Most Important Respiratory Pathogens

- Rhinoviruses
- Coronaviruses
- Adenovirus
- Respiratory syncytial virus
- Parainfluenza
- Human metapneumovirus
- Bocavirus
- Polyomaviruses
- Influenza
- *Bordetella pertussis*
- *Streptococcus pneumoniae*
- *Streptococcus pyogenes*
- *Mycoplasma pneumoniae*
- *Chlamydia pneumoniae*
- *Mycopathobacterium tuberculosis*

**Respiratory Syncytial Virus**

- Pathogen type – Single-stranded RNA, enveloped paramyxovirus; 2 antigenic subgroups with many variations not unlike influenza
- Key epidemiology features – Causes severe morbidity (bronchiolitis & pneumonia) among neonates, ~1% case fatality. Can cause lower respiratory tract disease in the elderly or immunocompromised.
- Vaccines – various vaccines (DNA vaccines, subunit vaccines, nano-vaccines) are under development
- Antimicrobials – Ribavirin aerosol, monoclonal antibody against RSV F glycoprotein (palivizumab)
- Other interventions – isolation; hospital infection control precautions

**Respiratory Syncytial Virus**

- RSV is the most important cause of viral lower respiratory tract illness in infants and children worldwide
- ~40% of all primary RSV infections in infancy are associated with bronchiolitis or pneumonia
- In the USA RSV causes an estimate 77,700 hospitalizations each year
- Infants hospitalized with RSV frequently have pulmonary function abnormalities for years

**Parainfluenza virus**

- Pathogen type – Single-stranded RNA enveloped paramyxovirus, 5 recognized serotypes; type 1 & 2 cause croup; type 3 is frequent cause of lower respiratory tract infection; type 4 is rare
- Key epidemiology features – human PIV type 3 is 2nd only to RSV in causing severe morbidity & mortality among neonates. These viruses also infect other groups, especially the elderly and immunocompromised
- Vaccines – hPIV3 vaccines under development
- Antimicrobials – None approved, ribavirin used with mixed results
- Other interventions – isolation; hospital infection control precautions

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**Acute Respiratory Infections II**

An Introduction to One Health Problem Solving

PHC 6006

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Vaccines, 5th Ed. 2008, Plotkin, Orenstein, Offit Eds.
Parainfluenza Virus

- HPIV 1 and HPIV2 are the principal causes of croup which affects children 6-48 months of age.
- HPIV 3 is a frequent cause of lower respiratory tract infection in children <12 mos.
- By 2 yrs of age 60% of children will have been infected by HPIV3.

Vaccines, 5th Ed. 2008, Plotkin, Orenstein, Offit Eds.

National Respiratory and Enteric Virus Surveillance System

The NREVSS is a laboratory-based system that monitors temporal and geographic patterns associated with the detection of RSV, PIV, human metapneumovirus, adenovirus, and rotavirus.

(86 laboratories from 43 states)

National Respiratory and Enteric Virus Surveillance System

- First reported 2001
- Virus: Single stranded, RNA, negative sense paramyxovirus, genetically similar to avian pneumovirus
- Disease: Early data suggest that the virus can cause severe respiratory disease and death, that reinfections may occur, and that all ages may be susceptible to infections
- Transmission: Likely via small droplet and direct contact

Human metapneumovirus

- First reported 2001
- Virus: Single stranded, RNA, negative sense paramyxovirus, genetically similar to avian pneumovirus
- Disease: Early data suggest that the virus can cause severe respiratory disease and death, that reinfections may occur, and that all ages may be susceptible to infections
- Transmission: Likely via small droplet and direct contact

Clinical Infectious Diseases 2007;44:152-8
Characteristics of Recent Human Metapneumovirus Outbreaks

- Infections may occur year-round
- Outbreaks can be nosocomial
- Associated with acute respiratory disease, pneumonia, and hospitalization
- May cause high attack rates (>70%) and severe morbidity or death among patients with chronic disease, the immunocompromised, the elderly, and the institutionalized

Influenza viruses

- Pathogen type – Influenza A, B, C viruses, A causes pandemics, A & B cause annual epidemics, C causes sporadic disease; RNA segmented viruses prone to antigen change
- Key epidemiology features – incubation 1-3 days, influenza A causes and estimated 36,000 US deaths each year
- Vaccines – Annual trivalent/quadrivalent vaccines (A,A,B,B) tailored for Northern and Southern hemispheres; pandemic vaccines under study
- Antimicrobials – 4 FDA approved; numerous new compounds under study

