COVID-19 Vaccines

An overview of COVID-19 vaccines, their distribution, and acceptance and hesitation

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Vaccine Development
What is a vaccine?

- Vaccines help the body’s immune system recognize and respond to severe diseases
  - To do this, a vaccine must trigger an immune response, usually through the use of an invader’s (virus, bacteria, pathogen) surface proteins, weakened or killed variants of an invader, or a byproduct of a disease
  - When a vaccinated individual is exposed to the disease, the body can more readily and quickly respond and neutralize the disease
- Vaccines can prevent and/or reduce the severity of diseases and are one public health’s most effective disease prevention methods
The push for COVID-19 vaccines

• Given the benefits of vaccines, global efforts for a vaccine for COVID-19 have been massive

• Vaccines could not only protect individuals, but if large enough populations received them, a COVID-19 vaccine could protect those who were ineligible to receive a vaccine through herd immunity
The push for COVID-19 vaccines

• However:
  • Vaccines need to show **efficacy** and **effectiveness** during testing; in other words, COVID-19 vaccines need to prove themselves effective at preventing COVID-19 infections
    • **Vaccine Efficacy:** How good a vaccine is at preventing a disease in a controlled experiment.
    • **Vaccine Effectiveness:** How good a vaccine is at preventing a disease among the general population
  • Vaccine testing must be **thorough** and **transparent** to ensure the risk of receiving a vaccine does not put individuals at unnecessary risk
  • Vaccines need **high uptake** to be effective; if nobody agrees to receive a vaccine, it is useless
What does vaccine development normally look like?

• Vaccine development is very similar to the development of pharmaceuticals.

• Extensive testing is completed through multiple phases to determine **efficacy** (how well the vaccine protects against disease) and **safety** (whether the benefits of the vaccine outweigh their potential side effects).

• Normally, a vaccine can take **10-15 years to develop**.
Pre-human stages of vaccine development

• **Exploratory Stage:** during this phase, all testing is done in labs; intention is to find antigens that could prevent/treat disease

• **Pre-clinical stage:** Candidate vaccines from the exploratory stage used on animal subjects to assess response; idea is to get a good picture of how living things will react to the vaccine

• Assuming candidate vaccine makes it through the pre-clinical stage, the company must apply for an Investigational New Drug (IND) application to the FDA; approval allows clinical trials in human subjects
Clinical Trials

• **Phase I:** Very few human subjects are given the candidate vaccine, with an emphasis on determining safety

• **Phase II:** At this stage, more subjects are brought in to test the vaccine’s safety and immunogenicity (ability to trigger an immune response – good!); may also look at potential schedules, dosing, and delivery methods

• **Phase III:** Generally, the final stage of a vaccine trial; involve thousands of individuals and assesses safety and efficacy

• If vaccines can make it through Phase III trials, developers get to apply for approval and licensure through the FDA; if approved can distribute vaccine to general population

• **Among all drug trials that make it to Phase I, less than 10% are approved.**
What happens once a COVID-19 vaccine is developed?

• Production, distribution, and storage are key.
  • Manufacturers must be ready to develop the vaccines
  • Facilities must have the means to storing the vaccines

• Vaccines would likely not be distributed to the general public until several months after development
  • High risk individuals (i.e. health care, incarcerated, older adults) would be prioritized because vaccinations in these populations would offer the highest benefit

• Even if logistic challenges are handled, individuals can opt out of receiving the vaccine
  • **Herd immunity is only possible if a large portion of the population is vaccinated!**
The pandemic does not immediately end just because a vaccine is developed!

- Vaccine efficacy is determined in an experimental setting. Therefore, it does not account for logistical challenges, risk of reinfection, etc.
Vaccine efficacy and herd immunity

What do we know from other vaccines?
• The measles vaccine is 98% effective. And in order to achieve herd immunity, approximately a +70% vaccination rate is needed.
• The seasonal flu vaccine efficacy varies between 40-60%.

What about for COVID-19?
• The number of people who would need to be immunized depends on the efficacy of the vaccine in the general population and among particular sectors
  • Will the vaccine be as effective for the very young and old
  • Will conditions like obesity effect efficacity
Out of the ~325 million people that live in the US, it is estimated that 70% will need to either be immune to COVID-19 (either through infection or vaccination) to achieve herd immunity.

At this point in time, less than 16 million people would be immune due to infection. We would still need to wait until 211.5 million more people become immune through infection or vaccination to reach herd immunity.
Factors that might affect an individual’s response to a vaccine

- It is unclear how individuals will respond to COVID-19 vaccines, but health conditions and other factors may influence your immune system’s reaction to the vaccination. The important point to remember though, is that these factors have historically influenced reactions to other vaccines as well and are not novel to vaccines for COVID-19. Below are just a few examples of such factors:
  - **Obesity:** among individuals vaccinated to influenza, obese individuals saw a nearly 2x increase in risk of influenza compared to those who were normal BMI
  - **Age:** age of vaccination may result in differing responses
    - Older individuals have been observed with diminished responses to vaccines for diphtheria, hepatitis A, hepatitis, etc.
  - **Comorbidities:** comorbidities such as diabetes, celiac disease, and renal failure in children have seen lower responses to various vaccines
  - **Other behavioral factors:** stress, smoking, and sedentary lifestyles may result in poorer vaccine responses
What makes COVID-19 vaccines different?

- Vaccine sponsors are attempting to safely condense the usual vaccine development process (10-15 years) into 1-2 years
  - Phases II and III clinical trials (which normally take place separately) now overlap
- COVID-19 vaccine development is being fast-tracked via **Operation Warp Speed (OWS)**
  - Huge amounts of resources from the federal government (CDC, National Institutes of Health, Biomedical Advanced Research and Development Authority, and Department of Defense) have been funneled to pharmaceutical companies and researchers looking to create a safe and effective COVID-19 vaccine
Is Operation Warp Speed (OWS) safe?

