Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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The public's role in COVID-19 vaccination: Human-centered recommendations to enhance pandemic vaccine awareness, access, and acceptance in the United States

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ABSTRACT

Given the social and economic upheavals caused by the COVID-19 pandemic, political leaders, health officials, and members of the public are eager for solutions. One of the most promising, if they can be successfully developed, is vaccines. While the technological development of such countermeasures is currently underway, a key social gap remains. Past experience in routine and crisis contexts demonstrates that uptake of vaccines is more complicated than simply making the technology available. Vaccine uptake, and especially the widespread acceptance of vaccines, is a social endeavor that requires consideration of human factors. To provide a starting place for this critical component of a future COVID-19 vaccination campaign in the United States, the 23-person *Working Group on Readying Populations for COVID-19 Vaccines* was formed. One outcome of this group is a synthesis of the major challenges and opportunities associated with a future COVID-19 vaccination campaign and empirically-informed recommendations to advance public understanding of, access to, and acceptance of vaccines that protect against SARS-CoV-2. While not inclusive of all possible steps than could or should be done to facilitate COVID-19 vaccination, the working group believes that the recommendations provided are essential for a successful vaccination program.

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1. Introduction

Since its first appearance in the United States in February 2020, the novel coronavirus (SARS-CoV-2) has infected over 7.6 million Americans and killed over 213,000 (as of October 10, 2020) [1]. Responses to the virus, including closing venues where person-to-person spread was likely, and requiring the use of masks and physical distancing measures when social contact could not be avoided, have reduced virus spread. At the same time, these protective actions have radically transformed social life and disrupted national and household economies [2]. As the health crisis continues to linger and a sense of pandemic fatigue starts to take hold, political leaders, health officials, and the general public are seeking solutions [3].

One of the most promising, if successfully developed and deployed, is vaccines. This technology could provide individual and population-level immunity, and through these the eventual conditions for the resumption of routine social and economic activities [3]. To facilitate the development and dissemination of such vaccines, the US government has committed over 10 billion dollars (via Operation Warp Speed) with the aim of delivering 300 million doses of a safe, effective vaccine by January 2021 [4]. While this timeline is likely overly optimistic—vaccine development, especially against a class of pathogens for which no licensed vaccine currently exists, typically takes 10–15 years [5]—progress is being made. As of October 10, 2020, 92 vaccines are in preclinical evaluation, 43 are in Phase I and II safety trials, 11 have entered Phase III efficacy trials, and five vaccines have been approved for limited use: two in China, two in the United Arab Emirates, and one in Russia [6].

Despite these promising developments, Operation Warp Speed manifests a key social gap. The program rests upon the compelling yet unfounded premise that 'if we build it, they will come.' Past experience in routine and crisis contexts demonstrates that, for a variety of reasons, not all segments of the public will accept medical countermeasures including vaccines [7–8]. A recent poll in the US suggests this is already the case for SARS-CoV-2 (COVID-19) vaccines. About half of US adults (51%) reported they definitely or probably would accept the vaccine, while 49% said they would not [9]. In the same poll, only 32% of Black Americans indicated they would definitely/probably accept the vaccine compared to 52% of white Americans.

A human factor-centered vaccination campaign is needed to address these issues, but this campaign must be effectively planned and implemented. If poorly designed and executed, a COVID-19 vaccination campaign could undermine increasingly tenuous beliefs in vaccines and the public health authorities that recommend them. At the same time, the broad impacts of a successful vaccination program would be considerable. Immediate benefits would include interrupted disease transmission; fewer cases, hospitalizations, deaths, and chronic sequelae; and the beginning of reinstated social and commercial exchanges. Longer term effects would include improved institutional capabilities to foster vaccine confidence among diverse communities, enhanced public understanding regarding vaccination's value to society, and heightened public trust in government, science, and public health.

The purpose of this article, which is based on a report on the same topic [10], is to outline the major challenges and opportunities associated with a future COVID-19 vaccination campaign and to provide empirically-informed recommendations to advance public understanding of, access to, and acceptance of vaccines that protect against SARS-CoV-2. With the current lag time in vaccine availability, vaccination planners and implementers in the US and around the world have the opportunity to exercise foresight and take proactive steps to overcome potential hurdles to vaccine uptake and maximize public acceptance. These steps, however, must be taken now before this critical window of opportunity closes.

