HIV/AIDS

Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome

Group 2

Introduction

- Human Immunodeficiency Virus = Retrovirus
- Infects CD4+ T cells in immune system, which causes Acquired Immune Deficiency Syndrome (AIDS)
  - *Without treatment, AIDS can take 8 years to develop*
- 2 strains: HIV-1 and HIV-2
  - *HIV-1 is most commonly associated with AIDS*

Sharp, 2011

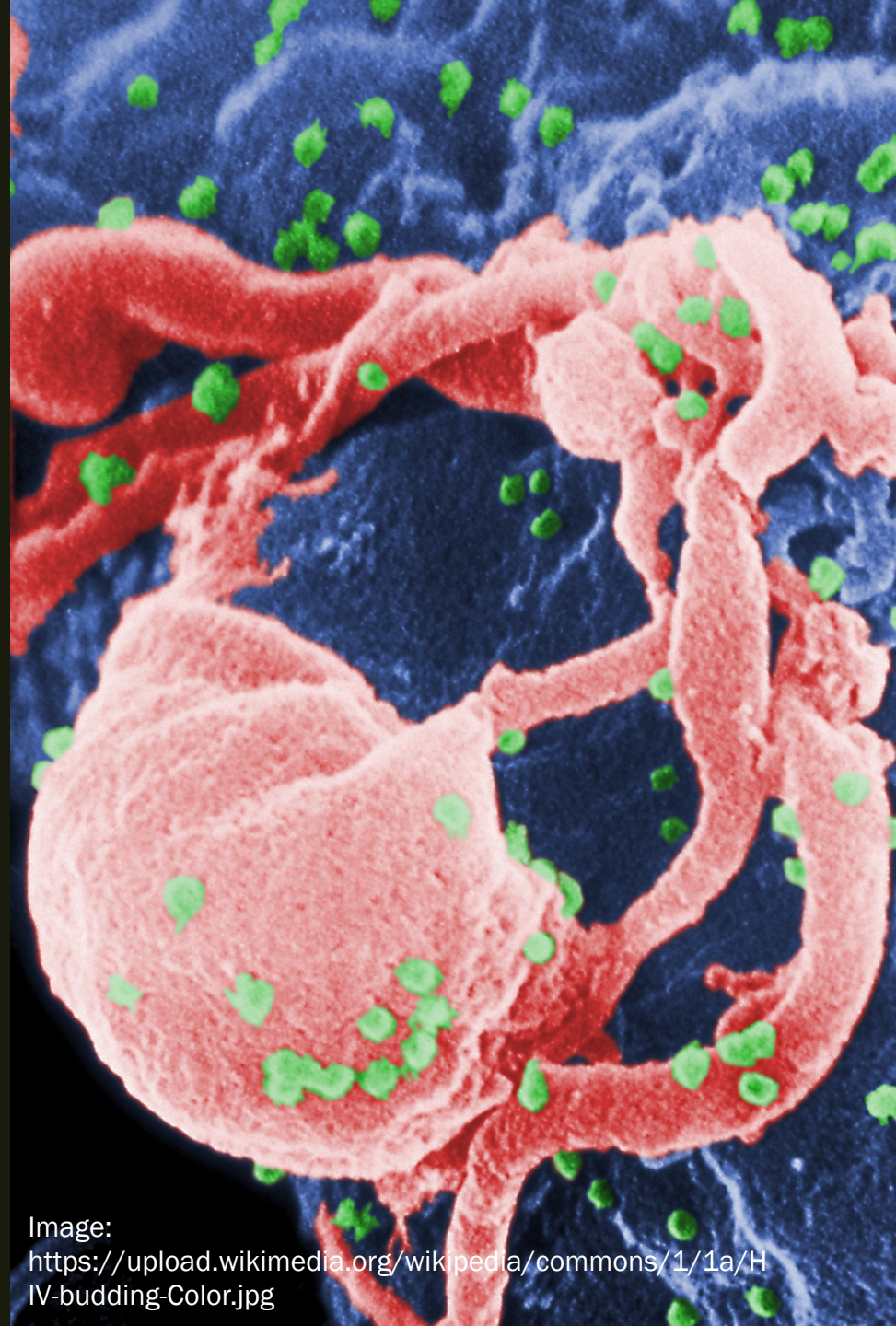
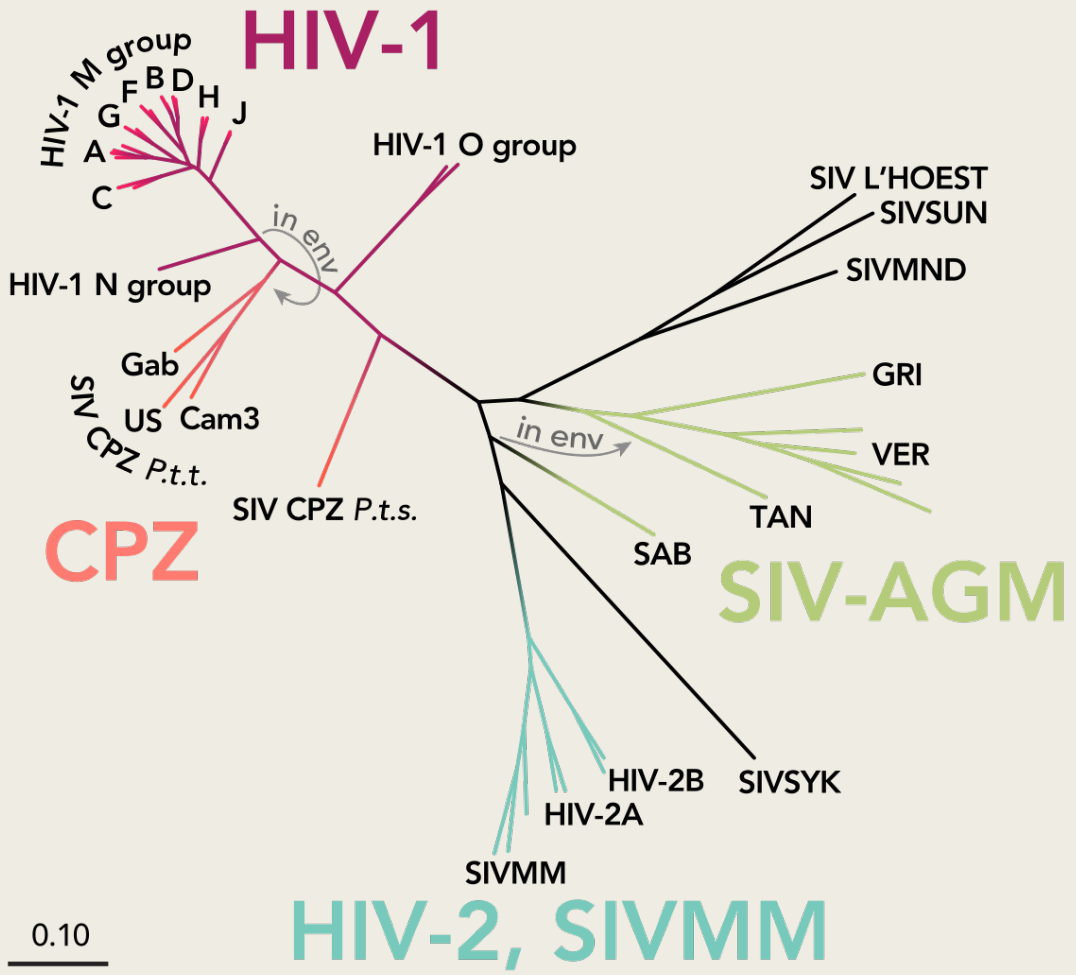