• The short answer: **Yes!**

• **This sped-up development process presents a financial risk to pharmaceutical companies** rather than a decrease in safety of the vaccine.
  • Most candidate drugs and vaccines are eliminated through the multi-phasic development process
    • The further a vaccine makes it through the multiphase process, the more expensive it becomes to develop and test it
    • E.g. Stopping a vaccine candidate at Phase I clinical trials saves huge amounts of money compared to stopping a vaccine at Phase III
  • Because in **OWS** these phases overlap, an ineffective vaccine might be stopped at Phase III when under normal circumstances, it might be stopped in Phase I/II

• Long-term safety of the vaccine will be continually assessed over time (Phase IV clinical trials)
The primary and secondary purpose of the initial COVID vaccine(s), as stated by Dr. Fauci

• The goal of the initial COVID-19 vaccines will be to prevent symptoms in those who become infected with the coronavirus rather preventing the infection entirely.
  • Preventing symptoms is a "primary endpoint" in the vaccine development process
  • Preventing the infection altogether is considered a "secondary endpoint."

• "What I would settle for, and all of my colleagues would settle for, is the primary endpoint to prevent clinically recognizable disease ... And that's what we hope happens, and if we do, that will go a long way to diffusing this very difficult crisis”
  • Even if a vaccine isn’t able to prevent someone from getting infection, if the vaccine reduces their chance of experiencing symptoms, you will have ultimately prevented them from getting seriously ill or dying.
  • With less people experiencing severe symptoms, the coronavirus would pose a lower threat to communities and prevent healthcare systems from becoming overloaded

• So just like with the seasonal flu, getting a vaccination may not prevent the illness but render it less serious
What types of COVID-19 vaccines are being developed and tested?

- **Inactivated vaccines**: inactivated vaccines are a common method for designing/creating a vaccine. This involves utilizing an inactive (killed) variant of the disease of interest and using the similarities between the dead form and “real” form to stimulate an immune response. Common examples include influenza and polio vaccines.
  - e.g. Vaccine being developed by **Sinovac**

- **Protein-based vaccines**: these vaccines are designed based on the surface proteins that are on the COVID-19 virus; these proteins are generally how the viruses are recognized.
  - E.g. Vaccine being developed by **CanSino Biologics**

- **Viral-vector vaccines**: these are non-replicating viruses that provide instructions in the form of viral DNA to utilize your body’s cells to produce COVID-19 proteins. These proteins then induce an immune response.
  - E.g. Vaccines being developed by **University of Oxford** and **Johnson & Johnson**

- **Gene-based vaccines**: these are similar to viral-vector vaccines, but provide the instructions in a different form (mRNA instead of viral DNA)
  - E.g. Vaccines being develop by **BioNTech/Pfizer** and **Moderna**
Gene-based vaccines were the first two to seek FDA approval

- Gene-based vaccines carry genetic instructions to our cells to produce an antigen that is used to initiate an immune response, just as it would in an actual infection.
  - In the case of coronaviruses, the antigen of interest is the surface spike protein the virus uses to bind and fuse with human cells.
  - Rather than the protein being supplied by the virus itself, the genetic material instructs our cells to make the spike protein necessary for an antibody response.
- The approach taken is similar to that used in live-attenuated vaccines for diseases like measles, mumps, and rubella.
  - Weakened viruses incorporate their genetic instructions into host cells, causing the body to produce viral copies that elicit an effective antibody response (B- and T-cell responses).
  - In the case of mRNA vaccines—scientists insert genetic instructions from the pathogen of interest to produce antigens in host cells instead of utilizing a virus.
Some cautious hope

• The FDA had previously indicated that it would be willing to approve a vaccine for use that was just 50% effective
  • On November 9th, Pfizer announced their vaccine was up to 94.5% effective in preventing COVID-19.
  • On November 15th, Moderna announced a vaccine that is 95% effective
• Both of these vaccines rank relatively high in effectiveness compared to other widely used vaccines. For example:
  • 1 dose of the measles vaccine is 93% effective. 2 doses (recommended) increases the effectiveness to 97%
  • For the Seasonal Flu vaccine, the effectiveness usually varies because of the differences in strains that are being transmitted each year, but they have ranged between 10-60% effective 2004-2019
    • Most seasonal flu vaccines are 40-60% effective though.
• There are still questions about these vaccines that need to be explored and researched!
Pfizer's and Moderna’s gene-based vaccines

- Both vaccines deliver a molecule known as messenger RNA, or mRNA. While mRNA-based vaccines seem like novel techniques, the research to develop mRNA vaccines began many years before the current pandemic.
  - Currently, no other vaccines utilize mRNA.
- Pfizer's and Moderna's vaccines have similar results (> 90% effectiveness in preventing symptoms) and use the same technique to activate the body's immune system.
  - The nearly identical effectiveness of the vaccines from Pfizer and Moderna validates the use of mRNA as a vaccination technique.
  - Both vaccines are given in two doses with 3-4 weeks between each dose.
- The vaccines have been generally well tolerated with few side effects among those who have already received them.
  - Side effects reported thus far are mild and short lived – similar to other seasonal flu vaccines.
Details about Pfizer’s study

- The Pfizer trial involved more than 43,000 participants (with a 1:1 randomization to vaccine or placebo) and a total of 170 confirmed cases of COVID-19 were evaluated, with 162 observed in the placebo group versus eight in the vaccine group
  - The trial is ongoing, and recruitment is now including a more diverse population in terms of age
- Among US participants in the trial, the majority were white:
  - 5.5% Asian
  - 10.1% Black
  - 13.1% Hispanic/Latinx
  - 1.0% Native American
- What does 94.5% effective mean?
  - **This means that those that received the vaccine were 94.5% less likely to exhibit symptoms**
    - It does NOT mean that the vaccine reduces transmissibility
    - Other details regarding have not been released yet, but publications will be rolling out soon
Five questions about the Pfizer vaccine

1. **How long will the vaccine protect patients?** Those in the trial got two shots between July and October. How long will the protection last and how often will people need boosters? Protection appears to be for two or three months - will it protect six months or a year?

