

## Factors Affecting Current SARS-CoV-2 Vaccine Reception

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## **Abstract**

The coronavirus disease 2019 (COVID-19), caused by infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), sparked a global pandemic accompanied by immense economic, social, and political disruptions. While physical distancing and masking have been used to contain the virus, a more effective countermeasure was needed, in the form of a SARS-CoV-2 vaccine. A widely administered vaccine is necessary to ease morbidity and mortality due to COVID-19 and to achieve herd immunity by preventing future outbreaks. There are three vaccines approved for emergency usage in the United States as of May 8<sup>th</sup>, 2021, so now it is of the utmost importance to vaccinate as much of the American population as possible.

There are many factors that will affect widespread immunization of the population: including the anti-vaccination movement, political affiliation, racial inequalities and distrust, and economic disparity. In order to analyze the potential effectiveness of a SARS-CoV-2 vaccine, the following question must be addressed: How does the network of anti-vaccination movements, racial and economic inequality, and politics affect widespread accessibility and administration of a SARS-CoV-2 vaccine and subsequent immunization to COVID-19? The actor-network theory will be used to assess the factors affecting the efficacy of the SARS-CoV-2 vaccine in achieving herd immunity in America by defining the network and relationships around the vaccine. A thorough look at the actors and network surrounding vaccine implementation provides steps for public health officials to target specific groups of the population and regain trust in the medical community and government. Public health officials and the medical community need to be transparent with the vaccine development process and use the media and internet to inform the community of vaccine importance and safety, while using celebrities and people who represent minority communities to gain the trust of the whole population.

## **Factors Affecting Current SARS-CoV-2 Vaccine Reception**

The coronavirus disease 2019 (COVID-19) has infected over 157 million people worldwide and over 3 million people have died as of May 8<sup>th</sup>, 2021 (*Coronavirus Update (Live)*, 2021; WHO, 2020). COVID-19 has a long incubation period and a high capacity for transmission between humans, even those who are asymptomatic, with no effective preventative measures to curtail the pandemic besides social distancing and masking (Case et al., 2020; CDC, 2020b). To reduce mortality and morbidity due to COVID-19, a severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) vaccine is essential (Amanat & Krammer, 2020; Callaway, 2020; *Novel Coronavirus Structure Reveals Targets for Vaccines and Treatments*, 2020). Researchers and biotechnology and drug companies rushed to develop and fast-track a vaccine to target the viral infection, and the US Food and Drug Administration (FDA) approved the first vaccine, Pfizer-BioNTech, for administration on December 11, 2020 (Craven, 2020; Ledford, 2020). As of March 28<sup>th</sup>, 2021, three SARS-CoV-2 vaccines have been authorized for emergency use in the United States with three more in phase three clinical trials, but just because a vaccine is available does not mean that everyone will get vaccinated, so widespread accessibility and administration of a vaccine is crucial to stop future COVID-19 outbreaks (Callaway, 2020; CDC, 2021; Seale et al., 2010).

An analysis of the different elements that impact implementation of the coronavirus vaccines will highlight factors that could hinder the widespread administration and, therefore, efficacy of a SARS-CoV-2 vaccine by preventing herd immunity to COVID-19. Racial and socioeconomic inequality in health care are two factors to consider during COVID-19 vaccine administration that necessitate equitable access to the vaccine, since these minority populations must overcome medical distrust and resource barriers before receiving the new vaccines. Anti-

vaccination movements and politically affiliated groups are also two groups that will affect the success of the COVID-19 vaccine in providing widespread immunization in America because of both of these groups' vaccine hesitancy and general distrust of the government. Actor-Network Theory (ANT) will be used to analyze the complex network surrounding the SARS-CoV-2 vaccines by determining the human and non-human actors that affect implementation of a vaccine and examining how the actors interact in and maintain the dynamic network surrounding the COVID-19 vaccine. In order to analyze the potential effectiveness of a SARS-CoV-2 vaccine, the following questions must be addressed: What are the factors that influence the effectiveness of the SARS-CoV-2 vaccine in dissipating the COVID-19 pandemic in America? How does the network of anti-vaccination movements, racial and economic inequality, and politics affect widespread accessibility and administration of a SARS-CoV-2 vaccine and subsequent immunization to COVID-19?

This paper will start by introducing the current global pandemic of COVID-19 and ongoing vaccine status and vaccination efforts in America and then provide background for the Actor-Network Theory used to analyze potential vaccine uptake by citizens. Next, the paper will provide background for the people groups discussed that are more likely to be distrustful of the COVID-19 vaccine: the anti-vaccination movement, Republican party, minority racial groups, and low socioeconomic status populations. Lastly, connections between different people groups and other non-human actor groups are drawn to reveal power relationships between actors and provide recommendations to increase COVID-19 vaccine uptake in America.

