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Major Article

Willingness to get the COVID-19 vaccine with and without emergency use authorization

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Key Words:

Health Belief Model

Theory of planned behavior

Background: This study assessed psychosocial predictors of U.S. adults' willingness to get a future COVID-19 vaccine and whether these predictors differ under an emergency use authorization (EUA) release of the vaccine.

Methods: A survey of 788 U.S. adults was conducted to explore the relationships between demographics and psychosocial predictors of intent to get a future COVID-19 vaccine as well as willingness to get such a vaccine under EUA.

Results: Significant predictors of COVID-19 vaccine uptake intentions were education, having insurance, scoring high on subjective norms, a positive attitude toward the vaccine, as well as high perceived susceptibility to COVID-19, high perceived benefits of the vaccine, scoring low on barriers to the vaccine, and scoring high on self-efficacy. Predictors of willingness to take a COVID-19 vaccine under EUA were age, race/ethnicity, positive subjective norms, high perceived behavioral control, positive attitudes toward the vaccine, as well as high perceived susceptibility to COVID-19, high perceived benefits of the vaccine, low barriers to the vaccine, and scoring high on self-efficacy for getting the vaccine. Concerns about rushed vaccine development appear to reduce vaccine uptake intent, as well as willingness to get the vaccine under EUA.

Conclusions: COVID-19 vaccine-related messages should both address concerns about the vaccine and its development and reinforce benefits of the vaccine (both factors significant in both models).

Vaccine efforts may need to go beyond just communications campaigns correcting misinformation about a COVID-19 vaccine to also focus on re-establishing public trust in government agencies.

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BACKGROUND

COVID-19 has spread quickly: worldwide, as of November 6, 2020, there were 48,196,862 total cases, with 1,226,813 total deaths.¹ Because there are currently no approved vaccines and few broadly applicable proven effective treatments for COVID-19, the best method of controlling the virus is widespread adoption of preventive

measures such as social distancing, mask-wearing when in public, and frequent hand washing.²

An approved COVID-19 vaccine is seen as one of the requirements for truly “opening up” societies around the world on a more permanent basis.³ As of late summer 2020, more than 150 COVID-19 vaccines were under development worldwide,⁴ with several in phase 3 clinical trials.⁵ However, even considering unusually rapid development, most experts are estimating an approved COVID-19 vaccine will not be available to the general public until sometime in 2021.⁶

There is some speculation that the Food and Drug Administration (FDA) may issue an Emergency Use Authorization (EUA) - allowing use of a yet-unlicensed vaccine outside of a clinical trial - for one of

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the versions of a COVID-19 vaccine.⁷ A previous study focused on the H1N1 vaccine, however, found that a majority of people would not accept a new but not yet fully approved vaccine.⁸ This paper reports an investigation into the predictors of the willingness of the US public to get a future COVID-19 vaccine with and without emergency authorization.

WILLINGNESS TO GET VACCINATED

Once a vaccine becomes available, it will be critical that as many individuals as possible receive the vaccine.⁹ However, a recent poll reported that only 50% of Americans plan to get the vaccine¹⁰; another indicated that two-thirds of Americans will not get the COVID-19 vaccine when it is first available, and 25% say they will never get it.¹¹ Both Black and Hispanic individuals appear to be less willing than White individuals to get the vaccine.¹¹ This projected COVID-19 vaccine hesitancy may partially be due to the significant amount of misinformation about the future COVID-19 vaccine circulating on social media platforms,¹² which is further amplified by the already high levels of vaccine misinformation in general.¹³ Vaccine hesitancy overall has risen so substantially that the WHO now considers it a major threat to global health.¹³ A challenge specifically to a COVID-19 vaccine is that its expedited development may contribute to the public impressions that the vaccine will not be sufficiently tested for safety and efficacy.¹⁴

Theoretical explanations for vaccine behavior

Psychosocial predictors of vaccine behavior have been well-studied through the lens of health behavior theories. Two of the most frequently used are the Health Belief Model (HBM) and the Theory of Planned Behavior (TPB). The HBM posits that the likelihood of an individual adopting a specific health behavior is determined by the belief in a personal threat of illness or disease, together with belief in the effectiveness of the recommended health behavior.¹⁵ Its constructs, as applied to COVID-19 and a future vaccine, are perceived severity of and perceived susceptibility to COVID-19, perceived benefits of and barriers to receipt of a COVID-19 vaccine, self-efficacy to overcome vaccination barriers, and cues to action to get a COVID-19 vaccine.

