

Influenza Update Seasonal and H1N1 2009-2010

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Influenza Virus

Orthomyxovirus RNA virus

Type A: humans, animals, birds

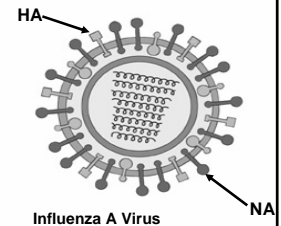
Type B: humans only

Glycoproteins

Determine virulence

Immunization targets

- Hemagglutinin (HA):
attach/enters host cell
 - HA subtypes H1, H2, H3
- Neuraminidase (NA):
allows viral release from infected cells
 - NA subtypes 1 and 2
 - Antibody to NA slows infection spread



Principles Practices ID 2005

Overview

- Influenza viruses:
 - ✓ Virology, spread, pandemic strain development
- Seasonal Influenza Recommendations
- Prevention of Seasonal, H1N1 Influenza
- Treatment
- Prevention: Infection Control and Antivirals
- Public Health Response
- H1N1 Vaccine Recommendations
- Case

Influenza Epidemic and Pandemic

- Antigens vary as a result of changes in genes coding for HA, NA
 - Antigenic Drift – point mutations (both A & B)
 - Minor changes, same subtype
 - Associated with epidemics
 - Antigenic Shift – genetic re-assortment (A)
 - Major change, new subtype
 - Associated with pandemics
 - Least immunity in the population

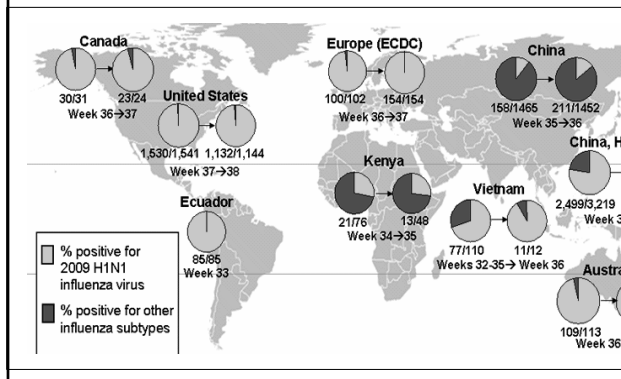
How does a Pandemic Happen?

- Re-assortment of Influenza A viruses
 - ✓ Avian reservoir with avian virus
 - ✓ Human reservoir with human viruses
 - ✓ Mammal reservoir with e.g. swine virus
 - ✓ Leads to a **NEWLY** re-assorted pandemic strain
- April 2009 pandemic strain
 - ✓ Swine flu
 - ✓ Swine origin influenza virus (SOIV)
 - ✓ Influenza A 2009
 - ✓ Influenza A H1N1 2009: genetic material from birds, humans and swine

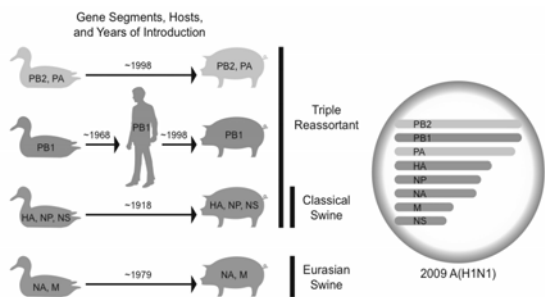
NEJM 2009;369:2605

Map: International Co-circulation of 2009 H1N1 and Seasonal Influenza

(As of September 20, 2009; posted September 25, 2009, 11:00 AM ET)

