect others when inhaled.
5. **Vector-Borne Transmission:** Spread through insects like mosquitoes or ticks.
6. **Fecal-Oral Transmission:** Pathogens from feces contaminate food or water.

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**2. Prevention of Transmission**

Prevention focuses on **breaking the chain of infection**. The chain includes:
**Pathogen → Reservoir → Portal of Exit → Mode of Transmission → Portal of Entry → Susceptible Host**

**Key Measures:**

1. **Hand Hygiene:** Frequent washing with soap and water or using alcohol-based sanitizers.
2. **Respiratory Etiquette:** Cover mouth/nose while coughing or sneezing; use tissues and masks.
3. **Vaccination:** Builds immunity and prevents spread of specific diseases.
4. **Safe Food and Water Practices:** Proper cooking, cleaning, and storage.
5. **Environmental Hygiene:** Regular cleaning and disinfection of surfaces.
6. **Vector Control:** Use of insect repellents, nets, and controlling breeding sites.
7. **Isolation & Quarantine:** Separating infected or exposed individuals to reduce transmission.
8. **Personal Protective Equipment (PPE):** Gloves, masks, gowns in healthcare or high-risk settings.
9. **Education & Awareness:** Informing the public about disease transmission and preventive measures.

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**3. Control Measures During Outbreaks**

When diseases spread rapidly, **control measures** help contain them:

1. **Surveillance:** Monitor and track cases to detect outbreaks early.
2. **Contact Tracing:** Identify and monitor people who had contact with infected patients.
3. **Travel Restrictions:** Limit movement from affected areas.
4. **Mass Immunization:** Vaccinate large populations to prevent disease spread.
5. **Environmental Measures:** Sanitation, water treatment, and vector eradication programs.

6. **Antimicrobial Treatment:** Early treatment of patients to reduce infectivity.

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**4. Summary Table**

| Measure | Purpose |
|---|---|
| Hand hygiene | Removes pathogens from hands |
| Masks & PPE | Prevent inhalation or contact with pathogens |
| Vaccination | Boosts immunity |
| Isolation/Quarantine | Limits exposure to susceptible individuals |
| Safe food & water | Prevents foodborne/waterborne diseases |
| Vector control | Stops vector-borne transmission |
| Environmental cleaning | Reduces indirect transmission |
| Public education | Encourages healthy behaviors |

## . What is a Virus?

A virus is a **tiny infectious particle** that can only replicate **inside the living cells** of a host. Unlike bacteria or human cells, viruses are **not considered fully alive** because they cannot grow or reproduce on their own.

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## 2. Composition of a Virus

A virus is mainly composed of:

1. **Genetic Material (Nucleic Acid):**
    - Can be **DNA** or **RNA**, but never both.
    - **Single-stranded (ssDNA/RNA)** or **Double-stranded (dsDNA/RNA)**.
    - Stores all instructions to produce new virus particles.

2. **Protein Coat (Capsid):**
    - Surrounds and protects the genetic material.
    - Made of **capsomeres** (protein subunits).
    - Shapes vary: **helical, icosahedral, or complex**.
3. **Lipid Envelope (in some viruses):**
    - Found in **enveloped viruses** like influenza or HIV.
    - Derived from the host cell's membrane.
    - Helps the virus enter host cells.
4. **Enzymes (optional):**
    - Some viruses carry enzymes to help them replicate.
    - Example: **Reverse transcriptase** in retroviruses like HIV.

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## 3. Structure of a Virus

### A. Basic Parts

1. **Capsid (Protein Shell)**
    - Protects viral nucleic acid.
    - Shapes:
        - **Helical:** rod-shaped, e.g., Tobacco mosaic virus.
        - **Icosahedral:** 20-sided, e.g., Adenovirus.
        - **Complex:** combination, e.g., Bacteriophage.
2. **Nucleic Acid (DNA or RNA)**
    - Core of the virus.
    - Can be linear or circular.
3. **Envelope (in some viruses)**
    - Outer lipid layer with embedded proteins (**spikes**).
    - Spikes help the virus **attach to host cells**.
4. **Tail and Base Plate (in some bacteriophages)**
    - Used to **inject DNA into bacteria**.

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### B. Optional Components

- **Spikes/Peplomers:** Glycoproteins on envelope for host cell recognition.
- **Matrix Proteins:** Between envelope and capsid, stabilize the virus.

