Guidance for people with questions about the COVID 19 vaccines

Prepared by Dr Priscilla Lui and Dr. Katy White, December 28,2020

Videos about the vaccines:

https://www.youtube.com/watch?v=LcTEmHlvY10-- brief 2 min video about mRNA vaccines and how they work

https://youtu.be/l7k8dDCvrrc- 20 min video by Dr ZDogg about the mRNA vaccine

https://www.cdc.gov/vaccines/covid-19/health-systems-communication-toolkit.html#video - 4 min CDC informational video

https://www.pbs.org/video/inside-the-lab-that-invented-the-covid-19-vaccine-jnt6jk/-- 11 minute PBS special looking at a lab that helped identify and create the spike protein that is used by the mRNA vaccines

https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines/mrna.html--CDC CDC information on mRNA vaccines (posted below in this document)

https://www.instagram.com/p/CI1UEAZBEOy/?igshid=9frze75mquf-- Instagram post by a physician recommending the vaccine for his pregnant sister

https://youtu.be/wvaJnXP9VoY- 36 min video by Dr Z Dogg, update on the safety of the vaccine from 12/16/2020 and him strongly suggesting we consider getting vaccinated

https://youtu.be/Ho2VRaIzj28-- 51 min video by Dr Z Dogg, from 12/4/2020, interviewing another physician/FDA expert on the COVID vaccine

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CDC information about COVID vaccine

https://www.cdc.gov/coronavirus/2019-ncov/vaccines/faq.html

https://www.cdc.gov/vaccines/covid-19/hcp/answering-questions.html

Pearls from CDC link here: https://www.cdc.gov/vaccines/covid-19/hcp/answering-questions.html

Answering Patients' Questions

Some patients won't have questions about coronavirus disease 2019 (COVID-19) vaccination when you give your strong recommendation and use language that assumes patients will get vaccinated when doses are widely available. If a patient questions your recommendation about COVID-19 vaccination, this does not necessarily mean they will not accept a COVID-19 vaccine. This is a new vaccine, and some questions are to be expected. Your patients consider you their most trusted source of information when it comes to vaccines, and sometimes they simply want *your* answers to their questions.

This page outlines some topics patients ask about most vaccines and tips for how to answer their questions.

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Questions about Vaccine Safety and the Speed of Vaccine Development

The federal government, under the umbrella of Operation Warp Speedexternal icon, has been working since the start of the pandemic to make a COVID-19 vaccine available as soon as possible. This accelerated timeline is unprecedented and has raised concerns for some people that safety may be sacrificed in favor of speed. However, as with all vaccines, safety is a top priority.

Patients may ask: How do we really know if COVID-19 vaccines are safe? To respond, you can explain how:

- The Food and Drug Administration (FDA) carefully reviews all safety data from clinical trials and an authorizes emergency vaccine use only when the expected benefits outweigh potential risks.
- The Advisory Committee on Immunization Practices (ACIP) reviews all safety data before recommending any COVID-19 vaccine for use. Learn how ACIP makes vaccine recommendations.
- FDA and CDC will continue to monitor the safety of COVID-19 vaccines, to make sure even very rare side effects are identified.

Example:
COVID-19 vaccines were tested in large clinical trials to make sure they meet safety standards. Many people were recruited to participate in these trials to see how the vaccines offers protection to people of different ages, races, and ethnicities, as well as those with different medical conditions.
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Questions about Whether It Is Better to Get Natural Immunity Rather than Immunity from Vaccines

Because some people with COVID-19 can have very mild symptoms, some may see natural infection as preferable to receiving a new vaccine. Others may be concerned that getting a COVID-19 vaccine could make a later illness worse. Help your patients understand the risks and benefits so they can be confident choosing to get vaccinated.

Patients may ask: Is the vaccine that helpful? I heard getting COVID-19 gives you better and longer immunity than the protection a vaccine can give. Can it actually make my illness worse if I do end up getting COVID-19? **To respond, you can:**

- Explain the potential serious risk COVID-19 infection poses to them and their loved ones if they get the illness or spread it to others. Remind them of the potential for long-term health issues after recovery from COVID-19 disease.
- Explain that scientists are still learning more about the virus that causes COVID-19. And it is not known whether getting COVID-19 disease will protect everyone against getting it again, or, if it does, how long that protection might last.
- Describe how the vaccine was tested in large clinical trials and what is currently known about its safety and effectiveness.

