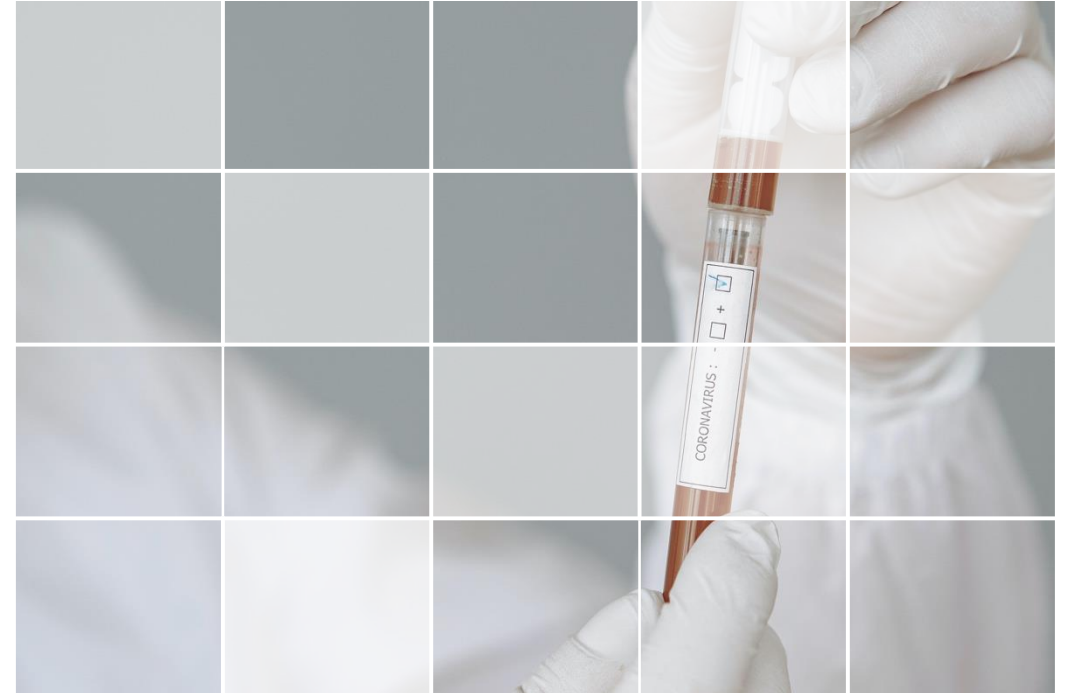




COVID-19 Vaccine Overview



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Types of Vaccines



mRNA Vaccine

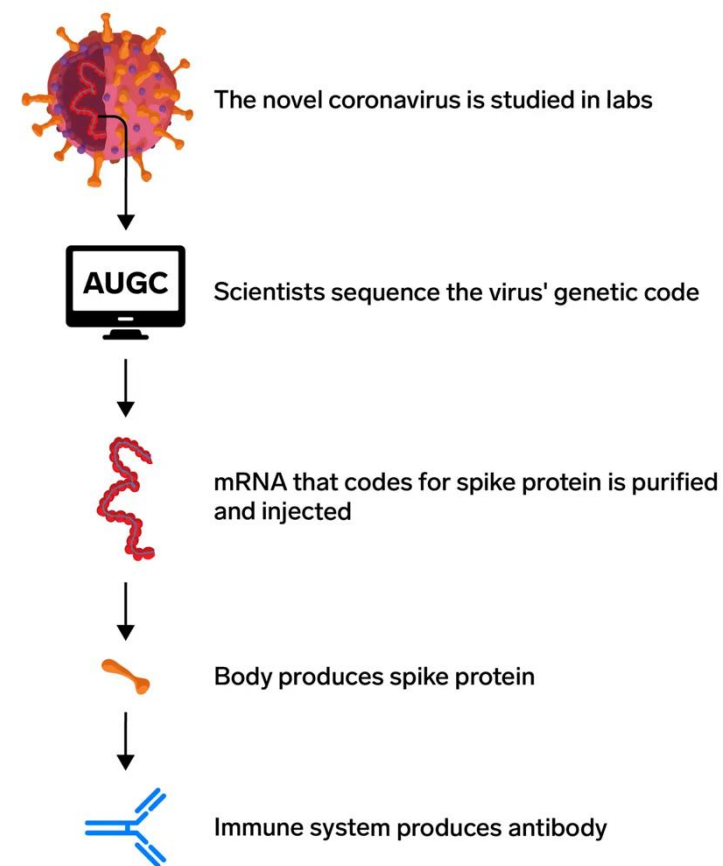
COVID-19 mRNA vaccines give instructions for our cells to make a **harmless piece** of what is called the “**spike protein.**” The spike protein is found on the surface of the virus that causes COVID-19.