### **The COVID-19 Pandemic and Actor-Network Theory**

In December 2019, SARS-CoV-2, an RNA virus, emerged in China and spread rapidly between people, causing a pandemic accompanied by significant disruptions worldwide (Bai et

al., 2020; Case et al., 2020). COVID-19 has a high capacity to transmit between humans, even asymptomatic ones, and a long incubation period, making outbreaks difficult to track and contain, and leading to fatalities (Case et al., 2020). Thus, an effective countermeasure to the SARS-CoV-2 virus, namely a vaccine, is needed to prevent further morbidity and economic and social disruption from COVID-19 (Case et al., 2020).

COVID-19 was declared a Public Health Emergency of International Concern by the World Health Organization on January 30, 2020 and vaccine research to target SARS-CoV-2 began (Callaway, 2020; *Novel Coronavirus Structure Reveals Targets for Vaccines and Treatments*, 2020). The coronavirus disease 2019, like former coronaviruses, is composed of spherical SARS-CoV-2 particles with protruding protein spikes that bind to human cells (*Novel Coronavirus Structure Reveals Targets for Vaccines and Treatments*, 2020). The SARS-CoV-2 vaccine seeks to neutralize the protein spikes, preventing cell changes and viral replication (Case et al., 2020). As of September 9, 2020, there were 320 COVID-19 vaccines undergoing development and clinical trials, in an effort to quickly produce a vaccine for distribution (Callaway, 2020). As of February 24, 2021, there were two approved SARS-CoV-2 vaccines being administered in the United States: the Pfizer and Moderna vaccines (Petri, 2021). These COVID-19 vaccines use messenger RNA (mRNA) to encode for the glycoprotein spike, allowing the B-cells to create protective antibodies to fight the virus (Petri, 2021). The current mRNA vaccines require two doses approximately four weeks apart, in order to prepare the immune system to create effective antibodies to fight the virus, and over 65 million total doses of the two vaccines were administered in the United States between December, 2020 and February, 2021 (CDC, 2021; Petri, 2021).

Then, on February 27<sup>th</sup>, 2021, the FDA approved the Johnson & Johnson (J&J) COVID-19 vaccine, which is currently the only approved one dose vaccine, but the FDA asked states to temporarily halt the use of the J&J vaccine on April 13<sup>th</sup>, 2021 after six women in the U.S. developed a rare blood-clotting disorder in the weeks following vaccination (Commissioner, 2021; Kopecki & Lovelace Jr., 2021). Seven million people have received the J&J vaccine in America and fifteen people have been diagnosed with the rare blood clotting disease from the vaccine (Mazziotta, 2021). Administration of the J&J vaccine was resumed on April 23<sup>rd</sup>, 2021 because the benefits of the vaccine outweigh the rare risks, but a feeling of fear about the potentially fatal side effects of the J&J vaccine remains (Mazziotta, 2021; Weiland et al., 2021).

While much is still unknown about the COVID-19 vaccines, such as the length of immunity provided and their response to COVID-19 variants, the public is being encouraged to receive the vaccines when they are able so that COVID-19 transmission decreases as immunity rises (Mahmud, 2021; Newman, 2021). The Centers for Disease Control and Prevention (CDC) provides recommendations for who should receive the vaccine first, such as health care workers and the elderly, but each state is responsible for implementing their own vaccine distribution plan (CDC, 2021; Hester, 2021). The CDC also provided three billion dollars in funding on April 6<sup>th</sup>, 2021 to local efforts and community organizations encouraging vaccine uptake and equitable access of the COVID-19 vaccines to underserved communities (CDC Press Release, 2021). The goal of the vaccine is that the majority of the population will receive immunization to COVID-19 and pandemic precautions can be lifted, but many people are hesitant and distrustful of the vaccines (Mahmud, 2021; Newman, 2021). A national forum was held by the CDC in February 2021, in order to increase confidence and gain citizen's trust about the safety and importance of the COVID-19 vaccine, while also acknowledging apprehension (Mahmud, 2021).

Black, Hispanic, and Native American communities are a few of the groups that are more likely to be distrustful of the SARS-CoV-2 vaccine because of America's history of mistreatment and racism towards those groups (CDC, 2020c; Mahmud, 2021; Park, 2017). People of low socioeconomic status in America are another population that are more likely to abstain from vaccinations because of lack of access to healthcare (Sharoni Bandyopadhyay, 2019). Yet, there are also people of high socioeconomic status that choose to abstain from vaccinations for a variety of personal reasons and perceived fears (Hussain et al., 2018; Sharoni Bandyopadhyay, 2019). The anti-vaccination movement is a trend seen in Western countries that is spurred by general fear and distrust of vaccines and the government, and has negatively affected herd immunity to diseases such as measles (Dunham, 2008; Hussain et al., 2018). Lastly, political stance also affects the likelihood of receiving the COVID-19 vaccine, with Republican men less likely to receive the vaccine, especially when vaccine coercion comes from a left-wing government (Edward Lempinen, 2021). In California, 37% of surveyed Republicans said they would not receive the SARS-CoV-2 vaccine, stating that vaccinations are a personal choice instead of what others might see as a shared responsibility (Edward Lempinen, 2021). Actor-Network Theory will be utilized to analyze how distrust and vaccine hesitancy from minority groups, low-income citizens, political affiliation, and the anti-vaccination movement will affect the widespread administration of the SARS-CoV-2 vaccine to the American population, and, therefore, affect herd immunity to COVID-19.

