



Vaccination and vacci-notions: Understanding the barriers and facilitators of COVID-19 vaccine uptake during the 2020-21 COVID-19 pandemic

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ABSTRACT

Objective: The COVID-19 pandemic continues to place an inordinate burden on U.S. population health, and vaccination is the most powerful tool for curbing SARS-CoV-2 transmission, saving lives, and promoting economic recovery. However, much of the U.S. population remains hesitant to get vaccinated against COVID-19, despite having access to these life-saving vaccines. This study's objective was to examine the demographic characteristics, experiences, and disease- and vaccine-related risk perceptions that influence an individual's decision to adhere to vaccine recommendations for COVID-19.

Study design: A telephone survey was performed with a convenience sample of 57 participants.

Methods: This mixed-methods study collected quantitative and qualitative responses about seasonal influenza and COVID-19 vaccine intentions to compare vaccine hesitancies between a novel and routine vaccine.

Results: The primary facilitators of uptake for the COVID-19 vaccine were personal protection, protecting others, preserving public health, and general vaccine confidence. Concerns about vaccine side effects, concerns about the COVID-19 vaccine trials, misinformation about vaccination, personal aversions to the vaccine, general distrust in vaccination, complacency, and distrust in government were the primary barriers to vaccine uptake. Race was also associated with COVID-19 vaccine intentions.

Conclusions: The results of this research have been condensed into four recommendations designed to optimize public health messaging around the COVID-19 vaccine and maximize future vaccine uptake.

1. Introduction

The World Health Organization (WHO) categorized COVID-19 as a pandemic on March 11, 2020, and the world has since battled staggering death tolls and invested billions of dollars to develop vaccines to combat SARS-CoV-2, the virus that causes COVID-19 [1]. Many have touted vaccination as the solution to ending the pandemic, and the FDA approved the first EUA for a COVID-19 vaccine on December 11, 2020 [1]. As of December 2021, three vaccines have been approved in the USA [2,3] and seven are approved by WHO for use globally [4]. These approved vaccines represent monumental achievements, demonstrating 65–95% efficacy against symptomatic illness and greater than 89% efficacy against hospitalization and death in all populations. Vaccinees are also less likely to transmit virus if they do become infected [5].

The potential impact of safe and available vaccines to squelch

transmission, save lives, and promote economic recovery around the globe cannot be overstated. However, it is ultimately vaccinations rather than vaccines that make the difference [6], and uptake has been less than targets [7]. It is clear that individual acceptance and motivation may determine how quickly vaccination goals are achieved to end the COVID-19 pandemic.

Vaccination is the most powerful public health tool for reducing disease incidence and disease symptom severity, yet considerable portions of the U.S. population remain hesitant to get vaccinated against COVID-19, despite having near universal access to vaccines [8,9]. Racial disparities and political viewpoint may be a notable source of COVID-19 vaccine hesitancy in certain U.S. subpopulations. Minority groups, particularly African American and Hispanic communities, have faced higher risks of developing COVID-19 throughout the pandemic, increasing the impact of hesitancy about the COVID-19 vaccine [10–12].

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Political influences have guided many Americans' preventive practices throughout the pandemic and may also contribute to COVID-19 vaccine hesitancy [13]. These socio-political factors merely scratch the surface of what guides individual decision-making for the novel COVID-19 vaccine in the United States; the barriers and facilitators to COVID-19 vaccine uptake must be better understood to optimize public health messaging and maximize future vaccine uptake. This study aimed to understand the demographic, risk-based, and experience-based factors that influence an individual's decision to accept vaccine recommendations for COVID-19 and considered seasonal influenza vaccine practices as a comparator.

