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COVID-19 Vaccine Comparison Chart - *Updated August 26, 2022*

	Vaccine Name	Comirnaty	SpikeVax	Johnson & Johnson	NVX-CoV2373	Vaxzevria	Sputnik V	BBIBP-CorV	CoronaVac
	Manufacturer	Pfizer-BioNTech	Moderna	Janssen Pharmaceutica	Novavax	Oxford-AstraZeneca	Gamaleya	Sinopharm	Sinovac Biotech
Details	MOA	mRNA vaccine	mRNA vaccine	Adenovirus vector vaccine	Protein-based vaccine	Adenovirus vector vaccine	Adenovirus vector vaccine	Inactivated coronavirus	Inactivated coronavirus
	Dosage	2 doses, 21 days apart	2 doses, 28 days apart	1 dose	2 doses, 1 month apart	2 doses, 3 months apart	Sputnik Light requires 1 dose	2 doses, 3 weeks apart	2 doses, 2-4 weeks apart
	Efficacy	95% at least 7 days after dose 2 **12/29/2021:** Research conducted in South Africa and published in the *New England Medical Journal* found that two doses of the Pfizer vaccine is 70% effective against hospitalization with the Omicron variant.	94.1% at least 14 days after dose 2	72% in the U.S. and 66% globally against moderate-to-severe disease; 85% effective against severe disease, 28 days after a single dose.	Vaccine demonstrated 100% protection against moderate and severe disease, 90.4% efficacy overall, and met the primary endpoint in its PREVENT-19 pivotal Phase 3 trial.	76% in a U.S. study against symptomatic COVID-19; 100% effective severe disease; 85% efficacy against symptomatic COVID-19 in those 65+. **9/29/21:** AstraZeneca publishes results from US clinical trial, stating their Covid-19 vaccine demonstrated 74% efficacy against symptomatic disease; efficacy increased to 83.5% in those 65+.	In a press release, the Gamaleya National Center of Epidemiology and Microbiology in Moscow claimed a large-scale Russian study saw 92% efficacy for its vaccine. However, other scientists have voiced concerns this claim is based on too few cases. Although the vaccine was trialled on 18,000 people, the efficacy claim has been based on an analysis of only 39 individuals to test positive.	78% according to the World Health Organization	Approxomiately 50% according to Sinovac's Phase 3 trial. However, real-world effectiveness has been shown to be approximately 67%.
		July 28, 2021: Pfizer reports that their vaccine efficacy wanes to 84% after six months post-vaccination.	**August 5, 2021:** Moderna releases statement sharing their vaccine has a 93% efficacy rate through six months after the second dose.		**June 30, 2021:** Results from the Phase 3 trial in the UK indicate an overall vaccine efficacy rate of 89.7%.		**September 12, 2021:** Research published in The Lancet states that Sputnik V demonstrated 78.6-83.7% real-world efficacy amongst 40,000 elderly people in Argentina.		**December 15, 2021:** A study conducted at the University of Hong Kong has shown that 2 doses of Sinovac shows very low efficacy against the Omicron variant. Researchers have not concluded whether a third dose will prevent infection.
Authorizations	W.H.O.	Dec 30, 2020	Apr 30, 2021	Mar 12, 2021	Dec 17, 2021	Feb 15, 2021	Suspended as of Sept 16, 2021 due to manufacturing concerns.	May 7, 2021	Jun 1, 2021
	U.S. EUA	Dec 11, 2020	Dec 18, 2020	Feb 27, 2021	July 13, 2022				
	U.S. FDA	Aug 23, 2021	Jan 31, 2022: approved for 18+						
	U.K.	Dec 2, 2020	Jan 8, 2021	May 28, 2021	Feb 3, 2022	Dec 30, 2020			
	E.U.	Dec 21, 2020	Jan 6, 2021	Mar 11, 2021	Dec 20, 2021	Jan 29, 2021			
	Russia						Feb 4, 2022: Sputnik V granted full approval		
	2022 U.S. Amendments	**1/3/22**: FDA authorizes booster doses for 12-15 year olds. Children 5-11 years old who are immunocompromised may now receive a 3rd dose at least 28 days after their primary series. **3/29/22:** The CDC and FDA updated their recommendation to include a second booster dose for immunocompromised persons and those 50+ who received an initial booster dose at least 4 months prior. **5/20/22:** The CDC updated their recommendation for children between 5-11; this age group should receive a 3rd dose of the Pfizer vaccine at least 5 months after their 2nd dose. Additionally, the CDC also now explicitely recommends that all persons 12+ receive a second booster, at least 4 months after their 1st dose. **6/17/22:** The FDA approves 2 dose series of Pfizer vaccine for children 6 months+.	**3/29/22:** The CDC updated their recommendation to include a second booster dose for immunocompromised persons and those 50+ who received an initial booster dose at least 4 months prior. **6/17/22:** The FDA approves two dose series of Moderna vaccine for children 6 months of age and up.	**3/29/22**: The CDC updated their recommendation to include an mRNA booster dose 4 months following a primary and initial booster dose of the J&J vaccine. **5/5/22**: The FDA recomends that the J&J vaccine only be used in cases where another vaccine is not available, or if people specifically request it, due to risk of blood clots within two weeks of receiving a J&J vaccine.	**7/13/22:** FDA authorizes a two-dose primary series of the Novavax vaccine for those 18+. **7/19/22:** CDC releases official recommendation for Novavax vaccine in those 18+.				

