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A coronavirus vaccine may require boosters – here's what that means

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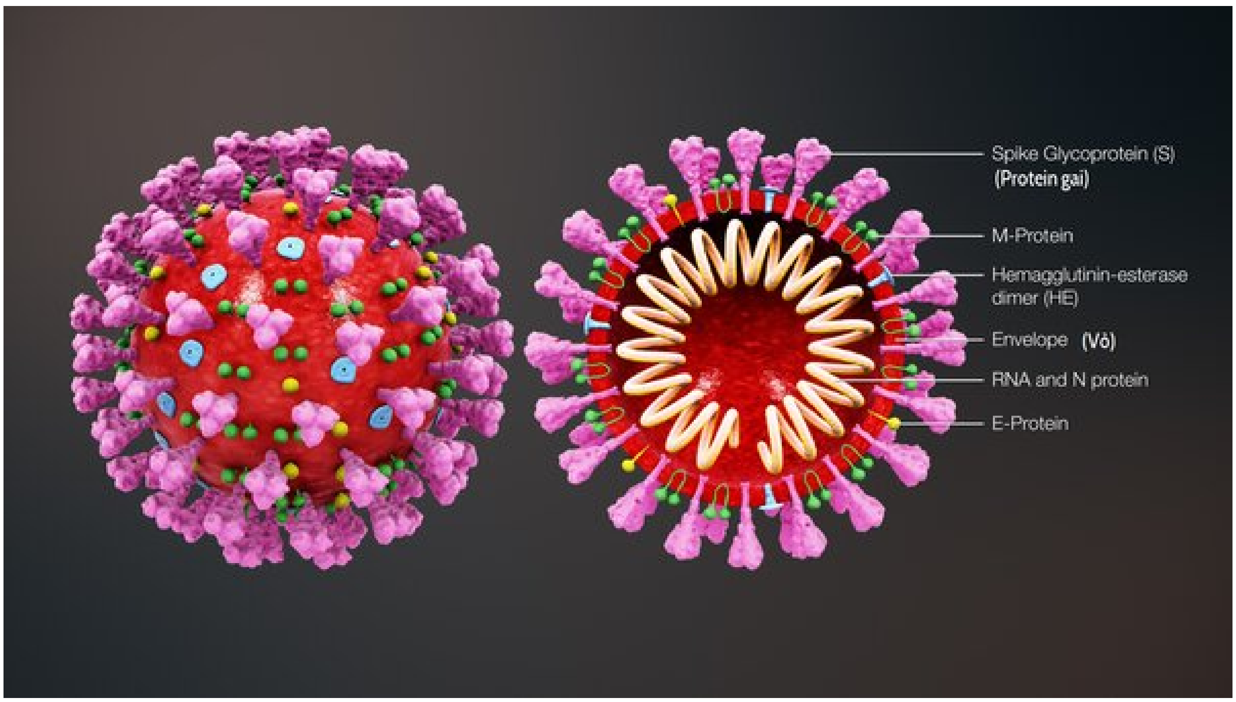

The Oxford University coronavirus vaccine candidate uses the genetic code from the virus's 'spike protein' Credit: https://www.scientificanimations.com, CC BY-SA

In the global race to contain the coronavirus pandemic, there is hopeful news on the vaccine front, with a number of potential candidates being developed and some promising early results. Based on what we know so far, it currently seems likely that most potential vaccines designed to protect against the SARS-CoV-2 virus that causes COVID-19 will require boosters, perhaps regularly. Why is this?

When an infectious agent enters the body, the immune system will notice this and create a memory, so that the next time it encounters the agent there will be a swift, repelling response. In the case of most infectious agents, such as viruses, natural infection produces a long-lasting memory. But this is not always the case.

The idea behind any vaccine is to give the recipient a version of the infectious agent which will not cause the disease, but will still create the immune system memory. How we achieve that varies based on the nature of the virus targeted by a vaccine, and how much we know about it.

Two types of vaccine

Some vaccines are made by disabling the infectious agent in some way so that it becomes safe to introduce to our bodies, but still goes through its normal life cycle. The theory is that this will stimulate something close to the natural immune response and produce the long-lasting memory without making the recipient sick.

This is the basis of the vaccine we are given for measles, mumps and rubella (MMR). It contains live but disabled versions of each virus. Children are given two doses of the vaccine a few years apart. This is in case the vaccine does not "take" the first time around and the immune system needs a reminder of what the viruses look like. This repeat vaccine is not technically a booster, but rather a second dose which allows for possible interference by other childhood infections the first time around, and because a pre-school child's immune system is still developing.

The MMR approach has been possible because the viruses that cause measles, mumps and rubella are well established in the human population and virologists know a lot about how they interact with the human immune system. But it takes years to create a safe and effective live vaccine, so for SARS-CoV-2, research teams are trying different routes. A good approach is to use a killed version of the virus rather than a modified, live version as in the case of MMR.

The inactivated polio vaccineand influenza vaccines both use killed viruses. The drawback of these vaccines is that the immune response does not last, which is why boosters are needed.

In the case of seasonal influenza, variations in the virus means a fresh vaccine is needed each year anyway, but even if the virus did not change, boosters would still be required to keep stimulating the immune memory because the virus in the vaccine is not live.

In the case of polio, most countries now use the inactivated polio vaccine in their childhood vaccination program instead of the live, oral version. As the disease is close to being eradicated, the theory is that giving each cohort of children a single dose should be enough to protect them as they start mixing with others. But if there was an outbreak, then everyone in close contact in the local area would need a booster.

What a COVID-19 vaccine may look like

The potential COVID-19 vaccine designed by French company Valneva, which will be manufactured in Scotland, is a killed vaccine. If it is effective in protecting against SARS-CoV-2, it could really help to reduce the spread of the virus.

In the case of this vaccine, regular (perhaps annual) boosters would probably be needed to help to ensure people keep their immune memory. In an outbreak situation, everyone in the affected area could be given a dose of the vaccine to help contain the transmission.

Another approach in vaccine design is to take the genetic code for a part of the virus which is known to stimulate an immune response, and place that into a carrier organism which cannot cause disease.

The Hepatitis B vaccine uses the code for the antigen found on the outside of infectious virus particles. This has been put into the genome of a harmless yeast and made into a vaccine. As the yeast grows and divides, it also makes the virus's surface antigen, thus stimulating the body to keep making an immune response. This vaccine is given in three doses over six months in the first instance, and most people require a booster after about five years.

The COVID-19 vaccine developed by the team at Oxford University, which has shown promising early results, uses a broadly similar approach, in that researchers have taken the code for the SARS-CoV-2 "spike protein" and put it into a harmless virus carrier.

So, it is possible that the initial schedule for everyone who received this type of vaccine would involve one or two booster doses a few months after the first, in a similar way to the Hepatitis B vaccine. We are not really sure how long we would protected against COVID-19 using this approach, by analogy with Hepatitis B—but it could be a few years. This might be enough to contain the spread of SARS-CoV-2 around the world.

The need for a booster should not provide a barrier for the roll-out of any potential COVID-19 vaccine, as our experiences with Hepatitis B, MMR and influenza prevention have shown.

But it will require a concerted effort to make billions of doses of the

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vaccine and distribute them efficiently and fairly around the world. All countries will need a robust vaccination program in place to invite everyone to have the first dose and then remind them to have the second or third dose as required. It will also be important to monitor how people respond to make sure that the booster works as planned.

If we can manage this, getting immunized against COVID-19 may just become a normal part of our routine health care duty—like regularly going to the dentist.

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