



# Respiratory Viruses in the Tropics

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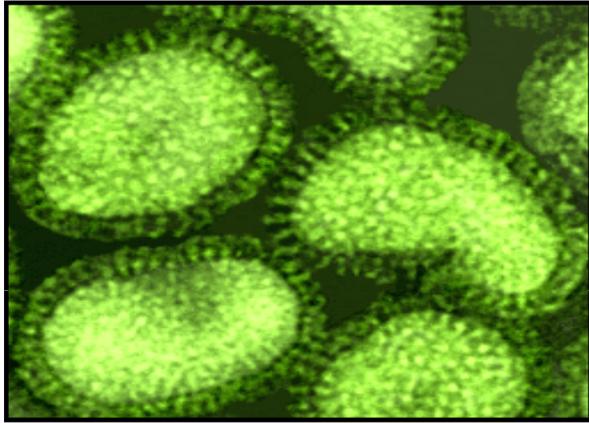
# Outline

- Influenza
  - Introduction
  - ‘Seasonal’ influenza – temperate/tropics
  - Pandemic Influenza
  - Avian Influenza
- Other respiratory viruses
- Respiratory viruses with high mortality
- Summary

# Influenza virus

Family *Orthomyxoviridae*

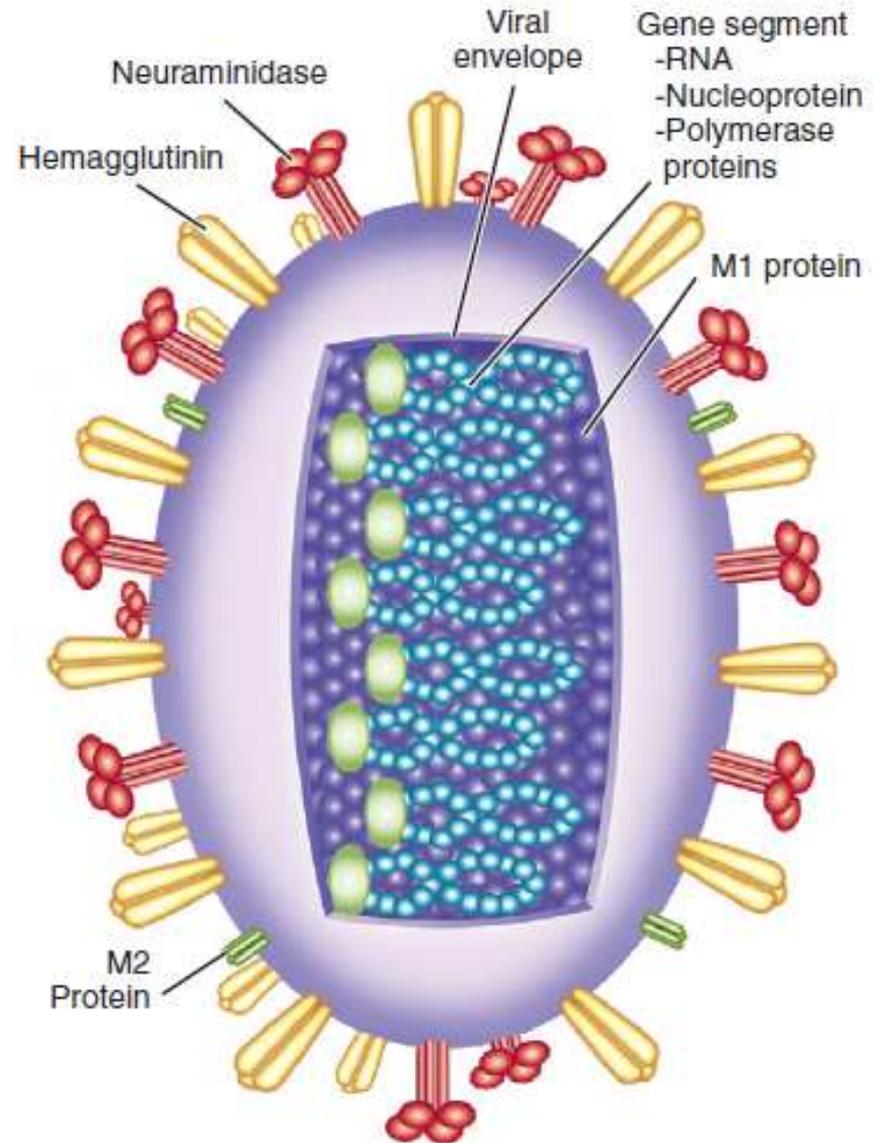
(-) sense ssRNA, 8 segments



A/USA/65/18 H1N1

↓                      ↓                      ↓                      ↓

Type                      Origin                      Strain #                      Yr Isolated                      Subtype



Hemagglutinin → 16 Antigens  
Neuraminidase → 9 Antigens

# Seasonal Influenza

- **An acute viral infection caused by an influenza virus**
  - three types of seasonal influenza – A, B and C
  - influenza A(H1N1) and A(H3N2) subtypes and B predominating
  - Emergent variant flu A viruses associated with swine/birds
- **Global circulation**
  - originate in tropical Asia and move to temperate regions
  - Extent of outbreaks vary year-to-year
- **Influenza A**
  - Remarkable ability for periodic change
  - Three major hemagglutinin (H1, H2, H3) subtypes
  - Two major neuraminidase (N1, N2) subtypes

# Flu Basics

- **Transmission**

- Large particle droplets
- Sneezing, coughing
- Close contact (~6ft)

- **Incubation**

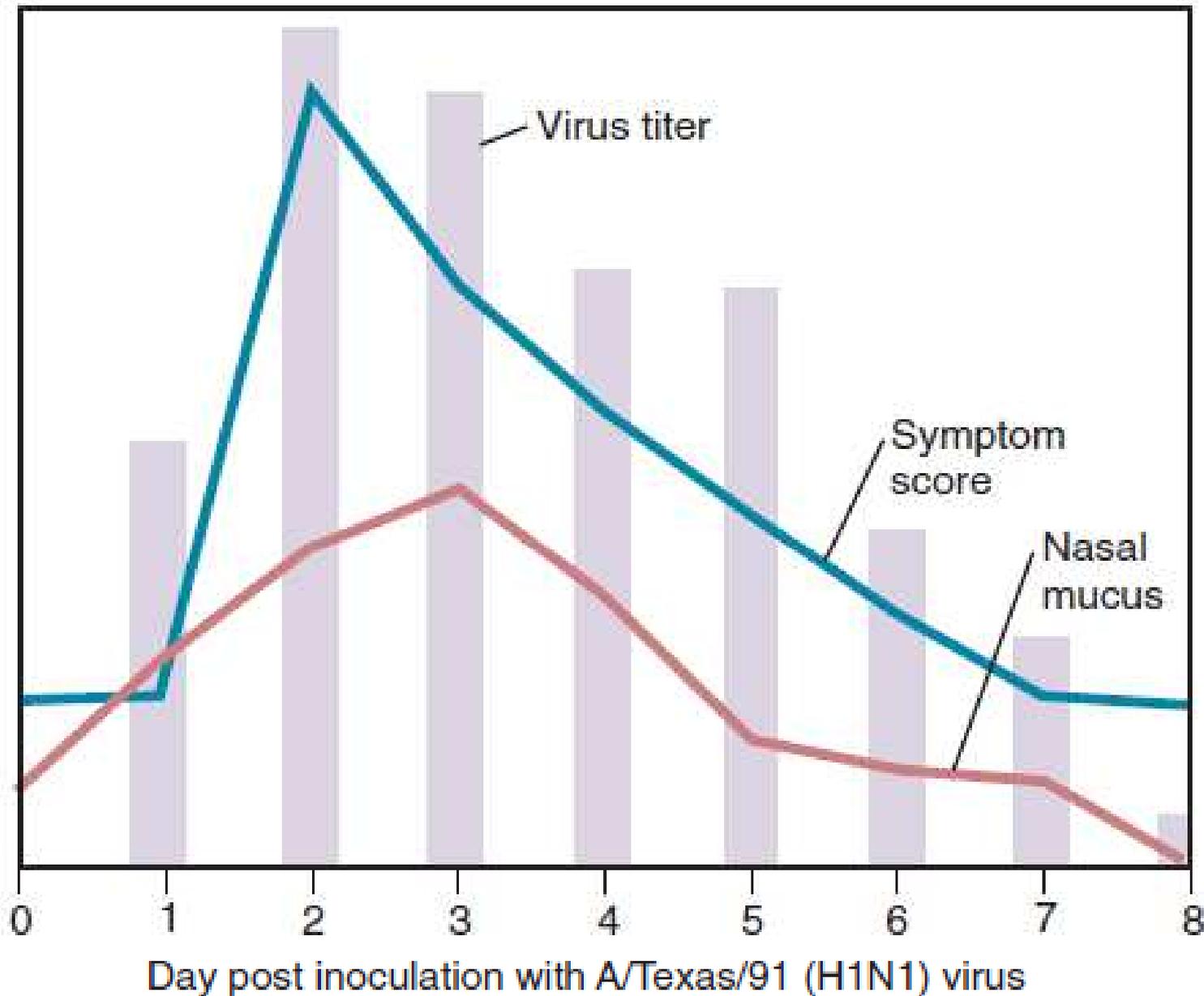
- 1-4 days

- **Shedding**

- 24-48hrs before illness onset
- Average duration 4-5 days



[sneeze 682 473022a-755805.jpg](https://www.flickr.com/photos/682473022a-755805/)



Hayden FG, Fritz R, Lobo MC, et al. Local and systemic cytokine responses during experimental human influenza A virus infection. *J Clin Invest* 1998;101:643-649.