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Authorizations	Prior U.S. Amendments	**12/11/20:** FDA authorizes vaccine for 16+. **5/10/21:** Authorized for ages 12-15 by the FDA. **8/12/21:** FDA amends EUA allowing for additional dose in certain immunocompromised individuals 18+. **9/22/21:** FDA recommends booster dose in those 65+, those 18+ at high risk for severe COVID-19, and those 18+ with high risk of exposure due to their occupation, which puts them at high risk of serious COVID-19. The booster EUA only applies to the Pfizer vaccine. **10/29/21:** FDA authoizes vaccine for children 5-11 years of age. **11/19/21:** FDA amends EUA to allow boosters for those 18+. **12/9/21:** FDA amends EUA to allow boosters for 16-17 year olds.	**12/18/20:** FDA authorizes vaccine for 18+. **8/13/21:** FDA amends EUA allowing for additional dose in certain immunocompromised individuals 18+. **9/1/21:** Moderna submits initial data for booster to FDA. **9/13/21:** Moderna submitts data for booster to EMA; FDA authorizes use of a third dose of the Moderna vaccine at 100 micrograms. This is the same dose as the first two of the primary series. **10/20/21:** FDA amends EUA, adding that "the use of a single booster dose of the Moderna COVID-19 Vaccine may be administered at least 6 months after completion of the primary series" to certain population groups in individuals 18+. **11/19/21:** FDA amends EUA to allow boosters for those 18+.	**2/27/21**: FDA authorizes vaccine for 18+. **4/13/21**: FDA and CDC pause vaccine due to blood clot concerns. **4/24/21**: FDA and CDC end pause to resume J&J vaccinations. **8/18/21**: FDA anticipates booster shots "will likely be needed for people who received the J&J vaccine. Administration of the J&J vaccine did not begin in the U.S. until March 2021, and we expect more data on J&J in the next few weeks. **10/5/21:** J&J requests EUA of a second dose of their vaccine. **10/20/21**: FDA amends EUA authorizing use of a single booster dose of the J&J vaccine at least two months after completion of the primary-dose series. **12/16/21:** CDC recommends those who received J&J for their primary series receive an mRNA vaccine for their booster. Those who have received two doses of J&J are not recommended to received a third dose of an mRNA vaccine.					
	2022 International Amendments	**3/3/22:** European Medicines Agency (EMA) recommends booster shots for those 12+. **3/21/22:** UK begins second booster doses for those 75+ or residing in a nursing home, as well as those 12+ years old who have a suppressed immune system. The second booster should be administered 6 months after the first booster. **7/11/22:** EMA recommends those 60+ receive a second booster.	**3/3/22:** EMA authorizes vaccine for children 6-11 years of age. **3/21/22:** UK begins second booster doses for those 75+ or residing in a nursing home, as well as those 12+ who have a suppressed immune system. The 2nd booster should be administered 6 months after the first booster. **7/11/22:** EMA recommends those 60+ receive a second booster. **7/14/22:** Health Canada approves Moderna vaccine in children 6 months thorugh 5 years of age. The two-dose primary series will be 25 micrograms each.	**7/11/22:** EMA recommends those 60+ receive a second booster.	**2/22/22:** India become the first country to authorize the Novavax vaccine for those under 18 year of age. **7/11/22:** EMA recommends those 60+ receive a second booster.	**7/11/22:** EMA recommends those 60+ receive a second booster.	**3/25/22**: Sputnik Light is authorized for those pregnant and breastfeeding.		
