# Microbiology

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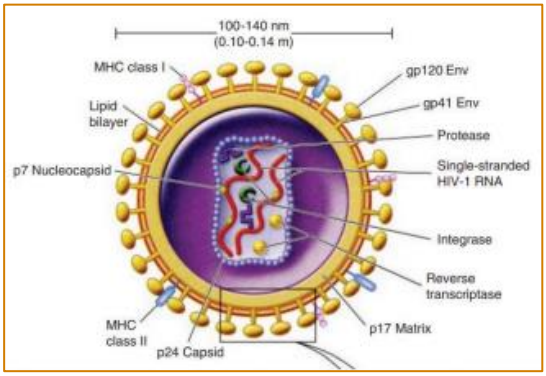
# Human Immunodeficiency Virus (HIV)

- **Introduction**
  - Etiologic Agent of AIDS: The causative agent of Acquired Immunodeficiency Syndrome (AIDS) is HIV.
  - Target Cell: The primary target cell is the human T helper cell (CD4).
  - Virus Type: HIV is a lentivirus, Genus of the retroviridae family.
  - First Described: The illness was first described in 1981, and HIV-1 was isolated by the end of 1983.
  - AIDS as an Epidemic: AIDS has become a global epidemic, characterized by long incubation periods, persistent infection, and development of opportunistic infections.
  - Infection Duration: Once infected, individuals remain infected for life.

- **Morphology**
  - Virus Structure:
    - ✓ Two strands of linear, positive-sense RNA [Retroviruses transcribe RNA to DNA].
    - ✓ HIV is an enveloped virus with icosahedral symmetry (20-sided).
    - ✓ The outer envelope contains a lipid matrix with specific viral glycoproteins (gp41 and gp120).
    - ✓ These glycoproteins bind to target cells (e.g., CD4 receptors).



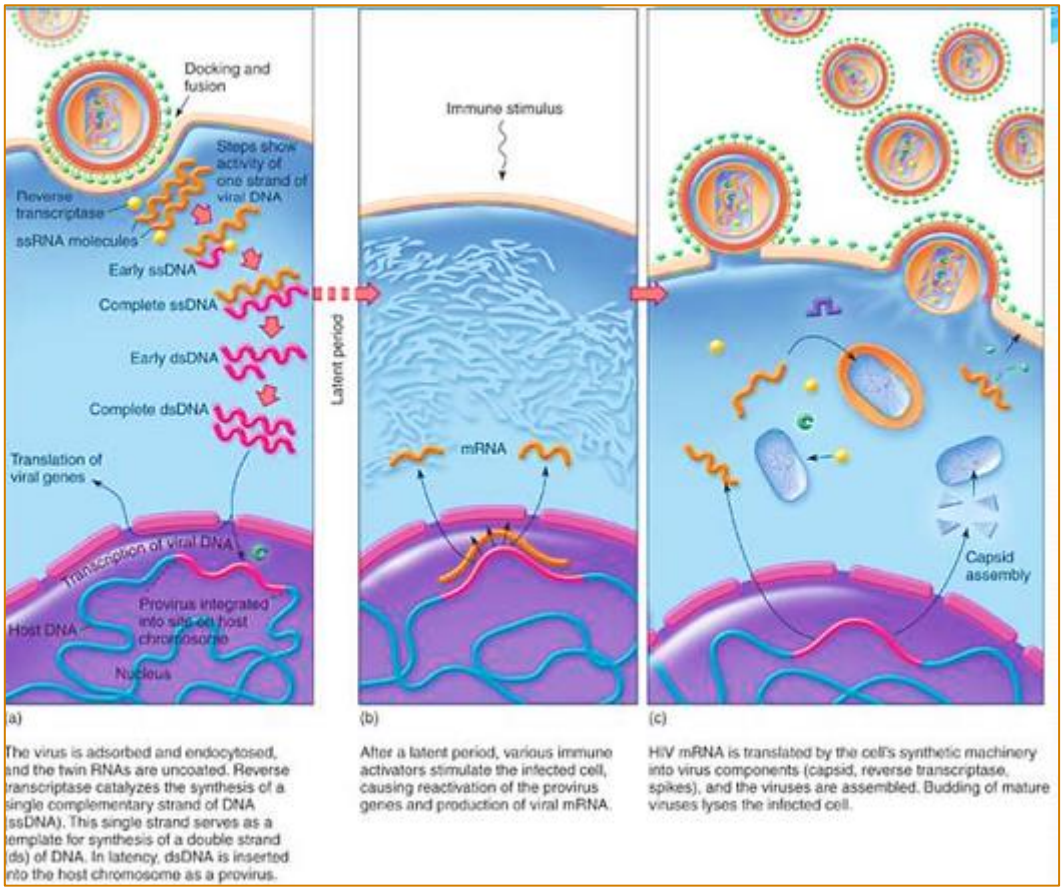

- **Types of HIV**
  1. **HIV-1**:
     - More virulent and easily transmitted.
     - Causes the majority of HIV infections globally.
     - Three subtypes based on changes in the env gene.
  2. **HIV-2**:
     - Less transmissible.
     - Primarily confined to West Africa.

- **Origins of HIV**
  - HIV-1: Likely descended from SIVcpz (simian immunodeficiency virus from chimpanzees).
  - HIV-2: Likely descended from SIVsm (simian immunodeficiency virus from sooty mangabey monkeys).