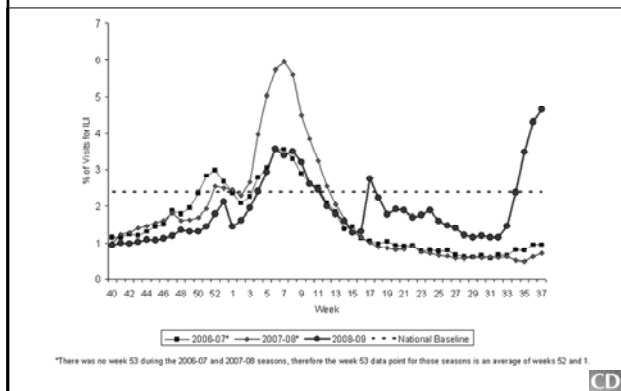


Host and Lineage Origins for the Gene Segments of 2009 A(H1N1) virus

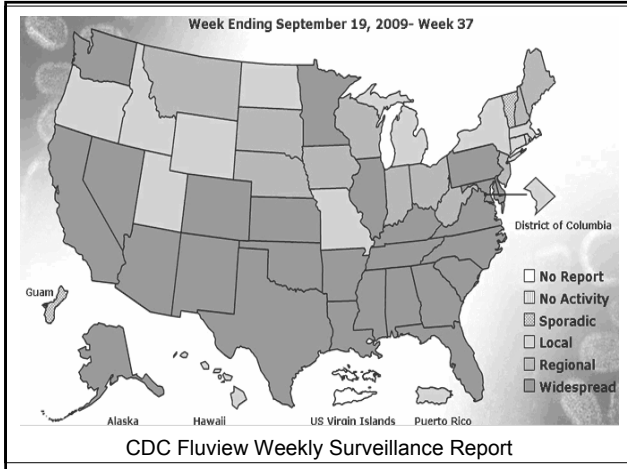


NEJM 2009;360:2605, Garten, Science 2009

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



CDC



Influenza: Key Facts 2009

- Older people, young children, pregnant women and people with certain health conditions
 - ✓ asthma, diabetes, or heart disease
 - ✓ are at increased risk for serious complications from seasonal flu illness
- Influenza A H1N1 2009 may cause a lot more to get sick, than during a regular flu season
- H1N1 also may cause more hospital stays and deaths than regular seasonal flu

Influenza: Key Facts 2009

- Flu is a contagious respiratory illness
 - ✓ Causes mild to severe illness
 - At times leads to death.
 - ✓ Best way to prevent seasonal flu is to get a seasonal flu vaccination each year.
- Annually, in the United States:
 - ✓ 5% to 20% of the population gets the flu
 - ✓ More than 200,000 people are hospitalized from flu-related complications
 - ✓ About 36,000 people die from flu-related causes

www. CDC.gov

H1N1 During Pregnancy

- CDC collected additional information about cases and deaths in the USA as part of enhanced surveillance.
- Confirmed case was ILI with RT PCR confirmation
- April 15 to May 18, 2009: 34 cases were reported in 13 states, 11 were hospitalized; 6 died with pneumonia and ARDS
- 0.32 cases per 100K with H1N1 in pregnancy vs. 0.076 cases per 100K population at risk for H1N1
- Pregnant women at increased risk for complications

Jamieson DJ, *Lancet* 2009 374:451

Symptoms of Seasonal and H1N1 Influenza

- Fever (often high, > 100.4° F) PLUS cough OR sore throat

AND

- Headache
- Extreme tiredness/fatigue
- Runny or stuffy nose
- Muscle aches
- Gastrointestinal symptoms: nausea, vomiting, diarrhea; more common in children than adults.
 - ✓ Influenza A H1N1 flu virus infected patients have reported diarrhea and vomiting.

How is influenza spread?

- Influenza is easy to spread
 - ✓ Spread by flu infected persons coughing or sneezing
 - ✓ Primarily droplets within 3-6 feet
 - ✓ Lives on surfaces for >24 hrs
 - ✓ People may become infected by touching something with influenza on it; who then touch their mouth, eyes or nose
 - ✓ Droplets, airborne and contact



Complications of Influenza

- Bacterial pneumonia
- Ear infections
- Sinus infections
- Dehydration
- Worsening of chronic medical conditions:
 - ✓ Congestive heart failure
 - ✓ Asthma
 - ✓ Diabetes

