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[Course starts on next page]

Flu: The Other Deadly Virus

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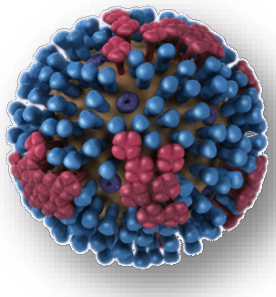
Contact hours: 5

Pharmacotherapy hours: 2

Price: $19



Course Summary

2018 was the 100th anniversary of one of the largest and most devastating flu pandemics in modern history in which more people died than in all of World War I. We offer this course as a review of the current and historical impact of influenza, seasonal and pandemic. It includes epidemiology, virus types and subtypes, and how influenza viruses drift and shift. We describe the immense impact the 1918–1919 influenza pandemic, including lessons learned. We also discuss diagnosis, and treatment, universal vaccination, and the composition of the current influenza vaccine.

Course Objectives

When you finish this course, you will be able to:

1. Describe the annual global incidence of seasonal flu worldwide.
2. State 2 characteristics each of influenza A, B, C, and D.
3. Define antigenic drift and antigenic shift.
4. Describe 3 characteristics of pandemic influenza.
5. Identify the 5 "classic" clinical features of seasonal influenza.
6. State the 3 types of flu vaccines available in the United States.
7. Relate the percentage of adults vaccinated against influenza during the 2020-2021 flu season.
8. Describe 3 reasons why healthcare providers refuse or fail to receive a seasonal influenza vaccination.
9. Summarize the purpose of antiviral medications in the treatment of flu.
10. State the 5 key influenza prevention strategies that should be practiced in all long-term care settings.
11. Describe the makeup of the 2021–2022 influenza vaccine.

1. The Scourge of Influenza

Influenza is one of the deadliest viruses in the world, yet we take for granted that we are protected from its ill effects. We are concerned about other viral infections, some of which affect far fewer people. Yet many of us skip our annual flu shots, giving various excuses for forgoing the vaccine. The impact of influenza is enormous—about 1 *billion* cases worldwide with a death rate estimated to be nearly half a million people annually.

The Flu IQ: Test Your Knowledge

Try this short quiz from the CDC.

https://www.cdc.gov/flu/freeresources/widgets/fluiq/index.html

Over the last several years in the United States, we have seen moderate to severe flu seasons. During the COVID-19 pandemic, flu cases have subsided, providing evidence for the effectiveness of masks and physical distancing.

The flu seasons leading up to the COVID-19 pandemic were particularly severe. The 2017–2018 influenza season was notable for an unusually long duration of widespread high influenza activity throughout the U.S. and higher rates of outpatient visits and hospitalizations compared with recent seasons. The 2017–2018 season was the first season to be classified as high severity across all age groups (CDC, 2019, September 5).

> During the 2017-2018 flu season, vaccination is estimated to have prevented more than 7 million illnesses, nearly 4 million medical visits, more than 100,000 hospitalizations, and 8,000 deaths, despite an overall estimated vaccine effectiveness of 38%.
>
> Grohskopf et al., 2021

The 2018–19 influenza season was of moderate severity and differed from recent seasons in that there were two waves of influenza A activity of similar magnitude. It was also longer than recent seasons with activity at or above baseline for 21 consecutive weeks. Overall, hospitalization rates were below those of the previous season, but rates for children under 17 years of age were similar to the previous year (Xu et al., 2019).

Although influenza activity during the 2020–21 season was low throughout the U.S., influenza vaccination remains an important tool for the prevention of potentially severe respiratory illness, which might decrease stress on the healthcare system during ongoing circulation of SARS-CoV-2 (Grohskopf et al., 2021).

The 2021–22 influenza season has coincided with continued circulation of COVID-19. Influenza vaccination of persons aged ≥6 months will reduce symptoms that might be confused with those of COVID-19. Preventing and reducing the severity of influenza illness continues to be an important factor in reducing stress on the U.S. healthcare system.

The Emergence of COVID-19

Respiratory tract infections are the most common type of infections worldwide, representing a source of significant morbidity and a considerable economic burden. In late 2019, a respiratory virus with symptoms similar to those caused by influenza (SARS-CoV-2, or COVID-19) began to spread globally. Within a short period of time, this highly infectious virus spread to every country in the world. Like flu, SARS-CoV-2 spreads easily via droplets, via direct and indirect contact, and via tiny aerosol droplets that can stay suspending in the air for more than an hour.

Comparison with 1918–1919 Flu Pandemic

The emergence of a global pandemic 100 years after the 1918–1919 influenza "mother of all pandemics" has led us to look back to analyze what worked and what didn't work in 1918. What started as a mild outbreak in the spring of 1918 was followed by a much more serious outbreak in the fall. Scientists and politicians initially downplayed the pandemic, believing it was caused by a bacterium rather than a virus—perhaps cholera or bubonic plague. With no vaccine and few analytic tools, public health practices such as masks, social distancing, refraining from spitting in the street, and covering your mouth when sneezing became important tools to slow the spread of the virus.

One hundred years ago the 1918 influenza pandemic devastated entire communities and took an estimated 675,000 American lives. It was the most severe pandemic in recent history, sweeping the globe quickly and killing more than 50 million people. Source: CDC.

Video 1: 1918 Pandemic [1:32] Source: CDC.

https://www.cdc.gov/flu/pandemic-resources/1918-pandemic-h1n1.html

Curiously, many of the political and personal issues we face today also occurred in 1918. Early on, public health officials, including President Woodrow Wilson, argued that the flu outbreak was caused by "ordinary" influenza and stated that the public need not worry so long as simple precautions were followed. There was no general lockdown, although many cities closed saloons, theatres, and places of public gathering (Soucheray, 2020, April 10) and, in the end the areas of the country that enforced strict public health measures fared better than areas that did not.

In January 1919, President Wilson and several members of his staff were felled by a severe case of the flu. The White House physician downplayed the President's illness, arguing that his symptoms were due to overwork and rainy weather (Solly, 2020, October 2).

Resistance to mask wearing, quarantine orders, and bans on public gatherings was common in 1918 (many people poked holes in their masks to allow smoking). Despite this, fear was pervasive and there was widespread absenteeism from work, whether out of fear or because workers were caring for sick people (Soucheray, 2020, April 10).

Even if you are not familiar with the 1918 pandemic, you may be aware of the 2009 H1N1 pandemic—the first global influenza pandemic in more than forty years. It was caused by the emergence of a novel* H1N1 influenza strain that reminded us just how serious an influenza pandemic can be. By the time the WHO declared the pandemic officially over in August 2010, the CDC estimated that 43 to 89 million people in the U.S. had become infected. It is estimated that worldwide, between 150,000 and 575,000 people died from 2009 H1N1 virus infection during the first year the virus circulated (CDC, 2021, September 8).

***Novel**: New (novel) influenza viruses are different from those currently circulating. This can include highly pathogenic influenza A viruses (H1N1, H5N1, H7N3, and H7N9).

Influenza experts believe that another influenza pandemic will occur—likely caused by an influenza subtype to which there is little or no pre-existing immunity in the human population. Even though the H1N1 pandemic of 2009 is officially over, the H1N1 virus continues to circulate as a seasonal virus and is expected to do so for several years. Fortunately, most (although not all) countries have developed influenza vaccines that protect against the H1N1 virus.

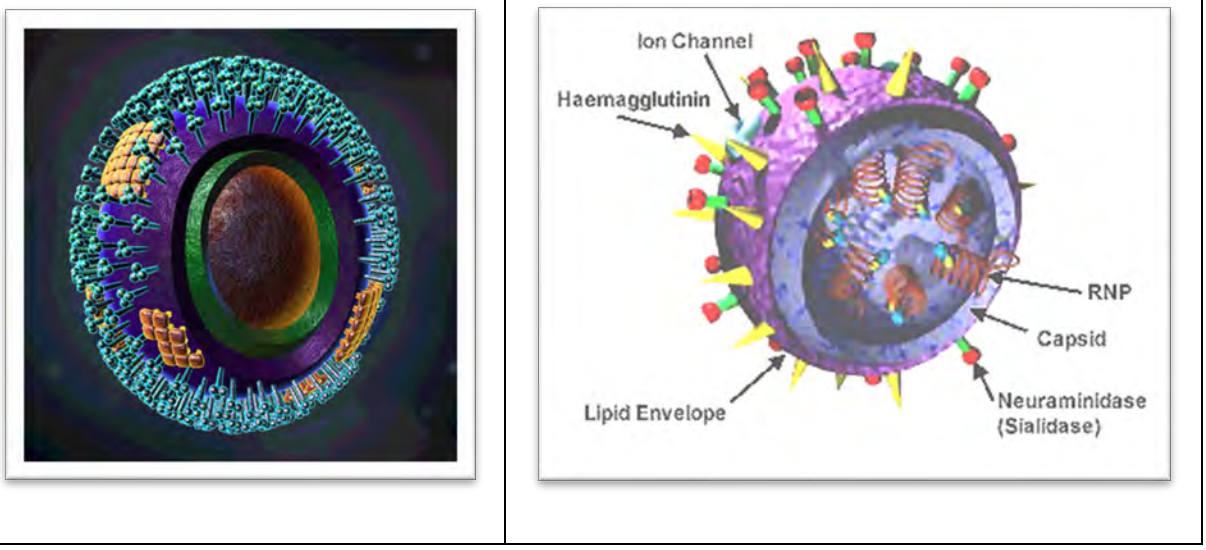
2. Influenza Virus Types and Subtypes

> Human influenza A and B viruses cause seasonal epidemics of disease (known as flu season) almost every winter in the United States. Influenza A viruses are the only influenza viruses known to cause flu pandemics, i.e., global epidemics of flu disease.
>
> CDC, 2021
>
> Types of Influenza Viruses

It is helpful to understand a little bit about the influenza virus—the different types, how they are named, and how they mutate. The more you know, the better you will be able to protect your patients, friends, and family members from catching the flu.

Influenza is a clever virus—it shifts, drifts, and adapts, every so often mutating into a virus to which humans have little or no immunity. When this happens, a pandemic can occur. The 1918 influenza pandemic killed *tens of millions* of people throughout the world; some of us lost grandparents, aunts, or uncles to the pandemic. All influenza A pandemics since that time, and almost all cases of influenza A worldwide, have been caused by descendants of the 1918 H1N1 virus (Taubenberger & Morens, 2006).

Influenza viruses are categorized and named by **type**. There are four types of influenza viruses—A, B, C, and D. Type is determined by the material within the nucleus of the virus.



Left: The influenza virus. Copyright Zygote Media Group. Used with Permission. Right: Structure of the influenza virion. The hemagglutinin (HA) and neuraminidase (NA) proteins are shown on the surface of the particle. The viral RNAs that make up the genome are shown as red coils inside the particle and bound to ribonuclear proteins (RNPs). Source: NIH, public domain.

The nomenclature used to describe a specific influenza virus was established by the World Health Organization in 1980 and is expressed in this order:

1. Virus type,
2. Geographic site where the virus was first isolated,
3. Strain or lineage number,
4. Year of isolation, and
5. Virus protein antigen subtype described by letter and number, H1 to H18 and N1 to N11.

For example, the 2009 H1N1 pandemic influenza virus was named as follows:

A/California/04/2009(H1N1)

This is translated as: Influenza type A, isolated first in California, lineage (strain) number 04, year 2009, and type H1N1.

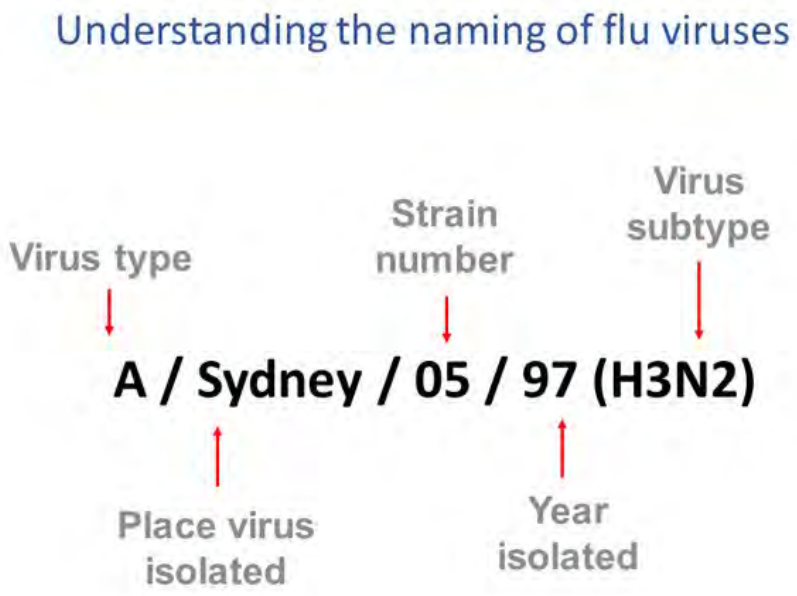
In another example, a Fujian influenza virus that circulated in 2002 was named as follows:

A/Fujian/411/2002(H3N2)

This is translated as: Influenza type A, first isolated in Fujian (a province on the Southeast coast of mainland China), lineage (strain) number 411, year 2002, type H3N2.

