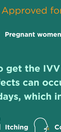
How Do INFLUENZA VACCINES WORK?

TECHNOLOGY NETWORKS

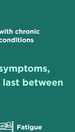
A century has passed since the 1918 global flu pandemic, aka the 'Spanish flu'. Back in the early 1900s, the virus was a relatively novel concept. Since then, our understanding of viruses has come a long way, as have our diagnostics tools, and control and preventative strategies.

Vaccines work by imitating an infection. They act alongside the body's natural defenses to enable a person to develop immunity safely, although some people can experience mild symptoms. The vaccine stimulates the immune system to fight the imitation infection. Once the imitation infection has gone, the body retains a "memory" of the infectious agent (for example a specific influenza virus) so that if the body is exposed to the same threat in the future it can recognize and respond quickly.

Due to the influenza virus's high mutation rate vaccine manufacturers must reformulate their vaccines annually.



The seasonal influenza vaccine is designed to protect against a select few influenza viruses that have been identified as 'circulating' and those that have been 'forecast' as the most likely to spread and cause illness during the upcoming flu season.



More than 100 national influenza centers in over 100 countries conduct year-round influenza surveillance.

Types of flu vaccine

There are two widely available types of influenza vaccine:

Inactivated influenza vaccines (IIV)

Live attenuated influenza vaccines (LAIV)

However, other types do exist, for example, **cell culture-based inactivated influenza vaccines** (ccIIV3) and **recombinant influenza vaccines** (RIV) are both licensed for use in the United States. While an influenza vaccine cannot give you an influenza infection, some people may experience side effects associated with your body mounting an immune response to the vaccine, which are generally mild and short-lasting.

Inactivated influenza vaccines (IIV)

These vaccines contain viruses that have been inactivated through physical or chemical processes, which stops the virus from replicating. IIVs are usually administered in one dose via intramuscular injection. However, children between 6 months to 8 years who did not receive the previous year's influenza vaccine, require two doses (4 weeks apart).

Approved for:

Persons > 6 months

Pregnant women

Persons with chronic medical conditions

Whilst most people who get the IVV experience no symptoms, a number of minor side effects can occur that typically last between 1-2 days, which include:

Aches

Headache

Itching

Cough

Fever

Fatigue

Soreness and/or redness at the injection site

Sore and/or red itchy eyes

Live-attenuated influenza vaccines (LAIV)

These **vaccines are made from weakened viruses** (attenuated) and do not cause influenza. To make the LAIV, the virulence of the pathogen is reduced, by modifying or deleting regions of genes within the influenza genome that impacts the virus's ability to infect, persist and cause illness, whilst remaining immunogenic. This type of vaccine is administered in one dose as a nasal spray.

LAIVs are only approved for use in 2–49 year olds with no underlying medical conditions

LAIVs should not be administered to pregnant women

LAIV side effects, if experienced, are usually mild and short-lasting, and may include:

Runny nose

Wheezing

Headache

Vomiting

Muscle pains

Fever

Cough

Sore throat

As with any medicine, there is a very remote chance of a vaccine causing a serious reaction.

How are influenza vaccines made?

Influenza vaccine manufacturing is a complex process, production takes **approximately 6 months.** There are **three main manufacturing approaches** approved by the U.S Food and Drug Administration (FDA).

	Egg-based	Cell-based	Recombinant
	Egg-based vaccine manufacture has been around for more than 70 years.	Cell-based flu vaccine manufacture was approved by the FDA in 2012.	Recombinant technology was approved in 2013 for use in the U.S. market.
STEP 1	The CDC or another public health partner prepares an egg-grown candidate vaccine virus (CVV).	The CDC or another public health partner prepares a cell-grown candidate vaccine virus (CVV).	Vaccine manufacturers isolate the 'HA' gene for a naturally occurring virus that has been recommended for vaccine development.
STEP 2	The recommended CVV is distributed to manufacturers.	The recommended CVV is distributed to manufacturers.	The HA gene is combined with parts of another virus that typically grows well inside insect cells.
STEP 3	The CVV is then injected into a fertilized hen's egg, which is incubated and the virus is left to replicate.	The CVVs are inoculated into cultured mammalian cells which are left to replicate.	The resulting "recombinant" vaccine virus is introduced to insect cells and is left to replicate.
STEP 4	Fluid containing the virus is then collected from the cells.	Fluid containing the virus is then collected from the cells.	The resulting HA flu protein is collected from the cells.
STEP 5	For **inactivated flu vaccines** the influenza virus is then 'killed' and the antigen is purified; further testing is performed, prior to vaccine approval and shipment.	The virus antigen is purified; further testing is performed, prior to vaccine approval and shipment.	HA flu protein is purified; further testing is performed, prior to vaccine approval and shipment.
	Note: The egg-based method can be used to make both **inactivated** and **live-attenuated** flu vaccines.	**FACT:** Flucelvax® was the first U.S.-licensed influenza vaccine manufactured using mammalian cell-culture technology.	**FACT:** The recombinant flu vaccine is the only vaccine in the U.S. market that is 100% egg-free.

While vaccination remains the best strategy for preventing influenza, the performance of existing vaccines can vary year-on-year, as vaccine manufacturers are required to reformulate annually based on the influenza they 'forecast' as the most likely to spread in the upcoming year. The influenza virus' ability to mutate its surface antigens – the targets of today's vaccines – makes producing an effective vaccine even more challenging.

A broadly protective influenza vaccine – which once administered would provide lifelong protection against influenza could be on the horizon. An increasing amount of effort is being directed at producing a **universal vaccine**, that could revolutionize the way we approach influenza prevention.