Be transparent that the vaccine is not a perfect fix. Patients will still need to practice other precautions like wearing a mask, social distancing, handwashing and other hygiene measures until public health officials say otherwise.

Example:

"Both this disease and the vaccine are new. We don't know how long protection lasts for those who get infected or those who are vaccinated. What we do know is that COVID-19 has caused very serious illness and death for a lot of people. If you get COVID-19, you also risk giving it to loved ones who may get very sick. Getting a COVID-19 vaccine is a safer choice."
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Questions about Known Side Effects

Some COVID-19 vaccines may be more reactogenic than vaccines that people are familiar with. Information about specific side effects of the COVID-19 vaccine will be available when it is approved. It is important to set this expectation with your patient, in case they experience a strong reaction.

Patients may ask: How much will the shot hurt? Can it cause you to get very sick? ***To respond, you can:***

- Explain what the most common side effects from vaccination are and how severe they may be.
- Provide a comparison if it is appropriate for the patient (for example, pain after receiving Shingrix for older adults who have received it).
- Make sure patients know that a fever is a potential side effect and when they should seek medical care.

- Let them know that symptoms typically go away on their own within a week. Also let them know when they should seek medical care if their symptoms don't go away.
- Explain that the vaccine cannot give someone COVID-19.
- Explain that side effects are a sign that the immune system is working.

Example:
"Most people do not have serious problems after being vaccinated. We will understand more about mild side effects of the COVID-19 vaccine before we start to use it. However, your arm may be sore, red, or warm to the touch. These symptoms usually go away on their own within a week. Some people report getting a headache or fever when getting a vaccine. These side effects are a sign that your immune system is doing exactly what it is supposed to do. It is working and building up protection to disease."
question circle solid icon

Questions about Unknown, Serious, Long-term Side Effects

Due to the relative speed with which these vaccines were developed, patients' concerns about long-term side effects are reasonable and to be expected.

Patients may ask: How do we know that these vaccines are safe when they are so new? Couldn't they cause problems that we don't know about yet? What about long-term problems? ***To respond, you can:***

- Explain how FDA and CDC are continuing to monitor safety, to make sure even long-term side effects are identified.
- Reassure patients that COVID-19 vaccines will be continuously monitored for safety after authorization, and ACIP will take action to address any safety problems detected.
- Compare the potential serious risk of COVID-19 infection to what is currently known about the safety of COVID-19 vaccines.

Example:
COVID-19 vaccines are being tested in large clinical trials to assess their safety. However, it does take time, and more people getting vaccinated before we learn about very rare or long-term side effects. That is why safety monitoring will continue. CDC has an independent group of experts that reviews all the safety data as it comes in and provides regular safety updates. If a safety issue is detected, immediate action will take place to determine if the issue is related to the COVID-19 vaccine and determine the best course of action.
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How Many Doses Are Needed and Why?

All but one of the COVID-19 vaccines currently in phase 3 clinical trials use two shots. The same vaccine brand must be used for both shots.

Patients may ask: How many shots am I going to need? To respond, you can:

- Explain that two shots are generally needed to provide the best protection against COVID-19 and that the shots are given several weeks apart. The first shot primes the immune system, helping it recognize the virus, and the second shot strengthens the immune response.
- When applicable, explain the dosing options available in your office and advise the patient that they can set up an appointment before they leave to come back for a second dose.

Example:
Nearly all COVID-19 vaccines being studied in the United States require two shots. The first shot starts building protection, but everyone has to come back a few weeks later for the second one to get the most protection the vaccine can offer.
Other Questions Patients May Have about COVID-19 Vaccination

If you have additional questions from patients, reference Frequently Asked Questions about COVID-19 Vaccination for regularly updated answers to common questions.

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https://robinschoenthaler.medium.com/eighteen-vaccine-questions-answered-in-under-six-minutes-16679c96cd8a

{Robin Schoenthaler, MD is a Boston-based cancer doctor who has been writing straightforward fact-based no-blame-no-rumors-all-science-all-the-time essays about Covid-19 since March 2020

Here are answers to eighteen common questions about the two approved vaccines: **Pfizer's** vaccine (first one out of the gate, the one which health care workers started getting first) and the **Moderna** vaccine (just arriving at hospitals this week).

