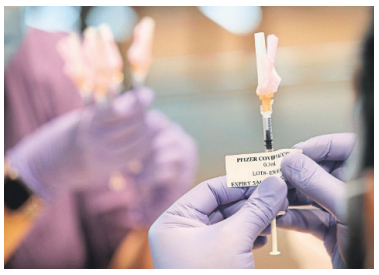
NERVOUS ABOUT PFIZER OR MODERNA VACCINES? READ THIS

COVID-19 vaccine uptake in Ontario has been high this spring and summer, with more than 60 per cent of residents now fully vaccinated. However, some people remain on the fence, mulling over questions that leave room for doubt about vaccine safety and efficacy. One of those questions is how mRNA vaccines like the ones Pfizer and Moderna produce could be developed so quickly and still be safe and effective.

To help clear up confusion, Bill Anderson, professor emeritus in chemical engineering at the University of Waterloo, answers this question and a few others.



Steve Russell photo

An expert in chemical engineering digs into the history of mRNA vaccines.

FIRST, HOW DO mRNA VACCINES WORK?

Before getting into how the mRNA vaccines are developed, it's helpful to know how they work. mRNA vaccines use ribonucleic acid (RNA), a molecule similar to DNA, to teach our cells how to mount an immune response against SARS-CoV-2 without using the live virus.

Messenger RNA (mRNA) is a molecule that gives cells instructions for making a protein like the one found on the surface of the virus. When a person receives the vaccine, their cells read the genetic instructions like a blueprint, produce the protein found on SARS-CoV-2 and toss out the blueprint.

The cells then display the protein on their surface, triggering an immune response and the production of antibodies the body can use to fight the actual virus if it enters in the future.

"The mRNA vaccine itself is simply the mRNA blueprint material held within a nanoparticle package, which serves two important functions," Anderson said.

"It protects the mRNA, since it is quickly and easily destroyed in the body, and it helps the mRNA get into your cells, where the blueprint gets read and the viral fragments are constructed."

HOW WERE mRNA VACCINES FOR COVID-19 DEVELOPED SO QUICKLY?

While mRNA COVID-19 vaccines are new, Anderson said there is a long history of development behind the platform used to produce them. Scientists confirmed the existence of mRNA in cells in 1961 and successfully injected synthetic mRNA into an animal for the first time in 1990. Moderna Therapeutics, one of the COVID-19 vaccine developers, was founded around commercializing mRNA technologies for infectious diseases and cancer in 2010.

Additionally, Google Scholar lists more than 250,000 research papers mentioning "mRNA vaccines" prior to 2020. "So, in some ways, this vaccine has decades of development work behind it," Anderson said.

Because mRNA technology is a platform into which vaccine developers can plug various blueprints to target different diseases, some of the work to develop a vaccine for COVID-19 was done long before the first case of the virus was ever detected.

"Once the virus responsible for COVID-19 was identified and genetically sequenced, companies just had to determine which part of the blueprint to use for the best effect," Anderson said. "Once that was done and tested, manufacturing could be quickly ramped up."

HOW IS mRNA VACCINE TECHNOLOGY DIFFERENT FROM OTHER TYPES OF VACCINES?

Traditional vaccines, such as live-attenuated or inactivated vaccines, rely on growing and harvesting cells for further processing, as well as multiple purification steps.

This process can take days or weeks, is much harder to scale up for mass production and allows more room for issues in production, which can result in batches being discarded, Anderson explained.

"The mRNA platform is great from a manufacturing point of view," he said. "It can essentially be done in a few hours with a mixture of known starting materials and some enzymes, followed by some purification and packaging — all under pharmaceutical-grade manufacturing conditions, of course."

Because of the quick and simple method used to manufacture mRNA vaccines, producers such as Moderna and Pfizer have been able to manufacture hundreds of millions of doses in a matter of months.

"From a development perspective, the simplicity and rapidity of the mRNA platform is a key benefit," Anderson said. "As more production capacity is developed and brought online, the response can accelerate further worldwide."