2. Methods

The research and recommendations presented in this paper are a product of the 23-person *Working Group on Readying Populations for COVID-19 Vaccine* (Table 1). This group was convened in April 2020 by principal investigators from the Johns Hopkins Center for Health Security and the Texas State University Department of Anthropology with support from the National Science Foundation-funded CONVERGE Initiative [11]. The purpose of the working group was to develop and disseminate recommendations informed by design thinking and evidence from social, behavioral, and communication sciences, that would support realistic planning for a US COVID-19 vaccination campaign. Members of the working group—listed as authors on this paper—included national figures in public health and social science with research, policy, and practice expertise in vaccinology, vaccine hesitancy/confidence, health disparities, infectious disease, bioethics, epidemiology, bioinformatics, public health law, pandemic mitigation, public health preparedness, mass vaccination campaigns, community engagement, and crisis and emergency risk communication.

A combination of literature reviews on vaccination, pandemic planning, and health crisis communication; an assessment of current news and social media trends regarding COVID-19 vaccines; and key informant interviews with each working group member focusing on their respective expertise formed the basis of the research presented in this article. This research was refined, and the recommendations were developed, through an iterative process involving the development of draft reports by a core working group, feedback from the entire working group via email and comments provided during a virtual meeting on May 21, 2020, and subsequent rounds of revisions and feedback (including a second virtual meeting on June 12, 2020). The final report from the working group, which forms the basis of the recommendations and best practices below, was finalized on July 9, 2020.

3. Results and discussion

3.1. Recommendation 1: Value social science as key to the success of COVID-19 vaccination

Envisioned largely as a biotechnology and logistics challenge, COVID-19 vaccination also poses complex human factors challenges. Such challenges have been observed during past emergencies. In 2010, for instance, many Americans rejected the H1N1 vaccine due to safety concerns [12], despite the fact that the vaccine only involved a strain change (i.e., it was not a new technology) and was fully tested before release. The H1N1 vaccine also amplified perceptions of bias. In Los Angeles, for example, distrust in public health—resulting from both prior experimentation on Blacks (e.g. the Tuskegee syphilis study) and long-term discrimination of Blacks in health care settings [13–15]—led local faith-based leaders, radio personalities, and other community representatives to advise Black community members to avoid vaccination [16]. Even though the Los Angeles County Health Department actively sought to address these concerns, these suspicions coupled with a lack of convenient access to H1N1 vaccines ultimately resulted in many Blacks in this community remaining unvaccinated [16].

Despite the existence and importance of such challenges, funding for research on human factors related to vaccine acceptance is not commensurate with its significance for vaccination success [17–18]. This type of inquiry—practical research of a social and behavioral nature on a medical technology—generally falls

Table 1
Summary of Working Group Recommendations, Best Practices for Implementation, and Tasks for Specific Entities.