2. **Will it protect the most vulnerable?** Pfizer did not disclose what percentage of its trial volunteers are in the groups most likely to be hospitalized or to die of COVID-19 — including people 65 and older and those with diabetes or obesity.
   - Some vaccines, particularly for influenza, may fail to protect the elderly though they protect younger people.
   - There’s presently no way to know whether the Pfizer vaccine will be the best overall or for specific age groups.
Five questions about the Pfizer vaccine

3. **Can the vaccine be rolled out to the population at large without major logistic issues?** The Pfizer vaccine, unlike others in late-stage testing, must be kept supercooled, on dry ice around 100 degrees below zero, from the time it is produced until a few days before it is injected.
   - What challenges will face cold chain delivery of the vaccine to different types of locales?

4. **Could the Pfizer study expedite future vaccines?** A small number of trial participants received the vaccine, but still got sick and produced lower levels of antibodies than the vaccinated individuals who remained well.
   - Blood studies of those people would help scientists learn whether there is a “correlate of protection” for COVID-19 — a level of antibodies that can predict whether someone is protected from the disease.
   - That knowledge could determine whether other vaccines under production are likely to be effective without necessarily having to test them on tens of thousands of people.
Five questions about the Pfizer vaccine

5. Could a premature announcement hurt future vaccines? The Pfizer vaccine may not be the best for all age groups. But if the FDA approves it quickly, that may make it harder for manufacturers of other vaccines to recruit participants for clinical trials.

• People may decline out of concern they could get a placebo or not be able to take an existing vaccine that may prove partially, if not wholly effective.
The Moderna vaccine

- In Moderna's trial of 30,000 participants, half of study participants (15,000) were given a placebo whereas the other half were given the vaccine.
  - Over several months, 90 of those who received a placebo developed COVID-19, with 11 developing severe forms of the disease.
  - Only five participants who received the vaccine developed COVID-19.

- Moderna’s vaccine appears to have also been protective in important subsets of participants — the elderly and people from racial and ethnic minority groups:
  - The 30,000-person trial included 11,000 participants from communities of color, making up 37% of the total study population.
  - It also included more than 7,000 participants over the age of 65 and >5,000 people younger than 65 who have chronic health conditions that put them at high risk of suffering from a severe infection (e.g., diabetes, severe obesity and heart disease).
What we do not know about the Pfizer/Moderna vaccines

- For both vaccines, we do not yet know how effective the vaccine is in the long-term... we will not know how long the immunity offered by either of these vaccines last until they begin to wear off.

- This has implications for:
  - How frequently people might have to get boosters shots to maintain immunity
  - The ongoing risk of transmission of SARS-CoV-2
    - It is not yet known whether the vaccine just prevents people from becoming severely ill, or if it prevents them from spreading the virus
Moderna’s vaccine has a practical advantage over Pfizer's

- Pfizer's vaccine needs to be kept at -75° Celsius.
- Moderna's vaccine can be kept at -20° Celsius.
  - Other vaccines, such as the one against chickenpox, need to be kept at that temperature.
- Most doctors' offices and pharmacies have freezers that are able to maintain the -20° Celsius temperature needed to store Moderna’s vaccine.
- Furthermore, Moderna's vaccine can stored for up to 30 days in the refrigerator, whereas Pfizer's vaccine can last only five days in the refrigerator.
Will the Pfizer and Moderna vaccines prevent transmission? We will have to wait to find out

• Currently, we don’t know the extent to which these vaccines will prevent asymptomatic infection. But we do know that because they reduce symptomatic infection, they should also reduce deaths, hospitalizations, and intubations in those who become infected.

• The trials were conducted with symptomatic endpoints, rather than testing everyone every day or every few days to look for infection, to save resources (let’s say 30,000 participants, tested every three days over a course of two months - that’s 600,000 PCR tests that need to be run).

• The hope is that once approved and with widespread use, we will see epidemiologic evidence to show reduction in transmission as well as reduction in symptomatic disease.
Moderina vs Pfizer mRNA Vaccine

During the middle of November 2020, two large biotechnology companies, Moderna Inc and Pfizer, announced interim results of candidate mRNA vaccines that reported 94.5% and 90% efficacy, respectively. These numbers represent a reduction in syndromic covid-19 compared to placebo groups. What remains unknown, however, is whether these vaccines prevent infection and spread, and for how long will it provide protection? (The vaccine uses mRNA vaccine technology that has only recently become feasible and has never been approved for similar purposes). Does the vaccine protect the elderly? Does it protect those with immune system dysfunction? Time will tell.

For more information, as well as daily COVID-19 research / policy updates, visit: https://brief19.com

MODERNA
- Stored at 25F
- Infections counted after 14 days
- 94.5% Effective
- No cases of severe covid-19
- NIH collaboration

PFIZER
- Stored at -94F
- Infections counted after 7 days
- 90% Effective
- No disclosure of severe cases with BioNTech SE
Adenovirus vaccines

The Oxford University-AstraZeneca vaccine and others *
What are Adenoviruses?

- **Modified Adenoviruses do not cause illness** and are effective carriers of antigens for infectious diseases
  - Adenoviral vectors act as vaccine carriers when armed with foreign genes and can elicit specific antibody and T-cell responses.
  - Adenovirus-based vaccines generally have few side-effects, like other vaccines.
- **These types of vaccines are used against a wide variety of pathogen including** *Mycobacterium tuberculosis*, human immunodeficiency virus (HIV), and *Plasmodium falciparum*. 
The Oxford-AstraZeneca vaccine

• The results reported on November 23rd from Oxford-AstraZeneca come from their Phase III trials involving 23,000 participants in Britain and Brazil.

• The Oxford-AstraZeneca vaccine uses an adenovirus (a weakened version of a common cold virus) with genetic material for the characteristic spike protein of the coronavirus that causes COVID-19.