ANT is a methodology that identifies and defines human and nonhuman actors as influences in a sociotechnical network (Alcadipani & Hassard, 2010; Crawford, 2020; Cressman, 2009). ANT works to uncover the "black box" of new technology and science by following and examining the complex relationships between actors to explain how the technology emerged

(Cressman, 2009). ANT is a unique theory because it identifies factors as both an actor and a network, depending on perspective, and uses the same framework on both human and nonhuman ideas and entities in a network. Actors can only be understood and defined in their network by their interactions with other actors, so ANT will be used to analyze the interconnectedness between the different groups that distrust the COVID-19 vaccine (Cressman, 2009).

ANT will be used to analyze the anti-vaccination movement, racial and economic disparity, and political affiliation roles as both actors and a network in the implementation of the SARS-CoV-2 vaccine, as well as the roles of distrust, myths, science, and the government. Each of the human actor groups will be broken down into why the actors are more likely to be hesitant to receive vaccinations, and then the interactions between actors will be analyzed. Relationships between actors will be established to better identify the network of distrust surrounding the new vaccine. Thorough analysis of the actor-network will reveal a better understanding of how to best implement the COVID-19 vaccine so that a majority of the population receives it amidst apprehension and concern among various groups. If America is able to reach the populations in the network that are apprehensive, the country is more likely to be able to reach herd immunity, save lives, and release pandemic precautions (Petri, 2021).

## **Literature Review of Actor Groups**

### *Anti-Vaccination Movement*

The anti-vaccination movement, a trend more commonly seen in Western countries as families abstain from vaccinations, is a result of a variety of fears and myths surrounding vaccinations (Sharoni Bandyopadhyay, 2019). Opposition to inoculation for deadly viruses can be traced back to the 18<sup>th</sup> century, when inoculation for the smallpox became a political matter accompanied by sexism, fear of foreign contaminants, and mistrust (NPR radio, 2021). While



significant advancements have been made in vaccination efforts since the 18<sup>th</sup> century, similar feelings toward inoculation have remained over time, leading to a recent increase in vaccine opposition in the 21<sup>st</sup> century, largely due to fears from the media, internet, and other misinformation (Hussain et al., 2018). The anti-vaccination movement is an important actor to consider in the implementation of SARS-CoV-2 vaccines, because it could prevent herd immunity to COVID-19 and result in future outbreaks of the highly transmissible disease (Hussain et al., 2018).

Recent measles outbreaks in America and Europe are a result of increased vaccination abstinence in populations where measles was once considered eliminated (Dunham, 2008; Hussain et al., 2018; Rao & Andrade, 2011). Many parents became fearful of the measles, mumps, and rubella (MMR) vaccine in 1998, when Andrew Wakefield and his colleagues published a study suggesting that the MMR vaccine causes autism in children (Rao & Andrade, 2011). Wakefield's study was quickly refuted and retracted after being disproved by epidemiological studies revealing no link between autism and the MMR vaccination, but the damage had been done by placing distrust in parent's minds (Hussain et al., 2018; Rao & Andrade, 2011). The myth about the MMR vaccine spread throughout the world with the help of the media and celebrities, such as Oprah Winfrey and Jenny McCarthy, giving credibility to the fears many people were feeling (Hussain et al., 2018). The misinformation about the MMR vaccine caused the vaccination rate to drop close to 80% in western countries instead of 96%, resulting in a loss of herd immunity and causing increased outbreaks and fatalities due to measles (Dunham, 2008; Hussain et al., 2018; Rao & Andrade, 2011).

People who consider themselves to be vaccine hesitant, also known as anti-vax, are fueled not only by perceived safety of the vaccine, but also by perceived risk of getting the

disease (Kandola & Arquilla, 2020; Seale et al., 2010; Seeman & Rizo, 2010). In the 2009 Influenza A (H1N1) pandemic, only 23% of 175 thousand surveyed Canadians thought that the H1N1 vaccine was safe and only 36% reported being somewhat concerned by the flu pandemic (Seeman & Rizo, 2010). In an Australian study, 53% of people felt they had a very low risk of getting H1N1 and only 55% of people reported that they would likely receive the H1N1 vaccination (Seale et al., 2010). These statistics reveal people's lack of faith in vaccine safety and their lack of fear in becoming infected. For the COVID-19 vaccine, it is important that people trust the vaccine's safety, as well as consider themselves and their communities at risk for infection. A common fear with the H1N1 vaccine, and now with the COVID-19 vaccine, is that the vaccine has been rushed and insufficient research and clinical trials have been conducted (Funk & Tyson, 2020; Seeman & Rizo, 2010). The pause of the J&J vaccine on April 13<sup>th</sup>, 2021, likely served to support and compound the fear and distrust that people feel about the new COVID-19 vaccines. The possibility of deadly blood clots from a COVID-19 vaccine, as well as rumors of infertility and other vaccine side effects, does not bode well for persuading hesitant individuals to receive the vaccine, making government press releases and publishing statistics even more important.

