VitaMins Health
mRNA technology – a silver spike-protein lining?

The COVID-19 pandemic has caused much devastation and disruption. But in the aftermath, are we now seeing a silver lining emerging in the form of mRNA technology?

Many people view the speed and effectiveness of the vaccine production as the highlight of the past 18 months. Multiple highly effective vaccine options were produced and tested within unprecedented time scales. Among the different types of vaccines, mRNA has played a key role, with both the Pfizer-BioNTech and Moderna COVID-19 vaccines using mNRA technology.

What is mRNA technology?

mRNA vaccines were used for the first time during the COVID-19 pandemic, but the underlying technology is something that scientists have been exploring for around 30 years. The first successful trial in mice was completed in the 1990s, but subsequent articles on the possibilities of mRNA largely flew under the radar, with many believing the hurdle of preventing extreme immune responses in humans insurmountable. However, in 2005 a breakthrough to this hurdle was found, which created a snowball of interest. Moderna (a word combining 'modified' and 'RNA') and BioNTech were formed, funding increased, and the research into the use of mRNA for medical purposes accelerated.

A virus consists of a core of DNA or RNA genetic material wrapped in a shell of proteins. The virus's DNA or RNA makes these proteins via single stranded RNA molecules known as messenger RNA (mRNA). mRNA vaccines use genetically engineered mRNA to instruct your cells to make proteins characteristic of a specific virus. This causes your body's immune system to make the antibodies that will fight the virus if you later become infected.

There is often a critical element of a virus' protein shell. In the case of SARS-CoV-2, the virus that causes COVID-19, it is the now infamous "spike protein". Amazingly, within just weeks of identifying SARS-CoV-2, scientists in China had determined the structure of the genes that make the spike protein. Minutes later, scientists around the world used this to begin work on the design of an mRNA vaccine.

mRNA technology is exciting!

mRNA vaccines have some impressive advantages when compared to their more traditional counterparts: they are easy and fast to mass-produce in a laboratory, they are easily adapted to combat new strains of a virus, and they create a stronger type of immunity in the body.

There is also now hope and expectation that, following the large-scale success of COVID-19 vaccines, the use of mRNA technology to combat other diseases will be accelerated.

BioNtech, the company who developed one of the successful COVID-19 vaccines in partnership with Pfizer has begun their phase 2 trials of a cancer vaccine for patients with skin cancer, after phase one showed evidence of safety and preliminary efficacy. They are also beginning mid-stage trials of vaccines for head and neck cancers.

Moderna is now starting trials of its experimental mRNA HIV vaccine, the first to be trialled in humans. There are also new mRNA vaccines being tested for Ebola virus disease, Zika, rabies and influenza.

Prophylactic vs Therapeutic Vaccines

Vaccines can be used in different ways. Prophylactic vaccines are those with which we are more familiar – i.e., vaccines to prevent disease, as was the case for the COVID-19 vaccine. The alternative is a therapeutic vaccine, which is used for the treatment, rather than the prevention of a disease. Although there are some differences between prophylactic and therapeutic mRNA vaccines, they are underpinned by a similar concept – they are designed to show the immune system a protein to which it needs to respond.

Despite the many clinical trials in progress, mRNA vaccines for cancer treatment have proved more difficult to develop than for COVID-19. Unlike SARS-CoV-2, which has a distinct and characteristic protein (known as a *single antigen)* that was relatively simple to identify, a cancer typically doesn't have a single antigen protein. Cancer treatments that attack a single protein have not, so far, been found to illicit strong enough immune responses. A successful cancer vaccine may need to target multiple antigens, or to find one that is vital for the cancer's survival.

What happens if mRNA 'cures' cancer?

If mRNA technology does succeed in removing cancer driven mortality, what would that mean for life expectancy? We saw in a previous Top Chart, that 'all forms of cancer' makes up one of the main killers in western society, so we would expect a significant impact.

Club Vita scenario modelling projects that curing cancer could ultimately increase life expectancy at age 65 by around 2-3 years, a figure corroborated by a publication by the Royal College of Surgeons of England.

In our analysis we assumed that if a cure for cancer were found tomorrow, there would be a ten-year lead time for that cure to be tested and approved by health authorities around the world, and a further five years until there is full uptake throughout society. Under these assumptions, more mature pension plans or insurance books covering only pensioners would see smaller impacts than we would expect at the societal level.

Under our assumptions, we calculated a 5%-6% increase in liabilities for a typical pension plan. However, given the speed at which COVID-19 vaccines have been approved and disseminated, perhaps a cure for cancer could make its way into general use more quickly, resulting in larger increases in liabilities.

What do you think?

Could mRNA technology propel a new revolution in health advances? And could this drive significant increases in future life expectancy similar to, or even greater than, those seen in the early 2000s (believed to be driven by advances in heart disease treatments)?