Influenza Vaccine Technologies Factsheet

Influenza is a respiratory disease in humans that can cause mild to severe illness, which can lead to hospitalization, complications, and death.

Influenza in humans is caused by two main types of influenza viruses: influenza A and influenza B. Luckily, we have influenza vaccines that can help protect us against seasonal influenza. This document will discuss and explain the current vaccine technologies used this 2023-2024 influenza season in Canada.

Categories of Influenza Vaccines in Canada

There are **three categories of influenza vaccines** (commonly known as flu shots) offered in Canada: inactivated influenza vaccines (IIV), recombinant influenza vaccines (RIV), and live attenuated influenza vaccines (LAIV).

- **Inactivated influenza vaccines (IIV)** use an inactivated (killed) version of the flu virus in the vaccine. They are given as an intramuscular (IM) injection.
- **Recombinant influenza vaccines (RIV)** teach your body to recognize a small protein on the surface of the influenza virus. Similar to IIV, it does not contain the live virus. They are given as an intramuscular (IM) injection.
- **Live attenuated influenza vaccines (LAIV)** use an attenuated (weakened) form of the live flu virus in the vaccine. They are given as a nasal spray.

In the chart below, we can see that there are different formulations and types of IIV, RIV and LAIV. All are proven to be safe and effective.

Influenza vaccine category	Formulation	Type	Current NACI* abbreviation
Inactivated influenza vaccine (IIV)	**Trivalent (IIV3)**	• Adjuvanted, IM administered, egg-based	**IIV3-Adj**
	Quadrivalent (IIV4)	• Standard dose, IM administered, egg-based	**IIV4-SD**
		• Standard dose, IM administered, cell culture-based	**IIV4-cc**
		• High dose, IM administered, egg-based	**IIV4-HD**
Recombinant influenza vaccine (RIV)	**Quadrivalent (RIV4)**	• Recombinant, IM administered	**RIV4**
Live attenuated influenza vaccine (LAIV)	**Trivalent (LAIV3)**	• Nasal spray, egg-based	**LAIV3**
	Quadrivalent (LAIV4)	• Nasal spray, egg-based	**LAIV4**

* National Advisory Committee on Immunization

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Formulations of Influenza Vaccines

Every year, the World Health Organization (WHO) monitors and predicts which influenza strains will be most prevalent in a given influenza season. Once the strains are decided upon, they are incorporated into the **trivalent** influenza vaccines and **quadrivalent** influenza vaccines.

Trivalent influenza vaccines protect against three different influenza virus strains. Trivalent influenza vaccines include three of the most common influenza strains predicted to be circulating in a given influenza season. These vaccines typically include two strains of influenza A and one strain of influenza B.

Quadrivalent influenza vaccines protect against four different influenza virus strains. Quadrivalent influenza vaccines include four of the most common influenza virus strains predicted to be circulating in a given influenza season. These vaccines typically include two strains of influenza A and two strains of influenza B.

Types of Influenza Vaccines

Standard-dose influenza vaccines provide protection against influenza and are offered for persons 6 months of age and older. They contain a standard amount of influenza virus antigen, the part of a vaccine that triggers your immune system to create protective proteins called **antibodies**. In the case of influenza vaccines, the antibodies created specifically target influenza viruses to protect you against future infections. For standard-dose influenza vaccines, they provide enough antigen so that individuals aged 64 and under can gain better protection against influenza.

High-dose influenza vaccines contain four times the amount of antigen than the amount contained in standard-dose influenza vaccines. High-dose influenza vaccines are specifically made and recommended for persons 65+ to improve their immune response to the vaccine. The additional antigen present in the high-dose vaccines helps persons 65+ produce a strong enough immune response to get better protection against influenza.

Adjuvanted influenza vaccines contain an adjuvant, an ingredient added to some vaccines to help produce a stronger immune response in vaccine recipients. Adjuvants have been safely used in vaccines for over 70 years and have a good safety record. Adjuvanted influenza vaccines are specifically made and recommended for children 6-23 months and persons 65+ to improve their immune response to the vaccine. The adjuvant in the vaccine may help children 6-23 months and persons 65+ produce a strong enough immune response to get better protection against influenza.

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Types of Vaccine Manufacturing

Egg-based influenza vaccine manufacturing has been used for the past 70 years and is the most common way influenza vaccines are made. This process uses influenza viruses that are grown in chicken eggs to create influenza vaccines. Influenza viruses are injected into a chicken egg and left for several days. This gives the viruses time to make copies of themselves. The influenza viruses are then collected from the eggs and either inactivated (killed) for use in IIVs, or weakened for use in LAIVs. Egg-based influenza vaccines are safe for use in persons with egg allergies as safety data has shown that the risk of having an adverse reaction to an egg-based influenza vaccine is low.

Cell culture-based influenza vaccine manufacturing uses influenza viruses that are grown in mammalian (animal) cells to create influenza vaccines. Influenza viruses are injected into mammalian cells that are grown in the lab, and left for several days. This gives the viruses time to make copies of themselves. The fluid that contains the influenza viruses is then collected. The viruses are then inactivated (killed) for use in IIVs.

Recombinant influenza vaccine (**RIV**) manufacturing uses the hemagglutinin (HA) protein (an antigen) located on the surface of the influenza virus to create influenza vaccines. To create the HA protein, scientists take the genetic code for the HA protein and combine it with a baculovirus (a virus that does not infect humans). The baculovirus is then introduced to a lab-grown cell, and passes on the genetic information for how to create the HA protein. The lab-grown cell uses this genetic material to create many HA proteins. These HA proteins are then collected and purified in the lab. The purified hemagglutinin proteins are used to create RIVs. Because the HA protein is not a living influenza virus, RIVs cannot give you influenza. **As well, RIVs contain three times the amount of antigens contained in standard-dose vaccines**.

Another way to think about how RIVs are made is comparing it to a car manufacturing plant. Let's say you want to create a hood for a new car model and need the blueprints to do so. An automobile engineer (the influenza virus) has the blueprints (the genetic code) for the hood (the HA protein) and gives the blueprints to the department head at a car manufacturing plant (the baculovirus). The department head would then pass the blueprints to a line supervisor (the lab-grown cell) so that the line supervisor and their unit can begin manufacturing the hood in mass quantities. By the end of this process, the hoods are taken from the manufacturing line and incorporated into a car (the RIV).

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How Influenza Vaccines are Administered

Method 1: Intramuscular (IM) Injection

IM injections are administered in a person via their muscle. This requires a needle. Children under one year of age are usually given the IM injection in their thigh, whereas IM injections are usually administered in the upper arm (deltoid) in persons over the age of one.
All influenza vaccines are given as an IM injection, with the exception of LAIVs.

Method 2: Nasal Spray

Nasal spray is administered in a person via each nostril. It does not require a needle. Only LAIVs are given as a nasal spray.

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