Review Article

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# The Anti-Vaccine Sentiment in America: A Barrier Against COVID-19 Elimination and National Health Wellbeing

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***Abstract***
*COVID-19 has had an immense global impact as evidenced by the 538 million infections and 6.32 million deaths recorded globally since June 2022. Americans experienced loss from over 975,000 COVID-19 deaths and many people lost their jobs while others struggled with working from home. Moreover, education suffered from fully remote online teaching and medical care providers worked overtime to save lives. The development of COVID-19 vaccines, by Pfizer and Moderna for example, brought hope for an end to the pandemic. However, apart from vaccine creation, other factors such as patient willingness is necessary to build immunity against the COVID-19 infection. Not all Americans optimistically embraced the COVID-19 vaccines. Though FDA-approved for safety and efficacy, only half of the American population is fully vaccinated as of September 2021. A major root of the anti-vaccine sentiment stems from misbelief against the vaccine's development process and timeline. Other causes of anti-vaccine sentiment include unknown long-term side effects, transparency of vaccine compositions, and a lack of scientific evidence. Furthermore, social media presence allows for increased misinformation and miscommunication on the COVID-19 topic itself, as well as the associated vaccines. This paper utilizes an evidence-based research method to analyze current research on the anti-vaccine sentiment and possible strategies to resolve these strong attitudes in efforts towards herd immunity.*

**Keywords:** Covid-19, Vaccine, Development, Herd Immunity, Social Media, Fear

## Introduction

The anti-vaccine sentiment is a barrier against full population inoculation or herd immunity against the COVID-19 pandemic. Opposition against vaccines is no novel concept; these opinions appeared soon after the introduction of the smallpox vaccine in the late 18th century [1]. However, the current social media presence and evolving scientific technology gives path for more information miscommunication. In 2019, the World Health Organization listed vaccine hesitancy as one of the top ten threats to global health.

The development of COVID-19 vaccines has been a contentious topic over the last two years. In the absence of effective treatment, there was a global attempt to contain the spread of the virus by implementing travel bans, enforcing quarantines and lockdowns, and developing social distancing and mask-usage protocols. In the United States, Operation Warp Speed allowed for an accelerated development and distribution of the COVID-19 vaccinations, therapeutics and diagnostics. Normally, vaccine development can take ten or more years but this partnership allowed for the first COVID-19 vaccine, by Pfizer, to be made in less than a year. This is primarily attributed to the new mRNA technology. The anti-vaccination population does not trust this novel technology as the rapid progress with new techniques means the data on the long-term safety and durability of these vaccines is unknown and still being retrieved after a vaccine has been approved for emergency use. Furthermore, these next-generation immunizations have never been tried at a large scale. The mRNA vaccine was tested against Zika virus, but never approved [2].

Even though the current scientific consensus is in overwhelming agreement over the safety and efficacy of vaccines, the anti-vaccine sentiment is characterized by extremist organizations and social media users who are bashing on the vaccine in an effort to undermine the government and evade immunization.3 The constituents of the vaccine-resistant groups are predominantly anti-government libertarians, advocates of the all-natural, and dismissive parents. Some individuals view the vaccination process as excessive government control, while others are adamant due to fear and false beliefs [3].A recent study reported data indicating that the critical factor in vaccine hesitancy was anxiety rather than familiarity with vaccines.3 Another study found a lower acceptance of vaccines among women, Blacks, unemployed people, and lower income, lower education, lower age cohorts.4 Additionally, religiosity is negatively correlated with vaccine support while declared democratic political support is positively associated [4].

The anti-vaccine sentiments negatively impact the confidence in COVID-19 vaccines, which may ultimately undermine efforts to fight the pandemic. Recent data has yielded central themes surrounding the opposition [Figure 1] [5].In this review, we chose and highlighted a few common roots of the anti-vaccine sentiment, how to combat them, and work towards herd immunity.

