Figure 1. Antigenic drift (Image source: NIAID)

1. Each year’s flu vaccine contains three flu strains – two A strains and one B strain – that can change from year to year.

2. After vaccination, your body produces infection-fighting antibodies against the three flu strains in the vaccine.

3. If you are exposed to any of the three flu strains during the flu season, the antibodies will latch onto the virus’s HA antigens, preventing the flu virus from attaching to healthy cells and infecting them.

4. Influenza virus genes, made of RNA, are more prone to mutations than genes made of DNA.

5. If the HA gene changes, so can the antigen that it encodes, causing it to change shape.

6. If the HA antigen changes shape, antibodies that normally would match up to it no longer can, allowing the newly mutated virus to infect the body’s cells.

This type of genetic mutation is called “ANTIGENIC DRIFT.”
Figure 2. Antigenic shift (Image source: NIAID)

The genetic change that enables a flu strain to jump from one animal species to another, including humans, is called "ANTIGENIC SHIFT." Antigenic shift can happen in three ways:

A-1 A duck or other aquatic bird passes a bird strain of influenza A to an intermediate host such as a chicken or pig. The new strain may further evolve to spread from person to person. If so, a flu pandemic could arise.

A-2 A person passes a human strain of influenza A to the same chicken or pig. (Note that reassortment can occur in a person who is infected with two flu strains.)

A-3 When the viruses infect the same cell, the genes from the bird strain mix with genes from the human strain to yield a new strain.

A-4 The new strain can spread from the intermediate host to humans.
Figure 3. The HIV Life Cycle (Image source: NIH)

The HIV Life Cycle

HIV medicines in six drug classes stop HIV at different stages in the HIV life cycle.

1. **Binding (also called Attachment):** HIV binds (attaches itself) to receptors on the surface of a CD4 cell.
   - CCR5 Antagonist

2. **Fusion:** The HIV envelope and the CD4 cell membrane fuse (join together), which allows HIV to enter the CD4 cell.
   - Fusion inhibitors

3. **Reverse Transcription:** Inside the CD4 cell, HIV releases and uses reverse transcriptase (an HIV enzyme) to convert its genetic material—HIV RNA—into HIV DNA. The conversion of HIV RNA to HIV DNA allows HIV to enter the CD4 cell nucleus and combine with the cell’s genetic material—cell DNA.
   - Non-nucleoside reverse transcriptase inhibitors (NNRTIs)
   - Nucleoside reverse transcriptase inhibitors (NRTIs)

4. **Integration:** Inside the CD4 cell nucleus, HIV releases integrase (an HIV enzyme). HIV uses integrase to insert (integrate) its viral DNA into the DNA of the CD4 cell.
   - Integrate inhibitors

5. **Replication:** Once integrated into the CD4 cell DNA, HIV begins to use the machinery of the CD4 cell to make long chains of HIV proteins. The protein chains are the building blocks for more HIV.

6. **Assembly:** New HIV proteins and HIV RNA move to the surface of the cell and assemble into immature (noninfectious) HIV.

7. **Budding:** Newly formed immature (noninfectious) HIV pushes itself out of the host CD4 cell. The new HIV releases protease (an HIV enzyme). Protease acts to break up the long protein chains that form the immature virus. The smaller HIV proteins combine to form mature (infectious) HIV.
   - Protease inhibitors (Pis)