

Influenza and Influenza Vaccines

Raymond A. Strikas, MD, MPH

Lead, Education Team, Immunization Services Division, National
Center for Infectious Diseases, Centers for Disease Control
and Prevention

Epidemiology and Prevention of Vaccine-Preventable Diseases
(Pink Book) Webinar Series

September 7, 2016

National Center for Immunization & Respiratory Diseases
Immunization Services Division



Influenza

- ❑ **Highly infectious viral illness**
- ❑ **First pandemic in 1580**
- ❑ **At least 4 pandemics in 19th century**
 - Pandemics of 1957 and 1968 of lesser severity
- ❑ **Most recent pandemic (H1N1) in 2009-2010**
- ❑ **Estimated 21 million deaths worldwide in pandemic of 1918-1919**
- ❑ **Virus first isolated in 1933**

Influenza Virus

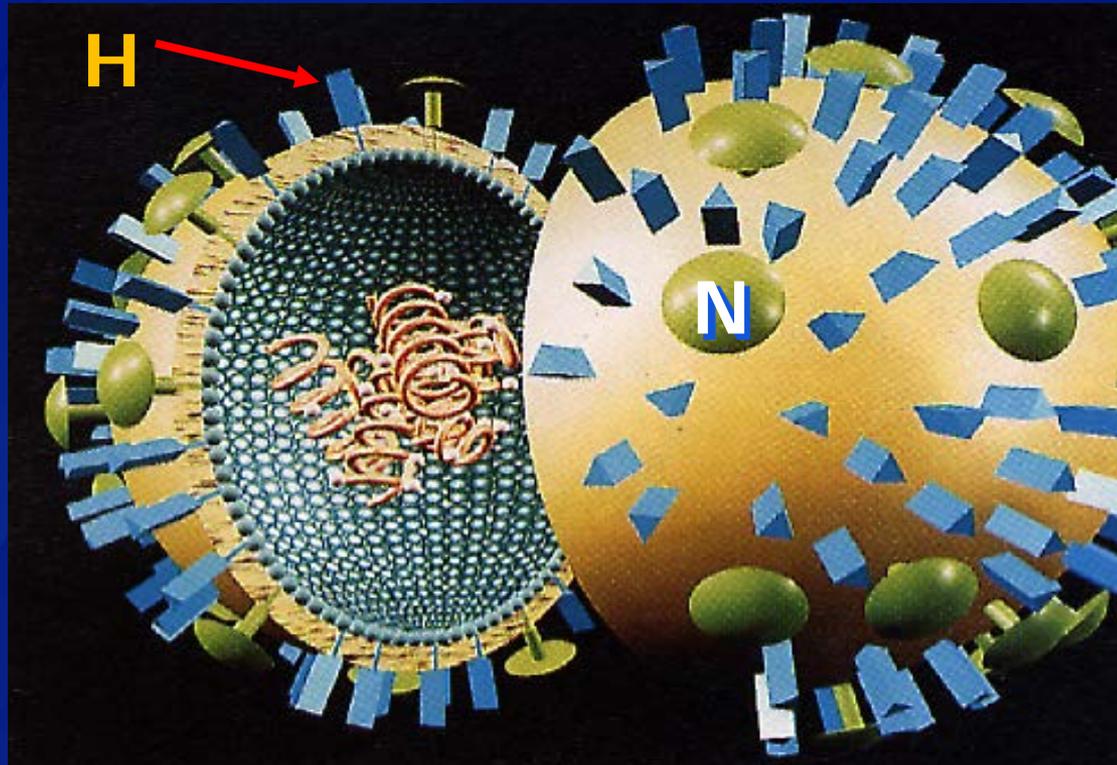
- ❑ **Single-stranded RNA virus**
- ❑ **Orthomyxoviridae family**
- ❑ **3 types: A, B, C**
- ❑ **Subtypes of type A are determined by hemagglutinin and neuraminidase**

Influenza Virus Strains

- ❑ **Type A**
 - Moderate to severe illness
 - All age groups
 - Humans and other animals
- ❑ **Type B**
 - Milder epidemics
 - Primarily affects children
 - Humans only
- ❑ **Type C**
 - Rarely reported in humans
 - No epidemics

Influenza Type A Subtypes

Subtypes of type A determined by hemagglutinin (H) and neuraminidase (N)



A/California/7/2009 (H1N1)

→ Virus type → Geographic origin → Strain number → Year of isolation → Virus subtype

Influenza Antigenic Changes

□ Antigenic Drift

- minor change, same subtype
- caused by point mutations in gene
- may result in epidemic

□ Antigenic Shift

- major change, new subtype
- caused by exchange of gene segments
- may result in pandemic

WHO declares first flu pandemic in 41 years

Updated 6/12/2009 12:08 AM | Comments [295](#) | Recommend [63](#) | E-mail | Save | Print | Reprints & Permissions | [RSS](#)



[Enlarge](#)

By Fabrice Coffrini, AFP/Getty Images

World Health Organization Director General Margaret Chan sits before Assistant Director General Keiji Fukuda at a Geneva news conference announcing that the WHO decided to raise the

By [Steve Sternberg](#), USA TODAY

The World Health Organization scaled up its flu warning to its highest level Thursday, declaring the first global influenza pandemic in 41 years as cases of H1N1 continued to mount in the USA, Europe, Latin America and Australia.