# Shift vs. Drift

## Antigenic Shift

- Major changes in envelope glycoproteins
  - hemagglutinin and neuraminidase
- associated with epidemics and pandemics of influenza
  - Ex: Spanish/swine influenza pandemic of 1918-19

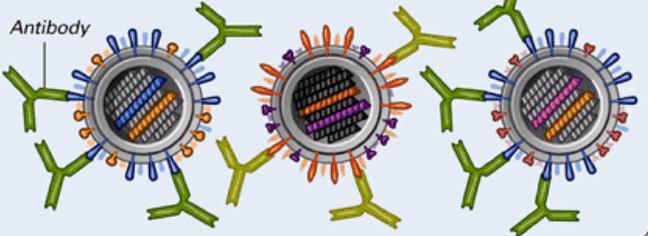
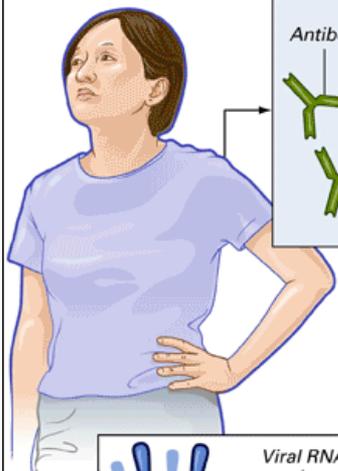
## Antigenic Drift

- results from point mutations in RNA gene segments that code for hemagglutinin or neuraminidase
- occurs sequentially with viral spread through a susceptible population
- Results in more localized outbreaks that occur annually



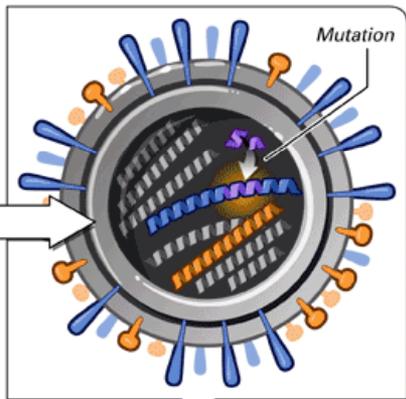
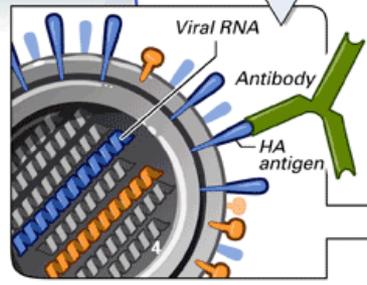
**1** Each year's flu vaccine contains three flu strains – two A strains and one B strain – that can change from year to year.

**2** After vaccination, your body produces infection-fighting antibodies against the three flu strains in the vaccine.



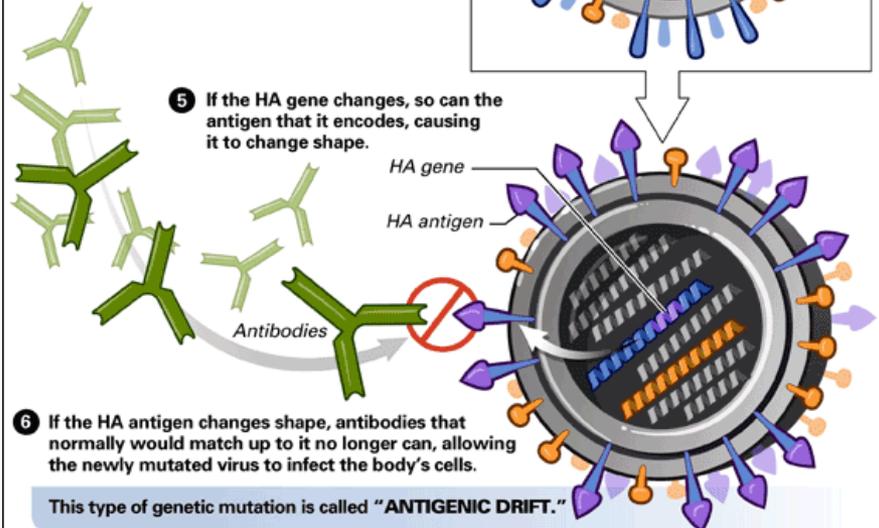
**3** If you are exposed to any of the three flu strains during the flu season, the antibodies will latch onto the virus's HA antigens, preventing the flu virus from attaching to healthy cells and infecting them.

**4** Influenza virus genes, made of RNA, are more prone to mutations than genes made of DNA.



Link Studio for NIAID

**5** If the HA gene changes, so can the antigen that it encodes, causing it to change shape.

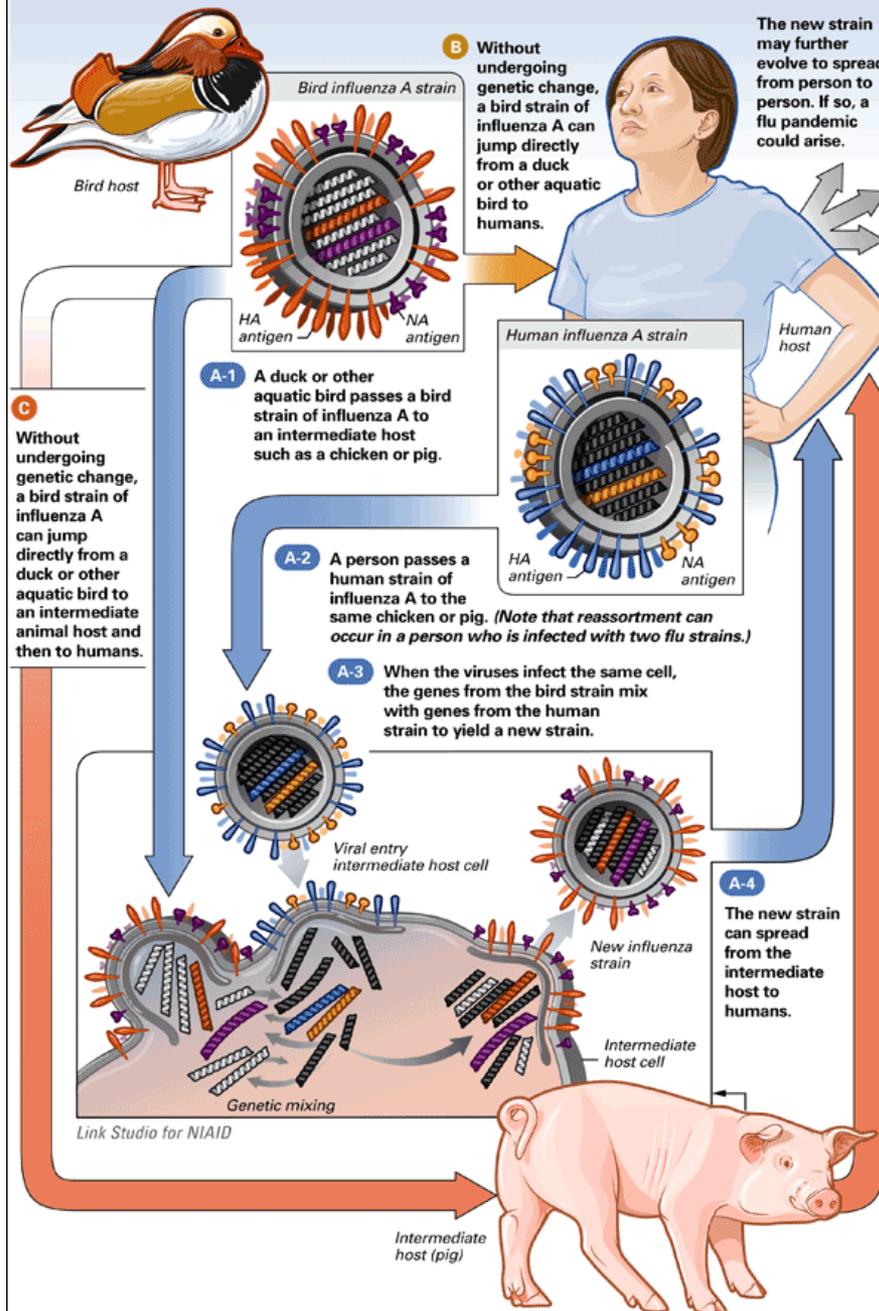


**6** If the HA antigen changes shape, antibodies that normally would match up to it no longer can, allowing the newly mutated virus to infect the body's cells.