	Prior International Amendments	**12/2/20:** Medicines and Healthcare products Regulatory Agency (MRHA) authorizes vaccine for 16+. **12/9/20:** Health Canada approves vaccine for 16+. **12/11/20:** FDA authorizes vaccine for 16+. **12/21/20:** EMA authorizes vaccines for 16+. **5/5/21**: Authorized by Health Canada for those 12-15 years of age. 5**/28/21**: Authorized for 12+ by the EMA. **6/4/21:** Approved for 12+ by the MHRA in the UK. **10/4/21:** EMA announces that a Pfizer booster can be given to healthy adults at least 6 months post-second dose. **11/9/21:** Health Canada authorizes boosters for those 18+ using the Pfizer vaccine, regardless of the manufacturer used for the primary series. **11/19/21:** Health Canada approves Pfizer vaccine for children 5-11 years of age. **11/29/21:** UK recommends booster dose for adults 18-39 years of age at least three months after their primary series. Immunocompromised may receive a 4th dose at least 3 months after their 3rd dose. 12-15 years of age are now allowed to receive a 2nd dose. **12/29/21:** MHRA authorizes Pfizer vaccine for 5-11 year olds.	**12/23/20:** Health Canada authorizes vaccine for 18+. **1/6/21:** EMA recommends vaccine for 18+. **1/8/21:** MHRA approves vaccine for 18+. **7/23/21:** EMA authorizes vaccine in 12+. **8/17/21:** MHRA approves use in those 12-17. **9/16/21**: Health Canada approves vaccine in 12+. **10/5/21**: EMA authorizes third dose for immunocompromised 12+. **10/25/21:** EMA announces that a Moderna booster may be administered at least 6 months after the primary series in those 18+. **11/29/21:** UK recommends booster dose for 18-39 year olds at least 3 months after their primary series. Those who are immunocompromised may receive a 4th dose at least 3 months after their 3rd dose. 12-15 years of age are now allowed to receive a 2nd dose.	**3/5/21:** Health Canada authorizes vaccine for 18+. **3/11/21:** EMA authorizes vaccine for 18+. **5/28/21:** MRHA approves vaccine for 18+. **12/15/21:** EMA authorizes a second dose of J&J in those 18+ two months after their initial dose. Those who received two doses of Pfizer and Modern may also receive a J&J booster dose.		**12/30/20:** MRHA authorizes vaccine for 18+. **1/29/21:** EMA authorizes vaccine for ages 18+. **2/26/21:** Health Canada authorizes vaccine for 18+. **3/29/21:** Health Canada suspends vaccine for those under 55, due to blood clot concerns. As of September 24, 2021, provinces resumed use of the vaccine and it is approved for those 18+.	**8/11/20:** Approved for ages 18+. **11/24/21:** A lower dose of Sputnik V, named Sputnik M, was approved for use in children 12-17 years of age.	**5/7/21:** Granted EUA for ages 18+.	**6/1/21:** Granted EUA for ages 18+. **10/21/21:** WHO recommends those 60+ vaccinated with Sinovac for their primary series receive a booster dose.

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Research & Development Highlights	Q1 & Q2 2020	**4/29/20:** Human trials begin in Germany. **5/5/20:** Pfizer and BioNTech Dose 1st U.S. Participants.	**3/16/20:** Moderna begins Phase 1 human clinical trial for their mRNA COVID-19 vaccine in the U.S. **5/12/20:** Moderna receives Fast Track designation from the FDA to proceed with a Phase 2 study of their vaccine. **5/18/20:** Moderna releases interim data from their Phase 1 clinical trial, stating plans for a Phase 3 trial to begin in July. **5/29/20:** Moderna announces purpose and enrollment of Phase 2 clinical trial. Enrollment was completed July 8.		**5/1/20**: Novavax announces a combined Phase 1/2 clinical trial, with phase 1 starting in Austraia and Phase 2 to be conducted in multiple countries following the results of Phase 1.		**June 2020:** The Gamaleya Research Institute begins clinical trials for a combination adenovirus vaccine.	**4/29/20:** Researchers begin Phase 1 trial. **6/6/20:** Researchers confirm promising results from trial in monkeys, stating the vaccine is genetically stable and seems to be safe in animals.	**January 2020:** Sinovac begins developing a vaccine using an inactivated coronavirus strain.