Recommendation	Best Practice	Action Items
Value social science as key to the success of COVID-19 vaccination	Reconfigure existing research investments to include social, behavioral, and communication science Embed rapid social, behavioral, and communication science in the response, delivering timely data and empirically based advice Transform the vaccine research enterprise by involving communities as active partners, not passive subjects Apply HCD principles to COVID-19 vaccination program planning and implementation	Joined by foundations, Operation Warp Speed should commit a portion of its budget, and work through the NIH, NSF, and CDC to support rapid response research into COVID-19 vaccination's human factors. NIH's ACTIV model should include social/behavioral research and recognize minority serving institutions as well-placed partners to study community-specific vaccine access and acceptance issues. With university social scientists, SLTT health officials should partner with grassroots groups to learn how their communities are thinking about, and wanting to learn more about, SARS-CoV-2 vaccines.
Inform public expectations bout COVID-19 vaccination benefits, risks, and supply	Temper expectations of vaccines as a "quick fix" Forecast a range of vaccine possibilities, from best case to works case scenarios regarding vaccine supply and effectiveness Persist in transparency around vaccine safety systems; actively work to protect their integrity Seek the input of communities of color that may have historic reticence toward public health	Pre-vaccine rollout, federal health agencies should develop a coordinated national promotion strategy, using HCD-informed interventions that enable a broad network of champions to communicate about risks, benefits, allocation, and availability. CDC, with support from Congress, should fund SLTT health departments, via PHEP grants, to partner with grassroots-level groups, practitioners, and others to engage early and often with communities around COVID-19 vaccination.
Communicate in meaningful ways, crowding out misinformation	Put public well-being at the center of vaccine communication, rejecting any political trappings Invest in qualitative research to identify specific community concerns and hopes about vaccination Using surveys, identify the prevalence of attitudes and beliefs across the US population, among specific subgroups, and over time Engage a broad network of trusted spokespersons to deliver and reinforce a unified message	USG should sponsor rapid efforts for public and stakeholder engagement, formative research, and message development for SARS-CoV-2 vaccines. Longitudinal efforts will permit strategic adjustments if attitudes or beliefs evolve over time. CDC should apply capabilities in risk communication and community engagement with broader local coalitions involving SLTT departments, universities, and community organizations. Trusted community spokespersons should be engaged in communication efforts to amplify vaccine-affirming, personally relevant messages.
Earn the public's confidence that allocation and distribution are evenhanded	USG, take active steps to make the vaccine available at no cost to all residents; publicly pledge vaccines to all who desire them Develop objective allocation and distribution strategies and provide concrete proof that the processes are apolitical Take racial, ethnic, and social factors into account when developing allocation and distribution strategies	With stakeholder and public feedback, and facilitation by a neutral third party, the CDC should reassess its pandemic vaccine allocation and targeting strategy, using multiple forms of widespread public engagement. Operation Warp Speed, HHS, CDC, and SLTT health officials should develop operational systems that involve nontraditional civilian partners and instill public confidence that vaccine distribution is evenhanded.
	Implement allocation and distribution guidelines consistently across providers and locations; provide timely explanations in dynamic scenarios	CDC should develop consistent guidelines and rubrics for evaluating operational systems on principles of effectiveness and equity.
Make vaccination available in safe, familiar, and convenient places	Use nontraditional sites: e.g., schools, pharmacies, places of worship, workplaces, grocery stores, health departments, senior centers, home visits Prepare, in advance, necessary educational materials and training for those tasked with vaccination at nontraditional sites Anticipate hesitancy among marginalized populations toward historically fear-inducing sites and develop contingency plans to assure access Foster interagency and nongovernmental collaborations to make vaccination available alongside provision of other safety net services Strengthen partnerships between health departments and media news sources to communicate about availability and access	CDC and relevant professional organizations should consolidate evidence on what has worked well at SLTT health departments for making vaccines widely accessible and locally acceptable. SLTT health departments should collaborate with interagency and nongovernment partners to use nontraditional vaccination sites and explore bundling vaccination with other safety net services. HHS and CDC should work together with SLTT health authorities to develop clear communication strategies for describing where vaccines are available and who should be seeking them.
Establish independent representative bodies to instill public ownership of the vaccination program	Establish public oversight committees to review and report on systems affecting public understanding, access to, and acceptance of COVID-19 vaccines	USG should sponsor a national panel convened by a neutral entity (e.g., NASEM) to review, synthesize, and report on best practices for engaging communities in vaccine allocation, deployment, and communication systems to achieve equity, solidarity, and good health outcomes. Each state (and the most populous cities) should stand up a committee that is demographically representative and incorporates diverse sectors of society including business and faith communities.

Abbreviations: HCD = human centered design; NIH = National Institutes of Health; NSF = National Science Foundation; CDC = Centers for Disease Control and Prevention; ACTIV = Accelerating COVID-19 Therapeutic Interventions and Vaccines; SLTT = state, local, tribal and territorial; PHEP = Public Health Emergency Preparedness; USG = United States Government; HHS = US Department of Health and Human Services; NASEM = National Academies of Sciences, Engineering and Medicine.

between the priorities of the National Institutes of Health ([NIH] which rarely funds social science research) and the National Science Foundation (which does not fund applied public health research). Funding from other sources including the Centers for Disease Control and Prevention (CDC) and private foundations has also historically been limited.