Viruses are classified based on several criteria, mainly **type of nucleic acid, shape, host, and mode of replication**. There are a few standard ways to classify them, like **ICTV classification** and **Baltimore classification**.

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### 1. Classification Based on Nucleic Acid (Baltimore Classification)

Viruses can contain **DNA or RNA**, which may be **single-stranded (ss) or double-stranded (ds)**. This is one of the most widely used methods.

| Group | Type of Genome | Example Viruses |
|---|---|---|
| I | dsDNA | Adenovirus, Herpesvirus |
| II | ssDNA (+) | Parvovirus |
| III | dsRNA | Rotavirus |
| IV | ssRNA (+) | Poliovirus, Coronavirus |
| V | ssRNA (–) | Influenza virus, Rabies virus |
| VI | ssRNA (+) with DNA intermediate (Retrovirus) | HIV |
| VII | dsDNA with RNA intermediate | Hepatitis B virus |

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### 2. Classification Based on Shape and Structure

- **Helical viruses** – Rod-shaped or filamentous (e.g., Tobacco mosaic virus, Rabies virus)
- **Icosahedral viruses** – Spherical with 20 faces (e.g., Adenovirus, Herpesvirus)

- **Complex viruses** – Have complex structures like a head and tail (e.g., Bacteriophage T4)

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### 3. Classification Based on Host

- **Animal viruses** – Infect animals (e.g., Influenza virus, HIV)
- **Plant viruses** – Infect plants (e.g., Tobacco mosaic virus)
- **Bacteriophages** – Infect bacteria (e.g., T4 phage)

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### 4. Classification Based on Mode of Replication

- **Lytic viruses** – Destroy host cells after replication (e.g., T4 bacteriophage)
- **Lysogenic viruses** – Integrate into host genome and replicate without immediate destruction (e.g., Lambda phage)

## 1. Modes of Transmission of Viruses

Viruses can spread in several ways depending on the virus type and the host. The main modes are:

### A. Direct Transmission

- **Person-to-person contact** (touch, handshake, kissing)
  - Example: Herpes simplex virus (cold sores), Influenza virus
- **Droplet transmission** (coughing or sneezing)
  - Example: COVID-19, Measles, Influenza

### B. Indirect Transmission

- **Fomites (contaminated objects)**
  - Example: Rhinovirus (common cold) via doorknobs, phones
- **Contaminated food or water**

- Example: Hepatitis A virus, Rotavirus

**C. Vector-borne Transmission**

- Viruses transmitted by **insects or animals** (vectors)
  - Example: Dengue virus, Zika virus, West Nile virus (mosquitoes)
  - Rabies virus (dog bite)

**D. Vertical Transmission**

- Virus passed **from mother to child** during pregnancy, childbirth, or breastfeeding
  - Example: HIV, Hepatitis B, Zika virus

**E. Airborne Transmission**

- Viruses that can stay in **air for long distances** and infect by inhalation
  - Example: Measles virus, Varicella-zoster virus (chickenpox)

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## 2. Common Viral Diseases and Their Causative Viruses

| Virus | Mode of Transmission | Disease Caused |
|---|---|---|
| Influenza virus | Droplets | Flu |
| HIV (Human Immunodeficiency Virus) | Blood, sexual contact, mother-to-child | AIDS |
| SARS-CoV-2 (Coronavirus) | Droplets, aerosols | COVID-19 |
| Hepatitis A virus | Contaminated food/water | Hepatitis A |

| Virus | Mode of Transmission | Disease Caused |
|---|---|---|
| Hepatitis B virus | Blood, sexual contact, mother-to-child | Hepatitis B |
| Herpes simplex virus | Direct contact | Cold sores, genital herpes |
| Rabies virus | Animal bite (saliva) | Rabies |
| Measles virus | Airborne/droplets | Measles |
| Varicella-zoster virus | Airborne/droplets | Chickenpox, Shingles |
| Dengue virus | Mosquito bite (Aedes) | Dengue fever |
| Rotavirus | Fecal-oral | Diarrhea in children |
| Human Papillomavirus (HPV) | Sexual contact | Warts, cervical cancer |

## 1. General Prevention Measures

Most viral infections can be prevented by **breaking the chain of transmission**:

### A. Personal Hygiene

- Wash hands regularly with soap and water
- Avoid touching eyes, nose, and mouth with unwashed hands
- Cover mouth and nose when coughing or sneezing