2. Methods

This is a cross-sectional phone-based exploratory study that examines factors associated with COVID-19 vaccine uptake. Participants were recruited for this study from two sources: 1) individuals that had previously participated in translational research and consented to future contact and 2) faculty or staff who responded to an email advertising the study. Participants were consented verbally. A mixed methods survey instrument ([Supplementary Appendix A](#)) was used to collect demographic information and qualitative and quantitative data on experience, perspectives, and beliefs related to public health practices, COVID-19, and seasonal influenza. The survey instrument was based on a survey tool developed by the SAGE Working Group on Vaccine Hesitancy to measure the contextual influences, individual beliefs, and vaccine-specific issues that contribute to vaccine hesitancy [14]. Individual beliefs were assessed using a series of health- and vaccine-related statements that were developed using the Health Belief Model, a framework used to understand preventative health behaviors through the domains of perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and cues to action [15,16]. Participants were asked to share their level of agreement with each statement using a five-point Likert scale. This study collected information about seasonal influenza vaccine preferences and practices, an approved and widely recommended vaccine, to use as a control in comparison to the newly approved and novel COVID-19 vaccine. The survey was divided into two similar sections to assess vaccine perceptions for each disease independently.

The survey instrument included seven open-ended questions, which were transcribed and coded using the Grounded Theory Approach. Responses were coded into narrow sub-themes and then combined into broader meta-themes to understand the broad facilitators and barriers to vaccine uptake [17]. Responses were stratified by vaccine intention to identify the most common themes among participants who intended to vaccinate and those who did not intend to vaccinate against each disease.

In the interest of statistical parsimony, the independent and dependent variables were recoded to binary or categorical variables for bivariate and multivariable analysis. Two independent variables, vaccine intention and vaccine hesitancy, were used in this analysis. Both variables capture responses to the questions, "If a COVID-19 vaccine becomes available, how likely are you to get vaccinated?" and "How likely are you to get the 2020–2021 seasonal influenza vaccine?" with "Intention to Vaccinate" representing participants who responded with "Very Likely" and "Likely" and "Hesitancy" representing all participants who provided a response other than "Very Likely." See [Supplementary Appendix B](#) for additional information on variable recoding.

Initial bivariate analyses comparing vaccine intentions with both demographic and experience variables were performed using a two-tailed Fischer's exact test. The multivariable statistical analysis was performed using an ordinary least squares (OLS) regression, post-lasso estimator. Holding constant core demographic variables, i.e. demographic data that may be collected with a patient intake form, the analysis used a least absolute shrinkage and selection operator (lasso) regression as a first-step estimator to identify which of the other

explanatory variables were most associated with the vaccine intention response variable [18,19]. The lasso regression retained all core demographic variables and the subset of experience and Likert scale variables that were predictive of vaccine intention. All variables selected by the lasso procedure were then included in an OLS regression to determine the fit or R^2 of the model and the statistical significance of each variable's association with vaccine intention. The R^2 of this regression was compared to that of an OLS regression containing only core demographic variables to determine the additional predictive power of the experience and Likert scale variables that were identified by the lasso procedure. Given the small sample size and many regressors in this analysis, an OLS post-lasso regression was better suited to identify potential predictor variables than an OLS or lasso regression alone [18]. Similar analyses were repeated using vaccine hesitancy as the response variable. Predictors of COVID-19 and seasonal influenza vaccine intentions and vaccine hesitancy were identified independently. All statistical analysis was performed using STATA statistical software.

3. Results

Participant recruitment took place between September 2020 and December 2020, before COVID-19 vaccine EUAs were extended to children. This research therefore focuses on adults' rationale for their personal vaccine decisions. In total, 265 adults (age ≥ 18) were contacted over the phone or via email about participation in this research study. Fifty-seven participants were ultimately consented and enrolled. The study population was predominately female, White, Christian, Democrat, and had obtained at least a college degree ([Table 1](#)). Enrolled participants all lived in or around Atlanta, GA and highly educated, medically trained, and healthcare-affiliated individuals were over-represented. Of the 57 participants, 91% ($n = 52$) intended to receive the 2020-21 seasonal influenza vaccine and 77% ($n = 44$) intended to receive a COVID-19 vaccine.