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.

How mRNA vaccines work



Source: National Institutes of Health presentation at Senate hearing on September 9, 2020.

INSIDER

Sources: Centers for Disease Control and Prevention. “Understanding mRNA COVID-19 Vaccines”, <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines/mRNA.html>. Accessed Sept. 2, 2021; Insider. “Moderna's groundbreaking coronavirus vaccine was designed in just 2 days”, <https://www.businessinsider.com/moderna-designed-coronavirus-vaccine-in-2-days-2020-11>. Accessed Sept. 2, 2021

Viral Vector COVID-19 Vaccines

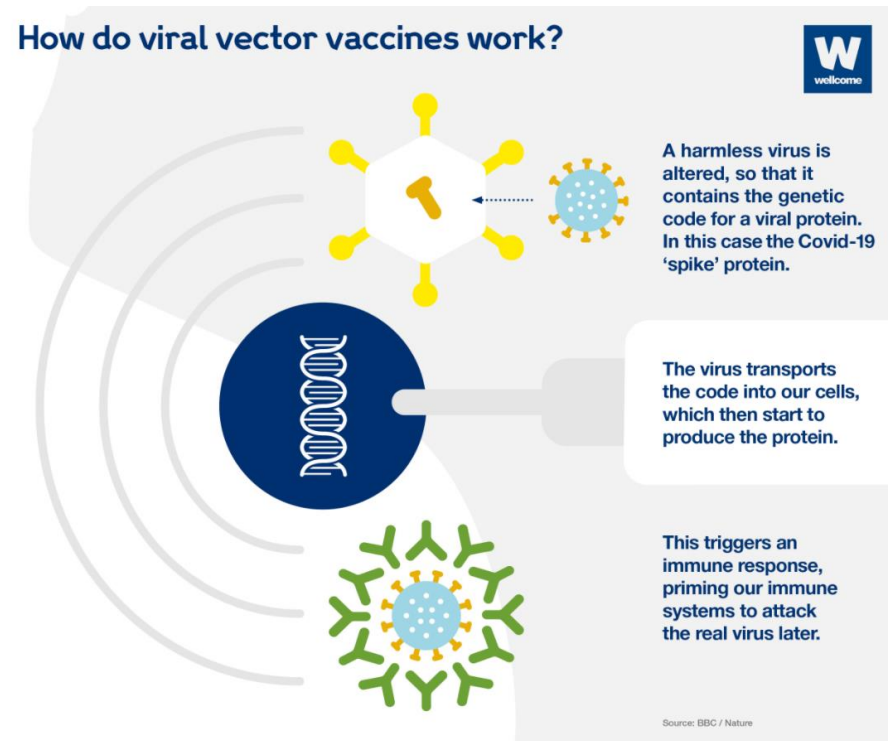
Viral vector vaccines use a **modified version** of a different virus (the vector) to deliver important instructions to our cells.

First, the vector (not the virus that causes COVID-19, but a different, harmless virus) will enter a cell in our body and then use the cell's machinery to produce a **harmless piece** of the virus that causes COVID-19. This piece is known as a spike protein and it is only found on the surface of the virus that causes COVID-19.

Next, the cell displays the spike protein on its surface, and our immune system recognizes it doesn't belong there. This triggers our immune system to begin **producing antibodies and activating other immune cells** to fight off what it thinks is an infection.

At the end of the process, our bodies have **learned how to protect us** against future infection with the virus that causes COVID-19. The benefit is that we get this protection from a vaccine, without ever having to risk the serious consequences of getting sick with COVID-19. Any temporary discomfort experienced after getting the vaccine is a natural part of the process and an indication that the vaccine is working.

How do viral vector vaccines work?