Effective communication by public health officials is crucial in calming vaccination fears, and accurate and transparent information about the vaccine and its development is needed to ease concerns (Seeman & Rizo, 2010). During the H1N1 pandemic, the internet was the first place people sought health advice, but many internet sites and blogs were laden with anti-vaccination views and concerns (Hussain et al., 2018; Seeman & Rizo, 2010). To combat misinformation from the internet, it is crucial that health officials are open about the COVID-19 vaccine and provide internet resources for individuals. The CDC has recently been hosting

forums to advocate for the safety and effectiveness of the SARS-CoV-2 vaccine in order to encourage Americans and ease fears (Mahmud, 2021). Overall, public confidence from Americans in the COVID-19 vaccine development process has increased from 65% to 75% from September to December of 2020 (Funk & Tyson, 2020). The amount of Americans who say they will get the vaccine has also been increasing, with 60% of Americans citing that they would get the vaccine in a poll from December 2020, up to almost 80% citing they would receive the vaccine in a poll taken in April 2021 before the pausing of the J&J vaccine (Funk & Tyson, 2020; Soucheray, 2021). High risk Americans and those with high personal concern of contracting COVID-19 are more likely to get the vaccine, whereas those who do not feel at risk of COVID-19 or are distrustful of the vaccine developmental process are less likely to get vaccinated (Funk & Tyson, 2020). Highly contagious diseases require higher vaccination rates. The MMR vaccination rate needs to be as high as 96% for herd immunity, so similar values will likely need to be obtained for herd immunity to COVID-19 to prevent future outbreaks (Hussain et al., 2018). Dr. Fauci, President Biden's chief medical advisor, predicts that at least 80% of the population must obtain resistance to the coronavirus to acquire herd immunity and prevent future COVID-19 outbreaks (Beer, 2021). Therefore, work still needs to be done to convince a greater percentage of American citizens of the safety and importance of getting a COVID-19 vaccine when they are able.

Another common reason for the anti-vaccination movement revolves around religious reasons (Hussain et al., 2018). Hindu, Orthodox Jewish, Jehovah Witness, and Protestant populations were more likely to debate the MMR vaccine, but mainly because of the components of the vaccine, not the vaccines in general (Hussain et al., 2018). Vaccines that are derived from aborted fetal tissue, such as the MMR vaccine, receive backlash from religious groups that are

opposed to abortion (Hussain et al., 2018). Some religious groups, such as Islam and Hinduism, are also opposed to injecting porcine products into their body, which can be used in vaccines to ensure effective storage (Hussain et al., 2018). The components of the COVID-19 vaccine need to be considered by the medical community to determine if certain religious communities will object to the ingredients and ask for exemptions. Transparency on what is in the vaccine and why, along with the significance of each component, would be an important resource for those with personal and religious reasons for vaccine opposition.

### *Political Affiliation*

In America, common trends can be seen in how the two major political parties view vaccinations. The role of ideology in determining vaccine attitude has been studied, and those with a conservative ideology are less likely to vaccinate and often have less trust in the government (Baumgaertner et al., 2018). Republicans are less inclined to view the coronavirus as a major threat to the U.S. population, with 43% of Republicans in November 2020 agreeing that COVID-19 is a large threat to public health, while 84% of Democrats agreed (Funk & Tyson, 2020). While there is a large gap between the parties concerning public health effects, more than 80% of both Republicans and Democrats agreed that the pandemic presents major threats to the U.S. economy (Funk & Tyson, 2020). Ratings of the trust in scientists have become more partisan over the past year than ever before, with Republican trust dropping to 22% and Democratic trust rising to 55% (Funk & Tyson, 2020). A poll conducted for Public Affairs Research found that 7% of Democrats would refuse vaccination when it is available, while 23% of Republicans would refuse the vaccine and an additional 21% would “probably” abstain from the vaccine (Beer, 2021). Republican trust in the SARS-CoV-2 vaccine and in the United States government must increase so that widespread immunity to COVID-19 can be reached.

Conservative media outlets should be targeted to promote vaccine receipt once available and advertise that the economy will recover and stores reopen as more people get the vaccine, because many Republicans are concerned about big business and the American economy (Funk & Tyson, 2020).