	Q3 2020	**8/12/20:** Peer-Reviewed Phase 1/2 Data Published in *Nature Magazine*.	**7/14/20:** Moderna publishes interim results of their Phase 1 trial in *The New England Journal of Medicine*. **7/27/20:** Moderna begins Phase 3 clinical trial, enrolling 30,000 adults across the U.S.	**7/30/20:** Single dose of J&J vaccine candidate demonstrates robust protection in pre-clinical studies. **9/3/20:** Vaccine prevents severe clinical disease in pre-clinical studies. **9/23/20:** Global Phase 3 'Ensemble' Clinical Trials begin. **9/25/20:** Interim results from Phase 1/2a clinical trial support further clinical development of vaccine, but Phase 3 PAUSED after a serious medical event ienced by 1 study participant.	**8/4/20:** Novavax announces the results of Phase 1 of the Phase 1/2 clinical trial stating the vaccine was "generally well-tolerated and elicited robust antibody responses." **8/24/20:** Novavax announces the initation of Phase 2 of its Phase 1/2 clinical trials. Participants are enrolled in both the U.S. and Australia. **9/2/20:** Novavax announces publication of Phase 1 results in The New England Journal of Medicine. **9/24/20**: Novavax announces initiation of Phase 3 clincial trial using 10,000 participants across the U.K. (enrollment is completed **11/30/20**).	**7/20/20:** AstraZeneca's Phase 1 human clinical trial results are published in *The Lancet*; results show vaccine is safe and create an immune response. **9/1/20:** Phase 3 clinical trials begin in the U.S.	**9/4/20:** The Gamaleya Research Institute publishes the results of their Phase 1/2 clinical trial, announcing their Sputnik V vaccine yielded antibodies with only mild side effects.	**7/18/20:** Phase 3 trial begins in the UAE, with subsequent Phase 3 trials in Peru and Morocco.	**July 2020:** China launches vaccine program to distribute Sinovac, Sinopharm and CanSino Covid-19 vaccines within China. Phase 3 testing was not complete at the time. Additional trials launched in Brazeil, Indonesia, and Turkey. **8/10/20:** Results of a Phase 1/2 trial are published stating no safety concerns were observed amonst 743 volunteers. Adverse events were mild in severity, and primarily isolated to pain at the injection site. The results have not been peer reviewed.
	Q4 2020	**11/18/20:** Pfizer and BioNTech conclude Phase 3 Study, meeting all primary and secondary efficacy endpoints. **12/10/20:** Pfizer and BioNTech Announce Publication of Results from Phase 3 Trial in The New England Journal of Medicine.	**11/16/20:** Moderna releases preliminary data from Phase 3 clinical trial, stating their vaccine is 94.5% effective. The data is released in full on November 30. **12/2/20:** Moderna files to test their vaccine in adolescents 12-18 years of age. Moderna announces the clinical trial on March 10, 2021. **12/31/20:** Moderna publishes results of Phase 3 trial in The New England Journal of Medicine.	**10/23/20:** Phase 3 Ensemble Trial resumes. **11/16/20:** Announcement of second Phase 3 clinical trial to observe the use of two doses versus one.	**12/28/20:** Novavax announces initiation of Phase 3 efficacy trial in U. S. and Mexico.	**11/23/20:** AstraZeneca and the University of Oxford announce the initial results of the Phase 3 clinical trials in the U.K., Brazil, and South Africa. The study showed the vaccine was safe and effective. Data from the study was published 11/19 in *The Lancet*.	**10/17/20:** Phase 2/3 trial launches in India. **11/11/20:** The Russian Direct Investment Fund announces that Sputnik's Phase 3 clinical trial demonstrated high efficacy rates, determining a 92% efficacy rate for the Sputnik V vaccine. **Dec 2020:** The Gamaleya Reserch Institute and AstraZeneca decide to combine vaccines in an effort to increase the efficacy of the AstraZeneca vaccine, with clinical trials beginning in February 2021.	**10/17/20:** Research published in *The Lancet* shares the results of a Phase 1/2 trial, showing the vaccine stimulates the production of antibodies and does not cause serious adverse effects. **Nov 2020:** Sinopharm reports that over 1 million doses have been administered to the public. **12/30/20:** Sinopharm states their vaccine has an efficacy rate of 79%.	**10/19/20:** Officials in Brazil quote Sinovac's vaccine as being the safest of five being tested in Phase 3 trials. **11/17/20:** Sinovac publishes the results of their Phase 1/2 trial in The Lancet. **12/23/20**: Brazil announces that CoronaVac has an efficacy rate of over 50%. **12/24/20:** Turkey announces that the vaccine has an efficacy rate of over 91%.