In contrast, the TPB suggests that behavior is driven by intention to carry out the behavior, which in turn is determined by attitudes toward a COVID-19 vaccine (ie, its perceived benefit, value, and positivity), social norms (ie, whether valued others support getting a vaccine), and perceived behavioral control (ie, whether the ability to get the vaccine is within an individual's control) as related to getting a COVID-19 vaccine.^{16,17} The TPB has been successfully applied to vaccine uptake in multiple studies.^{18,19} Interestingly, one study found the TPB explained more variance and produced better model fit than the HBM.²⁰

Considering the role any future COVID-19 vaccine will play in establishing herd immunity, and the importance of addressing vaccine hesitancy through well-developed and empirically-based education campaigns, it is critical that public health scientists understand beliefs and intentions about this yet-to-be-approved vaccine. The pandemic status of COVID-19 and the urgent action needed to mitigate its impact, mean that it is also important to understand how vaccine uptake intention might differ if a vaccine becomes available through the emergency authorization act. Using the HBM and TPB as frameworks, the purpose of this study is to assess psychosocial predictors of U.S. adults' willingness to get a future COVID-19 vaccine and whether these predictors would differ under an EUA release of the vaccine.

We must also acknowledge a few initial studies regarding likelihood and willingness of the COVID-19 vaccine. For example, a survey

in the US in April 2020 found high support for getting a COVID-19 vaccine, especially among those who perceived a higher level of threat to their family.²¹ A second study in the US in May 2020 also found relatively high intentions to get the vaccine, with worry, perceptions of threat, and susceptibility all predicting likelihood (but notably, not perceptions of severity).²² Other studies have occurred overseas.^{23,24} This study adds 3 important contributions. First, it is the first to compare both the HBM and TPB constructs – 2 prominent theories in health communication – in a single model. Second, it compares vaccine intentions overall to whether the vaccine becomes available under a UAE. Third, it updates the data to July 2020, reflecting potential shift in public attitudes towards the vaccine in the US that emerged in summer 2020.²⁵

METHODS

A survey of 788 U.S. adults was conducted to explore the relationships between demographics and psychosocial predictors of intent to get a future COVID-19 vaccine as well as willingness to get such a vaccine under EUA. The study was approved by the Institutional Review Board at Virginia Commonwealth University, a large public research university in the Mid-Atlantic U.S.

Sample

Survey research firm Qualtrics was hired to recruit participants and administer the online survey. A sample of 788 participants completed the survey in July 2020. Quotas were implemented to ensure a mixed distribution of males (50%) and females (50%) and individuals from racial and ethnic backgrounds (33% White, 33% Black, and 33% Hispanic/Latinx).

Measures

Demographics

Demographic variables included age, gender, ethnicity, insurance status, and education. Control variables also measured included political affiliation and religiosity.

Participants responded to each of the items described below using a 7-point Likert scale that ranged from “strongly disagree” to “strongly agree” except for the question about ease of access to the vaccine in the *Self-efficacy* domain, which used a 6-point Likert scale ranging from “very difficult” to “very easy.”

Health Belief Model

Perceived severity of COVID-19 was determined using 3 items from a study focused on a pandemic flu vaccine by Myers and Goodwin²⁶ (eg, “Complications of COVID-19 are serious”). Cronbach's alpha for items on the scale was 0.756. The mean of the 3 items was calculated as an overall measure of perceived severity.

Perceived susceptibility to COVID-19 was measured using 3 items (eg, “I am worried about the likelihood of getting COVID-19 in the near future”).²⁶ Cronbach's alpha for items on the scale was 0.811. The mean of the 3 items was calculated as an overall measure of perceived susceptibility.

