45 million adults in the U.S. received the "swine flu" vaccine (containing the A/New Jersey/76 influenza virus) during the 1976 New Jersey Influenza A immunization project.

Hot Topics in Biology

Flu Basics

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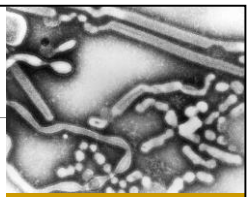
Image Reference:

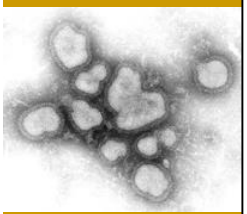
Department of Health and Human Services. Centers for Disease Control and Prevention. Public Health Image Library. Retrieved 10/12/2004 from: http://phil.cdc.gov/phil/detail.asp?id=2428

Flu: An Introduction

- Influenza, also know as Flu, is a respiratory disease caused by the influenza A or B virus.
- Flu is contagious and can be a mild, severe or, at times, deadly disease.
- In humans, the flu virus attacks the respiratory tract (nose, throat and lungs).
- Between 5-20% of the U.S. population contracts flu each year, resulting in more than 200,000 hospitalizations and about 36,000 deaths annually (1990-1999).
- People at high risk for flu complications include: elderly, young children, pregnant women, and people with certain health conditions.



Transmission Electron Micrograph of influenza A virus



Negative stain of the influenza virus

Source: CDC

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Flu: An Introduction

Influenza, commonly known as flu, is a contagious disease caused by the influenza type A, B, and C viruses. Type A, the most common and severe form in humans, also infects other animals, such as ducks, chickens, pigs, whales, horses, and seals. Type B circulates only among humans. Type C is believed to cause only mild respiratory illness and never has been associated with a large epidemic. Influenza type A is believed to be responsible for global flu outbreaks in 1918, 1957 and 1968.

In humans, influenza virus attacks the respiratory tract (nose, throat and lungs). Most people who contract influenza recover within a couple of weeks. However, life threatening conditions develop in some people. Annually, approximately 200,000 persons are hospitalized in the US due to flu (Thompson, *et al*., 2004; CDC, 2004). In addition, flu causes an average of 36,000 deaths per year. As reported by Thompson, *et al*. (2004), people 85 years or older had the highest rates of influenza-associated respiratory and circulatory hospitalizations over the past ten years. Children under the age of five had hospitalization rates similar to those of adults aged 50-64 years. Other groups at risk include pregnant women and persons with underlying health conditions.

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Flu: The virus

- Influenza viruses that cause serious human disease are divided into two groups: A and B.
- Influenza A
  - Most widespread type, responsible for major worldwide epidemics
  - Divided into subgroups based on two proteins on the surface of the virus
    - haemagglutinin (H) (15 subgroups)
    - neuraminidase (N) (9 subgroups)
    - H1N1 and H3N2 (associated with more deaths) are the current subtypes of flu virus A in humans
- Minor genetic changes in the virus help it to escape the immune system's memory. To keep up with these changes, influenza vaccines must be reformulated annually.

Electron micrographs of regular particles of influenza virus after growth in the laboratory.

Micrographs prepared by Ross Hamilton.

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Flu: The virus

Like all viruses, influenza viruses consist of genetic material surrounded by a protective coat. Viruses reproduce by entering a living host cell and hijacking the cell's machinery to manufacture new viruses. Flu viruses evolve very rapidly. Their genetic material consists of segments of single-stranded RNA that can be shuffled and exchanged whenever multiple viruses infect a single cell. In addition, flu virus RNA mutates at a very high rate (Smolinski, *et al*., 2003).

Human influenza viruses are divided into two main groups, type A and type B. Type A viruses are found in ducks, chickens, pigs, whales, and humans, among other animals. Type B viruses are known to circulate only among humans. An additional form of the virus, Type C influenza, has been identified in humans, pigs and dogs, but has not yet caused serious disease or epidemics in humans.

Influenza Type B viruses are not divided into subgroups, but A viruses are categorized into subtypes based on two important proteins present on the surface of the virus. In general, influenza type A virus is round (although it can be elongated or irregularly shaped). It is surrounded by a protein layer and a two-layered lipid envelope from which different kinds of protein spikes

protrude. Two of these proteins—hemagglutinin (H), a protein that helps the virus attach to host cells in the respiratory tract) and neuraminidase (N), which releases the newly created influenza virus from host cells—are variable. Types of Influenza A virus are based on variations in the hemagglutinin (H), of which there are 15 subgroups, and neuraminidase (N), of which there are 9 subgroups. Most of these subgroups are found only in bird populations. At this time, only three of the 15 H subtypes have infected humans. Currently, subtypes H1N1 and H3N2 are the active forms of human Type A influenza virus. The H3N2 subtype was responsible for the epidemic of "Hong-Kong" flu in 1968. The outbreak of "Bird" flu in Hong Kong was attributed to H5N1, however, this subtype was not shown to be transmissible form person to person (only from birds to humans).

Immunity is based on the body's ability to identify the viral surface proteins, hemagglutinin and neuraminidase. Antibodies produced by the immune system that fight one type or subtype of influenza confer very limited or no protection against other types. Since the viruses mutate rapidly, vaccines must be reformulated from year to year to be effective.