"The scientific criteria for a pandemic have been met," said Margaret Chan, director general of the WHO. "The world is now at the start of the 2009 influenza pandemic."

PHOTOS: [Schools closed in Hong Kong, Vermont \(and more\)](#)

INTERACTIVES: [World map, how H1N1 strain emerged](#)

FAQ: [What you should know about swine flu](#)

VIDEO: [Reporters answer your questions](#)

The decision marks the agency's formal recognition of the magnitude of the challenge posed by a novel, H1N1 flu virus now spreading unchecked among people who, because the virus is new, are virtually all susceptible to it.

The WHO is working closely with vaccine makers, who are just wrapping up production of seasonal flu vaccine for fall and gearing up to produce the first doses of an H1N1 vaccine by September. The agency urged member nations to maintain their vigilance to detect ominous changes in the virus's

Share

[Yahoo! Buzz](#)

[Add to Mixx](#)

[Facebook](#)

[Twitter](#)

[More](#)

Subscribe

[myYahoo](#)

[iGoogle](#)

[More](#)

2009 Influenza A(H1N1)

- ❑ In April 2009 a novel influenza A(H1N1) virus appeared and quickly spread across North America**
- ❑ By May 2009 the virus had spread to many areas of the world**
- ❑ Cause of the first influenza pandemic since 1968**
- ❑ Pandemic monovalent influenza vaccine produced and deployed in nationwide vaccination campaign**

Influenza Pathogenesis

- ❑ Respiratory transmission of virus**
- ❑ Replication in respiratory epithelium with subsequent destruction of cells**
- ❑ Viremia rarely documented**
- ❑ Virus shed in respiratory secretions for 5-10 days**

Influenza Clinical Features

- ❑ **Incubation period 2 days
(range 1-4 days)**
- ❑ **50% of infected persons develop classic symptoms**
- ❑ **Abrupt onset of fever (usually 101° - 102°F), myalgia, sore throat, nonproductive cough, headache**

Influenza Complications

❑ Pneumonia

- Primary influenza pneumonia
- Secondary bacterial pneumonia

❑ Reye syndrome

❑ Myocarditis

❑ Death reported in <1 per 1,000 cases

Impact of Influenza – United States, 1976-2007

- ❑ The number of influenza-associated deaths varies substantially by year, influenza virus type and subtype, and age group**
- ❑ Annual influenza-associated deaths ranged from 3,349 (1985-86 season) to 48,614 (2003-04 season), with an average of 23,607 annual deaths**
- ❑ Persons 65 years of age and older account for approximately 90% of deaths**
- ❑ 2.7 times more deaths occurred during seasons when A(H3N2) viruses were prominent**

Impact of influenza- United States

- ❑ Highest rates of complications and hospitalization among persons 65 years and older, young children, and persons of any age with certain underlying medical conditions**
- ❑ Average of more than 200,000 influenza-related excess hospitalizations**
- ❑ 37% of hospitalizations among persons younger than 65 years of age**
- ❑ Greater number of hospitalizations during years that A(H3N2) is predominant**

Influenza Among School-Aged Children

□ School-age children

- typically have the highest attack rates during community outbreaks of influenza
- serve as a major source of transmission of influenza within communities

Influenza Epidemiology

❑ Reservoir

- human, animals (type A only)

❑ Transmission

- respiratory, probably airborne

❑ Temporal pattern

- peak December – March in temperate climate
- may occur earlier or later

❑ Communicability

- 1 day before to 5 days after onset (adults)

Influenza Diagnosis

- ❑ **Clinical and epidemiological characteristics**
- ❑ **Isolation of influenza virus from clinical specimen (e.g., throat, nasopharynx, sputum)**
- ❑ **Significant rise in influenza IgG by serologic assay**

