

AIDS

1. Introduction

- **AIDS (Acquired Immunodeficiency Syndrome)** is a **chronic, life-threatening condition** caused by infection with the **Human Immunodeficiency Virus (HIV)**.
- It leads to **progressive destruction of the immune system**, particularly **CD4⁺ T lymphocytes**, resulting in **severe immunodeficiency** and **increased susceptibility to opportunistic infections and cancers**.

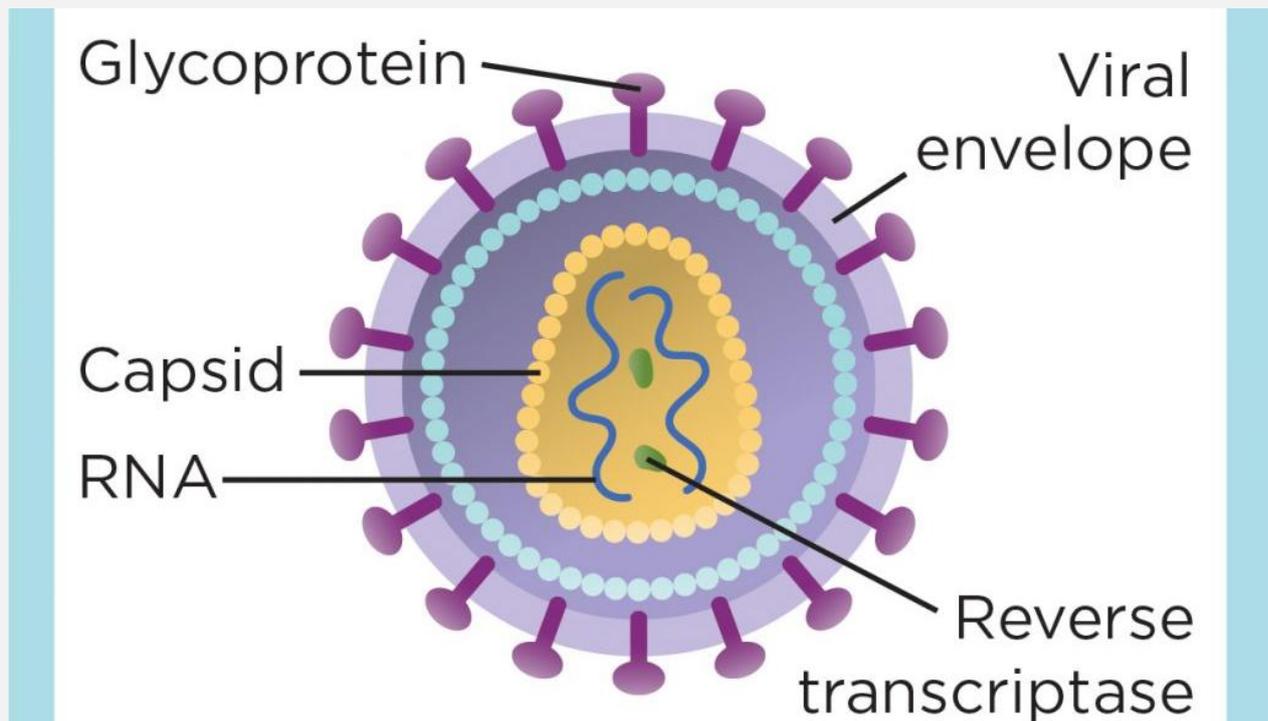
2. Causative Agent: Human Immunodeficiency Virus (HIV)

A. Classification

- **Family:** Retroviridae
- **Genus:** Lentivirus
- **Type:** Enveloped, positive-sense single-stranded RNA virus
- **Main types:**
 - **HIV-1** → Most common worldwide
 - **HIV-2** → Less virulent, mainly in West Africa

B. Structure of HIV

- **Diameter:** ~100–120 nm
- **Shape:** Spherical, enveloped virus
- **Components:**
 1. **Envelope:**
 - Lipid bilayer derived from host cell membrane.
 - Contains **viral glycoproteins:**
 - **gp120:** Binds to CD4 receptor on host cells
 - **gp41:** Mediates fusion with host cell membrane
 2. **Matrix protein (p17):** Provides structural support.
 3. **Capsid (p24):** Cone-shaped; encloses the viral genome.
 4. **Genome:** Two identical copies of **single-stranded RNA**.
 5. **Enzymes (within core):**
 - **Reverse transcriptase** (RNA → DNA)
 - **Integrase** (integration of viral DNA into host genome)
 - **Protease** (cleaves precursor proteins during maturation)



3. Transmission of HIV

Route	Description
Sexual transmission	Most common; through unprotected vaginal, anal, or oral sex
Blood transmission	Transfusion of infected blood, sharing of needles/syringes
Mother-to-child	During pregnancy, childbirth, or breastfeeding
Occupational exposure	Accidental needle-stick injuries (healthcare workers)

Not transmitted by:

- Casual contact (hugging, shaking hands)
- Saliva, tears, or sweat
- Insects (mosquitoes, etc.)

4. Pathogenesis

A. Target Cells

- **CD4⁺ T lymphocytes** (main target)
- **Macrophages**
- **Dendritic cells**

B. Mechanism of Infection and Replication

1. Attachment:

- Viral **gp120** binds to **CD4 receptor** on host cell.
- Requires a **co-receptor**:
 - **CCR5** (macrophage-tropic strain)
 - **CXCR4** (T cell-tropic strain).

2. Fusion and Entry:

- gp41 facilitates fusion of viral envelope with the host cell membrane.

3. Reverse Transcription:

- Viral **reverse transcriptase** converts viral RNA → complementary DNA (cDNA).