Q. Can I get infected from the vaccine?

A. No. Period. No. There is no virus in the injection so you cannot get COVID-19 from getting the vaccine.

Q. How effective are these vaccines?

A. Every vaccine trial has two groups of people — one who **gets** the vaccine and one who **doesn't** (they get a placebo). Then the scientists count up who gets sick.

Here's the results:

Pfizer:

18,000 people RECEIVED the vaccine: **8** got Covid

18,000 people DIDN'T GET the vaccine: **162** got Covid

Moderna:

14,000 people RECEIVED the vaccine: **11** got Covid

14,000 people DIDN'T GET the vaccine: **185** got Covid

So in total:

32,000 people RECEIVED the vaccine: **19** got Covid

32,000 people DIDN'T GET the vaccine: **347** got Covid

It adds up to >94% effectiveness — it's unbelievably fantastic, SPECTACULARLY good. This is why many health care workers are banging down the doors to get this vaccine in their arms as fast as they can.

Q. Why did this happen so fast? Isn't that dangerous?

A. This is the fastest vaccine development in the history of the world because a bunch of science went on for years before this and then a bunch of good stuff happened all at once. It's like a "perfect storm" of vaccine development:

1. Because our knowledge about genetic sequencing is about ten gajillion times better than it was a few years ago;
2. Because they figured out Covid's whole genetic code within days and then invented a vaccine in about half an hour (slight exaggeration but not much);
3. Because scientists have been studying other coronaviruses behind the scenes for years;
4. Because scientists have been studying mRNA vaccines behind the scenes for years;
5. Because researchers have figured out how to do really good vaccine trials and have worked out a lot of the kinks;
6. Because there was so much coronavirus around and it's so contagious that trials could finish up quickly;

7. Because the government, industry, and a bunch of charities poured buckets of money into this research;

8. Because the government paid for vaccines to be manufactured before the studies were done and sped all their processes up;

9. Because they've been working on vaccine distribution for months;

10. **Because if you spend a ton of money miracles can happen.**

Q. Don't scientists need more time to study these vaccines to be sure they're effective?

A. No. These trials were set up to accumulate a certain number of people and cases of Covid. Independent statisticians monitored the numbers throughout the study.

Once the trials hit those numbers, it was time to evaluate, and that's when they saw the big 95% differences in outcomes. There's no reason to think this will change much so boom! What's not to approve?

Q. Don't scientists need more time to study these vaccines to be sure they're safe?

A. They watched these 64,000 people in these trials super carefully:

- They kept close track of the short-term reactions (sore arm, fatigue, etc) and saw they didn't change over time and didn't last.

- Some people got their shots in July and they have been followed ever since (five months) with no new side effects during that time.
- As a rule with viruses you just don't see side effects or reactions more than few weeks after getting a vaccine
- The FDA didn't even look at the data until an average of **two** months after the last dose was given
- It is possible there will be new reactions or allergic reactions seen when the vaccine is given to eight gajillion more people but so far it's all been temporary and easily handled

Q. Could the data be fake?

A. The data has been examined by many different groups of scientists, doctors, statisticians etc., all along the way — independent groups early on and before approval, FDA career scientists, and CDC committee members (not to mention eight gazillion commenters on Twitter). It is probably the most examined data in history.

Q. Can these vaccines change my DNA?

A. No.

Q. Can these vaccines change my chromosomes?

A. No.

Q. Can these vaccines harm the chromosomes of my unborn child?

A. No.

Q. Do these vaccines impact a woman's fertility?

A. No.

Q. Do these vaccines impact a man's fertility or ability to have an erection?

A. No.

Q. Have these vaccines been tested on enough people?

A. Yes. In fact these trials are bigger than most.

Q. Do I have to get both shots?

A. Yes. The vaccines are about **50%** effective after one shot but then **95%** effective after the second dose. This is a no-brainer. Do not walk around in a state of 50/50 "maybe you'll get Covid, maybe you won't." **GET BOTH SHOTS.**

Q. Am I safe the day after the first shot?

A. No. It takes a while. You are super safe (94% safe!)a week after the second dose.

Q. Can I stop buying masks once I have my second shot?

A. No, not yet (unfortunately). We don't know yet about TRANSMISSION. Could you get vaccinated, get infected anyways, stay asymptomatic and then accidentally pass it along to others? Possibly. Since we don't know yet how often that happens, we need to mask up. We'll be wearing masks for a long while yet until the data on this critical question is in.

