**What is mRNA COVID 19 Vaccine
and What is the Safety and Efficacy of
mRNA COVID 19 Vaccine?**

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A Short Note on mRNA Vaccine

Only used for Awareness Purpose

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What is mRNA COVID 19 Vaccine and What is the safety and Efficacy of mRNA COVID 19 Vaccine?

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Any of the first COVID-19 vaccines approved for use in the U.S. is messenger RNA (mRNA) vaccines, also called mRNA vaccines. In order to activate an immune response and create immunity to SARS-CoV-2, the virus which causes COVID-19, mRNA vaccines take advantage of the mechanism that cells use to produce proteins. Many vaccines, on the other hand, use weakened or inactivated forms or elements of the pathogen causing disease to induce the immune system of the body to generate antibodies.

Mechanism of Action: mRNA vaccines have strands of genetic material called mRNA inside a special coating. That coating protects the mRNA from enzymes in the body that would otherwise break it down. It also helps the mRNA enter the dendritic cells and macrophages in the lymph node near the vaccination site.

mRNA can most easily be described as instructions for the cell on how to make a piece of the “spike protein” that is unique to SARS-CoV-2. Since only part of the protein is made, it does not do any harm to the person vaccinated but it is antigenic.

After the piece of the spike protein is made, the cell breaks down the mRNA strand and disposes of them using enzymes in the cell. It is important to note that the mRNA strand never enters the cell’s nucleus or affects genetic

material. This information helps counter misinformation about how mRNA vaccines alter or modify someone's genetic makeup.

Once displayed on the cell surface, the protein or antigen causes the immune system to begin producing antibodies and activating T-cells to fight off what it thinks is an infection. These antibodies are specific to the SARS-CoV-2 virus, which means the immune system is primed to protect against future infection.

Mechanism of mRNA Vaccine

Safety: The COVID-19 mRNA vaccines underwent the same comprehensive safety review as other vaccines before the Food and Drug Administration approved them for use in the United States. This entails major clinical trials and a safety testing board's analysis of results.

Live vaccines are also a problem for patients. mRNA vaccines are not live vaccines and do not use an infectious factor, so the person vaccinated has no chance of developing disease.

Fernando P Polak et al: In people 16 years of age or older, a two-dose regimen of BNT162b2 conferred 95% protection against Covid-19. The protection was comparable to that of other viral vaccines for a median duration of 2 months. (Funded by BioNTech and Pfizer; NCT04368728, ClinicalTrials.gov number.)

Edward E Walsh et Al: Protection and immunogenicity results from this U.S. phase 1 study of two candidate vaccines in younger and older adults, adding to earlier interim safety and immunogenicity data for BNT162b1 in younger adults from studies in Germany and the U.S., encourage the selection of BNT162b2 for progression to a pivotal phase 2-3 assessment of safety and efficacy. (Funded by BioNTech and Pfizer; NCT04368728, ClinicalTrials.gov number.)

Denis Y Logunov et al.: The vector-based COVID-19 heterologous rAd26 and rAd5 vaccines have a decent safety profile and have induced robust humoral and cellular immune responses in participants. The efficacy of this vaccine for COVID-19 prevention needs to be more studied.

Evan J Anderson et al: Adverse effects associated with the mRNA-1273 vaccine were mostly mild to moderate in this small sample affecting older adults. In a phase 3 vaccine trial, the 100 µg dose caused higher binding and neutralising antibody titers than the 25 µg dose, which encourages the use of the 100 µg dose. (Funded by the National Allergy and Infectious Diseases Institute and others; number of mRNA-1273 Research ClinicalTrials.gov, NCT04283461.).

Benefits of mRNA Vaccine: Compared to other types of vaccines, mRNA vaccines have many advantages, including the use of a non-infectious ingredient, faster development cycles, and the ability to target several diseases. Using a DNA prototype and readily available materials, mRNA vaccines can be produced in a laboratory. This ensures that it is possible to standardise and scale up the procedure, allowing the production of vaccines easier than conventional approaches. Moreover, DNA and RNA vaccines will usually be moved to the clinic for initial monitoring as soon as possible. The mRNA vaccine technology could allow one vaccine to target several diseases in the future.

WHAT ARE RNA VACCINES AND HOW DO THEY WORK?

WHAT ARE RNA VACCINES?

SARS-CoV-2

Viral RNA
The virus's genetic material. Contains instructions for making proteins.

Spike protein
Protein which helps the virus penetrate cells and initiates an infection.

The genetic code of the SARS-CoV-2 virus is made up of RNA. Scientists isolated the part of this genetic code that contains the instructions for making the virus's spike protein.

RNA INSTRUCTIONS → **LIPID NANOPARTICLES** → **VACCINE SHOT**

Synthetic RNA which codes for the virus spike protein is packed in lipid nanoparticles (very small fat droplets). This stops our bodies' enzymes breaking it down and helps our cells take it in.

Human cell → **Synthetic RNA** → **Viral protein** → **Immune response**

Once the synthetic RNA is inside one of our cells, the cell follows the RNA instructions to produce the virus spike protein. Its production then triggers an immune response in our bodies.

RNA VACCINES FOR COVID-19

Several proposed vaccines for COVID-19 are RNA vaccines. They can be based on two different types of RNA.

mRNA vaccines	saRNA vaccine
Moderna Pfizer & BioNTech CureVac	Imperial College Arcturus

mRNA AND saRNA: WHAT'S THE DIFFERENCE?

The structures of mRNA and saRNA are similar but have a key difference, as the diagrams below show.

mRNA mRNA stands for messenger ribonucleic acid

RNA cap
Stops RNA breaking down; helps start protein synthesis in human cells.

SPIKE PROTEIN CODING REGION

Untranslated regions
Regions which don't contain code for proteins.

Poly-A tail
Long chain of adenine (A) bases which help stabilise the RNA.

saRNA saRNA stands for self-amplifying ribonucleic acid

SPIKE PROTEIN CODING REGION

Code for viral replicase enzyme
Once in human cells, the creation of the viral replicase enzyme helps make multiple copies of the viral RNA.

As saRNA produces more copies of itself once it's in a cell, it can be given in smaller doses than mRNA vaccines. This makes the cost per dose lower and means higher numbers of doses can be produced from the same volume of vaccine.

RNA VACCINES: BENEFITS AND CHALLENGES

VACCINE PRODUCTION

RNA is easy to make in a lab, so RNA vaccines can be developed quicker than other vaccines.

SAFETY OF THE VACCINES

RNA can't cause infection and is broken down by normal processes in our cells. An RNA vaccine hasn't been licensed for use in humans before but they've been under development for several years for other viruses, including Influenza, HIV, and Zika.

STORAGE AND TRANSPORT

Some RNA vaccines must be stored at low temperatures to remain stable, which makes storage and transport more challenging.

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