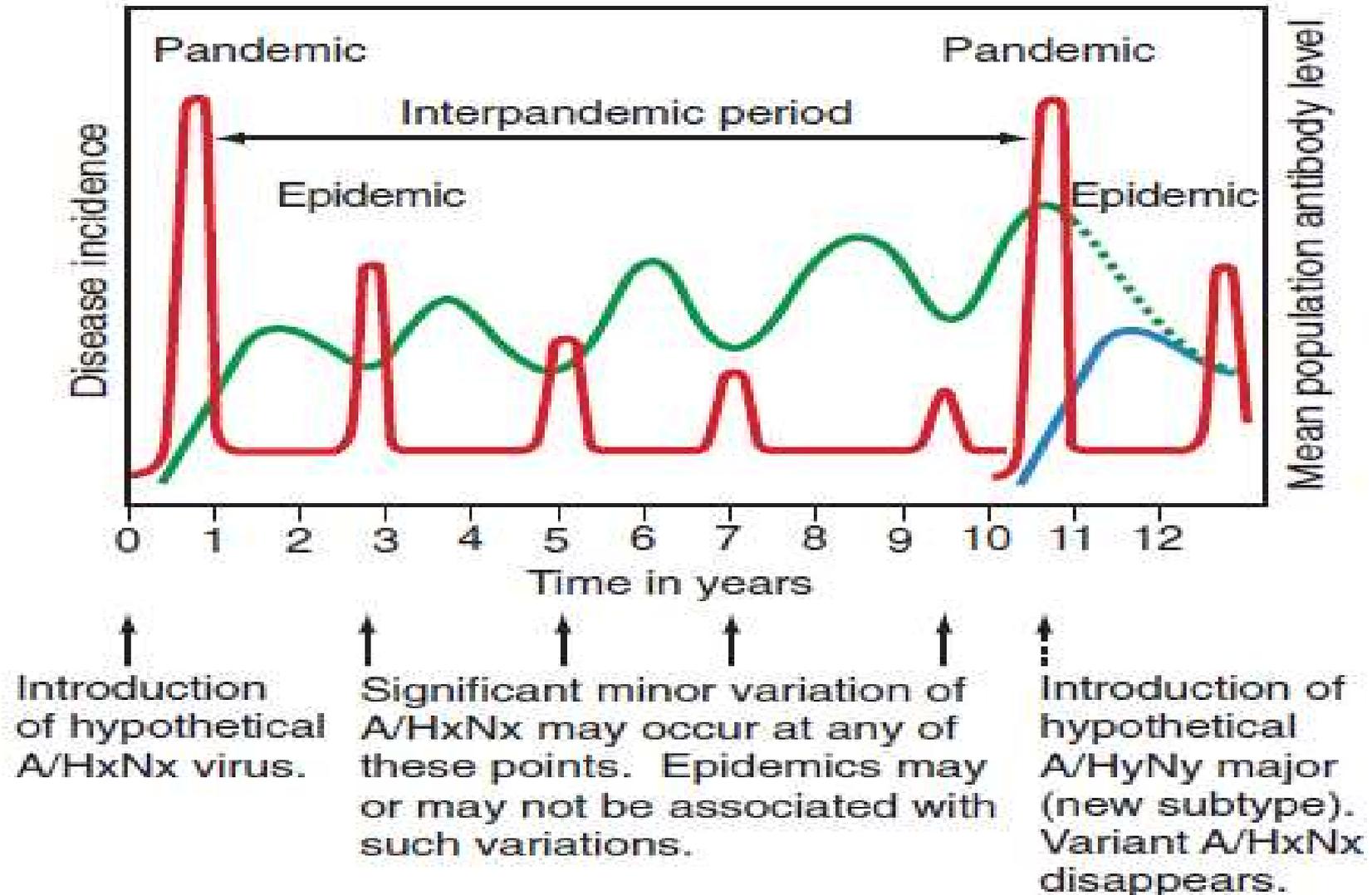
This type of genetic mutation is called "ANTIGENIC DRIFT."

<http://nieman.harvard.edu/Microsites/NiemanGuideToCoveringPandemicFlu/TheScience/HowFluVirusesChange.aspx>

The genetic change that enables a flu strain to jump from one animal species to another, including humans, is called "ANTIGENIC SHIFT."  
Antigenic shift can happen in three ways:



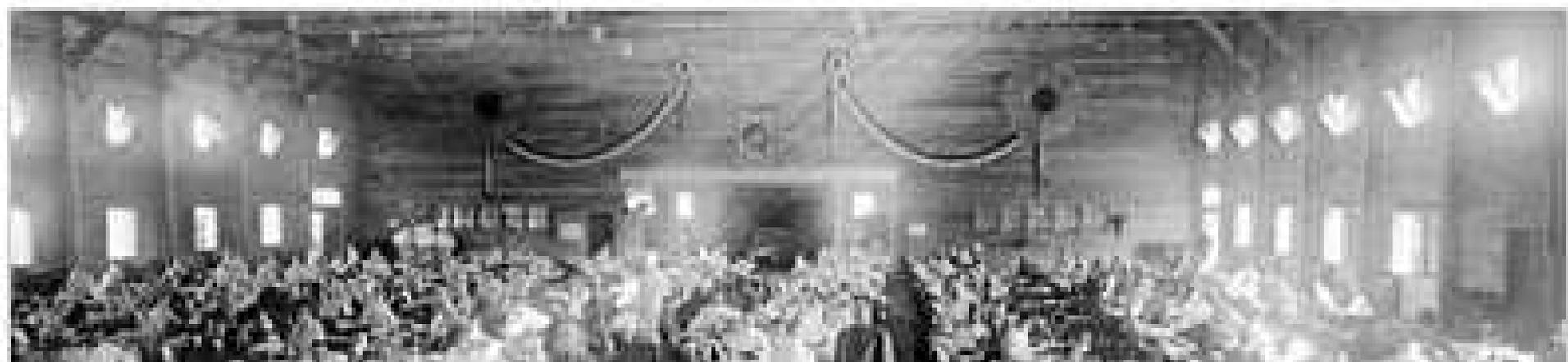
- Incidence of clinically manifest influenza
- Mean level of population antibody vs. A/HxNx virus
- Mean level of population antibody vs. A/HyNy virus



# Prior Pandemics/Epidemics

YEAR	Subtype	Outbreak Severity
1889-90	H2N8	Severe pandemic
1900-03	H3N8	Moderate epidemic
<b>1918-19</b>	<b>H1N1 (formerly HswN1)</b>	<b>Severe pandemic</b>
1933-35	H1N1 (formerly H0N1)	Mild epidemic
1946-47	H1N1	Mild epidemic
<b>1957-58</b>	<b>H2N2</b>	<b>Severe pandemic</b>
1968-69	H3N2	Moderate pandemic
1977-78	H1N1	Mild pandemic
<b>2009-10</b>	<b>H1N1</b>	<b>Mild-mod pandemic</b>

Dolin R. Influenza. In: Harrison's Principles of Internal Medicine, 17<sup>th</sup> Ed, Braunwald E, Fauci AS, Kasper DL, et al (Eds), McGraw Hill Book Company, New York 2008. p. 1127.



Street car conductor in Seattle not allowing passengers aboard without a mask. 1918.



# 1918 Influenza Pandemic

- 1/3 of the world's population (500m) infected / ill
- Case fatality rates of >2.5%
- 50-100m deaths
- 3 waves: spring/summer, summer/fall, winter
- Unclear source of pandemic virus, limited capabilities



# 2009 H1N1 Pandemic

- ‘Swine flu’ first reported March 2009 in Mexico
- High human to human transmission, WHO pandemic level declared 6 June 2009
- Influenza A virus
  - Reassortment of 2 swine, one human strain, one avian strains
- Secondary attack rate: 14-19%
- Average global H1N1 related fatality estimate: 201,200
- CDC US H1N1 related fatality estimate: 12,470
  - Less severe than 1918 H1N1 pandemic
- Immunity: natural infection, immunization, preexisting immunity from remote infection with related strain



