mRNA vaccines: What they are and how they are considered to work

Traditional vaccines contain an inactivated infectious pathogen or a part of it, but mRNA vaccines deliver the genetic instructions for our cells to make viral or bacterial proteins themselves.

Vaccines using mRNA, or messenger ribonucleic acid, are on the rise but a successful mRNA vaccine has never been created before, which presents new risks.

Vaccination is one of the major success stories of modern medicine, greatly reducing the incidence of infectious diseases such as measles, and eradicating others, such as smallpox.

Conventional vaccines usually contain inactivated disease-causing organisms or proteins made by the pathogen (antigens), which work by mimicking the infectious agent. They stimulate the body's immune response, so it is primed to respond more rapidly and effectively if exposed to the infectious agent in the future.

RNA vaccines use a different approach that relies on the process that cells use to make proteins: cells use DNA as the template to make messenger RNA (mRNA) molecules, which are then translated to build proteins. An RNA vaccine consists of an mRNA strand that codes for a disease-specific antigen. Once the mRNA strand in the vaccine is inside the body's cells, the cells use the genetic information to produce the antigen. This antigen is then displayed on the cell surface, where it is believed to be recognised by the immune system. The question is, is mRNA a vaccine by the conventional definition for vaccine or is mRNA really a genetic level *Treatment*?

- An mRNA vaccine encodes proteins of a virus, which is inserted into a cell to trigger an immune response and create antibodies. The mRNA sequence codes for antigens (disease-fighting agents), proteins that are identical or resemble those of the pathogen. Awkward if the pathogen has not been isolated!
- There has never been a successful mRNA vaccine before, but studies show they can elicit immunity against flu, Zika, rabies and coronavirus
- mRNA vaccines are considered risky because the technology is still new
- Unlike a normal vaccine, RNA vaccines work by introducing an mRNA sequence (the molecule which tells cells what to build) which is coded for a disease specific antigen. Once produced within the body, the antigen is recognised by the immune system, preparing it to fight the real thing
- There is still a lot of work to be done before mRNA vaccines can become standard treatments, in the meantime, we need a better understanding of their potential side effects, and more evidence of their long term efficacy. Vaccination and Induction of Autoimmune Diseases[1] can be an adverse effect for example.

[1] https://pubmed.ncbi.nlm.nih.gov/26728772/

- It is claimed that, mRNA vaccines only carry the information to make a small part of a pathogen. From this information, it is claimed that it is not possible for our cells to make the whole pathogen.

Types of mRNA 'Treatments'[2]

1. Non-replicating mRNA

   The simplest type of RNA vaccine, an mRNA strand is packaged and delivered to the body, where it is taken up by the body's cells to make the antigen.

2. In vivo self-replicating mRNA

   The pathogen-mRNA strand is packaged with additional RNA strands that ensure it will be copied once the vaccine is inside a cell. This means that greater quantities of the antigen are made from a smaller amount of vaccine, helping to ensure a more robust immune response.

3. In vitro dendritic cell non-replicating mRNA vaccine

   Dendritic cells are immune cells that can present antigens on their cell surface to other types of immune cells to help stimulate an immune response. These cells are extracted from the patient's blood, transfected with the RNA vaccine, then given back to the patient to stimulate an immune reaction.

The methods to make mRNA vaccines can be very effective. However, there are technical challenges to overcome to ensure these vaccines work appropriately:

- Unintended effects: the mRNA strand in the vaccine may elicit an unintended immune reaction. To minimise this the mRNA vaccine sequences are designed to mimic those produced by mammalian cells. Awkward if the pathogen has not been isolated!
- Delivery: delivering the vaccine effectively to cells is challenging since free RNA in the body is quickly broken down. To help achieve delivery, the RNA strand is incorporated into a larger molecule to help stabilise it and/or packaged into particles or liposomes.
- Storage: many RNA vaccines, like conventional vaccines, need to be frozen or refrigerated. Work is ongoing to reliably produce vaccines that can be stored outside the cold chain, since these will be much more suitable for use in countries with limited or no refrigeration facilities.

Challenges and further considerations.