The Fujian H3N2 influenza of 2002 caused an unusually severe 2003–2004 flu season, partly because it spread rapidly and partly because the vaccine for that season had already been formulated when the Fujian H3N2 virus was identified.

Influenza Virus Nomenclature



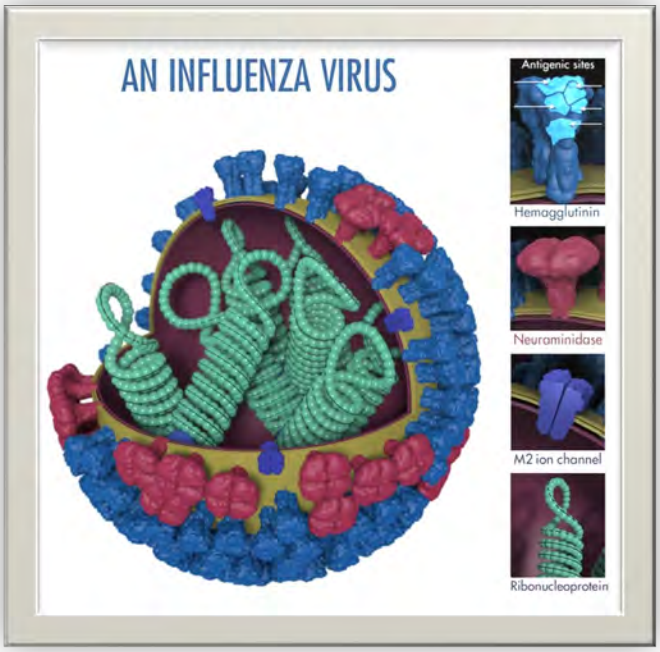
This image shows how influenza viruses are named. The name starts with the virus type, followed by the place the virus was isolated, followed by the virus strain number (often a sample identifier), the year isolated, and finally, the virus subtype. Source: CDC.

Type A Influenza and Its Subtypes

Type A influenza viruses are divided into **subtypes**, based on the presence of two glycoproteins on the surface of the virus. These glycoproteins are called **hemagglutinin (HA)** and **neuraminidase (NA)**. About 18 hemagglutinins have been identified, although generally, only H1, H2, and H3 are found in human influenza viruses. There are more than 100 types of neuraminidase, but only N1 and N2 have been positively linked to influenza epidemics in humans.

While more than 130 influenza A subtype combinations have been identified in nature, primarily from wild birds, there are potentially many more influenza A subtype combinations given the propensity for virus reassortment* (CDC, 2021, November 2).

***Reassortment**: the process by which influenza viruses swap gene segments. This genetic exchange is possible due to the segmented nature of the viral genome and occurs when two differing influenza viruses co-infect a cell.



The above image shows the features of an influenza virus, including the surface proteins hemagglutinin (HA) and neuraminidase (NA). Following influenza infection or receipt of the influenza vaccine, the body's immune system develops antibodies that recognize and bind to "antigenic sites," which are regions found on an influenza virus's surface proteins. By binding to these antigenic sites, antibodies neutralize flu viruses and prevent them from causing further infection. Source: CDC.

Hemagglutinin and neuraminidase are also called **antigens**, substances that, when introduced into the body, stimulate the production of an antibody. Currently, there are two subtypes of influenza A viruses found circulating among human populations: influenza A (H1N1) and influenza A (H3N2).

Wild Birds Provide the Usual Reservoirs

A **reservoir** is the place where a pathogen lives and survives. Wild aquatic birds—particularly certain wild ducks, geese, swans, gulls, shorebirds, and terns—are the natural hosts for most influenza type A viruses (CDC, 2017).

Most influenza viruses cause asymptomatic or mild infection in birds; however, clinical signs in birds vary greatly depending on the virus. Infection with certain avian influenza A viruses (for example, some H5 and H7 viruses) can cause widespread, severe disease and death among some species of birds (CDC, 2017).

Type A Influenza Viruses Also Circulate in Pigs

Pigs are susceptible to avian, human, and swine flu viruses and can potentially be infected with influenza viruses from different species. If this happens, it is possible for the genes of these viruses to mix (**reassort)** and create a new virus.

Influenza viruses that normally circulate in pigs are called “variant” viruses when they are found in people and denoted with a letter “v.” H3N2v viruses from the 2009 H1N1 pandemic virus were first detected in people in 2011 and were responsible for a multi-state outbreak in the summer of 2012 that resulted in 306 cases, including 16 hospitalizations and 1 fatality (CDC, 2019, January 3).

Most cases of H3N2v identified during 2012 were associated with exposure to pigs at agricultural fairs. Many fairs have swine barns where pigs from different places come in close contact with each other and with people. These venues can allow the spread of influenza viruses both among pigs and between pigs and people. Just as in humans, infected pigs can spread influenza viruses even if they are not symptomatic. Although instances of limited person-to-person spread of this virus have been identified in the past, sustained or community-wide transmission of H3N2v has not occurred (CDC, 2019, January 3).

Type B Influenza

Influenza type B viruses are separated into two genetic lineages (B/Yamagata and B/Victoria). They are not classified by subtype like influenza A viruses. Influenza B viruses from both the Yamagata and Victoria lineages have co-circulated in most recent influenza seasons, a major factor in adding 2 influenza B viruses to the 2021-2022 flu vaccine. The quadrivalent vaccine for 2021–2022 contains both the Yamagata and Victoria lineages (CDC, 2021, November 2).

Influenza type B viruses are usually found only in humans but in general are associated with less severe epidemics than influenza A viruses. Although influenza type B viruses can cause human *epidemics*, they have not caused *pandemics*. This is thought to be because influenza B viruses undergo genetic changes less rapidly than influenza A viruses.

In a review of laboratory-confirmed influenza cases from 2001 to 2018, data from the CDC and several European countries indicated that influenza B has been a major contributor to the total morbidity and mortality from influenza. During that time, 15% of all influenza-attributable respiratory and circulatory-related death in the U.S. and 34% among pediatric patients were attributed to influenza B. A recent study from Israel found similar rates of ICU admission and disease severity in patients hospitalized with either influenza A or B (Shasha et al., 2020).

Type C Influenza

Influenza C, a lesser-known type of influenza commonly causes cold-like symptoms and sometimes lower respiratory infection, especially in children <2 years of age. It is mainly a human pathogen; however, the virus has been detected in pigs, dogs, and cattle, and rare swine–human transmission has been reported. Seropositivity* has been found to be as high as 90% by 7–10 years of age, suggesting that most people are exposed to influenza C virus at least once during childhood (Sederdahl and Williams, 2020).

***Seropositivity**: having a positive test result for the presence of a specific antibody in the serum of the blood.

Influenza type C is less common and less studied than influenza A and B. The virus lacks the multiple subtypes (hemagglutinin and neuraminidase) found in influenza A, which limits its ability to mutate. Influenza C is thought to be unlikely to cause a pandemic, although localized epidemics have occurred. As with type B influenza viruses, type C influenza viruses are not classified according to subtype.

Type D Influenza

A new type of influenza virus, known as type D, has recently been identified in cattle and pigs. Influenza D virus infection in cattle is typically asymptomatic; however, its infection in swine can cause clinical disease. Swine can also be infected with all other types of influenza viruses, namely A, B, and C. Consequently, swine can serve as a "mixing vessel" for highly pathogenic influenza viruses. People working closely with calves have higher rates of seropositivity to the influenza virus (94%) than the general population (1.3%) (Kesinger et al., 2018).

Influenza Virus	
Influenza type	Characteristics
Type A	• Causes moderate to severe illness • Occurs in all age groups • Affects humans and other animals
Type B	• Causes milder disease than type A • Affects primarily children • Occurs in humans only • Thought to represent ~25% of laboratory confirmed cases worldwide
Type C	• Reported rarely in humans • No epidemics
Type D	• Was recognized as a new type of virus in 2016 • Affects cattle and pigs

3. Drifting and Shifting

To successfully infect a person, the influenza virus must develop ways to evade a person's immune system. Viruses do this through evolutionary processes called antigenic **drift** and antigenic **shift**. Influenza type A viruses undergo both kinds of changes, while influenza type B and C viruses change only by the gradual process of antigenic drift.

Antigenic Drift: Continual Small Changes

Antigenic drift involves continual small changes or mutations to a virus's surface antigens (HA or NA). Think of a small boat drifting across the ocean or clouds drifting across the sky. These changes produce new viral strains that are fairly closely related to one another and may be recognized by the immune system (sometimes called "cross-protection"). Changes due to antigenic drift can nevertheless accumulate over time, straining the ability of a person's immune system to recognize the new virus.

Like clouds drifting across the sky, antigenic drift involves small, continual changes to a virus's surface antigens. Source: Wikipedia Commons.

In most years, one or two of the virus strains in the influenza vaccine are updated to keep up with the changes in the circulating flu viruses. Changes in viruses due to antigenic drift can cause widespread infection because the protection that remains from past exposures to similar viruses is incomplete. Drift occurs in all three types of influenza virus (A, B, C).

Antigenic Shift, A Major Abrupt Change

Antigenic shift is a major, abrupt change in one or both surface antigens (HA or NA). Shift occurs at varying intervals and likely is the result of **reassortment (**the exchange of a gene segment) between influenza A viruses, usually those that affect humans and birds.

Like this lightning storm near New Boston, Texas, antigenic shift involves major, abrupt changes in surface antigens (HA or NA). Source: Griffinstorm, Wikipedia Commons.

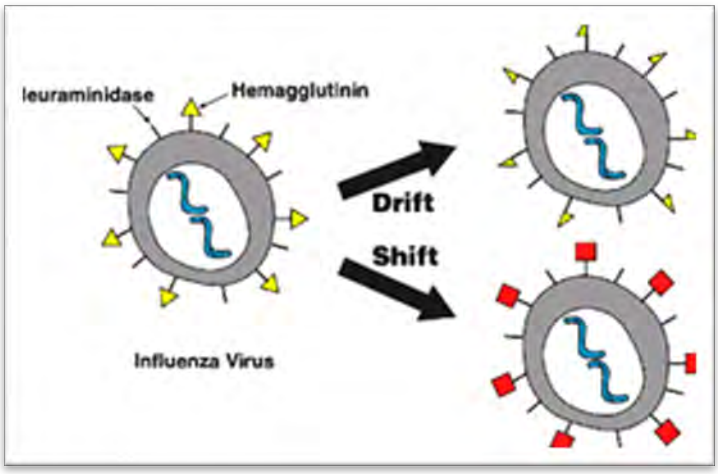
Antigenic shift results in a new influenza A subtype that is so different from previous subtypes in humans that most people do not have immunity to the new virus. An antigenic shift can lead to a worldwide pandemic if the virus is efficiently transmitted from person to person.

An example of a "shift" occurred in the spring of 2009, when a novel H1N1 virus with a new combination of genes (from American pigs, Eurasian pigs, birds, and humans) emerged in people and quickly spread, causing a pandemic. Since the late nineteenth century, four occurrences of antigenic shift have led to major influenza pandemics.

Although influenza viruses constantly and gradually change by antigenic drift, antigenic shift happens only occasionally. When a type A virus undergoes both kinds of changes, it is capable of evading host immunity, with profound implications for epidemiology and control. This is the main reason why seasonal influenza vaccines are updated frequently, to maintain protection in risk groups against currently circulating strains (Arinaminpathy & Grenfell, 2010).

Influenza Virus: Antigenic Changes	
Antigenic drift	• minor, continual changes, same subtype • caused by point mutations in gene • may result in epidemic
Antigenic shift	• major, abrupt changes, new subtype • caused by exchange of gene segments • may result in pandemic

Antigenic Drift and Shift of Influenza Strains



Antigenic drift vs. shift. Antigenic drift creates influenza viruses with slightly modified antigens, while antigenic shift generates viruses with entirely new antigens (shown in red). Source: Wikipedia Commons and USDA.

Video 2: Influenza: Get the (Antigenic) Drift [2:52] Source: NIAID

https://www.youtube.com/watch?v=ug-M1nIhfIA

The 2009 H1N1 Flu Pandemic—Quadruple Reassortment

The 2009 influenza A (H1N1) virus was a new flu virus that caused illness worldwide in March and April of 2009. This virus was originally referred to as “swine flu” because laboratory testing showed that many of the genes in this new virus were very similar to influenza viruses that normally occur in pigs in North America (CDC, 2010).

Further study showed that this new virus was different from the one that formerly circulated in North American pigs. It has two genes from flu viruses that have circulated in pigs in Europe and Asia, plus bird (avian) genes and human genes. Scientists call this a **quadruple reassortment virus** (CDC, 2010).

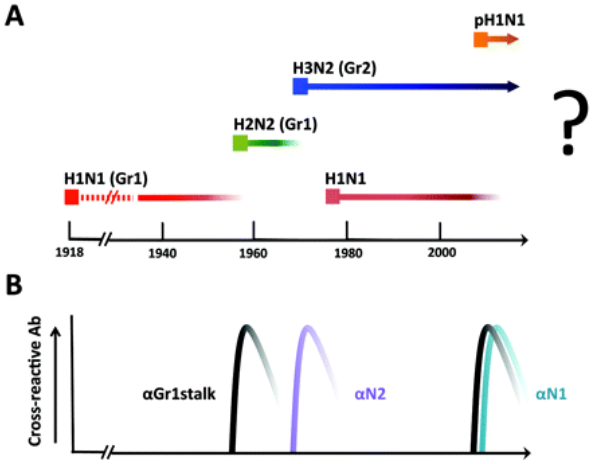
4. Pandemic Influenza

Influenza occurs in two distinct patterns: pandemic and seasonal. Pandemic influenza results from the emergence of a new influenza A virus to which the population possesses little or no immunity and that can occur at any time of year. Seasonal influenza is usually caused by influenza A or B viruses and generally occurs each year during a specific time of the year.