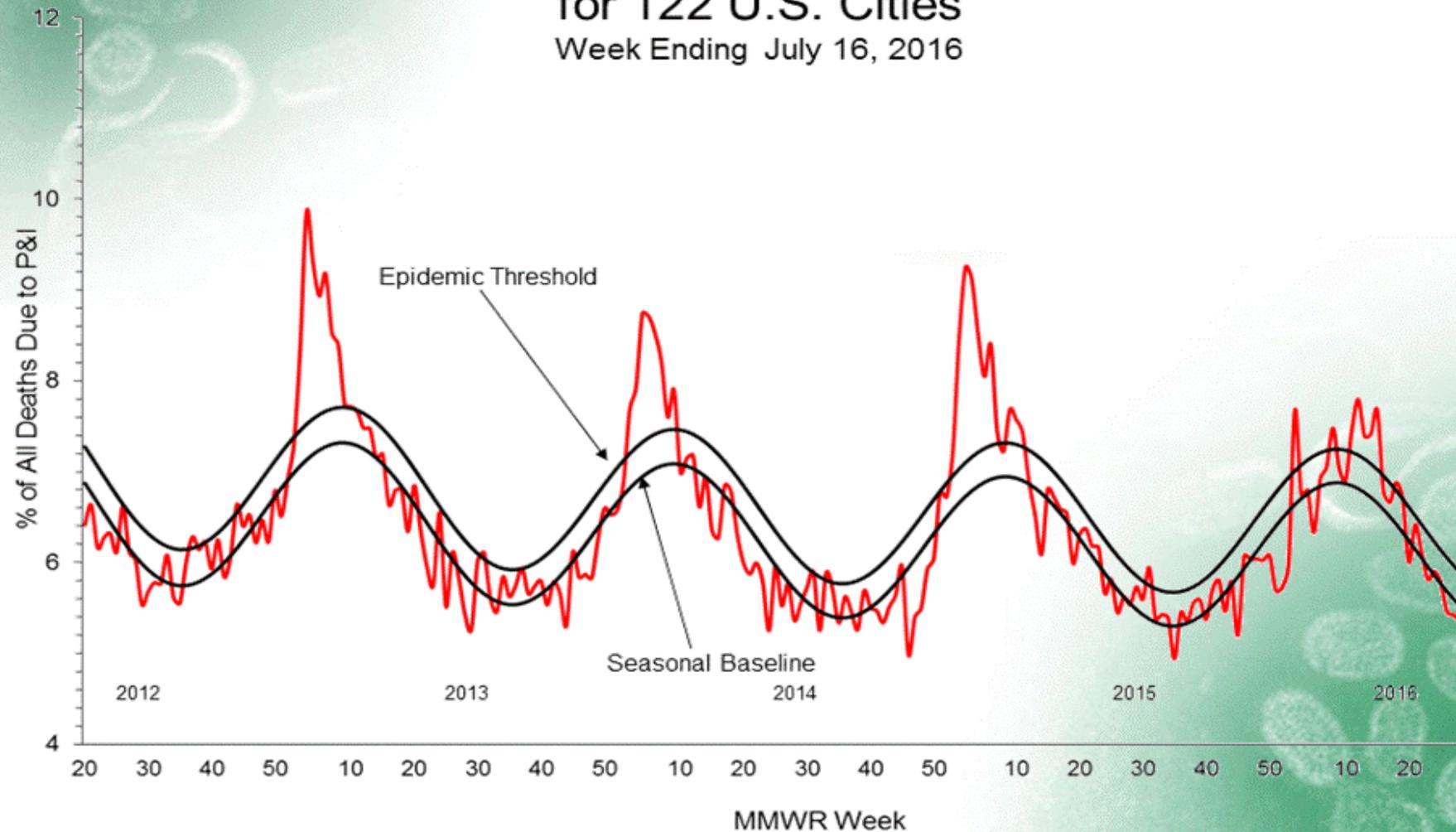
Influenza Virus Testing Methods

Method	Types Detected	Test Time
<u>Viral tissue cell culture</u>	<u>A and B</u>	<u>3-10 days</u>
Rapid cell culture (shell vials; cell mixtures; yields live virus)	A and B	1-3 days
Immunofluorescence, Direct (DFA) or Indirect (IFA) Florescent Antibody Staining	A and B	1-4 hours
<u>Reverse Transcriptase Polymerase Chain Reaction (RT-PCR)</u> and other molecular assays [influenza viral RNA or nucleic acid detection]	<u>A and B</u>	<u>Varies by assay (Generally 60-80 minutes and 4-8 hours)</u>
Rapid Molecular Assay [influenza viral RNA or nucleic acid detection]	A and B	Approximately 20 minutes
<u>Rapid Influenza Diagnostic Tests (antigen detection)</u>	<u>A and B</u>	<u><15 min.</u>

A Weekly Influenza Surveillance Report Prepared by the Influenza Division

Pneumonia and Influenza Mortality for 122 U.S. Cities

Week Ending July 16, 2016



Myths about the Flu Vaccine

- ❑ **“Every time I get the vaccine, I get sick”**
- ❑ **“Flu vaccine can give you the flu”**
- ❑ **“If I get the vaccine in October, it will not work in February or March of next year”**
- ❑ **“It’s not safe. It does not even work...”**
- ❑ **“Why get the vaccine every year? Last year’s vaccine is good enough”**

Influenza Vaccines

❑ Inactivated (IIV)

- Intramuscular or
- Intradermal

❑ Live attenuated vaccine (LAIV)

- Intranasal
- NOT recommended for use in 2016-17 influenza season
 - Reason: low effectiveness against influenza A(H1N1)pdm09 in the United States during the 2013–14 and 2015–16 seasons
 - Because LAIV is still a licensed vaccine that might be available and some providers might elect to use, for informational purposes, reference is made to information and previous recommendations for its use.