In addition, the existing funding infrastructure is not outfitted for rapid response research during dynamic crises like SARS-CoV-2. While initiatives are underway to develop communities of practitioners and a supportive infrastructure for disaster science in the US, including professional networks, streamlined Institutional Review Board processes, and joint responder-researcher training [19–20], more progress is needed especially in regards to rapid funding opportunities. In the case of SARS-CoV-2 vaccination, for instance, while an NIH Funding Opportunity Award that could support research on human factors related to vaccine acceptance was made possible in June 2020, the earliest project start date is September 2021, a full nine months after Operation Warp Speed plans for COVID-19 vaccines to become available [21].

3.1.1. Best practices

To ensure a successful COVID-19 vaccination campaign, it is necessary for sponsors to invest in time-critical investigations on human factors related to vaccine acceptance, and for public health authorities and other stakeholders to act on the social and behavioral findings of this research. Such efforts include:

- **Reconfiguring existing research investments to include social, behavioral, and communication science.** One possibility for this is to set aside a small portion of the Operation Warp Speed budget for research on human factors related to vaccine acceptance. Such an approach has been used with great success in the past with other cutting-edge scientific initiatives such as the Human Genome Project and manned space flight [22–24].
- **Embedding rapid social, behavioral, and communication science within the COVID-19 response, helping to deliver timely data and empirically based advice.** By including social scientists in planning and implementation efforts, their people-centered methodologies and specialized knowledge can be integrated in a timely manner to maximize critical insights [25–29].
- **Transforming the vaccine research enterprise by involving communities as active partners not passive subjects.** Traditional "one-sided, top down" approaches to community engagement are not always effective. Community partnerships during the West Africa Ebola outbreak, for example, were necessary to overcome issues of trust and produce needed behavioral changes [30–31].
- **Applying Human-Centered Design principles (aka "design thinking") to the planning and implementation of the COVID-19 vaccination program.** User-focused approaches can result in more usable, acceptable, and effective interventions compared with traditional expert-driven methods [32–33]. Such an approach has been very successful in promoting HPV vaccination [34].

3.2. Recommendation 2: Inform public expectations about COVID-19 vaccination benefits, risks, and supply

Vaccines typically require years of development and testing before licensure. Nonetheless, US political leaders have publicly promised to accelerate COVID-19 vaccine development at "an unprecedented pace," with the aim of delivering 300 million doses of a safe and effective vaccine by January 2021 [35]. Although the use of new technologies can potentially accelerate vaccine production, public expectations around vaccine availability may not align with the practical realities of vaccine development, licensure, manufacture, and distribution. By failing to deliver SARS-CoV-2 vaccines as promised, the US government could frustrate pandemic-weary communities, siphon away trust, and suffer a major loss of institutional legitimacy.

This situation is further complicated by public perceptions of the risks and benefits of SARS-CoV-2 vaccines. Recent polling suggests that increasing numbers of Americans plan to reject COVID-19 vaccines, even if they are available and affordable [9,36]. A review of news reports, blogs, and other social media suggests a variety of potential causes for this result, including nonchalance about the disease and concern about vaccine safety. Public perception, however, is a moving target. New developments, for example, an Emergency Use Authorization (EUA)—a power granted to the Food and Drug Administration (FDA) to make unlicensed drugs, vaccines, or other therapeutics available during a public health emergency, provided sufficient evidence that the countermeasure in question "may be effective"—for COVID-19 vaccines, could engender additional uncertainties around vaccine safety due to the public's lack of familiarity with this complex regulatory mechanism.

Whatever the public's beliefs about vaccine benefits, risks, and supply, they cannot be separated from the current cultural milieu. In the US this is currently characterized by division, partisanship, and eroding public trust in government institutions—including the biomedical and public health agencies tasked with overseeing vaccine development, licensure, and distribution. In relation to the latter, for example, the intellectual independence of the FDA has come under scrutiny for its ability to objectively assess vaccine safety and efficacy amid immense political pressure to quickly approve a SARS-CoV-2 vaccine [37]. This complicated social environment poses a distinct and unprecedented complication to all vaccine promotion efforts in the US.