### B. Respiratory Precautions

- Wear masks in crowded or infected areas
- Maintain safe distance from sick people
- Avoid sharing personal items (cups, towels, utensils)

**C. Food and Water Safety**

- Drink clean, safe water
- Cook food properly
- Wash fruits and vegetables before eating

**D. Vector Control**

- Use mosquito nets and repellents
- Eliminate stagnant water where mosquitoes breed
- Control rodent populations if needed

**E. Safe Practices**

- Use condoms to prevent sexually transmitted viral infections (HIV, HPV, Hepatitis B)
- Avoid sharing needles or syringes

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## 2. Vaccination

Vaccination is the **most effective method** to prevent many viral diseases:

| Disease | Vaccine |
|---|---|
| Measles | MMR (Measles, Mumps, Rubella) |
| Polio | OPV/IPV (Oral/Inactivated Polio Vaccine) |
| Hepatitis B | Hepatitis B vaccine |

| Disease | Vaccine |
|---|---|
| Influenza | Flu vaccine (annual) |
| COVID-19 | COVID-19 vaccines |
| HPV | HPV vaccine |
| Rabies | Rabies vaccine (post-exposure too) |
| Chickenpox | Varicella vaccine |

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## 3. Isolation and Quarantine

- **Isolation:** Separating infected individuals to prevent spreading the virus
- **Quarantine:** Restricting movement of those exposed to a virus until infection is ruled out

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## 4. Antiviral Medications

- Some viruses can be controlled with **antiviral drugs** (e.g., HIV, Influenza, Hepatitis B & C)
- These **do not always cure** but reduce severity, replication, and spread

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## Characteristics of Protozoa

Protozoa are **single-celled eukaryotic organisms** that are mostly **microscopic** and are found in **water, soil, and as parasites in animals**. They are classified under the kingdom **Protista**.

## 1. Cellular Structure

- **Unicellular:** Made of a single cell, but perform all life functions
- **Eukaryotic:** Have a true nucleus and membrane-bound organelles
- **Flexible cell membrane (pellicle):** Provides shape and protection

## 2. Nutrition

- **Heterotrophic:** Most protozoa feed on bacteria, algae, or organic matter
- Some are **parasitic**, deriving nutrition from a host
- Methods of nutrition:
    - **Phagocytosis:** Engulfing food particles (e.g., Amoeba)
    - **Absorption:** Absorbing dissolved nutrients (e.g., Giardia)

## 3. Locomotion

Protozoa move in different ways depending on the group:

- **Amoeboid movement:** Using pseudopodia (false feet) – Amoeba
- **Flagellar movement:** Using whip-like flagella – Trypanosoma
- **Ciliary movement:** Using tiny hair-like cilia – Paramecium
- **Non-motile:** Some are stationary (e.g., Plasmodium)

## 4. Reproduction

- **Asexual reproduction:** Most common, by binary fission or multiple fission
- **Sexual reproduction:** In some, via conjugation (e.g., Paramecium)

## 5. Habitat

- Mostly **aquatic**, in fresh or marine water
- Some live in **moist soil**
- **Parasitic protozoa** live in animals or humans (e.g., Plasmodium in red blood cells)

### 6. Other Features

- Some form **cysts** to survive harsh conditions (e.g., Entamoeba histolytica)
- Sensitive to environmental changes like temperature, pH, and moisture

## 1. Biology of Protozoa

Protozoa are **unicellular eukaryotic organisms** that can be **free-living** or **parasitic**. Key biological features include:

- **Unicellular and microscopic** – each cell carries out all life functions.
- **Eukaryotic** – have a nucleus and organelles.
- **Nutrition** – mostly heterotrophic; parasitic forms absorb nutrients from host.
- **Locomotion** – via **pseudopodia (Amoeba)**, **flagella (Trypanosoma)**, **cilia (Paramecium)**, or sometimes non-motile (**Plasmodium**).
- **Reproduction** – asexual (binary fission, multiple fission), sexual in some (conjugation).
- **Cyst formation** – some form resistant cysts to survive harsh conditions.
- **Habitat** – freshwater, marine environments, soil, and inside hosts.