Transmission of LAIV Virus

- ❑ LAIV replicates in the nasopharyngeal mucosa
- ❑ Vaccinated children can shed vaccine viruses in nasopharyngeal secretions for up to 3 weeks
- ❑ One instance of transmission of vaccine virus to a contact has been documented, who developed a mild respiratory illness. (Pediatr Infect Dis J 2006;25:590–5)

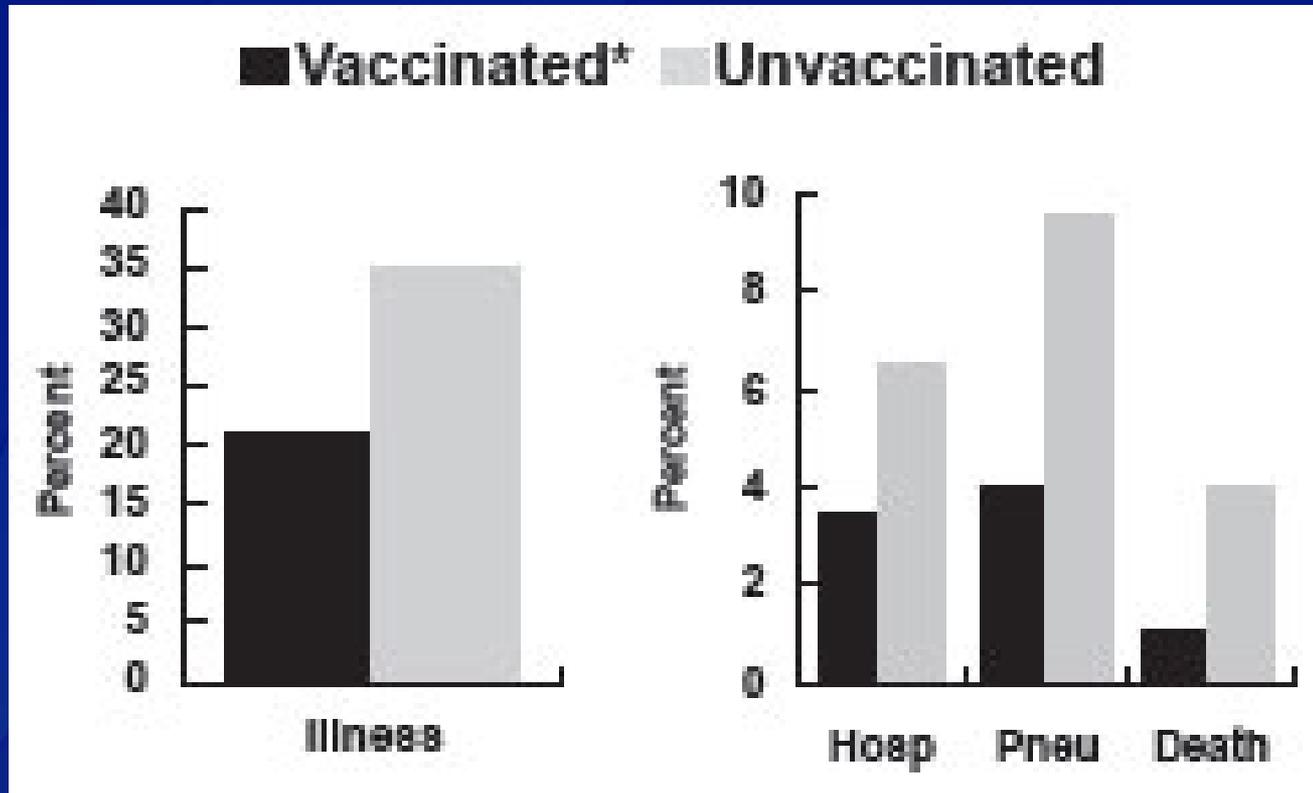
Inactivated Influenza Vaccine Efficacy

- **About 60% effective among healthy persons younger than 65 years of age**
- **50-60% effective in preventing hospitalization among elderly persons**
- **80% effective in preventing death among elderly persons**

Grohskopf LA, Sokolow LZ, Broder KR. Prevention and Control of Seasonal Influenza with Vaccines Recommendations of the Advisory Committee on Immunization Practices — United States, 2016–17 Influenza Season. *MMWR Recomm Rep* 2016;65(No. RR-5):[1-52].

www.cdc.gov/mmwr/volumes/65/rr/pdfs/rr6505.pdf

Influenza and Complications Among Nursing Home Residents



*Inactivated influenza vaccine. Genesee county, MI, 1982-1983

LAIV Efficacy In Healthy Children

❑ Older data:

- 87% effective against culture-confirmed influenza in children 60 - 84 months old
- 27% reduction in febrile otitis media (OM)
- 28% reduction in OM with accompanying antibiotic use
- Decreased fever and OM in vaccine recipients who developed influenza

- ❑ Given poor effectiveness of LAIV in the U.S. against influenza A(H1N1)pdm09 in 2 of the past 3 influenza seasons (2013-14 and 2015-16), for the 2016-17 season, ACIP makes the interim recommendation that LAIV should not be used.

