Novel Influenza H1N1

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Lecture Outline

- Origins of a virus
- Microbiology of the virus
- Viruses and human disease
- Influenza virus H1N1
- Prevention of disease (H1N1)
- Treatment of disease
- Summary (Q&A)
Origin

■ Where did viruses originate?
  - from free-living organisms like bacteria
  - from the host cell DNA or RNA molecules
  - evolved along with the most primitive molecules that first contained self-replicating abilities

■ Actually – we don’t know!
Viral Replication

- Life cycle of the Influenza Virus
Viruses and human disease

- Infections caused by viruses
  - Colds
  - Flu
  - Most coughs and bronchitis
  - Sore throats (except for those resulting from strep throat)
  - Some ear infections

Bacteria vs. Virus

- Bacteria are free-living. A virus must replicate in a host cell.
- Disease-causing bacteria trigger illnesses, such as strep throat, whooping cough, and some ear infections
- Most bacterial diseases can be treated by antibiotics.
- Antibiotics do not treat viral diseases
Characteristics of novel A(H1N1) virus

- Transmission of novel A(H1N1) is similar to seasonal influenza
- Clinical signs and symptoms similar to seasonal influenza, but with higher rates of nausea/vomiting and diarrhea
- Novel A(H1N1) is genetically different from the A(H1N1) strain included in seasonal influenza vaccines
  - Receipt of recent (2005-2009) seasonal influenza vaccines is unlikely to elicit a protective antibody response to the novel A(H1N1) virus
  - Cross-reactive antibody detected only in adults aged >60 years (33%)
- Susceptibility
  - Uniformly resistant to adamantanes (eg, amantadine and rimantadine)
  - Susceptible to oseltamivir and zanamivir
    - Rare sporadic cases of oseltamivir resistance have been detected worldwide

http://www.cdc.gov/mmwr/PDF/wk/mm5819.pdf
Weekly Influenza Activity Estimates Reported by State & Territorial Epidemiologists*
Week ending September 12, 2009 - Week 36
Influenza: Seasonal

- Percentage of Visits for Influenza-like Illness (ILI) Reported by the US Outpatient Influenza-like Illness Surveillance Network (ILINet), National Summary 2008-09 and Previous Two Seasons
Age Group

Laboratory-confirmed cases by age group
novel influenza A(H1N1) – 24 JUL 2009 (n=43,771)

Percentages represent proportion of total cases

- **0-4 Yrs**: 4,816 (11%)
- **5-24 Yrs**: 22,080 (50%)
- **25-49 Yrs**: 7,434 (17%)
- **50-64 Yrs**: 2,187 (5%)
- **65 Yrs**: 513 (1%)
- **Unknown**: 6,741 (15%)
Incidence: Novel H1N1

Incidence of confirmed or probable influenza A(H1N1) by age group, United States, March 15-May 16, 2009 (n=2672)*

*© Reed et al. CDC, provisional unpublished data
Pathogenesis: Host Factors

- Presence of target receptors on host cells
- Availability of enzymes in host cells which are essential for viral entry and replication
- State of immunocompetence of the individual host
- Specific immunity against certain viral epitopes in the individual host and target population
- Ability of the immune system to control the viral replication effectively without causing serious collateral damage for the host by its inflammatory response
Pathogenesis: Virus Factors

- Ability to bind to host cells
- Ability of virus shedding
- Restriction of cytopathogenic effects to allow for an appropriate balance between viral replication and control by the host
- Escape from immunosurveillance by evolution of antigenic variation driven by selective pressure of the immune response
- Escape from immunosurveillance by recombination with different virus strains from zoonotic disease
- Modulation of the immune response to attenuate effective host defense mechanisms
Preventative Measures

- Avoid touching your nose and mouth;
- Wash your hands thoroughly with soap and water or a hydroalcoholic solution, and do this regularly (especially if you touch your nose or mouth, or potentially contaminated surfaces);
- Avoid close contact with persons who may be sick;
- If you can, spend as little time as possible in crowded places;
- Open windows to ventilate interiors;
- Lead a healthy life – sleep enough, eat properly and carry out a physical activity.
Medical Options

- *ACIP Goals: 2009 H1N1 Vaccine Recommendations*
  - Vaccinate as many as possible as quickly as possible
  - Focus initial vaccination efforts on groups at higher risk for influenza and influenza-related complications
  - Expand recommendations to include larger population groups as supply increases
  - Allow for local flexibility because vaccine availability and demand for vaccination will vary

* Advisory Committee on Vaccine Practices: http://www.cdc.gov/vaccines/recs/ACIP/default.htm
Immunity

- Antigen – a substance, foreign to the body, that prompts the generation of antibody
Immunity

- Antibody – (Immunoglobulins) are proteins that are found in blood or other bodily fluids of vertebrates, and are used by the immune system to identify and neutralize foreign objects.
Antibody – Mechanism of action
- Antibodies are antigen-specific
- Prevent viral binding to cell receptors
- Facilitate phagocytosis by macrophage
- Directly destroy the antigen (with other enzymes in the blood).
Antibody Response
Amplitude proportional to immune protection

Antibody Titer vs. Days After Immunization

1º Ag

2º Ag
Response to H1N1

- **Study Design**
  - Two doses of vaccine administered at an interval of 21 days

- **Target Population**
  - 849 adults divided into two age cohorts
  - 18 to 64 Years Old
  - > 65

- **Treatment Groups:**
  - Placebo (Saline)
  - 7.5 μg virus antigen
  - 15 μg virus antigen
  - 30 μg virus antigen
Response to H1N1

- Outcome after 21 days – One Dose
  - 18 to 64: 98% seroprotective
  - 65 & older: 93% seroprotective
- Untoward effects
  - No serious events
  - Local injection site redness, swelling and pain
  - Systemic complaints
  - Very similar to seasonal influenza vaccine
Therapy (Treatment)

- Oseltamivir
  - an antiviral drug that slows the spread of influenza (flu) virus between cells in the body by stopping the new virus from chemically cutting ties with its host cell.
Therapy (Treatment)

- Zanamivir
  - neuraminidase inhibitor used in the treatment and prophylaxis of Influenzavirus A and Influenzavirus B.
Summary

Influenza spreads across the world and ages

1977  "Russian" flu
1968  "Hong Kong" flu
1957  "Asian flu"
1933  First human influenza virus isolated
1918  "Spanish flu" killed 20-40 million

Epidemic recorded by Hippocrates

412 B.C

Middle ages
Numerous episodes described

1781 & 1830 Epidemics spread from Asia across Russia

How did it start?