• Like the other vaccines discussed thus far, the spike protein from the vaccine primes the immune system to attack the coronavirus if it later infects the body.
  • The weakened version of the virus used in the vaccine has been genetically changed so that the virus is unable to replicate or cause illness in humans.
**The Oxford-AstraZeneca vaccine**

• A half-dose of the vaccine followed by a full dose at least one month later was found to be 90% effective.
  • A second regimen using two full doses one month apart was 62% effective.
  • The combined results showed an average efficacy rate of 70%.
  • Questions have been raised about the half dose regime which was not intentional and turned out to be serendipity

• However, the extent to which the vaccine induces strong antibody and T cell immune responses among elderly populations has yet to be determined because the half dose-full dose regimen was not tested in older participants.
Advantages of adenovirus vaccines

• Adenoviral vaccines can be stored in standard refrigerators, rather than needing freezers.
  • The AstraZeneca-Oxford vaccine can be transported under “normal refrigerated conditions” of 36°F to 46°F
• The Oxford-AstraZeneca vaccine is cheaper than the Pfizer and Moderna vaccines as well.
  • AstraZeneca, which has pledged not to make a profit on the vaccine during the pandemic, has reached agreements with governments and international health organizations that put its price at about $2.50 a dose.
  • Pfizer’s vaccine costs around $20 a dose while Moderna’s vaccine costs between $15 to $25 a dose based on the agreements between the companies and the U.S. government
Likely vaccine roll out according to Dr Fauci

• Several vaccine candidates are in late-stage clinical trials in the U.S. and safety and efficacy data could be ready for review by the end of the year.

• That would make initial doses of the vaccine available to frontline workers around the end of 2020 and beginning of 2021 and pave the way for widespread distribution several months into 2021.

• **Mitigation strategies such as wearing face masks, social distancing and avoiding large crowds will still be important in preventing the spread of infection for “quite some time.”**
## Vaccines currently under development

### Coronavirus Vaccine Tracker

By Carl Zimmer, Jonathan Corum and Sui-Lee Wee  
*Updated December 2, 2020*

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- Vaccines testing safety and dosage
- Vaccines in expanded safety trials
- Vaccines in large-scale efficacy tests
- Vaccines approved for early or limited use
- Vaccines approved for full use
What is the current status of COVID-19 vaccines for children?

• Children’s immune systems differ from adolescents.
  • There are certain vaccines that work better in children than adults. And there are certain vaccines that work less well in children compared to adults.

• So far, Pfizer’s COVID-19 vaccine has only been fully tested on adults.
  • In September, Pfizer began including teenagers as young as 16 in an ongoing trial, and last month they began a new trial including children as young as 12. But these results have yet to be shared.

• Children (age 18 and under) account for 1/5 of the population of the U.S. (~73 million individuals). Additionally, 3.7 million infants are born each year. This pool of unvaccinated people would still be at risk for COVID-19 disease and could contribute to its transmission is significant and herd immunity can not be established without vaccinating them.
Social and Cultural Issues that Influence Vaccine Acceptance

And the exaggerated expectations with respect to returning to life as usual
Vaccine issues that will need to be faced sooner rather than later

**Common Reasons for Vaccine Hesitancy**

- Little trust in the governmental agencies which declare it safe
  - Conspiracy theories abound
- “Rushed vaccine has not proven safe – I will wait”
- Concern about potential side effects
- “Vaccine acquired immunity is not as efficacious as infection acquired immunity”
- “Disease is no big deal for people like me, vaccine is an additional risk”
- “Vaccine against my belief system”

**Exaggerated Expectations for COVID-19 Vaccines**

- “Once a vaccine is introduced the public will no longer have to wear masks or social distance within a few months”
- “Herd immunity will be reached very quickly”
- “The vaccine will prevent all cases of COVID-19”
- “The vaccine will provide lifetime immunity”
What factors lead to vaccine hesitancy

- Trust and safety are the two major issues given the amount of mis- and disinformation circulating in our highly networked society.

**Trust**
- Distrust in the motives of vaccine manufacturers
- Distrust in the federal agencies responsible for regulating the vaccine industry and the fast-track warp speed imperative of the government
- Distrust in public health experts promoting vaccination
- Other vaccines that have been controversial and promoted by the same public health stakeholders

**Safety**
- Short-term and long-term side effects
- How long will it take to know if there are side effects
- Safety concerns for the very young and old
- Differences in opinion about the relative effectiveness of “natural” vs vaccine acquired immunity and disease “resistance”
Vaccine skepticism and suspicion are major challenges in reaching herd immunity

• The ability to reach 70-80% herd immunity to control COVID-19 is undermined by both:
  • **Skepticism** about medical authority and expertise. This has been more common among Trump supporters even though the president has been promoting vaccines as the soon coming magic bullet. This is paradoxical.
  • **Suspicion** that the administration is cutting corners on safety to rush thru a vaccine for political reasons (more common among Democrats).
What do recent surveys tell us about vaccine acceptance globally and locally?

Politics matter
International vaccine surveys

Bear in mind that for international travel to safely resume, global herd immunity will be required
International vaccine surveys

• In a survey of over 13,000 people from 19 countries published in Nature Medicine, nearly 72% of respondents said they would be very or somewhat likely to take a vaccine if it became generally available.

• Meanwhile, 14% of respondents said they would be very or somewhat likely to not take a vaccine and another 14% said they were still unsure.
The Nationalities Most Eager To Take A Covid-19 Vaccine

% who agree/disagree they would take a Covid-19 vaccine if it was available*

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* May not add up to 100% due to rounding
n=19,519 adults in 27 countries (Jul 27-Aug 07, 2020).
Source: Ipsos MORI
Results of a large international study of potential acceptance of a COVID-19 vaccine

• The study included 13,426 randomly selected individuals across 19 countries, most with a high COVID-19 burden.
  • Survey respondents represented a random sample of the populations of 19 countries that comprise around 55% of the global population.
• Of these, 71.5% responded that they would take a vaccine if it were proven safe and effective, and 61.4% said that they would get vaccinated if their employer recommended it.
Results of a large international study of potential acceptance of a COVID-19 vaccine

• However, there was a high of heterogeneity in responses between countries, which could be related to trust in one’s government
  • Countries where acceptance exceeded 80% tended to be Asian nations with strong trust in central governments (China, South Korea and Singapore)
  • Respondents from Poland reported the **highest proportion of negative responses**: 27.3%
  • Russian respondents gave the **lowest proportion of positive responses**: 54.9%
  • Until the origins of wide variation in willingness to accept a COVID-19 vaccine are addressed, differences in vaccine coverage between countries could delay global control of the pandemic

• **Note:** Reporting one’s willingness to get vaccinated might not be necessarily a good predictor of acceptance, as vaccine decisions are multifactorial and can change over time.
Vaccine intention may well vary by rate of vaccine effectiveness: Indonesia survey as an example

• Among 1,359 respondents, 93.3% of respondents (1,268/1,359) stated that they would like to be vaccinated if a vaccine was 95% effective.