# 2009 H1N1 Pandemic



# 2009 H1N1 Pandemic



# 2009 H1N1 Pandemic



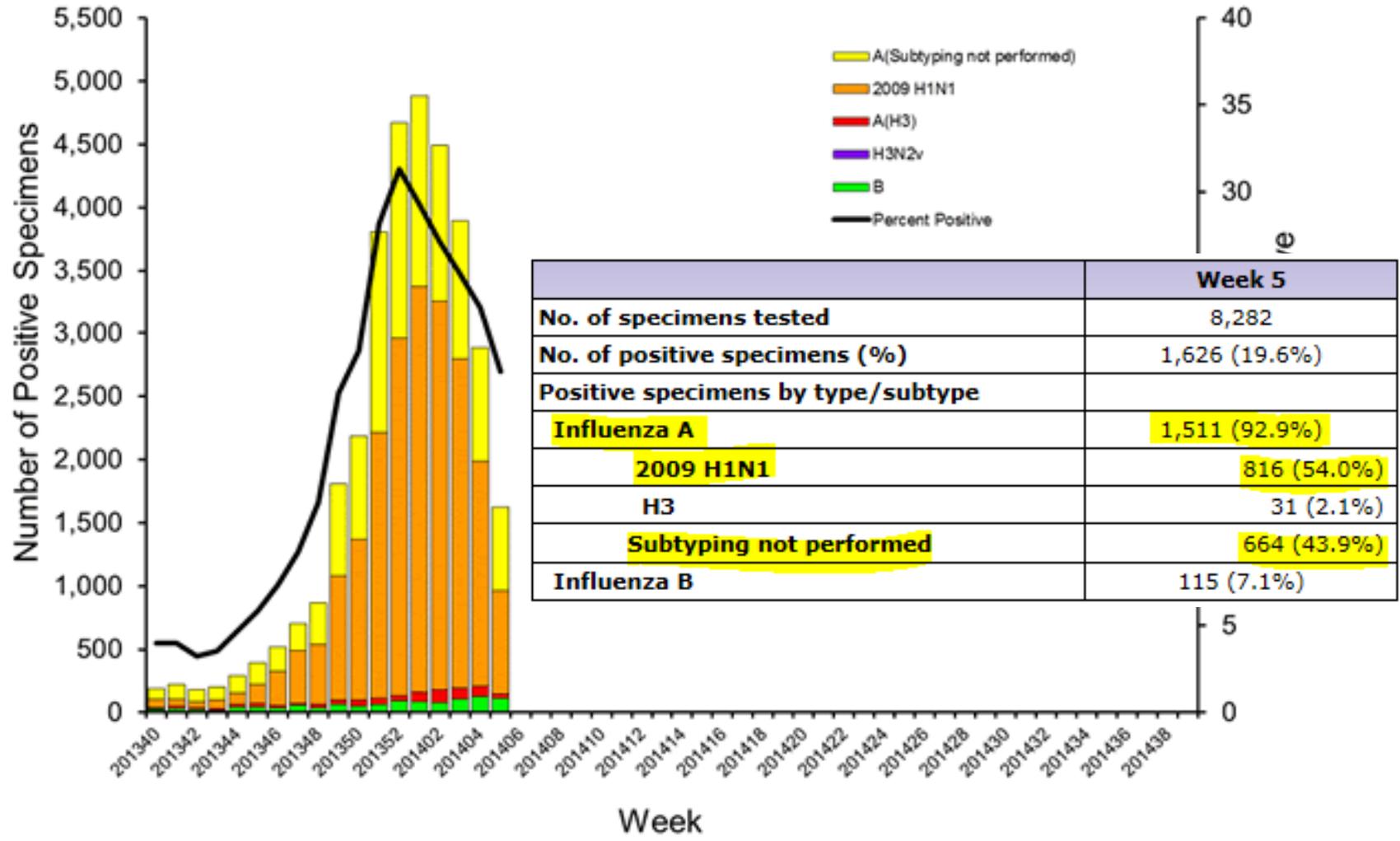
# Lessons from 2009 pandemic

- Vigilance and surveillance for novel strains
- Identify at risk population
- Limitations of laboratories and hospitals
- Educating the public about preventive measures
- Vaccine manufacturing and quality control
- Availability of antiviral drugs
- Each epidemic, pandemic is different



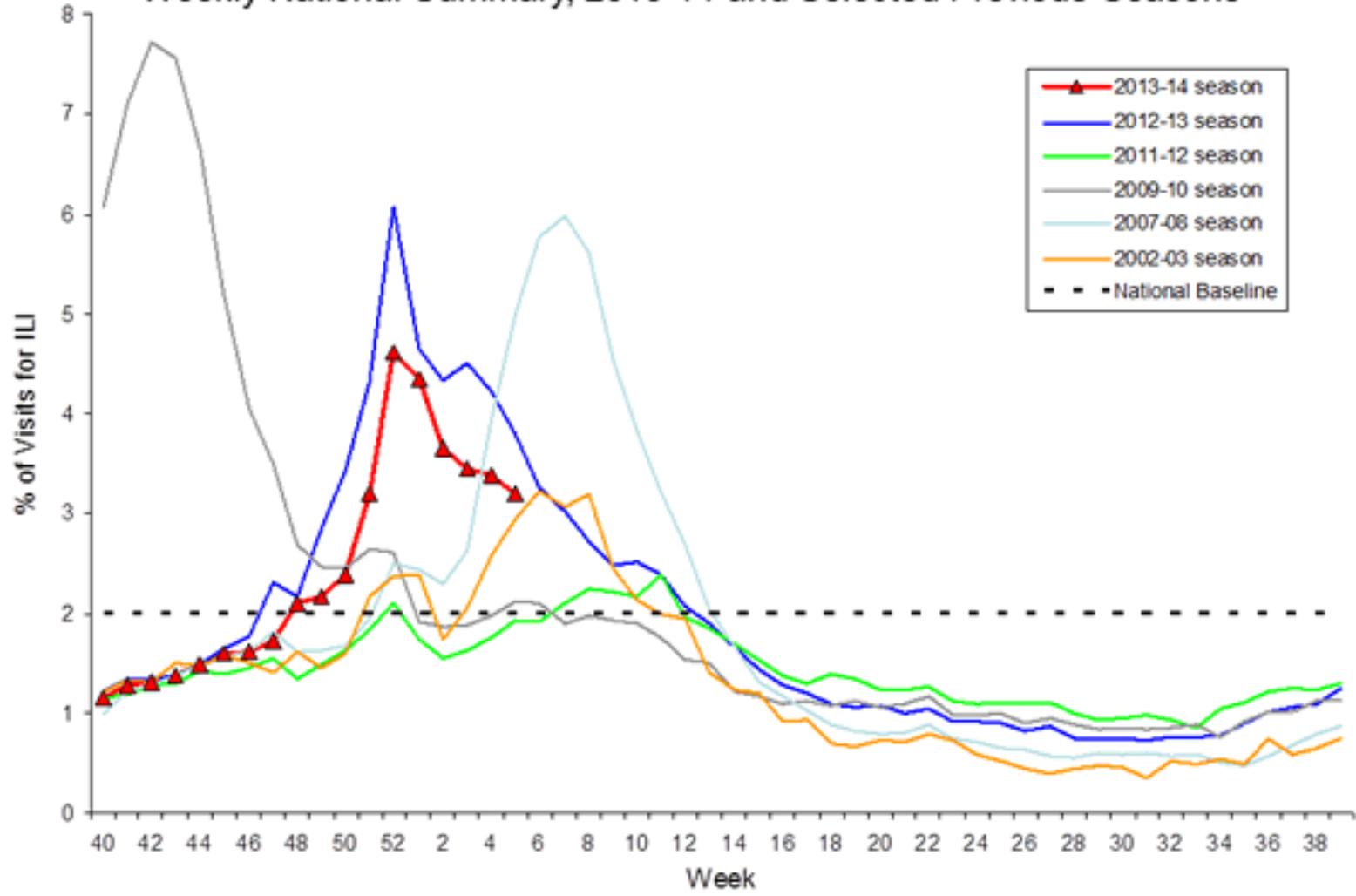
# Current Flu Trends in the US

Influenza Positive Tests Reported to CDC by U.S. WHO/NREVSS Collaborating Laboratories, National Summary, 2013-14