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## 2. Diseases Caused by Protozoa

Parasitic protozoa are responsible for many human and animal diseases. Here's a list of **major protozoan diseases**, their **causative agents**, and **mode of transmission**:

| Disease | Causative Protozoa | Mode of Transmission | Notes |
|---|---|---|---|
| **Malaria** | *Plasmodium* spp. (P. falciparum, P. vivax, etc.) | Bite of female *Anopheles* mosquito | Infects red blood cells; fever and chills |
| **Amoebiasis (Dysentery)** | *Entamoeba histolytica* | Fecal-oral (contaminated food/water) | Causes diarrhea, abdominal pain, ulcers |
| **Giardiasis** | *Giardia lamblia* | Fecal-oral (contaminated water) | Causes diarrhea, fatigue, bloating |
| **Trypanosomiasis (Sleeping sickness)** | *Trypanosoma brucei* | Bite of tsetse fly | Affects nervous system; sleep disturbances |
| **Chagas disease** | *Trypanosoma cruzi* | Triatomine (kissing) bug bite | Heart and digestive problems |
| **Leishmaniasis** | *Leishmania* spp. | Bite of sandfly | Causes skin sores (cutaneous) or organ damage (visceral) |
| **Toxoplasmosis** | *Toxoplasma gondii* | Fecal-oral (cat feces), undercooked | Can affect fetus in pregnant |

| Disease | Causative Protozoa | Mode of Transmission | Notes |
|---|---|---|---|
| | | meat | women |
| **Trichomoniasis** | *Trichomonas vaginalis* | Sexual contact | Causes genital infection, itching, discharge |

## 1. General Preventive Measures

Prevention focuses on **breaking the life cycle of the parasite** and **avoiding infection**:

### A. Personal Hygiene

- Wash hands with soap and clean water before eating and after using the toilet
- Drink **clean and boiled water**
- Wash fruits and vegetables properly

### B. Food Safety

- Cook food thoroughly, especially meat (prevents *Toxoplasma* infection)
- Avoid eating raw or undercooked food

### C. Environmental Hygiene

- Proper disposal of human waste to prevent **fecal-oral transmission** (*Amoeba*, *Giardia*)
- Keep surroundings clean to reduce breeding of vectors (mosquitoes, flies, sandflies)

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## 2. Vector Control

Many protozoan diseases are **vector-borne**, so controlling vectors is crucial:

| Protozoan Disease | Vector | Control Measures |
|---|---|---|
| Malaria | *Anopheles* mosquito | Mosquito nets, repellents, insecticides, draining stagnant water |
| Trypanosomiasis | Tsetse fly | Insecticide spraying, avoiding fly-infested areas |
| Chagas disease | Triatomine (kissing) bug | Improving housing, insecticide use |
| Leishmaniasis | Sandfly | Nets, insect repellents, vector habitat control |

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## 3. Vaccination and Prophylaxis

- Currently, **malaria vaccines** are available in some regions
- **Prophylactic drugs** can prevent malaria for travelers to endemic areas

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## 4. Early Diagnosis and Treatment

- Seek medical attention if symptomatic (fever, diarrhea, fatigue)
- **Anti-protozoal drugs** such as:
    - Malaria → Chloroquine, Artemisinin-based therapy

- Amoebiasis → Metronidazole
- Giardiasis → Tinidazole, Metronidazole
- Trypanosomiasis → Pentamidine, Suramin

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**5. Public Health Measures**

- Health education to promote hygiene and vector control
- Regular **screening and treatment programs** in endemic areas
- **Safe water supply and sanitation**

## Characteristics of Fungi

Fungi are **eukaryotic organisms** that can be **unicellular (yeasts)** or **multicellular (molds, mushrooms)**. They are **heterotrophic** and obtain nutrients by absorption.

**Key Features**

1. **Cell Type:** Eukaryotic, with a **true nucleus** and organelles.
2. **Cell Wall:** Made of **chitin** (not cellulose like plants).
3. **Nutrition:**
   - **Saprophytic:** Feed on dead organic matter
   - **Parasitic:** Feed on living organisms (plants, animals, humans)
   - **Some mutualistic** (e.g., mycorrhiza with plant roots)
4. **Reproduction:**
   - **Asexual:** Spore formation, budding (yeast)
   - **Sexual:** Fusion of gametes in some species
5. **Structure:**
   - **Hyphae:** Thread-like filaments forming **mycelium** in molds
   - **Yeasts:** Single-celled, reproduce by budding
6. **Habitat:**
   - Moist, warm, and nutrient-rich environments
   - Found in **soil, decaying matter, and host tissues**

## 2. Diseases Caused by Fungi (Mycoses)

Fungi can infect **skin, nails, respiratory system, and sometimes internal organs**.

