# Covid Vaccines compared

A note for Vasculitis UK by **Gareth Garner**
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## Pfizer/nBiotech and Moderna vaccine (both mRNA vaccines).

Messenger RNA (mRNA) plays a fundamental role in the production of proteins in biology. mRNA is essentially a piece of copied nucleic acid (DNA or RNA) which will encode for the production of proteins. Basically, what they do is allow a translation of genetic code into amino acids which subsequently produce proteins.

In human biology, mRNA is formed in the nucleus when DNA strands are separated it then leaves the nucleus through a nuclear pore into the cytoplasm. It is then 'read' by little proteins known as ribosomes which start the process of protein formation. With viruses, specifically RNA viruses, they inject their RNA into a host cell's cytoplasm and the host cell's ribosome will start making viral proteins because that's what it's supposed to do. However, it has no idea this mRNA is not self but in fact from a virus. The cell is therefore tricked into making lots of virus proteins and subsequently lots of virus. Some of these proteins are studded into the surface of the host cells and these are often responsible for the virus being able to bind to other cells (known as glycoproteins). Therefore, when the virus starts to push itself out of the cell, its pushes through the surface of the cell taking part of the cell surface with the glycoproteins on with it. This is called the viral envelope.

Now considering what I have said above, this is how the mRNA vaccines work. Scientists have identified the part of the virus RNA which encodes for the spike proteins, which are the proteins SARS CoV 2 uses to bind to host cells and propagate infection. They can then synthesise this sequence in the laboratory and encapsulate it into a liposome (fatty bilayer). The mRNA is then injected into a person where it subsequently reaches a host cell. The mRNA then enters the host cell's cytoplasm and the host cell ribosomes will start making the viral proteins. In this case, the viral proteins are the spike proteins. These spike proteins are part of the viral envelope, so they become studded into the surface of the host cell. As no infection is actually taking place, the spike proteins will remain studded on the cell surface and an immune response will be triggered - eventually leading to a generation of antibodies (I have left the immunology part brief if you need more on the immunology just say)

## Oxford/Astra Zeneca

Scientists will clone the adenovirus to bacteria or cell lines using specific genes of interest (in this case capsid genes - virus shell genes). This allows them to essentially make an empty adenovirus shell which can infect cells but has no genes in it to replicate and make copies of itself. Therefore, no infection can take place. So what you end up with is something that has the ability to enter a host cell.

Once scientists have the adenovirus vector, they can insert the RNA sequence which makes the spike glycoprotein and essentially inject it into someone. So the adenovirus vector will then enter the host and infect a cell. As with most nonenveloped virus, it will essentially fall apart in the cytoplasm and release its RNA, which in this case is the mRNA for the spike glycoprotein. The host ribosomes will then read the mRNA forming the spike proteins which will stud into the cell surface and generate an immune response against these proteins.