	Q1 2021	**2/25/21:** Pfizer and BioNTech Initiate a Study as Part of Broad Development Plan to Evaluate COVID-19 Booster and New Vaccine Variants. **3/31/21:** Pfizer announces positive topline results of their clinical trial in adolescents ages 12-15, in which the vaccine demonstrated 100% efficacy and produced a robust antibody response. The vaccine was also well tolerated.	**3/5/21:** Moderna announces Phase 1 clinical trial testing their vaccine against the B.1.351 variant. **3/15/21:** Moderna announces Phase 1 trial of refridgerator-stable vaccine. **3/16/21:** Phase 2/3 study in ic/adolescents begins.	**1/13/21**: Interim Phase 1/2a Data published in New England Journal of Medicine. **1/29/21:** Johnson & Johnson announce that their Phase 3 trial show their vaccine to be safe and effective; the results of the trial are published in The New England Journal of Medicine April 29, 2021. **2/21/21:** Johnson & Johnson announce upcoming clinical trial with pregnant women.	**1/13/21:** Interim Phase 1/2a Data published in New England Journal of Medicine. **Jan 2021:** Novavax announces that vaccine demonstrated 96% efficacy in a 15,000 person trial in Britain.	**2/3/21:** Oxford and AstraZeneca publish more data from clinical trials regarding efficacy and prevention. **2/15/21**: Oxford University begins a clinical trial testing the vaccine in children. **3/22/21:** AstraZeneca announces interim results from clinical trial in the U.S. and South America. **3/25/21:** AstraZeneca announces beginning of Phase 1 trial investigating use of vaccine components in a nasal spray.	**2/2/21:** The Gamaleya Research Institute, in part with Russia's Ministry of Health, publishes the results of their Phase 3 trial in *The Lancet*. **3/29/21:** Russia announces that "Sputnik Light" will be registered for use after the clinical trial, which began in January. This single-dose version of the Sputnik V vaccine is proposed to provide 4-5 months of protection against the novel coronavirus.		**1/7/21:** Researchers in Brazil specify that the CoronaVac vaccine has an efficacy rate of 78% and prevents severe disease. This figure was based on the results of a volunteer subgroup; the efficacy rate was not officially released. **1/13/21**: Brazilian researchers backtrack and announce that the CoronaVac actually has an efficacy rating of just over 50%.

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Research & Development Highlights	Q2 2021	**5/5/21:** Researchers at Pfizer and Israel's Ministry of Health observe Pfizer vaccine to be over 95% effective against infection, hospitalization and death against the B.1.1.7 variant amongst Israel's vaccinated population. The results of the study are published in The Lancet. " **5/25/21:** Pfizer begins Phase 3 trial using their pnuemococcal vaccine candidate in conjunction with the Pfizer Covid-19 vaccine as a booster in adults 65+. **6/8/2021:** Pfizer announces advancement of Phase 2/3 clinical trials in children ages 5-11. **6/28/21:** A study published in Nature confirms the Pfizer vaccine is highly effective against variants, including delta.	**5/6/21:** Moderna announces that vaccine is 96% effective in preventing infection in children 12+. **5/28/21:** Moderna begins Phase 1/2 clinical trial on the use of the Moderna vaccine as a booster shot to a range of other vaccine brands. **6/15/21:** Moderna begins clinical trial testing their vaccine as a booster shot. **6/29/21:** Moderna announces that a full dose of their vaccine provides protection against the delta, zeta and kappa variants.	**4/2/21:** Expands Phase 2a Clinical Trial to Include Adolescents.	**5/3/21:** Novavax expands Phase 3 trial to include children ages 12+. **5/21/21:** Novavax announces its participation in a UK mix-and-match booster trial alongside 6 other vaccine manufacturers. The study will include participants who have previously been vaccinated with 2 doses of an authorized vaccine. **6/14/21**: Novavax releases the results of their Phase 3 clinical trial in the US and Mexico, stating their vaccine is 90.4% effective overall, with 100% efficacy against moderate and severe disease. **6/30/21:** Novavax publishes the results of their Phase 3 trial in the New England Journal of Medicine. The trial was conducted in the UK and showed an overall vaccine efficacy rate of 89.7%. The vaccine showed 96.4% efficacy against non-B.1.1.7 variants, which parallel strains of the original virus.	