Abstract

Animals have evolved a multifaceted defense system that helps protect against the ravages of infectious diseases.

The combination of the innate and adaptive immune responses in humans is what allows you to recover from an infection and sometimes (but not always) acquire immunity to re-infection with the same agent.

Specific antiviral drugs and vaccines can help this process, and sometimes even prevent a clinically significant primary infection.

In this lecture, we will take a very quick tour of the human immune response, the effects of some successful vaccines and antiviral drugs in recent decades, and the prospects for the battles against viruses as we move deeper into the 21st century.
How does the anti-influenza drug “Tamiflu” work? This compound is an inhibitor of the viral enzyme neuraminidase on the viral surface. The enzyme acts to prevent newly emerging flu virions from clumping together. Inhibiting the action of this enzyme reduces the spread of new virus particles throughout the body.
<table>
<thead>
<tr>
<th>Type of pathogen</th>
<th>Examples</th>
<th>Diseases</th>
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| **Bacteria**     | *Salmonella enteritidis*  
|                  | *Mycobacterium tuberculosis* | Food poisoning  
|                  |                       | Tuberculosis |
| **Viruses**      | Variola  
|                  | Influenza  
|                  | HIV        | Smallpox  
|                  |           | Flu       |
|                  |           | AIDS      |
| **Fungi**        | *Epidermophyton floccosum*  
|                  | *Candida albicans* | Ringworm  
|                  |                   | Thrush, systemic candidiasis |
| **Parasites**    | **protozoa**  
|                  | *Trypanosoma brucei*  
|                  | *Leishmania donovani*  
|                  | *Plasmodium falciparum* | Sleeping sickness  
|                  |                   | Leishmaniasis |
|                  | **worms**    
|                  | *Ascaris lumbricoides*  
|                  | *Schistosoma mansoni*   | Malaria  
|                  |                   | Ascariasis  
|                  |                   | Schistosomiasis |
Immune system cells arise from stem cells in the bone marrow.

A variety of White Blood Cells form the basis for the “innate” and “adaptive” immune responses to infection.
Summary of the Adaptive Immune Response
(“in 80 words or less”)

Initial antigen presentation by "Antigen Presenting Cells" leads to the activation and proliferation of $T_H$ cells, which are required for the generation of the humoral response (clonally-selected $B$ cells secreting antigen-specific antibody that binds to extracellular virus particles) and the cell-mediated response (clonally-selected $T_c$ cells recognizing antigen-displaying "altered self" (i.e., infected) cells and killing them). A subset of these $B$ and $T_c$ cell populations become antigen-specific "memory" cells to provide long-lived immunity to re-infection.
Antibodies made during infection with measles virus bind to the virus and prevent reinfection with measles virus.

Antibodies made during infection with measles virus do not bind to influenza virus.
Global eradication of smallpox by vaccination with live Vaccinia virus.
Three other highly contagious infectious diseases for which vaccines have been very successful.
An early 21’st century vaccine: HPV VLPs

Relationship among incidences of cervical HPV infection, precancer, and cancer

Zostavax vaccine (2006) for Shingles – Herpes Zoster
**Rota-Teq** vaccine (2006) for Rotavirus Infection

**Rota-Teq** is a live, orally administered vaccine consisting of five “reassortment” viruses created from naturally occurring human and bovine strains.
H5N1 Influenza vaccine ?

HIV vaccine ?