

Demystifying and debunking mRNA vaccines

The development of vaccines has been one of the greatest ever public health achievements. They have given us the ability to remove the threat posed by many once-common diseases. Yet, throughout history, there have been people who have rejected the evidence that these products are, overall, safe and effective. In some cases, this is simply a misunderstanding (misinformation) but in others, anti-vaccination messages have been spread for other reasons, including the pursuit of political agendas (disinformation). The problem has been especially acute during the COVID-19 pandemic, especially in relation to the mRNA vaccines, exploiting the fact that they use a technology that for many people will be unfamiliar.

We on Independent SAGE have received many questions from people who are confused by the often contradictory information. To provide some clarity, we have assembled some reliable information about how vaccines work and specifically what mRNA vaccines are. We hope that this will help you understand these products better and make informed decisions about your vaccination. Whether you choose to receive a vaccine, or to access one for your children, is a personal choice, but please ensure that it's an informed one.

We have no conflicts of interest such as current funding from vaccine manufacturers to develop vaccines, and all our information is drawn from high-quality peer-reviewed scientific studies.

This text is organised into sections based upon common questions and misinformation about mRNA vaccines.

To summarise, the key take home messages are:

1. mRNA vaccines are not a new technology
2. The vaccines were not rushed into use and have been robustly tested
3. mRNA vaccines do not contain harmful chemicals
4. mRNA vaccines cannot permanently alter your DNA
5. The risks of being infected with COVID are significantly worse than risks of vaccination

The COVID-19 vaccines including the mRNA vaccines are now some of the best understood vaccines that we have with their protective data and safety demonstrated in many, many studies. The benefits of vaccination FAR outweigh the risks of infection with SARS-CoV2, which causes a life threatening and life altering disease, the consequences of which may be felt for years to come.

How does vaccination work?

When your immune system encounters a new infection like a virus for the first time, it takes time for it to respond. It does this in two main ways, both playing a role in finding the microorganism in question and inactivating or destroying it. This involves protective antibodies and killer T cells. You can become seriously ill or even die whilst your immune system is developing these responses that allow it to start fighting the infection. However, once your immune system has been trained by being exposed to the infection, special memory cells remember what to do and will respond much quicker if they meet the same infection again.

Vaccination will train your immune system for you, bypassing the dangerous infectious stage! All vaccines contain key information about the virus - whether it's a disabled form of the virus, rendered unable to cause infection in different ways, a chemically inactivated virus preparation, or just a small bit of the virus. COVID-19 vaccines target the virus' spike protein- this is the spiky bit on the outside that the virus uses to help it enter our cells. This is all the information our immune system needs to start making protective antibodies and killer T cells and, critically, those all-important memory cells, which can fight back against the virus if and when you become exposed. So, we no longer need to become infected by a virus that can cause a life threatening disease to obtain immunity. One study estimated that almost 20 million deaths had been prevented through vaccination during 2021, the first year they were rolled out.

Is it better to gain immunity through infection?

No. When infected with SARS-CoV-2, the virus that causes COVID-19, you become infectious to other people around you and can spread the disease. Infection also poses a serious short-term risk to your health and may also have longer-term implications, including a higher risk of cardiovascular disease and Long COVID. The vaccines are not passed onto anyone else and cannot result in Long COVID. They can cause short term side effects (sore arm, fever) and, very rarely, more serious problems (blood clots or heart inflammation), but the risks of these serious outcomes are far higher from infection with SARS-CoV2 and developing COVID-19 than from the vaccine.

How do mRNA vaccines work?

The vaccine contains some of the SARS-CoV-2 genetic material that codes for a specific viral protein, known as the spike protein. The genetic material in the vaccine is mRNA. mRNA is also found in abundance within our own cells, as it is also used as instructions for the cell to make all of its own proteins, naturally. When the vaccine is administered, our cells at the site of injection take up the mRNA and follow the instructions to make the SARS-CoV-2 protein – like putting a USB stick into a

computer and printing off the file stored on it. The foreign protein produced is then recognised by the immune system and triggers a specific response. The production of protein is temporary as the mRNA from the vaccine is short-lived, like all mRNA, and is destroyed by the body using special enzymes in our cells called RNAses, which chop up and destroy mRNA.

Is the COVID mRNA vaccine a new, untested technology?

This technology may seem new but is actually built on the back of many, many years of research. For example mRNA vaccines for some cancers, flu and rabies have been in clinical trials in humans for years, with promising results and no major safety concerns.