**6/27/21:** AstraZeneca starts Phase 2/3 clinical trial on vaccine specially tailored against the beta variant. **6/28/21:** Oxford researchers confirm that a third dose of the AstraZeneca vaccine elicited a strong immune response in clinical trial participants. Clinical trial data is still being peer-reviewed.	**5/6/21:** The Russian government authorizes Sputnik Light for use after their Ministry of Health announces Sputnik Light is 79.4% effective. Details of the study are not released. **6/2/21:** The Russian Direct Investment Fund announces that Sputnik Light demonstrated 78.6-83.7% efficacy amongst the elderly population in Argentina.	**4/28/21:** A third vaccine enters Phase 1/2 clinical trials. **5/7/21:** The World Health Organization states that Sinopharm's vaccine has an efficacy rate of 78%, and authorizes it for emergency use. The results of the Phase 3 trial have not yet been released. **6/10/21**: UAE begins testing in children ages 3-17.	**April 2021:** Sinovac releases the results of a Phase 3 trial showing that their vaccine is around 50% effective in preventing COVID-19 infections. Observing real-world results in Chile found it to be 67% effective in preventing infection. **5/13/21:** Sinovac begins Phase 2 clinical trial on children 3-17 years old. **6/19/21:** Sinovac begins Phase 4 clinical trial testing the efficacy of a booster shot. Participants include those 18-59 years of age. **6/28/21:** Sinovac publishes the results of a Phase 1/2 clinical trial testing their Covid-19 vaccine in youths ages 3-17. The study demonstrated high immunogenicity and safety levels.
	Q3 2021	**7/8/21:** Pfizer announces the development of a new coronavirus vaccine that specifically targets the Delta variant; clinical trials are expected to begin next month. **7/27/21:** Pfizer begins recruiting for clinical trial testing a second dose in those who experienced a systemic allergic reaction to the first dose of the Pfizer or Moderna vaccine. **7/28/21:** Pfizer releases statement suggesting need for boosters, citing study that shows their vaccine's efficacy wanes to 83.7% by six months after the second dose. The study's results have not been peer-reviewed. **8/25/21:** Pfizer releases data showing antibodies more than tripled in participants who received a booster dose 5-8 months after being fully vaccinated. Details of the study have not been released yet. **9/20/21**: Pfizer announces that in participants 5 to 11 years of age, the vaccine was safe, well tolerated and showed robust neutralizing antibody responses.	**8/5/21:** Moderna releases statement suggesting the need for boosters after 6 months, especially in light of the Delta variant. Clinical trial results cite a 93% efficacy rate through 6 months after the second dose, and a 98.3% efficacy rate against severe disease. Moderna is currently holding a clinical trial using a half dose of the vaccine; interim results show an uptick of antibodies that effectively neutralize the Delta variant. **9/9/21**: Moderna announces the development of a vaccine that combines a COVID-19 booster dose with an expermintal flu shot. **9/15/21:** Moderna publishes pre-print study on medRxiv stating that people vaccinated within the past 8 months have experienced 36% fewer breakthrough cases than those vaccinated a year ago."	**7/1/21:** Regarding the delta variant, J&J stated the vaccine offers effective protection. They have submitted a pre-print of data from the laboratory study to bioRxiv, further citing that immunity from the vaccine lasts at least 8 months. **8/25/21:** Johnson & Johnson announces that boosters raised antibody levels by 9x after the initial dose. These results follow a small trial including 17 participants, 6 months after their initial dose. The data has not been published yet. **9/21/21:** J&J announces real-world and Phase 3 efficacy data confirming long-lasting protection from single dose of vaccine. They also presented data showing booster offers 94% protection against moderate to severe COVID-19 when administered at 2 months after primary vaccination. "	**8/5/21:** Novavax issues statement on results from ongoing Phase 2 study, showing their vaccine demonstrated 4x increase in antibodies when used as a booster and 6x increase in antibodies against Delta variant compared to antibody response after primary vaccination series. Results have not been peer-reviewed. **9/8/21:** Novavax announces early-stage study combining flu and COVID-19 vaccine.	