4. Integration:

- Viral **integrase** inserts cDNA into the host cell genome → **provirus**.

5. Transcription and Translation:

- Host cell machinery transcribes and translates viral genes.

6. Assembly and Budding:

- New viral particles are assembled and bud off from the host membrane.

7. Maturation:

- **Viral protease** cleaves precursor proteins to form infectious virions.

C. Destruction of Immune System

- **Direct killing** of infected CD4⁺ cells by viral replication.
- **Apoptosis** of uninfected bystander T cells.
- **Destruction by cytotoxic T cells.**
- Progressive **decline in CD4⁺ T cell count** → immunodeficiency.

5. Stages of HIV Infection

Stage	Description	Typical Duration	CD4 Count (cells/ μ L)
1. Acute HIV infection	2–6 weeks after exposure; flu-like symptoms (fever, sore throat, rash)	Weeks	>500
2. Clinical latency (chronic HIV)	Asymptomatic or mild lymphadenopathy; ongoing viral replication	5–10 years	200–500
3. AIDS	Severe immunodeficiency; opportunistic infections and cancers	Variable	<200

6. Clinical Features

A. Early (Acute) Stage

- Fever
- Fatigue
- Rash
- Lymphadenopathy
- Pharyngitis (sore throat)
- Headache, myalgia

B. Asymptomatic (Latency) Stage

- No major symptoms
- Persistent generalized lymphadenopathy
- Gradual decline in CD4 count

C. AIDS Stage (Advanced Disease)

1. Opportunistic Infections:

- **Fungal:** *Candida albicans* (oral thrush), *Cryptococcus neoformans* (meningitis)
- **Viral:** Cytomegalovirus (retinitis), Herpes simplex (ulcers)
- **Bacterial:** *Mycobacterium tuberculosis*, *Mycobacterium avium* complex
- **Parasitic:** *Toxoplasma gondii* (encephalitis)

2. Malignancies:

- **Kaposi's sarcoma** (caused by HHV-8)

- **Non-Hodgkin's lymphoma**
- **Cervical carcinoma**

3. Neurological Manifestations:

- HIV-associated dementia
- Peripheral neuropathy
- Encephalopathy

4. Wasting Syndrome:

- Weight loss, chronic diarrhea, fever

7. Laboratory Diagnosis

A. Screening Tests (Detect antibodies)

1. ELISA (Enzyme-Linked Immunosorbent Assay):

- Detects anti-HIV antibodies (IgG, IgM).
- High sensitivity.
- Positive results must be confirmed.

B. Confirmatory Tests

2. Western Blot:

- Detects specific HIV proteins (gp120, gp41, p24).
- High specificity.

C. Direct Detection of Virus

3. PCR (Polymerase Chain Reaction):

- Detects viral RNA or DNA (used for early infection, newborns, and viral load monitoring).

4. p24 Antigen Test:

- Detects viral core protein; early infection marker.

5. CD4 Count:

- Monitors immune status.
- Normal: 500–1500 cells/ μ L
- AIDS: <200 cells/ μ L

6. Viral Load Test:

- Measures copies of viral RNA/mL plasma.
- Used to assess treatment response.

8. Treatment

A. Antiretroviral Therapy (ART)

- Standard treatment = **combination of ≥ 3 antiretroviral drugs** (“HAART” – Highly Active Antiretroviral Therapy).

Drug Classes:

Class	Mechanism	Example Drugs
NRTIs (Nucleoside Reverse Transcriptase Inhibitors)	Block reverse transcriptase	Zidovudine (AZT), Lamivudine (3TC), Tenofovir
NNRTIs (Non-Nucleoside Reverse Transcriptase Inhibitors)	Bind to reverse transcriptase directly	Efavirenz, Nevirapine
PIs (Protease Inhibitors)	Prevent viral maturation	Ritonavir, Lopinavir
INSTIs (Integrase Strand Transfer Inhibitors)	Block integration into host genome	Raltegravir, Dolutegravir
Fusion Inhibitors	Prevent viral entry	Enfuvirtide
CCR5 Antagonists	Block co-receptor binding	Maraviroc

B. Goals of ART

- Suppress viral replication (undetectable viral load)
- Restore and preserve immune function
- Reduce HIV-related morbidity and mortality
- Prevent transmission

9. Prevention and Control

A. Primary Prevention

- Safe sex practices (condom use)
- Avoid sharing needles
- Screening of blood products
- Use of sterile instruments
- HIV education and awareness

B. Mother-to-Child Transmission Prevention

- ART for pregnant women
- Avoid breastfeeding (if safe alternatives)
- Cesarean delivery (if viral load high)

C. Post-Exposure Prophylaxis (PEP)

- **Within 72 hours** of potential exposure
- 28-day course of ART (e.g., Tenofovir + Lamivudine + Dolutegravir)

D. Pre-Exposure Prophylaxis (PrEP)

- For high-risk individuals (e.g., serodiscordant couples)
- Daily oral **Tenofovir + Emtricitabine**

10. Complications

- Opportunistic infections
- Malignancies
- HIV-associated neurocognitive disorders (HAND)
- Drug toxicity (ART-related)
- Lipodystrophy, metabolic syndrome

11. Prognosis

- Without treatment: progression to AIDS in ~8–10 years.
- With ART: near-normal life expectancy possible if adherence is good and viral suppression achieved.

12. Key Differences: HIV vs. AIDS

Feature	HIV Infection	AIDS
Definition	Infection with HIV virus	Final stage of HIV infection
CD4 count	Usually >200 cells/ μ L	<200 cells/ μ L
Symptoms	May be asymptomatic	Severe infections, cancers
Reversibility	Manageable with ART	Partially reversible if treated early