While outbreaks of influenza may be traced as far back as 412 B.C.E., the first **pandemic**, or worldwide epidemic, that clearly fits the description of influenza occurred in 1580. It began in Asia and spread to most of the rest of the world, affecting nearly all of Europe in just six weeks. At least four influenza pandemics occurred in the nineteenth century, followed by three more in the twentieth century and one in this century.

In the twentieth century, the most devastating example of a new influenza subtype emerging in the human population occurred 1918. The virus contained a subtype 1 hemagglutinin protein (H1) and a subtype 1 neuraminidase protein (N1). After the 1918 pandemic, H1N1 variants circulated for 39 years before being replaced by an H2N2 virus in 1957. The H2N2 virus was prevalent for only 11 years until 1968, when it was replaced by an H3N2 virus (Palese & Wang, 2011). In 2009, a new strain of H1N1 influenza emerged and caused a worldwide pandemic in which as estimated 280,000 people died.

Influenza A Viruses Circulating in the Human Population



(A) H1N1 indicates virus with hemagglutinin subtype 1 and neuraminidase subtype 1. H2N2 and H3N2 indicate viruses with hemagglutinin subtype 2 and neuraminidase subtype 2 and hemagglutinin subtype 3 and neuraminidase subtype 2, respectively. pH1N1 indicates the novel swine origin virus first isolated in 2009. (B) Antibody response in the human population, which the authors propose to have contributed to the elimination of existing seasonal influenza virus strains. Source: Palese & Wang, 2011.

Video 3: How Influenza Pandemics Occur [3:23] Source: NIAID
http://www.youtube.com/watch?v=DdFCx8jbesQ

The Mother of All Pandemics: 1918–1919

> The influenza pandemic of 1918–1919 killed more people than the Great War, known today as World War I, at somewhere between 20 and 40 million people. It has been cited as the most devastating epidemic in recorded world history. More people died of influenza in a single year than in the four years of the Black Death Bubonic Plague from 1347 to 1351. Known as "Spanish Flu" or "La Grippe," the influenza of 1918–1919 was a global disaster.
>
> Molly Billings, 2005
>
> The Influenza Pandemic of 1918

The 1918 influenza pandemic, caused by an H1N1 influenza subtype came on suddenly in March of 1918 and spread rapidly throughout the world. In the United States the first reports came from public health officials in Haskell County, Kansas, who reported “18 cases of influenza of a severe type.” By June the virus had spread from the United States to Europe, where it quickly moved from the military to the civilian population. From there, the disease circled the globe—to Asia, Africa, South America, and, back again, to North America.

The effect of the influenza epidemic was so severe that the average lifespan in the United States was depressed by 10 years (Billings, 2005). The “Spanish influenza” of 1918 is estimated to have hit nearly a third of the world's population. Conditions at the end of World War I likely contributed to the mortality (Nicholls, 2006).

The 1918 pandemic occurred in three waves. The first wave was seen when mild influenza erupted in the late spring and summer of 1918. The second wave occurred with an outbreak of severe influenza in the fall of 1918 and the final wave hit in the spring of 1919. A physician stationed at Fort Devens, outside Boston, reported in late September 1918:

> This epidemic started about four weeks ago, and has developed so rapidly that the camp is demoralized and all ordinary work is held up till it has passed. . . . These men start with what appears to be an ordinary attack of La Grippe or Influenza, and when brought to the Hosp. they very rapidly develop the most viscous type of Pneumonia that has ever been seen. Two hours after admission they have the Mahogany spots over the cheek bones, and a few hours later you can begin to see the Cyanosis extending from their ears and spreading all over the face, until it is hard to distinguish the coloured men from the white. It is only a matter of a few hours then until death comes, and it is simply a struggle for air until they suffocate. It is horrible. One can stand it to see one, two, or twenty men die, but to see these poor devils dropping like flies sort of gets on your nerves. We have been averaging about 100 deaths per day, and still keeping it up. There is no doubt in my mind that there is a new mixed infection here, but what I don't know.

Influenza Ward During the 1918–1919 Epidemic

Source: Office of the Public Health Service Historian.

Few Tools to Fight the Pandemic

[Material in this section is from HHS, 2009 unless otherwise cited.]

Unfortunately, few tools were available to either prevent the spread of influenza or treat patients during the 1918–1919 pandemic. A variety of remedies were tried, many of which could be found in local drugstores. **Patent medicines** (medicines whose ingredients were secret and trademarked) were still in widespread use in 1918. Among these medicines, Vicks Vapo-Rub, atropine capsules (belladonna), and a host of other treatments were especially common. In terms of curing or treating influenza symptoms, these remedies did little to nothing.

Patent Medicine Label

Drug advertisers routinely promised quick and painless cures.

Source: National Library of Medicine.

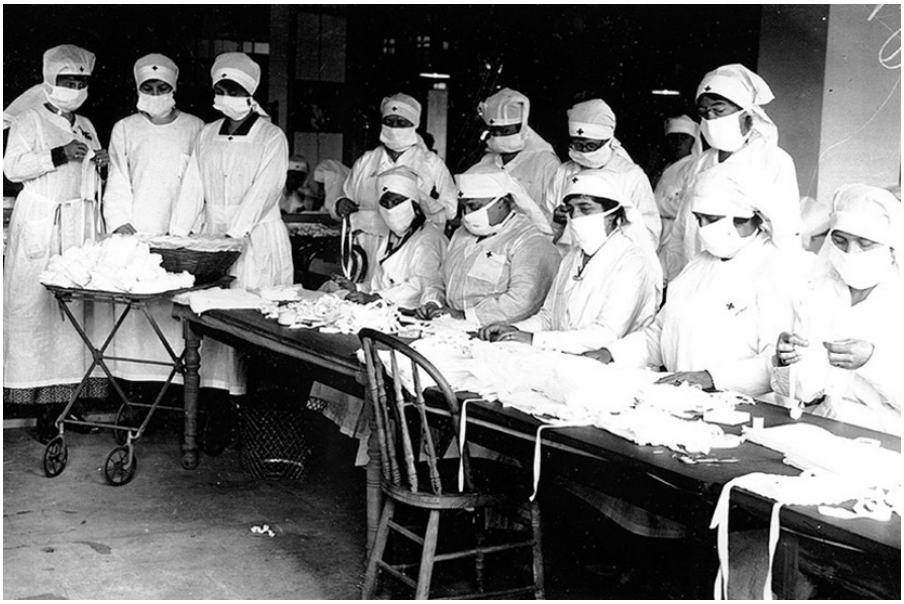
At the time, most physicians believed that influenza was caused by a bacillus. Nevertheless, many practitioners resorted to treatments derived from older medical theories. These treatments included causing patients to sweat by wrapping them in blankets or cupping them to remove excess blood. People were also encouraged to wear masks, which had little effect.

Because patients experienced symptoms not traditionally associated with influenza, physicians found the disease especially difficult to diagnose in 1918. In the early stages of the pandemic, many physicians and scientists even claimed that influenza patients were suffering from cholera or bubonic plague, not influenza.

During the fall of 1918, researchers from the Public Health Service began looking for a vaccine. They were joined by researchers in many other countries. These researchers developed a range of vaccines that were then tested in communities all over the world. None of these vaccines proved effective. While researchers placed their hope in vaccines, many politicians and physicians came to believe that the spread of the disease could be contained by quarantines and bans on public gatherings.

Across the United States, cities and counties began to require or recommend that citizens wear gauze masks. Unfortunately, while masks are highly effective at preventing diseases that are caused by bacteria, they are less effective in providing protection against viral diseases. As a result, even in communities where the wearing of masks was mandatory, influenza could not be contained. Public officials also sought to limit influenza by banning spitting in public places and demanding that those who sneezed covered their mouths.

Red Cross Volunteers in Boston, Massachusetts, 1918



Massachusetts had been drained of physicians and nurses due to calls for military service, and no longer had enough personnel to meet the civilian demand for healthcare during the 1918 flu pandemic. Governor McCall asked every able-bodied person across the state with medical training to offer their aid in fighting the epidemic. Boston Red Cross volunteers assembled gauze influenza masks for use at hard-hit, Camp Devens in Massachusetts. Source: CDC Historical Image Gallery.

Early Symptoms, Recovery, and Relapse

During the 1918 pandemic, early symptoms included a temperature in the range of 102°F to 104°F. Patients experienced a sore throat, exhaustion, headache, aching limbs, bloodshot eyes, a cough, and occasionally a violent nosebleed. Some also suffered from digestive symptoms such as vomiting or diarrhea. Many patients who experienced these symptoms made a full recovery, only to suffer a relapse. Their temperatures, which had fallen, rose again and they now experienced serious respiratory problems. In some cases, these patients also experienced massive pulmonary hemorrhage. After death, pathologists found these victims to have swollen lungs and oversized spleens (HHS, 2009).

The Spanish Influenza

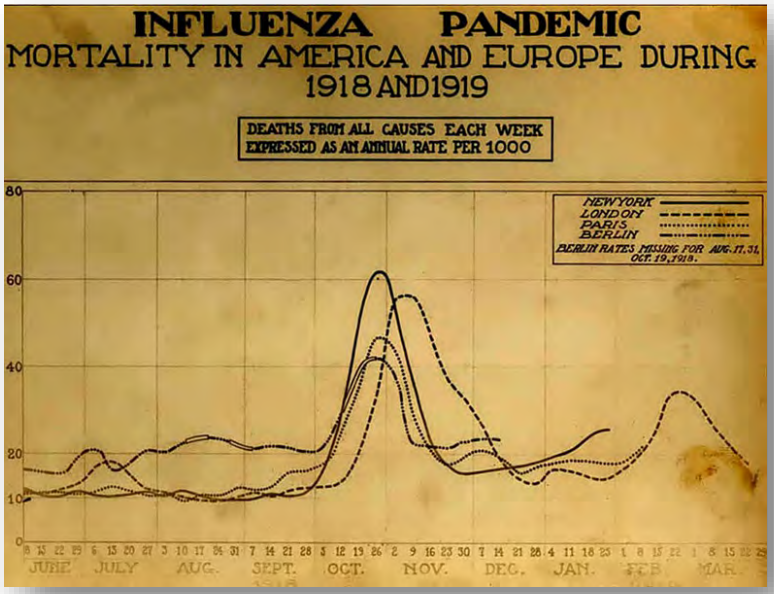


Chart showing mortality from the 1918 influenza pandemic in the United States and Europe, peaking in October and November 1918 and again in February and March of 1919. Courtesy of the National Museum of Health and Medicine.

Origin of the 1918 Pandemic Strain

The 1918 pandemic strain of influenza is thought to have originated in China in a rare genetic shift of the influenza virus. The recombination of its surface proteins created a virus novel to almost everyone (Billings, 2005).

In the late 1990s, researchers found isolates of the 1918 pandemic virus in the formalin-fixed, paraffin-embedded lungs of an American serviceman. They subsequently retrieved further samples of this deadly virus from a second soldier, and also from a flu victim exhumed from a frosty mass grave in Alaska. The genetic sequencing of the 1918 HIN1 virus was completed in 2005 (Nicholls, 2006).

The sequencing of the 1918 pandemic strain resulted in a key finding. Each segment is more similar to avian viruses than to segments from any human strains. This suggests that the virus did not emerge through reassortment of genetic material but evolved directly via mutation from an avian virus (Nicholls, 2006).

Lung Tissue from Influenza Patient

Lung from deceased influenza patient similar to that used to extract RNA from the 1918 killer strain. Source: Courtesy of the National Museum of Health and Medicine, Armed Forces Institute of Pathology, Washington, D.C.

In the end, more than 50 million people throughout the world died as a result of the influenza pandemic. An estimated 675,000 people died in the United States. More people died from influenza than died during World War I.