Image: https://upload.wikimedia.org/wikipedia/commons/1/1a/HIV-budding-Color.jpg

Origins



- Simian Immunodeficiency Virus = SIV
  - *Infected African primates*
- Cross-species transmission → HIV emergence
  - *Genetic modifications in SIV occurred as it passed from different primates → humans*
- Spread to Human populations → pandemic
  - *Hunters in West Africa exposed to infected blood*
  - *International travel*
  - *Changing patterns of sexual behaviour*

Image: https://commons.wikimedia.org/wiki/File:HIV-SIV-phylogenetic-tree_straight.svg

Sharp, 2011

History of AIDS

1983, Pandemic
- Re-labelled to AIDS
- Leading cause of death in people aged 25-44
- Research funding was compromised due to prejudice towards gay men

1981, USA
- AIDS discovered with an outbreak of an unusual disease that infected gay men
- Labelled: GRID = Gay-related Immune Deficiency

1984, First Method of Prevention
- Safe sex (condoms)
- Testing blood in Blood banks
- Giving clean needles to drug users

"A Timeline of HIV/AIDS", n.d.; Holland, 2013

History of AIDS

1987
- HIV = official cause of AIDS
- First antiretroviral drug created
  - Prevents AIDS progression
  - No cure

1999
- 33 million people living with HIV
- 14 million had died since the disease was first diagnosed

2016
- People diagnosed early and receiving proper treatment → healthy
- People lacking access to treatment
  - Most prevalent in Sub-Saharan Africa

"A Timeline of HIV/AIDS", n.d.; Holland, 2013

Today…

- 36.7 million people living with AIDS
  - *1.8 million are children*
- Since the start of the epidemic, 35 million people have died
- 17 million are receiving antiretroviral treatment
- 77% of pregnant women are receiving treatment
- Rate of incidence in newborns has declined by 50%

"Global HIV/AIDS Overview", 2016

Transmission

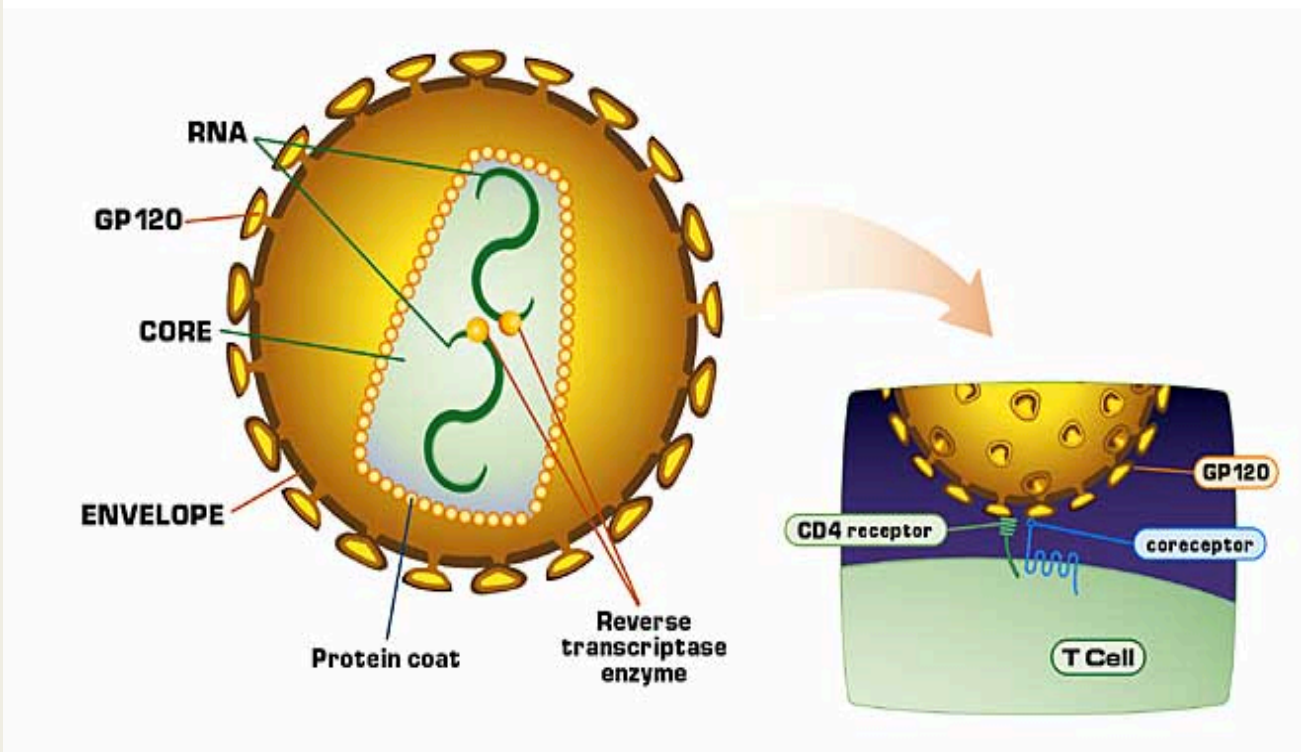
- Through bodily fluids: blood, semen, pre-seminal fluids, breast milk, and rectal and vaginal fluids
- Contact with mucosal membranes, damaged tissues, and direct injection of virus into bloodstream
- Mother-to child transmission

(AIDSinfo, 2016)

Retrieved from http://www.avert.org/hiv-transmission-prevention/how-you-get-hiv

HIV Structure

- Phospholipid envelope
- GP41 and GP120 glycoproteins
- Protein nucleocapsid
  - *2 single stranded RNAs*
  - *Reverse transcriptase*
  - *Protease*
  - *Integrase*