Q. What if I have allergies?

A. Tell your doctor, but at this point it is fine to get the vaccine no matter what kind of allergies you have (the only exception being of a history super huge allergic reactions to a past vaccine or components of this vaccine, in which case they'll make special arrangements).

Q. What if I'm pregnant? Or nursing?

A. Talk to your Ob. There's not a lot of data on these women, but so far there's no theoretical reason to think it's unsafe for you or baby. But being pregnant means you have an increased chance of getting bad Covid, so you need to think hard about how high your exposure risk is.

Q. What about the kids?

A. Kids weren't studied in the Pfizer/Moderna trials (children are never studied early on, they always test adults first). We may have data later in 2021. In the meantime, vaccinate their teachers and janitors and the kids will automatically be safer.

And one last word about the holidays — this is me pleading with you to stay home and stay safe:

An old patient of mine with an old cancer and an old heart told me he's going to spend Christmas alone to keep himself safe while waiting for his vaccine.

He said, "I know how to do this; it's what I did in Vietnam the last month of my tour. All I had to do was stay alive long enough to get to the troopship. I dreamt about that troopship every night, I could practically smell it. And every morning I got up and my goal was to be the grunt who stayed safe just long enough to get on that troopship home."

May we all be the grunt who stays safe this Christmas, and may every person in our family end up on the troopship with us, too.

Let's picture it in our dreams, this ship I'm calling The Vaccine Salvation, waiting for us in the harbor, waiting to take us home.

{Robin Schoenthaler, MD is a Boston-based cancer doctor who has been writing straightforward fact-based no-blame-no-rumors-all-science-all-the-time essays about Covid-19 since March 2020.}

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https://www.cas.org/blog/covid19-vaccine-questions

Updated: December 22, 2020

Recent promising news on the efficacy and safety of COVID-19 vaccines provides a light at the end of the tunnel of the pandemic that has upended normal life around the globe throughout 2020. Two mRNA vaccines, one from Pfizer/BioNTech and the other from Moderna, just received Emergency Use Authorization (EUA) in the U.S. and have also been authorized in the U.K and Canada, and there are many additional candidates following closely behind. However, with multiple vaccines expected to become available to the

public in the coming months, for many people this hope comes with a multitude of questions. Here, I will answer some of the most common scientific questions about the current COVID vaccine candidates that I am being asked and point you to key resources for additional information. I encourage everyone to share accurate, scientifically vetted information sources such as these with others to help ensure they can make well-informed decisions about vaccination.

What major types of vaccines are in development for COVID-19?

There are over 200 COVID-19 vaccine candidates in development around the world based on multiple different vaccination approaches. All vaccines work by giving the human body a weaker or non-disease-causing pathogen (or antigen) similar in structure to the disease causing pathogen, so that the human immune system can be trained to recognize that specific pathogen and respond to it effectively when encountering the actual pathogen. However, vaccine platforms differ in what antigen is used and how they introduce that antigen to initiate our bodies' immune response.

mRNA vaccines are relatively new in the vaccine research field. However, this technology has already shown great promise in vaccines against Zika virus and cytomegalovirus. The Pfizer/BioNTech vaccine (BNT162b2) and Moderna vaccine (mRNA-1273) candidate, which are expected to be the first made widely available, both use this vaccine approach, and there are more than 20 additional mRNA COVID-19 candidate currently in various stages of development.
Instead of directly delivering an immune-triggering antigen into the human body, mRNA vaccines deliver a piece of mRNA with the genetic code that our cells can use to make the antigen. mRNA is a fragile biomolecule that is easily degraded at increased temperatures or by enzymes in the human body. Therefore, these vaccines must be stored at very low temperatures. The mRNA in these vaccine formulations is also packaged in lipid nanoparticles that preserve their stability and help facilitate delivery of the mRNA to human cells.

Despite limited experience with mRNA vaccines, they are generally considered safer than traditional vaccines that use viral material because they minimize the risk of introducing pathogens or causing genomic mutations. The manufacturing of mRNA vaccines is also more rapid, less expensive and more scalable than other vaccine types, which is especially important given the urgency of the current COVID-19 situation.