Video 4: We Heard the Bells - 1918 Flu Pandemic Trailer [8:00] Source: UDHHS

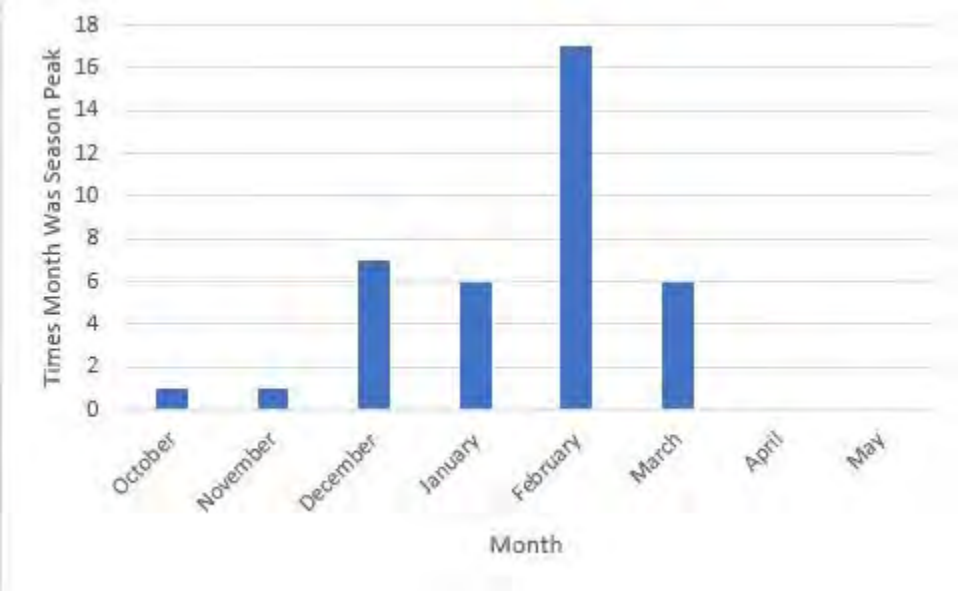
https://www.youtube.com/watch?v=8NRTC1BlHg0

5. Seasonal Influenza

Seasonal influenza differs from pandemic influenza in that it occurs each year, typically during a specific time of the year. Seasonal flu generally causes less illness because the population has some immunity left over from previous, similar influenza strains. In the Northern Hemisphere, winter is the time for seasonal influenza, but the exact timing and duration of influenza seasons vary. While influenza outbreaks can happen as early as October, activity usually peaks in January or later.

The figure below shows peak seasonal flu activity for the United States by month for the 1982–1983 through 2019-2020 flu seasons. The "peak month of flu activity" is the month with the highest percentage of respiratory specimens testing positive for influenza virus infection during that influenza season. During this 38-year period, flu activity most often peaked in February (17 seasons), followed by December (7 seasons), March (6 seasons), and January (6 seasons) (CDC, 2021, September 28).

Peak Month of Flu Activity
1982-1983 through 2019-2020



Source: CDC, September 28, 2021

Seasonal Influenza Clinical Features

[Material from this section from Hall, E. (2021). Centers for Disease Control and Prevention. Epidemiology and Prevention of Vaccine-Preventable Diseases. 14th ed.].

Influenza is a contagious respiratory illness caused by influenza viruses. It can cause mild to severe illness resulting in hospitalization or even death. "Classic" influenza is characterized by the abrupt onset of fever, myalgia, sore throat, nonproductive cough, and headache. The fever is usually 101°F to 102°F and accompanied by prostration (bedridden).

The onset of fever is often so abrupt that the exact hour is recalled by the patient. Myalgias mainly affect the back muscles. Cough is believed to be a result of tracheal epithelial destruction. Additional symptoms may include runny nose, headache, substernal chest burning, and ocular symptoms such as eye pain and sensitivity to light.

The incubation period for influenza is usually 2 days but can vary from 1 to 4 days. The severity of illness depends on whether the immune system has been exposed to related virus variants. Somewhat surprisingly, only about 50% of infected people will develop the classic clinical symptoms of influenza.

Systemic symptoms and fever usually last from 2 to 3 days, rarely more than 5 days. They may be decreased by such medications as aspirin* or acetaminophen. Recovery is usually rapid, but some patients may have lingering depression and lack of strength or energy for several weeks.

*Aspirin should NOT be used for infants, children, or teenagers because they may be at risk for contracting Reye syndrome following an influenza infection.

Influenza Clinical Features

- Incubation period 2 days (range, 1–4 days)
- About 8% of U.S. population gets sick each season
- Sudden onset of symptoms
    - Respiratory: cough, sore throat, runny or stuffy nose
    - Systemic: fever, chills, headache, malaise, myalgia
    - Gastrointestinal: vomiting, diarrhea
- Rapid recovery

Complications

[Material from this section from Hall, E. (2021). Centers for Disease Control and Prevention. Epidemiology and Prevention of Vaccine-Preventable Diseases. 14th ed.].

People most at risk of developing serious influenza-related complications include people age 65 years and older, people with chronic medical conditions (e.g., heart disease or diabetes), pregnant women, and young children, especially those younger than age 2 years. More common complications of influenza include secondary bacterial pneumonia (e.g., *Streptococcus pneumoniae*, *Haemophilus influenzae*, or *Staphylococcus aureus*), exacerbations of underlying respiratory conditions, otitis media, laryngotracheobronchitis, and bronchitis.

Other complications may include primary pneumonia, encephalitis, aseptic meningitis, transverse myelitis, myocarditis, pericarditis, Guillain-Barré syndrome, and Reye Syndrome. Reye syndrome is a complication that occurs almost exclusively in children taking aspirin, primarily in association with influenza B virus (or varicella zoster virus), and presents with severe vomiting and confusion, which may progress to coma due to swelling of the brain.

Most deaths due to influenza typically occur among people 65 years and older.

Influenza Complications

- Secondary bacterial pneumonia
- Exacerbations of underlying respiratory conditions
- Otitis media
- Laryngotracheobronchitis
- Bronchitis
- Other less common complications may occur

Transmission

Influenza is primarily a community-based infection that is transmitted in households and community settings. In humans, influenza is primarily transmitted from person to person via large virus-laden droplets that are generated when infected individuals cough or sneeze. These large droplets can then settle on the mucosal surfaces of the upper respiratory tracts of susceptible people who are nearby (within 6 feet).

Cone-Shaped Dispersion of Sneeze Particles

This photograph captures a sneeze in progress, revealing the plume of salivary droplets as they are expelled in a large cone-shaped array from this man's open mouth, thereby dramatically illustrating the reason for covering your mouth when coughing or sneezing, in order to protect others from germ exposure. Source: James Gathany, CDC PHIL, 2009.

Transmission can also occur through direct or indirect contact with respiratory secretions, such as when touching surfaces contaminated with influenza virus and then touching the eyes, nose, or mouth. Adults can transmit influenza from the day before symptom onset to approximately 5 days after symptoms begin. Children can transmit influenza to others for 10 or more days.

Healthy adults may be able to infect others beginning 1 day before symptoms develop and up to 5 to 7 days after becoming sick. Some people, especially young children and people with weakened immune systems, might be able to infect others for an even longer time.

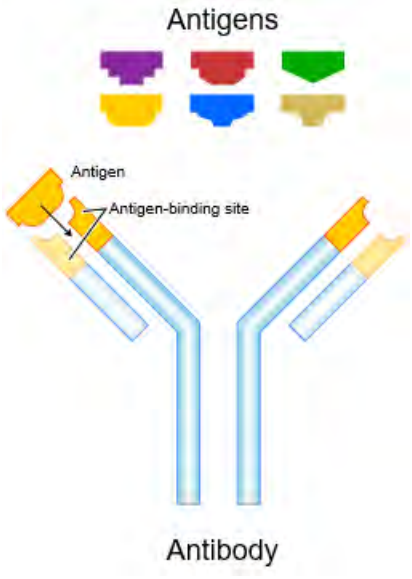
Watch this fascinating 3-minute video showing how influenza is transmitted and replicated.

Video 5: Flu Attack! How a Virus Invades Your Body (3:39) Source: NPR

https://www.youtube.com/watch?v=Rpj0emEGShQ

6. Influenza Vaccines

A **vaccine** is a substance (an antigen) made from a virus or bacterium that triggers the body's immune system to develop antibodies. Substances are sometimes added to a vaccine to generate a stronger immune response so that less vaccine is needed for the body to recognize and fight the antigen. Influenza vaccines cause antibodies to develop about 2 weeks after vaccination.



Schematic diagram of an antibody and antigens. Source: Wikimedia Commons.

In late February to early March—before the new flu season begins—an FDA advisory committee reviews data about which flu viruses have caused disease in the past year, how the viruses are changing, and disease trends, and recommends the three or four flu strains to include in the trivalent and quadrivalent influenza vaccines for the U.S. in the upcoming flu season (FDA, 2020, September 28).

There is often more than one type of influenza virus circulating each season, so influenza vaccines are formulated to target the most likely influenza viruses of the season: two influenza A types (H1N1 and H3N2) and one (trivalent vaccine formulation) or two (quadrivalent vaccine formulation) types of influenza B (FDA, 2020, September 28).

The most common way that flu vaccines are made is using an *egg-based* manufacturing process that has been used for more than 70 years. Egg-based vaccine manufacturing is used to make both inactivated (killed) vaccine used in the flu shot and live attenuated (weakened) vaccine used in the nasal spray flu vaccine (CDC, 2021b, August 31).

Types of Vaccines Available in the U.S.

Three *types* of influenza vaccine are available in the United States:

1. Inactivated influenza vaccine (IIV)
2. Live, attenuated influenza vaccine (LAIV)
3. Recombinant influenza vaccine (RIV) (Hall, 2021).

Inactivated influenza vaccines (IIV) have been available since the 1940s and have traditionally been administered intramuscularly or intradermally. They are produced by killing the disease-causing microbe with chemicals, heat, or radiation. Inactivated vaccines are more stable and safer than live vaccines because the dead microbes cannot mutate back to their disease-causing state. However, most inactivated vaccines stimulate a weaker immune system response than do live vaccines (NAIAD, 2019, July 1).

Trivalent inactivated flu vaccine (TIV) containing 2 influenza A antigens and 2 influenza B antigen has, until recently, been the mainstay of seasonal flu vaccination programs. In 2012, the FDA approved the first quadrivalent flu vaccine containing an additional B antigen.

Quadrivalent inactivated flu vaccine (QIV) is designed to protect against four different flu viruses: two influenza A viruses and two influenza B viruses. All flu vaccines in the U.S. for the 2021-2022 season are quadrivalent vaccines. Different vaccines are approved for different age groups: there is a quadrivalent flu shot that can be given to children as young as 6 months old. Flucelvax Quadrivalent is now approved for people 2 years and older (CDC, 2021, August 27).

Live attenuated influenza vaccine (LAIV) was approved for use in the U.S. in 2003. These vaccines contain a version of the living microbe that has been weakened in the lab so it cannot cause disease. It does not contain thimerosal or any other preservative.

LAIV is provided in a single-dose sprayer unit; half of the dose is sprayed into each nostril. The weakened viruses are cold-adapted, which means they are designed to only multiply at the cooler temperatures found within the nose. The viruses cannot infect the lungs or other areas where warmer temperatures exist.

All nasal spray flu vaccines for the 2021-2022 season are quadrivalent. The nasal spray flu vaccine is approved for use in healthy non-pregnant people, 2 through 49 years old. People with certain medical conditions should not get the nasal spray flu vaccine (CDC, 2021 August 3).

Recombinant influenza vaccine (RIV) was first approved for use in 2013. The RIV manufacturing process uses recombinant DNA technology and does not require an egg-grown vaccine virus. The resulting vaccine contains recombinant hemagglutinin (Hall, 2021).

Recombinant technology can produce a vaccine in a shorter amount of time than either egg-grown or cell-grown technologies. The only influenza vaccine produced using recombinant technology is **Flublok Quadrivalent**. It has been licensed by the FDA for use in adults 18 years and older (CDC, 2021b, August 31).

Flublok Quadrivalent (RIV4) is available for the 2021–2022 influenza season for persons aged ≥18 years. Flublok RIV4 is manufactured without the use of influenza viruses so no shedding of vaccine virus will occur. This vaccine contains recombinant HA produced in an insect cell line using genetic sequences from cell-derived influenza viruses and is manufactured without the use of influenza viruses or eggs (Grohskopf et al., 2021).

For more information on approved flu vaccines for the 2021–2022 flu season, as well as age indications for each vaccine, please see FDA's Table, *Influenza Vaccine for the 2021-2022 Season.*

Influenza Vaccine Key Points	
Inactivated influenza vaccine (IIV)	• Trivalent, quadrivalent • Intramuscular or intradermal • Multidose vials contain thimerosal • Some products contain residual egg protein
Live attenuated vaccine (LAIV)	• Quadrivalent • Intranasal • Administered by intramuscular injection • Contains residual egg protein
Recombinant influenza vaccine (RIV)	• Administered by intramuscular injection • Does not contain egg protein

Immunity Following Vaccination

Immunity following administration of inactivated influenza vaccine is less than 1 year, due to waning of vaccine-induced antibodies and antigenic drift of circulating influenza viruses. Influenza vaccine efficacy varies by the similarity of the vaccine strain to circulating strains and the age and health of the recipient.

CDC conducts studies each year to determine how well the influenza vaccine protects against flu illness. While vaccine effectiveness can vary, recent studies show that flu vaccination reduces the risk of flu illness by between 40% and 60% among the overall population during seasons when most circulating flu viruses are well-matched to the flu vaccine. In general, current flu vaccines tend to work better against influenza B and influenza A(H1N1) viruses and offer lower protection against influenza A(H3N2) viruses (CDC, 2021, October 25).

Pregnant Women and Neonates

Pregnant and postpartum women have been observed to be at higher risk for severe illness and complications from influenza, particularly during the second and third trimesters. Influenza vaccination during pregnancy is associated with reduced risk for respiratory illness and influenza among pregnant and postpartum women, as well as infants during the first several months of life (Grohskopf et al., 2021).