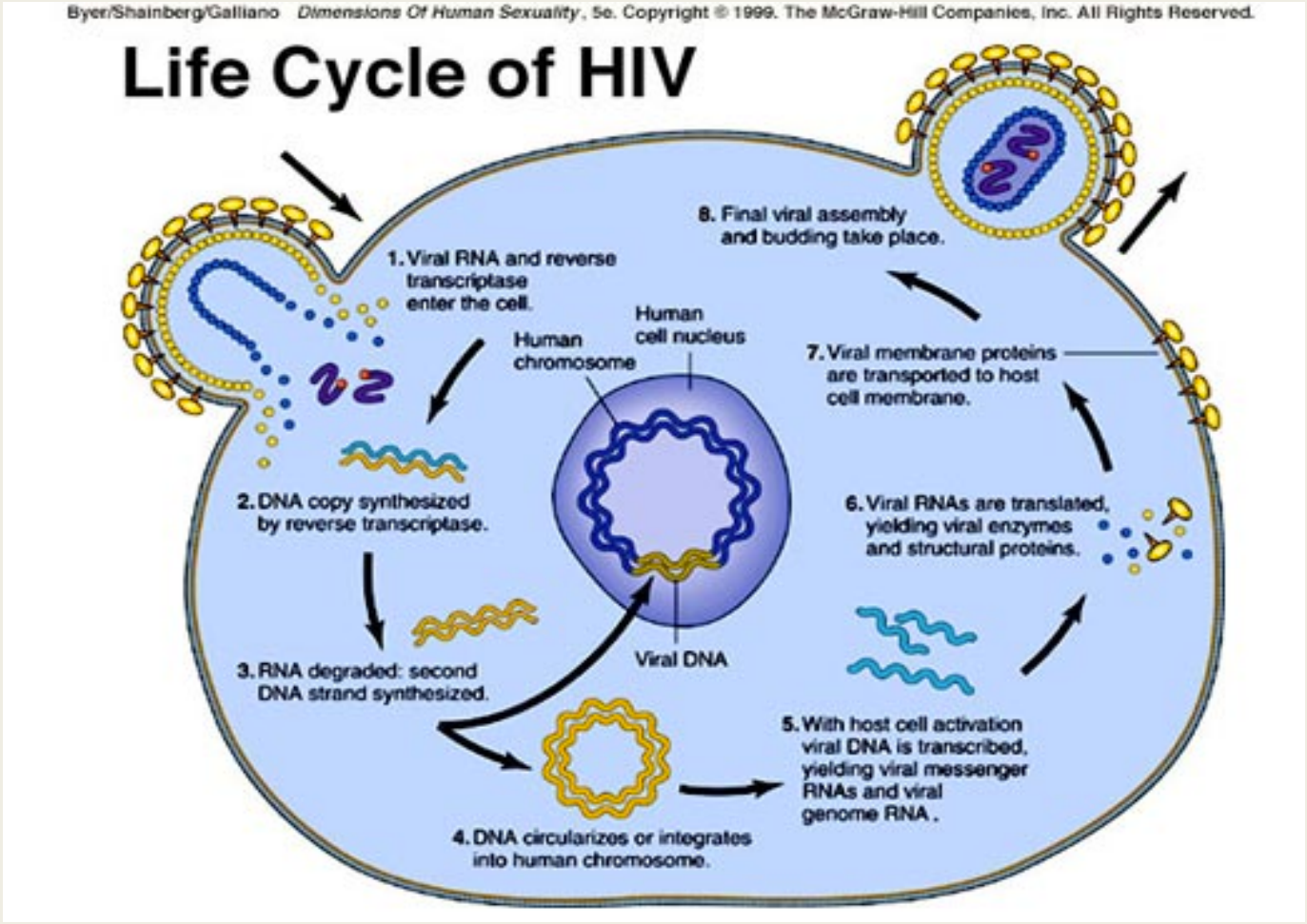


Retrieved from: https://learner.org/courses/biology/units/hiv/index.html

(Berger et al., 2016)

HIV Life Cycle

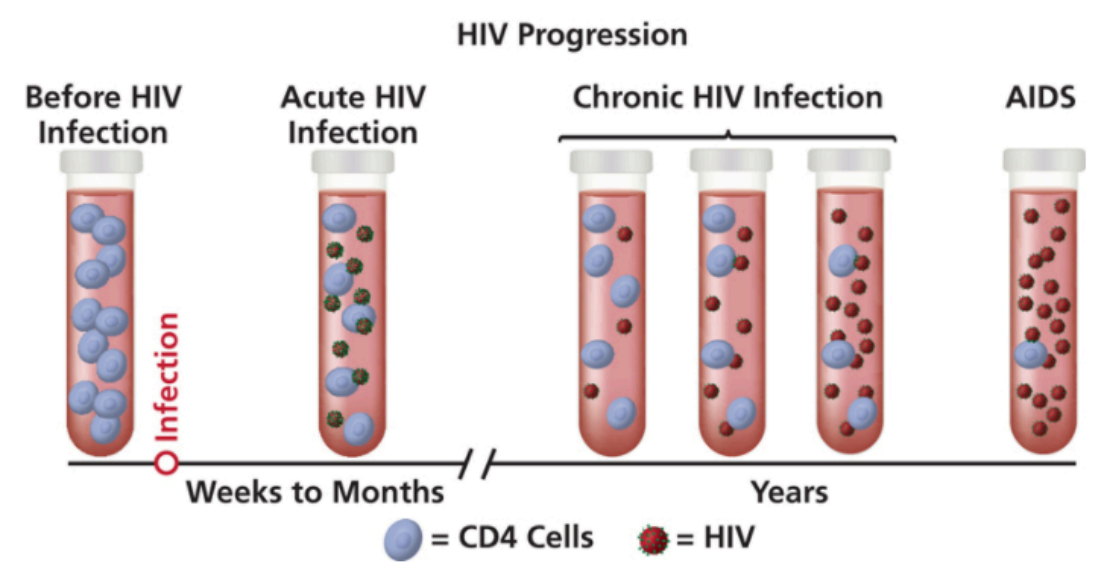
1. Entry into host cell – CD4 immune cells
   - *GP41 and GP120 proteins bind to CD4 receptors*
   - *Conformational change and spore formation*
2. Reverse transcription
3. Insertion into host chromosome
4. Transcription and Translation
5. Vesicular sorting pathway
6. Protease cleaves protein chains → mature infectious HIV



Retrieved from: http://nigeriahivinfo.com/wp-content/uploads/2015/10/hiv-virus-life-cycle.jpg

(AidsInfo, n.d.).

HIV → AIDS



Retrieved from: https://aidsinfo.nih.gov/education-materials/fact-sheets/19/45/hiv-aids--the-basics

- HIV proliferates → Chronic HIV
- Progression to AIDS ~10 years
- AIDS = <200 CD4 T cells/mm^3 and/or one or more opportunistic infections

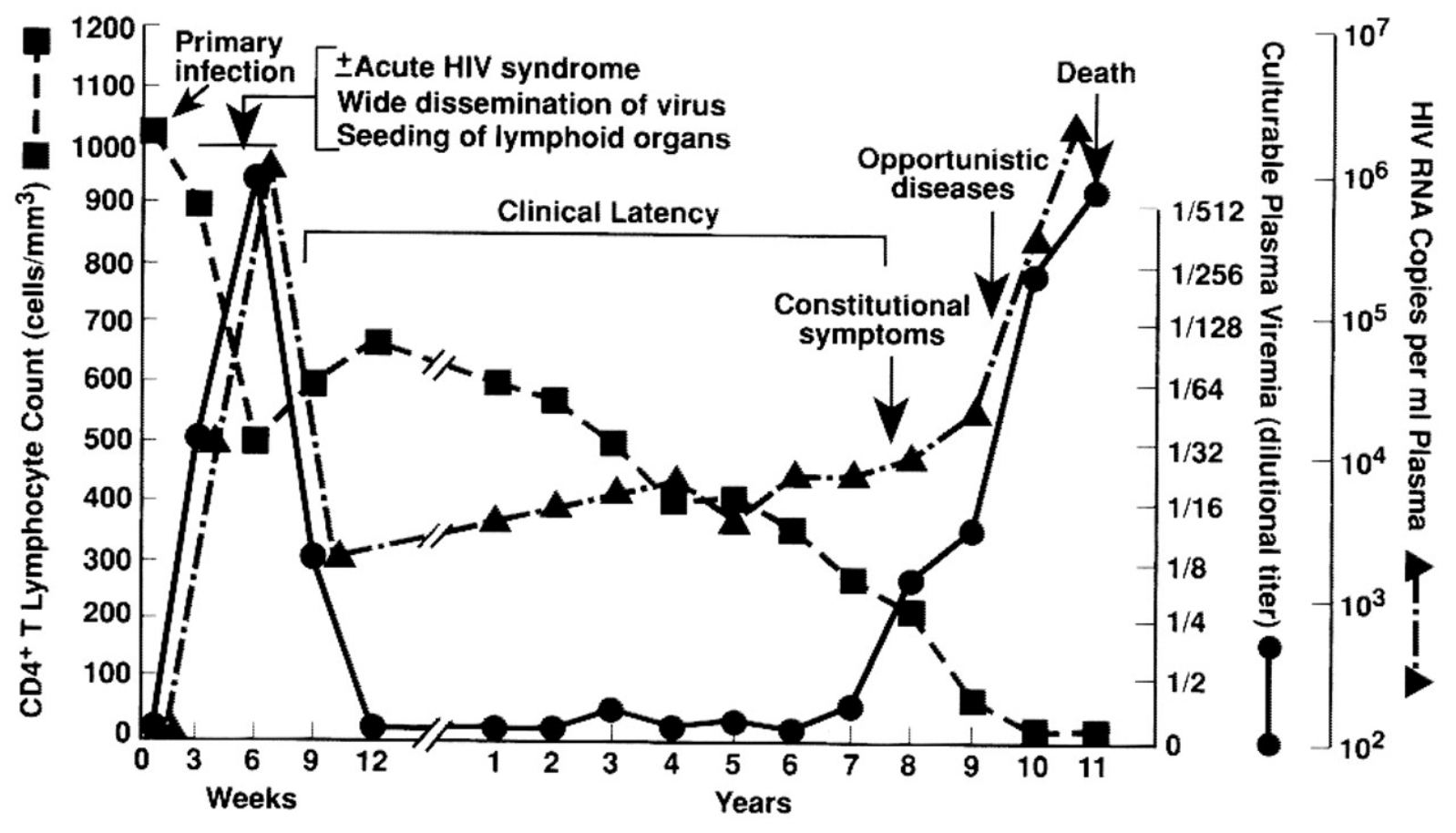
(AidsInfo, n.d.).