Inactivated Influenza Vaccine (IIV) Recommendations (1)

- ❑ Advisory Committee on Immunization Practices recommends annual influenza vaccination for all persons 6 months of age and older**
- ❑ Protection of persons at higher risk for influenza-related complications should continue to be a focus of vaccination efforts as providers and programs transition to routine vaccination of all persons aged 6 months and older**

Inactivated Influenza Vaccine (IIV) Recommendations (2)

- When vaccine supply is limited, vaccination efforts should focus on delivering vaccination to the following groups of persons:**
 - Children 6 months through 4 years (59 months) of age**
 - Persons 50 years and older**
 - Persons with chronic pulmonary (including asthma), cardiovascular (except hypertension), renal, hepatic, neurologic, hematologic, or metabolic disorders (including diabetes mellitus)**
 - Persons who are immunosuppressed (including immunosuppression caused by medications or by human immunodeficiency virus)**
 - Women who are or will be pregnant during the influenza season**

Inactivated Influenza Vaccine (IIV)

Recommendations (3)

- **Children 6 months through 18 years of age and receiving long-term aspirin therapy and who therefore might be at risk for experiencing Reye syndrome after influenza virus infection**
- **Residents of nursing homes and other chronic-care facilities**
- **American Indians/Alaskan natives**
- **Persons who are extremely obese (body-mass index is 40 or greater)**
- **Healthcare personnel**
- **Household contacts and caregivers of children younger than 5 years of age and adults 50 years of age or older, with particular emphasis on vaccinating contacts of children aged younger than 6 months**
- **Household contacts and caregivers of persons with medical conditions that put them at higher risk for severe complications from influenza**

Pregnancy and Inactivated Influenza Vaccine (IIV)

- ❑ Risk of hospitalization 4 times higher than nonpregnant women**
- ❑ Risk of complications comparable to nonpregnant women with high-risk medical conditions**
- ❑ Vaccination (with IIV) recommended if pregnant during influenza season**
- ❑ Vaccination can occur during any trimester**

HIV Infection and Inactivated Influenza Vaccine (IIV)

- ❑ Persons with HIV at increased risk of complications from influenza**
- ❑ IIV induces protective antibody titers in many HIV-infected persons**
- ❑ IIV will benefit many HIV-infected persons**

Inactivated Influenza Vaccine (IIV) Contraindications and Precautions

- ❑ Severe allergic reaction (e.g., anaphylaxis) to a vaccine component or following a prior dose of inactivated influenza**
- ❑ Moderate or severe acute illness**
- ❑ History of Guillain-Barré syndrome (GBS) within 6 weeks following a previous dose of influenza vaccine**

Live Attenuated Influenza Vaccine (LAIV) Precautions

- ❑ Persons with chronic medical conditions**
- ❑ Children 5 years or older with asthma**
- ❑ Moderate or severe acute illness**
- ❑ History of Guillain-Barré syndrome (GBS) within 6 weeks following a previous dose of influenza vaccine**

Influenza Vaccine Adverse Events

□ IIV

- Local reactions - common
- Guillain-Barré syndrome (GBS) - expected to be greater among persons with a history of GBS than among persons with no history of GBS

□ LAIV

- Nonspecific systemic symptoms - common

Inactivated Influenza Vaccine (IIV) Adverse Reactions

- ❑ **Local reactions (soreness, redness)**
 - 15% - 20%
- ❑ **Fever, malaise, myalgia**
 - Less than 1%
- ❑ **Allergic reactions (hives, angioedema, anaphylaxis)**
 - Rare

Live Attenuated Influenza Vaccine (LAIV)

Adverse Reactions

□ Children

- **No significant increase in URI symptoms, fever, or other systemic symptoms**
- **Increased risk of wheezing in children 6-23 months of age**

□ Adults

- **Significantly increased rate of cough, runny nose, nasal congestion, sore throat, and chills reported among vaccine recipients**
- **No increase in the occurrence of fever**

□ No serious adverse reactions identified

Influenza Antiviral Agents*

- ❑ **Amantadine and rimantadine**
 - **Not recommended because of documented resistance in U.S. Influenza isolates**

- ❑ **Zanamivir and oseltamivir**
 - **Neuraminidase inhibitors**
 - **Effective against influenza A and B**
 - **Oseltamavir and zanamavir approved for prophylaxis**

*See CDC website at www.cdc.gov/flu/professionals/antivirals/index.htm for details

Influenza Surveillance

- **Monitor prevalence of circulating strains and detect new strains**
- **Estimate influenza-related morbidity, mortality and economic loss**
- **Rapidly detect outbreaks**
- **Assist disease control through rapid preventive action**

Influenza Vaccines 2016-2017 Season

- ❑ **Trivalent influenza vaccines will contain:**
 - A/California/7/2009 (H1N1)- like virus
 - A/Hong Kong/4801/2014 (H3N2)-like virus;
 - B/Brisbane/60/2008-like virus (B/Victoria lineage).