• The rate of acceptance decreased to 67.0% (911/1,359) if the vaccine was only 50% effective.
USA Vaccine Surveys

Older and more recent surveys to show change over time
The AP-NORC Survey, May 2020

The Associated Press-NORC Center for Public Affairs Research
AP Poll, May 2020

If a vaccine against coronavirus becomes available to the public:

- 49% say they plan to get vaccinated
- 20% say they will not.
- Another 31% are not sure.

Question: If a vaccine against the coronavirus becomes available, do you plan to get vaccinated or not?

Source: AP-NORC Poll conducted May 14-18, 2020 with 1,056 adults
Why would you get a coronavirus vaccine?

- I want to protect myself: 93%
- I want to protect my family: 88%
- It would be the best way to avoid getting seriously ill from the coronavirus: 82%
- It would allow me to feel safe around other people: 81%
- I want to protect my community: 78%
- Life won’t go back to normal until most people are vaccinated: 72%
- My doctor recommends vaccines: 66%
- I have a chronic health condition, such as asthma or diabetes, so it is important that I receive a coronavirus vaccine: 33%

Percent among those who plan to get the vaccine who select each item.

Question: ASKED OF THOSE WHO SAY THEY WOULD GET VACCINATED: Which of the following are reasons you would get a coronavirus vaccine? Select all that apply.

Source: AP-NORC Poll conducted May 14-18, 2020 with 1,056 adults
**Why would you NOT get a coronavirus vaccine?**

- I would be concerned about side effects from the vaccine: 70%
- I would be concerned about getting infected with the coronavirus from the vaccine: 42%
- I’m not concerned about getting seriously ill from the coronavirus: 31%
- I don’t think vaccines work very well: 30%
- The coronavirus outbreak is not as serious as some people say it is: 24%
- I don’t like needles: 10%
- I am allergic to vaccines: 5%
- I won’t have time to get vaccinated: 2%

*Percent among those who do not plan to get the vaccine who select each item*

**Question:** ASKED OF THOSE WHO SAY THEY WOULD NOT GET VACCINATED: Which of the following are reasons you would not get a coronavirus vaccine? Select all that apply.

**Source:** AP-NORC Poll conducted May 14-18, 2020 with 1,056 adults
Newsweek survey, June 2020
How many Americans would be willing to take a COVID-19 vaccine?

• 30% of respondents agreed with the conspiratorial sentiment that “the dangers of vaccines are being hidden by the medical establishment.”
  • Agreement with the statement varied by race and ethnicity: 25% of white people agreed compared with 29% of Latinos and 49% of Black people.
  • 25% of respondents agreed with the statement “the coronavirus is being used to force a dangerous and unnecessary vaccine on Americans.” Only 22% of white people and Latinos agreed while 42% of Black people did.

• “If a vaccine for COVID-19 becomes available, would you be willing to take it?”
  • Nearly two-thirds of respondents indicated they would be willing to take it.
  • But race and ethnicity mattered: While 70% of white people agreed, only 62% of Latinos and 44% of Black people did.
Willingness of Americans to become vaccinated

Since May, fewer Americans overall say they would get a COVID-19 vaccine when it becomes available. If and when a coronavirus vaccine becomes available, will you get vaccinated? (% who say “yes”)

- US Adults
- Democrats
- Independents
- Republicans

A Third Of Americans Unwilling To Get Covid-19 Vaccine
Share of U.S. adults willing to get an FDA approved, no cost vaccine for Covid-19

- All Americans
  - Yes: 35%
  - No: 65%
- Democrats
  - Yes: 19%
  - No: 81%
- Independents
  - Yes: 41%
  - No: 59%
- Republicans
  - Yes: 47%
  - No: 53%

- 18-29 years old
  - Yes: 24%
  - No: 76%
- 30-49 years old
  - Yes: 36%
  - No: 64%
- 50-64 years old
  - Yes: 41%
  - No: 59%
- 65+
  - Yes: 30%
  - No: 70%

n=7,632 (July 20-August 02, 2020)
Source: Gallup
Majority unlikely to get vaccine as soon as one is available
Additionally, most Americans unwilling to spend much to get vaccinated against COVID-19

How likely are you to get the first generation COVID-19 vaccine, as soon as it’s available?

- Very likely/ Somewhat likely
  - All Americans: 39%
  - Democrats: 43%
  - Republicans: 33%
  - September 18-21
  - All Americans: 47%
  - Democrats: 56%
  - Republicans: 41%
  - August 28-31

- Not very likely/ Not at all likely
  - All Americans: 60%
  - Democrats: 57%
  - Republicans: 66%
  - September 18-21
  - All Americans: 53%
  - Democrats: 44%
  - Republicans: 59%
  - August 28-31

How much would you be willing to pay out of pocket for the COVID-19 vaccine?

- < $20: 33%
- $20 to <$50: 26%
- $50 to <$100: 5%
- $100 or more: 10%
- Nothing: 25%
Newer USA Vaccine Surveys
Roughly Six in 10 Americans Would Agree to Be Vaccinated Against COVID-19

If an FDA-approved vaccine to prevent coronavirus/COVID-19 was available right now at no cost, would you agree to be vaccinated?