Although experience with the use of IIVs during pregnancy is substantial, data specifically reflecting administration of influenza vaccines during the first trimester are relatively limited. Most studies have not noted an association between influenza vaccination and adverse pregnancy outcomes, including spontaneous abortion (Grohskopf et al., 2021).

Substantially less experience exists with more recently licensed IIVs (e.g., quadrivalent and cell culture–based vaccines) during pregnancy as compared with previously available products. For RIV, data are limited (Grohskopf et al., 2021).

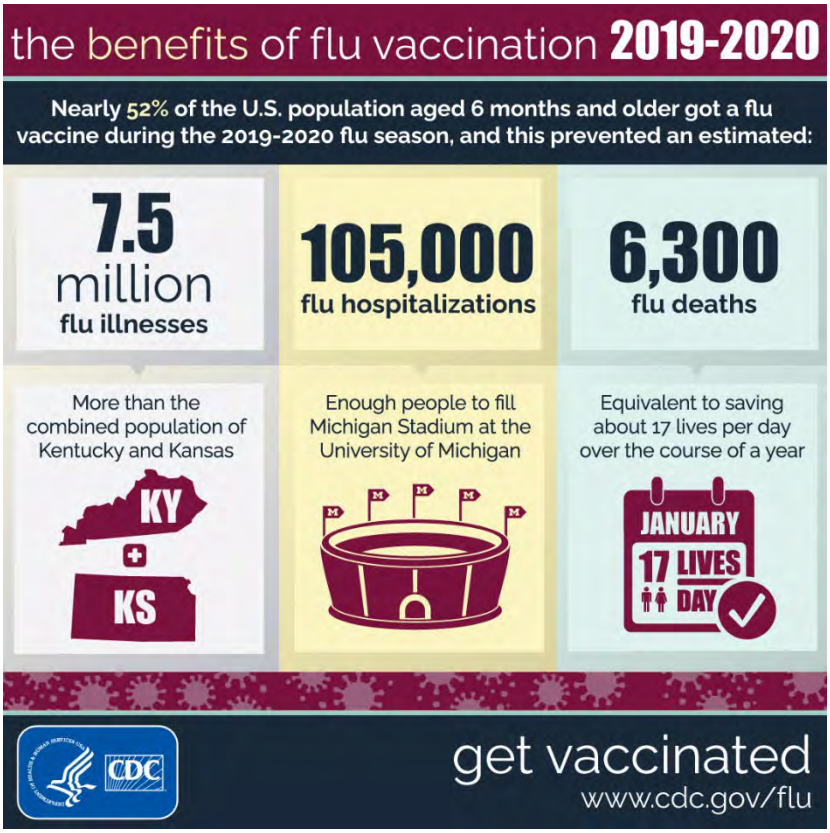
Older Adults

Because of the vulnerability of older adults to severe influenza illness, hospitalization, and death, and efficacy and effectiveness of influenza vaccines among older adults is an area of active research (Grohskopf et al., 2021).

Comparative studies of vaccine efficacy and effectiveness against laboratory-confirmed influenza outcomes among older adults have focused on HD-IIV3 (Fluzone High-Dose), RIV4 (Flublok Quadrivalent), and aIIV3 (Fluad). Each of these three vaccines has been studied in comparison to a standard dose, unadjuvanted IIV. Although HD-IIV3 has been the most extensively studied, evidence has accumulated for its superior efficacy and effectiveness compared with SD-IIV3 in this population. For the 2020–21 season, quadrivalent formulations of high-dose and adjuvanted influenza vaccines have been introduced; trivalent formulations of these vaccines will not be available for the 2021–22 season. (Grohskopf et al., 2021).

7. The Goal of Universal Vaccination

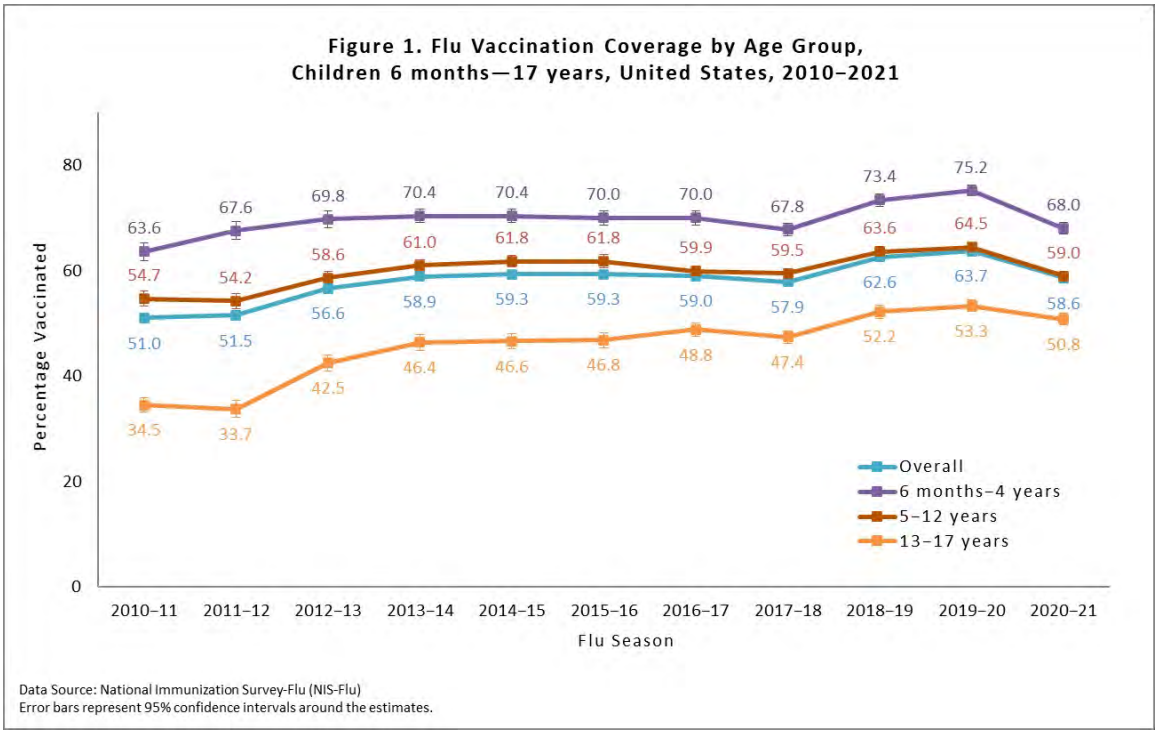
It has been well-established that influenza vaccination reduces influenza-associated illness. CDC estimates that tens of thousands of hospitalizations are *averted* because of vaccination each year and that vaccination prevents millions of influenza-related illnesses. This is despite that fact that fewer than half of those over the age of 6 months are vaccinated each year. Higher vaccination rates almost certainly would prevent a substantial number of additional cases and hospitalizations.



Since 2010 CDC has recommended that all people 6 months of age and older receive annual influenza vaccination. Despite gains in the number of people vaccinated each year, we have yet to come close to the goal of universal influenza vaccination.

Influenza Vaccination Coverage, 2020-2021 Season	
Age group	**(2020-2021 rates)**
All people (≥6 months)	52.0%
Children (6 months – 17 years)	58.6%
Adults (18 - 49 years)	37.7%
Adults (50 – 64)	54.2%
Adults 65 and older	75.2%
Healthcare personnel	75.9%

Source: CDC, October 7, 2021.



Source: CDC.

The College of Physicians of Philadelphia provides a fascinating look at the issues associated with vaccines on their *History of Vaccines* website (http://www.historyofvaccines.org/). It is well worth the time to look over the website and explore "the ways in which vaccines, toxoids, and passive immunization work, how they have been developed, and the role they have played in the improvement of human health."

Adult Vaccination Rates

For the 2020-2021 season, flu vaccination coverage among adults ≥18 years was 50.2%, a slight increase from the prior season. Half of people ≥6 months were vaccinated during the 2020–2021 season, similar to coverage in the prior season. Flu vaccination coverage has increased for adults over the past three flu seasons and had also been increasing for children until the 2020-2021 season (CDC, October 7, 2021).

Racial/ethnic disparities in flu vaccination coverage persist. Non-Hispanic Black children had lower flu vaccination coverage than children in all other racial/ethnic groups, and Hispanic children had lower coverage than non-Hispanic white children and children of other or multiple other races. Hispanic adults and Black adults had lower flu vaccination coverage than white adults and adults of other races (CDC, October 7, 2021).

Vaccination Rates Decline as Clinic Day Progresses

A retrospective study of 11 primary care practices at the University of Pennsylvania Health System from 2014 to 2017 yielded interesting results. Researchers found that influenza vaccination rates significantly declined as the clinic day progressed.

Offering an "active choice" intervention in which medical assistants were prompted to ask patients about vaccinations and record the answers in patients' electronic health record for clinicians to review was associated with a significant increase in vaccination rates. Importantly, the active choice intervention was associated with a significant increase in influenza vaccination rates that were similar in magnitude throughout the day.

Source: Kim et al., 2018.

Vaccination Rates Among Children

Influenza-associated deaths in children (less than 18 years) were added as a nationally notifiable condition in 2004. For children in the U.S., influenza vaccination rates are higher in young children but decrease with increasing age. During the 2020-2021 flu season vaccination rates in children were as follows:

- 6 months–4 years: 68%
- 5–12 years: 59%
- 13–17 years: 50.8%
- All children: 58.6%

Healthcare Worker Vaccination Rates

Overall, 75.9% of healthcare personnel reported receiving influenza vaccination during the 2020–21 season. Coverage was lower than in the previous season (80.7% for 2019-20) (CDC, October 7, 2021).

During the 2020-2021 flu season, physicians, nurses, and pharmacists had the highest coverage (91.3%, 90.3%, and 90.3%). Coverage significantly **decreased** in 2020–21 season among assistant/aides, pharmacists, and healthcare workers with an associate or bachelor's degree (CDC, October 7, 2021).

As in previous seasons, non-clinical personnel and assistants/aides, healthcare personnel working in long term care facilities or home health care settings and healthcare personnel with less than a college degree had the lowest coverage among all occupations, work settings and education levels, respectively (CDC, October 7, 2021).

Did You Know. . .

> Workplace vaccination programs that have been successful in increasing coverage in hospital settings could be implemented in long-term care and other settings with lower vaccination coverage.
>
> Employers can use the long-term care **web-based toolkit** developed by CDC and the National Vaccine Program Office to access resources, strategies, and educational materials for increasing influenza vaccination among healthcare personnel in long-term care settings (Black et al., 2017).

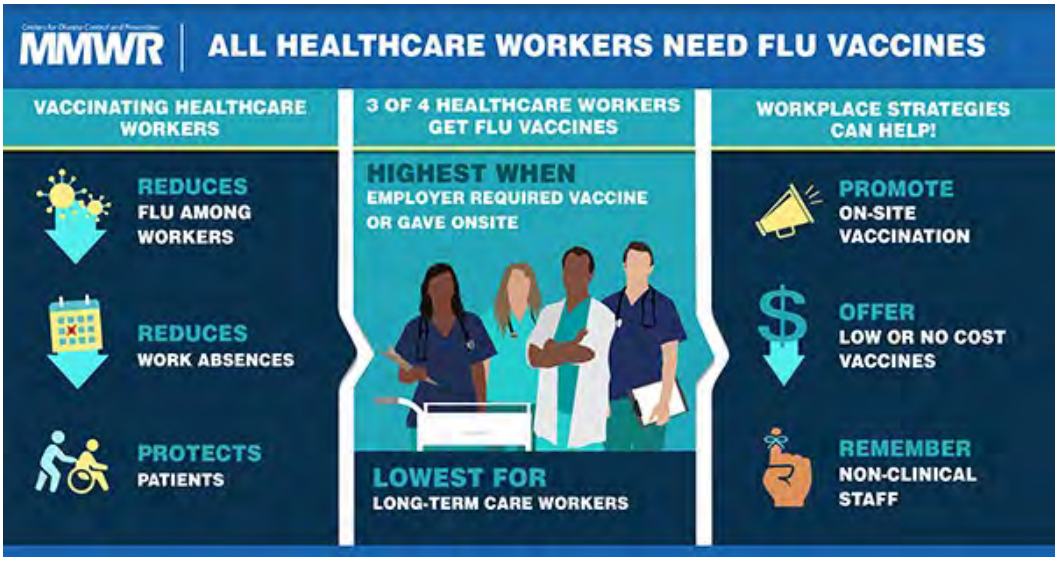
Low vaccination rates are certainly at least partly related to high staff turnover, especially in long term care. It is not uncommon for a long-term facility's staff to turn over completely every few years. Newly hired managers may not adhere to existing policies related to vaccinations, or they may decide to discard such policies and implement new ones.

Issues related to COVID-19 vaccination has shed light on some of the difficulties faced by organizations trying to increase flu vaccination rates. In March 2021, data from 300 long-term care facilities across the U.S. highlighted disparities in COVID-19 vaccination coverage, with a 30% difference in coverage between physicians and other advanced practice providers (75.1%) and aides (45.6%) (Lee et al., 2021).

Among aides, lower COVID vaccination coverage was observed in facilities located in more socially vulnerable zip code areas. This suggests that COVID vaccination disparities among job categories mirror social disparities in general as well as disparities in the surrounding communities. Vaccination promotion and outreach efforts focused on socially vulnerable and marginalized groups and communities could help address inequities (Lee et al., 2021).

