

I³: Infection, Immunity, and Influenza

What you should know . . .
what you can do

What are we facing?

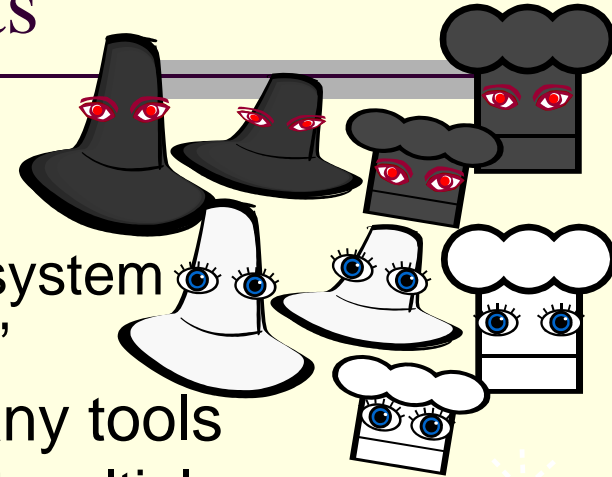
- Biologically, there are viruses and . . . *everything else*: birds, bugs, us
- Everything else is comparatively complex: assembling, disassembling, and cycling energy and materials
- Viruses are simple: an enclosure containing information
- Influenza are viruses
 - They hijack *our* factories to do *their* work



Antigens vs. Antibodies:

The black hats vs. the white hats

- The black hats belong to the viruses
 - Generically, we refer to “antigens”
- The white hats belong to the immune system
 - Generically, we refer to “antibodies”
- Both are fierce competitors with many tools
 - An individual virus type can present multiple antigens, and has the advantage in a 1st encounter
 - The immune system “remembers” antigens via specific antibodies, and has the advantage in a 2nd encounter
- Biochemistry of infection links attackers and defenders through stereochemistry and “receptors”
 - Three-dimensional fits of one molecule to another

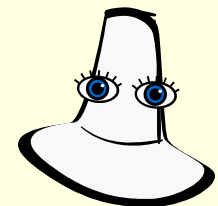
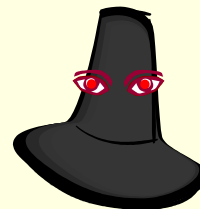


Immune system: To win the race . . .

- Alert
 - It belongs here or it doesn't – antigens or not
 - The first step the immune system takes
- Identify
 - Each virus is different
 - *The* crucial step in fighting viruses is recognizing a known threat – the path of immunity
- Isolate
 - Keep the viruses from reaching their targets
 - Neutralize those that do
- Destroy
 - Finish the job
 - Bring home trophies for antibody recognition

Immunization: a (BIG) head start

- Presents the immune system with a (weakened) antigen
 - The structure of the antigen – the protein “face” the immune system must recognize
- The virus is thus a known black hat
 - Attacked immediately . . .
 - By antibodies that specifically fit the antigens presented by the virus



Viruses, however, are tricky

- They mutate and mingle
- Influenza viruses are RNA viruses
 - Single strand of code
 - Not the double-strand helix of DNA
- With no double-check system, they mutate quickly
- Two different viruses mingling in one cell can also exchange genetic material
- Viruses thus have lots of antigen “faces” in their infectious toolbox

Antigens: many black-hat variants

- Influenza strains have two types of antigens
 - H - Hemagglutinin: 10 different types
 - N - Neuraminidase: 16 different types
- Thus are referred to as H1N1, H1N2, etc
 - 1918 (Spanish) flu was H1N1
 - 1957 (Asian) flu was H2N2
 - 1968 (Hong Kong) flu was H3N2
 - 2005 bird flu is H5N1
- Each combination represents a different black hat, and requires a companion white hat to fight the infection
- Cannot immunize against 160 different antigen combinations to produce 160 different white hats

Antigens: drift versus shift

- Drift: the basic antigen structure stays the same but the geometry changes
 - A H1N1 variation
- Shift: the basic antigen structure changes
 - H1N1 to H1N2 or H5N1
- Why do we care?
 - Both are new infections, but the immune system is better prepared for the modest change of drift
 - Shifts are new – no previous experience and antibodies



Bird flu, swine flu, human flu

- Major human influenza arises from bird flu
 - Type A influenza
 - ‘Human’ influenza – Types B and C – is milder
- Type A may first “jump” to swine
- Current Asian outbreaks are from bird to human
 - Appear to be a result of massive exposure to, and infection from, the *avian* form of H5N1
 - 1999 and current outbreaks are H5N1
- The fear is a new subtype that will allow direct human-human infection – a *human* form of H5N1

Modern travel: flu's best friend

- A pandemic is an epidemic over more than one geographic area
- People routinely set foot on three continents in one day
- Abetted by latency period – people infected but not yet aware
- A virus couldn't ask for better help
- If a human H5N1 influenza arises, a pandemic **is a certainty**
- Locally severe infection, however, **is not**

What to do

- Prepare to minimize interactions
 - Store food, water, and medicine (for *weeks*, not days)
 - Buy personal-protection equipment: gloves, masks
- Get a flu shot
 - A mix of several strains (*not* H5N1)
 - A little more immunity never hurts . . .
- Limit surface/airborne contact
- A good time to listen to your mother
 - Cleanliness counts: wash your hands, wash your hands, wash your hands . . .
 - But remember: viruses are untouched by antibiotic wipes, sprays, detergents, etc
- Repeat: Minimize interactions and wash your hands

A side note on Tamiflu

- The H and N antigens perform two different functions in the infectious process
 - Hemagglutinin gets the virus into the cell
 - Neuraminidase lets it escape the cell
- Tamiflu is a neuraminidase inhibitor
 - It *slows* the spread of infection
 - Is it useful? Absolutely
- But the supply is limited
 - Strong personal opinion: with a limited supply, the priority recipients are our critical medical resources: EMTs, doctors, nurses, orderlies
 - Don't plead for a prescription "just in case"

Finally, a reality check

- Morbidity vs. mortality
 - Many may get sick – comparatively few will be terminal
- Relative risk: over your lifetime, you are more likely to be taken out by a car than the flu
- A human H5N1 flu may be fearsome . . . or mild
- With rapid mutation, even a more virulent strain will likely weaken over time
 - Regresses to the mean
- We are planners and analysts
 - Planning and common sense will make all the difference