



# Challenges, Inquiry, and Recommendations: Effective COVID-19 Vaccine Management in the Face of Public Mistrust and Concern

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By examining concerns about safety, compliance, and distribution through an interdisciplinary approach of public health and history, we argue that historical and contemporary mistrust of immunizations serves to challenge the successful management of a COVID-19 vaccine program in the U.S. Unique circumstances surrounding the development of a COVID-19 vaccine, including pressure for rapid production, unclear communication from public health officials, and existing resistance to behavioral protective public health policy measures (e.g., mask-wearing) complicate widespread vaccine adoption. Currently, the demand for first and second COVID-19 vaccine doses, as well as the COVID-19 booster, continues to fluctuate in the U.S. population as COVID-19 variants continue to emerge. This hesitancy has resulted in a stalled vaccination program and the absence of herd immunity. To support the successful management of a vaccine program, we recommend public health education and communication measures that can be tailored to local community needs while preparing realistic public expectations surrounding the efficacy of a COVID-19 vaccine. A tailored approach may reduce vaccine hesitancy in American society. The perspectives offered herein present a pathway that is applicable to the current COVID-19 vaccine management program in the U.S., other global locations, and future pandemics.

**Keywords:** COVID-19, vaccine, safety, compliance, distribution

## INTRODUCTION

Absence of realistic expectations about COVID-19 vaccine protection against emerging virus variants and knowledge about potential serious side-effects following vaccine administration could compromise both the public's health and long-term trust in vaccine science. While vaccines have saved numerous lives and often are perceived to be "magic bullets" (Marcotte et al., 2015) against disease, history as well as contemporary events reveal multiple reasons why Americans may mistrust vaccines or hold unrealistic expectations about them. In an environment where public health efforts (e.g., mask-wearing and social distancing) are often rejected by individuals, or where ignorance remains about implementing these defensive measures properly, it is challenging, yet critical, to ensure that the United States (U.S.) administers a COVID-19 vaccine effectively for it to have a substantial role in curtailing the pandemic.

At the beginning of the pandemic, there were considerable supply issues with COVID-19 vaccines. In early January 2021, COVID-19 vaccine demand far outstripped vaccine supply worldwide. The U.S. had a considerable need; hundreds of thousands had died, meaning the U.S. had the highest recorded cases of COVID-19 deaths worldwide. Fortunately, due to heavy investment, the U.S. also quickly had the world's largest stockpile of COVID-19 vaccines. From a conventional perspective, it would be expected that the population would rush to get vaccinated and receive herd immunity. But this was not the case. This disconnect in a country which desperately needed vaccines, had them, and the population refused them needs to be understood, as this pattern appears to be emerging in developing countries. Here, we will examine three issues related to vaccine hesitancy (namely, concern about safety, compliance, and distribution) through an interdisciplinary approach of public health and history. Vaccine hesitancy can be defined as the delay in acceptance of, or wariness about, vaccine effectiveness despite the availability of vaccination services (MacDonald, 2015). Because individuals who are hesitant may accept vaccines eventually, we will focus on this group rather than those who reject vaccines absolutely. This approach will illustrate that successful vaccine administration, regardless of the infectious disease threat, may prove challenging because there are historical as well as contemporary bases, sometimes controversial, for questioning immunizations.

These doubts might be exacerbated by unique circumstances surrounding the COVID-19 vaccine. (Although there are several COVID-19 vaccines and boosters that currently exist, more may be developed. Some may face more scrutiny than others, such as the mRNA-based Pfizer/BioNTech and Moderna vaccines. This article will refer to them all as one COVID-19 vaccine because hesitancy to COVID-19 vaccines, as a whole, is the focus of our work). Overall, a vaccine is likely to evoke public hesitancy by challenging lay behavior, public expectations, and individual rights. To address these challenges to vaccine adoption, we recommend an approach that utilizes scientific and political comprehension of the vaccine-related obstacles. Such efforts, adjustable to meet specific community needs, will set the stage for realistic expectations and understanding of the COVID-19 vaccine, updated vaccine versions, and related public health concerns, thus restoring trust in vaccine science more generally. This pathway can be utilized in other global locations and future pandemics.