Prevention of Influenza: Vaccines

- Types of influenza vaccines:
 - ✓ Inactivated (1968)
 - ✓ Live attenuated (2003)
- Trivalent (covers 3 circulating strains)
- Usually available in October
- Works by stimulating antibody production against viral surface proteins
- Re-dosed annually because circulating viruses alters surface proteins

Influenza Vaccines: How they Differ

	Live Attenuated	Inactivated
Route	Intranasal	Intramuscular Injection
Type	Live	Killed
Frequency	Annual	Annual
Approved Ages	Healthy*, non-pregnant 2-49 years	≥ 6 months
Side effects	Runny nose, sore throat	Sore arm, arm swelling

*Exception: Healthy persons who care for those with severely weakened immune systems (e.g. AIDS, on steroids or other immunosuppressive drugs) or require a protected environment should get the killed type of vaccine.

Seasonal Inactivated Influenza Vaccine Efficacy

- **70% - 90% effective among healthy persons younger than 65 years of age**
- **For those > 65 years old:**
 - ✓ **30 - 58% effective**
 - ✓ **27-70% effective in preventing hospitalization**
 - ✓ **80% effective in preventing death**

MMWR 2009;58(RR-8)

Who should Get the Seasonal Flu Shot?

- Children 6 months to their 19th birthday
- Pregnant women
- People 50 years of age and older
- People of any age with chronic medical conditions
- Those who live in nursing homes, long-term care facilities
- People who live with or care for those at high risk for complications from flu, including:
 - ✓ Health care workers
 - ✓ Household contacts of persons at high risk for complications from the flu
 - ✓ Household contacts and out of home caregivers of children less than 6 months of age (these children are too young to be vaccinated)

Why is Healthcare Worker Influenza Vaccination SO Important?

- HCWs have frequent contact with patients at high-risk for influenza and complications
- HCWs can serve as a vehicle for spread of flu
 - ✓ Patient to patient
 - ✓ Visitor to patient
 - ✓ Patient to HCW and HCW to patient
- HCW absenteeism can stress health system in times of community epidemics

Talbot et al. ICHE 2005;36:882.

Seasonal Influenza Vaccination of HCW

- Annual influenza vaccination is recommended for all persons who work in any medical care facility or provide care in any setting to persons at increased risk of influenza or complications of influenza (JC, IDSA, CDC)
- In the 2007-08 National Health Interview Survey, only 44% of healthcare workers reported receiving influenza vaccine in the 2006-2007 season

MMWR 2009;58(RR-8)

Healthcare-Associated Influenza

- Outbreaks reported in most clinical care areas
- Influenza can cause minimal / no symptoms in up to 25% of cases
 - ✓ Workers still shed and spread virus
- 83% HCW work with an influenza like illness (ILI)
 - ✓ Worked mean 2.5 days while ill with ILI
- Self reported survey: 47% admitted coming to work sick, i.e. "presenteeism"
- Patient safety at stake

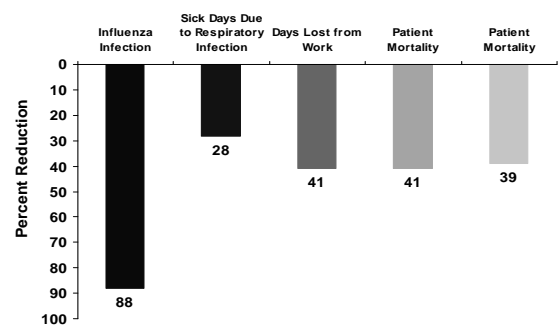
Talbot, ICHE 2005 MMWR 2004;53:1156 Lester, ICHE 2003 Ablah, AJIC 2008:36:588

Location of Healthcare-Associated Outbreaks of Influenza

- Neonatal ICUs
- Pediatric wards
- Adult transplant units
- Pediatric transplant units
- Infectious disease units
- General medical wards
- Geriatric wards
- Long-term care facilities
- Oncology units
- Pulmonary rehabilitation centers
- Emergency departments

Talbot, ICHE 2005. Stott, Occup. Med 2002

Impact of HCW Influenza Vaccination



Talbot, ICHE 2005; Feery, JID 1979; Saxen, PIDJ 1999; Wilde, JAMA 1999; Carman, Lancet 2000; Potter, JID 1997.