- ❑ **Quadrivalent influenza vaccines will contain:**
 - ❑ these antigens, and also
 - ❑ B/Phuket/3073/2013-like virus (Yamagata lineage)

Recent New Influenza Vaccine Licensures

- ❑ **An MF59-adjuvanted trivalent inactivated influenza vaccine (aIIV3), Flud (Seqirus, Holly Springs, North Carolina), was licensed by FDA in November 2015 for persons aged ≥ 65 years.**
 - aIIV3 is an acceptable alternative to other vaccines licensed for persons in this age group.
- ❑ **Quadrivalent formulation of Flucelvax (cell culture based inactivated influenza vaccine [cIIIV4], (Seqirus), licensed by FDA in May 2016, for persons aged ≥ 4 years. cIIIV4 is an acceptable alternative to other vaccines licensed for persons in this age group.**
- ❑ **ACIP and CDC do not express a preference for any particular vaccine product.**

Influenza Vaccination Recommendation

- ❑ **Annual influenza vaccination is now recommended for every person in the United States 6 months of age and older**

See ACIP recommendations at
www.cdc.gov/mmwr/volumes/65/pdfs/rr6505.pdf

Influenza Vaccination Recommendation

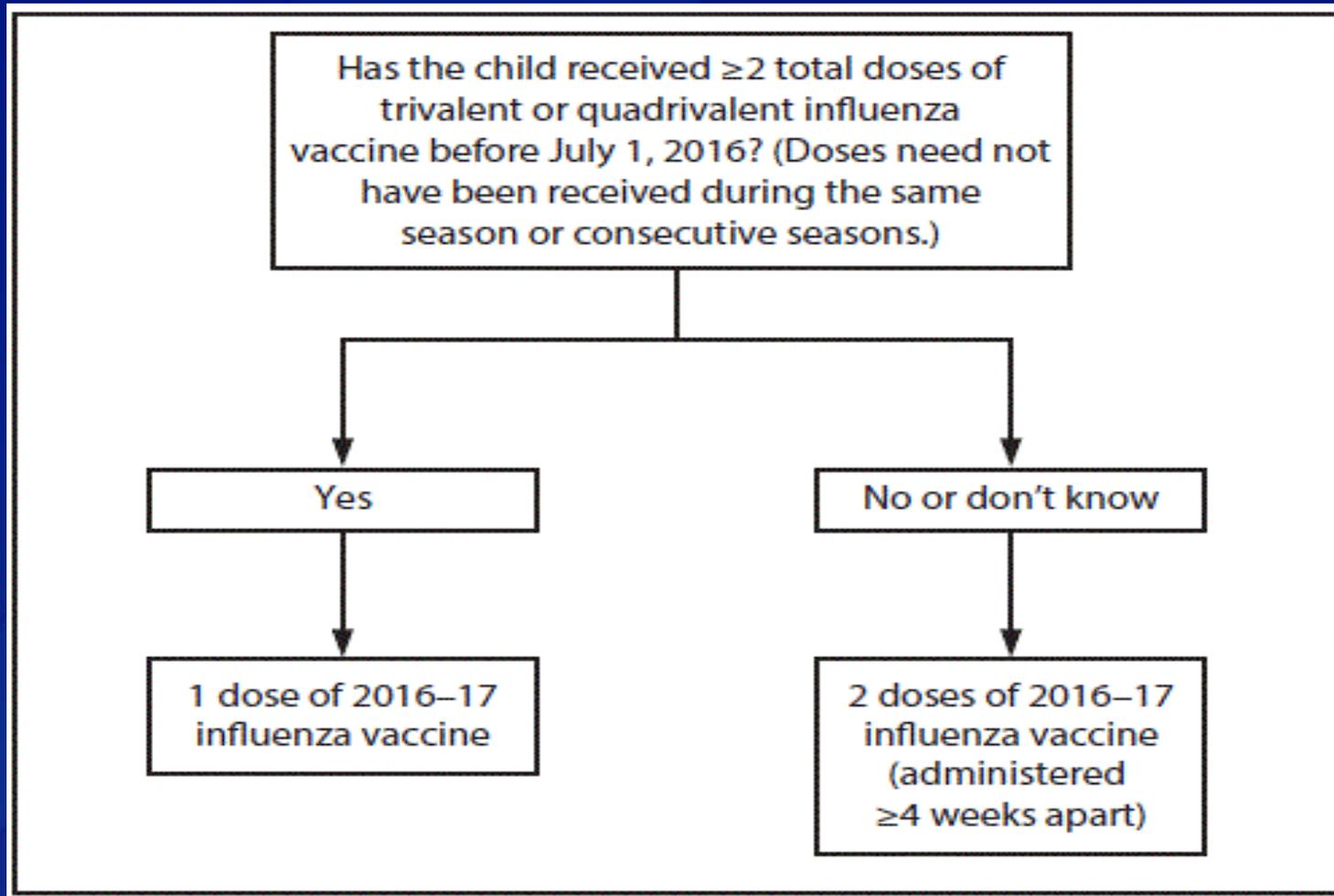
- ❑ **Providers should make a special effort to vaccinate persons at increased risk of complications of influenza**
 - Children 6 months through 4 years
 - Persons 50 years and older
 - Persons with underlying medical conditions
 - Pregnant women
- ❑ **Close contacts of high-risk persons**
- ❑ **Healthcare personnel**