In the multivariable analysis, race was the only demographic variable found to have a statistically significant association with both vaccine intention and vaccine hesitancy for the COVID-19 vaccine ([Table 2](#)). Black participants intended to vaccinate at a lower proportion than White participants (4 of total 44 vs. 33 of total 44; regression coefficient -0.337 ; $p < 0.01$) and exhibited vaccine hesitancy at a higher proportion than White participants (12 of total 19 vs. 2 of total 19; regression coefficient 0.425 ; $p < 0.01$). Other participants of color also exhibited vaccine hesitancy at a higher proportion than White participants (5 of total 19 vs 2 of total 19; regression coefficient 0.302 ; $p < 0.05$) ([Tables 2 and 3](#)).

The COVID-19 vaccine lasso analysis indicated that participants' religion, their reason behind getting a COVID-19 test, their preference for getting the vaccine over the disease, their intention to comply with a government recommendation, and whether they were concerned about vaccine safety and side effects were potential predictors of both COVID-19 vaccine intentions and vaccine hesitancy ([Table 2](#)). Of these variables, three were significantly associated with vaccine intention and/or vaccine hesitancy in the final OLS regression. Individuals who agreed with the statement "I would rather receive a COVID-19 vaccine than get COVID-19" reported intending to vaccinate at a higher proportion than those who did not agree with the statement (43 of total 44 vs. 1 of total 44; regression coefficient 0.336 ; $p < 0.05$). Participants who agreed with the statement "I worry about the safety and/or side effects of the COVID-19 vaccine" intended to vaccinate at a lower proportion (14 of total 44 vs. 30 of total 44; regression coefficient -0.177 ; $p < 0.05$) and exhibited vaccine hesitancy at a higher proportion (16 of total 19 vs. 3 of total 19; regression coefficient 0.227 ; $p < 0.05$) than those who did not agree with the statement. Finally, participants who agreed with the statement "If a government health authority recommends that I get a COVID-19 vaccine, I will get one" exhibited vaccine hesitancy at a lower proportion than individuals who did not agree with the statement (4 of total 19 vs. 15 of total 19; regression coefficient -0.397 ; $p < 0.01$) ([Tables 2 and](#)

Table 1
Demographic characteristics of study population (n = 57).

Study Population Demographics (n = 57)	Frequency	Percentage (%)
Age		
18–30yrs	11	19
31–40yrs	13	23
41–50yrs	8	14
51–60yrs	13	23
61yrs or older	12	21
Gender		
Male	22	39
Female	35	61
Race		
White	34	60
Hispanic or Latino	3	5.3
Black or African American	14	25
Asian	4	7
Middle Eastern or North African	1	1.8
Other (specify)	1	1.8
Religion		
Christian	21	37
Jewish	2	3.5
Muslim	1	1.8
Hindu	1	1.8
Atheist	4	7.0
Agnostic	4	7.0
Not religious	22	39
Other	2	3.5
Political Affiliation		
Democrat	42	74
Republican	3	5.3
Independent	7	12
Other	5	8.8
Level of Education		
High School	2	3.5
Some College	1	1.8
College	13	23
Graduate School and beyond	41	72
Profession		
High Education Administrator/Research Coordinator	6	11
Professor/Researcher	15	26
Public Health/Healthcare Professional	12	21
Engineer	2	3.5
Business/Marketing	6	11
Finance/Accounting/Economics	4	7.0
Nonprofit Fundraising/Grant Manager	2	3.5
Lawyer	1	1.8
Teacher	2	3.5
Graduate Student	2	3.5
Unemployed	3	5.3
Other	2	3.5
Living Situation		
Single and living alone	9	16
Single and living with roommates	3	5.3
Living with a partner	20	35
Living with a partner and children	16	28
Living with children and no partner	3	5.3
Living with family members other than partner or children	3	5.3
Other	3	5.3
Living with High Risk Individual		
Yes	34	60
No	23	40
Has at Least 1 Medical Condition		
1 or more Medical Conditions	34	60
No Medical Conditions	23	40

*Percentages may not add up to 100 due to rounding.