Prognosis of HIV: 3 stages

1. Acute stage: 2-4 weeks
   - *Experience flu-like symptoms 2-4 weeks post infection*
   - *Individual at most risk of transmitting the virus to other people, as the viral load is highest in blood*
2. Latency stage: 10 years
   - *Viral particles reproduce at a very slow pace*
   - *No symptoms in infected individual*
3. AIDS: 1-3 years
   - *CD4 T cell levels fall extremely low (200 cells/μL)*
   - *Exposes immune system, opportunistic infections occur*
   - *Most common and severe infection: pneumocystis pneumonia*

(AIDS.gov, 2015)

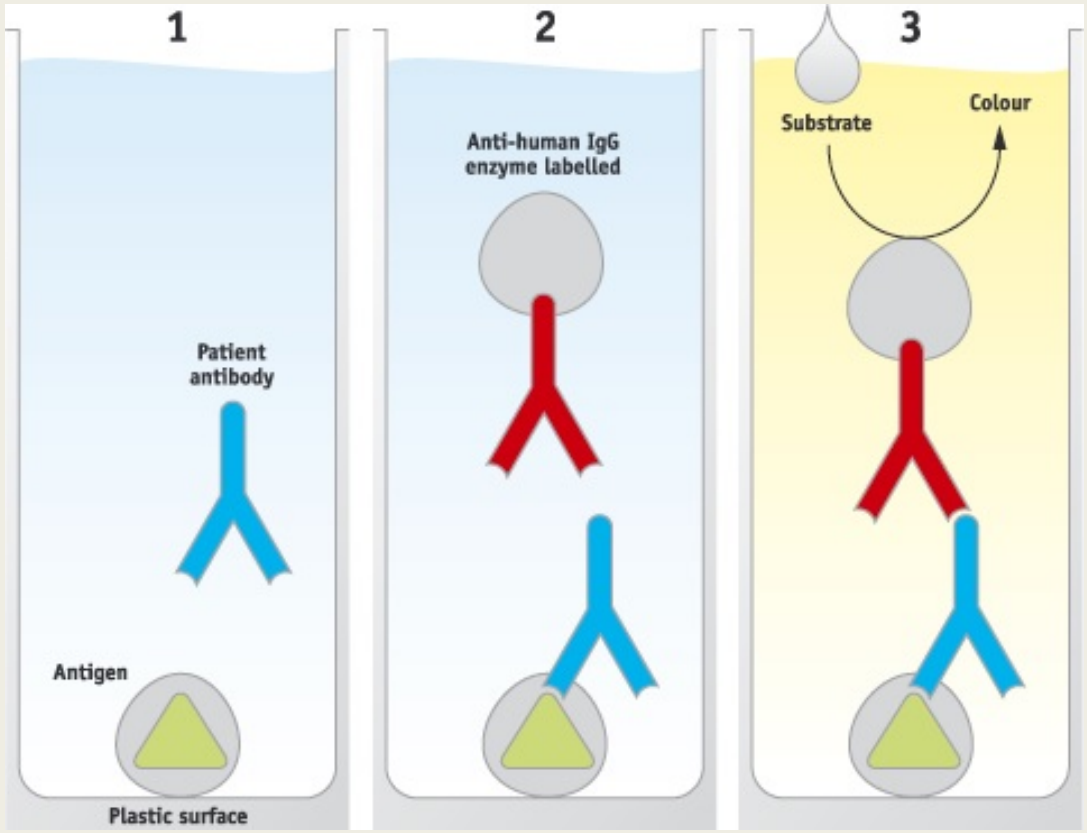
Prognosis of HIV



Retrieved from http://annals.org/aim/article/709558/immunopathogenic-mechanisms-hiv-infection

Screening and Diagnosis

- Most common: Enzyme-Linked Immunosorbent Assays (ELISA)



Retrieved from http://www.wieslab.se/diagnostic-services/index.php?langId=1&headId=72&subId=92&pageId=124

Screening and Diagnosis II

- Fourth generation assay: detects both HIV antibodies and p24 antigen
  - *Used by all laboratories in Canada*

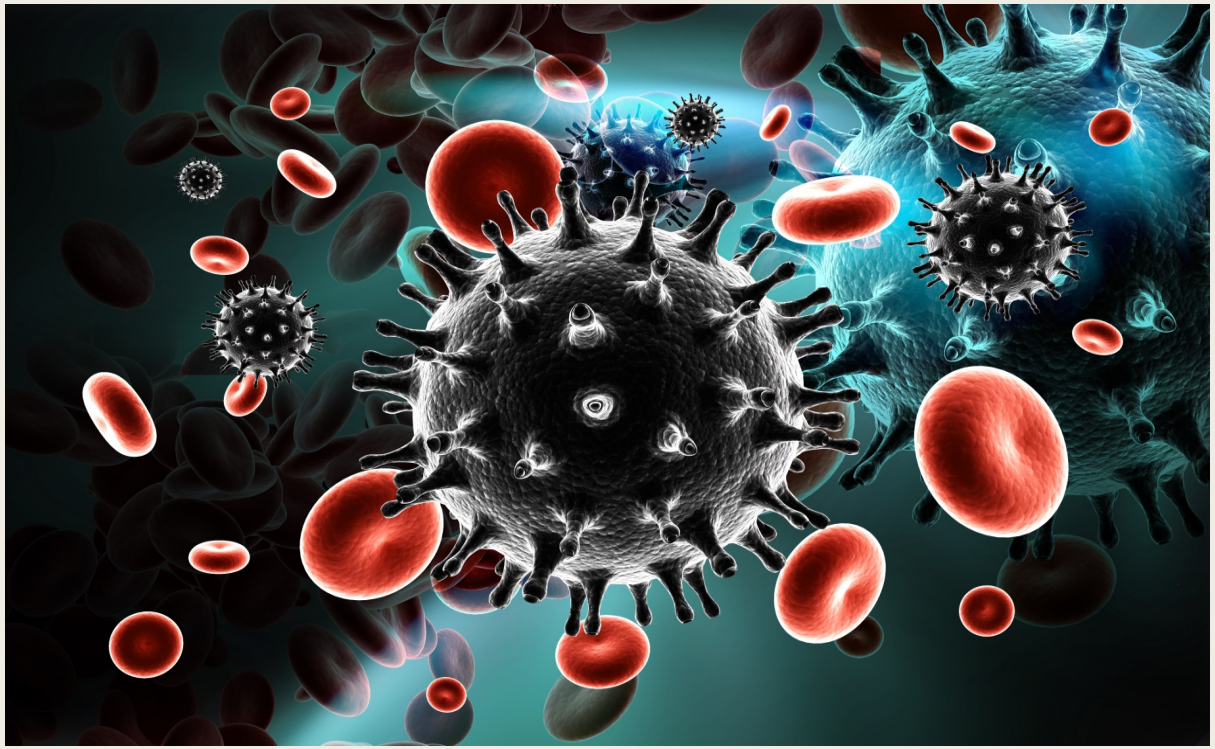
- Two home tests available:
  1. *Home Access HIV-1 Test System*
  2. *OraQuick In-Home HIV test*