Healthcare workers with the most patient contact had the lowest COVID vaccination coverage (like flu vaccination rates). In long-term care facilities, where residents were highly vaccinated, COVID transmission occurred through unvaccinated staff members (Lee et al., 2021).

This finding has equity implications: aides in nursing homes are disproportionately women and members of racial and ethnic minority groups, with median hourly wages of $13–$15 per hour. Aides are more likely to have underlying conditions that put them at risk for adverse outcomes from COVID-19. As vaccination was made available on site, vaccine hesitancy may have been an important contributor to under-vaccination in these facilities (Lee et al, 2021).



Source: Morbidity and Mortality Weekly Report, 2018.

Vaccination Rates by Healthcare Setting

[Material in this section from CDC, 2021, October 17 unless otherwise cited.]

By setting, coverage was highest among healthcare personnel working in hospitals (91.6%) and lowest among healthcare personnel working in long-term care facilities and home health care settings (66.0%). An employer vaccination requirement was one of the strongest factors associated with vaccine receipt; coverage was the highest among healthcare personnel who were required by their employer to be vaccinated (95.9%), and the lowest among healthcare personnel whose employers neither required nor recommended vaccination (46.0%).

Receipt of a COVID-19 vaccine was the second strongest factor correlated with higher influenza vaccination coverage. Implementing workplace strategies to improve vaccination coverage among healthcare personnel, particularly those working in long-term care and home healthcare settings, ensures that healthcare personnel and patients are protected against influenza. Reducing the overall burden of respiratory illnesses by maximizing healthcare personnel influenza vaccination uptake can protect healthcare personnel and vulnerable populations and conserve healthcare resources for the treatment of COVID-19 patients.

8. Reasons for Refusing or Accepting the Flu Vaccine

Each year, we must decide whether to get vaccinated against the flu. Many of us get the vaccine without a second thought, while a significant percentage of healthcare personnel either choose not to get vaccinated or simply never get around to it.

Vaccine Hesitancy

Vaccines are generally safe, effective, and relatively inexpensive. They save about three million lives every year and protect hundreds of millions of people against acute and chronic infections and their consequences. While administering a vaccine is a fairly simple process, the enterprise of vaccination is complex. To invent, test, and produce a vaccine is difficult, and protecting people against infectious diseases requires high levels of organization and participation (Sabin Vaccine Institute, 2020).

For many individuals, the health benefits associated with vaccination is not a sufficient reason to embrace vaccination. Some doubt the benefits of vaccines, worry over their safety, and question the need for them, an attitude referred to as **vaccine hesitancy**. This differs from **vaccine refusal**; even those who are vaccinated can harbor hesitancy toward certain aspects of vaccination (Yaqub et al., 2014).

Despite considerable evidence showing vaccines are safe, there is increasing skepticism toward vaccination. Vaccine hesitancy has led to a decline in vaccine uptake and to an increase in the prevalence of vaccine-preventable diseases. Ironically, the objection to vaccines is commonly a consequence of their effectiveness—because individuals have lower exposure to vaccine-preventable diseases, they are less concerned about contracting them, which consequently leads to greater vaccine hesitancy (Fridman, Gershon, Gneezy, 2021).

While coverage rates are helpful for identifying those who reject vaccines, it does little to help us understand hesitant attitudes, their origins, and how to change them. Maintaining high coverage rates ensures that vaccination benefits are delivered widely, but the very act of delivering wide-scale vaccination can make vaccines “victims of their own success.” As the ravages of disease become less familiar to people, it becomes more challenging to explain the benefits of vaccination (Yaqub et al., 2014).

Reasons for Refusing the Flu Vaccine

Why so many people, both in and out of healthcare, decide **not** to get vaccinated against influenza each year? In a 2021 survey of healthcare personnel, the main reasons cited among unvaccinated healthcare personnel were:

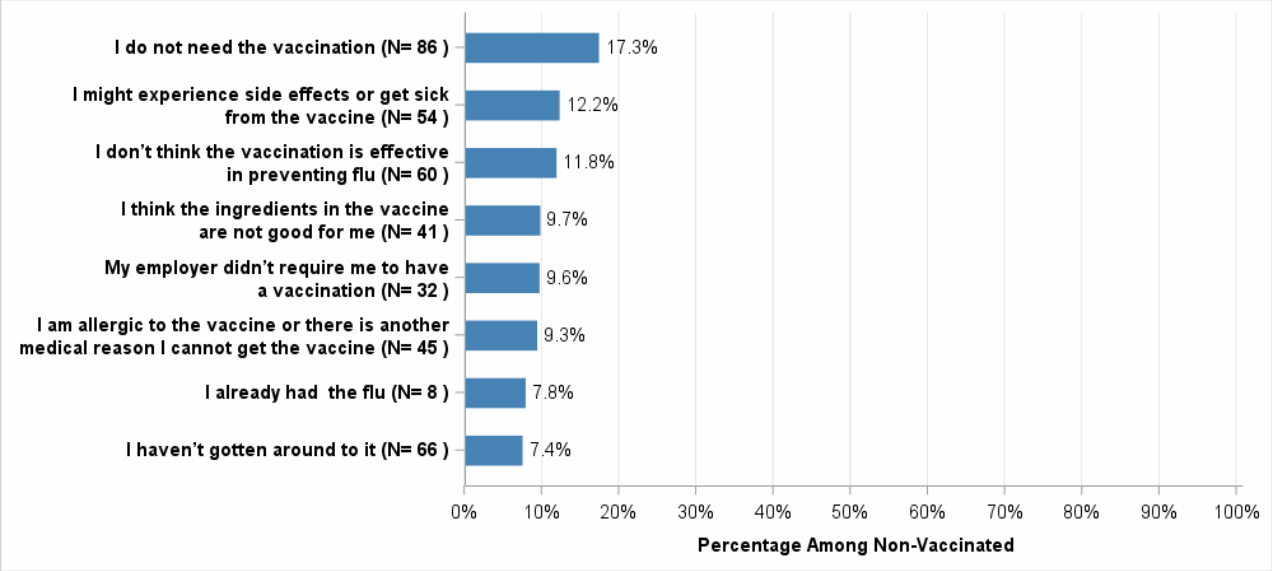
- “I do not need the vaccination” (17.3%)
- “I might experience side effects or get sick from the vaccine” (12.2%)
- “I don’t think the vaccination is effective in preventing flu” (11.8%).

CDC, 2021, October 7

Misconceptions about vaccination include:

- A fear that the immune system will be “overloaded” by vaccines, especially in children.
- The belief that many common diseases have disappeared, and it is no longer necessary to vaccinate against them.
- The belief that more vaccinated than unvaccinated people get sick.
- The belief that hygiene and better nutrition are responsible for the reduction in disease rates, not vaccination.
- The belief that natural immunity is better than vaccine-acquired immunity. (College of Physicians of Philadelphia, 2022)

Main Reasons Reported for Not Getting the Flu Vaccine Among Healthcare Personnel
Internet Panel Survey, April 2021, USA



Source: CDC, 2021, October 7.

Reasons for Accepting the Flu Vaccine

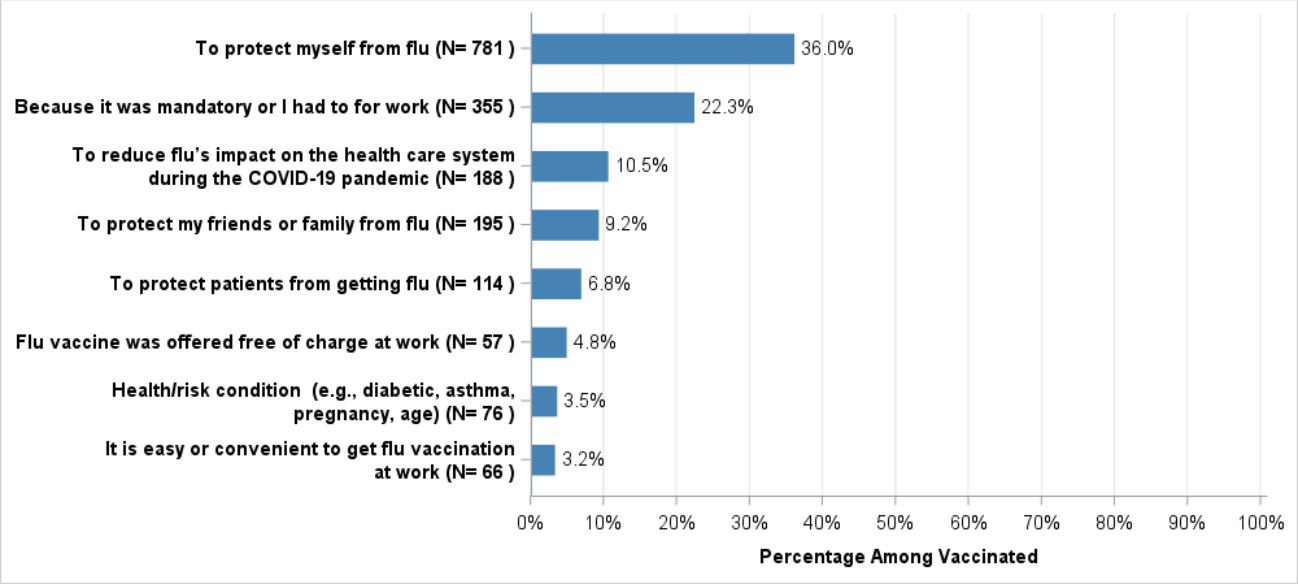
> When I first started work as a nurse, I never got a flu shot. If I got the flu, I went to work even though I was sick. One year I got the flu shot on a Friday morning and was sick as a dog by the evening. Now I know that I already had the flu when I got the shot—back then I blamed it on the vaccine and didn't get a shot for several more years. One year I got the flu, missed several days of work, and coughed my lungs out for almost two weeks. After that I thought, this is ridiculous, the flu vaccine will stop all of this. It was a no-brainer. Now I get a shot every year.
>
> ER Nurse, California, 2022

For healthcare personnel, there are many good reasons to get a flu vaccine, not least of which is they are less likely to become ill themselves and much less likely to pass the virus on to their patients and families.

In a 2021 survey of healthcare personnel, the main reasons cited for *receiving* an influenza vaccine were:

- "To protect myself from flu" (36.0%),
- "Because it was mandatory, or I had to for work" (22.3%) and
- "To reduce flu's impact on the healthcare system during the COVID-19 pandemic" 10.5%) (CDC, 2021, October 7).

Main Reasons Reported for Getting the Flu Vaccine
Among Healthcare Personnel
Internet Panel Survey, April 2021, USA



Source: CDC, 2021, October 7.

During the 2009–2010 H1N1 influenza pandemic in France, Germany, and Mexico, the most common reason given to be vaccinated for A/H1N1 pandemic influenza was a physician's advice or recommendation. In the U.S., media advertising was the most important motivating factor, although a physician's advice was nearly as important (Blank et al., 2012).

Encouraging Vaccinations

Useful resources that can help with increasing vaccination coverage among healthcare personnel include CDC's long-term care web-based toolkit, which provides access to resources, strategies, educational materials, and interventions recommended by the Community Preventive Services Task Force. These resources can be used by healthcare employers to increase influenza vaccination coverage among healthcare personnel and reduce influenza-associated morbidity and mortality among patients (CDC, 2021, October 7).

Given relatively lower COVID-19 vaccination coverage in the same healthcare personnel subgroups that showed lower influenza vaccination coverage, it is especially important to implement systems that support and encourage vaccination, particularly healthcare personnel working at long-term care facilities and home healthcare settings (CDC, 2021, October 7).

Outbreaks of COVID-19 in long-term care facilities have had a critical impact on the health of vulnerable older adults. Many of the long-established public health actions aimed at increasing influenza vaccination coverage among healthcare personnel can be used not only for routine vaccinations but also for improving a COVID-19 vaccination coverage (CDC, 2021, October 7).

9. Diagnosis and Treatment of Influenza

Influenza Antiviral Quiz for Clinicians

https://www.cdc.gov/flu/freeresources/widgets/antivirals/antivirals.html

During the influenza season, when flu is circulating within the community, most people who get the flu experience self-limiting symptoms. However, severe disease can occur in older adults, in those with underlying medical conditions, and in the very young. The diagnosis of influenza is usually suspected based on characteristic clinical findings, particularly if influenza has been reported in the community.

Early diagnosis can reduce the inappropriate use of antibiotics and provide the option of using antiviral therapy. However, because certain bacterial infections can produce influenza-like symptoms, bacterial infections should be considered and appropriately treated, if suspected. In addition, bacterial infections can occur as a complication of influenza.

Although summer influenza activity in the U.S. is typically low, influenza cases and outbreaks can occur during summer months. Clinicians should consider influenza in the differential diagnosis of summer respiratory illnesses. Testing for seasonal influenza viruses and monitoring for novel influenza A virus infections should continue year-round (Xu et al., 2019).

Healthcare providers should also consider novel influenza virus infections in persons with influenza-like illness and swine or poultry exposure or with severe acute respiratory infection after travel to areas where avian influenza viruses have been detected. The local public health department should be alerted if a novel influenza virus infection is suspected.