Perceived benefits of a COVID-19 vaccine were measured using 4 items focused on the benefits of a future COVID-19 vaccine (eg, “Vaccination will decrease my chance of getting COVID-19 or its complications”).^{26,27} Cronbach's alpha for these items was 0.818, and the mean of the 4 items was calculated as an overall measure of perceived benefits.

Perceived barriers to a COVID-19 vaccine were measured using ten items (eg, “The development of a COVID-19 vaccine is too rushed to properly test its safety,” and “I am concerned about the side effects of a future COVID-19 vaccination”).^{26,27} Cronbach's alpha for these items

was 0.800, and the mean of the 10 items was calculated as an overall measure of perceived barriers.

Self-efficacy was measured by 3 items (eg, “How certain are you that you could get a future COVID-19 vaccination?” with responses ranging from “very uncertain” to “very certain”).²⁶ Cronbach’s alfa for items on the scale was 0.768. The mean of the 3 items was calculated as an overall measure of self-efficacy.

Theory of Planned Behavior constructs

Attitude was measured using one statement: “Once a recommended COVID-19 vaccine is available to the public, getting it would be:” followed by a series of 6 semantic differential scales: wise-foolish, beneficial-harmful, valuable-worthless, good-bad, positive-negative, and satisfactory-unsatisfactory.²⁶ Cronbach’s alfa for these items was 0.973 and the mean of the 6 items was calculated as an overall measure of attitude. Items were reverse coded such that higher scores indicate more positive attitudes towards the future vaccine.

The following domains used a 7-point Likert scale that ranged from “strongly disagree” to “strongly agree,” similar to that used in the HBM construct items, except for *Intention* which used a 6-point such scale ranging from “definitely unwilling” to “definitely willing.”

Subjective norms were measured by 5 items (eg, “People who are important to me would approve of me getting a COVID-19 vaccination when it is available”).²⁶ Cronbach’s alfa for these items was 0.764, and the mean of the 5 items was calculated as an overall measure of subjective norms.

Perceived behavioral control was measured by 3 items (eg, “It will be mostly up to me whether or not I get a COVID-19 vaccination when it is available”).²⁶ Item 2 was reverse coded, Cronbach’s alfa for these items was 0.621, and the mean of the 3 items was calculated as an overall measure of perceived behavioral control, with higher values indicating higher perceived control.

Intention to get a future COVID-19 vaccine was measured using 2 items: “I intend to get the COVID-19 vaccine when it becomes available,” with responses ranging from “strongly disagree” to “strongly agree” on a 6-item Likert scale²⁶ and “How willing would you be to get a COVID-19 vaccine offered under the Emergency Use Authorization rule?” with responses ranging from “definitely unwilling” to “definitely willing” on a 6-point Likert scale.

Statistical approach

Analyses were performed using SPSS 26.0. Bivariate associations were assessed using Pearson’s correlation. Differences in ethnicity and political affiliation were explored using one-way analysis of variance and, when appropriate, with post-hoc tests with significance levels at $P < .05$. Gender, insurance, and education differences were explored using t tests. Linear hierarchical multiple regression analysis was used to explore which variables predicted vaccine intention as well as willingness to get a vaccine under the EUA. Demographic variables were entered in Block 1, Theory of Planned Behavior variables were entered in Block 2, and Health Belief Model variables were entered in Block 3. The effects of the independent variables were expressed in terms of standardized regression coefficients (betas). The amount of variance explained in the model was reported in terms of R^2 .

RESULTS

Of the 788 survey participants, quota matching was successful with 50% male and 50% female ($n = 394$ each) and 34.0% ($n = 268$) White, 33.4% ($n = 263$) Black, and 32.6% ($n = 257$) Hispanic or Latinx. The mean age of participants was 45.9 (SD: 17.15). Of the total sample, 87.7% ($n = 691$) reported having health insurance; as far as political affiliation was concerned, 48.1% identified as Democrat, 21.7%

Republican, and 30.2% Independent. Finally, 21.3% reported being very religious, 31.1% moderately religious, 23.1% slightly religious, and 24.5% not at all religious.