- Research and clinical trials: further research is needed to address technical hurdles such as vaccine stability and delivery. It is not yet certain which production method(s) are currently the best. Clinical trial data is limited – more long-term studies are needed to determine the effectiveness of RNA vaccines.
- Safety: better understanding of vaccine adverse effects is needed – these can include inflammation or autoimmune reactions.

[2] https://www.phgfoundation.org/briefing/rna-vaccines

The USA FDA have commented;

> "The most commonly reported side effects, which typically lasted several days, were pain at the injection site, tiredness, headache, muscle pain, chills, joint pain, and fever," the FDA wrote in their statement. *"Of note, more people experienced these side effects after the second dose than after the first dose, so it is important for vaccination providers and recipients to expect that there may be some side effects after either dose, but even more so after the second dose."*[3]

Current clinical trials of the coronavirus SARS-COV 2 have not yet (6/01/21) been published[4].

"The mRNA in the BNT vaccine was sequenced from the 3rd iteration of the original WUHAN published Genome SARS-CoV-2 (MN908947.3). However, the WHO protocols Pfizer used to produce the mRNA do not appear to identify any nucleotide sequences that are unique to the SARS-CoV-2 virus. When investigator Fran Leader questioned Pfizer they confirmed:

The DNA template does not come directly from an isolated virus from an infected person.

The fact that there are no completed clinical trials for the Pfizer and BioNTech BNT vaccine also explains why the FDA State:

Additional adverse reactions, some of which may be serious, may become apparent with more widespread use of the Pfizer-BioNTech COVID-19 Vaccine.

The FDA also noted:

[There is]…currently insufficient data to make conclusions about the safety of the vaccine in sub-populations such as children less than 16 years of age, pregnant and lactating individuals, and immunocompromised individuals…..[the] risk of vaccine-enhanced disease over time, potentially associated with waning immunity, remains unknown."

The most comprehensive study on mRNA treatment against SARS-CoV published that I have uncovered came in 2012 [5] which concluded;

These SARS-CoV vaccines all induced antibody and protection against infection with SARS-CoV. However, challenge of mice given any of the vaccines led to occurrence of Th2-type immunopathology suggesting hypersensitivity to SARS-CoV components was induced. Caution in proceeding to application of a SARS-CoV vaccine in humans is indicated.

This may explain why to date no mRNA 'vaccine' has been approved other than those approvals recently granted under **Emergency Conditions**!

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[3] https://www.medicalnewstoday.com/articles/how-do-mrna-vaccines-work#Addressing-stability-and-safety

[4] https://off-guardian.org/2021/01/03/what-vaccine-trials/

[5] https://pdfs.semanticscholar.org/962c/58e6dc9c1ea550eb51ce70b0d7c83dc7eff6.pdf

The head of the Modernal mRNA SARS-CoV vaccine when commenting on it suitability and durability was reported in RTnews on the 7th Jnaury 2021;

"The boss of biotech company Moderna has claimed that the "nightmare" worst-case scenario in which a Covid-19 vaccine will only offer protection against illness for a few months is not something we need to worry about anymore.

"The antibody decay generated by the vaccine in humans goes down very slowly... We believe there will be protection potentially for a couple of years," said Moderna CEO Stephane Bancel at an online event on Thursday.

"The nightmare scenario that was described in the media in the spring with a vaccine only working a month or two is, I think, out of the window," he added.

The Moderna boss continued on to note, however, there may be challenges among the elderly as their immunity is unlikely to last as long as other demographics.

Speaking on Tuesday, Bancel said he was confident that the company's Covid-19 vaccine was effective against new, more contagious, strains found in the UK and South Africa.

Should it mutate even further, the current vaccine could be quickly redeveloped to encompass other new strains and mixed with the existing jab as a kind of inoculation 'cocktail'.

The US biotech company received approval for its shot from the EU medicines regulator and the European Commission on Wednesday 6th January 2021[6].

Will PHE maintain records of when mRNA is administered for SARS-CoV and when people subsequently die and from what causes?

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[6] https://www.rt.com/news/511816-vaccine-protection-covid19-moderna/