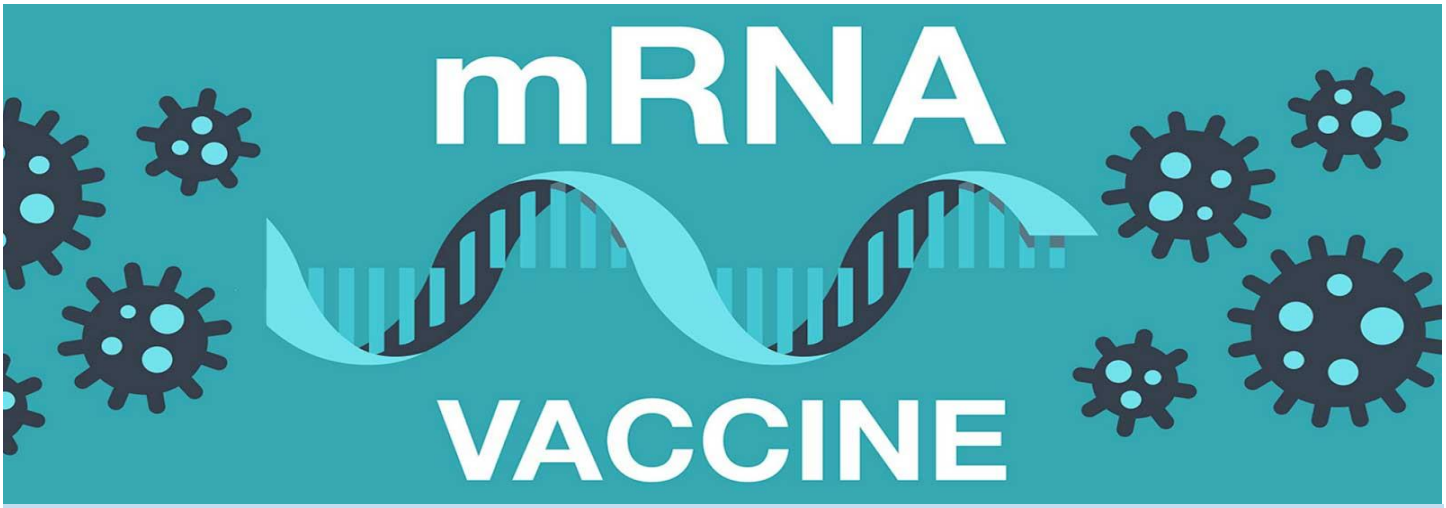
mRNA VACCINES



mRNA vaccines have garnered immense attention in recent times due to their remarkable success in combatting infectious diseases, most notably the COVID-19 pandemic. Let's delve into the unique features and mechanisms that make mRNA vaccines so potent.

HARNESSING THE BLUEPRINT OF LIFE: GENETIC INFORMATION

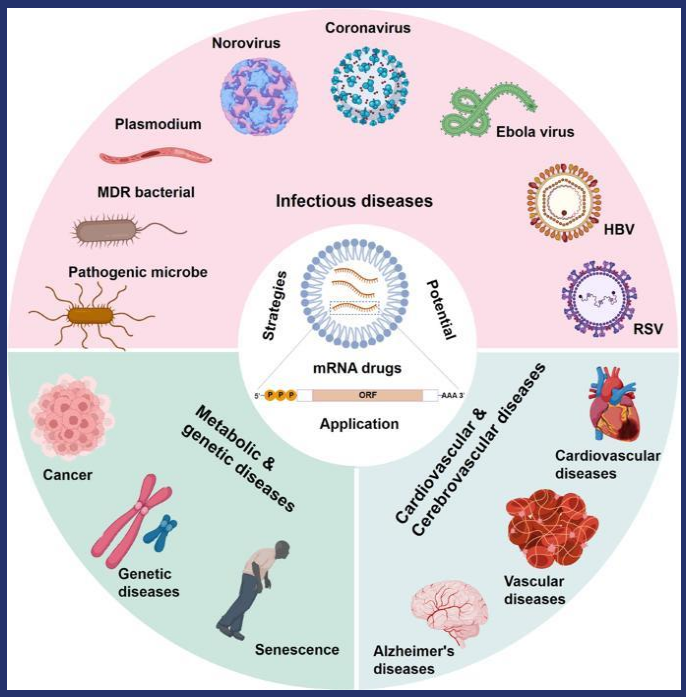
mRNA vaccines harness the power of our own genetic machinery to trigger an immune response. They utilize a synthetic version of messenger RNA (mRNA) that carries the instructions for producing a specific viral protein, such as the spike protein found on the surface of the SARS-CoV-2 virus.