Use of Seasonal LAIV Among Healthcare Personnel

- ACIP recommends that LAIV can be given to eligible HCWs *except those that care for severely immunosuppressed persons (hospitalized and in protective isolation)*
- No special precautions are required for HCWs who receive LAIV

MMWR 2009;58(RR-8)

HEALTH ALERT!

If you have flu-like symptoms (fever with cough or cold):

- Take a mask and place it securely over your mouth and nose.
- Clean your hands with waterless hand sanitizer.
- Report your symptoms to the receptionist in the lobby or the nurse's station.



ATTENTION

Notify Hospital Staff
If you have the following symptoms:

- FEVER PLUS
- NASAL CONGESTION
- SORE THROAT
- COUGH
- BODY ACHES
- HEADACHE



Infection Control for Influenza

- Hand hygiene
- Respiratory hygiene / cough etiquette
- Contact avoidance, social distancing
- Antiviral medications

Infection Control for H1N1

- Screening of patients who present to a medical facility; if feasible, in negative pressure
- Individual patient room, with door closed
- Aerosol generating procedures such as: bronchoscopy, elective intubation, suctioning, administering nebulized medications should be in a negative pressure room with 12 air exchanges/hour; N-95 for HCWs
- Ill person should wear a surgical mask to contain secretions if/when outside of the patient room and perform hand hygiene frequently
- Limit HCW to those performing direct patient care.

www.cdc.gov/h1n1flu/guidelines_infection_control.htm

Infection Control for H1N1

- Isolation precautions: standard + contact + eye protection should be used for all patient care activities.
- Hand hygiene immediately after removing gloves
- Limit visitors
- Respiratory protection: fit tested N-95 respirator mask
- Duration of precautions are for 7 days from symptom onset or symptom resolution, whichever is longer

cdc.gov/h1n1flu/guidelines_infection_control.htm

Making the Diagnosis of Influenza

- Easiest if patient is lying down
- Insert swab into the nostril parallel to the palate until resistance is met by contact with nasopharynx. Rotate swab.
- Place swab back into a sterile specimen container.
- One specimen for both rapid and RT PCR testing
- Label specimens
- Transport the specimen to the laboratory on ice or store in refrigerator while waiting for transport.



Infection Control for H1N1

- Contagious: 1 day before symptoms to 7 days after illness onset
- Persons ill for >7 d: consider potentially contagious until symptoms have resolved.
 - ✓ Young children, immune-suppressed contagious for longer periods?
- In contrast to seasonal influenza with surgical masks, “more conservative approach is needed until more is known about the transmission characteristics of this virus.”

cdc.gov/h1n1flu/guidelines_infection_control.htm

Influenza: Lab Diagnosis

Test	Sensitivity	Specificity
Rapid Antigen*		
DFA		
RT-PCR		
Viral Culture		

*Sensitivity: type and quality of specimen, time from illness onset, age of pt, time from specimen collection to testing and storage/processing

Hurt, AC. *Influenza and other Resp Viruses* 2009;3 (4) 171.

Ginocchio, C. *J Clin Virol*. 2009 July;45 (3) 191-195. P.Pancholi, PHD, personal comm.