See www.cdc.gov/mmwr/volumes/65/rr/pdfs/rr6505.pdf

Inactivated Influenza Vaccine Schedule

Group Age	Dose	No. Doses
6-35 mos	0.25 mL	1 or 2
3-8 yrs	0.50 mL	1 or 2
9 yrs and older	0.50 mL	1

Influenza vaccine dosing algorithm for children aged 6 months through 8 years — Advisory Committee on Immunization Practices, United States, 2016–17 influenza season



Recommendations regarding influenza vaccination of persons who report allergy to eggs — Advisory Committee on Immunization Practices, United States, 2016–17 influenza season

1. Persons with history of egg allergy who have experienced only hives after exposure to egg should receive influenza vaccine. Any licensed and recommended influenza vaccine (i.e., any age-appropriate IIV or RIV3) appropriate for the recipient's age and health status may be used.
2. Persons who report prior reactions to egg involving symptoms other than hives, such as angioedema, respiratory distress, lightheadedness, or recurrent emesis; or who required emergency medical intervention, may also receive any licensed and recommended influenza vaccine appropriate for the recipient's age and health status. Vaccine should be administered in an inpatient or outpatient medical setting (including but not necessarily limited to hospitals, clinics, health departments, and physician offices). Vaccine administration should be supervised by a health care provider who can recognize and manage severe allergic conditions.
3. A previous severe allergic reaction to influenza vaccine, regardless of the component suspected of being responsible for the reaction, is a contraindication to future receipt of the vaccine.

Timing of Vaccination

- ❑ Vaccination should occur before onset of influenza activity. Health care providers should offer vaccination by the end of October, if possible.
- ❑ Children aged 6 months through 8 years who require 2 doses should receive their first dose as soon as possible after vaccine becomes available, and the second dose ≥ 4 weeks later.
- ❑ Vaccination should continue to be offered as long as influenza viruses are circulating and unexpired vaccine is available.
- ❑ To avoid missed opportunities for vaccination, providers should offer vaccination during routine health care visits and hospitalizations when vaccine is available.

CDC website on influenza: www.cdc.gov/flu/index.htm

FLU BASICS

Symptoms, How Flu Spreads, Higher Risk Groups, Past and Current Flu Season

HEALTH PROFESSIONALS

Vaccination, Antiviral Drugs, Infection Control, Diagnostic Testing, and Training

PREVENTION - FLU VACCINE

Vaccine Safety, Vaccination Coverage, Influenza VIS, NIVW, Infection Control

FREE RESOURCES

Printable Materials, Photos, Podcasts, Videos, PSAs, eCards, Badges & Buttons, Articles

TREATMENTS

Drugs to Treat Flu Virus, Stay Home When Sick, Caring for Someone Sick With Flu

INFORMATION FOR PARTNERS

Campaign Highlights, Partner Activity, Media Briefings, Promotional/Educational Tools

SUPPLY AND DISTRIBUTION

Approved U.S. Flu Vaccines, Total Doses Distributed

QUESTIONS & ANSWERS

Answers to Flu-Related Questions

NEWS & HIGHLIGHTS

Flu Spotlights, Press Releases...

PUBLIC HEALTH IMAGE LIBRARY

Photographs, Illustrations, and Multimedia Files

Flu Vaccine Finder

Find flu clinics near you

Everyone six months of age and older needs a flu vaccine.

Enter Zip Code

GO

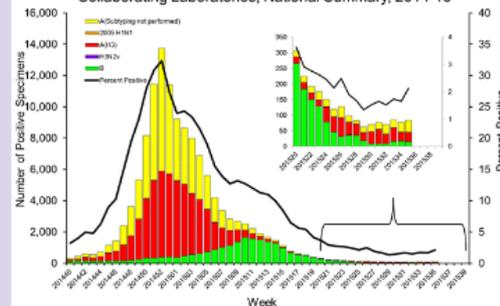
powered by HealthMap

VISIT FLU.GOV

SHARE THIS WIDGET

Flu Activity & Surveillance

Influenza Positive Tests Reported to CDC by U.S. WHO/NREVSS Collaborating Laboratories, National Summary, 2014-15



Check where flu is active near you.