The rights and autonomy ethical approach would be a common way that Republicans perceive vaccinations, desiring to have the freedom to choose what works for them medically. Many institutions, individuals, and community groups try to appeal to the common good ethical approach by explaining how widespread vaccination protects the vulnerable and achieves herd immunity, in order to persuade the community to receive a COVID-19 vaccine. Yet, in reaching skeptical Republicans, it would be more prudent to appeal to an autonomy ethical approach and explain the individual effects that come with the right to being fully vaccinated against COVID-19. In a poll taken in March 2021, 49% of Republican men said they would not choose to be vaccinated, which is a substantially increased percentage of Republican men rejecting the vaccine since the poll taken in December and the largest rejection ratio across any other groups of U.S. adults polled (Bump, 2021; Montanaro, 2021). It is likely that President Biden's push for widespread COVID-19 vaccinations is deterring Republican men, as they do not respond well to government mandates nor what they might perceive as an oppressive leftist government (Bump, 2021). Therefore, Republican men remain an important population to target for vaccination efforts, but coercion must not be forced. Vaccination persuasion for Republican men will be most effective if it comes from trusted individuals in one's family or political affiliation, and if it appeals to the Republican's desire for autonomy and boosting of the American economy.

### *Racial Distrust*

Another actor that affects COVID-19 vaccine distribution is racial inequalities in healthcare (Guzman & Hilton, 2020). Since the start of the pandemic, racial and ethnic minority groups have experienced an increased risk of morbidity from COVID-19 due to health inequalities such as: discrimination, healthcare access and lack of insurance, work environment, income and education gaps, and housing location (CDC, 2020a). These factors result in minority groups in America experiencing increased prevalence of SARS-CoV-2, increased medical conditions that risk severe illness, and increased deaths due to COVID-19 (CDC, 2020a). African-Americans and Latino Americans are dying at three times the rate of Caucasian Americans from the coronavirus (Guzman & Hilton, 2020). In a study done in June 2020 in Louisiana, only 31% of the population were Black, but Blacks comprised 77% of hospitalized COVID-19 patients and 71% of those who died in the health district (Price-Haywood et al., 2020). Despite the increase in hospitalizations and deaths among Black patients, Black Americans were less inclined in December 2020 to desire to get vaccinated than any other ethnic group (Funk & Tyson, 2020). Asian, Hispanic, and White adults ranged from 61 to 83% likely to get the vaccine, while only 42% of surveyed Black adults said they were likely to get vaccinated (Funk & Tyson, 2020).

Black abstinence from the SARS-CoV-2 vaccine is likely due to a long history of mistreatment and discrimination of Blacks and other minority groups in America (Scharff et al., 2010). An atmosphere of mistrust and skepticism in Black communities is a result of inequalities in social and historical contexts where Black health was not prioritized, therefore the medical community has much work to do to regain the trust of Black patients (Gamble, 1997; Scharff et al., 2010). While this is not the sole cause of Black mistrust of the public health system, the

Tuskegee Syphilis Study in the 20<sup>th</sup> Century was an important catalyst for Black distrust (Gamble, 1997). From 1932 to 1972, the Public Health Service conducted a study on 600 Black males in Alabama, called the Tuskegee Study of Untreated Syphilis in the Negro Male (CDC, 2020c; Park, 2017). The study was conducted without informed consent and the participants were not told their disease nor given any treatments (CDC, 2020c). Penicillin became the treatment for syphilis in 1947, but the researchers chose to not administer the drug to Black participants nor let the subjects quit the study, instead continuing to monitor the disease progression (CDC, 2020c). Imperial racist ideals and discrimination against African Americans resulted in the Tuskegee Syphilis Experiment, culminating in distrust from the Black community and many needed reparations from the U.S. government (CDC, 2020c; Park, 2017). Yet, more reparations from the public healthcare system are needed as racism is still prevalent in America today and many Blacks are still distrustful of the system that mistreated them (Elise Gould, 2020).

Lack of vaccination among minority communities is not all due to mistrust of the system though, but also lack of adequate access to healthcare (Guzman & Hilton, 2020). Communities of color have been more impacted by COVID-19 because of a lack of ability to be tested, with testing centers not being placed within their zip codes (Guzman & Hilton, 2020). This requires planning and development from public health officials on putting systems in place to ensure vaccine access to these communities. Access to healthcare for these communities will require money and resources to provide these areas with cooling storage containers to hold the vaccine, locations to administer the vaccine, and locations to test for COVID-19 (Guzman & Hilton, 2020). Diversity in vaccine trials is also important to convince all racial groups that a vaccine is safe, which requires transparency and communication on the part of research committees and

health officials. Trust can also be gained by public acceptance and receipt of the vaccine by doctors and celebrities of minority racial and ethnic groups (Gamble, 1997; Guzman & Hilton, 2020).

### *Economic Disparity*

Lack of access to healthcare is not only seen in minority racial groups, but also in groups of low socioeconomic status, though these groups are far from mutually exclusive (Elise Gould, 2020). Economic disparity in American healthcare due to the privatized nature of the U.S. healthcare system is a final actor group to consider in the network preventing herd immunity to COVID-19. America is the only industrialized nation that does not have universal health insurance, leaving about 42 million Americans without adequate health insurance (Collins et al., 2020; Ridic et al., 2012; Vladeck, 2003). The U.S. healthcare system boasts advanced technologies, pharmaceutical innovation, and high life expectancies, but at high costs (Ridic et al., 2012; Scott, 2020). America has the largest medical care spending in the world, both as a percentage of gross domestic product and in spending per capita (Ridic et al., 2012). The high cost of healthcare is a barrier and burden on the low-income population, who are more likely to be underinsured (Collins et al., 2020; Elise Gould, 2020). The economic disruptions caused by the pandemic further exacerbated the issue, increasing both unemployment and hospitalization due to COVID-19 (Scott, 2020). Lower income families are less likely to say they will get vaccinated, with 55% saying they would get immunized, as opposed to 71% of upper income families (Funk & Tyson, 2020).