Was the vaccine rushed into use?

Before any vaccine can be given to people it must go through rigorous testing. Like all medicines, vaccines undergo extensive clinical trials, where they are administered and monitored in groups of volunteers. Vaccines for COVID-19 were developed at a much faster pace than normal for several reasons and to understand why it seemed so fast you need to understand why vaccine production is usually slow.

It takes a long time to apply for funding and obtain it and this causes delays between each phase of vaccine testing. It also takes time to get ethical approval for each phase of the study and to recruit enough volunteers. There can also be delays whilst researchers negotiate with manufacturers to scale up production of vaccines products. However, in the emergency created by the COVID-19 pandemic the scientists, doctors, ethics approval boards, manufacturers and regulatory agencies all came together to work harder and faster. There was also a massive response from the public, with volunteers coming forward in large numbers to help with the trials. Scientists have been sharing knowledge openly and promptly during the pandemic, meaning vaccine targets were identified extremely quickly. Clinical trial phases and manufacture were able to run in parallel to speed up the process.

In the UK, the results of the trials (including the trials for the mRNA vaccines) are then assessed by the Medicines and Healthcare products Regulatory Agency (MHRA). Stringent licencing processes and safety tests ensure that the health benefits of all medicines and vaccines that are provided via the NHS are safe. As vaccines are given to healthy people, these regulatory measures are even stricter than with conventional medicines, meaning that the level of 'acceptable risk' for vaccines is much lower than it would be for other medicines. Like all vaccines, the safety of the mRNA vaccines has continued to be monitored by regulatory authorities. To date, approximately 12.7 billion COVID-19 vaccines have

been administered in 184 countries, with a now vast body of evidence on their safety and health benefits that greatly outweighing any risks. As of August 2022, over 81 million doses of the Pfizer/BioNTech vaccine had been administered in the UK.

What is in the mRNA vaccine?

Each vaccine made by a different manufacturer will be made up of slightly different ingredients depending on how the vaccine has been developed. The active ingredient in an mRNA vaccine is a very small amount of mRNA, just 30 or 50 micrograms; a microgram is just one millionth of a gram. The paediatric vaccines have a dose of mRNA that approximately one third lower.

To help deliver this mRNA into the cell it is packaged into what is called a lipid nanoparticle. Lipid is another word for fat and nano means microscopically small, so in essence the mRNA is held in microscopically small blobs of fat. This is needed to help deliver the mRNA into the cell, which itself is contained within a layer of fat known as a membrane, and to stop the mRNA being degraded too quickly. The lipid nanoparticle is not harmful and is disposed of in the same way our bodies process natural fats.

Vaccines may also contain very small amounts of preservatives and stabilisers, such as sorbitol (a sugar often used as a sweetener in our foods) and citric acid (the zingy taste in a lemon or an orange), to maintain the high manufactured quality, and ensure the vaccine is safe to be transported and stored. These ingredients can be found naturally in the body or in food at much higher levels than in a vaccine. Preservatives are added to vaccines to prevent unwanted contamination, much like they're used in food products to stop them from spoiling. Stabilisers are used to stop the vaccine components separating or sticking to the vial during transportation and storage.

Can mRNA vaccines alter my DNA?

No. The mRNA delivered by the vaccine cannot enter the nucleus of your cells, where your DNA is stored, and will degrade naturally within hours. At no point is your DNA interfered with.

Are there animal products in mRNA vaccines for COVID-19?

No. The current COVID-19 mRNA vaccines approved for use in the UK (Pfizer Biontech and Moderna SpikeVax) do not contain animal products.

Do mRNA vaccines have side effects?

All medicines, including vaccines, can have side effects. The most important thing is to consider how serious these side effects are compared with the risk of catching a disease.

The most common side effects experienced by mRNA vaccine recipients are mild-to-moderate pain at the injection site, fatigue and headache which resolve within a few days. These expected side effects happen shortly after vaccination and are not associated with serious or lasting illness.

One of the side effects of mRNA vaccines that has attracted particular attention is myocarditis (1 event per million doses) in younger males between 16-29 years of age. Myocarditis is inflammation of the heart muscle and pericarditis is inflammation of the lining outside of the heart. In younger males (aged 12-15) the risk is less than 0.5 events per million vaccines administered. The risks in other age groups and females are much lower than this, with the risk in younger children (under 12s) virtually zero because of the use of a reduced mRNA dose. This may sound scary, but the virus itself can cause myocarditis and here the risk of myocarditis is 11 fold higher (irrespective of age group) in the 28 days following a SARS-CoV-2 positive test. Other heart problems such as pericarditis and cardiac arrhythmias are also higher following a positive SARS-CoV-2 test.