Intention to get a vaccine descriptives and demographic differences

Of the total sample, 30.7% of respondents were *definitely planning*, 29.2% were *probably planning*, 18.8% were *neutral*, 9.4% *probably not planning* and 11.9% would *definitely not planning* to receive a future COVID-19 vaccine. When asked if they would get the vaccine under the EUA, 10.4% reported being *definitely willing* to do so, 14.2% willing, 22.3% *somewhat willing*, 14.3% *somewhat unwilling*, 16.4% *probably unwilling*, and 22.3% *definitely unwilling*.

T-tests indicated that people with a bachelor’s degree or higher ($P < .001$), those who reported having insurance ($p < .001$), and men (compared to women, $P = .003$) were significantly more likely to express intent to get a future COVID-19 vaccination. An ANOVA indicated that both White and Hispanic/Latinx participants were significantly more likely than Black participants to intend to get a future COVID-19 vaccination ($P = .001$ and $P < .001$). In addition, an ANOVA also indicated that Democrats were more likely than Independents to intend to get a future COVID-19 vaccination ($P = .008$) (there was no significant difference between Democrats and Republicans in this study).

T-tests indicated that people with a bachelor’s degree or higher ($P < .001$) and men (compared to women, $P < .001$) were significantly more likely to be willing to get a future COVID-19 vaccination under EUA. An ANOVA indicated that both White and Hispanic/Latinx people were significantly more likely than Black people to be willing to get a future COVID-19 vaccination under EUA (both $P < .001$).

Bivariate correlations between vaccine intention, HBM, and TPB constructs

Table 1 presents the correlations between intention to get a future COVID-19 vaccine with and without EUA and HBM and TPB constructs. Intention to get a future COVID-19 vaccine was positively associated with subjective norms, attitudes, perceived severity, perceived susceptibility, perceived benefits, and self-efficacy; and negatively associated with perceived barriers and religiosity. There was no association with age or perceived behavioral control. Willingness to get a future COVID-19 under the EUA was positively associated with subjective norms, attitudes, perceived behavioral control, perceived severity, perceived susceptibility, perceived benefits, and self-efficacy, and negatively correlated with age and perceived barriers. Religiosity was not significantly correlated with intention.

Psychosocial predictors of vaccine intention

To investigate determinants of intention to get a COVID-19 vaccine and willingness to get one under EUA, 2 hierarchical multiple regressions were carried out (Tables 2 and 3). Demographic covariates not significant at the bivariate level were not included in the regression models. The model for predicting intent to get a future COVID-19 vaccine explained 66.6% of the variance in intention ($R^2 = 0.666$), while the model for predicting willingness to get a future COVID-19 vaccine under EUA explained 35.5% of the variance in willingness ($R^2 = 0.355$).

Across both models, Black respondents were less likely to express intent or willingness to get a COVID-19 vaccine. For both models having a positive attitude toward a vaccine, as well as scoring high on norms and self-efficacy related to a vaccine, high perceived susceptibility to COVID-19, high perceived benefits of a future COVID-19 vaccine, and low perceived barriers to a vaccine were significant predictors. A higher level of education predicted intent to get a future

Table 1.
Correlation matrix COVID-19 vaccine uptake intent and COVID-19 vaccine uptake willingness under EUA

Variable	1	2	3	4	5	6	7	8	9	10	11
1. COVID-19 vaccine uptake intent											
2. EUA willingness	0.383**										
3. Age	0.015	-0.077*									
4. Religiosity	-0.011	0.052	0.090*								
5. Norms	0.459**	0.444**	-0.059	-0.067							
6. Perceived Behavioral Control	0.048	-0.096**	-0.199**	0.014	0.170*						
7. Attitudes	0.550**	0.435**	0.098**	-0.093**	0.592**	-0.018					
8. Severity	0.226**	0.129*	0.012	-0.031	0.282**	-0.062	-0.317**				
9. Susceptibility	0.272**	0.217**	0.026	-0.062	0.307**	-0.164**	-0.347**	0.550**			
10. Benefits	0.467**	0.480**	-0.007	-0.059	0.547**	-0.091*	-0.642**	0.308**	0.312**		
11. Barriers	-0.358**	-0.321**	-0.230**	0.063	-0.228**	-0.211**	0.430**	-0.002	-0.008	-0.348**	
12. Self-efficacy	0.338**	0.327**	0.042	-0.037	0.307**	0.283**	-0.335**	0.093**	0.066	0.393**	-0.309**

*= P < .05.
**= P < .01.