Antivirals:

- **Adamantanes:**
 - ✓ Rimantadine and Amantadine
 - ✓ Used to treat and prevent influenza A virus infections
 - ✓ Now of little use: widespread resistance to seasonal/H1N1 2009
- **Neuraminidase Inhibitors**
 - 1) Oseltamivir:
 - ✓ Treatment should begin as soon as possible after symptoms onset
 - 75 mg BID for 5 days
 - ✓ Prophylaxis: 75 mg every day for 10 days
 - 2) Zanamavir: age > 7
 - ✓ Treatment should begin as soon as possible after symptoms onset
 - 10mg (2 inhalations) twice daily for 5 days
 - ✓ Prophylaxis: 10 mg (2 inhalations) once daily for 10 days

CDC. Updated Interim Recs for Use of Antivirals in Tx and Prev for 2009-2010 9-22-09

Antiviral Treatment Guidance

- Start ASAP after illness onset.
- Do NOT delay treatment while awaiting lab confirmation
- Empiric treatment is necessary for most patients
- Who is treatment *recommended* for?
 - ✓ Anyone hospitalized with confirmed or suspected influenza
 - ✓ Anyone with confirmed / suspected influenza viral pneumonia
 - ✓ Anyone with confirmed / suspected influenza and complicating bacterial pneumonia

Summary of Antiviral Resistance 2009

Antiviral	Influenza viruses			
	Seasonal H1N1	Seasonal H3N2	B	2009 H1N1
Adamantanes	Susceptible	Resistant	Resistant	Resistant
Oseltamivir	Resistant	Susceptible	Susceptible	Susceptible
Zanamavir	Susceptible	Susceptible	Susceptible	Susceptible

Antiviral Treatment Guidance

- Treatment is *to be considered* for confirmed / suspected influenza based on risk for influenza complications, regardless of severity
 - ✓ Pregnant women
 - ✓ Children <2 years old
 - ✓ Persons with chronic medical conditions
 - ✓ Persons 65 years old or older (lower risk for infection, but higher risk for complications)
- Use clinical judgment when making treatment decisions

Antiviral Post Exposure Prophylaxis (PEP) Recommendations

- PEP: start ASAP after exposure to case likely to be infectious
- Don't start PEP > 48 hours after last exposure
- Persons *considered for* PEP:
 - ✓ Persons at high-risk for complications of influenza and are close contacts of persons with confirmed, or suspected influenza.
 - ✓ HCWs, public health workers, or first responders who have a recognized, unprotected (inadequate PPE) close contact exposure to a person with confirmed / suspected influenza during that person's infectious period

Revised Antiviral Guidance

- Use oseltamivir or zanamivir
 - ✓ (99% circulating viruses are 2009 H1N1)
- Options to reduce treatment delays
 - Discuss treatment plan w/ higher risk patients now
 - Triage (office and telephone) for higher risk
 - Empiric treatment if flu suspected: don't await testing results
- Limit use of PEP
 - ✓ Consider education / early treatment as alternative
- No groups for pre-exposure chemoprophylaxis

CDC. Updated Interim Recs for Use of Antivirals in Tx and Prev for 2009-2010. 9-22-09

Antiviral Post Exposure Prophylaxis (PEP) Recommendations

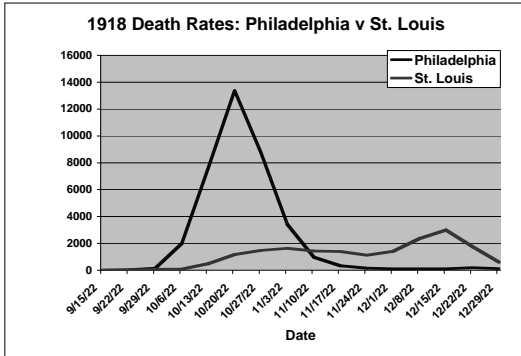
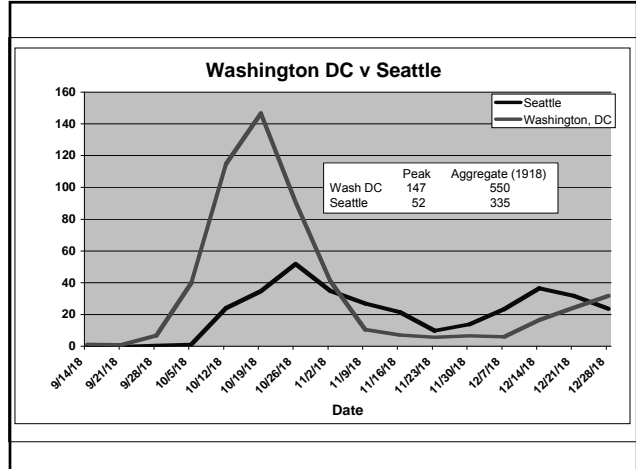
- Antiviral PEP should not be used in healthy children/adults based on *potential* exposures in the community, school, camp.
- Alternative: Watchful waiting; early treatment if illness develops
 - ✓ Educate about symptoms and use of antivirals
 - ✓ Start empiric treatment if illness develops in a person at risk for complications
 - ✓ Reduces antiviral use and unnecessary side effects!