Sources: Centers for Disease Control and Prevention. "Understanding Viral Vector COVID-19 Vaccines", <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines/viralvector.html>. Accessed Sept. 30, 2021; World Economic Forum. "Chart of the day: How do the different COVID-19 vaccines work?", <https://www.weforum.org/agenda/2021/01/how-do-covid-19-vaccines-work-pfizer-oxford/>. Accessed Sept. 2, 2021

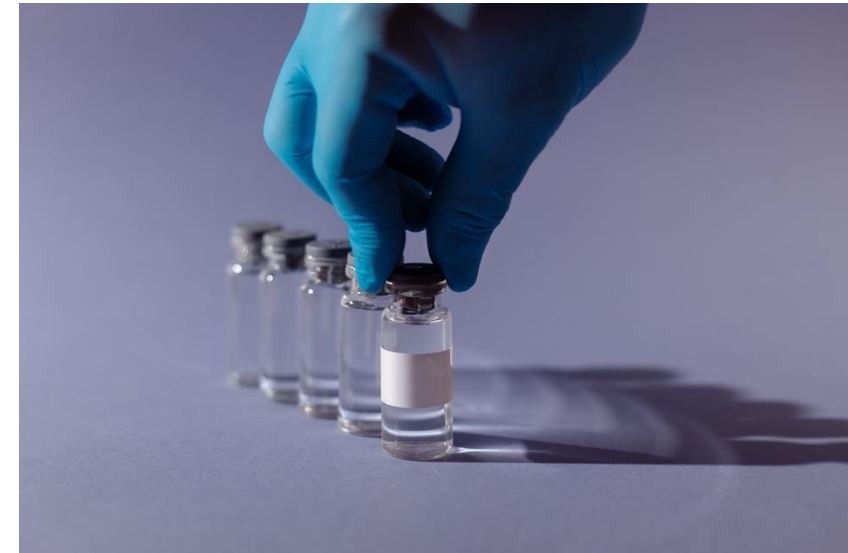
Inactivated Vaccines

Inactivated vaccines contain whole bacteria or viruses which **have been killed or have been altered**, so that they cannot replicate. Because inactivated vaccines do not contain any live bacteria or viruses, they **cannot cause the diseases** against which they protect, even in people with severely weakened immune systems. However, inactivated vaccines do not always create such a strong or long-lasting immune response as live attenuated vaccines.



Protein Subunit Vaccines

Protein subunit vaccines include **harmless pieces** (proteins) of the virus that causes COVID-19 instead of the entire germ. Once vaccinated, our bodies recognize that the protein should not be there and build **T-lymphocytes and antibodies** that will remember how to fight the virus that causes COVID-19 if we are infected in the future.



Vaccine Efficacy





How to Calculate Vaccine Efficacy?

$$VE = (ARU - ARV) / ARU * 100\%$$

VE = Vaccine efficacy

ARU = Attack rate of unvaccinated people

ARV = Attack rate of vaccinated people



COVID-19 Vaccines Overview

Types of Vaccines	Vaccine Name	Vaccine Efficacy
mRNA Vaccines	Pfizer-BioNTech	95% (People 16 years and older)
	Moderna	94.1% (People 18 years and older)
Viral Vector Vaccines	Johnson & Johnson's Janssen	66.3%
	AstraZeneca/Oxford	63.09%
Inactivated Vaccines	Sinopharm	79%
	Sinovac	51%

Sources: Centers for Disease Control and Prevention. "Information about the Pfizer-BioNTech COVID-19 Vaccine", <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines/Pfizer-BioNTech.html>; "Moderna COVID-19 Vaccine Overview and Safety", <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines/Moderna.html>; "Information About Johnson & Johnson's Janssen COVID-19 Vaccine", <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines/janssen.html>; World Health Organization. "The Sinopharm COVID-19 vaccine: What you need to know", <https://www.who.int/news-room/feature-stories/detail/the-sinopharm-covid-19-vaccine-what-you-need-to-know>. "The Sinovac COVID-19 vaccine: What you need to know", <https://www.who.int/news-room/feature-stories/detail/the-sinovac-covid-19-vaccine-what-you-need-to-know>; "The Oxford/AstraZeneca COVID-19 vaccine: what you need to know", <https://www.who.int/news-room/feature-stories/detail/the-oxford-astrazeneca-covid-19-vaccine-what-you-need-to-know>. Accessed Sept. 2, 2021

Children and COVID-19 vaccines

The FDA has given the Pfizer-BioNTech COVID-19 vaccine emergency use authorization for children **ages 12 through 15**.

The Pfizer-BioNTech COVID-19 vaccine requires two injections given 21 days apart. The second dose can be given up to six weeks after the first dose, if needed.

Research has shown that the Pfizer-BioNTech COVID-19 vaccine is **100%** effective in preventing the COVID-19 virus in children ages 12 through 15. Previous research has shown that the vaccine is **95%** effective in preventing the COVID-19 virus with symptoms in people age 16 and older.