In 1963, the federal government passed the Vaccination Assistance Act, which has supported childhood vaccinations and has led to greater than 90% of children receiving required immunizations (Hinman et al., 2004). About 43% of childhood vaccines are purchased through



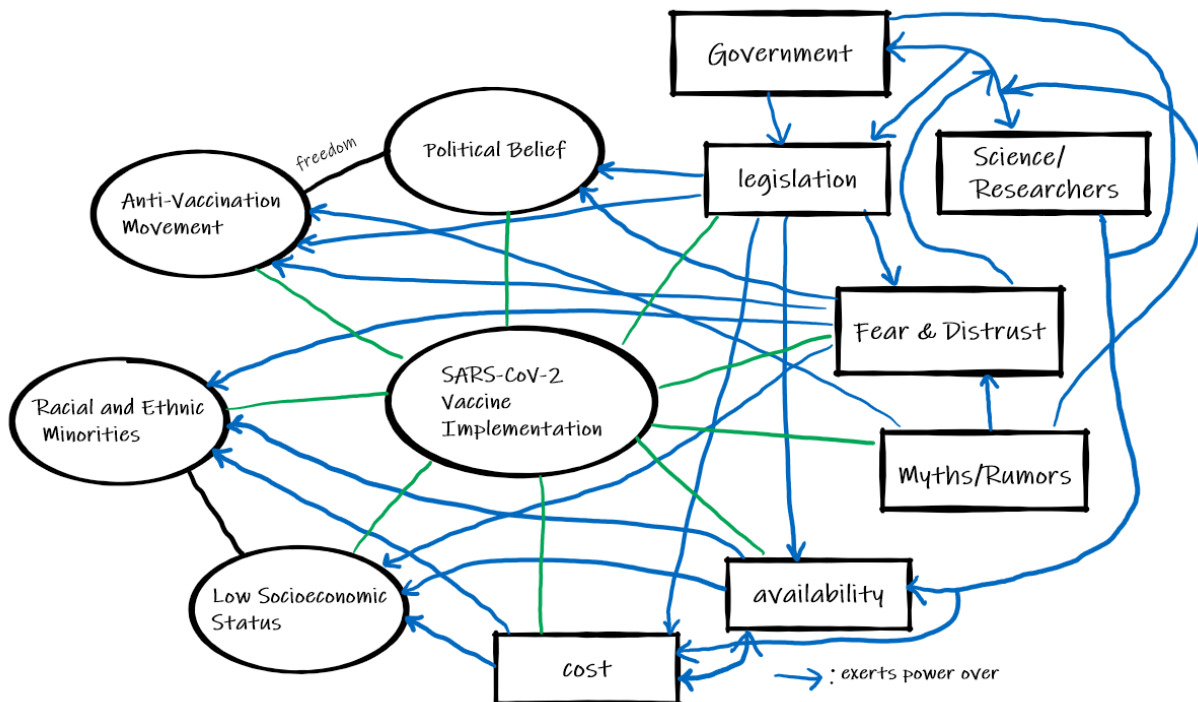
the private sector and the rest through the public sector, but adult vaccinations are mainly performed in the private sector without federal support (Hinman et al., 2004). Vaccination costs have risen dramatically since the 1990s, leading to lower vaccination coverage rates for adults compared to children because people do not want to pay out of pocket fees (Hinman et al., 2004). Therefore, government subsidizing or free-market distribution of the SARS-CoV-2 vaccine is essential so as not to prevent low socioeconomic groups from receiving the vaccine due to cost and/or lack of insurance (Gavin Yamey, 2020). The COVID-19 pandemic has already disproportionately affected poor communities, so it is important to not overlook these communities when administering the SARS-CoV-2 vaccine (Gavin Yamey, 2020).

The COVID-19 vaccine is being administered for free in America regardless of insurance status, which opens the vaccine to all socioeconomic groups. Yet, free administration of vaccines also comes with downsides, as funding for the vaccines comes from tax payers' dollars, leading some Americans to be distrustful of how much money is going to pharmaceutical companies and to the government (Stone, 2020). Republican men comprise a population who would oppose the increase in taxes to fund the COVID-19 vaccines, but on the flip side, government funding serves to ensure equitable access of the COVID-19 vaccine to all citizens. Administering free vaccines and offering widespread locations and hours for vaccine clinics will improve the chances of reaching low socioeconomic groups in America, which is important for the country as a whole to achieve herd immunity and prevent future outbreaks.