**Common Human Fungal Diseases**

| Disease | Causative Fungus | Mode of Transmission | Symptoms |
|---|---|---|---|
| **Athlete's foot (Tinea pedis)** | *Trichophyton* spp. | Direct contact, contaminated surfaces | Itchy, red, scaly skin |
| **Candidiasis (Thrush, Skin infection)** | *Candida albicans* | Overgrowth of normal flora, immunocompromised patients | White patches in mouth, genital infections |
| **Ringworm (Tinea corporis)** | *Trichophyton*, *Microsporum* spp. | Direct contact | Circular, red, itchy lesions |
| **Aspergillosis** | *Aspergillus* spp. | Inhalation of spores | Respiratory infection, sinusitis |
| **Histoplasmosis** | *Histoplasma capsulatum* | Inhalation of spores from soil/bird droppings | Fever, cough, lung infection |

## 3. Fungal Infections Relevant to Operation Theater (OT)

In an OT, **sterility is crucial**, because fungi can cause **post-surgical infections**, especially in **immunocompromised patients**.

### A. Candidiasis (by Candida albicans)

- Can infect **surgical wounds, catheters, or implanted devices**
- **Mode:** Opportunistic, overgrowth in immunocompromised patients
- **OT relevance:** Causes **nosocomial (hospital-acquired) infections**, delayed wound healing

### B. Aspergillosis (by Aspergillus spp.)

- Can infect **lungs, sinuses, or surgical wounds** if **airborne spores** enter OT
- **Mode:** Inhalation of spores from contaminated air or instruments
- **OT relevance:** Risk for **post-operative respiratory infections** in susceptible patients

## 4. Control and Prevention of Fungal Infections

Fungal infections can be controlled by **preventing exposure, maintaining hygiene, and using antifungal measures**.

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### A. General Measures

1. **Personal Hygiene**
    - Wash hands regularly, especially before eating or after touching potentially contaminated surfaces
    - Keep skin clean and dry (prevents tinea infections)
    - Avoid sharing personal items like towels, shoes, or combs
2. **Environmental Hygiene**
    - Maintain clean living and hospital environments

- Remove **moisture and dampness** to prevent mold growth
- Proper disposal of contaminated materials

3. **Food and Water Safety**
   - Consume properly cooked food
   - Avoid spoiled or moldy food

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**B. Hospital/OT-Specific Measures**

Fungal infections in the **Operation Theater (OT)** are particularly dangerous, as they can infect **surgical wounds, catheters, or implants**. Prevention focuses on maintaining **sterility**:

1. **Air Control**
   - Use **HEPA filters** to remove fungal spores from air
   - Maintain **positive pressure ventilation** in OT
   - Regular cleaning and fumigation of OT
2. **Instrument Sterilization**
   - Autoclave surgical instruments
   - Use antifungal disinfectants on surfaces
3. **Patient Care**
   - Screen immunocompromised patients for fungal infections
   - Minimize invasive devices like catheters unless necessary

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**C. Medical Measures**

1. **Antifungal Drugs**
   - **Topical antifungals:** For skin infections (e.g., clotrimazole, miconazole)
   - **Systemic antifungals:** For serious infections (e.g., fluconazole, amphotericin B)
2. **Prophylaxis**

- In high-risk patients (immunocompromised or post-surgery), antifungal prophylaxis may be recommended

## 1. Sterilization vs Disinfection

| Feature | Sterilization | Disinfection |
|---|---|---|
| **Definition** | Process of **killing or removing all forms of microbial life**, including spores | Process of **destroying or reducing pathogenic microorganisms**, but **not necessarily spores** |
| **Effect on Microbes** | Kills **all microbes** (bacteria, viruses, fungi, spores) | Kills **pathogens** but may not kill all spores |
| **Use** | Surgical instruments, catheters, lab media, implants | Surfaces, floors, tables, equipment that do not enter sterile body sites |
| **Methods** | Physical (heat, radiation), Chemical | Chemical disinfectants (alcohol, bleach) |
| **Examples** | Autoclaving, dry heat, UV radiation | Phenol, 70% alcohol, chlorine solutions |

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## 2. Methods of Sterilization

### A. Physical Methods

1. **Moist Heat (Autoclaving)**
   - Steam under pressure (121°C, 15–20 min)
   - Kills all microorganisms including spores
   - Used for surgical instruments, dressings, glassware