3.2.1. Best practices

Amid this increasingly complex social landscape, there are several measures that US public health and healthcare practitioners, political leaders and policymakers, and communication experts can implement to prime the general public for SARS-CoV-2 vaccines including:

- **Tempering expectations of vaccines as a "quick fix."** Because COVID-19 vaccines will not immediately be available to everyone who wants them, and time will be needed to develop immunity (especially given the likelihood of two-dose regimens), communicators must prepare the public to continue implementing a mix of protective actions and harm reduction strategies.
- **Forecasting a range of vaccine possibilities: from best case to worst case scenarios regarding vaccine supply and effectiveness.** From a position of openness and transparency, public health communicators should address inevitable roadblocks and bottlenecks at every stage of vaccine testing, licensure, distribution, and administration, and convey to the public how this could affect vaccine availability. In addition, it will be necessary to reframe the dialogue about the value of vaccines, given that future SARS-CoV-2 vaccines may be not be the public's hoped for silver bullet. A vaccine, for example, may prevent the most severe disease but not prevent SARS-CoV-2 infection. In this scenario, vaccination could keep hospitals from being overwhelmed, prevent declines into frailty after severe bouts of disease, and avert medical bankruptcies that may arise with the longer-term impacts of COVID-19, but not provide the community immunity necessary to halt the spread of SARS-CoV-2.
- **Persisting in transparency around vaccine safety systems and actively work to protect their integrity.** Health authorities should focus existing vaccine safety infrastructure on the use of SARS-CoV-2 vaccines. In this vein, health authorities should develop a robust system for post-licensure surveillance, including ascertaining background rates of anticipated adverse events prior to vaccine rollout to enable comparison with post-rollout incidence of adverse events. Independent oversight of vaccine safety, as occurred during the 2009–10 H1N1 pandemic, should also be used [38].

- **Early on, seeking the counsel and input of communities of color that may have historic reticence towards public health.** Vaccine promotion efforts should engage these communities early and as frequently as possible. As partners in the task, they must also empathize with legitimate concerns around vaccine safety, medical experimentation, and inequalities in health care [13–14], while also identifying and sharing salient information that can help assuage unwarranted worry.

3.3. Recommendation 3: Communicate in meaningful ways, crowding out misinformation

A profusion of true and false information, which the WHO recently referred to as an "infodemic" [39], is now circulating around COVID-19. In this crowded information landscape, the veracity of information can be difficult to determine and key messages can be lost. In the US, public discourse on the pandemic currently incorporates a panoply of topics including science, public health, social disruptions, political divisions, and economic fallout [40], each of which can be a vehicle for misinformation—information that differs from expert consensus at the time it is shared [41]. While many reasons exist for this flood of misinformation, including the widespread public adoption of social media platforms as a tool for information seeking, the uncertain nature around COVID-19 as a novel infectious disease, and the presence of disinformation campaigns aimed at deflecting blame and pushing false narratives around the global COVID-19 response [42–44], no easy solutions exist to stem the tide [45–46].

Regarding COVID-19 vaccination specifically, while the first vaccine is minimally months away from materializing, the topic has already commanded immense public attention and generated its own pool of misinformation [47–48]. This ranges from rumors questioning vaccine safety to more complicated narratives suggesting that future COVID-19 vaccines were created alongside the virus and that major organizations are planning to use a COVID-19 vaccination campaign for financial gain [49–50]. While not the sole factor in determining behavior adoption, effective communication is necessary to address these issues and build public confidence in COVID-19 vaccination [51].

Such communication will require addressing the enduring problem of how to best engage, exchange information with, and empower audiences who have diverse beliefs and life circumstances. Past communication experience with vaccines has shown the importance of engaging with key audiences to understand their concerns, values, attitudes, perceptions, and beliefs [52–55], and using this understanding to develop messages that resonate [56–57]. Messages that do not do this are often ineffective and, worse, can move audiences further away from the desired behaviors [58]. Given the diverse nature of social identities in the US, COVID-19 vaccination communications will need to be tailored to meet the needs of specific audiences including essential workers, parents, groups with high comorbidity rates, and communities of color.