A METICULOUS CELLULAR SYMPHONY

Upon administration, the mRNA molecules enter the cells and journey to the cytoplasm, the cellular region where protein synthesis occurs. Ribosomes, the cellular factories responsible for protein production, read the mRNA instructions and begin assembling the viral protein.

EMPOWERING THE IMMUNE SYSTEM

mRNA vaccines unleash the immune system's potential by presenting viral proteins on cell surfaces. This prompts B-cells and T-cells to mount a targeted defense, educating the immune system to neutralize the actual virus if encountered. It's a breakthrough approach with immense promise for disease prevention and treatment.

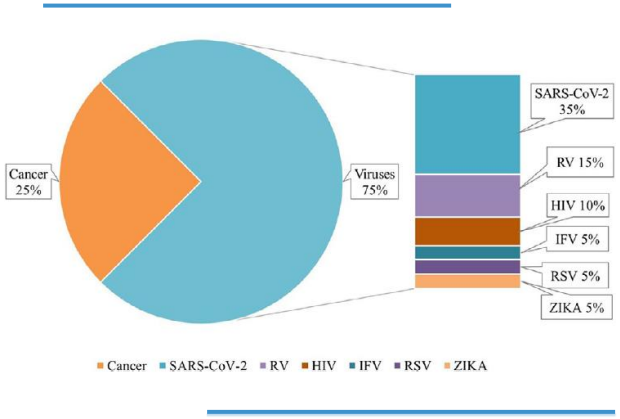


Advantages of mRNA Vaccines

1. **Rapid Development:** The development process for mRNA vaccines is significantly faster compared to conventional vaccines. This agility is crucial in responding to emerging viral threats and pandemics.
2. **Safety and Efficiency:** mRNA vaccines are non-infectious, as they do not contain live or weakened viruses. This eliminates the risk of causing the disease they protect against. Moreover, their precise targeting allows for a robust immune response with a lower dose of the vaccine.
3. **Flexible Manufacturing:** The manufacturing process for mRNA vaccines can be quickly adapted to produce new formulations. This flexibility provides the ability to modify vaccines in response to viral mutations, such as those observed in SARS-CoV-2 variants.
4. **Broader Applicability:** mRNA technology holds promise for developing vaccines against a wide range of diseases, including infectious diseases, cancer, and genetic disorders. Ongoing research is exploring their potential in various therapeutic areas.

mRNA vaccine technology holds great promise for developing vaccines against various virological diseases. While mRNA vaccines have gained significant attention due to their successful application against COVID-19, ongoing research and development efforts are exploring their potential for other viral diseases as well. Here are a few examples of viral diseases for which mRNA vaccines are being investigated:

Influenza: mRNA vaccines offer the potential for rapid response to seasonal influenza strains and emerging pandemic strains. The ability to quickly modify the mRNA sequence encoding viral proteins could allow for the development of tailored vaccines each flu season.



Zika Virus: The Zika virus is a mosquito-borne virus that can cause severe birth defects and neurological complications. mRNA vaccines targeting the Zika virus envelope protein have shown promising results in preclinical studies and are being further evaluated for their efficacy and safety.

Respiratory Syncytial Virus (RSV): RSV is a common respiratory virus that primarily affects young children and older adults. Development of an mRNA vaccine for RSV is underway, aiming to provide protection against this significant cause of respiratory illness, especially in vulnerable populations.

Human Immunodeficiency Virus (HIV): HIV remains a major global health concern, and efforts are ongoing to develop an effective HIV vaccine. mRNA vaccine approaches are being explored to elicit broad and durable immune responses against HIV, which has been challenging due to the virus's ability to evade the immune system.

Dengue fever: Dengue fever is a mosquito-borne viral disease that affects millions of people worldwide. Researchers are investigating mRNA vaccine strategies to provide protection against the different serotypes of the dengue virus and to overcome the challenges associated with vaccine-induced immune enhancement.

Ebola: The Ebola virus causes severe and often fatal hemorrhagic fever. mRNA vaccines targeting the Ebola virus glycoprotein have shown promise in preclinical and early clinical trials, offering hope for the prevention of Ebola outbreaks.

Human Papillomavirus (HPV): HPV is a sexually transmitted virus that can cause various cancers, including cervical, anal, and oropharyngeal cancers. mRNA vaccines have already been successfully deployed against HPV, with vaccines like Gardasil and Cervarix providing protection against the most common oncogenic HPV types.