## State of COVID-19 Vaccination in the United States

Although vaccines have been effective in preventing diseases that we rarely observe today (e.g., pertussis and polio), historical and contemporary events reveal that there are reasons why Americans may mistrust vaccines or hold unrealistic expectations about them. For example, the COVID-19 vaccine, especially because it was developed at “warp speed,” elicits safety, compliance, and distribution concerns among Americans. There are also several unknowns about the vaccine (e.g., length of vaccine protection and effectiveness against new SARS-CoV-2 variants) that both

create friction with lay expectations and confront some individuals' mistrust in science. In particular, at least two COVID-19 vaccine versions, namely Pfizer/BioNTech and Moderna, use mRNA techniques which are a new biotechnical approach for which long-term effects are unknown.

If people do not complete the COVID-19 vaccine series, including the recommended booster; do not continue behavioral defenses (e.g., mask-wearing, social distancing); and fail to recognize that there are unidentified limitations to the vaccine's effectiveness, will they inhibit our ability to suppress transmission of the disease? If the vaccine fails to be a magic bullet for these reasons, will individuals blame the vaccine and then elevate general mistrust in vaccine science? To be effective, the COVID-19 vaccine may need to continue to be combined with behavioral protections (e.g., mask-wearing) in some U.S. settings, along with clear communication that scientific uncertainty should not breed mistrust, at least until and if herd immunity can be achieved. Reinforcing these concerns, COVID-19 has currently infected over forty-nine million people in the U.S. and resulted in over 780,000 U.S. deaths so far (Johns Hopkins University and Medicine, 2021; Our World in Data, 2021). To provide perspective, the number of COVID-19 deaths to date are equivalent to the populations of the U.S. cities of Denver, Colorado, or; Seattle, Washington, or; El Paso, Texas, or; Detroit, Michigan (World Population Review, 2021). Thus, why would a country that has lost the equivalent of the populations of entire cities from COVID-19 refuse a vaccine which has demonstrated it does not increase mortality among COVID-19 recipients, as well as has decreased serious morbidity and mortality from the disease? (Scobie et al., 2021; Xu et al., 2021). Vaccine hesitancy may play a significant role in these outcomes to date.

## Vaccine Science Mistrust

The Centers for Disease Control and Prevention (CDC), the premier public health agency for the U.S. responsible for promoting health and preventing disease, has provided education to prevent the spread of COVID-19 at the personal, community, and school levels (Centers for Disease Control and Prevention, 2021a). Despite CDC identifying vaccinations as one of the greatest public health achievements of the 20th century because they increased longevity and improved population health status, vaccines and their administration have resulted in rare, but grievous, errors, thus generating public mistrust when adverse events occur (Centers for Disease Control and Prevention, 1999; Centers for Disease Control and Prevention, 2021b). Notorious examples include the 1955 Cutter Incident in which live polio virus in a vaccine batch (produced by Cutter Laboratories) that had undergone a safety review prior to administration resulted in approximately 250 cases of polio, although, later it led to an improved regulatory system for vaccine production (Centers for Disease Control and Prevention, 2021c). Another example involves Gardasil, a vaccine that prevents cervical cancer caused by the human papillomavirus. In 2013, a manufacturing error resulted in the potential for broken glass in the vaccine vial, leading to Gardasil's recall. No adverse health effects were reported (Centers for Disease Control and

Prevention, 2021c). These examples and other purported, and even sometimes discredited, vaccine-related adverse health effects [e.g., measles-mumps-rubella (MMR) vaccine and autism] have contributed to the public's mistrust of vaccine science and safety (Centers for Disease Control and Prevention, 2021c). Some individuals are hesitant about all vaccines for non-scientific reasons ranging from philosophical rationales to suspected conspiracies (Calandrillo, 2004). Hence, the development of a novel COVID-19 vaccine should expect to encounter widespread resistance in adoption if history is any indicator of future practice.