3.3.1. Best practices

Despite the existing challenges in communicating about SARS-CoV-2 vaccination, past research suggests specific approaches that can be taken to ensure meaningful and relevant communication and to mitigate the effects of misinformation including:

- **Putting communities' well-being at the center of SARS-CoV-2 vaccine communication, rejecting any political trappings.** The politicized nature of the COVID-19 pandemic in the US is well documented, and there is potential for it to worsen as the country enters the 2020 election cycle [59]. The public health community and its partners should work to avoid the political arena when providing vaccine communication. Ideally this communication should come from an apolitical entity with only the interest of the health and well-being of the country's residents in mind.
- **Investing in qualitative research to identify specific community concerns and hopes in relation to COVID-19 vaccination.** Qualitative research can provide insight into "how" and "why" participants feel, think, or behave a particular way [60–61]. Such insight, in turn, is the basis for developing more meaningful, trusted, and influential communication strategies [62].
- **Using surveys to identify the prevalence of attitudes and beliefs across the US population, among specific subpopulations, and, over time, to detect any changes.** Building on qualitative findings, survey research can capture a wide range of public opinion. To inform a communication campaign about COVID-19 vaccination, important lines of inquiry for surveys include perceived susceptibility and severity of COVID-19 disease, perceived effectiveness and safety of vaccines, trust in public health authorities, credible sources for information, cognitive and affective measures of risk perception, and perceived influential others.
- **Engaging a broad network of trusted spokespersons who can deliver and reinforce a unified message about COVID-19 vaccination.** Trusted sources delivering tailored messages to key audiences will mitigate some of the challenges inherent in the COVID-19 information landscape. It is also important for communities themselves to share messages (i.e., messages going viral). Recommendations from family and friends may carry more weight than recommendations that come only from government officials or other spokespeople [63].

3.4. Recommendation 4: Earn the public's confidence that allocation and distribution is evenhanded

The current climate of racial, political, and economic division in the US has created a charged environment that necessitates both a fair vaccination campaign and widespread, public recognition of its fairness. An initial test of this will be how limited, initial doses of vaccines are allocated. In past public health emergencies, including the 2009–10 H1N1 pandemic, allocation strategies have been used to prioritize delivery of medical countermeasures to specific groups like critical health care workers and those who are at particular risk [64]. While allocation planning for COVID-19 vaccines is currently underway, questions surrounding prioritization based on race/ethnicity and income remain. Such questions, and the general allocation strategy of balancing societal benefits and individual health, leave plenty of room for perceived inequities in allocation decisions.

Perceived inequalities could also influence public opinions of fairness regarding vaccine distribution once allocation is no longer necessary. COVID-19′s impact on the US healthcare system has already necessitated the allocation of scarce medical resources such as diagnostic tests and personal protective equipment, prompting discussion about the equitable distribution of future SARS-CoV-2 vaccines [65–66]. The backdrop for such discussions includes systemic and pervasive racial biases in the US healthcare system, including lack of insurance and a lesser quality of care for non-white, rural, and low-income populations [67–69]. Such disparities have long-term consequences. Black populations in the US, for example, experience increased morbidity and mortality compared to their white peers, sometimes in ways that cannot be accounted for by access to health care and income [70]. Public health authorities will need to anticipate and mitigate public discourse regarding vaccine allocation and distribution along with prejudicial ideas about social worth, explaining that vaccinating individuals residing in the US, regardless of social or legal status, is critical to the public's health as a whole.

Finally, politicization of the pandemic—both real and perceived—may prime expectations of a partisan-based vaccine allocation and distribution rather than an equitable one. Some Americans, for instance, perceive the use of masks as a slight against President Trump by his detractors [71]. Likewise Trump has signaled his preference for having a vaccine available prior to the 2020 election (a projection not in keeping with expert assessments), prompting concerns about whether he could turn a potential but inadequately tested vaccine into a campaign tool [37]. Such polarized views of COVID-19 raise concerns about whether vaccine allocation and distribution can and will be judged as fair by the majority of Americans.

3.4.1. Best practices

People will judge a COVID-19 vaccination campaign's integrity not simply on biomedical merits, but on matters of fairness and equity—that is, have people received their just portion of health services, and has disease prevention, ultimately, been fairly distributed? Past experience suggests the following steps may contribute to a fair process:

- **The US government taking steps to make the vaccine available at no cost to all Americans and publicly pledge that everyone who wants COVID-19 vaccines will get COVID vaccines.** Removing cost as a barrier is among the most significant ways to assure that all individuals benefit from the life-preserving benefits of SARS-CoV-2 vaccines, and that the public can have the utmost confidence that public health needs and not economics will determine access.
- **Developing objective allocation and distribution strategies and provide concrete proof that the processes are apolitical.** Any allocation strategy should be as devoid of politics as possible. Such a step can help assure a more equitable plan and enhance public confidence in the fairness of the resulting process.
- **Taking racial, ethnic, and social factors into account when developing allocation and distribution strategies.** Technical aspects of future vaccination efforts, including the possibility of multiple SARS-CoV-2 vaccines and the need for multiple doses, have yet to be determined. Such uncertainties could cause concern in skeptical populations, including communities of color who fear being experimented on or provided with a countermeasure perceived as less safe or less protective. Such situations have occurred in the past [12–13,64–66] and unless they are anticipated and consciously remedied they could inhibit widespread vaccination.
- **Implementing vaccine allocation and distribution guidelines consistently across different geographic locations and healthcare providers.** During the 2009–10 H1N1 pandemic, there were instances of different applications of allocation guidelines in the US [64]. This inconsistency caused confusion and led to claims of favoritism. Future vaccination efforts should assure that allocation criteria are applied consistently across geographic locales and healthcare providers. When dynamic supplies and local conditions (e.g., high disease burden) prevent such consistencies, then federal, state, and local public health authorities should provide the public with timely, open, and frank insights into these predicaments.

3.5. Recommendation 5: Make vaccination available in safe, familiar, and convenient places

In the time that exists before vaccines are produced it is critical that safe and accessible vaccination sites are identified. This process will require ramping up the use of sites that are already available and accessible, but are used less frequently for vaccination efforts. Community pharmacies, for example, are widespread and have been mobilized for past vaccination efforts [72]. To fully utilize pharmacies in COVID-19 vaccination efforts, however, it will be necessary to address state-level policies that may currently preclude pharmacists from administering these vaccines without standing orders from physicians. Other nontraditional, potential vaccination settings that should be considered include grocery stores, senior citizen centers, workplaces, and schools [73–77]. In some cases, it also may be acceptable and feasible to deliver vaccination via home visits by community health nurses when vaccination is bundled with delivery of other preventive health services; this approach has received a strong recommendation in the past from the Community Preventive Services Task Force [78].

For marginalized populations, including racial and ethnic minorities, additional consideration must be given to what constitutes a "safe" vaccination site. During the 2009–10 H1N1 pandemic, for example, mistrust and fear among marginalized communities posed a challenge. Latino farmworkers were at greater risk for H1N1-related morbidity and mortality. However, reports of bullying and harassment within and outside of local healthcare settings led many members of this population to be fearful and hesitate to seek out H1N1 vaccination [79]. While national patterns may exist, assessments of what constitutes safe vaccination sites for marginalized populations should be conducted at local levels.

Once vaccination sites are identified, it will be essential for public health authorities to disseminate up-to-date, comprehensible, and trustworthy information about vaccination opportunities. Much of this communication work will be done by local and state health departments, which may be challenging in light of budget cuts and strained local public health infrastructure. An additional complication will be the likely complex COVID-19 vaccination environment, characterized by multiple manufacturers, multiple vaccine doses, and differently timed follow-up doses.

3.5.1. Best practices

Making vaccines widely accessible is a complex endeavor. Past experience suggests that this is possible with proactive, thoughtful coordination and clear communication like the following:

- **Utilizing nontraditional vaccination sites like schools, pharmacies, places of worship, workplaces, grocery stores, health departments, mass vaccination clinics, senior centers, home visits, and others.** Utilizing these sites, as well as clinical sites that already serve vulnerable or underserved populations (e.g., free/low cost community health care clinics, STD clinics, substance use treatment centers) will be important to improve uptake in populations that outreach efforts have failed in the past.
- **Preparing, in advance, all necessary educational materials and training that may be needed for those tasked with vaccination at nontraditional sites.** Training may include information on how to look up immunization records in state immunization registries, how to safely store vaccines, and how to safely recommend vaccines for targeted populations, keeping in mind any contraindications.
- **Anticipating hesitancy among marginalized populations who may be fearful or wary of seeking vaccination at sites that have historically caused mistrust, and plan to either expand sites to better serve these populations or engage these populations early to earn and build trust.** This may require using novel sites to better serve marginalized populations (e.g., places of worship, schools, culturally specific community centers or senior centers, mobile clinics). These nontraditional settings will also require those administering vaccines to be culturally competent. Vaccination sites should

not be heavily policed or send any signals that they may be somehow unsafe for vulnerable persons.

