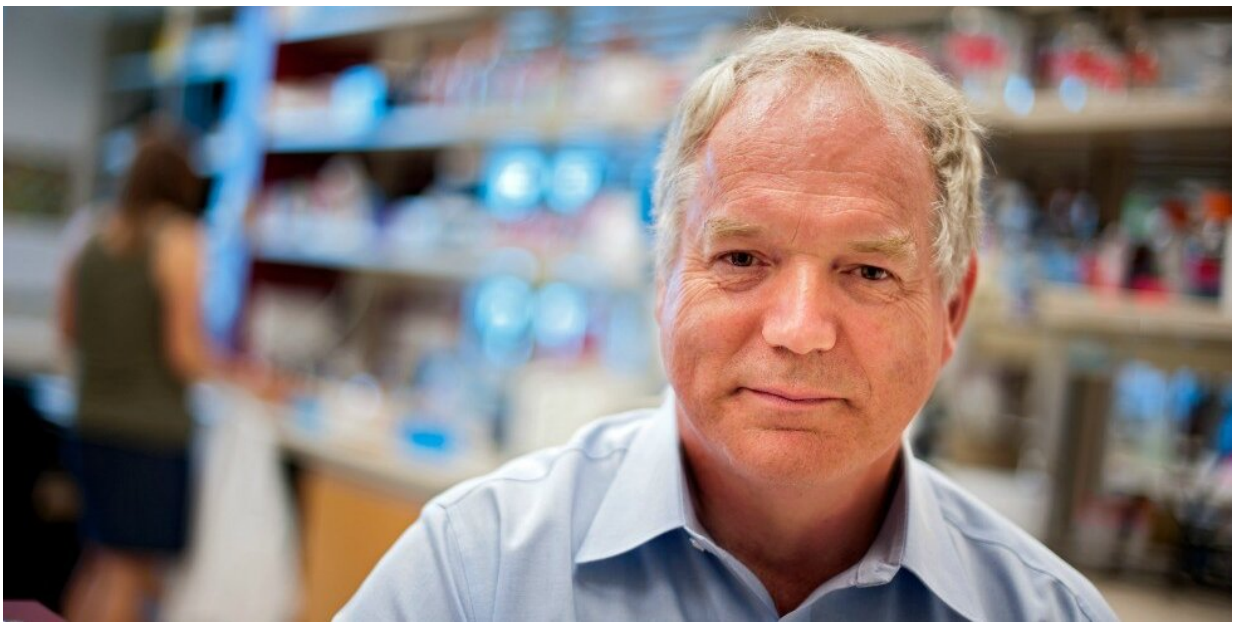
Virologist developing hepatitis C vaccine now focused on finding vaccine to stop SARS-CoV-2

May 14 2020, by Gillian Rutherford



U of A virologist Michael Houghton, who developed a hepatitis C vaccine headed for clinical trials next year, says using a similar approach to create a COVID-19 vaccine will be faster and likely more effective than other methods. Credit: Richard Siemens

The approach used to design a promising vaccine against hepatitis C could be the key to stopping the virus that causes COVID-19 as well, according to University of Alberta virologist Michael Houghton.

Working with Li Ka Shing Institute of Virology founding director Lorne Tyrrell, Houghton developed a hepatitis C vaccine that is set for clinical trials early next year. It is a subunit protein vaccine, which means it elicits an immune response by administering the protein found on the surface of the virus rather than the whole germ itself.

"My experience with hepatitis C, as well as other pathogens, is that if you want the best protective antibody response, use subunit proteins," said Houghton, who is the director of the U of A's Li Ka Shing Applied Virology Institute.

"We can save time by transferring the technology we developed for the hepatitis C vaccine into the COVID research."

Houghton—who together with Tyrrell received $750,000 from the Canadian Institutes of Health Research and Alberta Innovates to initiate the development of a vaccine against SARS-CoV-2—said he is applying for more funding to have it manufactured for human trials early next year.

The two researchers are working closely with U of A oncologist John Lewis, who is developing a DNA-based vaccine that is already being tested in animals and could go to human trials by the end of this year.

"DNA vaccines are quicker to make and can get into the clinic fast," Houghton explained. "So in addition to testing each vaccine alone, we're planning to offer a staged regimen where we immunize first with the DNA vaccine, then optimize the protective antibodies by boosting with our subunit protein vaccine."