We see parallels from these historical examples and the current COVID-19 vaccine where conspiracy theorists and some influential voices promote false information, such as the claim that the U.S. Food and Drug Administration is not telling Americans that the COVID-19 mRNA vaccines cause serious side-effects including death (Fichera, 2021; Frenkel, 2021). There is historical precedent for this; for example, Walter Winchell, one of the most famous broadcasters in the U.S., broadly aired a misleading story about the Salk vaccine's safety during the preparations for the national trials in 1954 (Money, 2021). Currently, belief that the seriousness of the SARS-CoV-2 virus has been exaggerated to sway political elections has contributed to vaccine hesitancy among many conservative Americans (Uscinski et al., 2020). Beliefs that the COVID-19 vaccine causes infertility and that a micro-chip is injected into individuals who receive the vaccine contributes to vaccine hesitancy globally, such as in Arab countries, in addition to the U.S. (Berg, 2021; Black and Schoolov, 2021; Sallam et al., 2021). Further, the indeterminant origin of the SARS-CoV-2 virus (i.e., bioweapon or a naturally occurring event) has also contributed to mistrust among the U.S. population about the seriousness of COVID-19 (McNutt et al., 2021). These select examples, along with a reliance on social media as a main source for COVID-19 vaccine information (Lazer, 2021), demonstrate a significant obstacle to controlling the COVID-19 pandemic.

## COVID-19 Vaccine Hesitancy Behavior

While beliefs in conspiracy theories, combined with mistrust in science, policymakers, and governmental information channels may contribute to COVID-19 vaccine (including booster) hesitancy (Simione et al., 2021), awareness of the underlying psychological basis for vaccine hesitancy and recognition of enhanced levels of hesitancy in certain demographics may improve our ability to respond to the current and future pandemics. Several studies have determined a positive correlation between vaccine hesitancy and the following psychological factors: belief in conspiracy theories; absence or low fear level of COVID-19 health effects; fear of potential side effects from a vaccine that many still consider too new; and philosophical or religious beliefs that are not consistent with seeking the COVID-19 vaccine (Nazlı et al., 2021). With regard to demographics, women have demonstrated a greater hesitancy than men towards the vaccine before its release (although more females have received the vaccine in the U.S.), and to date, Black and Hispanic populations have been more hesitant than their White counterparts to receive the first dose of the COVID-19

vaccine in the U.S. (Centers for Disease Control, 2021; Kaiser Family Foundation, 2021; Stanford University, 2021).

An international comparison demonstrates that philosophical approaches to vaccination and public health may have an impact on hesitancy, too. A comparator country to the U.S., in terms of societal development, is the United Kingdom (U.K.) which has experienced over ten million COVID-19 cases and 146,000 deaths to date (Johns Hopkins University and Medicine, 2021; Our World in Data, 2021). Yet, the U.K. approach to the COVID-19 vaccine has been more from a collective societal benefit attitude compared to the U.S., which is a more individualistic society (Feuerstein et al., 2021). This philosophy has resulted in an overall low vaccine hesitancy rate among the British population with higher vaccine hesitancy rates occurring in those who have a low education level, are female, in the 16–24 age group, and those of a Black or Pakistani/Bangladeshi ethnic group (Robertson et al., 2021). To an extent, the contrasting American perspective has had a different impact on some of the same demographic groups in the U.S.; for example, those in poverty, working outside of the home, or of a conservative political viewpoint were found to be more unwilling to acquire the COVID-19 vaccine (El-Mohandes et al., 2021).

Successful messaging also requires recognition that hesitancy may stem from immediate opportunity costs as well. For example, some individuals refused smallpox vaccinations at the turn of the 20th century because of concern that a resulting temporarily sore and incapacitated arm meant the recipient could not earn a living and feed his family; he might avoid smallpox later, but he and his loved ones might suffer now (Willrich, 2012a). Today, concerns about losing pay if one took time off work to get a COVID-19 vaccine because of side-effects have increased some reluctance, especially among demographic groups, such as Hispanics, who are often more vulnerable to economic instability (Hamel, 2021).

To resolve hesitancy generated by misinformation about the COVID-19 disease, vaccine, and boosters, as well as psychological, demographic, philosophical, economic, or other issues, requires building trust among the intended audience. One approach is for experts to contextualize the information they are communicating based on what is known at the time of the messaging and informing the audience that the information could change as more is learned about the disease, transmission, mitigation, and prevention efforts (Jamieson, 2021). Respect for the legacies of historical experiences may be necessary, too. Black distrust of the medical establishment, stemming from ill-treatment in the Tuskegee syphilis study, influences current wariness about vaccine recommendation (Koplowitz, 2021). In fact, some descendants of the men in the study are speaking out in favor of the vaccine, explicitly recognizing history's impact on current reluctance (O'Reilly, 2021). Also, it is possible that a traditional protein-based vaccine, like those made for influenza and shingles, but developed specifically for COVID-19, could help allay the fears of a vaccine hesitant population who are concerned about the potential mRNA COVID-19 vaccine side-effects (e.g., heart inflammation and blood clots). The protein-based COVID-19 vaccine is currently being tested in national efforts in Cuba and Taiwan (Dolgin, 2021a).