4).

Including the potential predictor variables identified by the initial lasso regression in the final OLS regression increased the predictive power of the COVID-19 vaccine intentions and vaccine hesitancy regressions. The R^2 for the COVID-19 vaccine intentions regression containing only demographic variables was 0.560 (Supplementary Table 1),

while the regression containing the additional predictor variables had an R^2 of 0.760 (Table 2). Similarly, the R^2 for the COVID-19 vaccine hesitancy regression containing only demographic variables was 0.591 (Supplementary Table 1), while the regression containing the additional predictor variables had an R^2 of 0.809 (Table 2).

Utilizing this same statistical procedure on the seasonal influenza dataset increased the predictive power of the seasonal influenza vaccine intentions and vaccine hesitancy models as well. The seasonal influenza vaccine multivariable analysis indicated that participants' intention to comply with a doctor or nurse recommendation was significantly associated with their vaccine intentions and vaccine hesitancy towards the 2020-21 seasonal influenza vaccine. Participants' preference for getting the vaccine over the disease was significantly associated with vaccine intention, but not vaccine hesitancy. Prior 2019-20 seasonal influenza vaccination was significantly associated with vaccine hesitancy, but not vaccine intentions. Participants' religion and their intention to comply with a government recommendation were identified as potential predictors by the lasso procedure, but were not statistically significant in the final regression. The R^2 for the OLS regression for vaccine intentions that included all potential predictor variables was 0.691 (Table 2), compared to 0.183 (Supplementary Table 1) without these variables. The R^2 for the OLS regression for vaccine hesitancy that included potential predictors was 0.637 (Table 4), compared to 0.267 (Supplementary Table 1) without these variables.

Many of these quantitative findings were supported by the major themes identified in the qualitative analysis (Fig. 1). Qualitative responses were divided into personal views and perspectives on the U.S. general population's rationale behind vaccine decisions. Participants described factors positively associated with their personal COVID-19 vaccine uptake, including personal protection, protecting others, public health motivations, returning to normalcy, and general confidence in vaccines; they also described personal uptake barriers, including concerns about the COVID-19 clinical trials, distrust in government, and concerns about the safety, side effects, or efficacy of the COVID-19 vaccine. These themes also appeared in participants' responses about the general population's barriers and facilitators to COVID-19 vaccine uptake, alongside themes of lack of understanding or ignorance about the vaccine, general distrust in vaccination or science, personal aversions to the vaccine, and complacency or low perceived personal health risks. Similarly, in their rationale behind their personal seasonal influenza vaccine decisions, participants commonly cited themes of personal protection, regularly getting the flu vaccine, public health motivations, protecting others, general confidence in vaccination, complacency or low perceived risk, access issues, and concerns about the seasonal influenza vaccine as their barriers or facilitators to vaccine uptake. Participants' responses about the general population's vaccine rationale also include the themes of lack of understanding or ignorance about the vaccine, personal aversion to the vaccine, general distrust in vaccination, and distrust in government.

4. Discussion

This study examined the role of demographic traits, personal experience, and personal health beliefs in defining individuals' vaccine intentions towards the novel COVID-19 vaccine. Given the high prevalence of COVID-19 infection in the United States and the availability of COVID-19 diagnostic testing, we hypothesized that the heightened fear of infection and increased awareness about vaccination would displace the complacency that typically hinders uptake of routine vaccines and increase people's intention to vaccinate. We further hypothesized that individuals who had been tested for or diagnosed with COVID-19 would be more likely to express an intention to receive the COVID-19 vaccine. While direct personal experience with COVID-19 did not appear to be a major driver of vaccination intentions, several important themes shaping vaccination intentions did emerge.

Table 2
OLS post-lasso regression analysis of vaccine intentions and vaccine hesitancy.