2. **Dry Heat**
    - Oven at 160–170°C for 2 hours
    - Used for powders, oils, metal instruments
3. **Filtration**
    - Removes microbes from heat-sensitive liquids (e.g., vaccines, serum)
4. **Radiation**
    - UV radiation for surfaces, gamma radiation for disposable syringes

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### B. Chemical Sterilization

- **Ethylene oxide gas** – for heat-sensitive equipment
- **Glutaraldehyde solution** – immersion of instruments

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## 3. Methods of Disinfection

### A. Chemical Disinfectants

- **Alcohol (70%)** – skin and small surfaces
- **Chlorine compounds (bleach)** – floors, walls, water
- **Phenol** – surfaces and instruments
- **Iodine / Iodophors** – skin antiseptic

### B. Physical Disinfection

- Boiling (kills most bacteria, not spores)
- UV light (surface disinfection)

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## 4. Application in OT and Hospitals

- **Sterilization**: Surgical instruments, catheters, implants, suture materials
- **Disinfection**: OT floors, tables, surfaces, gloves, floors, and walls
- **Aseptic technique**: Hand washing, wearing sterile gloves, gowns, masks

## 1. Chemotherapeutic Agents – Overview

**Chemotherapeutic agents** are **chemical substances used to treat diseases by killing or inhibiting the growth of pathogens**. In the context of the OT, they are mainly **antimicrobial agents** used to **prevent or treat infections**.

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## 2. Characteristics of Chemotherapeutic Agents

1. **Selective Toxicity**
    - They kill or inhibit microbes **without harming human tissues**.
    - Example: Penicillin targets bacterial cell wall, which human cells don't have.
2. **Broad or Narrow Spectrum**
    - **Broad-spectrum:** Effective against a wide range of microbes (e.g., Tetracycline)
    - **Narrow-spectrum:** Targets specific organisms (e.g., Isoniazid for *Mycobacterium tuberculosis*)
3. **Mode of Action**
    - **Bactericidal / Fungicidal / Virucidal:** Kill microbes
    - **Bacteriostatic / Fungistatic / Virustatic:** Inhibit growth, allowing the immune system to act
4. **Chemical Nature**
    - Can be **natural (from microorganisms)**, **semi-synthetic**, or **synthetic chemicals**.

    - Examples: Penicillin (natural), Ampicillin (semi-synthetic), Sulfonamides (synthetic)
5. **Pharmacokinetics in OT Use**
    - Absorption, distribution, and excretion should allow **effective concentration at the surgical site** without toxicity.

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## 3. Uses of Chemotherapeutic Agents in OT

In the **Operation Theater**, chemotherapeutic agents are used for **infection prevention and treatment**, especially in **surgical procedures**:

### A. Prophylactic Use (Before Surgery)

- Prevent **surgical site infections (SSI)**
- Common agents:
    - **Cefazolin** – prevents bacterial infections in clean surgeries
    - **Vancomycin** – used in MRSA-prone cases

### B. Treatment of Post-Operative Infections

- Used when infection develops after surgery
- Common agents:
    - **Metronidazole** – anaerobic bacteria in abdominal surgeries
    - **Fluconazole** – fungal infections like candidiasis

### C. Topical Use

- Disinfecting **skin or wounds**
- Example: Povidone-iodine, chlorhexidine

### D. Systemic Use

- Administered **intravenously or orally** to prevent or treat infections

- Ensures drug reaches surgical site tissues effectively

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### 4. Summary Table

| Characteristic | Description | OT Use Example |
|---|---|---|
| Selective toxicity | Targets microbes, not human cells | Penicillin for prophylaxis |
| Spectrum | Broad or narrow | Cefazolin (broad) vs Vancomycin (narrow) |
| Mode of action | Bactericidal / Bacteriostatic | Metronidazole – bactericidal anaerobes |
| Administration | Topical, oral, IV | Chlorhexidine (skin), IV antibiotics |
| Goal in OT | Prevent or treat infections | Surgical prophylaxis, wound care |

## Introduction to Immunity and Immunology

Immunity is the ability of the human body to protect itself against harmful microorganisms such as bacteria, viruses, fungi, and parasites, as well as against foreign substances called antigens. This protection is provided by a complex system of cells, tissues, organs, and molecules that work together to recognize and destroy invading pathogens. Without immunity, the body would be unable to survive infections and diseases.