- **Fostering collaboration among interagency and nongovernment partners to make vaccination available alongside provision of other safety net services.** Bundling services that address individuals' broader needs during the pandemic (e.g., food security, rent assistance, workforce development) could be a way to build trust, streamline vaccine provision, and enhance more convenient access for community members.
- **Strengthening partnerships between local and state health departments and media news sources to communicate effectively to local communities about vaccine availability and access.** These stakeholders can play a key role in disseminating information in real time to eligible vaccine recipients on where and how they can get vaccinated.

3.6. Recommendation 6: Establish independent representative bodies to instill public ownership of the vaccination program

The protracted COVID-19 pandemic has placed multiple stresses on the American people: the threat of illness and death, the isolating effects of physical distancing measures, and the uncertainties and hardships associated with disrupted economic and schooling activities. The public's patience is understandably wearing thin. Operation Warp Speed is taking revolutionary steps to develop SARS-CoV-2 vaccines as swiftly as possible and, along the way, to inspire hope that relief from the pandemic's multiple burdens is coming. Despite vaccination's promise of release from the confines of the pandemic, some members of the US public—including those most at risk of COVID-19's impacts—are already reluctant to embrace this public health measure [9].

Likewise, current protests against nonpharmaceutical interventions to the SARS-CoV-2 crisis, including criticisms about government over-reach, encroachment on individual freedoms, and a clash of personal values, have the potential to further erode public trust in future SARS-CoV-2 vaccines. Under these circumstances, bold measures are necessary to instill public trust and to change the reality and the perception that COVID-19 vaccination is a top-down program administered without regard to public sentiment, concerns, or priorities.

One potential solution to these issues is the formation of public oversight committees at state and, in large metropolitan areas like New York and Los Angeles, local levels. Governance structures that incorporate public oversight and community involvement have the potential to inspire greater public confidence in, and a sense of ownership over, public health interventions. Such "ownership" can fortify the intent to vaccinate and strengthen distribution systems to reach throughout communities, thus helping to assure the fitting and fair use of a public good. This type of community engagement entails the collaboration of affected and at-risk populations with policymakers and practitioners in the generation, implementation, and evaluation of measures to safeguard public health and safety [80–82].

3.6.1. Best practices

- **Establishing public oversight committees at state and, as needed, local levels to review and report on systems that have an impact on public understanding of, access to, and acceptance of COVID-19 vaccines.** Members of state-level public oversight committees for COVID-19 vaccination should reflect the demographic make-up of the state/local area, incorporate diverse sectors of society including business and faith communities, and involve thought leaders on public health, vaccination, bioethics, and human factors. This neutral and broadly representative body can report to the public on planning and progress made in connection with COVID-19 vaccination, including efforts being made to ensure that those who need the vaccine the most actually receive it. An accountability mechanism and metrics will be necessary to ensure that allocation is fair, target groups receive vaccine, and underserved populations that have been disproportionately affected during the pandemic are justly attended.

4. Conclusion

While vaccines represent a promising solution to the COVID-19 pandemic, the development of vaccines is only part of the answer. Widespread acceptance of vaccines is also needed. This acceptance, in turn, requires more than just making safe and effective vaccines available. It is a complex social endeavor that necessitates deep engagement around the human element, and requires the efforts of US policymakers; federal, state, and local public health officials; private funders; professional and community organizations; university researchers; and nontraditional partners.

While the content provided in this article is not all-inclusive of what can, or should, be done to support widespread acceptance of COVID-19 vaccines, the recommendations and best practices outlined here are important for such a vaccination program to be successful. As experts in a wide variety of vaccination-related topics, we fear that unless these critical steps are taken, any future COVID-19 vaccination campaign will be less than hoped for. A worst-case scenario would involve an inability to stop the ravages of the disease and its cascading social and economic effects; further erosion of public trust in government, public health, and vaccine science; and potential threat to other life-preserving and life-enhancing vaccination efforts. That said, a successful COVID-19 vaccination endeavor promises an alternative future: a return to a sense of normalcy, major innovations in vaccine research and operations, and the investment of US society as a whole in making vaccines a public good in which all can share and derive value.

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