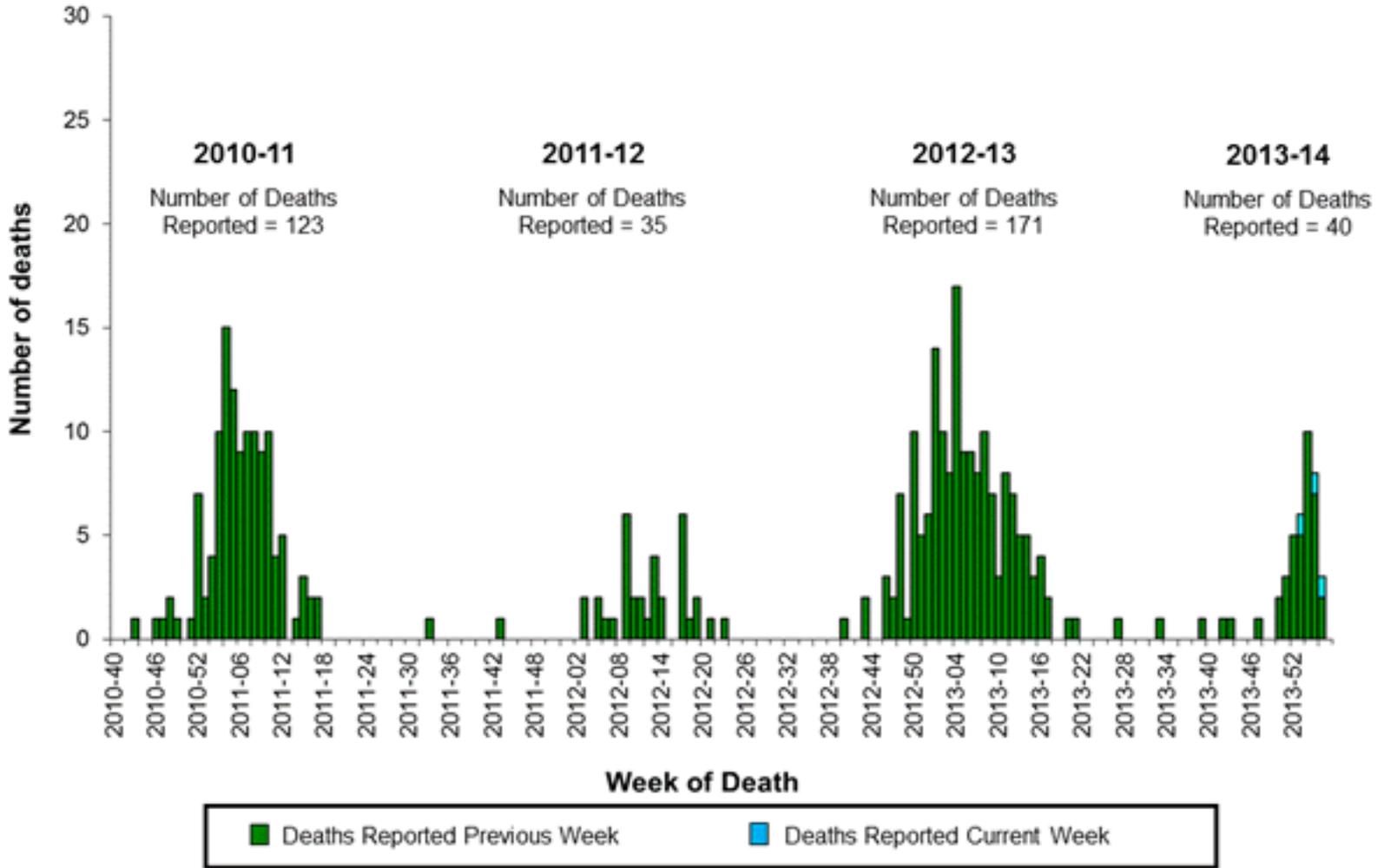


Percentage of Visits for Influenza-like Illness (ILI) Reported by the U.S. Outpatient Influenza-like Illness Surveillance Network (ILINet), Weekly National Summary, 2013-14 and Selected Previous Seasons





# Number of Influenza-Associated Pediatric Deaths by Week of Death: 2010-11 season to present





# Influenza in the Tropics

- Less distinct 'seasonal' pattern vs. temperate regions
- Year round infections
- 'seasonal' patterns vary by location
  - Peaks related to rainy seasons
  - Biannual peaks (rainy season and winter months)
  - Year round infection without clear peaks



- Study conducted at 78 study sites globally
- Two types of environmental conditions associated with seasonal flu epidemics:
  - “cold-dry”: peaks in “winter season” in regions with monthly avg specific humidity or temperature below 11-12g/kg and 18-21°C
  - “humid-rainy”: peaks in month of highest precipitation in regions where specific humidity and temperature do not decrease below above thresholds



# Influenza in the tropics



# Influenza in the tropics



Tamerius J, et al. Global influenza seasonality: reconciling patterns across temperate and tropical regions. *Environ Health Perspect.* 2011;119:439-445.



# Multiple Factors Impact Influenza Epidemics

Tamerius et al.  
*Environ Health Perspect* 2011



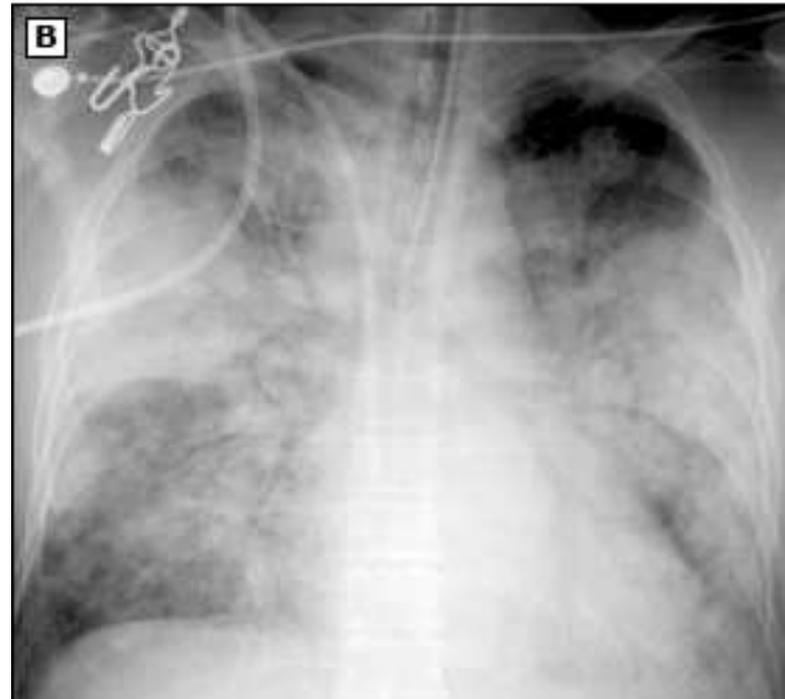
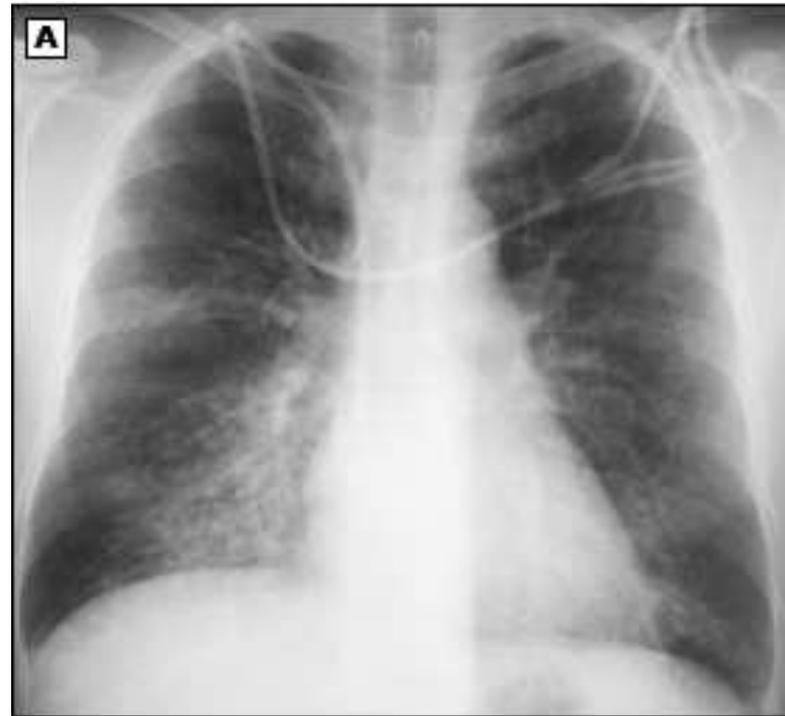
# Flu Symptoms

- Fever ( $T > 100.0^{\circ}\text{F}$ )/Chills\*
- Cough
- Sore Throat
- Runny or stuffy nose
- Muscle or body aches
- Headaches
- Fatigue
- Vomiting/Diarrhea is rare (children)

\*Note: Immunocompromised patients may not manifest with fever/chills

# Flu complications

- Primary viral pneumonia
- Secondary bacterial pneumonia
- COPD/asthma exacerbations
- Dehydration
- Myo- or pericarditis
- Myositis
- GBS, encephalitis
- Post-influenza asthenia
- Death



- RT-PCR
- < 2 min hands on time
- results in 75min
- Accepts nasal aspirate/washes or nasopharyngeal swabs
- Detection of flu A, flu B, and 2009 H1N1
- Sensitivity 91.2%, specificity 99.4%



- Detects viral antigens via immunofluorescence

Nasal Swab



# Who do we treat?

- Severe illness requiring hospitalization
- Progressive or complicated illness
- Age > 65 years
- Pregnant women and  $\leq 2$  weeks post-partum
- Immunosuppressed
- Individuals with certain medical conditions that constitute a higher risk of complications
  - See next

## Groups at high risk for influenza complications

Children <2 years\*

Adults  $\geq 65$  years of age

Persons with chronic pulmonary (including asthma), cardiovascular (except hypertension), renal, hepatic, hematologic (including sickle cell disease), metabolic (including diabetes mellitus), neurologic, neuromuscular, and neurodevelopmental disorders (including disorders of the brain, spinal cord, peripheral nerve and muscle such as cerebral palsy, epilepsy, stroke, intellectual disability [mental retardation], moderate to severe developmental delay, muscular dystrophy, or spinal cord injury)

Immunosuppression (including immunosuppression caused by medications or by human immunodeficiency virus)

Women who are pregnant or postpartum (within 2 weeks after delivery)

Children <19 years of age and receiving long-term aspirin therapy

Native Americans and Alaskan Natives

Morbidly obese (body mass index [BMI]  $\geq 40$  for adults or BMI  $> 2.33$  standard deviations above the mean for children)

Residents of nursing homes and other chronic care facilities

# Treatment for 2013-2014 Season

- Neuraminidase inhibitors:
  - Oseltamivir (Tamiflu) –
    - approved for > 2 weeks old
    - nausea/vomiting, rare neuropsychiatric SE
  - Zanamivir (Relenza) –
    - Approved for > 7 years old
    - Not recommended in asthma/COPD
    - SE - Diarrhea, sinusitis, cough, HA, ENT infections
- Adamantanes (rimantadine, amantadine) are NOT effective against Flu B