For more detailed information about mRNA vaccines, read this recent blog and watch the video below that shows how these vaccines work at the cellular level

Non-replicating viral vector vaccines use a non-disease causing virus as a vector to carry the genetic instructions for expressing the antigen protein of the disease-causing virus, yet this carrier virus has been genetically modified so that it cannot replicate in our bodies. One good example of this vaccination technology in use is the Ebola virus vaccine, which was recently licensed for emergency use in the European Union. There are ~30 COVID-19 candidate vaccines being developed based on this vaccine platform, including the leading candidates from AstraZeneca/Oxford (AZD1222) and Janssen (Ad26COVS1). This vaccine approach offers several advantages including high production capacity, low cost and less stringent temperature requirements during storage and transportation.

Protein subunit vaccines differ from both the mRNA and non-replicating viral vaccines because they introduce the antigen proteins that trigger an immune response directly into the body, instead of introducing genetic information that our cells use to make these antigens in vivo. The FluBlok vaccine for influenza is an example of a currently licensed vaccine that uses this approach. Currently, there are ~70 COVID-19 candidate vaccines being developed based on the protein subunit vaccine technology, with more than 10 in clinical trials.

Inactivated virus vaccines are produced by growing the pathogenic virus via cell culture that is then inactivated and introduced into the body. Most common influenza vaccines use this approach. Currently, there are about 20 COVID-19 candidate vaccines being developed based on an inactivated virus vaccine approach. Because the whole virus is introduced to the body, this approach applies to wide range of antigenic proteins and often mimics the true infection in terms of immune response. However, production capacity is limited because it requires a facility with a high biosafety level to support handling of the live virus.

Further comparison of each of the vaccine types and more information on how they work can be found in this article.

How was a COVID-19 vaccine developed so fast?

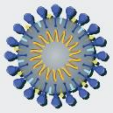
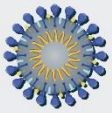
Traditionally vaccines have often taken 15 years or more to get from the lab to the market, including design, development, pre-clinical testing, clinical trials, and regulatory review. Thus, the fact that we have multiple highly effective vaccines for COVID-19 approved or near approval in less than a year is remarkable. This record-breaking speed does not reflect a lack of

diligence in development or testing. No steps were skipped or regulatory standards lowered in the development of these vaccines. Instead, the development process was able to be accelerated in the following ways: (1) Researchers have collaborated and shared information to an unprecedented degree, starting with Chinese scientists releasing the genomic sequence of the SARS-CoV-2 virus to the global research community in early January. (2) Although the mRNA vaccine is considered a new technology, the foundational idea actually emerged in the 1990s, and research on mRNA vaccine technology that has been ongoing since 2003 with the SARS outbreak was heavily leveraged for COVID-19. (3) COVID-19 vaccine development has been actively supported from a financial and regulatory perspective by global governments, with efforts such as the Operation Warp Speed in the U.S. prioritizing these vaccines to move them through the regulatory process as quickly as possible and pre-planning for distribution. (4) The widespread nature of the pandemic and high public interest provided an adequate pool of participants to support multiple simultaneous late-stage clinical trials.

What COVID-19 vaccines will be available soon, and which is the best?

Overall, there are more than 50 candidate vaccines currently in clinical investigation and close to 170 in pre-clinical evaluation around the world. More than 30 countries have been working on developing COVID-19 vaccines, and at least half have one or multiple vaccines in clinical trials (Figure 1). The vaccines expected to be publically available first are the mRNA vaccines from Pfizer/BioNTech and Moderna, which were recently approved for distribution in the U.S., U.K. and Canada. China and Russia have also begun distribution of vaccines they have developed and have chosen to grant authorization ahead of the completion of clinical trials.
The table below highlights key features of the four leading vaccines for which preliminary efficacy data from late stage clinical trials has been released. The mRNA vaccines both show higher efficacy than the non-replicating viral vector vaccine candidate from AstraZeneca/Oxford does, based on initial data. However, the latter offers some advantages in cost and storage requirements.. Another non-replicating adenovirus vector vaccine developed by Janssen is expected to have large clinical trial enrollment and may only require one dose, but the efficacy data is not available yet.