COVID-19 vaccine, but not of willingness to get a vaccine under EUA; older respondents were less likely to express willingness to get a future COVID-19 vaccine under EUA, but age made no difference in intent to get a vaccine without EUA (Tables 2 and 3).

Probing the impact of barriers

Finally, 2 follow-up linear regressions were run, first with intent to get a COVID-19 vaccine as the outcome, then willingness to get a COVID-19 vaccine under EUA, in order to obtain an indication of the relative contribution of specific barriers to the significance of the barriers-construct. Predictions of lower intent to get a future COVID-19 vaccine included: high scores on cannot be bothered to get the vaccine, fear of needles, concern about side effects, possible vaccine shortage, and concern about rushed development of the vaccine. Higher scores on fear of needles, concern about bad reaction to vaccine, possible vaccine shortage, and concern about rushed development of the vaccine all were significant predictors of lower willingness to get a COVID-19 vaccine under EUA (Tables 4 and 5).

DISCUSSION

This is one of the first studies investigating both predictors of future COVID-19 vaccine uptake as well as willingness to get the vaccine under EUA. Overall, 60% of participants in this diverse sample were either definitely or probably willing to receive a future COVID-19

vaccine and 25% were either definitely or probably willing to receive the vaccine under an EUA authorization. Black respondents were less likely to indicate intent to get the vaccine than White respondents, including under EUA. Prior research on attitudes toward vaccination across ethnic and racial groups suggests that this may in part be attributable to greater mistrust of government and health information possibly due to historical and present-day medical and structural racism.^{28,29} Because structural racism also places Black Americans at increased risks from COVID-19,³⁰ high levels of COVID-19 vaccine hesitancy present a distinct challenge and threat to achieving health equity. It will be critical for health systems and public health agencies to build trust among communities that have historically had harmful experiences with medical providers and government agencies.²⁸ In

Table 3.
Hierarchical multiple regression predicting future COVID-19 vaccine uptake willingness under EUA

Variable	Beta	P value	Beta	P value	Beta	P value
Gender: women	-.103	.008*	-.097	.004*	-.056	.087
Age	-.118	.001*	-.130	<.001*	-.138	<.001*
Education	.113	.001*	.065	.038*	.034	.205
Race: Black (Ref: White)	-.144	.001*	-.110	.004*	-.105	.004*
Race: Hispanic (Ref: White)	-.029	.528	-.061	.099	-.061	.087
TPB: Norms			.235	<.001*	.159	<.001*
TPB: PBC			.030	.344	.090	.007*
TPB: Attitude			.293	<.001*	.091	.038*
HBM: Severity					.054	.138
HBM: Susceptibility					.089	.014*
HBM: Benefits					.184	<.001*
HBM: Barriers					-.172	<.001*
HBM: Self-efficacy					.131	<.001*

*P < .05.

Table 2.
Hierarchical multiple regression predicting future COVID-19 vaccine uptake intent

Variable	Beta	P value	Beta	P value	Beta	P value
Gender: women	-.047	.214	-.034	.197	.006	.811
Education	.148	<.001*	.088	<.001*	.050	.021*
Race: Black (Ref: White)	-.159	.001*	-.064	.043*	-.063	.026*
Race: Hispanic (Ref: White)	.023	.564	.007	.803	.007	.765
Political: Democrat (Ref: Republican)	.158	.001*	.031	.360	.028	.363
Political: Independent (Ref: Republican)	-.012	.788	.001	.975	.020	.482
Insurance	.130	<.001*	.076	.002*	.057	.008*
Religiosity	-.055	.114	.000	.999	.003	.904
TPB: Norms			.225	<.001*	.130	<.001*
TPB: PBC			.001	.962	.046	.052
TPB: Attitude			.557	<.001*	.312	<.001*
HBM: Severity					.005	.850
HBM: Susceptibility					.074	.005*
HBM: Benefits					.276	<.001*
HBM: Barriers					-.169	<.001*
HBM: Self-efficacy					.097	<.001*

*P < .05.