Children and COVID-19 vaccines

PFIZER AND BIONTECH ANNOUNCE POSITIVE TOPLINE RESULTS FROM PIVOTAL TRIAL OF COVID-19 VACCINE IN CHILDREN 5 TO 11 YEARS

- Results are the first from a pivotal trial of any COVID-19 vaccine **in children under 12 years of age**
- In participants 5 to 11 years of age, the vaccine was **safe, well tolerated and showed robust neutralizing antibody responses**
- Companies plan to submit these data to the FDA, EMA and other regulatory agencies around the world as soon as possible
- Results in children under 5 years of age are expected as soon as later this year

Source: Pfizer. “PFIZER AND BIONTECH ANNOUNCE POSITIVE TOPLINE RESULTS FROM PIVOTAL TRIAL OF COVID-19 VACCINE IN CHILDREN 5 TO 11 YEARS”, <https://investors.pfizer.com/investor-news/press-release-details/2021/Pfizer-and-BioNTech-Announce-Positive-Topline-Results-From-Pivotal-Trial-of-COVID-19-Vaccine-in-Children-5-to-11-Years/default.aspx>. Accessed Sept. 22, 2021

Variants and COVID-19 Vaccines

In the U.S., the **delta (B.1.617.2) variant** is now the most common COVID-19 variant. It is nearly twice as contagious as earlier variants and might cause more severe illness.

While research suggests that COVID-19 vaccines are slightly less effective against the variants, the vaccines still appear to provide **protection against severe COVID-19**. For example:

Early research from the U.K. suggests that, after full vaccination, the Pfizer-BioNTech COVID-19 vaccine is **88%** effective at preventing **symptomatic COVID-19 virus**. The vaccine is also **96%** effective at preventing **severe disease** with the COVID-19 virus caused by the **delta variant**.

Early research from Canada suggests that, after one dose, the Moderna COVID-19 vaccine is **72%** effective at preventing **symptomatic COVID-19 virus** caused by the **delta variant**. One dose of the vaccine is also **96%** effective at preventing **severe disease** with the COVID-19 virus caused by the delta variant.

The Janssen/Johnson & Johnson COVID-19 vaccine is **85%** effective at preventing **severe disease** with the COVID-19 virus caused by the **delta variant**, according to data released by Johnson & Johnson.

Israel MoH Vaccination Program and Analysis

In January, **Pfizer and the Israel MoH** entered into a collaboration agreement to monitor the real-world impact of the Pfizer-BioNTech COVID-19 Vaccine.

Findings from the analysis were derived from de-identified aggregate Israel MoH surveillance data collected between January 17 and March 6, 2021, when the Pfizer-BioNTech COVID-19 Vaccine was the **only vaccine available in the country** and when the more transmissible B.1.1.7 variant of SARS-CoV-2 (formerly referred to as the U.K. variant) was the dominant strain. Vaccine effectiveness was **at least 97% against symptomatic COVID-19 cases, hospitalizations, severe and critical hospitalizations, and deaths**. Furthermore, the analysis found a vaccine effectiveness of **94% against asymptomatic SARS-CoV-2 infections**. For all outcomes, vaccine effectiveness was measured from two weeks after the second dose.

Explanation About the Effectiveness of the Vaccine for Coronavirus in Israel

The Ministry of Health is continuously monitoring the effectiveness of the vaccine for coronavirus.

As published yesterday (5.7.2021) in the Ministry of Health's announcement, epidemiological analysis by the public health services in the Ministry of Health reveals that starting June 6th, the effectiveness of the vaccine decreased to **64% in preventing infection** and **64% in preventing symptomatic illness**.

This decrease was observed simultaneously with the spread of the Delta variant in Israel. Nevertheless, the effectiveness of the vaccine in **preventing serious illness and hospitalization** cases is estimated at **93%**.