Historical and current events suggest that understanding the reasoning behind reluctance, transparency in how recommendations are developed, providing reputable sources of information, and then educating the population about the basics of public health, could help to promote an educated citizenry who is more apt to make informed, rational decisions based on evidence as opposed to conspiracies and fake news.

## Novel COVID-19 Vaccine

Operation Warp Speed (OWS) aimed “to deliver 300 million doses of a safe, effective vaccine for COVID-19 by January 2021, as part of a broader strategy to accelerate the development, manufacturing, and distribution of COVID-19 vaccines, therapeutics, and diagnostics” (U.S. Department of Health & Human Services, 2021). It is reasonable to believe that the public expected that any COVID-19 vaccine be effective and safe, and its distribution be equitable and transparent (National Academies of Science et al., 2021). Hence, a mass medical intervention for the COVID-19 vaccine must overcome several select challenges outlined below.

## Safety

What is novel about reluctance to receive a COVID-19 vaccine are new concerns, namely that the rushed scientific process is flawed or will produce a vaccine that is not only ineffective but also dangerous. A survey implemented during the vaccine development and testing stage in 2020 reported that 50% of Americans may refuse a COVID-19 vaccine; of the 20% who planned to reject it, 70% cited safety concerns, such as the inability to see if health problems developed during clinical trials, as their motivation (Cornwall, 2020; Neergaard et al., 2021). As of early December 2021, approximately 469 million doses of the COVID-19 vaccine have been administered with 197 million Americans fully vaccinated (which may require a person to receive two doses and be 2 weeks past the second dose) representing only 59.8% of the U.S. population, despite the eligibility of everyone aged 5 and over (CDC, 2021; Mayo Clinic, 2021). While some statistics may reflect logistical challenges, including access to a vaccination site and scheduling conflicts, in some places available vaccines go unused (FEMA, 2021).

The reality that vaccines lead to iatrogenic harm has historical foundation, and even current, official recognition. The National Vaccine Injury Compensation Program acknowledges that government-approved vaccines cause serious harm to a few individuals, often because of allergic reactions. The Program protects vaccine manufacturers and healthcare providers from legal damages that would deter them from offering vaccines, thus weakening societal protection against diseases (Health Resources and Services Administration, 2021a). An addendum, inspired by the 2009 influenza pandemic, the Countermeasures Injury Compensation Program (CICP), focuses on pandemics and other emergency defenses that produce unintended injury, suggesting government awareness that rapidly developed and somewhat experimental treatments or protections might harm patients (Health Resources and Services Administration, 2021b). CICP’s extended protection for COVID-19 vaccines treats them

like other vaccines and experimental treatments, yet it acknowledges the dangers inherent in emergency measures (Health Resources and Services Administration, 2021c).

Furthermore, history demonstrates that there can be multiple rationales for questioning vaccine safety. For example, smallpox vaccines tainted with tetanus killed over 13 children in 1901, leading to popular resistance against the mandatory vaccine (Willrich, 2012b; Bencks, 2021). The Brodie-Park and Kolmer polio vaccines led to six deaths from polio, another six cases of it, and systemic infection, as well as widespread inflammation in other children—out of a testing pool of 19,000 children in 1935 (Kluger, 2021). The military mandates smallpox vaccines for some soldiers, despite noticeable side effects, particularly for those with heart ailments (Military Health System, 2021). In these cases, local or federal governments approved the vaccines while reputable pharmaceutical companies developed and manufactured them.