KEY PLAYERS

moderna

Pfizer BIONTECH

Johnson & Johnson GSK

GENNOVA

CUREVAC

NOVARTIS

FUTURE OUTLOOK

mRNA technology in viral disease vaccines is highly promising. The success of mRNA vaccines against COVID-19 has showcased their effectiveness and has opened doors for further advancements. Ongoing research aims to optimize formulations, enhance durability, and expand their application to various viral diseases. With their flexibility and rapid production capabilities, mRNA vaccines have the potential to revolutionize viral disease prevention. Continued investment and innovation in this field will pave the way for a healthier and more resilient future such as;

1. Optimization for improved effectiveness and safety.
2. Potential for passive immunization and targeted immunotherapy
3. Comparative studies to determine the most suitable mRNA platforms
4. Advancements in innate immune sensing and delivery methods
5. Commercialization and investments driving research and availability
6. Swift response to emerging viral epidemics with platform-based vaccines

China Approves its First mRNA Vaccine!

China has granted approval for its first mRNA vaccine developed by the pharmaceutical company CSPC.

- Independantly developed mRNA vaccine SYS6006 targets major Omicron variants and its booster dose shown good neutralization effect against Omicron subvariants BA.5, BF.7, BQ.1.1, XBB.1.5 and CH.1.1. in clinical trials.
- The vaccine shown the efficacy of 85.3 per cent 14 to 28 days after a booster vaccination.
- Vaccine could be stored at 2 – 8 degree celcius for a long time.

Baidu Unveils AI-driven mRNA Technology: Unlocking the Potential

Chinese tech giant Baidu's research arm has unveiled a groundbreaking AI-driven software that has the potential to revolutionize mRNA vaccines and cancer drugs. The algorithm, known as LinearDesign, has demonstrated impressive capabilities in designing mRNA vaccine sequences and enhancing their effectiveness.

- **Boosting Antibody Responses:** Baidu's AI-driven software has successfully generated code for COVID-19 vaccines that trigger antibody responses up to 128 times greater than previous designs, promising improved immune protection.
- **Extended Shelf Stability:** LinearDesign has also shown the ability to extend the shelf stability of mRNA vaccines sixfold, even when exposed to body temperatures. This breakthrough could greatly facilitate vaccine distribution efforts, particularly in regions with challenging cold storage requirements.
- **Potential for Cancer Treatments:** The AI tool developed by Baidu holds promise beyond vaccines. It could contribute to the design of potent new cancer treatments, with personalized mRNA vaccines already demonstrating encouraging results in preventing tumor recurrence.
- **Overcoming Stability Challenges:** Maintaining mRNA stability has been a hurdle in this field. However, LinearDesign addresses this challenge by optimizing the compactness and structure of mRNA, ensuring its integrity and effectiveness.

CureVac files expanded patent lawsuit against Pfizer/BioNTech over mRNA technology

CureVac NV recently announced that it has filed an expanded patent infringement claim against Pfizer Inc and BioNTech, alleging the unauthorized use of its mRNA technology. The company has broadened its claim from three to nine patents, seeking to protect its intellectual property rights.

- **Counterclaim and Transfer of Trial:** CureVac has filed a counterclaim, asserting that Pfizer and BioNTech infringed on nine of its patents. Additionally, the trial has been transferred from the Federal District Court of Massachusetts to the Eastern District of Virginia, enabling expedited proceedings and a likely trial date in 2024.
- **Response from Pfizer and BioNtech:** Pfizer and BioNtech have not yet responded to CureVac's expanded claim. In their defense, they had previously filed a complaint with the U.S. District Court in Massachusetts, asserting that they did not infringe on CureVac's U.S. patents.
- **Differences in Technology:** Pfizer and BioNTech have argued that their COVID-19 vaccine, Comirnaty, operates using a distinct mechanism from CureVac's patented technology. They maintain that their vaccine does not infringe on CureVac's intellectual property.
- **Additional Patent Infringement Lawsuits:** Apart from the ongoing dispute with CureVac, Pfizer and BioNTech are facing similar patent infringement lawsuits from other companies. These cases underscore the growing significance of intellectual property rights in the rapidly evolving field of medical technology.