Key features of the COVID-19 vaccine frontrunners

	Pfizer/ BioNTech BNT162b2	**Moderna** mRNA-1273	**AstraZeneca/ Oxford** ChAdOx1-S/ AZD1222	**Janssen (Johnson & Johnson)** Ad26COVS1
Type of vaccine	mRNA in lipid nanoparticles 	mRNA in lipid nanoparticles 	Non-replicating adenovirus vector 	Non-replicating adenovirus vector 
Dosage	2 doses 21 days apart	2 doses 28 days apart	2 doses 28 days apart	1 dose or 2 doses 56 days apart
Antibody detection	7 days after booster	14 days after booster	14 days after booster	14 days after booster
Efficacy	95%	95%	70%	N.A.
Planned production volume	50M (2020) 1.3B (2021)	20M (2020) 0.5-1B (2021)	3B (2021)	1B (2021)
Storage requirement	-70°C±10°C	-20°C	2-8 °C	2-8 °C
Shelf life once thawed	5 days	30 days	180 days	180 days
Phase III trial enrollment	43,000 (age 16-85)	30,000 (age 18+)	11,500 (age 18+)	Single dose 60,000 Two dose 30,000 (age 18 +)
Percentage high-risk population in phase III trial	40.90%	42%	N.A.	N.A.

Keep in mind, however, that the first to market is not necessarily the best long-term solution for everyone. In addition to the above frontrunners, there are many other promising vaccine candidates still working their way through clinical trials. Some of those candidates may offer alternatives to overcome key logistical challenges faced by the leading candidates, including the need for multiple doses, extreme storage temperature requirements, short shelf life and possible low public confidence in new vaccine platforms.

These additional late-stage candidates, if approved, will be especially important to support vaccination programs in places where physical, clinical and public health infrastructure are more limited. For example, NVX-CoV2373, developed by Novavax and currently in phase III clinical trial, is a protein subunit vaccine, based on the same vaccine technology as the existing hepatitis B vaccine. This vaccine candidate appears to have milder side effects, triggers a stronger immune response than the mRNA vaccines, can be stored at normal refrigeration temperatures and may offer public confidence of safety due to familiarity with the technology. Another example, ARCT-021 from Arcturus Therapeutics, currently in phase II clinical study, is another mRNA vaccine candidate. It delivers a self-amplifying RNA payload directly into cells, which requires only one shot at a much lower dose. Thanks to the freeze-drying, ARCT-021 can also be stored at normal refrigeration temperatures.

How do I know that the COVID vaccines are safe?

Vaccination is considered one of the greatest medical achievements of modern civilization. It has freed us from many deadly infectious diseases that decimated populations in the past. Since the pioneering work of Dr. Edward Jenner on a cowpox vaccine more than 200 years ago, vaccines against many deadly infectious diseases such as measles, mumps, rubella, polio, hepatitis A and B, human papillomavirus (HPV) and influenza have become a common part of basic medical care. The development process for the COVID-19 vaccine is no different from that used for the development of these vaccines most people take without concern, other than it has benefited from expedited research and approval focus.

The entire development, evaluation and regulatory process that a vaccine must undergo before being deployed to the public has been carefully designed with safety as the primary focus. Clinical trials of vaccines are massive undertakings that include large groups of diverse volunteers to establish vaccine efficacy and rule out rare short- and long-term safety issues. A wealth of previous vaccine development data shows that most severe vaccine reactions and side effects occur within 6 weeks after vaccination. For this reason, the FDA insists on having at least two months of

safety data from a phase III clinical trial before even considering granting EUA, but participant data is tracked for many years to ensure no long-term issues arise.

The clinical trial population sizes for the leading COVID-19 vaccines were consistent with those for past vaccine trials. The Pfizer clinical trial data show that among the 44,000 participants there have been 170 confirmed COVID-19 cases to date. Of those cases, 162 came from the placebo group, while only eight were from the vaccinated group. Moderna's 30,000-person clinical trial data showed that only five people in the vaccinated group developed confirmed cases of COVID-19, whereas 90 people who received placebo shots became ill. Though most trial participants did experience some side effects, they were mostly mild and included fatigue, headache, injection site pain, and muscle pain, which many participants noted were more significant after the second dose.

How long will the vaccine protect me against COVID-19?