<table>
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GALLUP PANEL. 2020

Gallop poll in October
Gallop poll in October
As of November 20, 2020, the Pew Research Center reported that the majority of Americans say they would receive a COVID-19 vaccine, with acceptance of the vaccine having increased among the most population groups.
However, many Americans would still be uncomfortable to be among the first to receive the vaccine, a sign that there is still some hesitancy towards receiving it.
Minority Populations: distrust of medical interventions may affect vaccine acceptance

• Minority populations, especially Black and African Americans, are largely underrepresented in several vaccine studies.

• Historically and presently, patterns of blatant and systemic racism have sowed discord and mistrust between minority populations and medical research communities:
  • Tuskegee Study: In 1932, federal organizations (including the Public Health Service) began working with a population of black men to see the long-term effects and outcomes from syphilis
    • Participants were not consented; instead, being told they were being treated for “bad blood”
    • Treatment was withheld; doctors were told not to treat men in the study for syphilis
    • Even in 1947, when penicillin was shown to be an effective treatment, men in the study were not offered any treatment
  • False racial beliefs about biological differences have been shown to affect treatment outcomes → potentially propagating discriminatory/differential treatment
Black Americans are more skeptical of experimental treatments, potential COVID-19 vaccine than Hispanic and white adults

% of U.S. adults who say ...

- Benefits outweigh the risks of allowing more access to experimental treatments before completion of clinical trials
  - Black: 41%
  - Hispanic: 53%
  - White: 63%
  - U.S. adults: 59%

- They would definitely/probably get a COVID-19 vaccine if it were available today
  - Black: 54%
  - Hispanic: 74%
  - White: 74%
  - U.S. adults: 72%

Note: Whites and blacks include those who report being only one race and are non-Hispanic. Hispanics are of any race.

PEW RESEARCH CENTER
Vaccine intention

• A UC survey of 1,056 people in May found that only 25% of Blacks and 37% of Hispanics were willing to receive a COVID-19 vaccine, and 32% and 37% respectively were unsure.
November poll finds majority of Canadians open to getting COVID vaccine, but many want to wait

- A new Ipsos/Radio-Canada poll has found that most Canadians intend to get vaccinated against COVID-19, but that many would prefer to wait at least a month or two after a vaccine is approved.
  - The internet poll surveyed 3001 people over the age of 18 across the country between November 20th and November 25th.
- Of those who responded, 64% said they would probably or certainly get vaccinated, while 16% said they would not.
  - 20% of these respondents said they were unsure as to whether they would get vaccinated.
- Of those who said they would get vaccinated, only 36% said they'd get vaccinated as soon as possible. Another 38% said they’d wait one or two months, and 11% were undecided as to when.
The USA is not the only country where vaccine hesitancy appears to be a problem at the moment

- French opposition to the COVID-19 vaccine grows as government unveils campaign
- A poll conducted by the weekly *Journal du Dimanche* on November 28th found that 59% of French people did not plan to get inoculated against the coronavirus.
- “Before we immunize ourselves against the virus, we need to immunize ourselves against fear,” (health minister Olivier Véran referring to the rise in reticence of the French people)
Trust is essential for vaccine acceptance

Who the public trusts can influence vaccine uptake
Hesitancy to receive first generation vaccines

How likely would you be to take a first generation COVID-19 vaccine if…

… your **doctor** said it was safe 62%**

… the **cost** were completely **covered by insurance** 56%

… the **FDA** said it was safe 54%

… you could get it easily, from a walk-in or drive-thru clinic 50%

… you were paid $100 to receive the vaccine 44%

… you had to make an **appointment and get it at a hospital** 37%

… it **cost you $100** 26%**

… President Trump said it was safe 19%**

*From a survey of 1,075 U.S. adults, Sept. 24-27, 2020
Trust issues may affect lower tier health care workers’ willingness to accept vaccines

- ‘If There’s No Trust, There’ll Be More Hesitancy’: Nursing Homes Must Overcome Staff Skepticism of COVID Vaccine’ (Skilled Nursing News 12/2/2020)

- This may especially be the case if the health care worker is from a minority group that may have suspicions that those who are first to receive vaccination are guinea pigs to test the vaccine’s safety and efficacy.

- In order to get buy-in from this group that is at greatest risk to COVID-19, they must feel that they have a safety net in the event that they fall ill from taking the vaccine and are unable to come to work and/or get a paycheck.
Transparency about side effects of vaccines is a trust issue
Vaccine side effects as demonstrations of efficacy

- When you experience relatively mild side effects from a vaccine, this means that your immune system has started a response to the vaccine. This is what you want to happen!
- Public health officials and vaccine developers need to warn people that the coronavirus vaccines may have side effects that mimic the symptoms of a mild COVID-19 disease.
  - By being transparent about the possible discomorts people may experience, they will be less likely to be scared away from getting the second scheduled dose of the vaccines.
- These side effects are likely to include:
  - Sore arm, muscle pain, chills, headache, fatigue, and fever.
  - One should plan for a day of rest and recuperation after getting vaccinated.
    - These symptoms have only lasted for a day in the three vaccines soon to be available to the public.
- As with other vaccines, the public needs to be encouraged to think of short-term vaccine side effects as evidence that the vaccine is working as intended and of side effects as a “positive response” instead of an “adverse reaction.”
What about reactions in people with severe allergies?

• At the moment it is recommended that anyone with a history of severe allergic reactions to a vaccine, medicine or food, or those who carry an adrenaline autoinjector pen, should wait to get Pfizer’s vaccine.

• The warning came after two NHS workers in the UK had allergic reactions on Tuesday after receiving the vaccine
  • Both NHS workers have a history of serious allergies and carry adrenaline pens around with them
What about reactions in people with severe allergies?