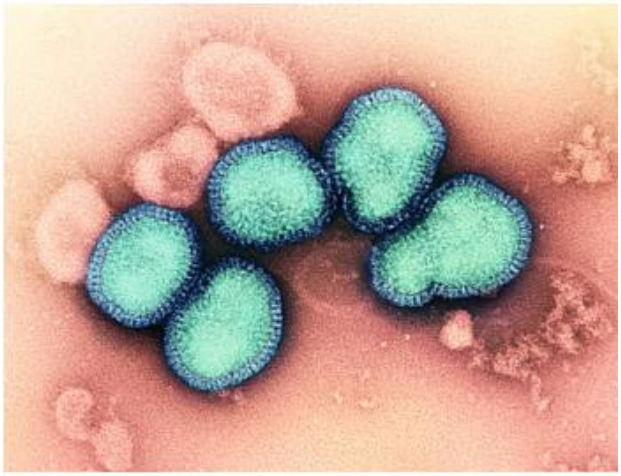
Clinical trial of mRNA universal influenza vaccine candidate begins

Pancreatic cancer, known for its high mortality rate and limited treatment options, has presented a significant challenge in the medical field. However, recent findings from an early-stage trial have shown encouraging results. In a study published in Nature, researchers administered personalized mRNA cancer vaccines to pancreatic cancer patients after surgery, resulting in a remarkable outcome: half of the patients did not experience tumor recurrence even after a year and a half.

Trial Details:

- **Study Published:** Nature
- **Patient Cohort:** 16 individuals
- **Cancer Type:** Pancreatic ductal adenocarcinoma
- **Primary Treatment:** Surgery
- **Experimental Vaccines**: Personalized mRNA cancer vaccines developed by BioNTech and Pfizer
- **Target:** Patients' own tumor neoantigens using mRNA technology

- **Trial Details:** The trial involved 16 patients and focused on pancreatic ductal adenocarcinoma, the most common type of pancreatic cancer. Surgery is the primary treatment, but recurrence rates remain high. The experimental vaccines, developed by BioNTech in collaboration with Pfizer, targeted the patients' own tumor neoantigens using mRNA technology.



Influenza A Virus (H3N2) *NIAID*

- **Positive T Cell Response:** Eight out of the 16 patients exhibited a strong T cell response to the vaccines. These individuals showed extended survival without cancer recurrence during the median follow-up period of 18 months.
- **Potential for larger studies:** While the initial trial showcased promising results, it is essential to conduct larger studies to determine the vaccine's effectiveness and establish it as a standard treatment option. Further research is required to confirm the therapy's viability for a more diverse patient population.
- **Significance of mRNA Technology:** mRNA vaccines have gained recognition for their role in combating COVID-19. This study demonstrates the versatility of mRNA technology in addressing other challenging diseases, such as pancreatic cancer, by targeting specific neoantigens unique to each patient's cancer

The study's findings offer hope for pancreatic cancer patients, highlighting the potential of personalized mRNA vaccines as an additional treatment approach. As this research progresses, it is crucial to closely monitor further developments and advancements in the field.

medRxiv

THE PREPRINT SERVER FOR HEALTH SCIENCES

Study validates vaccine effectiveness: COVID-19 shots cut hospitalization and mortality rates in England

A recent study published on the medRxiv* preprint server examined hospitalization and mortality rates from COVID-19 in England before and after the rollout of the vaccine. The study analyzed population-level data from the 2021 Census, encompassing over 580,000 individuals aged 16 years or older.

Vaccine Effectiveness Against Hospitalization:

- One dose of the COVID-19 vaccine reduced the likelihood of hospitalization by 52%, while two doses increased vaccine effectiveness (VE) to 56%.
- VE against hospitalization was highest in the 65-79 years age group after the third booster dose, reaching approximately 88%.
- After three doses, the risk of hospitalization declined by almost 78%.
- VE declined at three or more months from the third dose, particularly in the 30-64 years age group.

Vaccine Effectiveness Against Mortality:

- The risk of mortality declined by almost 60% after one vaccine dose.
- VE against mortality was highest after the second dose, reaching 90% overall.
- VE declined at three or more months from the second and third doses, except in the 16-29 years age group.

Vaccine Effectiveness by Variant:

- During the Omicron wave, the COVID-19 vaccine offered better protection against hospitalization than previous reports, but VE against mortality declined.
- VE against hospitalization was highest after the second dose during the Omicron wave.
- VE declined at three to six months from the second dose and further reduced to about 40% over six months from the second dose.
- After the third dose, protection against hospitalization declined from 80% before the Omicron wave to 55% thereafter.
- Protection against mortality declined after each vaccine dose during the Omicron-dominant period.

Vaccine Effectiveness by Vaccine Type:

- Overall, mRNA vaccines performed better than other COVID-19 vaccines.
- mRNA vaccines exhibited waning VE against hospitalization at three months or more from the booster dose.
- Both vaccine types showed waning VE against mortality at three months or more following the second dose.

The study provides evidence of increased protection with each vaccine dose and a high level of effectiveness against both COVID-19 hospitalization and mortality for the third/booster dose. It highlights the importance of vaccination in reducing severe outcomes and underscores the significance of ongoing research and monitoring to evaluate long-term vaccine effectiveness.