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Columbus Public Health

Flu Pandemics Throughout History

- “Spanish Flu” - 1918-1919
 - ✓ Spread around the world in four to six months
 - ✓ At least 40-50 million people died worldwide
 - 600,000 deaths in the U.S.
- “Asian Flu” – 1957-1958
 - ✓ At least 1.5 million people died worldwide
 - 70,000 deaths in the U.S.
- “Hong Kong Flu” - 1968-1969
 - ✓ At least 700,000 people died worldwide
 - 34,000 deaths in the U.S.



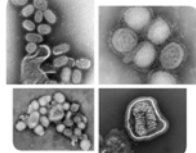
Weekly mortality data provided by Marc Lipsitch (personal communication)

Recognition of an Influenza Virus with Potential to cause a Pandemic

- **Between April 15-17, 2009**
 - ✓ 2 residents of adjacent counties in southern California with a febrile respiratory illness
 - ✓ Cause identified as a swine-origin influenza A (H1N1) virus
 - Neither child had contact with pigs
- **Viruses were genetically closely related to each other**
 - ✓ resistant to amantadine and rimantadine
 - ✓ combination of gene segments previously not recognized among influenza viruses in the United States
- **Similar virus identified as cause of community outbreaks in Mexico, March-April 2009**
- **WHO: Pandemic phase 6 declaration: June 11, 2009**

Pandemic Influenza 2009

- April to Aug 2009
 - ✓ 1 million infected in US
 - ✓ 9036 hospitalizations
 - ✓ 593 deaths
 - ✓ Age 25-64 = 71% of deaths
- Since Aug 30, 2009
- New reporting for ILI
 - ✓ 10,082 hospitalizations
 - ✓ Deaths 936
 - ✓ Novel virus, low mortality, high transmissibility
 - ✓ 97% ILI are due to Influenza A H1N1



H1N1 Update Public Health Predictions

Pandemic H1N1

- Could strike up to 50% of U.S population
 - ✓ Estimated 100,000 deaths or more
- New at-risk groups
 - ✓ Pregnant women
 - ✓ Young persons
 - 6 mo. – 24 year olds
 - ✓ Minorities in priority groups
 - Minorities 4 times more likely to be hospitalized

Seasonal

- 36,000 deaths in U.S. per year
- More than 200,000 hospitalized in U.S. per year
- Affects the very young and elderly

U.S. Virologic Surveillance:

WHO and NREVSS collaborating laboratories located in all 50 states and Washington D.C. report to CDC the number of respiratory specimens tested for influenza and the number positive by influenza type and subtype. The results of tests performed during the current week are summarized in the table below.

	Week 37
No. of specimens tested	9,744
No. of positive specimens (%)	2,326 (23.9%)
Positive specimens by type/subtype	
Influenza A	2,324 (99.9%)
A (2009 H1N1)	1,395 (60.0%)
A (subtyping not performed)	907 (39.0%)
A (unable to subtype)	17 (0.7%)
A (H3)	1 (0.1%)
A (H1)	4 (0.2%)
Influenza B	2 (0.1%)

During week 37, seasonal influenza A (H1), A (H3) and influenza B viruses co-circulated at low levels with 2009 influenza A (H1N1) viruses. Ninety-nine percent of all subtyped influenza A viruses reported to CDC this week were 2009 influenza A (H1N1) viruses.