# 2013-2014 Vaccine Selection

- WHO Vaccine Composition Meeting (North - FEB 2013; South – SEP 2012)
- U.S. FDA Vaccines and Related Biological Products Advisory Committee (VRBPAC)
- Fluzone – trivalent; FluMist - quadrivalent
  
- A/CA/7/2009 (H1N1)-like virus\*
- A/TX/50/2012 (H3N2)-like virus
- B/MA/2/2012-like virus
- B/Brisbane/60/2008-like (Victoria lineage virus)<sup>δ</sup>

\*Same H1N1 virus from prior season's since 2010

<sup>δ</sup>additional strain included in quadrivalent vaccine



- Jan 1967 – Feb 2011
- Efficacy of TIV and LAIV
- 31 eligible studies
  - 17 RCTs, 14 observational studies
- Pooled efficacy 59% in adults (18-65 years)
- Efficacy of LAIV up to 83% in young (6mo-7yrs)
- Pandemic H1N1 vaccine effectiveness 69%



# Avian Influenza

- Reservoir: Aquatic birds
- Transmission between birds
  - Direct
  - Indirect (fecal aerosols, water, feed, etc.)
- Most isolates are avirulent
- Epidemic fowl mortality caused by highly pathogenic variants
  - H5 and H7
  - ↓ egg production, respiratory disease, head edema, diarrhea, death



# Asian Bird Migratory Patterns

Figure 2. Migration routes of Asian birds. A) Distribution and migration routes of bar-headed geese (courtesy of P. Leader). B) The Asia-Pacific region contains >240 species of migratory birds. The 3 flyways run primarily in a north-south direction, overlapping and extending from Australia/New Zealand to India, Central Asia, and Siberia. The outbreak of highly pathogenic (HP) H5N1 in migratory waterfowl at Qinghai Lake, China, affected primarily bar-headed geese (*Anser indicus*); however, other species, including gulls and ducks, were affected (16,17). The outbreak started in early May 2005, and by June >5,000 birds had died. The birds exhibited neurologic signs, inability to stand, diarrhea, and death. Systemic infection was detected in all organs tested. C) Bar-head-



# H5N1 in Humans

- First human infection in 1997
- Poultry outbreak in Hong Kong
- Widespread emergence 2003-2004
- Spread from Asia to Europe and Africa
- Ongoing circulation with potential for disease in humans



# Risks for H5N1 Infection

- Direct/close contact with sick or dead poultry
- Visiting a live poultry market
- Prolonged unprotected close contact with an ill H5N1 patient (rare)
- Often source is unknown
- Endemic countries:
  - Bangladesh, China, Egypt, India, Indonesia, Vietnam
  - Isolated outbreaks in other countries have occurred

# Human H5N1 Clinical Presentation

- Disease seen mostly in children and adults < 40y/o
  - Mortality highest in 10-19y/o
  - High fever, flu-like symptoms with rapid progression/deterioration
  - Severe respiratory disease
    - Pneumonitis
    - Respiratory failure
  - Extrapulmonary involvement
    - Encephalitis
    - Myocarditis
    - Diarrhea
    - Vomiting
    - Abdominal pain
- \*\*Overall case fatality ~60%**



# Severe Illness from H5N1



# Severe Illness from H5N1







# Association between receipt of oseltamivir and H5N1 outcome, Indonesia

- 116 confirmed cases 2005 – 2008

	Alive	Dead	Total
No Oseltamivir	0	21	21
Yes Oseltamivir	21	74	95
<b>Total</b>	<b>21</b>	<b>95</b>	<b>116</b>

Unpublished data, H. Kosasih, et al, NAMRU-2/LITBANGKES **p = 0.0125**

**\*H5N1 vaccine licensed by Sanofi Pasteur, FDA-approved in 2007**



**Total 251 cases, 56 deaths (CFR 22.3%)**





# Other Common Respiratory Viruses

- **Respiratory syncytial virus (RSV)**
  - Seasonal outbreaks during rainy season in tropics; bronchiolitis in infants
- **Human metapneumovirus (HMPV)**
  - Similar spectrum as RSV but less virulent
- **Parainfluenza virus**
  - Four types, no seasonal variations in tropics
  - PIV-1/2 – croup, upper airway
  - PIV-3 – bronchiolitis, pneumonias
- **Adenovirus**
  - 51 serotypes, types 1-7 responsible for most infections.
  - Oral adenovirus type 4 & 7 vaccine for military recruits
- **Rhinoviruses**
  - Common cold virus, 100 + serotypes, year-round in tropics



# Rubeola Virus (measles)

- *Morbillivirus* genus, Paramyxoviridae family (mumps, parainfluenza, hMPV, RSV)
- Enveloped ssRNA (-)
- Only 1 antigenic type, minor shifts in some strains
  - Neutralizing Ab directed mostly against H protein, some against F protein
- Infects only humans and primates
  - **Aerosol transmission**



# Clinical Manifestations

- 8-12d incubation period
- Fever, hacking/brassy **cough**, non-purulent **conjunctivitis**, photophobia, **coryza**
- Within 2-3 days -> white macular 1mm lesions appear on buccal mucosa, coalesce (enanthem)
- 2-3 days after **Koplik spots** -> rash
  - Erythematous, maculopapular
  - Starts on forehead/occiput spreads to trunk/LE over 3 days
  - Fades to copper-brown -> desquamation
- GI sx – diarrhea, emesis, abdominal pain
  - Major complication in developing nations





# Black (hemorrhagic) Measles

A CASE OF HEMORRHAGIC MEASLES

71

## A Case of Hemorrhagic Measles\*

Reported by R. O. ROETT, M. D., Assistant Director, Tuskegee Institute, Ala.

Black, hemorrhagic or malignant measles is said to be a rare disease, except in widespread epidemics. Directly speaking, no general description is given to this type of the disease as yet, which should be separated from general measles and put in a classification by itself.

ly. She complained of headache and sore throat. There were acute coryza, enlargement of the post cervical glands, and the presence of Koplik's spots which were bluish-white in appearance. Slight cough and temperature 101 degrees F.

The case pointed to one of typical measles,

- Most common in infants in developing countries
- Sudden onset of high fever, seizures, altered MS
- Pneumonia, hemorrhagic exanthem and enanthem, bleeding from the mouth, nose and GI tract, and DIC



# Complications

- CFR 4-10% in developing countries
- Pneumonia
  - Local viral invasion and bacterial superinfection
    - Accounts for 60% of all measles deaths in infants
- Encephalitis
  - 1 in 1000, most common cause of death in 10-14 yo
  - 15% develop rapidly progressive fatal disease
  - Resurgence of fever during convalescence, HA, seizures, altered MS
  - 50% of patients with measles have subclinical EEG abnormalities



# Diagnosis

- Leukopenia, marked lymphopenia are characteristic
- 4-fold rise from paired sera or single elevated IgM – indicative of recent infection
  - IgM detectable 1-2 days after rash onset, can persist 30-60 days
- rRT-PCR of blood, urine, nasopharyngeal secretions – CDC
- Very difficult to isolate on culture



# Treatment

Committee on Infectious Diseases

In spite of the availability of effective vaccines, measles continues to be a public health problem throughout the world. In 1990, the Centers for Disease Control received more than 27 672 reports of

vitamin A levels were documented in 22% of 89 measles-infected New York children younger than 2 years of age. This correlated with lower measles-specific antibody levels and increased morbidity.<sup>6</sup> A

- Ribavirin – active in vitro, used in a few complicated cases, no controlled studies
- **Vitamin A**
  - Decreases diarrhea/PNA complications in developing nations
  - Can boost antibody responses
  - Measles seems to affect populations with low vitamin A levels preferentially
  - Increased measles morbidity in children with low vitamin A levels
- Consider Vitamin A in:
  - Children 6mo-2yr, immune def, vit A def, impaired intestinal absorption, malnutrition, recent immigration from area of high measles mortality
  - Dose: 100,000 IU orally for 6-11mo infants, 200,000 IU for children 12mo and older



# Measles Vaccine

*Kuehn B, JAMA, 2014;311(4):345-6*



**Legend (%)**

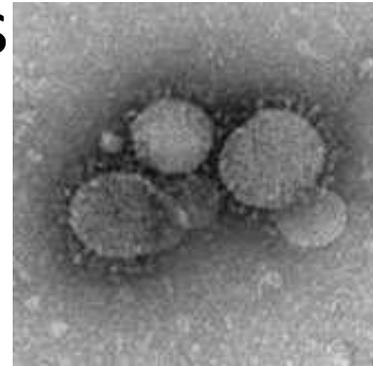


-  <50
-  50-79
-  80-89
-  ≥90
-  Not applicable



# Coronaviruses

- widespread in bats worldwide
- found in many other species,
  - birds, cats, dogs, pigs, mice, horses, whales
- 4 respiratory coronaviruses endemic in humans
  - human coronaviruses (HCoV) 229E, OC43, NL63, and HKU1
- 2003: previously unknown coronavirus caused a global outbreak of SARS





# SARS-CoV

- Severe acute respiratory syndrome – coronavirus
- First recognized in Hong Kong, Feb 2003
- Rapid human-to-human spread worldwide
- Transmission from civet cats to humans?
- No cases since 2004
  - Likely secondary to delayed peak infectivity period
    - Transmission rare in first 5 days of symptoms
    - Allowed for easier recognition, isolation, interruption