The full extent of immunity for those that have had COVID-19 or gain immunity through vaccination is not yet fully known. Researchers report that the antibody levels in the blood of COVID-19 patients drop quickly during the weeks after their recovery. However, the memory B cells and T cells, both capable of rapid immune response to possible reinfection, are known to last for a much longer period. The idea that these cells may provide longer lasting immunity is supported by the observation that recovered COVID-19 patients are highly unlikely to contract the disease again for at least six months. In addition, scientists also anticipate that COVID-19 vaccine-induced immunity may be stronger than that from natural viral infection. That belief is supported by early antibody tests in people vaccinated with Moderna's mRNA vaccine that showed higher antibody production than observed in recovered COVID-19 patients as well as longer-term data on many widely used vaccines including human papillomavirus and tetanus vaccines. In addition, from what has been observed to date, this coronavirus does not mutate as fast as the influenza virus, so it is very unlikely that researchers will need to redesign another vaccine for COVID-19 each year.
It is important to understand, however, that most COVID vaccine clinical trials are designed to prove that each vaccine is safe and establish how effectively it prevents disease. They do not necessarily establish that the vaccines prevent infection altogether. Therefore, until further tests are conducted next year, it is still unknown whether these vaccines prevent people from spreading the virus even if they do not become ill. Thus, masks and social

distancing may still be recommended until a high portion of the population has been vaccinated.

For more detailed information on COVID-19 vaccines and therapeutics, including scientific insights, open access datasets, and special reports, check out the CAS COVID-19 resources.

CDC information on mRNA vaccines:

https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines/mrna.html

Messenger RNA vaccines—also called mRNA vaccines—are some of the first COVID-19 vaccines authorized for use in the United States.

New Approach to Vaccines

mRNA vaccines are a new type of vaccine to protect against infectious diseases. To trigger an immune response, many vaccines put a weakened or inactivated germ into our bodies. Not mRNA vaccines. Instead, they teach our cells how to make a protein—or even just a piece of a protein—that triggers an immune response inside our bodies. That immune response, which produces antibodies, is what protects us from getting infected if the real virus enters our bodies.

A Closer Look at How COVID-19 mRNA Vaccines Work

COVID-19 mRNA vaccines give instructions for our cells to make **a harmless piece** of what is called the "spike protein." The spike protein is found on the surface of the virus that causes COVID-19.

COVID-19 mRNA vaccines are given in the upper arm muscle. Once the instructions (mRNA) are inside the immune cells, the cells use them to make the protein piece. After the protein piece is made, the cell breaks down the instructions and gets rid of them.

Next, the cell displays the protein piece on its surface. Our immune systems recognize that the protein doesn't belong there and begin building an immune response and making antibodies, like what happens in natural infection against COVID-19.

At the end of the process, our bodies have learned how to protect against future infection. The benefit of mRNA vaccines, like all vaccines, is those vaccinated gain

this protection without ever having to risk the serious consequences of getting sick with COVID-19.

Facts about COVID-19 mRNA Vaccines

They cannot give someone COVID-19.

- mRNA vaccines do not use the live virus that causes COVID-19.

They do not affect or interact with our DNA in any way.

- mRNA never enters the nucleus of the cell, which is where our DNA (genetic material) is kept.
- The cell breaks down and gets rid of the mRNA soon after it is finished using the instructions.

COVID-19 mRNA Vaccines Will Be Rigorously Evaluated for Safety

mRNA vaccines have been held to the same rigorous safety and effectiveness standardsexternal icon as all other types of vaccines in the United States. The only COVID-19 vaccines the Food and Drug Administration (FDA) will make available for use in the United States (by approval or emergency use authorization) are those that meet these standards.

mRNA Vaccines Are New, But Not Unknown

Researchers have been studying and working with mRNA vaccines for decades. Interest has grown in these vaccines because they can be developed in a laboratory using readily available materials. This means the process can be standardized and scaled up, making vaccine development faster than traditional methods of making vaccines.

mRNA vaccines have been studied before for flu, Zika, rabies, and cytomegalovirus (CMV). As soon as the necessary information about the virus that causes COVID-19 was available, scientists began designing the mRNA instructions for cells to build the unique spike protein into an mRNA vaccine.

Future mRNA vaccine technology may allow for one vaccine to provide protection for multiple diseases, thus decreasing the number of shots needed for protection against common vaccine-preventable diseases.

Beyond vaccines, cancer research has used mRNA to trigger the immune system to target specific cancer cells.

Related Links

- FDA's Vaccine Development 101external icon
- FDA's Emergency Use Authorization for Vaccines Explainedexternal icon
    - FDA Infographic: The Path for a COVID-19 Vaccine from Research to Emergency Use Authorizationexternal icon