Annual influenza vaccination is recommended for all persons aged ≥6 months and remains the most effective way to prevent influenza illness. Treatment as soon as possible with influenza antiviral medications is recommended for patients with confirmed or suspected influenza who have severe, complicated, or progressive illness; who require hospitalization; or who are at high risk for influenza-associated complications, including adults ≥65 years. Providers should not rely on less sensitive assays such as rapid antigen detection influenza diagnostic tests to inform treatment decisions. (Xu et al., 2019).

Laboratory Testing

The diagnosis of influenza is usually based on characteristic clinical findings, particularly if influenza has been reported in the community. Influenza virus testing is not required to make a clinical diagnosis but can inform clinical management when results may influence decisions to initiate antiviral treatment, perform other diagnostic testing, or implement infection and prevention control measures (Hall, 2021).

Diagnostic tests include:

- Molecular assays (i.e., rapid molecular assays, reverse transcription polymerase chain reaction (RT-PCR), and other nucleic acid amplification tests)
- Antigen detection tests (i.e., rapid influenza diagnostic tests and immunofluorescence assays)

In addition to diagnostic testing for only influenza virus, the Flu SC2 Multiplex Assay is a real-time RT-PCR test that detects and differentiates RNA from SARS-CoV2, influenza A virus, and influenza B virus in upper or lower respiratory specimens. Serology testing is no longer used for clinical diagnosis of influenza but is still used for research studies (Hall, 2021).

Flu Antiviral Agents

Antiviral medications are an important adjunct to influenza vaccine in the control of influenza. They work best when they are started within two days of getting sick. However, starting them later can still be beneficial, especially if the sick person is at higher risk of serious flu complications or is in the hospital with more severe illness (CDC, 2021a, August 31).

Antiviral treatment should start as soon as possible for adults and children with documented or suspected influenza—regardless of influenza vaccination history—who meet the following criteria (Uyeki et al., 2018):

- Persons of any age who are hospitalized with influenza, regardless of duration of illness.
- Outpatients of any age with severe or progressive illness, regardless of the duration of illness.
- Outpatients with chronic medical conditions and immunocompromised patients.
- Children younger than 2 years and adults ≥65 years.
- Pregnant women and those within 2 weeks postpartum.

Antiviral treatment should be *considered* for adults and children who are not at high risk of influenza complications, with documented or suspected influenza, irrespective of influenza vaccination history, who are

- Outpatients with up to 2 days illness onset before presentation.
- Symptomatic household contacts of persons at high risk of developing complications from influenza, especially those who are severely immunocompromised.
- Symptomatic healthcare providers of patients at high risk of developing complications from influenza, especially those who are severely immunocompromised (Uyeki et al., 2018)

During the SARS-CoV-2 pandemic, coinfection with influenza A or B viruses and SARS-CoV-2 should be considered. Influenza and COVID-19 have overlapping signs and symptoms. Studies have found that patients with COVID-19 who were coinfected with influenza shed SARS-CoV-2 longer than other patients with only COVID-19. Therefore, antiviral treatment is recommended as soon as possible, particularly for hospitalized patients with severe respiratory disease, outpatients with influenza-like illness, and patients with higher risk for influenza complications (Liu et al., 2021).

While flu vaccine can vary in how well it works, vaccination remains the best way to help prevent seasonal flu and its potentially serious complications. Antiviral drugs are a second line of defense that can be used to treat flu (including seasonal flu and variant flu viruses) (CDC, 2021a, August 31).

Four influenza antiviral medications approved by the FDA for use in the U.S. during the 2021–22 influenza season:

1. oseltamivir phosphate (available as a generic version or under the trade name Tamiflu®),
2. zanamivir (Relenza®)
3. peramivir (Rapivab®), and
4. baloxavir marboxil (Xofluza®). (CDC, 2021a, August 31)

10. Infection Control and Prevention

Influenza viruses spread from person to person primarily through large-particle respiratory droplet transmission. These large-particle droplets require close contact between source and recipient persons, because droplets generally travel relatively short distances through the air. Indirect contact transmission via hand transfer of influenza virus from virus-contaminated surfaces or objects to mucosal surfaces of the face can also occur (CDC, 2021, May 13).

Airborne transmission via small particle aerosols in the vicinity of the infectious individual can also occur; however, the relative contribution of the different modes of influenza transmission is unclear. Airborne transmission over longer distances, such as from one patient room to another, has not been documented and is thought not to occur (CDC, 2021, May 13).

All respiratory secretions and bodily fluids, including diarrheal stools, of patients with influenza can be potentially infectious; however, the risk may vary by strain. Detection of influenza virus in blood or stool in influenza infected patients is very uncommon (CDC, 2021, May 13).

In Healthcare Settings

Preventing transmission of influenza within a healthcare setting requires a multi-faceted approach. Spread of influenza occurs among patients, healthcare personnel, and visitors. In addition, healthcare personnel can acquire influenza from people in their household or community (CDC, 2021, May 13).

Core infection prevention strategies include:

- Administration of seasonal influenza vaccine
- Implementation of respiratory hygiene and cough etiquette
- Management of ill healthcare personnel
- Adherence to infection control precautions for all patient-care activities and aerosol-generating procedures
- Implementation of environmental and engineering infection control measures (CDC, 20221, May 13)

Successful implementation of many, if not all, of these strategies is depends on clear administrative policies and organizational leadership that promote and facilitate adherence to these recommendations among the various people within the healthcare setting, including patients, visitors, and healthcare personnel (CDC, 2021, May 13).

In Long-Term Care Facilities

Influenza can be introduced into a long-term care facility by newly admitted residents, healthcare workers, or visitors. Spread of influenza can occur between and among residents, healthcare providers, and visitors. Residents of long-term care facilities can experience severe and fatal illness during influenza outbreaks (CDC, 2020, November 17).

Prevention Strategies

As in any healthcare setting, key prevention strategies in long-term care settings include:

1. Annual vaccination
2. Testing
3. Infection control
4. Antiviral treatment
5. Antiviral chemoprophylaxis (CDC, 2020, November 17)

If possible, all residents should receive an influenza vaccine annually before influenza season. Influenza vaccines usually become available to long-term care facilities beginning in September, and influenza vaccination should be offered by the end of October. Informed consent is required to implement a standing order for vaccination, but this does not necessarily mean a signed consent must be present (CDC, 2020, November 17).

Although vaccination by the end of October is recommended, influenza vaccine administered in December or later, even if influenza activity has already begun, is likely to be beneficial. During the majority of influenza seasons, the duration of the season is variable, and influenza activity might not occur in certain communities until February or March (CDC, 2020, November 17).

When a new patient or resident is admitted after the influenza vaccination program has concluded in the facility, the benefits of vaccination should be discussed, educational materials should be provided, and an opportunity for vaccination should be offered to the new resident as soon as possible after admission to the facility (CDC, 2020, November 17).

Since October 2005, the Centers for Medicare and Medicaid Services (CMS) has required nursing homes participating in Medicare and Medicaid programs to offer all residents influenza and pneumococcal vaccines and to document the results. Each resident is to be vaccinated unless contraindicated medically, the resident or legal representative refuses vaccination, or the vaccine is not available because of shortage. This information is to be reported as part of the CMS Minimum Data Set, which tracks nursing home health parameters (CDC, 2020, November 17).

If one laboratory-confirmed influenza positive case is identified along with other cases of acute respiratory illness in a unit of a long-term care facility, an influenza outbreak might be occurring. Active surveillance should be implemented as soon as possible once one case of laboratory-confirmed influenza is identified. When 2 cases of laboratory-confirmed influenza are identified within 72 hours of each other in residents on the same unit, outbreak control measures should be implemented (CDC, 2020, November 17).

Implementation of outbreak control measures can also be considered as soon as possible when one or more residents have acute respiratory illness with suspected influenza and the results of influenza molecular tests are not available the same day of specimen collection. While unusual, an influenza outbreak can occur outside of the normal influenza season; therefore, testing for influenza viruses and other respiratory pathogens should also be performed during non-influenza season periods (CDC, 2020, November 17).

Prevention Recommendations

Influenza prevention recommendations for long-term care facilities include:

- Residents with signs and symptoms of influenza-like illness should be tested for influenza.
- Residents being tested for other respiratory pathogens during non-influenza season periods should also be tested for influenza.
- Facilities should implement daily active surveillance for respiratory illness among ill residents, healthcare personnel, and visitors to the facility.
- Standard and Droplet Precautions should be used for all residents with suspected or confirmed influenza.
- Influenza antiviral treatment and chemoprophylaxis should be administered to residents and healthcare personnel according to current recommendations. Treatment should not wait for laboratory confirmation of influenza.
- Residents in the entire long-term care facility (not just currently impacted areas) should receive antiviral chemoprophylaxis as soon as an influenza outbreak is determined.
- Antiviral chemoprophylaxis can be considered or offered to unvaccinated personnel who provide care to people at high risk of complications.
- Drug-resistant viruses are a possibility and should be considered.

(CDC, 2020, November 17)

Current CDC Influenza Recommendations

To access the current (2021-2022) CDC influenza recommendations please see:

Prevention and Control of Seasonal Influenza with Vaccines: Recommendations of the Advisory Committee on Immunization Practices, United States, 2021–22 Influenza Season

Source:
https://www.cdc.gov/mmwr/volumes/70/rr/rr7005a1.htm#suggestedcitation

11. Make-Up of the Flu Vaccines 2021–2022 Season

The FDA recommends that the quadrivalent formulation of **egg-based** influenza vaccines for the U.S. 2021-2022 influenza season contain the following:

- an A/Victoria/2570/2019 (H1N1) pdm09-like virus;
- an A/Cambodia/e0826360/2020 (H3N2)-like virus;
- a B/Washington/02/2019- like virus (B/Victoria lineage);
- a B/Phuket/3073/2013-like virus (B/Yamagata lineage).

The FDA recommends that the quadrivalent formulation of **cell- or recombinant based** influenza vaccines for the U.S. 2021-2022 influenza season contain the following:

- an A/Wisconsin/588/2019 (H1N1) pdm09-like virus;
- an A/Cambodia/e0826360/2020 (H3N2)-like virus;
- a B/Washington/02/2019- like virus (B/Victoria lineage);
- a B/Phuket/3073/2013-like virus (B/Yamagata lineage).

Because flu viruses are constantly changing, it is not possible to predict with certainty which types of viruses will predominate during a given season. Flu viruses can change from one season to the next and can even change within the course of one flu season. Because of these factors, there is always the possibility of a less-than-optimal match between circulating viruses and the viruses in the vaccine.

Six Updates for the 2021–2022 Season

The 2021-2022 season includes 6 updates (Grohskopf et al., 2021):

1. All seasonal influenza vaccines available in the U.S. are quadrivalent.
2. The composition of U.S. influenza vaccines includes updates to the influenza A(H1N1)pdm09 and influenza A(H3N2) components. U.S.-licensed influenza vaccines will contain hemagglutinin derived from an influenza A/Victoria/2570/2019 (H1N1)pdm09-like virus (for egg-based vaccines) or an influenza A/Wisconsin/588/2019 (H1N1)pdm09-like virus (for cell culture–based and recombinant vaccines), an influenza A/Cambodia/e0826360/2020 (H3N2)-like virus, an influenza B/Washington/02/2019 (Victoria lineage)-like virus, and an influenza B/Phuket/3073/2013 (Yamagata lineage)-like virus.
3. The approved age indication for the cell culture–based inactivated influenza vaccine, Flucelvax Quadrivalent (ccIIV4), has been expanded from ages ≥4 years to ages ≥2 years.
4. Administration of influenza vaccines with other vaccines includes considerations for co-administration of influenza vaccines and COVID-19 vaccines. Vaccines given at the same time should be administered in separate anatomic sites.

5. Flu vaccination soon after vaccine becomes available can be considered for pregnant women in the third trimester. As previously recommended, children who need 2 doses (children aged 6 months through 8 years who have never received influenza vaccine or who have not previously received a lifetime total of ≥2 doses) should receive their first dose as soon as possible after vaccine becomes available to allow the second dose (which must be administered ≥4 weeks later) to be received by the end of October.

6. Contraindications and precautions to the use of ccIIV4 and RIV4 have been modified, specifically for those with a history of severe allergic reaction (e.g., anaphylaxis) to an influenza vaccine. A history of a severe allergic reaction to a previous dose of any egg-based IIV, LAIV, or RIV of any valency is a precaution to use of ccIIV4.

   A history of a severe allergic reaction to a previous dose of any egg-based IIV, ccIIV, or LAIV of any valency is a precaution to use of RIV4. Use of ccIIV4 and RIV4 in such instances should occur in an inpatient or outpatient medical setting under supervision of a provider who can recognize and manage a severe allergic reaction; providers can also consider consulting with an allergist to help identify the vaccine component responsible for the reaction.
   For ccIIV4, history of a severe allergic reaction (e.g., anaphylaxis) to any ccIIV of any valency or any component of ccIIV4 is a contraindication to future use of ccIIV4. For RIV4, history of a severe allergic reaction (e.g., anaphylaxis) to any RIV of any valency or any component of RIV4 is a contraindication to future use of RIV4.

Vaccines for the 2021-2022 Flu Season

The following vaccine list is grouped by category.