# MERS-CoV

- Middle-East Respiratory Syndrome Coronavirus
- Novel coronavirus
- Enveloped, single-stranded, positive sense RNA virus







# MERS – What We Know

- 79 of 182 (43.4%) cases have died
- 3/4 of cases had at least 1 underlying medical condition
  - Chronic renal failure, DM, heart disease
  - Fatal cases more likely to have comorbidities
- 2/3 cases experienced severe respiratory disease
- Index cases tend to have more severe disease than secondary cases
- Sustained human-to-human transmission has not been observed
  - > 50% of all secondary cases associated with health-care settings



# MERS – Case Definition

- **Patient Under Investigation**
  - Fever > 100.4°F and pneumonia or ARDS **AND EITHER**
  - History of travel in/near Arabian Peninsula within 14 days of symptom onset **OR**
  - Close contact with symptomatic traveler **OR**
  - Member of cluster of patients with symptoms
- **Confirmed**
  - Laboratory confirmation of MERS-CoV infection
- **Probable**
  - A PUI with absent or inconclusive lab tests who is close contact with lab-confirmed MERS-CoV case

# MERS – Clinical Presentation

- Range of symptoms from mild to severe
- Most cases develop severe acute respiratory illness
  - Fever, chills, cough, sore throat, myalgias
  - shortness of breath, pneumonia
  - 1/3 with GI symptoms (vomiting or diarrhea)
- Clinical and/or radiographic ARDS
  - Viral pneumonitis/ARDS on CXR
- Leukopenia



# MERS Co-V

# MERS - Treatment

- No vaccine or chemoprophylaxis available
- Supportive measures
- Some success in NHPs:
  - Ribavirin and IFN- $\alpha$  2b
- No success with:
  - Antivirals, high dose corticosteroids
- Possible future strategies:
  - Convalescent sera
  - vaccination

# MERS – What We Don't Know

- Is an intermediate animal reservoir involved? (Camels?)
- What is the route of transmission from animal to human?
- Are there more asymptomatic cases that are transmitting infection?
- Are there any definitively effective treatment options?



# Current Guidance – MERS-CoV

- All cases linked to travel or residence:
  - Saudi Arabia, Qatar, Jordan, United Arab Emirates
- Epidemiology updated by WHO, ECDC, US CDC
- Assess risk, suspect disease
- Lower respiratory tract specimen for rRT-PCR
- Follow up serology testing
- Isolation Precautions
  - Airborne for suspected cases
    - For SARS, CDC: ‘airborne precaution preferred’
  - Other standard precautions



# Hantavirus Pulmonary Syndrome

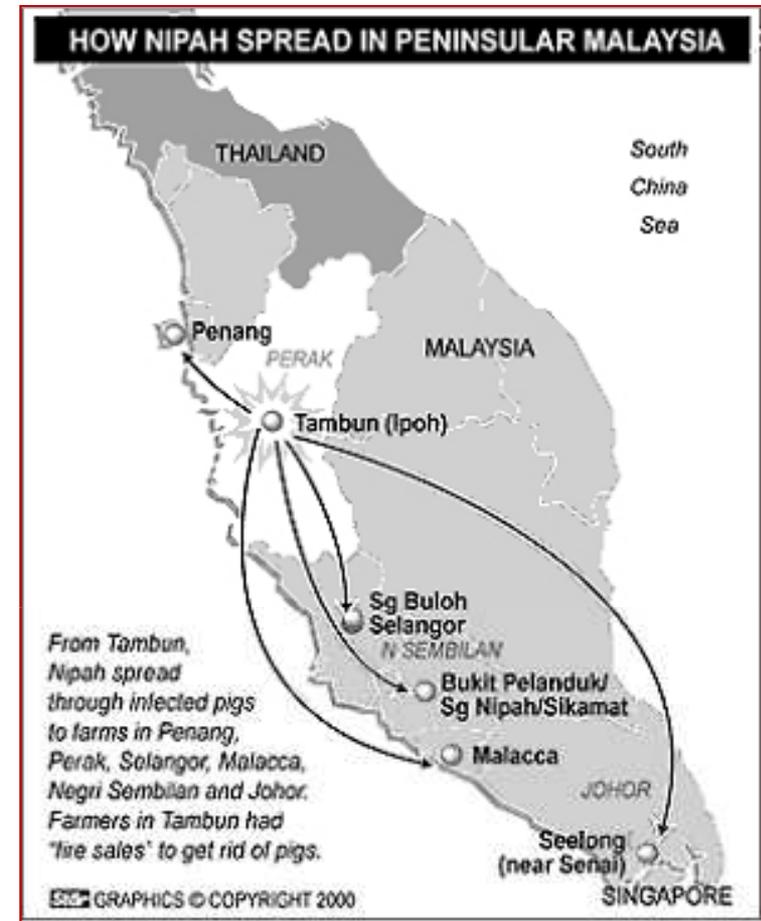
- Bunyavirus, enveloped, neg. SS RNA
- New World Hantavirus
  - Approx. 300 cases per year, mortality up to 60%
  - Sporadic cases in the North America: US, Canada
  - Sporadic cases and outbreaks in South America: Argentina, Bolivia, Brazil, Chile, Panama, Paraguay, Uruguay
- Mice and rats are reservoirs
  - Urine, dropping, nesting materials are aerosolized and inhaled by humans
  - Bites and ingestion of contaminated food
  - Barns, outbuildings, and shed are exposure sites
- Incubation 1-4 weeks, initially non-specific myalgia, HA, chills, nausea, vomiting, GI symptoms
- Shortness of breath and cough develops later
  - Rapidly progressive cardiopulmonary phase
  - Bilateral infiltrates, pulmonary edema
- Conjunctival injection, renal involvement, and hemorrhage reported





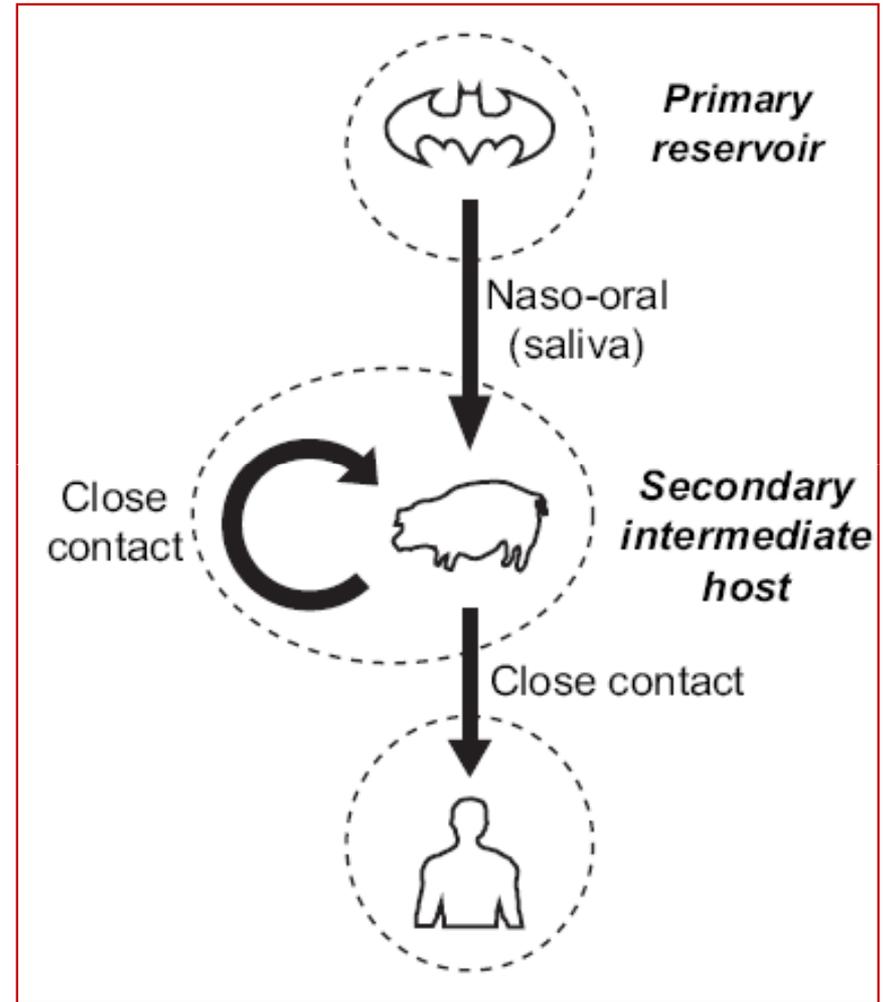
# Nipah Virus

- Highly pathogenic paramyxovirus
  - Isolated from CSF
  - Sungai Nipah village
- Natural host are fruit bats
- Causes severe febrile encephalitis
- Outbreaks
  - Peninsular Malaysia and Singapore (1998 – 1999)
  - Bangladesh: 2001, 2003, 2004, 2005, 2007 and 2008
  - India: 2001 and 2007