VARIABLES	Intention to Receive the COVID-19 Vaccine	Intention to Receive the Seasonal Influenza Vaccine	Hesitancy to Receive the COVID-19 Vaccine	Hesitancy to Receive the Seasonal Influenza Vaccine
	REGRESSION COEFFICIENT			
HELD CONSTANT IN LASSO REGRESSION				
<i>Age</i>				
vs. 18-30yrs				
31-59yrs	0.00617 (0.116)	-0.0561 (0.0756)	0.0703 (0.116)	0.136 (0.0884)
60yrs or older	-0.00249 (0.122)	-0.0551 (0.0862)	0.0555 (0.122)	0.128 (0.103)
<i>Gender</i>				
vs. Male				
Female	-0.0543 (0.0774)	-0.0162 (0.0550)	-0.0562 (0.0775)	0.0225 (0.0642)
<i>Race</i>				
vs. White				
Black	-0.337*** (0.116)	-0.0149 (0.0808)	0.425*** (0.116)	-0.0522 (0.0958)
Non-White/Non-Black	-0.0855 (0.114)	0.0364 (0.0833)	0.302** (0.114)	0.0140 (0.101)
<i>Profession</i>				
vs. Non-Healthcare Field				
Healthcare Field	-0.0671 (0.127)	-0.143* (0.0763)	0.120 (0.127)	0.168* (0.0943)
<i>Level of Education</i>				
vs. College Level or Below				
Graduate Level or Beyond	0.127 (0.101)	0.0917 (0.0655)	-0.0956 (0.101)	-0.147* (0.0769)
<i>Living Situation</i>				
vs. Living Alone				
Living with Children	-0.0276 (0.120)	0.0216 (0.0809)	0.0431 (0.120)	-0.0516 (0.0950)
Living with Non-Children	0.0913 (0.103)	-0.0462 (0.0751)	0.00768 (0.103)	0.0597 (0.0890)
<i>Enrollment Relative to Pfizer Phase 3 Trial Data Release</i>				
vs. Before Pfizer Phase 3 Results				
After Pfizer Phase 3 Results	-0.0662 (0.112)		0.0936 (0.112)	
POTENTIAL PREDICTORS IDENTIFIED BY LASSO REGRESSION				
<i>Religion</i>				
vs. Non-Religious				
Religious	0.0821 (0.0877)	0.00363 (0.0608)	-0.0191 (0.0878)	0.0142 (0.0716)
<i>Reason for COVID-19 Test</i>				
vs. Not-Symptomatic				
Symptomatic	-0.137 (0.0910)		0.134 (0.0912)	
<i>I would rather receive a COVID-19 vaccine than get COVID-19</i>				
vs. Does Not Agree				
Agree	0.336** (0.137)		-0.0981 (0.137)	
<i>If a government health authority recommends that I get a COVID-19, I will get one.</i>				
vs. Does Not Agree				
Agree	0.176 (0.119)		-0.397*** (0.119)	
<i>I worry about the safety and/or side effects of the COVID-19 vaccine.</i>				
vs. Does Not Agree				
Agree	-0.177** (0.0863)		0.227** (0.0864)	
<i>I would rather receive a seasonal influenza vaccine than get seasonal influenza</i>				
vs. Does Not Agree				
Agree		0.366** (0.132)		
<i>If my doctor/nurse recommends that I get a seasonal influenza vaccine, I will get one.</i>				
vs. Does Not Agree				
Agree		0.649*** (0.127)		-0.535*** (0.136)
<i>If a government health authority recommends that I get a seasonal influenza, I will</i>				
vs. Does Not Agree				
Agree		-0.0959 (0.0816)		-0.0248 (0.0950)
<i>Received 2019-20 Seasonal Influenza Vaccine</i>				
vs. No/Unsure				
Yes				-0.260** (0.0979)

(continued on next page)

Table 2 (continued)

VARIABLES	Intention to Receive the COVID-19 Vaccine	Intention to Receive the Seasonal Influenza Vaccine	Hesitancy to Receive the COVID-19 Vaccine	Hesitancy to Receive the Seasonal Influenza Vaccine
Observations	57	57	57	57
R-squared	0.760	0.691	0.809	0.637

Note.
 Standard errors in parentheses.
 ***p < 0.01, **p < 0.05, *p < 0.1.
 Constant included in all regressions but not reported.