Public Health Surveillance

- Traditional seasonal influenza surveillance from October – May
- Extended influenza surveillance through summer and into next season as a result of the new influenza virus (H1N1)
- August 30th CDC switch to reporting all influenza and pneumonia-associated hospitalizations and deaths and not just those due to 2009 H1N1

Monitoring Influenza Activity

- What is reportable?
 - ✓ Pediatric influenza deaths
 - ✓ Influenza Associated Hospitalizations (IAH)
 - Lab confirmed or syndrome based
 - Ohio reports lab confirmed IAHS
 - ✓ Pneumonia & Influenza Deaths
 - Lab confirmed or syndrome based
 - Ohio reports P&I deaths that are syndrome based (based on presence of key words in cause of death section on death certificates)
 - ✓ Both are reported regardless of actual influenza strain identified

Vaccines Pandemic H1N1 Influenza Vaccine



- Seasonal flu shot will **NOT** protect against H1N1
- H1N1 shot will **not** protect against seasonal flu
- Fall H1N1 Vaccination Effort
 - ✓ Scheduled for mid/late October through winter
 - ✓ Specifics unknown for
 - # of doses
 - Timing

What Can You Do?

Wash your hands



Cover your cough



Stay home if you're sick



Get your flu shots



Vaccines Seasonal Influenza Vaccine

- Available now
- Recommended groups
 - ✓ Anyone who wants to decrease risk of getting flu should be vaccinated
 - ✓ Children 6 months – 18 years
 - ✓ Adults 50 years or older
 - ✓ Pregnant women
 - ✓ Anyone with medical conditions
 - ✓ Those who live with or care for people at high risk (healthcare workers)
- Decreases risk of getting seasonal flu
- Annual vaccination needed



Vaccines Pandemic H1N1 Influenza Vaccine

- Vaccination Priority Groups

- ✓ Healthcare workers and emergency personnel
- ✓ Pregnant women
- ✓ Household contact of children less than 6 months old
- ✓ Children and young adults 6 months – 24 years
- ✓ Non-elderly adults 25-64 with underlying conditions
- ✓ *Approximately 160 million Americans in total*



Influenza Vaccine Safety

- Seasonal influenza vaccine has very good safety profile
- Expect H1N1 influenza vaccine to have similar safety profile as seasonal influenza vaccine
- Common side effects are mild such as soreness, redness, tenderness, swelling at injection site
- All vaccines monitored for safety by CDC via:
 - ✓ VAERS (Vaccine Adverse Event Reporting System)
 - CDC and FDA
 - ✓ VSD (Vaccine Safety Datalink)
 - CDC and Managed Care organizations (MCOs)

Who should Not Get Vaccinated?

- People who have a *severe allergy* to eggs
 - ✓ Hives, swelling of lips/tongue, difficulty breathing.
 - ✓ Does not include gastrointestinal symptoms
- People who have had a *severe reaction* to an influenza vaccination, i.e. other component of the vaccine
 - ✓ Hives, swelling of lips/tongue, difficulty breathing.
 - ✓ Does not include a sore arm, local reaction, or subsequent upper respiratory infections
- People who developed Guillain-Barré syndrome within 6 weeks of getting an influenza vaccine

Influenza Vaccines and Guillain-Barre' Syndrome (GBS)

- GBS is a rare disorder
 - ✓ 3,000- 6,000 people develop the disease each year in the U.S. (1-2 people/100,000)
 - ✓ Most people fully recover
 - ✓ In rare cases, people die
- Causes of GBS:
 - ✓ 2/3 of people with GBS, develop it days to weeks following a diarrheal or respiratory illness
 - ✓ Infection with *Campylobacter jejuni* most common
 - ✓ On rare occasions can develop it after receiving a vaccine

Influenza Vaccines and Guillain-Barre' Syndrome (GBS)

- GBS in 1976
 - ✓ Small risk of GBS following swine flu vaccination
 - ✓ An additional 1 case/100,000
 - ✓ Research unable to identify cause

What Can You Do?

