The Impact of Pandemic Influenza on Public Health

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Part One of Six

Basics
Influenza Virus

- RNA, enveloped
- Viral family—orthomyxoviridae
- Size—80-200nm or 0.08 – 0.12 μm (micron) in diameter
- Three types
  - A, B, C
- Surface antigens
  - H (haemaglutinin)
  - N (neuraminidase)

Source: CDC Public Health Image Library
# Natural Hosts of Influenza Viruses

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<thead>
<tr>
<th>Haemagglutinin subtype</th>
<th>Neuraminidase subtype</th>
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<td>Human</td>
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The Burden of Influenza

- Seasonal influenza
  - Globally—250,000 to 500,000 deaths per year
  - In the U.S. (per year)
    - ~35,000 deaths
    - >200,000 hospitalizations
    - $37.5 billion in economic cost (influenza and pneumonia)

- Pandemic influenza
  - An ever present threat
Influenza is a highly contagious disease
Typical incubation is two days (range one to four days)
Individuals are contagious for one to four days before the onset of symptoms and about five days after the first symptoms
  - Peak viral shedding—first three days of illness
Subsides usually by fifth to seventh day in adults
  - Can be ten or more days in children
Approximately 50% of infected people do not present any symptoms but are still contagious
Spread of Influenza

- Most human influenza infections are spread by virus-laden respiratory droplets that are expelled during coughing and sneezing.
- Influenza viruses range in size from 0.08 to 0.12μm.
- They are carried in respiratory secretions as small-particle aerosols (particle sized <10μm).
- Sneezing generates particles of varying sizes
  - 10-100μm

Photo by AnA oMeLeTe via flickr. Some rights reserved.
The three modes of transmission include the following:

− Droplet transmission
− Airborne transmission, and
− Contact transmission
Droplet Transmission

- Droplet transmission occurs when contagious droplets produced by the infected host through coughing or sneezing are propelled a short distance and come into contact with another person’s ...
  - Conjunctiva
  - Mouth
  - Nasal mucosa
Airborne Transmission

- Airborne transmission occurs when viruses travel on dust particles or on small respiratory droplets that may become aerosolized when people sneeze, cough, laugh, or exhale
  - They can be suspended in the air like invisible smoke
  - They can travel on air currents over considerable distances
  - With airborne transmission, direct contact with someone who is infected is not necessary to become ill
Contact Transmission

- Two types
  - Direct—involves body-to-body surface contact
  - Indirect—occurs via contact with contaminated intermediate objects, such as contaminated hands, or inanimate objects (fomites), such as countertops, door knobs, telephones, towels, money, clothing, dishes, books, needles, etc.
Survival of Influenza Virus on Surfaces

- With humidity 35%-40%, temperature 28C (82F)
- Hard non-porous surfaces—24-48 hours
  - Plastic, stainless steel
    - Recoverable for more than 24 hours
    - Transferable to hands up to 24 hours
- Cloth, paper, and tissue
  - Recoverable for eight to twelve hours
  - Transferable to hands for 15 minutes
- Viable on hands less than five minutes only at high viral titers
  - Potential for indirect contact transmission
Humidity’s Affects on Infectivity Influenza

Adapted from: Loosli, et al. (1943)
DIRECT: Expelled from infectious host by violent expiration (cough, sneeze) or simply exhalation.

INDIRECT: Aerosolization of infectious agent from environmentally contaminated sources (fomites, sewage).
Particle Inhalation

Particle Composition

Density (Settling Velocity)

Physical Decay

Dynamic Particle Size

Virus Particle's Genetic Vulnerability

Temperature and Relative Humidity

Ultraviolet Radiation

Biologic Decay
Particle Inhalation

Particle Inhalation

Nasopharyngeal

Tracheobronchial

Pulmonary

Particle Size (μm)

0.1

100
Definitions

- Epidemic—a located cluster of cases
- Pandemic—worldwide epidemic
- Antigenic drift
  - Changes in proteins by genetic point mutation and selection
  - Ongoing and basis for change in vaccine each year
- Antigenic shift
  - Changes in proteins through genetic re-assortment
  - Produces different viruses not covered by annual vaccine
Re-Assortment (in Humans)

Migratory water birds → Domestic birds

Source: WHO/WPRO
Re-Assortment (in Pigs)

Migratory water birds

Source: WHO/WPRO
Mutation (in Humans)

Migratory water birds → Domestic birds → Humans

Source: WHO/WPRO
From Birds to Humans

- Hong Kong, SAR China, 1997, H5N1
- Hong Kong, SAR China, 1999, H9N2
- The Netherlands, 2003, H7N7
- Hong Kong, SAR China, 2003, H5N1

Source: WHO/WPRO