• They are understood to have had an anaphylactoid reaction, which tends to involve a skin rash, breathlessness and sometimes a drop in blood pressure. This is not the same as anaphylaxis which can be fatal
  • Reactions like this are uncommon for most people with minor allergies
  • They do occur with other vaccines, including the annual influenza vaccines
  • These reactions are also short lived and do not result in long term consequences

• As with other vaccinations, individuals with a history of severe allergies should ALWAYS consult with their medical provider/physician before receiving ANY vaccine. If you and your medical provider decide that you should receive the vaccine, it can be administered under close supervision to mitigate any potential reactions you may experience as a result.
What happens if not enough people nationally take the vaccine?

What happens if many people in some regions take it but in other regions a smaller percentage agree to do so?
Vaccine hesitancy is a global public health problem that must be addressed

• In 2019, before the pandemic hit, the World Health Organization (WHO) listed vaccine hesitancy as one of the top 10 global health threats.

• Those who hold off on getting the eventual COVID-19 vaccine pose a threat to developing herd immunity to the virus.

• Vaccine hesitancy is a persistent problem fostered by both mistrust in one’s government and misinformation propagated by stakeholders with a variety of self-serving agendas.
  • Some of these same stakeholders have challenged COVID-19 policies linked to mask wearing and shutdowns as ways of mitigating the virus.

• Mis/disinformation does not only reinforce the views of anti-vaxxers but leads many others to also become vaccine hesitant which will ultimately delay herd immunity.
Community variation in rates of vaccination

- If the members of a particular community chose not to vaccinate, then the entire community is vulnerable to an epidemic (think of a pandemic, but only contained to that specific community/neighborhood communities).
- Once a critical mass of infected individuals is reached in one locale, it enables a contagion to spread throughout the rest of the population.
  - This is true even if a significant fraction of the overall population is vaccinated.
- Remember, if and when a community has reached herd immunity, there will still be a proportion of people in that community that will be susceptible to infection.
  - We need to think of communities as fluid. As isolated as a community may be, there will still always be some level of travel in and out of that community which would allow for transmission of the virus from a locale that chooses not to vaccinate to locales that do receive vaccinations.
When enough people become vaccinated, the number of people the disease can spread to is limited.
What is the government's role in insuring vaccination coverage? Anticipate some political controversy.

- In order to reach herd immunity, it is likely that vaccines will need to be mandated for workplaces and schools.
  - As is the case of measles, those who refuse to get their children vaccinated for religious reasons may find their children are barred from public schools, day care, other childcare facilities, etc.

- However, there is a difference between COVID-19 and measles.
  - Measles is highly infectious and results in serious disease for a significant percentage of children.
  - Although the likelihood will children experience a severe illness from COVID-19 is relatively lower than measles, they can still transmit the infection to other vulnerable populations (teachers/school faculty) who may experience severe disease.
Employer citizenship and civil liberties

• If the government does not mandate vaccination, it may be left up to employers to mandate vaccination (similar to how some employers have mandated mask wearing indoors and physical distancing).

• This will be a major headache for business owners and human relations departments who will be left with a decision as to whether to mandate or encourage vaccination for COVID-19.
  • If they mandate vaccinations (once deemed safe and available), then by law they must allow for exemptions
  • However, those who chose not vaccinate due to some conviction will likely be required to protect other employees by alternative means like continued mask wearing and physical distancing for some time into the future until vaccination is no longer required to prevent transmission.
Queries about vaccines
If I get vaccinated, can I still get COVID-19?

• Vaccines are not 100% effective, but two of the vaccines under development for COVID-19 have reported that they are 95% effective in preventing severe COVID-19.
  • So, if you are vaccinated it is highly unlikely you will get severe COVID-19 over the next 6 months or perhaps longer (the duration of efficacy remains to be seen).

• It is possible to be re-infected with COVID-19 – rare but possible.

• It takes time for vaccines to work: It typically takes a few weeks for the body to build immunity after vaccination. That means it’s possible a person could be infected with the virus that causes COVID-19 just before or just after vaccination and get sick. This is because the vaccine has not had enough time to provide protection.
Will those who have already had COVID-19 be encouraged to get vaccinated?

• It is “very likely” that adults who have recovered from COVID-19 will be encouraged to take the vaccine.

• The reason is because the duration of protection from someone who has already been infected is unknown. We do not yet know how long protection will last in general and for specific categories of people
  • Factors that might influence duration of immunity include the state of person’s health, whether they were symptomatic vs asymptomatic, and how severe their illness was.
  • Until we know for certain, vaccination will most likely be recommended.

• Some recovered COVID-19 patients were among the participants in the Moderna trial.
If I get the vaccine, how will I know whether I have the disease if I am exposed to someone who has come down with it? **Will I test positive just because I have been vaccinated?**

- If you are experiencing symptoms consistent with COVID-19, you will be administered a diagnostic test such as a PCR or antigen test.
  - Neither of these tests look for antibodies to the virus
  - These types of tests determine whether you have an active infection by detecting proteins that are expressed by the virus or by detecting the genetic material from the virus.

- **COVID-19 vaccines do not contain the virus that causes the disease and will therefore not cause you to test positive on COVID-19 viral tests.**
  - These vaccines cause your immune system to produce antibodies to the virus.
  - If you have been vaccinated for the virus that causes COVID-19, you will later test positive via an antibody test.
After getting vaccinated will I still have to wear a mask?

- **YES**

- Getting vaccinated for COVID-19 will not mean the end of wearing face masks in public places, physical distancing or frequent hand-washing to prevent the spread of COVID-19.
  - This is due to the fact that the vaccines may not entirely prevent COVID-19 infection, so there is a chance you may still be able to get COVID-19 and spread it to others even after vaccination.
Sobering scenario related to the impact of vaccines taking account the current infection rates

• At the current level of infection in the U.S. (about 200,000 confirmed new infections per day), a vaccine that is 95% effective — distributed at the expected pace — would still leave a terrible toll in the six months after it was introduced. Almost 10 million or so Americans would contract the virus, and more than 160,000 would die.

• This is far worse than the toll in an alternate universe in which the vaccine was only 50% effective, but the U.S. had reduced the infection rate to its current level in early September (about 35,000 new daily cases). In that scenario, the death toll in the next six months would be kept to about 60,000.