Things to Know before Vaccination

	Pfizer-BioNTech	Moderna	Johnson & Johnson's Janssen
Recommended Group	12 years and older	18 years and older	18 years and older
Fully Vaccinated Time	Two weeks after the second shot	Two weeks after the second shot	Two weeks after the shot
Number of shots	2 shots, 21 days apart Moderately to severely immunocompromised people should get an additional shot (3rd dose) at least 28 days after their 2nd shot. Other groups of people are recommended to get a booster shot at least 6 months after getting their 2nd shot.	2 shots, 28 days apart Some immunocompromised people should get 3 shots	1 shot

Sources: Centers for Disease Control and Prevention. “Pfizer-BioNTech COVID-19 Vaccine Overview and Safety”, <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines/Pfizer-BioNTech.html>; “Moderna COVID-19 Vaccine Overview and Safety”, <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines/Moderna.html>; “Johnson & Johnson’s Janssen COVID-19 Vaccine Overview and Safety”, <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines/janssen.html>; “When You’ve Been Fully Vaccinated”, <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/fully-vaccinated.html>. Accessed Oct. 1, 2021

Who Needs an Additional COVID-19 Vaccine?

Currently, CDC is recommending that moderately to severely immunocompromised people receive an additional dose. This includes people who have:

- Been receiving active cancer treatment for tumors or cancers of the blood
- Received an organ transplant and are taking medicine to suppress the immune system
- Received a stem cell transplant within the last 2 years or are taking medicine to suppress the immune system
- Moderate or severe primary immunodeficiency (such as DiGeorge syndrome, Wiskott-Aldrich syndrome)
- Advanced or untreated HIV infection
- Active treatment with high-dose corticosteroids or other drugs that may suppress your immune response

People should talk to their healthcare provider about their medical condition, and whether getting an additional dose is appropriate for them.

Pfizer-BioNTech COVID-19 Vaccine Booster Shot

COVID-19 Vaccine booster shots are available for the following Pfizer-BioNTech vaccine recipients who completed their initial series **at least 6 months ago** and are:

- 65 years and older
- Age 18+ who live in long-term care settings
- Age 18+ who have underlying medical conditions
- Age 18+ who work in high-risk settings
- Age 18+ who live in high-risk settings

Local Adverse Reactions (Within 7 Days After Each Dose)

	P-B D1	P-B D2	M D1	M D2	J
	N=2291	N=2098	N=11406	N=10985	N=2036
Pain	83.1%	77.8%	86.9%	89.9%	58.6%
Pain ^b	1%	1.2%	3.2%	4.6%	0.4%

P-B=Pfizer-BioNTech (Participants 18-55 Years of Age) M=Moderna (Participants 18-64 Years) J=Johnson & Johnson's Janssen (Individuals 18 to 59 Years of Age) D1=Dose 1 D2=Dose 2

Pain^b: P-B: Prevents daily activity. M: Defined as any use of prescription pain reliever; prevents daily activity. J: Defined as incapacitating symptoms; inability to do work, school, or usual activities; use of narcotic pain reliever.

Sources: Food and Drug Administration. <https://www.fda.gov/media/144637/download>; <https://www.fda.gov/media/144413/download>; <https://www.fda.gov/media/146304/download>. Accessed Mar. 31, 2021

Local Adverse Reactions (Within 7 Days After Each Dose)

	P-B D1	P-B D2	M D1	M D2	J
	N=2291	N=2098	N=11406	N=10985	N=2036
Erythema / Redness ^a	4.5%	5.9%	3.0%	8.9%	9%
Erythema /Redness ^b	0.3%	0.5%	0.3%	1.9%	0.3%
Swelling ^a	5.8%	6.3%	6.7%	12.6%	7%
Swelling ^b	0.2%	0.3%	0.5%	1.7%	0.2%

P-B=Pfizer-BioNTech (Participants 18-55 Years of Age) M=Moderna (Participants 18-64 Years) J=Johnson & Johnson's Janssen (Individuals 18 to 59 Years of Age) D1=Dose 1 D2=Dose 2

Erythema/ Redness^a & Swelling^a : P-B: Defined as >2cm M: Defined as ≥ 25 mm J: Defined as ≥ 25 mm

Erythema /Redness^b & Swelling^b : Defined as >100 mm

Sources: Food and Drug Administration. <https://www.fda.gov/media/144637/download>;
<https://www.fda.gov/media/144413/download>; <https://www.fda.gov/media/146304/download>. Accessed Mar. 31, 2021

Systemic Adverse Reactions (Within 7 Days After Each Dose)

	P-B D1	P-B D2	M D1	M D2	J
	N=2291	N=2098	N=11406	N=10985	N=2036
Headache	41.9%	51.7%	35.3%	62.8%	44.4%
Headache ^b	1.0%	3.2%	1.9%	5.0%	0.9%
Fever	3.7%	15.8%	0.9%	17.4%	12.8%
Fever ^b	0.3%	1.2%	<0.1%	1.7%	0.3%

P-B=Pfizer-BioNTech (Participants 18-55 Years of Age) M=Moderna (Participants 18-64 Years) J=Johnson & Johnson's Janssen (Individuals 18 to 59 Years of Age) D1=Dose 1 D2=Dose 2

Headache^b: P-B: Prevents daily activity. M: Defined as significant; any use of prescription pain reliever or prevents daily activity. J: Defined as incapacitating symptoms; requires bed rest and/or results in loss of work, school, or cancellation of social activities; use of narcotic pain reliever.