Regardless of these problems, vaccines have saved millions of lives. Still, current recognition that there can be dangers in approved vaccines means that the lay concerns about safety have a long and reasonable basis. Some experts, such as the Association of American Medical Colleges, warned about a COVID-19 vaccine produced too rapidly and incautiously. This stance recognizes that the rapid timeline for COVID-19 vaccine invention and availability is unsettling since vaccine development and the human body’s response (e.g., antibody production and vaccine side effects) both can occur slowly (Boyle, 2021). In contrast, federal officials reassured the public that some challenges that slowed past vaccines’ development have been overcome; these include identification of the genetic make-up of SARS-CoV-2 (a years-long process in polio), recent advances in vaccines for similar diseases (e.g., Middle East Respiratory Syndrome), and funding and contracts to anticipate manufacturing needs (e.g., syringes) (Padron-Regalado, 2020; Zhang, 2020; Pawlowski, 2021). Still, public concerns have some basis (e.g., the likely association between the COVID-19 vaccine and rare heart conditions in young people, discovered after vaccine administration began) (Centers for Disease Control and Prevention, 2021d), but the political pressure in the current situation exacerbates them, seemingly more than scientific advances calms them.

## Administration

Common consensus is that safe vaccines offer absolute protection against viruses. After all, they have rid the world of smallpox and are close to eradicating polio. Perhaps that is one reason that the flu vaccine engenders grumbling: it is a well-known exception. It fails to safeguard against all influenzas; one needs a new vaccine annually; and it neither protects the recipient immediately nor completely (at times less than 40%) (Centers for Disease Control and Prevention, 2021e). Yet, expectations exist that vaccines should provide a perfect shield, or, at the very least, that there is a known pathway to full protection, such as a specific series of shots on a set schedule followed by a booster at particular intervals. The COVID-19 vaccination adheres to similar rules. With less than 60% of the U.S. population fully vaccinated, have uncertainties about key elements of successful vaccine



administration (e.g., compliance, compulsion, and effectiveness) shaped Americans' behavior and expectations about a COVID-19 vaccine? Will violated expectations hinder a vaccine's ability to help suppress the pandemic? If so, will one repercussion be an increased mistrust in vaccines?

## Compliance and Compulsion

- Will individuals get both doses of a two-shot COVID-19 vaccine (e.g., Pfizer/BioNTech's option) and any booster? CDC reports approximately 70% compliance with a seven-disease early childhood vaccine schedule (National Center for Health Statistics, 2021). Is there any reason COVID-19 compliance will be higher, especially when some incomplete vaccination records arise from reasons unrelated to COVID-19, such as failure or inability to return to a vaccine administration location or provider? In the U.S., for example, the 7-day average for those partially vaccinated is currently 71.1% (Our World in Data, 2021). What are other reasons individuals do not become fully vaccinated when many communities have extended clinic hours, mobile clinics, and walk-in clinics at local pharmacies?
- Will it be possible to require the vaccine, thus increasing compliance? *Jacobson v. Massachusetts*, a 1905 U.S. Supreme Court case, governs the state's ability to require vaccines (Jacobson, 1905). Henning Jacobson could be jailed and fined—or today, we see children excluded from school—when he refused a smallpox vaccine, but the government could not immunize him forcibly. That still applies, but private employers have begun to bring pressure that different loci and agencies of government may not have applied (State Covid-19 Data and Policy Actions, 2021). Even before COVID-19, some hospitals made annual influenza immunization a condition of employment. In June 2021, the U.S. District Court ruled that Houston Methodist healthcare could require workers be vaccinated against COVID-19 after approximately 100 individuals sued, claiming the vaccine was “experimental and dangerous” (Jacob Gershman, 2021). Might other employers attempt similar tactics in the form of an “immunity passport,” converting debate about mandatory vaccination into debate about individual rights versus public health, similar to the one we see about mask-wearing (Branswell, 2021a; World Health Organization, 2021)? While the U.S. Equal Employment Opportunity Commission allows employers to ask about COVID-19 vaccination status, it must keep that data private. Some companies, though, have plans to make information public by differentiating between vaccinated and unvaccinated workers with different rules about mask-wearing or lanyard identification colors (U.S. Equal Employment Opportunity Commission, 2021). Will COVID-19 vaccination status become public knowledge, and could this extend to other infectious diseases (e.g., hepatitis or meningitis)?
- Can the federal government compel vaccination in new ways? In the Fall 2021, President Biden announced that the COVID-19 vaccine is required for federal employees,