Wash your hands



Cover your cough



Stay home if you're sick



Get your flu shots



Influenza Vaccine and Thimerosal

- Thimerosal is a mercury based preservative to prevent growth of microorganisms in multi-dose vials
- The H1N1 vaccine will come in several formulations
 - ✓ The multi-dose vial will contain thimerosal
- Numerous studies show no association with thimerosal and autism
- Since 2001, FDA has not licensed any new vaccine for children that contains thimerosal

Limiting the Spread Handwashing Key Messages

- Number one defense against spread of illness
- Wash often with soap and warm water
- Wash for 20 seconds (sing ABCs)
- Use a paper towel or arm to turn off faucet and open door
- Wash hands after using bathroom, coughing, sneezing, blowing nose
- Wash hands before preparing food or eating.
- Supervise children washing and role model



Limiting the Spread Cover Your Cough

- Prevent the spread of infection from sneezing or coughing
- Proper ways to cover your cough
 - ✓ Cover mouth and nose with tissue, throw tissue away, and then wash hands
 - ✓ Cough or sneeze into upper sleeve, *not into hands*



Limiting the Spread Use of Hand Sanitizers

- Use brand with min. 60% alcohol
- Divide sanitizer into palms and scratch in with fingernails (to clean under nails)
- Cover all surfaces of hands and fingers
- Rub for at least 15 seconds until absorbed or evaporated
- Do not wipe excess - works by evaporation
- Use soap and warm water after every 5-10 uses to avoid build-up



Limiting the Spread Stay Home If You're Sick

- Staying home helps protect others
- Don't go to work if you're sick
- Keep kids out of school or childcare if they are sick
- Call your healthcare provider if you have a high fever, sore throat or body aches
- Stay home for 24 hours after fever-free without fever-reducing medications



Social Distancing

Social distancing...

- Allowing space between people so the virus does spread
- Methods include:
 - ✓ Stop shaking hands
 - ✓ Stay 6 feet away all around from someone coughing and sneezing
 - ✓ Avoid crowded settings



50 year old female

- PMHx: Type II DM and HPT
- Renal transplant on September 3
- Discharged on September 15
- Daily meds included:
 - ✓ mycophenolate 500 bid, cyclosporine 150 bid, insulin, and tmp-smx DS

Prevention Messages for Healthcare Workers

- Get vaccinated
 - ✓ Seasonal influenza now
 - ✓ H1N1 influenza when available
- Vaccinate your patients
- Practice good infection control
- Stay home if you are ill
 - ✓ Individuals working in healthcare settings should be excluded for 7 days from symptom onset or until the resolution of symptoms, whichever is longer.

50 year old female hospital course

- Re-presents to the facility on September 22 with
- 2 days of SOB / DOE / cough / RR 24 and fever to 101.6 / nausea and vomiting
- CXR: RML infiltrate; hazy throughout
- WBC: 10.3
- Differential diagnosis

What's in her Differential Diagnosis?

- Viral pneumonia: Influenza
 - ✓ Was she vaccinated?
- Community acquired pathogens
 - ✓ *Strep pneumo*, *Moraxella catarrhalis*, *H. flu*
 - ✓ *Mycoplasma*, *Chlamydia*, *Legionella*
- Health care associated pathogens
 - ✓ *Pseudomonas*, *Staph aureus*
- Fungi
 - ✓ Any duct cleaning, gardening
 - ✓ *Pneumocystis jiroveci*

Diagnostic Studies

- ISOLATE patient
- Sputum Gram stain and culture
- Blood cultures: 2 sets
- ABG: hypoxia
- Nasopharyngeal swab for flu rapid antigen and RT-PCR
- Urinary *Legionella* antigen assay
- Empiric: macrolide, piperacillin-tazobactam, vancomycin for HAP pathogens and oseltamivir
- Bronchoscopy (?) severity of illness:
 - ✓ Cell count and differential
 - ✓ Routine, fungal, and viral cultures