• INFLUENZA VIRUSES
  - Type A
    - humans, domestic and wild animals
  - Type B
    - humans (pigs, seals)
  - Type C
    - humans, pigs…minor pathogens

• INFLUENZA A VIRUSES
  - Hemagglutinin (HA: 1-17)
  - Neuraminidase (NA: 1-9) (Subtypes)
  - Matrix (M1 and M2)
  - Nucleoprotein (NP)
  - Polymerase proteins
    - (PA, PB1, PB2)
  - Non-structural proteins

• HUMAN INFLUENZA
  - Yearly Epidemics
    - United States
      - 10-20% A.R.
      - 114,000 hospitalizations
      - 36,000 deaths
      - $10+ billion
    - Globally
      - 3-5 million severe illnesses
      - 250,000-500,000 deaths

From Chris Olsen
ANTIGENIC DRIFT

• H3N2
• 1995
• Wuhan

• H3N2
• 1997
• Sydney

• H3N2
• 1999
• Panama

• H3N2
• 2002
• Panama

ANTIGENIC SHIFT

• H1N1
• 1918

• H2N2
• 1957

• H3N2
• 1968

From Chris Olsen

PIGS AS INTERMEDIATE HOSTS

1. Adaptation in Pigs
2. Reassortment in Pigs
3. Amplified spread through pigs

From Chris Olsen

From Chris Olsen

From Chris Olsen

From Chris Olsen

FLUVIEW

A Weekly Influenza Surveillance Report Prepared by the Influenza Division
Weekly Influenza Activity Estimates Reported by State and Territorial Epidemiologists*
Week Ending April 19, 2014- Week 16

From Chris Olsen

From Chris Olsen

From Chris Olsen

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Other Common Cold Viruses

Other viruses include:

- Coxsackieviruses (29 types),
- Echoviruses (34 types),
- Enteroviruses (4 types)

Together these explain at least 10-15% of colds.

Respiratory Pathogen Discovery

How can we screen for viruses in comprehensive fashion?

The “Virochip”: a microarray for simultaneous screening of ALL known viruses


Pan-Viral Screening of Respiratory Tract Infections in Adults With and Without Asthma Reveals Unexpected Human Coronavirus and Human Rhinovirus Diversity

New Diagnostic Strategies Yield Newly Recognized Viruses

- Bocavirus
- WU polyomavirus
- KI polyomavirus

Cloning of a human parvovirus by molecular screening of respiratory tract samples

Identification of a Novel Polyomavirus from Patients with Acute Respiratory Tract Infections

- New diagnostic strategies yield newly recognized viruses
Bocavirus

- **Pathogen type** – first reported in 2005, causes respiratory and gastrointestinal disease, single stranded DNA virus of the family Parvoviridae
- **Key epidemiology features** – prevalence 3-5% among patients hospitalized with pneumonia, difficult to grow, detected in respiratory secretions, sera, and stool, frequently detected with other viruses, much to be learned about this virus
- **Vaccines** – None
- **Antimicrobials** – None

WU and KI Polyomaviruses

- **Virus type** – in 2007 the WU virus (WUV) and KI polyomavirus (KIpyV) cloned from respiratory tract specimens; new group within the Polyomaviridae, small DNA viruses with circular, covalently closed double-stranded DNA genomes
- **Key epidemiology features** – Pathogen? Infections from 2 previously recognized human polyomaviruses, BK virus and JC virus (JCV) are acquired through the respiratory routes at a young age, cause persistent infections in the kidneys and central nervous system
- **Vaccines** – None
- **Antimicrobials** – None

Torque Teno Virus (TTV)

- **Virus type** – a circular, single-stranded DNA virus, genus Anellovirus virus, that chronically infects healthy individuals of all ages worldwide
- **Key epidemiology features** – Human pathogen? high prevalence in healthy people. Has been implicated in respiratory infections. Parenteral & sexual transmission likely. May be associated with severe disease in pigs infected with porcine circovirus 2 and porcine respiratory and reproductive syndrome virus
- **Vaccines** – None
- **Antimicrobials** – None

Questions?