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Image Reference:

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Flu: Transmission and Symptoms

- When infected individuals cough or sneeze, droplets and small particles pass the virus from person to person through the air.
- Sudden onset of high fever, headache, sore throat, non-productive cough, muscle aches, gastrointestinal problems and fatigue are characteristics of flu.
- Adults may be contagious one day before flu symptoms begin and up to seven days after symptoms appear.
- Complications can include bacterial pneumonia, dehydration, and worsening of chronic medical conditions.

Influenza germs spread through the air when someone coughs.

Emergency hospital during the 1918 influenza epidemic, Camp Funston, Kansas

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Flu: Transmission and Symptoms

Flu spreads through the air, in droplets and small particles emitted when infected individuals cough or sneeze. Flu also can be spread when someone touches respiratory droplets on another person or an object and then touches his or her own mouth or nose. Symptoms include high fever (102-104°F), headache, sore throat, non-productive and dry cough, muscle aches, some gastrointestinal problems, and extreme tiredness.

A person can spread the flu one day before he or she feels any symptoms, and remains contagious for three to seven days after symptoms begin.

Most people recover from flu within one to two weeks. However, others may develop life threatening complications, such as bacterial pneumonia, dehydration, and worsening of chronic medical conditions.

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http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5306a1.htm Department of

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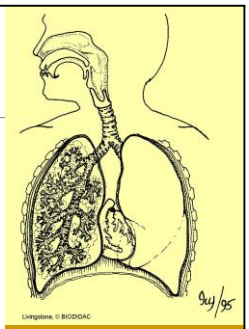
Image NCP 1603, Emergency hospital during 1918 influenza epidemic, Camp Funston, Kansas. National Museum of Health and Medicine, Armed Forces Institute of Pathology, Washington, D.C. Retrieved 10-06-2004 from http://www.vaccineinformation.org/photos/index.asp

Flu: Treatment

- Influenza usually is an upper respiratory tract infection that the body can eliminate with only symptomatic treatment.
- Antibiotics have no impact in treating influenza because the flu is caused by a virus.
- Antiviral drugs can aid in flu treatment and prevention, but should not be substituted for vaccination.
  - Four antiviral drugs targeting influenza virus replication are available.
- Traditionally, physicians recommend the following for patients with flu.
  - Drink plenty of fluids.
  - Get a lot of rest.
  - Do not give aspirin to children or adolescents with flu.



Patients with chronic respiratory conditions often are more at risk from serious complications from influenza.

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Flu: Treatment

Usually, influenza is an upper respiratory disease. In most healthy adults, it can be cleared by the immune system without additional treatment. Since influenza is caused by a virus, antibiotics are not effective. However, antibiotics sometimes are prescribed when the flu leads to additional complications, such as bacterial pneumonia.

Antiviral drugs can aid in flu treatment and prevention, but should not be substituted for vaccination. Currently, four licensed influenza antiviral prescriptions are available in the US: amantadine, rimantadine, zanamivir, and oseltamivir. Each differs in terms of its administration, side effects, target age group, dosage and cost. To be effective, these medications must be administered within 48 hours after symptoms appear. They may reduce the length of time that symptoms will last, but also may have some unpleasant side effects.

Patients with flu should drink plenty of fluids, rest, avoid alcohol and tobacco, and take medications to relieve the symptoms of flu. To avoid a rare, but serious complication (Reye Syndrome), children should not be given aspirin for flu symptoms.

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Flu: Prevention

- Vaccination
  - Flu shot or nasal flu spray
  - Recommended for "at-risk" groups
  - Given during flu season, starting in October
- Good health habits
  - Wash hands
  - Avoid touching nose, mouth, and eyes
  - Cover mouth and nose when coughing or sneezing
  - Avoid close contact with infected individuals
  - Avoid public areas when infected

U.S. Army Camp Hospital No. 45, Aix-Les-Bains, France, Influenza Ward No. 1, 1918.

Photo by Dr. Al Jenny

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Flu: Prevention

The influenza vaccine is the single best preventative measure. Currently there are two types of vaccines available. The "flu shot" contains an inactivated virus and usually is administered to people older than 6 months. About 55 million flu shots will be available in the United States this season. The second vaccine is a nasal spray made with live but weakened flu viruses. This vaccine is approved for healthy people aged 5 to 49, not including pregnant woman. Vaccinations are not recommended for individuals who are allergic to chicken eggs, have had a severe reaction to an influenza vaccination in the past, have developed Guillain-Barre syndrome within six weeks of a previous vaccination, are less than six months of age, or have a fever.

Because of a shortfall in flu vaccine production this season, the Centers for Disease Control and Prevention (CDC) is recommending that certain people be given priority for getting a flu shot. People in the following groups should seek vaccination this season: all children aged 6–23 months; adults aged 65 years and older; persons aged 2–64 years with underlying chronic medical conditions; all women who will be pregnant during the influenza season; residents of nursing homes and long-term care facilities; children aged 6 months–18 years on chronic aspirin therapy; health-care workers involved in direct patient care; and out-of-home caregivers and household contacts of

children aged <6 months. These are people who are at high risk for serious flu complications or are in contact with people at high risk for serious flu complications.

The CDC requests that people who are not included in one of the priority groups forego or defer vaccination because of the vaccine supply situation. This means that preventive measures—covering one's mouth when coughing or sneezing, staying home if infected with flu, avoiding touching of the mouth and nose, and washing hands frequently—will be even more important this flu season.

Due to genetic changes in the virus, flu vaccines are adjusted each year. Changes are based on international surveillance of the virus and scientists' predictions about which types viruses will be circulating during the coming year. The vaccination begins to take effect about two weeks after administration, because it takes the body this long to develop antibodies against the influenza virus.

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