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SARS-CoV-2 spike protein is vaccine target

Vaccines teach the immune system to make antibodies that can block the virus from infecting cells - and activate other immune responses to fight viral infection.

Model rendering of Coronavirus Spike Protein – Allows researchers to find unique binding areas to target for vaccine development.

COVID-19: Examples of Types of Vaccines

Protein vaccine injected into muscle

DNA or RNA vaccine injected in muscle

mRNA is the genetic backbone that encodes for the spike protein for SARS-CoV-2

mRNA for spike protein of coronavirus

Inject into muscle cells

Muscle cells read the mRNA and make spike protein

Muscle cells

Immune system generates antibodies to fight viral infection

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Examples of COVID-19 Vaccine products

**Type of vaccine approach**

**Protein Sub-Unit**
- Ex: Hepatitis B, Influenza

**Genetic**
- (DNA, mRNA)

**Viral Vectors**
- Ex: ERVEBO Ebola vaccine manufactured by Merck

**Vaccine companies**

- Novavax
- Sanofi
- Inovio
- Moderna
- Pfizer
- AstraZeneca
- Janssen
- Merck
- IAVI
Vaccine Development Timeline
(rapid scientific and clinical progress)

Virus is called SARS-CoV-2; the disease is COVID-19

- Genetic sequence of virus made available January 10\textsuperscript{th}, 2020 – allowed for development of mRNA for genetic vaccine approach
- Vaccine phase 1 clinical trials started in March 2020 to assess safety
- Various types of vaccine in clinical trials: DNA, mRNA, protein sub-unit, viral vectors, inactivated virus
- Phase 3 trials will test if a vaccine works (efficacy) – begin summer 2020; initial effectiveness information could be available by end of 2020
COVID-19 Vaccine Development Process

- Phase 3 trials of several types of vaccines to test if vaccine can prevent COVID-19 disease
- In parallel, scale up and manufacture vaccines, so there is no gap between information above, and availability of vaccine
- In U.S., the FDA would review clinical data, and decide if vaccine should be licensed for use
- CDC would make recommendations for who should get vaccine
DARPA COVID-19 Antibody Efforts

Biological Technologies Office
DoD Problem: Current medical countermeasure development is not rapid enough to effectively prevent infectious disease outbreaks, which impedes warfighter readiness.

Goal: Develop a disease-agnostic, integrated platform to identify the most potent antibodies against ANY VIRUS in days, and scale to manufacture for human trials in months instead of years.
Rapidly discovered antibodies against COVID-19 can be manufactured as traditional protein therapeutics, or nucleic acid (DNA or RNA) constructs.

1. Obtain sample from recovered patient
2. Screen immune cells and find antibodies
3. Manufacture antibodies for clinical testing

DNA or RNA
Protein antibodies
**Vision:** to use the body as a bioreactor to produce anti-infective therapeutics

Program Goals:
- Gene-encoded antibodies for near immediate, non-permanent protection

Advantages of nucleic acid-based antibody approach:
- Platform capability; can be re-administered (no vector-based immune response)
- Rapid Response – provide protection in <3 days
- Transient – lasting for months, not years
  - Not a replacement for vaccines
  - Prophylactic for temporary protection before a vaccine is available or elicited an immune response
References

• Rapid isolation and profiling of a diverse panel of human monoclonal antibodies targeting the SARS-CoV-2 spike protein: https://www.biorxiv.org/content/10.1101/2020.05.12.091462v1


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