Retrieved from http://www.oraquick.org/hiv-test-denmark-me/

(AIDS.gov, 2015)

Treatments - Current research

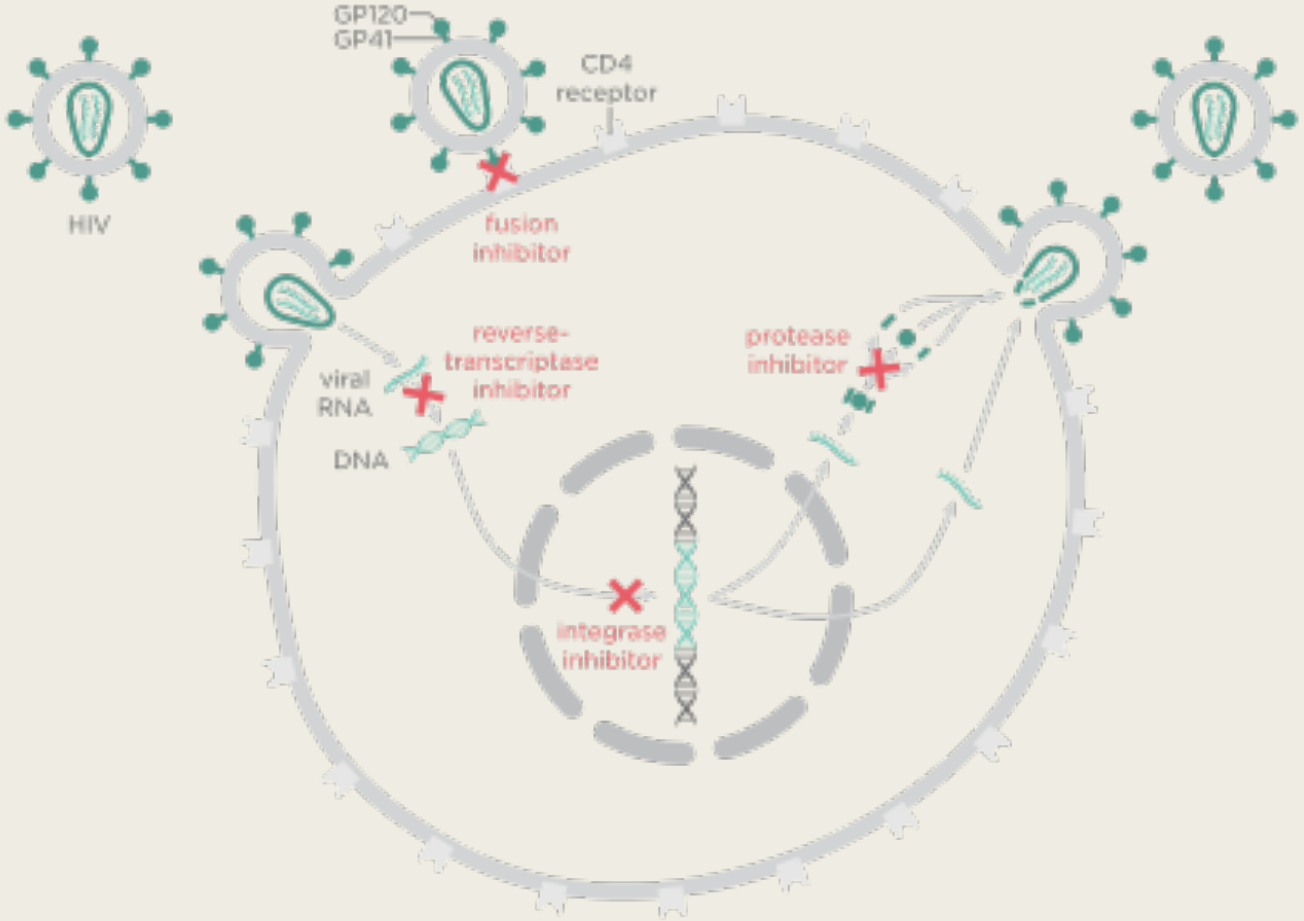
- Currently, there is no cure for HIV/Aids
- Most of the treatments are designed to:
  - *Reduce HIV in your body*
  - *Keep your immune system healthy*
  - *Decrease the complications*



http://americanpregnancy.org/app/uploads/2012/04/HIV_during_pregnancy.jpg

(Nordqvist, 2016)

Past HIV Antiretroviral Treatment (ART)



- Improves quality of life
- Extends life expectancy
- Reduces the risk of transmission
- Begin treatment when HIV-positive adults CD4 cell count is 500 cells/mm³ or lower

https://upload.wikimedia.org/wikipedia/commons/thumb/d/d5/HIV-drug-classes.svg/450px-HIV-drug-classes.svg.png

(Nordqvist, 2016)

Antiretroviral Treatment (ART)

- *Several types of anti-HIV drugs and each type attacks the virus in its own way.*
- *HIV patients take 3 or more drugs*
- *Combination therapy or “the cocktail”*
- *Newer drug combinations package three separate medicines into only one pill*
- *Minimal side effects.*

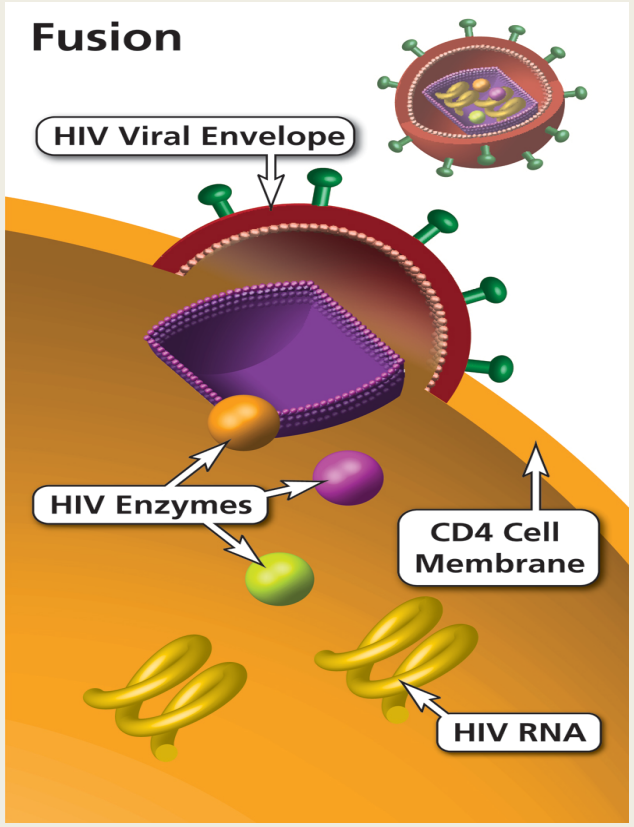
https://www.hivthrive.com/wp-content/uploads/2016/03/antiretroviral-drugs.jpg