Table 4.
Multiple linear regression: Perceived barrier items predicting future COVID-19 vaccine uptake intent

Variable	Beta	P value
Perceived barriers: Cannot be bothered to get vaccine	-.387	<.001*
Perceived barriers: Fear of needles	-.066	.026*
Perceived barriers: Concern about side effects of vaccine	-.221	<.001*
Perceived barriers: Concern about bad reaction to vaccine	-.052	.347
Perceived barriers: Vaccine will be expensive	.026	.455
Perceived barriers: Shortage of vaccine	.105	.001*
Perceived barriers: Getting vaccine will be inconvenient	-.032	.320
Perceived barriers: Shortcuts taken in vaccine development	.000	.998
Perceived barriers: Not enough time for scientists to assess risks	.003	.947
Perceived barriers: Development too rushed to test safety	-.176	<.001*

*P < .05.

Table 5.

Multiple linear regression: Perceived barrier items predicting future COVID-19 vaccine uptake willingness under EUA

Variable	Beta	P value
Perceived barriers: Cannot be bothered to get vaccine	-.071	.067
Perceived barriers: Fear of needles	-.072	.036*
Perceived barriers: Concern about side effects of vaccine	-.110	.086
Perceived barriers: Concern about bad reaction to vaccine	-.158	.014*
Perceived barriers: Vaccine will be expensive	.006	.888
Perceived barriers: Shortage of vaccine	.076	.047*
Perceived barriers: Getting vaccine will be inconvenient	-.016	.680
Perceived barriers: Shortcuts taken in vaccine development	-.010	.802
Perceived barriers: Not enough time for scientists to assess risks	-.031	.534
Perceived barriers: Development too rushed to test safety	-.164	.001*

* $P < .05$.

addition, older people were less likely to be willing to get the vaccine under EUA; another area of concern because this group is also at higher risk for COVID-19 morbidity and mortality and will likely be a priority group to receive the vaccine.³¹

An extended Theory of Planned Behavior including Health Belief Model variables was successful in explaining 66% of the variance in intention to get a COVID-19 vaccine, providing a useful framework for interventions to encourage uptake of the future vaccine. However, the same model was successful in explaining only 35% of the variance in willingness to get a COVID-19 vaccine under EUA. A possible explanation for this difference is that there are likely other factors that should be considered, such as the level of uncertainty related to an EUA for a new vaccine, as well as such as trust in government agencies and vaccine development.

These results indicate the following significant predictors of COVID-19 vaccine uptake intentions: education, insurance, scoring high on subjective norms, having a positive attitude toward the vaccine, as well as high perceived susceptibility to COVID-19, high perceived benefits of the vaccine, high on self-efficacy for getting the vaccine, and scoring low on barriers to the vaccine. These relationships are consistent with health behavior change theory. Specifically, the TPB predicts that more positive attitudes and stronger subjective norms favoring vaccine behavior should result in stronger intentions to get vaccinated, and the HBM predicts that those who feel susceptible to the health threat, have benefits that outweigh the barriers, and have the self-efficacy to overcome barriers are most likely to be willing to get vaccinated. Moreover, having insurance and higher education both contribute to overcoming barriers.