Fever^b: P-B: Defined as $>38.9^{\circ}\text{C}$ to 40.0°C M: Defined as $\geq 39.0^{\circ}\text{C}$ – $\leq 40.0^{\circ}\text{C}$ / $\geq 102.1^{\circ}\text{F}$ – $\leq 104.0^{\circ}\text{F}$ J: Defined as 39.0°C - 40.0°C

Sources: Food and Drug Administration. <https://www.fda.gov/media/144637/download>;
<https://www.fda.gov/media/144413/download>; <https://www.fda.gov/media/146304/download>. Accessed Mar. 31, 2021

Systemic Adverse Reactions (Within 7 Days After Each Dose)

	P-B D1	P-B D2	M D1	M D2	J
	N=2291	N=2098	N=11406	N=10985	N=2036
Fatigue ^a	47.4%	59.4%	38.4%	67.6%	43.8%
Fatigue ^b	1.4%	4.6%	1.1%	10.7%	1.2%
Myalgia ^a	21.3%	37.3%	23.7%	61.6%	39.1%
Myalgia ^b	0.6%	2.2%	0.6%	10.1%	1.4%

P-B=Pfizer-BioNTech (Participants 18-55 Years of Age) M=Moderna (Participants 18-64 Years) J=Johnson & Johnson's Janssen (Individuals 18 to 59 Years of Age) D1=Dose 1 D2=Dose 2 Myalgia: Muscle Pain

Fatigue^b & Myalgia^b: P-B: Prevents daily activity. M: Defined as significant; prevents daily activity. J: Defined as incapacitating symptoms; requires bed rest and/or results in loss of work, school, or cancellation of social activities; use of narcotic pain reliever.

Sources: Food and Drug Administration. <https://www.fda.gov/media/144637/download>;
<https://www.fda.gov/media/144413/download>; <https://www.fda.gov/media/146304/download>. Accessed Mar. 31, 2021

Systemic Adverse Reactions (Within 7 Days After Each Dose)

	P-B D1	P-B D2	M D1	M D2	J
	N=2291	N=2098	N=11406	N=10985	N=2036
Nausea/ Vomiting ^a	1.2%	1.9%	9.4%	21.4%	15.5%
Nausea/ Vomiting ^b	0	0.2%	<0.1%	<0.1%	0.1%

P-B=Pfizer-BioNTech (Participants 18-55 Years of Age) M=Moderna (Participants 18-64 Years) J=Johnson & Johnson's Janssen (Individuals 18 to 59 Years of Age) D1=Dose 1 D2=Dose 2

Nausea/Vomiting^b: P-B: Vomiting: Requires intravenous hydration. M: Nausea/Vomiting: Defined as prevents daily activity, requires outpatient intravenous hydration. J: Nausea: Defined as incapacitating symptoms; requires bed rest and/or results in loss of work, school, or cancellation of social activities; use of narcotic pain reliever.

Sources: Food and Drug Administration. <https://www.fda.gov/media/144637/download>; <https://www.fda.gov/media/144413/download>; <https://www.fda.gov/media/146304/download>. Accessed Mar. 31, 2021

Systemic Adverse Reactions (Within 7 Days After Each Dose)

	P-B D1	P-B D2	M D1	M D2	J
	N=2291	N=2098	N=11406	N=10985	N=2036
Use of antipyretic or pain medication	27.8%	45.0%	23.3%	57.3%	26.4%

P-B=Pfizer-BioNTech (Participants 18-55 Years of Age) M=Moderna (Participants 18-64 Years) J=Johnson & Johnson's Janssen (Individuals 18 to 59 Years of Age) D1=Dose 1 D2=Dose 2

Sources: Food and Drug Administration. <https://www.fda.gov/media/144637/download>; <https://www.fda.gov/media/144413/download>; <https://www.fda.gov/media/146304/download>. Accessed Mar. 31, 2021



Thank you!



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