### **Analysis of the Network**

The anti-vaccination movement, political affiliation, racial identity, and socioeconomic status are four actor groups that affect how Americans identify themselves and might affect how they view vaccinations. There are also non-human actors that affect vaccine distribution and

implementation: cost, availability, distrust, fear, government, science, and legislation. The actors have interconnected relationships that work together to impact widespread administration of the SARS-CoV-2 vaccines, as detailed in *Figure 1*. The power relationships between actors will be revealed through ANT to define the SARS-CoV-2 vaccine network and to reveal to health officials how herd immunity is affected by the complex relationships among actors.



*Figure 1.* Figure showing the COVID-19 Vaccine Network's Interconnected Relationships.

The anti-vaccination movement and political affiliation are interconnected through the desire to have freedom. Anti-vaxxers and Republicans often overlap because they want the freedom to choose what vaccines they receive and do not want the government to interfere with their decisions. Republican families often use religious exemptions to avoid vaccinating their children at the times designated for public school children in America (Altimari, 2021). The desire to have full autonomy and freedom over vaccine receipt is a powerful connector between the anti-vaccination movement and political party, typically associated with Republicans (Allen,

2019). Americans who relate to these identities will likely want less government interference because of the importance of freedom to them (Allen, 2019). Therefore, a vaccine mandate will simply serve to anger these actors, so persuasion and propaganda geared towards these groups should be used instead of legislation or force.

There is a deep seeded connection between race and socioeconomic status. Blacks and Hispanics are more likely to be of low socioeconomic status than any other racial group, thus disadvantaging the minority races even more (Elise Gould, 2020). Minority racial groups are more likely to be uninsured, with American Indians at 22% uninsured, Hispanics at 19%, and Blacks at 12% (Artiga et al., 2020). Therefore, cost and availability will exert a heavy influence on whether Blacks, Hispanics, and others of low socioeconomic status will consider themselves able to receive the vaccine. Widespread distribution of the SARS-CoV-2 vaccines will be necessary to reach the groups that could be looked over. Equitable distribution looks like setting up vaccine distribution centers in low-income areas, providing vaccines at no cost, and offering a wide range of hours outside of the normal work day so that people do not have to choose between their job and the vaccine. Vaccines are currently being offered at no cost in America to people regardless of health insurance status during the pandemic, but increased availability of SARS-CoV-2 vaccines are still needed (Ries, 2020). People of low-socioeconomic status are less likely to be informed about when COVID-19 vaccine appointments are available and less likely to have the time, transportation, or resources to schedule and attend their appointment and wait in long lines. This problem is exemplified in the homeless population in America, because they lack the resources to successfully schedule and attend vaccine appointments (Oreskes, 2021). Having to schedule two appointments for the Moderna and Pfizer vaccine makes SARS-CoV-2 vaccine distribution even more of a hassle for citizens of low socioeconomic status, which makes

the Johnson & Johnson vaccine, which is currently a one-dose shot, an appealing alternative for people with less time and resources to dedicate to getting a vaccine (Commissioner, 2021).

Therefore, since the J&J vaccine is reapproved for administration after further study into side effects, the government should focus their attention on sending healthcare workers to low-income areas, often near cities, to administer the one-shot vaccine to people who might otherwise not go out of their way twice to receive a COVID-19 vaccine.

The anti-vaccination movement and Blacks are interconnected through their distrust of the government, which is also a driver of politically-based vaccine hesitancy. Distrust has exerted power over many Americans as news about new SARS-CoV-2 vaccines have emerged. While Blacks and low-income groups might be distrustful because of a history of racism, lack of access, or abuse from the system, anti-vaccination groups are distrustful due to lack of information, skepticism on what is in the vaccine, and a desire to protect their rights, and Republican political affiliates are distrustful of a leftist, overinvolved government under President Biden. Though the cause of their distrust differs, the lack of trust in the government and in science remains. Widespread distrust of the SARS-CoV-2 vaccines have been evident during the past year, with rumors circulating that the government is using the vaccine to microchip and track its citizens (Goodman & Carmichael, 2020). Other myths about the SARS-CoV-2 vaccine have been circulating as well, accusing the vaccines of altering human DNA and causing infertility (Henry Ford Health System, 2020). Myths and rumors are holding power over American citizens in the SARS-CoV-2 network by sparking fear and distrust and discouraging citizens from wanting the new vaccines. Many of the myths about the COVID-19 vaccine stem from the fear that the vaccine was rushed, causing people to believe that scientists do not really know if the vaccine works and what its side effects are (Henry Ford Health System, 2020). The

pausing of the J&J vaccine after reports of blood clots in April 2021 will only serve to increase fear of vaccination. In response to public fear, public health officials and scientists need to be transparent and provide more information to the public so that citizens feel well-informed and at ease. This transparency requires news articles on various sites as well as social media news updates to provide citizens with widespread factual information on what is in the vaccine and to combat the myths that spread online.