businesses with more than 100 employees, healthcare workers, teachers, and school staff, to name a few sectors. President Biden also urged the acquisition of the COVID-19 booster following the initial dosing regimen (Kavi, 2021). Currently, this time-sensitive, federal mandate that was brought forth by the Occupational Safety and Health Administration (OSHA) is on hold in the 5th circuit due to legal challenges to OSHA's authority and the breadth of the requirement (Engelhardt, 2021; Krisher, 2021). It is likely that the legality of the COVID-19 vaccine mandate will be heard by the U.S. Supreme Court which is expected to rule in favor of the vaccine mandate based on a framework of legal and public health safety regulations (Breuninger, 2021; 2021), including the precedent case of *Jacobson v. Massachusetts*.

- What are other venues for government compulsion of vaccination, ones that strive to reach wider groups or vulnerable ones? Governmental entities below the federal level have also begun to explore vaccination mandates, particularly for access to activities. One of the broadest is in New York City where vaccine requirements for restaurant dining, indoor physical activities, and entertaining options are expanding even as access to vaccines grows to include younger children (NYC Health, 2021). Some mandates focus on particular demographic groups; California has promulgated a vaccine requirement for students, likening the COVID-19 vaccine to other required vaccines against communicable diseases necessary for children who spend hours a day in proximity and thus may be particularly susceptible to easily transmissible illnesses (Office of Governor Gavin Newsom, 2021).

## Effectiveness

- Will a COVID-19 vaccine thwart lay expectations because it requires time after administration before it shields an individual? The annual influenza vaccine necessitates approximately 2 weeks before it protects someone. However, if someone develops influenza before then, the common misperception is that the flu vaccine failed, or the vaccine transmitted the flu. The National Opinion Research Center at the University of Chicago reported that approximately 31% of respondents feared becoming ill from the influenza vaccine, and the same number thought it was ineffective (NORC at the University of Chicago, 2021). How many people get COVID-19 before their immunization is fully effective? One study suggested that subjects were 80% protected 2 weeks after the first vaccine dose of Pfizer/BioNTech or Moderna, but approximately 90% protected 2 weeks after the second vaccine dose (Branswell, 2021b). Will individuals attribute sickness before full protection to an ineffective vaccine, as many do with regard to the flu?
- Currently, we are observing how long the COVID-19 vaccine's protection lasts and whether it will provide protection against all disease variants, such as Omicron (Yong et al., 2019; Callaway and Ledford, 2021). In the

1990s, researchers recommended adults receive pertussis boosters because statistics revealed increasing numbers of whooping cough cases in vaccinated adults (Cherry, 1996). At the end of 2021, experts engaged in vigorous discussions about the need for, and value of, boosters before the CDC recommended boosters for all adults (Dolgin, 2021b). Recipients of a COVID-19 vaccine are in a large natural experiment testing the robustness of the vaccine.

- Vaccines must be safe and effective, but they need not be 100% effective. In 1955, Dr. Tommy Francis announced the results of a national polio vaccine trial involving nearly two million children. Jonas Salk's vaccine prevented 68–100% of different polio strains, thus serving as a new weapon against polio (Kluger, 2004). Between immunizations, herd immunity, and personal protective practices (e.g., covering mouth when coughing), many formerly catastrophic diseases essentially have been eliminated in the U.S. We have witnessed people relax or renounce mask-wearing and other protective actions because they expect a COVID-19 vaccine will immediately protect them from sickness, not just serious illness or death. Yet, in some settings, despite vaccination against COVID-19, mask-wearing may be warranted, perhaps to enter a retail business (Money, 2021). Will such recommendations result in decreased visitation to such venues? In contrast, polling suggests that at least 25% of unvaccinated individuals may not wear a mask, even when that is optional only for those vaccinated (Motta, 2021). How will personal protective practices be influenced as we witness that the COVID-19 vaccine can be an effective mitigator that lessens the severity of a case but may not prevent the disease altogether?