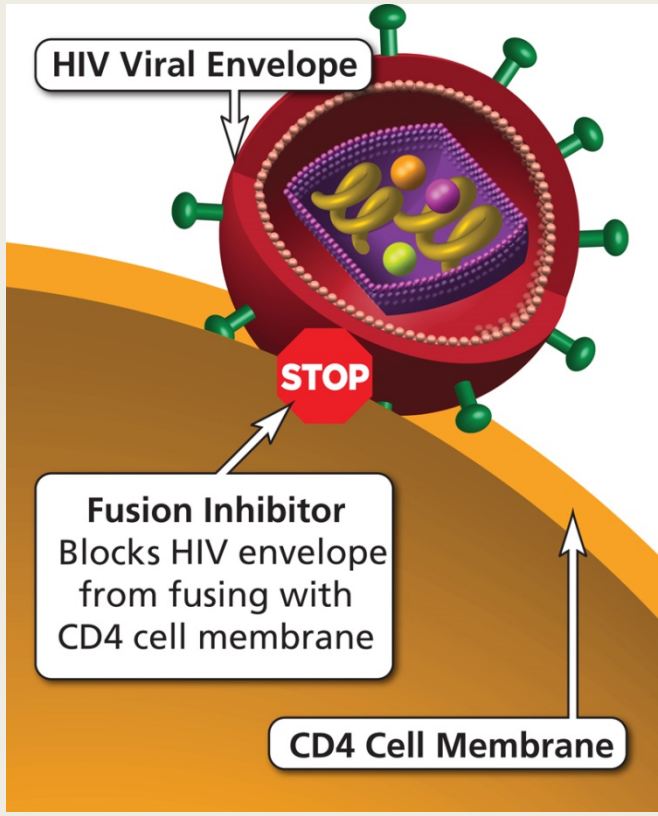
(Robinson,2016)

Other HIV Medications

Fusion Inhibitors:

- New class of drugs that act against HIV
- Prevents the virus from fusing with the inside a cell, preventing it from replicating
- Drugs include Enfuvirtide, also known as Fuzeon or T-20.



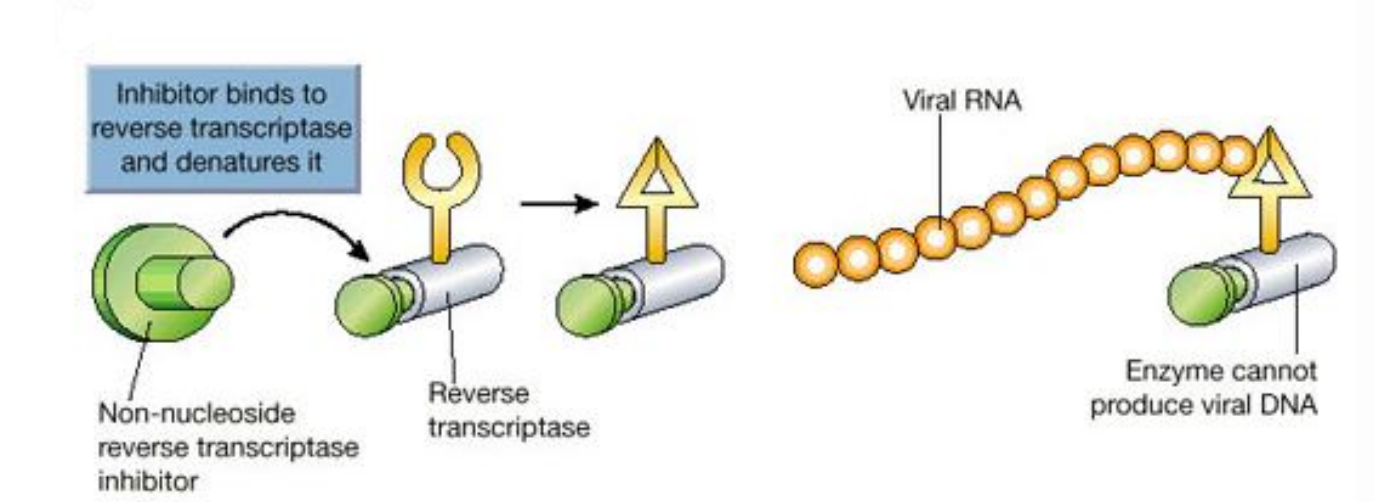


https://aidsinfo.nih.gov/images/glossaryimages/Fusion-Inhibitor2-800.jpg https://aidsinfo.nih.gov/images/glossaryimages/Fusion-(Step-2)-800.jpg (Nordqvist, 2016)

Other HIV Medications

Non-Nucleoside Reverse Transcriptase Inhibitors (NNRTI)

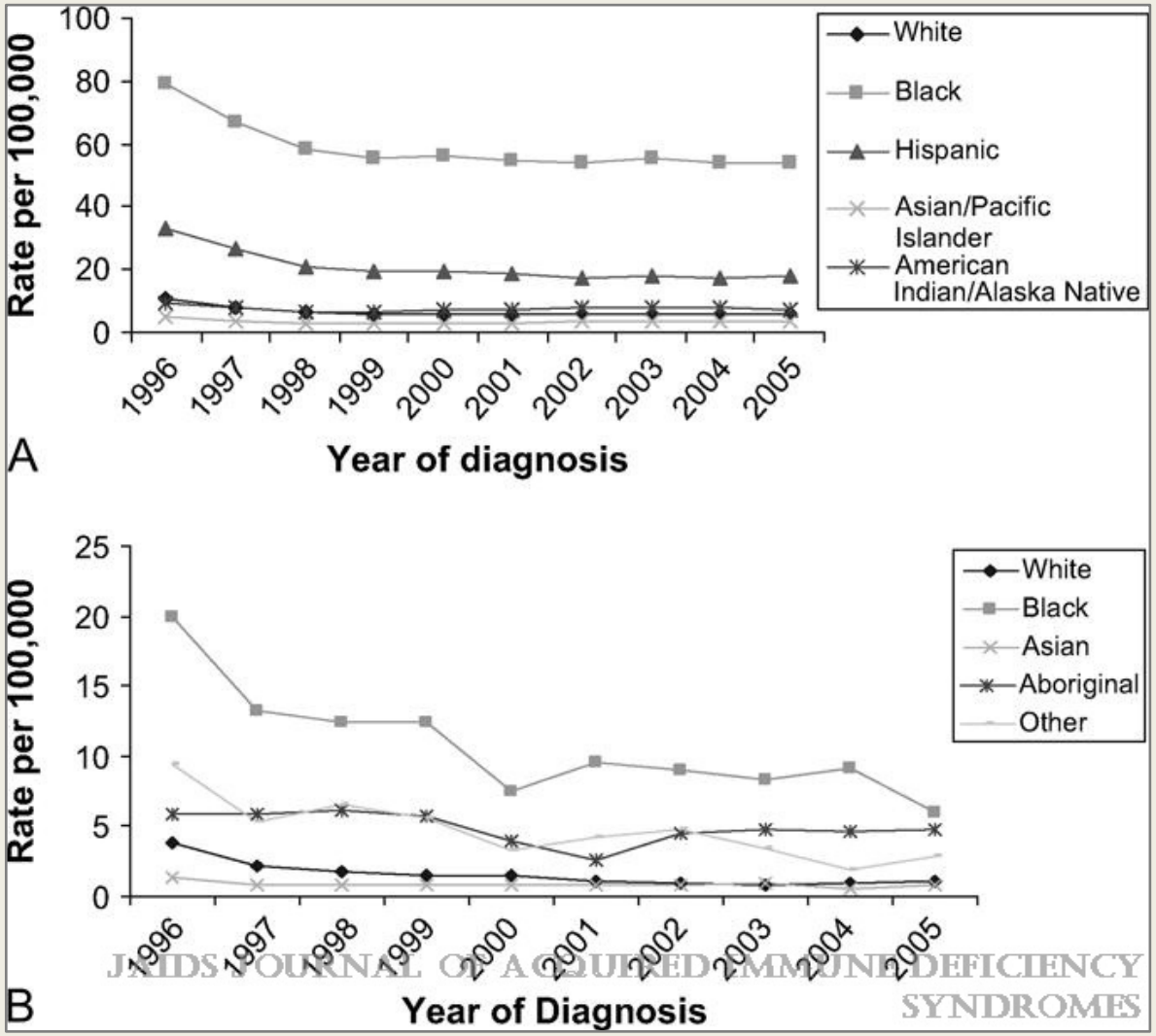
- Non-nucleoside reverse transcriptase inhibitors block the infection of new cells by HIV.
- May be prescribed in combination with other anti-retroviral drugs such as:
  - Delvaridine
  - Efavirenz
  - Nevirapine