• No vaccine can eliminate a pandemic immediately, just as no fire hose can put out a forest fire. While the vaccine is being distributed, the virus continues to do damage. “Bluntly stated, we’ll get out of this pandemic faster if we give the vaccine less work to do.”
We need to get the case number down, not just wait for the vaccine to be a magic bullet, if we want to get back to normal any time soon.
COVID-19, the Seasonal Flu, and Vaccinations
COVID-19 and the Seasonal Flu

• The seasonal flu caused an estimated 400,000 hospitalizations and 22,000 deaths in the US during the last flu season, according to the CDC.

• Both the flu and COVID-19 have many of the same symptoms.
  • One symptom that differentiates flu from COVID-19 is loss of taste or smell, especially smell
  • If you lose your sense of smell, get a COVID-19 test as soon as possible.

• It is possible to have COVID-19 and the flu at the same time.

• For your own safety and to keep hospitals from being overwhelmed, please get a flu vaccination NOW and a COVID-19 vaccination as soon as it becomes available.
Should I get a seasonal flu vaccine if I have not done so? Yes! For four good reasons:

1. It is possible to get the “flu” and COVID-19 at the same time and this would increase the severity of your illness.

2. As the coronavirus continues to spread across the country, doctors say it's more important than ever to build up herd immunity for strains of “flu.”
   • This protects the elderly and other vulnerable people.

3. It is very important to protect yourself from the influenza virus and not put more pressure on the health system with the impending cases of coronavirus.
   • The last thing they need is this double burden.
   • The best time to get a seasonal influenza vaccine is mid September to mid October

4. Cross-protection at some level is a possibility that is presently being investigated for several different vaccines. This has not yet been demonstrated for COVID-19, but cross protection has been documented for other diseases.
Does getting a flu shot make you temporarily more susceptible to COVID-19

• Does receiving a flu vaccine lower your immunity, making you briefly more susceptible to catching COVID-19?
  • Probably not, there's very little scientific basis that getting a flu shot will temporarily weaken your immune system.
  • Your immune system encounters and reacts to multiple pathogens all the time, so it is highly unlikely that reacting to one vaccine will put you at greater risk to infection from other pathogens.
Vaccine Accessibility
Pragmatic issues related to vaccine coverage:

• Will COVID-19 vaccines be free or affordable?
• Will insurance cover it?
• Will vaccines be easy to access?
  • If provided outside a clinic, will they be provided in places that all segments of the population feel comfortable visiting?
  • Will they be given by people who are trusted?
How do I estimate what position I am most likely to have when in line for a COVID-19 vaccination?

• The New York Times in conjunction with the Surgo Foundation and Ariadne Labs have created a vaccine tool to calculate the number of people who will need a vaccine in each state and county — and where you might fit in that line.

• You can access this tool at: https://www.nytimes.com/interactive/2020/12/03/opinion/covid-19-vaccine-timeline.html?referringSource=articleShare
Potential COVID-19 Vaccine Prioritization Overview*

**Phase 1**
- December 2020 - Spring 2021
  - Healthcare Workers + Includes EMS Workers
  - Adults Older than 65
  - Long-term care facility staff & residents

**Phase 2**
- Spring 2021 - Summer 2021
  - Any Remaining Phase 1 Populations
  - Additional High-risk/Critical Populations
  - Adults of Any Age with High-risk Medical Conditions

**Phase 3**
- Summer 2021 - Beyond
  - Any Remaining Phase 1 or 2 Populations
  - General Population

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**When can I get a coronavirus vaccine?**

- **Week of Dec 14**: Pfizer’s shot is distributed to states across the US, with 2.9 million doses initially sent out to vaccinate some of the most vulnerable groups.
- **Dec 17**: Moderna’s application for Emergency Use Authorization is reviewed by a non-binding advisory committee. FDA approval could then be granted within days.
- **Mid Dec. 2020 - Jan. 2021**: Authorized vaccines are injected into 4 priority groups: healthcare workers, frontline workers, people over 65, and people with preexisting conditions. Roughly 90 million people across the US are expected to receive injections by February.
- **Feb. 2021**: 90 million more in the priority groups get vaccinated.
- **Mar. - Apr. 2021**: Vaccine distribution to 4 priority groups continues.
- **May/June 2021**: Vaccines become more widely available to young, healthy members of the general public.
- **Jul. - Sep. 2021**: Most adults in the US who want a vaccine likely have access at this point. But, remember, many coronavirus vaccines require 2 shots to become fully effective. The vaccination process can take 3-4 weeks per person.
- **Oct. - Dec. 2021**: herd immunity through vaccination could be reached in the US, if 75% of people (or more) get their shots.

*Distribution groups and timelines of phases shown are tentative. This information is subject to change due to future vaccine distribution guidance recommendations, FDA approval of vaccines, and vaccine allocation/availability.

Source: Business Insider

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HCW HOSTED

Coordinating Community Support for Healthcare Workers and Families
Emergency COVID-vaccine approvals pose a dilemma for scientists for two reasons

• Once a vaccine is granted emergency approval, there is pressure on developers to offer the immunization to trial participants who received a placebo.

• But if too many people cross over to the vaccine group, the companies might not have enough data to establish:
  • Long-term outcomes, such as safety
  • How long vaccine protection lasts
  • Whether the vaccine prevents infection or just the disease
Emergency COVID-vaccine approvals pose a dilemma for scientists for two reasons

- It will become more difficult to recruit volunteers for the trials of other new vaccines.
  - If a vaccine exists that has been identified as efficacious in the media, why would someone want to be part of a trial of a yet to be fully tested vaccine if being part of that trial means they cannot take another proven efficacious vaccine until the trial ends?
  - If the comparator for new COVID-19 vaccines becomes vaccines like those produced by Pfizer and Moderna (with efficacy rates >90%) instead of a placebo group, it may be harder to recruit the sample needed to demonstrate the level of efficacy the FDA would demand.*
    - In this case, drop out of new candidate vaccines in phase I and II trials may occur.