## Distribution

Traditionally, the federal government allocates doses to states, while the latter establishes distribution guidelines (including who has priority and who may be inoculated) and even punishments if they are violated. In 2009, during the H1N1 flu vaccine shortage, some states gave the most vulnerable individuals preference while Maine named healthy children as potential vectors and thus as priority vaccine recipients (Ruiz, 2009; Bristow et al., 2017, 2021). State-based discretion led to varied policies, especially since states had different stockpiles, needs, and interests. Individual states allocated COVID-19 vaccine based on their respective populations and federal guidance. The National Academy of Medicine created guidelines, and OWS proclaimed control over this, although normally the National Advisory Committee on Immunization Practices provides recommendations to the states (Branswell, 2021c). Individuals already debating the state governments' rights to mandate masks in public or establish stay-at-home orders for COVID-19, may also perceive government-determined distribution and, perhaps, employer or government compulsory orders for immunization, as threats to individual liberties, even if that weakens public health. The fact that new agencies developed the national COVID-19 vaccine guidelines, and that certain groups received priority for immunization and boosters, may challenge public expectations and increase frustration, if not misunderstanding and mistrust of scientific priorities.

## DISCUSSION

We look to public health to offer the following recommendations as we prepare for the continued management of an effective and safe COVID-19 vaccine and necessary COVID-19 vaccine booster:

1. Encourage scientists, politicians, and the public to clear confusion and increase respect for each other by:
  - Recognizing that mistrust of vaccines comes from a range of current and historical experiences; anti-vaccination stances cannot simply be dismissed as being ignorant.
  - Implementing two-way communication between the public health experts and the lay public so views and misunderstandings about COVID-19 and other public health issues can be discussed and addressed. Communicate in a transparent manner that emphasizes the state of knowledge at the time of the messaging. Also, evolution of messaging is expected as new information is learned about public health issues of concern.
  - Engaging in discussions to help the public, government, and communities establish realistic expectations about what a COVID-19 vaccine can achieve and how it will be distributed. How can communities best control COVID-19's spread while balancing personal freedom with the protection of the population's health?
2. Adopt actions to increase the likelihood of COVID-19 vaccine and booster adoption:
  - Consider providing vaccine education and vaccination clinics in places where the community spends its time (e.g., work and school), thus lowering logistical barriers to vaccination (Cornwall, 2020).
  - Develop and implement community vaccine policies, with the assistance of the public, that are fair and transparent.
3. Encourage public health education in the general population to ensure a citizenry competent in the basics of public health functions. One that is:
  - Prepared to understand and act upon ongoing and novel public health problems.
  - Able to recognize that what appears as conflicting messaging in the media can be rather understood as the scientific process in action.
  - Assure trusted voices in the community (e.g., physicians, clergy) are heard.

These recommendations could be viewed through the lens of risk communication which requires effectively communicating science and health risk (Environmental Protection Agency, 2021). The governmental officials responsible for monitoring community and national health threats should be skilled in a way that they can clearly and effectively present the immediate and long-term risks of the issues at hand, the magnitude of the threat, and steps to mitigate and/or prevent adverse health outcomes. Concomitantly, the public needs to be educated to understand the significance, prevalence, and incidence of a disease threat, the difference between morbidity and mortality, and the health purpose for recommended actions that may limit

one's personal freedom to a small (e.g., mask-wearing) or large degree (e.g., COVID-19 vaccine mandate) in juxtaposition to the physical, mental, emotional, and economic health of society. The COVID-19 vaccine response should be tailored to meet populations' needs. Stakeholders are likely to accept vaccine distribution policies, despite their level of controversy, if they are evidence-based, realistic, equitable, transparent, and include the input and concerns of those affected.

While COVID-19 is a new health threat, and the vaccine was developed at an unprecedented rate, the core challenges presented with respect to vaccine safety, administration, and distribution are timeless, although accompanied by unique circumstances that increase their complexity. We present considerations about the safety, administration, and distribution of the COVID-19 vaccine and offer recommendations for responses to this ongoing, unique public health event. The steps scientists, governments, and communities take to enhance U.S. vaccine deployment and reduce vaccine hesitancy may save lives threatened by

COVID-19 today and in the future. These steps also may apply, and even improve, the protection of global populations facing COVID-19 and its variants, as well as other emerging infectious diseases.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author.

## AUTHOR CONTRIBUTIONS

RC proposed the topic for discussion. RC and MD co-developed the manuscript outline and co-wrote the article. All authors contributed to the article and approved the submitted version.

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