http://www.pharmacology2000.com/Antiviral/images/non-nucleoside_reverse_transcriptase_inhibitor1B.png

(Robinson, 2016)

Demographics:

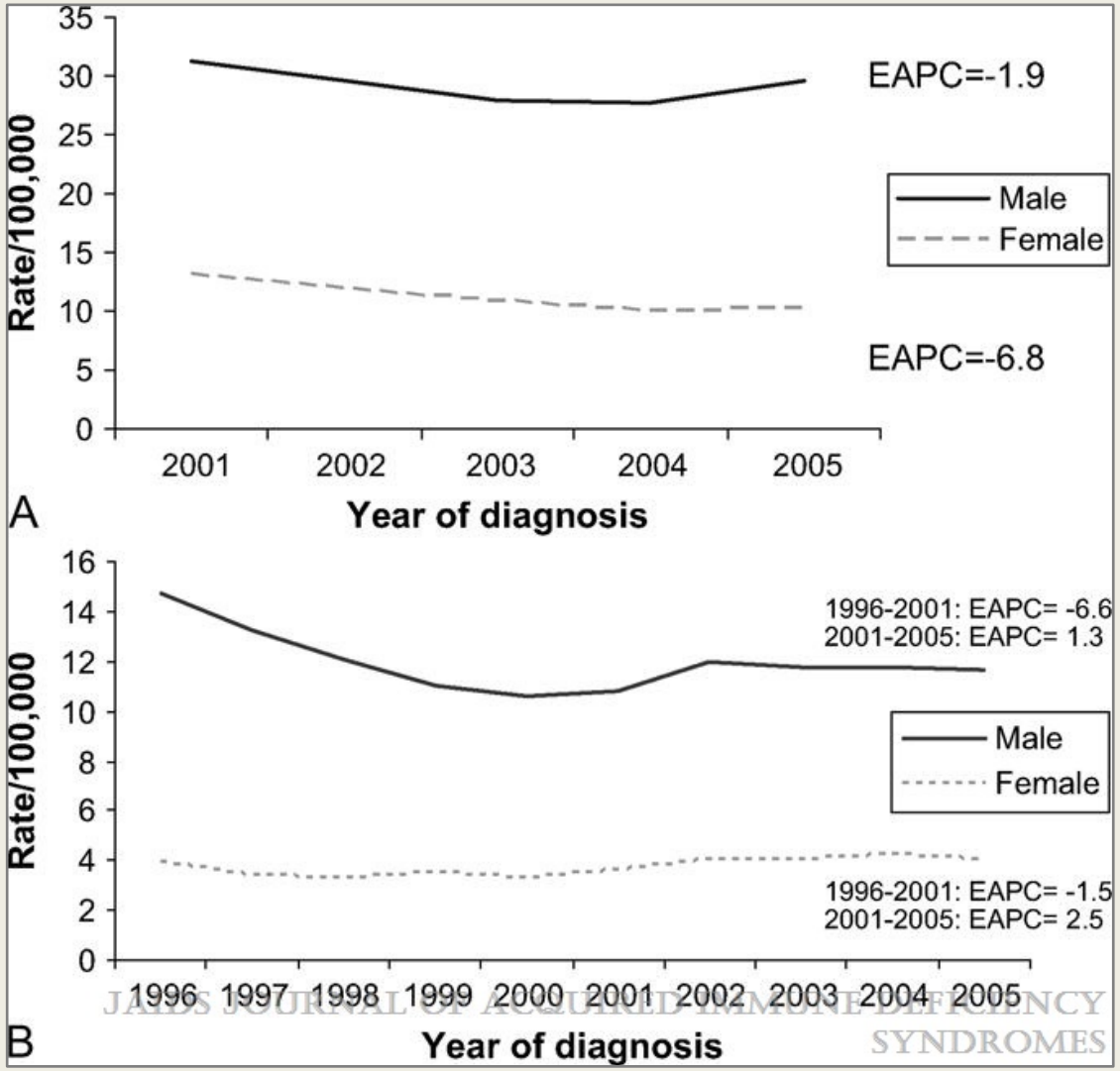


http://dx.doi.org/10.1097/qai.0b013e3181a2639e

Rates of AIDS incidence by **race/ethnicity**, United States (A) and Canada (B), 1996-2005.

- In Canada: highest in Aboriginals
- In USA: highest in Blacks

Demographics:



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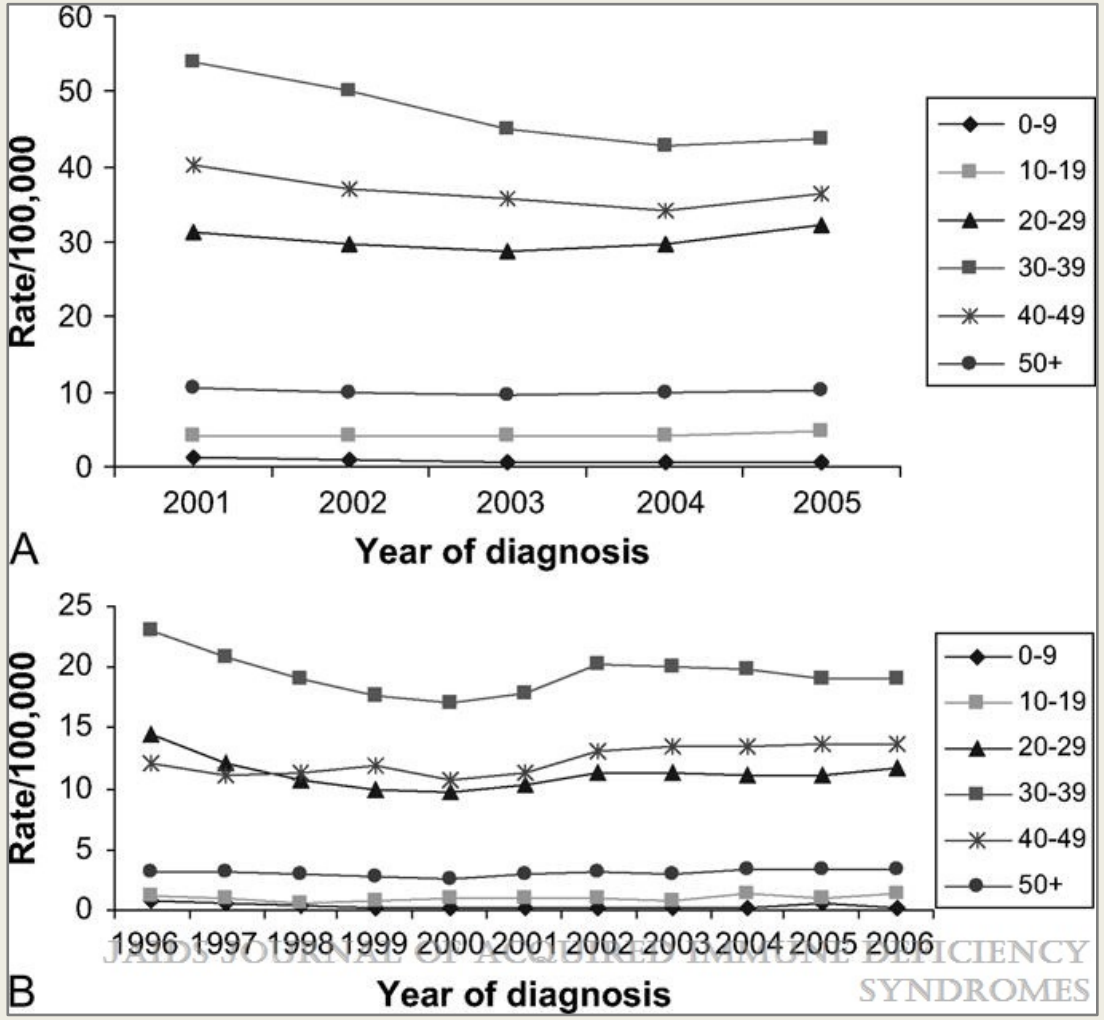
Rates of AIDs incidence by **sex** in 2005:

- Men > Women

Demographics:

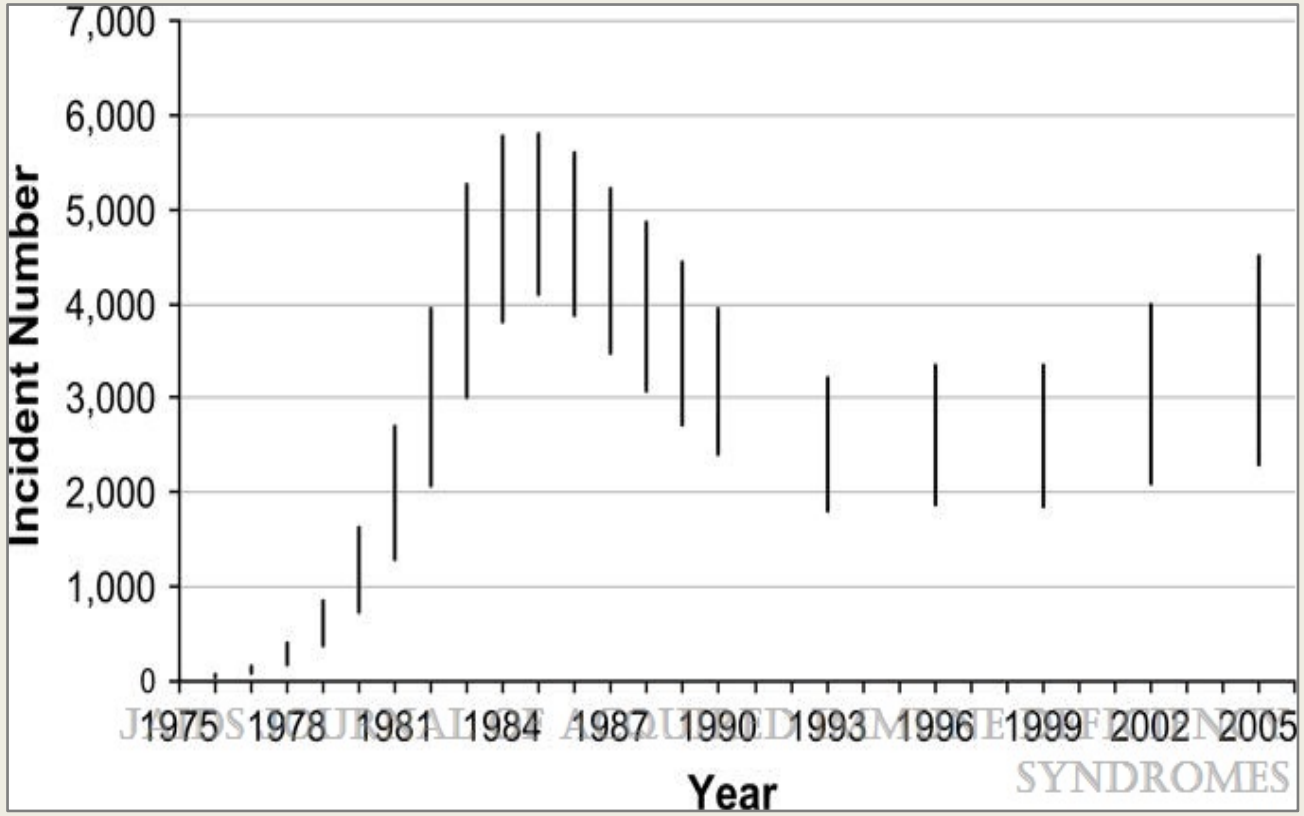


http://dx.doi.org/10.1097/qai.0b013e3181a2639e

Rates of AIDs incidence by **age** in 2005:

- Highest rate of diagnosis: age 30-39

Demographics:



http://dx.doi.org/10.1097/qai.0b013e3181a2639e

Rates of AIDs incidence in **Canada**

- Peaks associated with:
  - Male homosexual population
  - Injection drug users

HIV Vaccine Trials - November 2nd 2016

First large-scale HIV vaccine trial in seven years to start in South Africa

Over three years, scientists will test the safety and efficacy of a vaccine regimen to prevent HIV.

By Léa Surugue

November 2, 2016 10:33 GMT ⊙ *Updated 3 hr ago*

- HIV Vaccine = HVTN 702
  - HIV Vaccine Trials Network
  - Monoclonal antibody to gp120
  - Preventing HIV infection
- Phase III Clinical Trials
- 5400 South African Men and Women (18-35)
- November 2016 – December 2020

http://www.ibtimes.co.uk/first-large-scale-hiv-vaccine-clinical-trial-seven-years-start-south-africa-1589468

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Multiple Choice Questions

1. What CD4+ T cell count is needed to be diagnosed with AIDS?
    a. *<200 cells/uL ##*
    b. *<200 cells/mL*
    c. *500 cells/mL*
    d. *750 cells/uL*
2. How does the HIV virus replicate its genome?
    a. *Reverse transcriptase ##*
    b. *DNA transcriptase*
    c. *RNA transcriptase*
    d. *RNA polymerase*