Myocarditis, like any disease, is not all or nothing- ranging from no symptoms (asymptomatic) to severe. Thankfully, myocarditis after the vaccine is relatively mild: only 2% of the small proportion of people who develop myocarditis may need to go to hospital and nearly all people fully recover within a week, perhaps two. However, it is for this reason that vaccine use in this group is much more closely monitored.

The severity of myocarditis **after a virus infection**, including common bouts with SARS-CoV2, is much higher: approximately 50% of people go to hospital and intensive care, 25% do not fully recover, and 11-22% die.

What about long term effects of the vaccine that we can't know about yet?

The vaccine constituents-the mRNA, lipid nanoparticles and any protein made by the cells in our body that become programmed by the vaccine exist only transiently in any measurable quantities and will therefore not persist in the body which is why such long term effects are unlikely.

We might not, so far, have long term data on COVID vaccines, but we do for many other vaccines. Vaccination has been used regularly as a tool to protect our health since the 18th century. Importantly, without exception, adverse reactions to vaccines tend to occur a maximum of twelve or so weeks post inoculation – mostly much earlier. Whilst the effects may rarely be long-lasting, what has never been observed are “latent” vaccine reactions i.e. random effects arising many months or even years later.

Thus, now that vast numbers of people have been vaccinated over the past 22 months, it is almost vanishingly unlikely that we might see any further rare reactions to the vaccine in addition to those we already know about.

Importantly, yet again, the situation is demonstrably worse for those who are infected with SARS-CoV2. This is now well-known as a cause of the complicated spectrum of long COVID symptoms that follow infections in a substantial number of people. This can, sadly, occur even following mild infection, although also in those who have been vaccinated and then have a “breakthrough” infection. Moreover, growing evidence shows there ARE certain “latent” predispositions to some cardiovascular (e.g. cardiac issues, blood clots), metabolic (e.g. type 1 diabetes) and neurological (causing loss of concentration and other symptoms) problems following COVID, which will add additional burden on the NHS in years to come.

I have heard some worrying figures about the harm from mRNA vaccines- should I be worried?

A [paper](#) comparing mRNA vaccines with no vaccine was published in 2022 that looked at all reported side effects from the initial Moderna and Pfizer trials. Some people have, inappropriately, used this paper to claim that the vaccine is more harmful than the disease. This is simply wrong. This [study NEVER looked at disease](#). It compared healthy volunteers receiving a placebo injection with healthy volunteers receiving a vaccine. A recent study from the CDC has now compared the rates of myocarditis from the virus with the vaccine and confirmed that the risk of myocarditis is much more common and serious from infection with the virus than vaccination.

Another misuse of the paper’s data is to report all “serious side effects” whether they were specific to the vaccine or not. The individual side effects were rare in both groups (placebo versus vaccine, ranging between often around 0.5 -26 events in every 10,000 people reporting data- which is less than 1% of people) and sometimes these events were actually as, or more, common in the group getting the placebo. This means that many of these purported effects are just a matter of chance and cannot be blamed on the vaccine –.

The severity of side effects ranged hugely from diarrhoea through to something that sounds a lot more scary - “*other forms of acute cardiac injury.*” This is a rather broad term that means that blood markers such as troponin (a chemical that indicates damage to the cells in the heart) have increased temporarily. However, this can occur due to a whole range of reasons, such as temporary high blood pressure or cardiac arrhythmia, and many causes of acute cardiac injury are not linked to heart disease at all. As such “acute forms of cardiac injury” is quite a broad definition that would usually require further investigation to determine whether it were serious or not.

So how common was this? Well the results varied between the two trials: In one trial (Moderna)- 26 vaccinated people out of 10,000 cases reported acute cardiac injury as an effect but 26 people NOT receiving a vaccine reported the same thing. In a different trial (Pfizer) 16 people reported this post-vaccination and 10 people reported it post-placebo.

In summary, some of the figures from this study have been grossly misrepresented in several ways, including by failing to consider the severity of any side effects or discussing how these can occur by chance. Unfortunately, these misrepresentations have been spread widely in social and mainstream media, both in the UK and abroad.