Science and the government are two broad actor groups that influence a majority of the vaccine distribution network. Science holds the power in the beginning of the relationship, as the vaccine is being created. Scientists and research are necessary to solve the government's problem, and the solution created by science was the SARS-CoV-2 vaccines. Then, there is a translation of power as the government provides funding for the vaccines and takes over the legislation and distribution process for COVID-19 vaccinations. This power relationship between science and government controls the cost and availability actors. Science supplies the quantity and price of the vaccines and the government determines the funding. This relationship determines how many people are able to get the vaccine and in what time frame. The intertwined relationship between science and the government might ostracize people who do not trust one actor or the other because of lack of transparency. Fear and distrust, as well as myths and rumors, hold power over the science and government relationship, affecting how people view the reliability of these actors. To increase vaccine compliance, the power must shift from fear and myths to the government and science. A shift in power away from rumors will require increased transparency from the government and researchers on the internet and on social media to gain the population's trust. Scientists can have power over myths and rumors by directly addressing them and explaining why and how the myth is wrong or misleading. To have power over distrust from

racial and ethnic minorities, scientists can conduct their clinical trials of the vaccine with a diverse population representing all the minority groups, and then release their studies on the internet so that people believe them. The government can have power over vaccine distrust by diversifying the media outlets and representation they use to advertise for the vaccines and by keeping people informed about the vaccine process and distribution centers.

Cost and availability are also in a power relationship that is controlled by scientists and the government. In the development stage of vaccines, cost holds power over availability because researchers need the funding to be able to research, create vaccines, and conduct clinical studies before getting approval. Once the vaccine is approved, the power translates to availability, because if a product is not widely available, the price of the product to consumers is generally higher. Yet, the role of the government in SARS-CoV-2 vaccine distribution is to prevent availability from gaining price control power. The government is providing funding for vaccine distribution so that the COVID-19 vaccine is free of charge for all Americans, regardless of the quantity available. This action also shifts the power away from cost and to the people, because cost will not prevent people of low-income status from getting the vaccine. Government funding allows the vaccine to be free and accessible to all people and funding to the vaccine companies allows for increased production and availability of COVID-19 vaccines for the population.

## **Conclusion**

In order to combat the COVID-19 pandemic and restore normalcy to life in America, widespread administration of the SARS-CoV-2 vaccines are necessary to reach herd immunity. As of April 12<sup>th</sup>, 2021, the FDA has three approved SARS-CoV-2 vaccines to be administered to Americans, but there are many actors that affect implementation of the vaccines. There are four

groups that typically are hesitant to get vaccines or are left behind in healthcare: the anti-vaccination movement, political affiliation, racial minorities, and low socio-economic status. The non-human actors that exert power over these groups and influence their views are cost, vaccine availability, distrust and fear, myths and rumors, and government legislation. All these actors are intertwined in a complex network that determines who will actually receive SARS-CoV-2 vaccines.

It could be argued that my human actor groups are too broadly generalized and that someone could identify with a certain actor group in my network but not be opposed to the COVID-19 vaccine. This is a valid point, but the aim of the human actor groups is to display trends in the population rather than being an overarching truth. Someone who identifies as Republican might be pro-vaccine and someone who identifies as a racial minority might have full trust in the vaccine. This nuance can be used as an advantage, because someone who identifies with an actor group but is pro-vaccine will have more sway in convincing their actor group to consider vaccination because a trusted and relatable person is advocating for the SARS-CoV-2 vaccine. The actor groups in this study, therefore, are not comprehensive nor exclusive, but merely provide a guide to represent the major factors affecting vaccine implementation.

Since the SARS-CoV-2 vaccine is the only effective countermeasure against the COVID-19 pandemic, it is important to address the actors in the network so that more Americans will receive the vaccine. One important step health officials and scientists need to take is to be transparent about the vaccine process and vaccine components to keep citizens informed and combat distrust. Then, social media and news outlets need to be used to encourage citizens, dispel myths, and reinforce facts about the SARS-CoV-2 vaccine. Lastly, vaccine production needs to be ramped up so that it is readily available to people and provided at no cost, regardless

of health insurance as it is now. Equitable vaccine distribution requires an increase in resources on the part of the national and state governments to provide health care workers to administer the vaccines, locations for the administering of the vaccine, and coolers and other equipment to send and store the vaccines.

Resources need to be especially focused on low-income areas where people are less likely to have the time and resources on their own to go out of their way for a vaccine appointment. Expanding hours of vaccine administration will help accommodate individuals who work long hours. Vaccine mandates will likely not help encourage vaccinations, but rather anger members of the Republican party and anti-vaccination movement for encroaching on their freedom. Continuing to get high-profile celebrities to receive and endorse the COVID-19 vaccine will also help encourage trust among minority groups, political groups, and those involved in the anti-vaccination movement, as will continuing to use major radio campaigns to target minority communities and churches. Using these measures in response to the network opposing SARS-CoV-2 vaccine deliverance, will help encourage all Americans to receive their vaccines when able so that herd immunity can be achieved against the deadly COVID-19 pandemic.



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