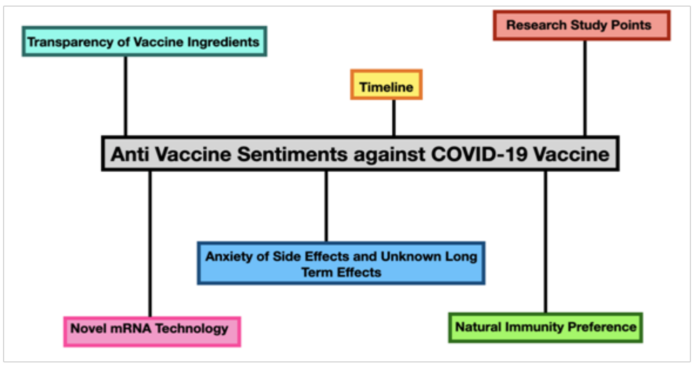


**Figure 1:** General Common Causes of Anti-Vaccine Sentiments Against the Covid-19 Vaccines.

## Discussion

Vaccine development is not a novel concept, nor is its pathway to licensure such as undergoing clinical trials for evaluating safety and efficacy.Extensive vaccine development in the industry and academia have been ramping up and evolving over the past two decades [6]. This resulted in new platforms and modalities of developing the newer and more recently licensed vaccines. Several candidates such as viral vector based vaccines and recombinant protein-based vaccines were initially pursued; however, genetic vaccine technology, which was already in development for 30 years, produced promising results and led to the development of today's DNA and mRNA-based COVID-19 vaccines [6]. Before SARS-CoV-2 was discovered in 2019, the medical community had been aware of previous coronaviruses such as SARS-CoV1 and MERS-CoV that had been studied over the last two decades [7]. Because of commonalities due to their crown-shaped envelope and spike proteins, the subclasses of coronaviruses, SARS and MERS, were great candidates to for foundational investigations into COVID-19 vaccine development [8, 9].

Scientific collaboration and massive funding never before seen in history were carried out during the vaccine development. Given the significant impact that the pandemic had on human lives and the global economy, over ten billion doses (2-dose regimen) were needed to vaccinate the global population. This number exponentially increases when considering how crucial it is to pursue multiple vaccine candidates since it is so unlikely that any one trial will succeed [10].Collaborative efforts among researchers across the globe produced more than 200 vaccine candidates within months after receiving the genetic sequence of the virus from China in January 12, 2020 [6].Scientific organizations, such as Pfizer/BioNTech, Moderna, AStraZeneca, Johnson & Johnson, Novavax, Sanofi/GSK, received a combined total of over $10 billion from the US government as part of Operation Warp Speed to support basic/clinical research and vaccine production in exchange for delivering doses by a set date [11,12].By taking out unnecessary financial or bureaucratic delays from the equation, this allowed for faster vaccine approval and production.

Aspects of the clinical trial that assess the safety, immunogenicity and efficacy are vital to vaccine approval and remained intact, as no steps were omitted in evaluation of the vaccine candidates. For example, key features of standard research principles (scientific methods, clinical trials study protocols, informed consent, IRB, compliance to Good Laboratory Practice, Good Clinical Practice, and Good Manufacturing Practice, etc.) were strictly followed, and large scale efficacy and safety studies involved 30,000 to 45,000 subjects for a randomized, double-blind, placebo-controlled trial to evaluate the efficacy and safety of SARS-CoV-2 vaccine [13-15].In addition, every subject went through a safety follow-up plan through the use of Data Safety Monitoring Board (DSMB), which included daily reporting of post vaccination events that ranged from weeks or up to 2 years.The DSMB's purpose is to conduct multiple reviews of trial safety data, stop any studies deemed unsafe, and to protect participants from harm [6].

In order to meet the global urgency during this pandemic, a combination of standardized procedures and innovative techniques were applied.The innovative technique that expedited the clinical trial process involved implementing clinical trials that ran parallel with each other rather than sequentially [Figure 2].By overlapping specific phases of clinical trials regulators were able to maintain safety and efficacy requirements while simultaneously accelerating the study timelines. For example, initiating phase 2 once phase 1 safety data requirements were met reduces risk and improves efficiency [6].Similarly, the parallel method was applied for expediting the manufacturing of vaccines as well [Figure 2]. Usually, vaccine production takes place after regulatory approval [Figure 2], such by organizations like the Food and Drug Administration (FDA), however, in the case of COVID-19 vaccines, the U.S. took on the financial burden by funding the manufacturing of the vaccine candidates before approval in order to expedite the availability of COVID-19 vaccines [6,16].