Significant predictors of willingness to take a COVID-19 vaccine under EUA are age (younger respondents were more likely), race/ethnicity (White respondents were more likely compared to Black respondents), positive subjective norms, high perceived behavioral control, positive attitudes toward the vaccine, as well as high perceived susceptibility to COVID-19, high perceived benefits of the vaccine, high self-efficacy for getting the vaccine, and low barriers to the vaccine. The specific barriers that appear to have a higher relative contribution to the perceived barriers construct – such as concern about side effects or bad reactions to the vaccine – should be incorporated in vaccine communication campaigns and interventions, both to increase vaccine uptake intent as well as potentially increase willingness to get the vaccine under EUA.

Finally, concerns about rushed vaccine development appear to reduce vaccine uptake intent, as well as willingness to get the vaccine under EUA. Recent polling from the Kaiser Family Foundation suggest that over 60% of the U.S. public is worried that “political pressure from the Trump administration will lead the FDA to rush to approve a coronavirus vaccine without making sure that it is safe and effective.”³² Trust in the CDC also declined from 83% to 67% in April to September 2020, with trust particularly low among Republicans.³² Public

figures have also suggested a concern with a rushed process, with former CDC Director Tom Frieden³³ stressing the importance of vaccines going through the “full CDC and FDA processes.” If findings from rigorous vaccination trials do imply safety, countering these concerns with appropriate information may be important.

It appears that the current political climate and recent challenges within federal public health agencies have complicated efforts to ensure full COVID-19 vaccination. As noted by Jamison et al,²⁸ trust in public institutions “may take considerable time and effort to repair.” Further research is needed to understand the impact of trust in government on COVID-19 vaccine intentions. Vaccine efforts may need to go beyond just communications campaigns correcting misinformation about a COVID-19 vaccine to also focus on re-establishing public trust in government agencies. Groundwork for public acceptance of a COVID-19 vaccine, with or without EUA, should be started immediately, before a vaccine is approved and becomes available. Such campaigns should address known potential barriers using culturally appropriate messages as well as specifically target social media influencers.

Strengths and limitations

Strengths of this study include a large and diverse sample, the focus on theoretical factors that might explain vaccine hesitancy, and multivariate modeling to identify the most salient predictors. Such findings can help guide efforts to improve vaccine uptake when and if a vaccine becomes available. Limitations include the reliance on a convenience sample where population weighting was not employed. This limits our ability to interpret results as being nationally representative. However, the focus was on determining factors that relate to uptake and not necessarily on describing the percent of the population who might be hesitant. In this regard the findings do support a set of predictors that could be used as a target of future intervention efforts. Nevertheless, a future nationally representative population survey could be helpful in better elucidating the percent of the population that might be vaccine hesitant and if hesitancy differs by race, gender, or age within the US population. Second, it should be noted that the link between behavioral intention and actual health behaviors has been shown to be modest.³⁴ As a result, it is unknown whether the predictors of behavioral intention found in the current study would equally predict whether individuals choose to obtain the COVID-19 vaccine once it actually becomes available. While there is no vaccine widely available at the writing of this article, and thus this extension of the theories examined cannot yet be tested, it is critical that a parallel study be conducted once a vaccine is available and a critical threshold of people have been able to obtain it. This type of study would help identify barriers to actual behavior in those who choose not to be vaccinated. Finally, the survey questions for general future vaccine uptake willingness and EUA vaccine uptake willingness were not randomized, and as such the methodology may have signaled to participants that something was different about the EUA circumstances and therefore primed skepticism regarding EUA vaccine, underestimating participants’ willingness to obtain the vaccine under an EUA.

Despite these limitations, this is one of the first studies to use well-established models of health behaviors to examine predictors of COVID-19 vaccine uptake intention, with and without an EUA. These models explained a very large amount of variance in uptake intention, though nearly twice as much variance when predicting uptake intention without an EUA as with one. The biggest unique predictors in these models were attitudes and norms, with not wanting to be bothered to get the vaccine as the biggest barrier to COVID-19 vaccine uptake intent without an EUA and the development of the vaccine being too rushed to test its safety as the biggest barrier with an EUA. These sets of predictors present important targets for vaccine

communication campaigns and interventions, and these campaigns are particularly important when attempting to reach Black populations who may have lower levels of trust in medical research and in the federal government's response to the pandemic and COVID-19 vaccine EUAs.

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