More >

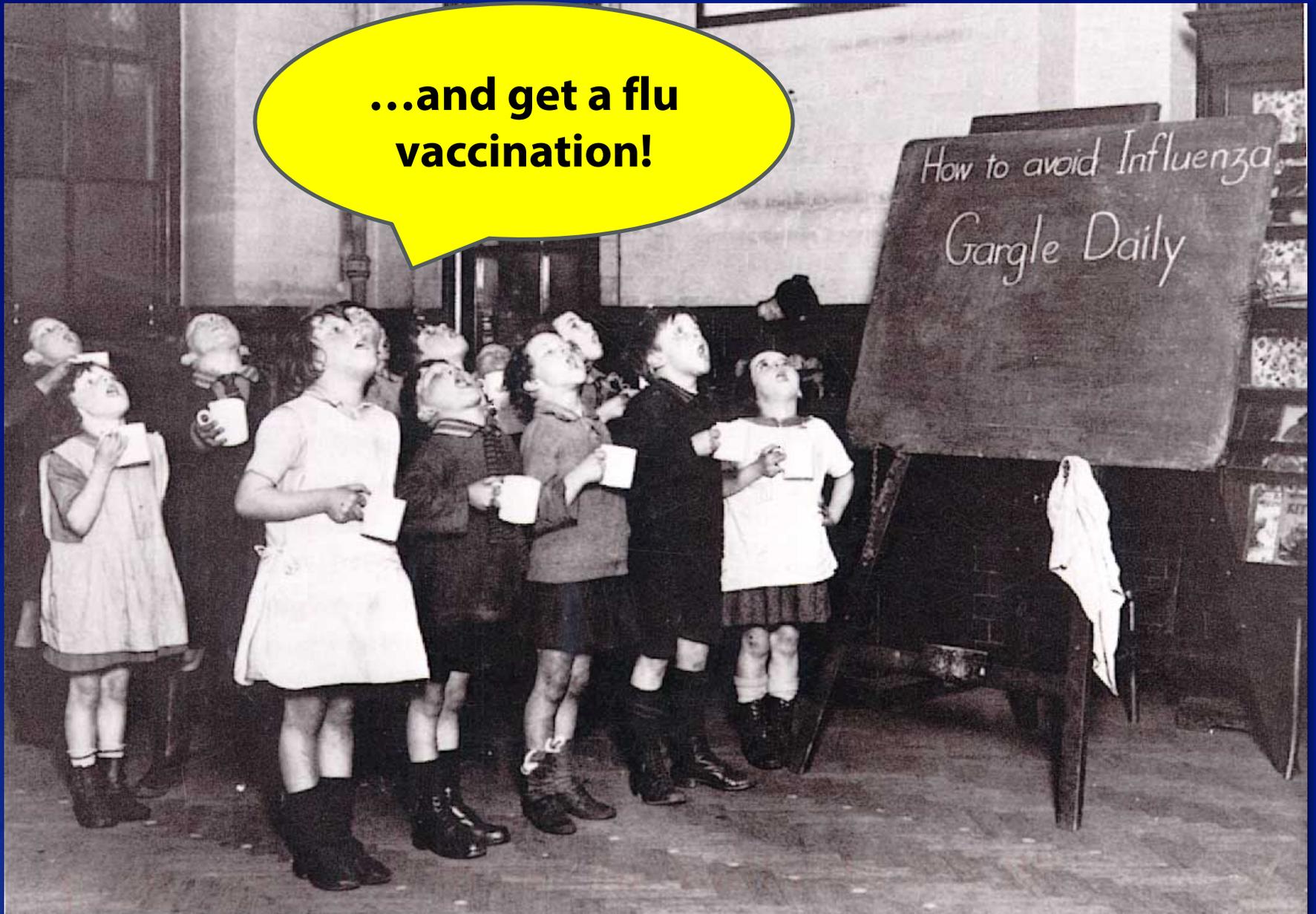


Influenza Resources

- ❑ **ACIP's Influenza Recommendations web page**
www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/flu.html
- ❑ **CDC's Influenza web page**
www.cdc.gov/flu/index.htm
- ❑ **Immunization Action Coalition Influenza web page**
www.immunize.org/influenza/
- ❑ **Children's Hospital of Philadelphia Vaccine Education Center Influenza web page**
<http://www.chop.edu/centers-programs/vaccine-education-center/vaccine-details/influenza-vaccine#.VgHMa3YpCAU>



**...and get a flu
vaccination!**



Thank you!