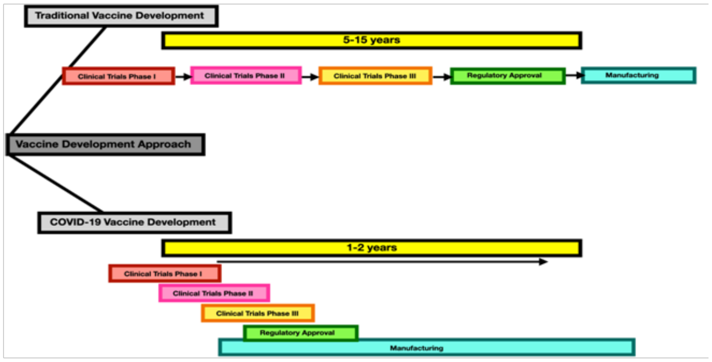


**Figure 2:** Sequential (Top) And Parallel (Bottom) Step Approach of Covid-19 Vaccine Development (adapted from kaiserpermanente)

Even though the COVID 19 vaccine was developed and distributed at an unprecedented speed, the rigorous standards forvaccine approval were maintained during the COVID-19 vaccine development.The FDA issued extensive guidance documents early in the pandemic to clarify the licensure pathway for manufacturers,which stated that safety and efficacy would need to meet the usual high standards for any licensed vaccine.It required, for example, clinical trials to meet the same statistical endpoints for efficacy and present with sufficient safety data on all subjects.In addition, to meet the criteria of Emergency Use Authorization (EUA) a mandatory two monthsafety follow up for adverse events must occur for the 3000+ subjects from the phase 3 trial [17,18].

To facilitate development, regulatory agency authorities introduced pre-existing expediting procedures to speed up the review process without sacrificing the safety or accuracy standards for vaccines.These standards included fast-track designation, a"process designed to facilitate the development, and expedite the review of drugs to treat serious conditions and fill an unmet medical need [19]." Another pre-existing condition to increase engagement is the scheduling of more informal meetings with manufacturers, which can occur more promptly rather than arranging a formal meeting (i.e. Type C meeting) that can take months to years to schedule. A rolling review is also stipulated, which allows manufacturers to submit the data they have at that moment for review rather than waiting to submit all the data after finishing the clinical trials.In addition, there are now more reviewers and staff available for the approval process, and agencies conduct facility inspections earlier in the vaccine development process for any potential issues [6].

Many studies have found that the widespread hesitancy against the vaccine is due to fear of the "unknown" (i.e. the associated adverse effects or side effects) since the initial development of the vaccine [20,21].Vaccine side effects such as infertility, severe headache, fever, and pain at the injection site are of concern to many. Some people also believe that the vaccines could gain entry into the cells and manipulate one's DNA, affecting gene inheritance in future generations. Others postulate that the vaccine could cause re-infection, as seen in some previous cases of live polio vaccines [22]. Anxiety of the unknown is a result of "over-information," "under-information" ormisinformation. One study found the fear of COVID-19 is from the general population's inability to tolerate uncertainty and quickly turn their focus to the predominantly negative emotions relating to the infection and its associated therapies and vaccines [23].Therefore, uncertainty and fear are inevitable and the focus should therefore be turned to educating the population with accurateinformation. Addressing concerns with evidence-based information is crucial for increasing the number of vaccinated individuals.

The rapid development and manufacturing of the COVID-19 vaccine did not evidently allow for full research on associated side effects or long term effects. However, the mRNA technology used to develop the COVID-19 vaccine were previously undergoing trials for use against the influenza virus, zika virus and rabies [24].These clinical studies found that mRNA vaccines are inherently unstable and therefore difficult to develop yet showed cellular responses that conferred complete immunity with no adverse effects [25]. However, this background regarding mRNA vaccines is not well shared and therefore leads to rumors and increased anxiety in general population. The trials on the Pfizer and Moderna COVID-19 vaccines reported the following reactogenicity post-injection: fever, fatigue, headache [26, 27]. Of the 18,860 patients enrolled in the Pfizer COVID-19 vaccine clinical trials treatment group, only four recipients reported serious adverse events including shoulder injury related to vaccine administration, right axillary lymphadenopathy, paroxysmal ventricular arrhythmia, and right leg paresthesia [26].Additionally, these side effects were found to commonly occur in younger patients (16-55). However, this information is not well known to Americans. The scientific community should work to translate this information into a user-friendly language and share on platforms such as the traditional media or internet to reduce concerns on associated adverse and side effects.