Immunology is the branch of biology and medical science that deals with the study of the immune system. It focuses on understanding how immunity works, how the body responds to infections, and how immune responses can sometimes fail or become harmful. Immunology also

explains the basis of vaccination, allergies, autoimmune diseases, and organ transplantation.

The immune system operates through two main types of immunity: **innate immunity**, which is present from birth and provides immediate but non-specific defense, and **acquired (adaptive) immunity**, which develops after exposure to pathogens and provides specific and long-lasting protection. Together, these immune responses help maintain health by defending the body against disease-causing agents.

## Acquired Immunity

**Definition:**
Acquired immunity (also called **adaptive immunity**) is the type of immunity that develops **after exposure to a specific pathogen**. Unlike innate immunity, it is **specific** to a particular microorganism and can remember the pathogen for faster response in future infections.

**Key Features:**

1. **Specificity:** Targets a specific pathogen (e.g., measles virus, tuberculosis bacteria).
2. **Memory:** Once exposed, the immune system "remembers" the pathogen for quicker response later.
3. **Delayed Response:** Takes a few days to become fully effective when first exposed.
4. **Two Types:**
    - **Active Acquired Immunity:** Produced when your body **actively fights an infection** or after **vaccination**.
      *Example:* Getting chickenpox as a child or receiving the chickenpox vaccine.
    - **Passive Acquired Immunity:** Occurs when **ready-made antibodies** are given to a person.
      *Example:* Newborns receiving antibodies through **breast milk** or **antiserum injection** after snake bite.

**Importance:**
Protects the body from **specific infections**, prevents reinfection, and is the basis for **vaccination programs**.

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## Resistance Factors

**Definition:**
Resistance factors are characteristics or mechanisms that **help an organism survive infection** or prevent disease. In humans, they are the **defenses that make us resistant to microbes**.

**Types of Resistance Factors:**

1. **Natural (Innate) Resistance Factors:**
    - **Physical Barriers:** Skin, mucous membranes.
    - **Chemical Barriers:** Stomach acid, enzymes in saliva and tears.
    - **Cellular Defenses:** Phagocytes, natural killer cells.
2. **Acquired (Adaptive) Resistance Factors:**
    - **Antibodies:** Produced by B-cells against specific pathogens.
    - **Memory T and B Cells:** Recognize pathogens and respond faster upon re-exposure.
3. **Genetic Factors:**
    - Some people are naturally resistant due to their **genes**.
      *Example:* Certain people are resistant to malaria due to sickle cell trait.

## Methods of Environmental Cleanliness

Maintaining a **clean environment** is essential to prevent infections, control diseases, and promote overall health. Environmental cleanliness can be achieved by several **methods**, which can be grouped as follows:

## 1. Cleaning

**Definition:**
Removing visible dirt, dust, and debris from surfaces using water, soap, or detergents.

**Methods:**

- **Sweeping:** Removes dust and solid debris from floors.
- **Mopping:** Cleans floors with water and disinfectant to remove germs.
- **Washing:** Cleaning utensils, equipment, and surfaces with soap and water.

**Importance:**
Reduces the number of microorganisms and prevents contamination.

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## 2. Disinfection

**Definition:**
Killing or inactivating most **pathogenic microorganisms** on surfaces or objects using chemical agents.

**Common Disinfectants:**

- Chlorine bleach (sodium hypochlorite)
- Phenolic compounds
- Alcohol solutions (70% ethanol)

**Applications:**

- Cleaning hospital surfaces and operation theatres (OT)
- Disinfecting contaminated instruments

- Water purification

**Note:** Disinfection **does not kill all bacterial spores** (unlike sterilization).

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### 3. Sterilization

**Definition:**
Complete destruction of **all forms of microorganisms**, including bacterial spores.

**Methods:**

- **Physical Sterilization:**
  - **Autoclaving:** Steam under pressure (most common in hospitals and labs).
  - **Dry Heat:** Hot air ovens for instruments.
- **Chemical Sterilization:**
  - Ethylene oxide gas for heat-sensitive equipment.

**Importance:**
Essential for surgical instruments, lab equipment, and medical devices to prevent infection.

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### 4. Proper Waste Disposal

**Definition:**
Safe handling and disposal of solid, liquid, and hazardous waste to maintain cleanliness.

**Methods:**

- **Segregation:** Separating infectious, non-infectious, and sharps waste.
- **Incineration:** Burning infectious waste to ashes.
- **Deep Burial:** Safe burial of non-infectious waste.
- **Sewage Treatment:** Treating wastewater before disposal.