- **Epidemiology**
  - Global Statistics (2009):
    - ✓ 39.5 million people infected with HIV/AIDS.
    - ✓ 2.9 million deaths.
    - ✓ 4.3 million new infections (65% of cases in sub-Saharan Africa).
    - ✓ Increased infection rates in Eastern Europe and Central Asia.

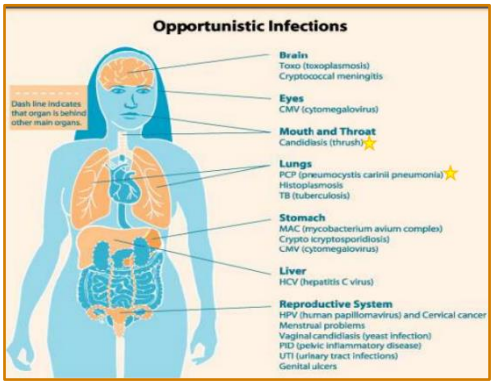
- Transmission:
  - ✓ Unprotected sexual contact with an infected person (particularly homosexual transmission).
  - ✓ Blood transfusions and organ transplants.
  - ✓ Sharing infected drug needles/syringes.
  - ✓ Accidental needle sticks, especially in healthcare workers.
  - ✓ Mother-to-fetus transmission during pregnancy or delivery.
  - ✓ Transmission via breast milk from an infected mother to her baby.

- **Pathogenesis and Virulence Factors**
  - Entry: HIV enters through mucous membranes or skin and is taken up by dendritic cells beneath the epithelium, multiplies and is shed.
  - Amplification: The virus is amplified by macrophages in the skin, lymph organs, bone marrow, and blood.
  - Viral Binding: HIV binds to CD4 and coreceptors, fuses with the cell membrane, and integrates its RNA into the host DNA. [Reverse transcriptase]
  - Replication: The virus can cause a lytic infection or remain latent.



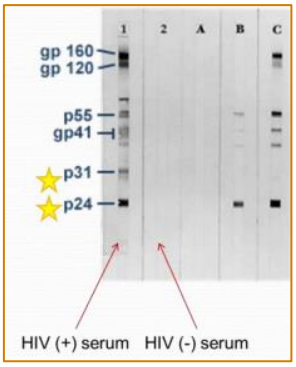

- **Primary and Secondary Effects**
  - Primary Effects:
    - ✓ Extreme leukopenia, especially of lymphocytes.
    - ✓ Formation of giant T cells that allow direct viral spread from cell to cell.
    - ✓ Infected macrophages in the central nervous system release the virus, causing toxicity and inflammation.
  - Secondary Effects:
    - ✓ Destruction of CD4+ T lymphocytes leads to opportunistic infections and malignancies.

- **Clinical Manifestations**
  - Incubation Period: HIV has an incubation period of about 10 years before AIDS develops.
  - AIDS: Leads to immune system impairment, resulting in death from infections or secondary diseases (opportunistic bacteria, viruses, or cancers).
  - Common Diseases Associated with HIV:
    - ✓ Kaposi's sarcoma (KS).
    - ✓ Pneumocystis carinii pneumonia (PCP).
    - ✓ Mycobacterium avium complex (MAC).
  - Early Symptoms:
    - ✓ Most individuals do not exhibit symptoms when first infected.
    - ✓ However, flu-like symptoms (fever, headache, fatigue, enlarged lymph nodes) may appear 1-2 months after exposure.
    - ✓ Highly infectious during this early period.
  - Later Symptoms:
    - ✓ Severe symptoms may not appear until after 10 years, but this varies by individual.
    - ✓ Decline in CD4+ T cells (below 200 cells/mm³ indicates advanced AIDS).
    - ✓ Oral candidiasis (thrush) is common.






- **Laboratory Tests**
  - Screening Tests:
    - ✓ ELISA for HIV antibodies (p24, gp120, gp160, gp41).[screening]
    - ✓ Detection of p24 HIV antigen.
    - ✓ Indirect immunofluorescence.
    - ✓ HIV Western Blot.
    - ✓ PCR for viral nucleic acid.
    - ✓ Viral isolation and culture.




- **Prevention**
  - Preventive Measures:
    - ✓ Avoid sexual contact with infected individuals.
      - Abstinence, monogamous relationships, protected sex.
    - ✓ Avoid sharing needles or syringes.
    - ✓ Avoid contact with bodily fluids from infected individuals.
    - ✓ Prevention of mother-to-child transmission during pregnancy, delivery, and breastfeeding.

- **Treatment**
  1. Nucleoside Reverse Transcriptase Inhibitors (NRTIs): e.g., Zidovudine.
  2. Non-Nucleoside Reverse Transcriptase Inhibitors (NNRTIs): e.g., Nevirapine.
  3. Protease Inhibitors: e.g., Ritonavir.
  4. Fusion Inhibitors: e.g., Enfuvirtide.
  5. Entry Inhibitors: e.g., Maraviroc.
  6. Integrase Inhibitors: e.g., Dolutegravir.

  - Highly Active Antiretroviral Therapy (HAART):
    - ✓ Suppresses viral replication and reduces viral load.
    - ✓ Enhances immune responses to opportunistic pathogens.
    - ✓ Prolongs survival.
    - ✓ ***Does not cure HIV-1 infections***.

- **Vaccine**
  - Currently, there are no FDA-approved vaccines for HIV.
  - Vaccine Development:
    - ✓ Therapeutic Vaccine: Aimed at boosting the immune system of individuals already infected.
    - ✓ Preventive Vaccine: Aimed at generating an immune response to prevent future infections in uninfected individuals.

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