- **Inactivated Influenza Vaccines** (IIV4s) and **Recombinant Influenza Vaccine** (RIV4)
    - Quadrivalent IIVs (IIV4s)—Standard-dose—Egg-based: Afluria Quadrivalent, Fluarix Quadrivalent, FluLaval Quadrivalent, Fluzone Quadrivalent
    - Quadrivalent IIV (ccIIV4)—Standard-dose—Cell culture-based
        - Flucelvax Quadrivalent
    - Quadrivalent IIV (HD-IIV4)—High-dose—Egg-based
        - Fluzone High-Dose Quadrivalent
    - Adjuvanted quadrivalent IIV4 (aIIV4)—Standard-dose with MF59 adjuvant—Egg-based
        - Fluad Quadrivalent
    - Quadrivalent RIV (RIV4)—Recombinant HA
        - Flublok Quadrivalent

- **Live Attenuated Influenza Vaccine (LAIV4)**
    - Quadrivalent LAIV (LAIV4)—Egg-based
        - FluMist Quadrivalent

For a table of approved influenza vaccines for the 2021–2022 season, click here.

Source: CDC, December 10, 2021

Giving an Influenza Vaccination via Needle

Source: United States Navy. Public domain.

12. Concluding Remarks

Influenza has been with us for a long time: more people died from influenza during the 1918–1919 influenza pandemic than died during World War I. Like all viruses, influenza is very good at finding ways to mutate and bypass our immune system defenses. We have been able to stay a step ahead by developing vaccines that stimulate our immune systems to fight off these potentially deadly viruses.

Periodically however, influenza outsmarts us by mutating or shifting into a virus that our immune systems fail to recognize. When this happens, influenza pandemics can occur, as happened in 1918 with disastrous results. Although public health officials are rightly concerned about pandemics, seasonal influenza kills many thousands of people every year and many of these deaths can be prevented by getting a flu vaccination.

In past years CDC has emphasized the importance of increasing vaccination rates among high-risk groups, working toward a goal of universal vaccination. To simplify vaccination recommendations and increase vaccination rates, CDC has issued guidelines stating all individuals aged 6 months or older should be vaccinated annually. This universal vaccination guideline reflects lessons learned from the 2009 H1N1 pandemic.

Despite these strong recommendations, more than half of the general public and about a quarter of healthcare workers fail to get vaccinated against flu each year. The situation is particularly dire in long-term care settings, where some of our most vulnerable citizens are exposed to influenza by unvaccinated workers, visitors, and other residents. Getting vaccinated each year protects high-risk populations from catching the flu from the people who are supposed to be helping and protecting them.

Vaccination is available in a live-attenuated (LAIV) and an inactivated (IIV) form. Knowing which one works best for you and your patients is important. The makeup of this year's influenza vaccine is based on information about which influenza viruses are circulating, how they are spreading, and how well the previous season's vaccine viruses protected against any that are being newly identified.

For the 2021–2022 U.S. influenza season, providers may choose to administer any licensed, age-appropriate influenza vaccine. Vaccination should be offered as long as influenza viruses are circulating. To avoid missed opportunities for vaccination, providers should offer vaccination during routine healthcare visits and hospitalizations when vaccine is available.

Getting an annual influenza vaccine provides the best protection against influenza for virtually everyone.

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[Continue to next page to complete the quiz]

Quiz: Flu: The Other Deadly Virus

1. Although the H1N1 influenza pandemic of 2009 has been declared officially over:

a. Public health officials are not concerned about another influenza outbreak.

b. The H1N1 virus is expected to continue to circulate for many years.

c. There is still no vaccine against this strain of influenza.

d. So many people were infected by the H1N1 virus that it likely conferred herd immunity to the entire population.

2. An antigen is:

a. A substance or microorganism that stimulates production of an antibody.

b. The place where a pathogen lives and survives.

c. A protective protein produced by the immune system in response to the presence of a foreign substance.

d. A type of antiviral drug approved for preventing or treating influenza.

3. The primary natural reservoir of influenza type A viruses is:

a. Pigs.

b. Humans and monkeys.

c. Reptiles.

d. Wild birds.

4. Influenza type A viruses from birds, humans, and other pigs can circulate in pigs. This is important because:

a. Humans can become infected with influenza by eating pork.

b. Wild pigs can transmit these viruses to wild birds.

c. It is possible for the genes of these viruses to mix (reassort) and create a new virus.

d. Mosquitoes that have bitten a pig can transmit these viruses to humans.

5. Compared to influenza caused by type A viruses, type B influenza viruses:

a. Are found only in pigs.

b. Are rarely reported in humans.

c. Are the cause of most historical influenza pandemics.

d. Cause milder disease than type A.

6. Antigenic drift, continuous small changes in one or more surface antigens of the influenza A virus:

a. Causes such gradual change in the virus that it is unrelated to major outbreaks of influenza.

b. May cause widespread infection because protection from past exposures is incomplete.

c. Occurs because of the overuse of antibiotics, resulting in antibiotic-resistant strains of the virus.

d. Happens because of mutations in immune system of the affected person.

7. Antigenic shift, a major and abrupt change in influenza A viruses:

a. Can lead to a worldwide pandemic.

b. Occurs regularly, making it relatively easy to adjust vaccines.

c. Only occurs every few centuries and has caused pandemics every time it has happened.

d. Has not occurred in the past hundred years.

8. Pandemic influenza:

a. Generally occurs each year during a specific time of the year.

b. Results from the emergence of a novel bacterium to which the population possesses little or no immunity.

c. Results from the emergence of a new influenza A virus to which the population possesses little or no immunity.

d. Occurred regularly in ancient times but has not occurred in modern times.

9. The 1918 influenza pandemic, caused by an H1N1 influenza subtype:

a. Killed more people in 1 year than died in 4 years from the bubonic plague.

b. Was particularly virulent in North America but caused only mild illness in Europe.

c. Caused more deaths in hot climates and countries closer to the equator.

d. Was contained effectively with prevention efforts such as hand hygiene and masking.

10. Seasonal influenza differs from pandemic influenza in that:

a. The length of the season is unpredictable.

b. It generally causes more illness than pandemic influenza.

c. It spreads rapidly because there is little or no immunity to a new strain.

d. It occurs each year, typically during a specific time of the year.

11. The “classic” clinical symptoms of influenza:

a. Typically last for at least 1 to 2 months.

b. Include abrupt onset of fever, myalgia, sore throat, cough, and headache.

c. Can be treated with antibiotics in infants, children, and teenagers.

d. Occur more often in adults than in children.

12. The most frequent influenza complication is:

a. Meningitis that may occur up to 2 weeks after initial symptoms.

b. Pneumonia, especially secondary bacterial pneumonia.

c. Reye syndrome, especially in older adults taking aspirin.

d. Myocarditis, especially in people with severe asthma.

13. Transmission of influenza in humans: a. Occurs from chronic carriers of the disease who don't know they are infected.

b. Is primarily through the blood of an infected person.

c. Can be through contact with fecal material of individuals who have symptomatic diarrhea.

d. Occurs primarily person to person via large virus-laden droplets generated by cough or sneeze.

14. Vaccines are:

a. Medicines that are used to treat infections caused by bacteria.

b. Substances (an antigen) made from a virus or bacterium that trigger the body's immune system to develop antibodies.

c. Genetically engineered proteins derived from human genes.

d. The therapeutic delivery of nucleic acid polymers into a patient's cells as a drug to treat disease.

15. Inactivated influenza vaccines:

a. Contains four times the antigen of standard-dose live influenza vaccines.

b. Are produced by killing the disease-causing microbe with chemicals, heat, or radiation

c. Are stronger than live vaccines.

d. Are always trivalent vaccines.

16. According to the CDC, during the 2021–2022 flu season, LAIV influenza vaccine:

a. Must be followed up with two more vaccinations over two months.

b. Must be given only intramuscularly or subcutaneously.

c. Is an option for vaccination of persons for whom it is appropriate.

d. Is approved for administration to healthy, pregnant women.

17. Immunity following inactivated influenza vaccination (IIV) is less than 1 year because:

a. The pharmaceutical companies weaken the vaccine to ensure sales of vaccine each year.

b. The immune system produces less vaccine-induced antibodies over time.

c. Circulating influenza viruses change dramatically from year to year.

d. The amount of antigen in the vaccine is too low to last for very long.

18. Older adults:

a. Should avoid getting the flu vaccine because it may cause them to get the flu.

b. Should only receive a nasal vaccine to avoid urticaria.

c. A quadrivalent formulation of the flu vaccines is available.

d. Are at significantly lower risk for contracting the flu than adults aged 18 to 49.

19. Although influenza vaccination rates are higher in young children:

a. Rates decrease with increasing age.

b. Rates increase with increasing age.

c. Rates are close to 100% in children aged 13 to 17 years.

d. After 2 to 4 years, influenza vaccination is no longer needed.

20. In long-term care facilities, one of the reasons that influenza vaccination rates are so low is that:

a. The CDC has failed to set realistic goals for vaccination.

b. A high percentage of staff in long-term care are allergic to the egg products found in the influenza vaccine.

c. Staff turnover is high, meaning workers and managers may not be familiar with existing vaccination policies.

d. Increasing influenza vaccination rates has no effect on flu rates among residents.

21. Which work setting has the lowest vaccination rate among its healthcare employees?

a. Hospitals

b. University-based healthcare clinics

c. Physician's offices

d. Long-term care facilities

22. Among healthcare workers, the most common reason for not getting an influenza vaccine is:

a. I may get sick from the vaccine.

b. I don't want a vaccination.

c. I'm protected by herd immunity.

d. I don't need a flu vaccination.

23. Among healthcare providers, the most common reason for receiving an influenza vaccination is:

a. To protect myself from the flu.

b. I want to protect my patients from getting the flu from me.

c. I want to protect my friends and family from getting the flu.

d. The flu vaccine was offered free of charge at my work.

24. During flu season, healthcare providers should consider that influenza may be present in infants and young children, regardless of vaccination status:

a. True

b. False

25. Antiviral agents for influenza:

a. Were first used against the 2009 H1N1 influenza.

b. Are an adjunct to vaccine, not a substitute for vaccine.

c. May be used freely, as there are no problems with resistant viral strains.

d. Are quickly replacing vaccines as the primary means to combat influenza.

26. Preventing the spread of flu in long-term care settings is a public health priority. Important prevention approaches include:

a. Family education, isolation, and vaccination.

b. Classes on influenza, facemasks, and infection control.

c. Breathing treatments, hand hygiene, and antiviral prophylaxis.

d. Vaccination, testing, and infection control.

27. For the 2021–2022 flu season:

a. It is recommended that flu vaccination wait until February 2019, which is the month of highest flu reports.

b. The LAIV4 flu vaccine is ~~strongly~~ not recommended by CDC.

c. Routine annual flu vaccination of all people aged ≥6 months without contraindications continues to be recommended.

d. Routine annual flu vaccination is not recommended for people over the age of 65.

[Continue to next page for answer sheet]

Answer Sheet
Flu: The Other Deadly Virus

Name (Please print)_____

Date_____

Passing score is 80%

1. _____	15. _____
2. _____	16. _____
3. _____	17. _____
4. _____	18. _____
5. _____	19. _____
6. _____	20. _____
7. _____	21. _____
8. _____	22. _____
9. _____	23. _____
10. _____	24. _____
11. _____	25. _____
12. _____	26. _____
13. _____	27. _____
14. _____	

[Continue to next page for course evaluation]

Evaluation: Flu: The Other Deadly Virus

Please use this scale for your course evaluation. Items with asterisks * are required.

1 = Strongly agree 2 = Agree 3 = Neutral 4 = Disagree 5 = Strongly disagree

*Upon completion of the course, I was able to:

1. Describe the annual global incidence of seasonal flu worldwide.	1 2 3 4 5
2. State 2 characteristics each of influenza A, B, C, and D.	1 2 3 4 5
3. Define antigenic drift and antigenic shift.	1 2 3 4 5
4. Describe 3 characteristics of pandemic influenza.	1 2 3 4 5
5. Identify the 5 “classic” clinical features of seasonal influenza.	1 2 3 4 5
6. State the 3 types of flu vaccines available in the United States.	1 2 3 4 5
7. Relate the percentage of adults vaccinated against influenza during the 2020-2021 flu season.	1 2 3 4 5
8. Describe 3 reasons why healthcare providers refuse or fail to receive a seasonal influenza vaccination.	1 2 3 4 5
9. Summarize the purpose of antiviral medications in the treatment of flu.	1 2 3 4 5
10. State the 5 key influenza prevention strategies that should be practiced in all long-term care settings.	1 2 3 4 5
11. Describe the makeup of the 2021–2022 influenza vaccine.	1 2 3 4 5
*The author(s) are knowledgeable about the subject matter.	1 2 3 4 5
*The author(s) cited evidence that supported the material presented.	1 2 3 4 5
*Did this course contain discriminatory or prejudicial language?	Yes No
*Was this course free of commercial bias and product promotion?	Yes No
*As a result of what you have learned, will make any changes in your practice?	Yes No

If you answered Yes above, what changes do you intend to make? If you answered No, please explain why.

[Continue to next page to complete course evaluation]

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Please enter your comments or suggestions here:

[Continue to next page for registration and payment]

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