**Importance:**
Prevents contamination of the environment, water, and soil.

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## 5. Ventilation and Air Quality

**Definition:**
Maintaining clean air and proper airflow to reduce airborne infections.

**Methods:**

- Natural ventilation (windows, doors)
- Mechanical ventilation (fans, air-conditioning with filters)
- HEPA filters in critical areas like ICUs and OTs

**Importance:**
Reduces transmission of respiratory infections and maintains a healthy environment.

---

## 6. Personal Hygiene Practices

Though not directly "environmental," these practices **support environmental cleanliness**:

- Regular handwashing
- Wearing clean clothes/uniforms
- Covering mouth/nose while sneezing or coughing

**Summary Table for Easy Revision**

| Method | Purpose/Goal | Example/Use |
|---|---|---|
| Cleaning | Remove dirt & debris | Sweeping, mopping, washing surfaces |
| Disinfection | Kill most pathogens | Bleach on floors, alcohol on instruments |
| Sterilization | Destroy all microbes & spores | Autoclaving surgical instruments |
| Waste Disposal | Prevent contamination | Segregation, incineration, sewage treatment |
| Ventilation/Air Quality | Reduce airborne infections | HEPA filters, fans, natural ventilation |
| Personal Hygiene | Support environment | Handwashing, clean uniforms |

## How to Keep Instruments, Equipment, and Other Things Bacteria-Free

### 1. Cleaning (First Step)

**Purpose:** Remove dirt, blood, and organic matter that can protect bacteria.

**Methods:**

- **Manual Cleaning:** Use water, soap, or detergent to scrub instruments.
- **Ultrasonic Cleaning:** High-frequency sound waves remove tiny debris from instruments.
- **Rinse Thoroughly:** After cleaning, rinse with sterile or clean water to remove residues.

**Tip:** Cleaning alone doesn't kill bacteria—it only removes them.

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**2. Disinfection (Reduce Microbial Load)**

**Purpose:** Kill most bacteria and pathogens on surfaces or equipment.

**Methods:**

- **Chemical Disinfectants:**
  - **Alcohol (70% ethanol or isopropyl alcohol)** → for thermometers, stethoscopes.
  - **Chlorine compounds (bleach)** → for floors, sinks, and non-metal surfaces.
  - **Phenol-based solutions** → for countertops and walls.
- **Soaking Instruments:** Some equipment can be soaked in disinfectants for a specific time.

**Note:** Disinfection reduces bacteria but **doesn't eliminate spores**.

---

**3. Sterilization (Complete Bacteria Removal)**

**Purpose:** Kill **all bacteria, viruses, fungi, and spores**, making instruments completely safe.

**Methods:**

1. **Autoclaving (Steam under Pressure):**
    - Common for surgical instruments, glassware, and metal tools.
    - Standard: 121°C for 15–20 minutes at 15 psi pressure.
2. **Dry Heat Sterilization:**
    - Hot air ovens (160–180°C for 1–2 hours).
    - Used for metal instruments and glass that cannot be autoclaved.
3. **Chemical Sterilization:**
    - **Ethylene oxide gas** → for heat-sensitive equipment like endoscopes.
    - **Glutaraldehyde solution** → for soaking delicate instruments.
4. **Radiation Sterilization:**
    - UV or gamma radiation → for lab surfaces or specialized equipment.

---

**4. Proper Storage**

Even after sterilization, instruments can get contaminated if not stored properly.

- **Sterile Packs:** Keep instruments in sterile pouches or wraps.
- **Dry, Clean Cabinets:** Avoid humidity and dust.
- **Handle with Sterile Gloves:** Only touch sterile items with clean hands/gloves.
- **Separate Sterile and Non-Sterile Items:** Never mix sterilized and used instruments.

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**5. Regular Monitoring**

- **Check Autoclave Indicators:** Chemical strips show if sterilization is effective.
- **Surface Swabs:** Occasionally check for bacterial contamination on equipment.
- **Replace Old or Damaged Instruments:** Cracks or rust can harbor bacteria.

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**Quick Summary**

1. **Clean** → remove visible dirt and organic material.
2. **Disinfect** → kill most pathogens with chemicals.
3. **Sterilize** → eliminate all bacteria, spores, and viruses.
4. **Store properly** → maintain sterility until use.
5. **Monitor regularly** → ensure all methods are working effectively.