**7/21/21:** A study published in the *New England Journal of Medicine* shows that two doses of the AstraZeneca vaccine are 67% effective in neutralizing the Delta variant. **8/16/21:** Imperial College London registers for a trial of an aerosol version of the vaccine. It has yet to start recruiting. **9/29/21:** Brazilian researchers register a Phase 2/3 trial testing efficacy of a half dose of AstraZeneca's vaccine. **9/29/21**: AstraZeneca publishes results from US clinical trial, stating their Covid-19 vaccine demonstrated 74% efficacy against symptomatic disease; efficacy increased to 83.5% in those 65+.	**7/12/21:** A study on behalf of the Ministry of Health of the Russian Federation shows that antibodies from the Sputnik V vaccine effectively neutralize the Delta variant, albeit less than previous strains. **7/18/21:** Researchers register a Phase 2/3 trial for 12-17 year olds. **8/11/21:** Researchers announce that pre-clinical trials of an intranasal version of the Sputnik V vaccine have been completed. The research has not been released. **9/15/21:** The Russian Direct Investment Fund announces that the Sputnik V vaccine demonstrated 97.2% in Belarus' vaccination campaign. Sputnik Light gets go-ahead for Phase 3 trial in India.	**7/19/21:** Sinopharm publishes results of study coming out of Sri Lanka, showing their vaccine was effective in neutralizing the Delta variant. The results have not been peer-reviewed. **8/3/21:** A Hungarian study shows that the vaccine failed to produce sufficient antibodies in a quarter of elderly participants. **8/13/21:** A clinical trial coming out of Peru indicates the vaccine is 50.4% effective in preventing infection. **9/6/21**: Announcement of development of mRNA COVID-19 vaccine. **9/17/21**: A study published in The Lancet showed that the Sinopharm vaccine was deemed safe in participants 3-18 years of age. **9/17/21**: A small study concludes that a booster shot increases antibodies after ~5 months. The findings have not been peer-reviewed. "	**7/25/21:** Coronavac publishes interim results of Phase 2 clinical trial using booster shots 6-8 months after second dose. Boosters resulted in a "remarkable increase in antibody levels." **8/4/21:** Sinovac starts recruiting for Phase 4 trial on booster shots in healthy adults ages 18-59. **8/5/21:** Sinovac starts Phase 3 trial using vaccine in participants 6 months through 17 years of age. **9/6/21:** Chinese media reports announce that a third dose of Sinovac prolongs immunity against SARS-CoV-2. The lab study cited has not been peer-reviewed.

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Vaccine Name		Comirnaty	SpikeVax	Johnson & Johnson	NVX-CoV2373	Vaxzevria	Sputnik V	BBIBP-CorV	CoronaVac
Manufacturer		**Pfizer-BioNTech**	**Moderna**	**Janssen Pharmaceutica**	**Novavax**	**Oxford-AstraZeneca**	**Gamaleya**	**Sinopharm**	**Sinovac Biotech**
Research & Development Highlights	**Q4 2021**	**10/21/21:** Pfizer releases results of booster study, in which five out of over 5,000 participants developed symptomatic COVID-19, producing a 95.6% efficacy rate. **12/09/21:** Pfizer announces that a third dose increases antibody titers by 25x compared to two doses against the Omicron variant. **12/14/21:** Researchers in South Africa released data from real-world evidence showing two doses of Pfizer is 70% effective at preventing hospitalizations from the Omicron variant. That being said, two doses are only about 33% effective at preventing infection. **12/17/21:** Pfizer releases interim data showing children 6 months to 2 years of age who received a 3 microgram dose of the Pfizer vaccine did not show similar antibody production to 16-25 year olds. Pfizer anounced they will test a 3rd 3 microgram dose in this age group, as well as 2-5 year olds. Pfizer also announced a study testing 10 and 30 microgram doses in 12-17 year olds.	**10/7/21:** Moderna announces that a combination booster + flu vaccine from Sanofi produced positive results in those 65+ in a US study. **10/25/21:** Moderna states their vaccine is safe and effective in children 6-11 years of age; Data from their clinical trial of 4,753 children has not been released. **12/15/21:** Duke University provides preliminary analysis of booster dose to increase protection against the Omicron variant. Those who received a booster dose may have protection comparable to two doses against the Delta variant. Research conducted by Kaiser Permanente and publsiehd in The British Medical Journal shows a drop in vaccine efficacy after 6 months to 80%; protection against hospitalization from the Delta variant remains at 98%. This particular study did not include cases with the Omicron variant.	**12/29/21:** A pre-print study of 69,000 healthcare workers in South Africa determined a second dose of the J&J vaccine reduced th risk of hospitalization from Omicron by approximately 85%. Data from a US trial has shown one dose to be 74% effective against mild-to-severe disease.	