# Nipah Transmission Dynamics

- Pigs crowded in pens
- Pens near fruit trees
- Fruit bat original home destroyed
- Fruit bats relocate to fruit trees
- Bat fluids contain Nipah
- Aerosolized virus infects pigs
- Pigs infect handlers



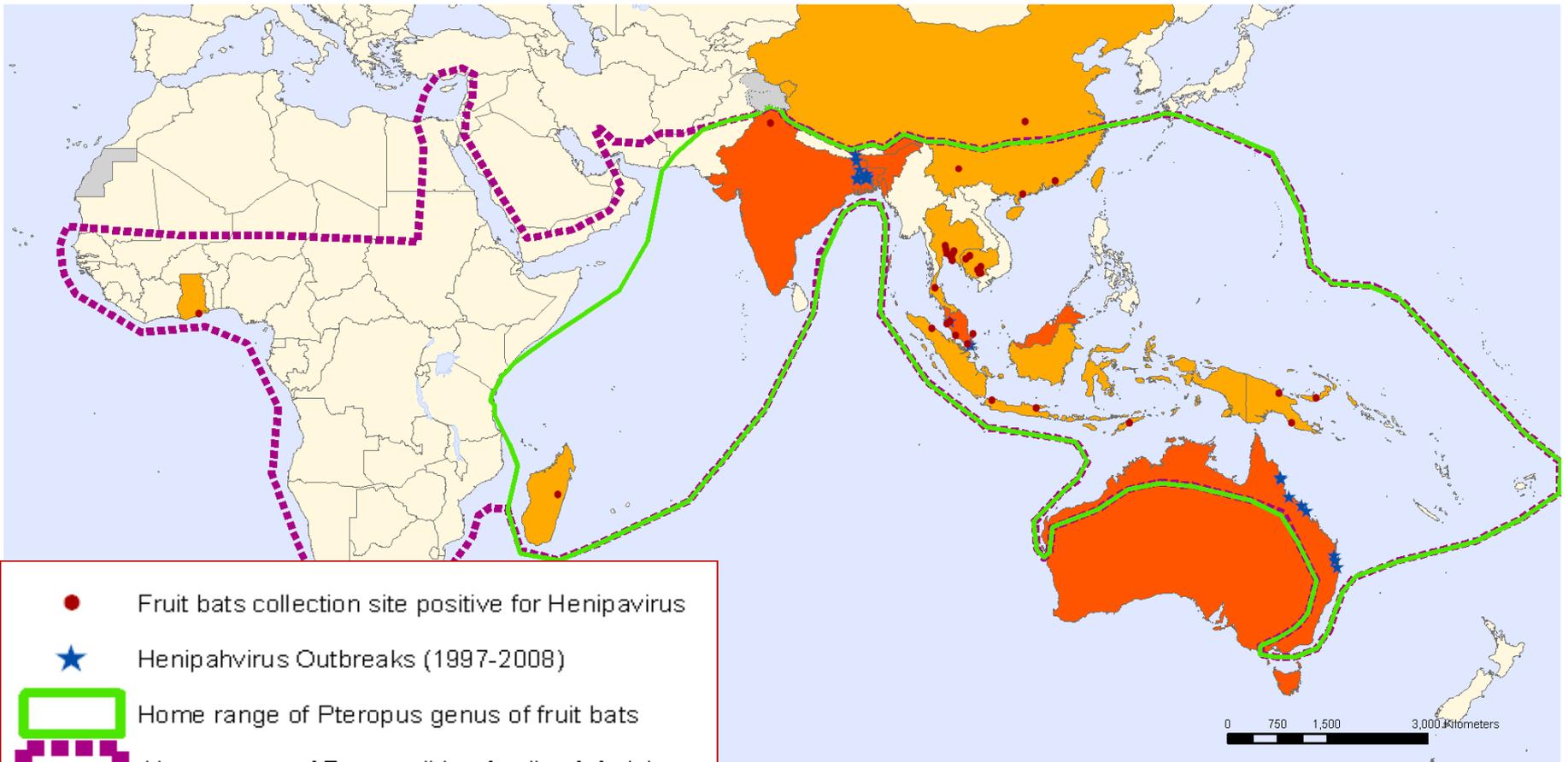
*E. Ka-Wai Hui / Microbes and Infection 8 (2006) 905–916*



Year	Country	State or District	Cases	Deaths	Case fatality
1998 - 1999 (Sept 1998 to May 1999)	Malaysia	Perak, Selangor and Negeri Sembilan states	265	105	40%
1999	Singapore	Singapore	11	1	9%
2001	India	Siliguri district, West Bengal	66	49	74%
2001	Bangladesh	Meherpur district	13	9	69%
2003	Bangladesh	Naogaon district	12	8	67%
2004	Bangladesh	Rajbari district	29	22	76%
2004	Bangladesh	Faridpur district	36	27	75%
2005	Bangladesh	Tangail district	12	11	92%
2007	Bangladesh	Thakurgaon district	7	3	43%
2007	Bangladesh	Kushtia district	8	5	63%
2007	India	Nadia district, West Bengal	5	5	100%
2008	Bangladesh	Manikgonj district	3	3	100%
2008	Bangladesh	Rajbari district	8	3	38%



# Geographic distribution of Henipavirus outbreaks and fruit bats of Pteropodidae Family



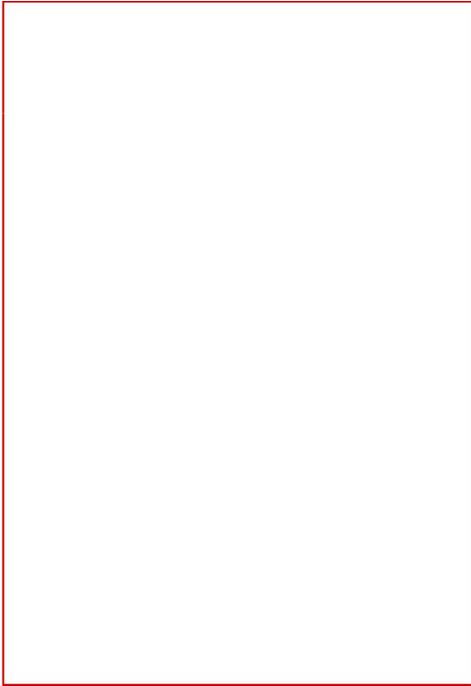
- Fruit bats collection site positive for Henipavirus
- ★ Henipavirus Outbreaks (1997-2008)
- ▭ Home range of Pteropus genus of fruit bats
- ▭ Home range of Pteropodidae family of fruit bats
- ▭ Countries at risk (serological evidence)
- ▭ Countries with reported outbreaks

Data Source: Global Alert and Response Department  
World Health Organization  
Map Production: Public Health Information  
and Geographic Information Systems (GIS)  
World Health Organization



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# Hendra Virus

- RNA virus, novel paramyxoviruses,
- Natural reservoir: fruit bats (flying-foxes)
- Outbreak in horses in Australia
  - Brisbane suburb, Hendra: 21 horses, 2 humans
  - 48 outbreaks on east coast of Australia to-date
- Symptoms:
  - Acute influenza-like illness, meningoencephalitis, seizures, coma
- Transmission via close contact during care, necropsy of ill or dead horses



# Hendra Virus





# Summary

- Virus are constantly evolving and novel highly virulent respiratory viruses WILL circulate in the future
- An influenza strain that is highly transmissible (H1N1) and highly virulent (H5N1) will likely result in high mortality
- Get vaccinated: provides some protection even when mismatches occur
- Maximize good hand hygiene, distance from others, and personal protective measures
- Consider isolation of patients and assume worst case initially
- Use common sense and avoid contact with animals, local markets, and areas with known outbreaks of respiratory infections





**QUESTIONS?**



## Tropical Medicine Course: 'Respiratory Viruses in the Tropics' Lecture Questions:

- 1). A main difference between the recent H1N1 influenza pandemic and epidemics of avian influenza (H5N1 and H7N9) is:
  - a). A vaccine is available for H1N1 whereas avian influenza vaccines are impossible to make
  - b). Oseltamivir is only effective for avian influenza but not H1N1
  - c). H1N1 is an influenza A virus whereas the avian influenza viruses are influenza B viruses
  - d). H1N1 has sustained human to human transmission but this is not true for avian influenza
  
- 2). A 24 y.o. SM began experiencing fever, chill, gastrointestinal symptoms, and a cough shortly after returning from a trip in Argentina. After reading about a recent outbreak in Yosemite National Park, you suspect hantavirus as a possible pathogen. Which of the following answers would support your suspicion ?
  - a). He visited several rural villages and saw mice
  - b). He fed some pigs and explored caves inhabited with bats
  - c). He was bitten by several mosquitoes
  - d). He rode horses
  
- 3). Which of the following is NOT likely to improve overall outcome at your facility when managing a patient with flu-like illness and respiratory symptoms for 4 days who recently visited Saudi Arabia ?
  - a). Closely monitor those who came in contact or traveled with the sick individual
  - b). Start oseltamivir immediately on the patient
  - c). Airborne precautions for the patient and N-95 mask for visitors if available or at minimum droplet precautions
  - d). Obtain lower respiratory tract specimens for testing for MERS-CoV