Table 3
 COVID-19 and seasonal influenza vaccine intentions and vaccine hesitancy by demographic group.

VARIABLES	Intention to Receive the COVID-19 Vaccine (n = 44/57)	Intention to Receive the Seasonal Influenza Vaccine (n = 52/57)	Hesitancy to Receive the COVID-19 Vaccine (n = 19/57)	Hesitancy to Receive the Seasonal Influenza Vaccine (n = 6/57)
FREQUENCY OF RESPONSES (n = 57)				
<i>Age</i>				
18-30yrs	8 (18%)	10 (19%)	4 (21%)	1 (17%)
31-59yrs	24 (55%)	28 (54%)	12 (63%)	5 (83%)
60yrs or older	12 (27%)	14 (27%)	3 (16%)	0 (0%)
<i>Gender</i>				
Male	19 (43%)	21 (40%)	7 (37%)	2 (33%)
Female	25 (57%)	31 (60%)	12 (63%)	4 (67%)
<i>Race</i>				
White	33 (75%)	33 (63%)	2 (11%)	1 (17%)
Black	4 (9%)	11 (21%)	12 (63%)	3 (50%)
NonWhite/NonBlack	7 (16%)	8 (15%)	5 (26%)	2 (33%)
<i>Profession</i>				
Non Healthcare Field	36 (82%)	41 (79%)	12 (63%)	5 (83%)
Healthcare Field	8 (18%)	11 (21%)	7 (37%)	1 (17%)
<i>Level of Education</i>				
College Level or Below	8 (18%)	13 (25%)	9 (47%)	4 (67%)
Graduate Level or Beyond	36 (82%)	39 (75%)	10 (53%)	2 (33%)
<i>Living Situation</i>				
Living Alone	8 (18%)	10 (19%)	3 (16%)	0 (0%)
Living with Children	14 (32%)	19 (37%)	8 (42%)	2 (33%)
Living with Adults	22 (50%)	23 (44%)	8 (42%)	4 (67%)
<i>Religion</i>				
Religious	15 (34%)	21 (40%)	14 (74%)	3 (50%)
Non-Religious	29 (66%)	31 (60%)	5 (26%)	3 (50%)
<i>Political Affiliation</i>				
Democrat	34 (77%)	33 (63%)	12 (63%)	3 (50%)
Non-Democrat	10 (23%)	19 (37%)	7 (37%)	3 (50%)
<i>Living with a High Risk Individual</i>				
Yes	17 (39%)	22 (42%)	9 (47%)	1 (17%)
No	27 (61%)	30 (58%)	10 (53%)	5 (83%)
<i>Has at Least One Medical Condition</i>				
1 or More Medical Conditions	16 (36%)	19 (37%)	9 (47%)	4 (67%)
No Medical Conditions	28 (64%)	33 (63%)	10 (53%)	2 (33%)

Note.
 *Percentages may not add up to 100 due to rounding.

4.1. Demographic influences on vaccine uptake

Race was the only demographic variable significantly associated with COVID-19 vaccine intentions and hesitancy. Black and African American participants exhibited significantly higher rates of COVID-19 vaccine hesitancy and intended to vaccinate at lower rates than White participants. Other participants of color also exhibited significantly higher rates of vaccine hesitancy than White participants. In their qualitative responses, participants noted that African Americans may feel a greater mistrust towards the healthcare system, because the COVID-19 pandemic has disproportionately burdened their communities.