**12/15/21:** Results of a Phase 3 trial with over 29,000 participants in the US and Mexico are published in *The New England Journal of Medicine*, where the Novavax vaccine demonstrated 90.4% efficacy. **12/21/21:** Novavax announces that they expanded their Phase 3 trial to include boosters. On Dec 22, they announced that a booster at 6 months restored protection from the primary series. Observation of efficacy and safety data is ongoing.	**12/23/21:** AstraZeneca publishes news release stating that a third dose boosts antibodies against the Omicron variant comparable to two doses against Delta.	**11/2/21:** Results of Sputnik Light's Phase 1/2 trial published in *The Lancet*. **11/24/21:** An intranasal version of Sputnik V is approved for human trial.	**12/20/21:** Rearchers from Shanghai Jiao Tong University and the Institute of Respiratory Diseases found that antibodies from two doses of the Sinopharm vaccine declined significantly by 8-9 months after the second dose, and provided weak protection against the Omicron variant.	**12/14/21:** A Hong Kong University study found that two doses of the Sinovac vaccine failed to protect against Omicron (test sample was 25 people). A third shot produced antibodies in 94% of particpants. That being said, antibody levels were not adequate for neutralizing SARS-CoV-2.
	Q1 2022	**1/24/22:** Pfizer shares results from two studies that show 3 doses of the vaccine can generate antibodies against the Omicron variant. **1/25/22:** Pfizer begins a clinical trial for an Omicron-specific vaccine with approximately 1400 participants.	**1/26/22:** Moderna announces they have begun a clinical trial of an Omicron-specific booster shot with approximately 600 participants. Protection has been observed to wane within six months of a booster dose.	**2/9/22:** The final analysis of the Phase 3 trial was published in the *New England Journal of Medicine*, stating the J&J vaccine is 56.3% effective against moderate to severe disease, dropping to approximately 52% after 4 weeks.	**2/3/22:** Novavax announces they are developing an Omicron-specific vaccine. **2/28/22:** Novavax releases 6-month follow-up results from their Phase 3 trial in the UK, showing efficacy waned to approximately 82%. Efficacy against severe disease remained at 100%.		**1/18/22:** The Director of the Gamaleya Research Institute states that Sputnik V demonstrates approximately 75% efficacy against the Omicron variant, and that those boosted with Sputnik Light have 100% protection against Omicron. Results have not been peer-reviewed.		
	Q2 2022	**4/14/22:** Pfizer releases clinical trial data showing a 10 microgram booster dose in children 5-11 years of age raised antibody levels against the omicron variant. This study was the basis for offering boosters to this age cohort. **5/23/22:** Pfizer announces that a third dose of the vaccine in children ages 6 months through 4 years produced a favorable amount of antibodies for regulatory authorization, versus just two doses of the Pfizer vaccine.	**4/19/22:** Moderna announces preliminary results of a redesigned booster which produced over 2x the level of antibodies against the Omicron variant compared to the existing Moderna booster. These antibodies were documented for 6 months against the Omicron variant but decreased against the Delta variant at the same rate as the existing vaccine.		**5/12/22:** Novavax begins Phase 3 trial to evaluade the safety and immunogenicity of 2 booster doses tailored to the Omicron variant.				**4/26/22:** Sinovac announces it will begin testing a redesigned vaccine tailored for the Omicron variant.
			6/8/22: Moderna shares preliminary data analysis of Omicron-specific booster, which produced a superior increase in antibodies against the Omicron variant.		**6/28/22:** Novavax presents data to the FDA on Omicron-specific vaccine producing antibodies against Omicron subvariants BA.4/5.				
Reported Adverse Reactions*		- Myocarditis and pericarditis	- Immune thrombocytopenia	- Guillain-Barre syndrome		- Thrombosis with thrombocytopenia syndrome			
		- Immune thrombocytopenia	- Bell's Palsy	- Thrombosis with thrombocytopenia syndrome		- Immune thrombocytopenia			
		- Bell's Palsy		- Immune thrombocytopenia		- Thrombocytopenia			
				- Venous thromboembolism					

*** The adverse events included in this list have been verified by the CDC, FDA and/ or WHO. Official statements regarding these adverse events can be found on the respective websites.**