Houghton said he used a similar approach to generate protective antibodies against the SARS (severe acute respiratory syndrome) virus in 2003, but the SARS outbreak ended before a commercial vaccine was

developed. While a SARS vaccine wouldn't have been perfect against COVID-19, Houghton said there are enough similarities between the two viruses that it definitely could have been useful now.

"I wish we had gone forward and produced the SARS vaccine and had it stockpiled, because we could have used that to ameliorate the COVID-19 epidemic since some of the antibodies cross-react."

Houghton's lab continues to prepare the hepatitis C vaccine for testing while also now working to develop the COVID-19 vaccine. Houghton supervises the lab researchers remotely from his family home in California, where he is sheltering in place.

How vaccines work

Vaccines work by causing people's immune systems to produce antibodies against a virus in advance of full exposure so they cannot be infected. Houghton explained there are several ways to approach the development of a vaccine against a virus like SARS-CoV-2.

The traditional approach involves growing the virus in a cell culture, purifying it, chemically inactivating it and then inoculating people with it. The recipients produce antibodies that, when exposed to the fully active virus, help to shut down any potential infection and prevent disease. However, such an approach requires a very large biohazard manufacturing facility.

Another traditional method involves weakening the virus before inoculation. This is the type of vaccine given routinely to Canadian children to prevent diseases such as measles, mumps and chickenpox. It can take a long time to develop a safe version—a big risk to take while there is no approved treatment for COVID-19.

That's why many COVID-19 vaccine projects are taking one of two newer tacks to produce effective antibodies. Some will isolate and inject a nucleic acid (DNA or RNA) that produces the spike protein of the virus in order to trick the body into mounting an immune response even though the whole virus isn't present. Other researchers will inject a harmless, defective "vector virus" that acts as a delivery vehicle for the surface spike protein of the coronavirus, which cells then produce, again tricking the body into an immune defence when the entire virus is not present.

Houghton said he expects the usual regulatory steps for vaccine approval—starting with testing in animals, then moving on to human trials—will be accelerated by Health Canada.

"One of the ways regulators have done this in the past is to identify a firm correlate of protection, in this case antibodies to the spike protein, and then approve the vaccine on the basis of clinical trials which demonstrate safety and the ability to produce antibodies in patients," Houghton said.

"Then they may let us deliver the vaccine rapidly to the high-risk groups first, such as people in elderly care homes, medical first responders and family members of people with COVID-19."

Once a vaccine is fully approved, the challenge will be to scale up manufacturing capacity so it can be distributed to as many people as possible. Houghton said the Alberta Cell Therapy Manufacturing Facility, run by surgery professor Greg Korbutt, could potentially manufacture enough doses for a few million Canadians. Houghton expects other public production facilities, both private and public, to be able to handle much of the country's priority needs.

Houghton is hopeful we will learn the lessons of COVID-19 and be

better prepared for future viral outbreaks.

"Unfortunately, COVID is a terrible pandemic, but it will teach us how to respond better to the next one, be it another coronavirus, an influenza virus or something else," Houghton said.

"Just in the past 40 years, we have seen many viruses emerge into humans such as HIV, new influenza strains, West Nile virus, SARS-CoV-1 in 2003 and now SARS-CoV-2 in 2020."

"It will happen again for sure, so we need to keep training and supporting our researchers and clinicians, and expand our care and vaccine production facilities in readiness."

The race

Estimates of how quickly a vaccine for COVID-19 can be developed, tested, manufactured and begin to be distributed range from six months to two years, depending on the type of vaccine. RNA, DNA and viral vector vaccines will likely be first out of the gate, Houghton said, but may not be the best at producing protective antibodies, which is why the subunit protein vaccine alone or a combination of vaccines and boosters may be optimal.

The Government of Canada is paying for at least six vaccine research projects, and is also contributing $850 million to a worldwide fund set up by the European Union to fund pandemic research, including dozens of vaccine hopefuls. Vaccine researchers in China, the United Kingdom and the United States are already reporting promising results.

Houghton said with so many different projects around the world looking for a vaccine breakthrough, he expects at least some of the approaches will work, and that the successful vaccine formulas will be shared

widely.

"I am absolutely so impressed with how the global medical research and clinical community is responding," Houghton said. "I am confident that successful technologies will be shared and transferred quickly."

"COVID is just too serious an issue. Everyone wants to solve this problem."

Provided by University of Alberta