Historically, the anti-vaccine community has predominantly been made of concerned parents and predates the 1800s when sanitary, religious, scientific, and political objections were made against vaccines [28].Despite the scientific evidence, vaccine safety and efficacy are questioned. Furthermore, vaccine excipients, needed for storage, transportation, and viability purposes, are constantly questioned. In the case of COVID-19, a new nucleotide technology was used and the anti-vaccine community questioned not only the technology but also the ingredients. This information is available on the Center for Disease Control and Prevention (CDC) website but was unfortunately not easily accessible to the general public until recently. During the initial steps of EUA, the documents showcasing a vaccine's efficacy, ingredients, and other information were difficult to find and therefore the population that was "uncertain" about the vaccine easily chose not to get the injection and further even believed anti-vaccine sentiments. As the anti-vaccine community primarily uses social media platforms to convey their messages, communication experts and researchers have advised re-butting anti-vaccine arguments with evidence (i.e. user-friendly research and visuals) rather than completely removing their opinions as shutting down conspiracy theorists and campaigners' risks lending credibility to their arguments [29].

With the emergence of the internet and social media as well as the increased access to technology, these platforms have attained global penetrance. Unlike traditional media, the web and social media applications allow for content to be shared rapidly and globally without any editorial oversight. Furthermore, algorithms show users self-selected content. With regards to the COVID-19 vaccine, there are considerable concerns raised and spread by the anti-vax community that carry the consequent potential for downstream vaccine hesitancy. A report found thirty-one million people follow anti-vaccine groups on Facebook, with seventeen million people subscribing to similar accounts on YouTube [29]. A letter was published by American Medical Association (AMA) eagerly requesting technology companies to ensure accurate information regarding the vaccination is shared [30].However,effective strategies must be developed to promote the COVID-19 vaccine and increase vaccine uptake.

The social media platform may prove a viable tool to engage the public and have them participate in epidemiological research about vaccine misinformation, vaccine hesitancy, communicable disease incidence and prevalence, and recruitment of participants for studies. By recognizing public concerns in this manner, healthcare providers and company leaders may incorporate strategies to combat misinformation early.

A recent study found that people unintentionally share misinformation regarding the COVID-19 pandemic and vaccines because they do not reflect if the content they forward are accurate [31]. Companies and networks should work to create structural changes with the enforcement of protocols and personnel to filter accurate information on their platforms. Furthermore, they should encourage their users to only share accurate information. The same study reported that a simple accuracy reminder before users share information on social media significantly increased the level of truth judgment in participants' subsequent sharing intentions.CAdditionally, the same information presented in terms of losses or costs and gains or benefits significantly impacts individuals' attitudes and responses to the COVID-19 vaccine. Therefore, theframing of messages is vital to successfully communicating pro-vaccine messages [32].

Different social media companies must identify and flag potentially harmful misinformation. The platform, Pinterest, redirected vaccine-related searches to public health organizations and further removed advertisements on these topics to prevent further misinformation from nonscientific sources [33]. Facebook also worked to remove inaccurate information from its platform [34]. Accurate information regarding the vaccine will properly be shared on these platforms when the companies arrange their algorithm to remove entirely and/or reduce the ranking of anti-vaccine pages and reject advertisements with anti-vaccine messaging.

## Conclusion

Most scientific communities would agree that the COVID-19 vaccine benefits far outweigh the associated risks. The speed of response to this pandemic was driven by the recognition of the magnitude of threat this virus posed to the health of the world. Anti-vaccine sentiments have affected the number of vaccinated Americans and the country's progression through combating the pandemic. The effects of the deadly virus continue to be experienced even after launching mass vaccination in the states. The resurgence of the virus in new variants such as omicron has also proven to exhibit a more severe disease course among the unimmunized than the immunized individuals who have already developed antibodies against infection.

Such health considerations indicate the impact of the anti-vaccine sentiment.This review highlighted relevant issues surrounding COVID-19 vaccine mistrust that prevents its acceptance. Health care reforms should address the anti-vaccine opinions. The deficiency in scientific facts in the sentiments indicates the need to carry out massive sensitizations, using posters, social media platforms, and campaigns on the vitality of vaccination [35]. Existing misleading beliefs should be countered with evidence and reassurance.

## Declaration of Interest

There is no conflict of interest.


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