Journey to COVID-19 Vaccines

Science Before SARS-CoV-2

Vaccines to protect against COVID-19 were ready for studies in people in record time. This was because years of research happened long before the pandemic. In fact, that research gave a lot of new information about viruses that was very useful when the COVID-19 hit.

When scientists discovered COVID-19 in China, they looked at almost ten years of research on spike proteins. Spike proteins are those points that stick out from the outside of coronaviruses (as seen in pictures). Using what they learned about how to stop a spike protein from spreading the disease in the body's cell, the scientists were able to make COVID-19 vaccines.

Read about some of the advances that opened the door for creating safe and effective COVID-19 vaccines.

1990-2019

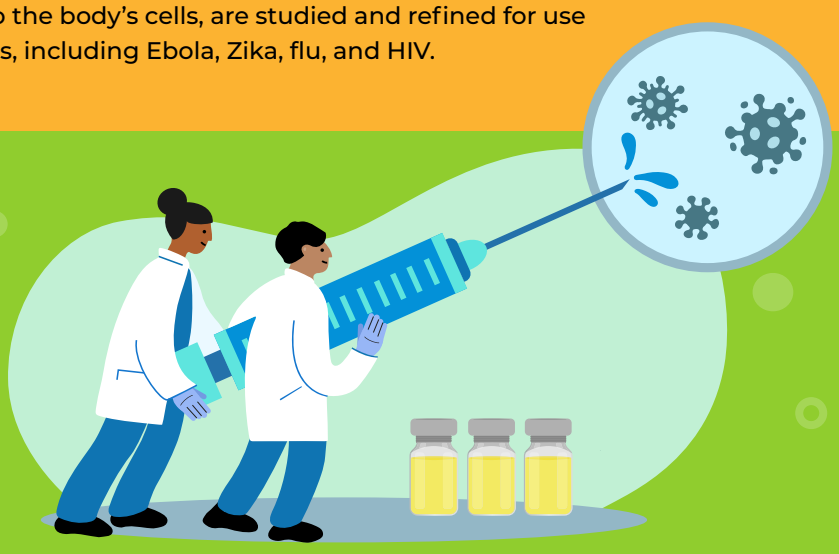
mRNA is explored to prevent diseases such as influenza (flu), Ebola, Zika, and others. Viral vector vaccines, which are vaccines that use a harmless virus as a vehicle to carry genetic information to the body's cells, are studied and refined for use against viruses, including Ebola, Zika, flu, and HIV.

2001-2010

2002-2003: First reports of coronavirus SARS-CoV-1—the original SARS—appear in China. Researchers at NIH and around the globe study the virus' origins, as well as how it makes people sick and spreads, and start to design ways to treat and prevent it.

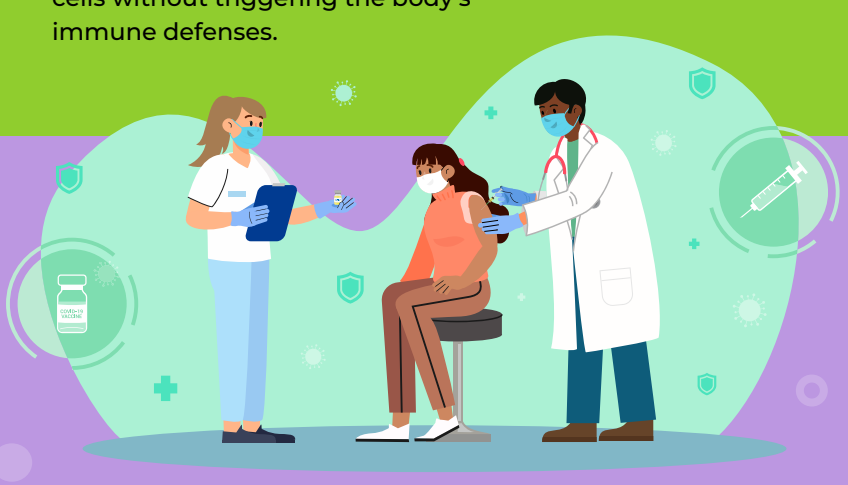
2002-2003: NIH researchers build more research about vaccines and treatments for coronaviruses, including SARS-CoV-1.

2005: A laboratory breakthrough creates medical mRNA parts that can safely deliver instructions to cells without triggering the body's immune defenses.



2005: The country's first Pandemic Influenza Preparedness Plan is created by the U.S. Department of Health and Human Services (HHS), laying the groundwork for pandemic response efforts ahead.

2010: For the first time, high-tech, 3D pictures are taken of respiratory syncytial virus (RSV), showing the structure of the virus, how it invades cells, and how it avoids the immune system. The lessons from these pictures of RSV give important details about the structures of viruses that are similar to coronaviruses, and their spike proteins.



2013: Researchers study a coronavirus called MERS-CoV that emerges from the Middle East/North Africa region. They apply what they have learned about viruses like HIV and RSV that change shape to "hide" from the immune system

2013: Scientists find a chemical combination that keeps the RSV from changing its shape to infect cells. Stopping that process gives the immune system more time to create antibodies against the virus.

2015-2016: A cryogenic (super-cold) electron microscope captures the first 3D images of a coronavirus spike protein.

2017: Scientists publish findings from clinical trials, or the first tests in humans, of mRNA-based vaccines for common infections, including flu and rabies.

2017: Based on earlier studies of coronaviruses and RSV, scientists find a chemical combination that keeps the MERS-CoV spike protein from changing shape as it invades cells. Stopping the protein from shape shifting gives the immune system more time to make antibodies against the virus, just like with RSV.

2011-2019

2019: Researchers publish the first evidence that a vaccine designed using what we know about specific proteins found on the surface of a virus like RSV can work to protect people. They showed that this kind of vaccine can successfully teach the body to make more antibodies that are ready to recognize and try to stop the virus.

2019: A World Health Organization's advisory group recommended a viral vector vaccine to combat Ebola in the Democratic Republic of Congo. The adenovirus used as the vehicle for that vaccine is later used in the viral vector vaccine for COVID-19.

2019: First signs of the novel coronavirus 2019 (2019-nCoV), later renamed SARS-CoV-2, emerge.

2020

January: Scientists map the DNA sequence of both the SARS-CoV-2 virus and its spike protein.

January: Scientists use the super cold cryogenic microscope to take pictures of the spike protein of SARS-CoV-2.

February: The chemical combination that kept the spike protein of MERS-CoV from changing shape to avoid the immune system is adapted to use for the spike protein of SARS-CoV-2.

March: A phase 1 COVID-19 vaccine study using mRNA begins enrolling volunteers in the U.S.

July: A phase 1 study of a viral vector COVID-19 vaccine begins in the U.S. Like mRNA vaccines, this viral vector vaccine uses the same chemical combination developed to keep the SARS-CoV-2 spike protein from changing its shape.

To learn more about the journey each COVID-19 vaccine followed from this point, see the Journey of a Vaccine.

Find more vaccine resources to share at:
https://covid19community.nih.gov/resources/learning-about-vaccines

NIH National Institutes of Health