In trials that they are doing with the vaccines, as an African American, I don't feel like they have had a big enough sample size to test the efficacy and complications of the vaccines on African Americans. (female respondent, age 43)

African Americans have not only faced higher risks of COVID-19 exposure and infection during this pandemic, they have also faced a history of mistreatment by the United States medical system that dates to the time of slavery [20,21]. These factors likely contribute to African Americans' hesitations towards the novel COVID-19 vaccine, whereas more established vaccines, like the seasonal influenza vaccine, may not elicit such concerns. These findings are evidence of a major paradoxical hurdle in the fight to curb COVID-19 spread: African Americans, and other people of color, face the greatest need for a COVID-19 vaccine to

Table 4
 COVID-19 and seasonal influenza vaccine intentions and vaccine hesitancy by Likert scale responses.

	Intention to Receive the COVID Vaccine (n = 44/57)	Intention to Receive the Seasonal Influenza Vaccine (n = 52/57)	Hesitancy to Receive the COVID Vaccine (n = 19/57)	Hesitancy to Receive the Seasonal Influenza Vaccine (n = 6/57)
VARIABLES	FREQUENCY OF RESPONSES (n = 57)			
<i>I think [seasonal influenza/COVID-19] is a serious illness.</i>				
Agree	44 (100%)	51 (98%)	18 (95%)	5 (83%)
Does Not Agree	0 (0%)	1 (2%)	1 (5%)	1 (17%)
<i>I think the complications associated with [seasonal influenza/COVID-19] are serious.</i>				
Agree	44 (100%)	50 (96%)	19 (100%)	5 (83%)
Does Not Agree	0 (0%)	2 (4%)	0 (0%)	1 (17%)
<i>I think I have a high personal risk of getting [seasonal influenza/COVID-19].</i>				
Agree	17 (39%)	16 (31%)	15 (79%)	0 (0%)
Does Not Agree	27 (61%)	36 (69%)	4 (21%)	6 (100%)
<i>I think people close to me have a high risk of getting [seasonal influenza/COVID-19].</i>				
Agree	23 (52%)	26 (50%)	15 (79%)	1 (17%)
Does Not Agree	21 (48%)	25 (48%)	4 (21%)	5 (83%)
Agree		^a One response left blank		
<i>If I were diagnosed with [seasonal influenza/COVID-19], I think it would be dangerous for my health.</i>				
Agree	38 (86%)	17 (33%)	18 (95%)	4 (67%)
Does Not Agree	6 (14%)	35 (67%)	1 (5%)	2 (33%)
<i>If I were diagnosed with [seasonal influenza/COVID-19], I think it is plausible that I would infect people around me.</i>				
Agree	38 (86%)	48 (92%)	17 (89%)	4 (67%)
Does Not Agree	6 (14%)	4 (8%)	2 (11%)	2 (33%)
<i>I would rather receive a [seasonal influenza/COVID-19] vaccine than get [seasonal influenza/COVID-19].</i>				
Agree	43 (98%)	51 (98%)	9 (47%)	3 (50%)
Does Not Agree	1 (2%)	1 (2%)	10 (53%)	3 (50%)
<i>If my doctor/nurse recommends that I get a [seasonal influenza/COVID-19] vaccine, I will get one.</i>				
Agree	42 (95%)	51 (98%)	11 (58%)	2 (33%)
Does Not Agree	2 (5%)	1 (2%)	8 (42%)	4 (67%)
<i>If a government health authority recommends that I get a [seasonal influenza/COVID-19], I will get one.</i>				
Agree	38 (86%)	43 (83%)	4 (21%)	1 (17%)
Does Not Agree	6 (14%)	9 (17%)	15 (79%)	5 (83%)
<i>I worry about the safety and/or side effects of the [seasonal influenza/COVID-19] vaccine.</i>				
Agree	14 (32%)	9 (17%)	16 (84%)	3 (50%)
Does Not Agree	30 (68%)	43 (83%)	3 (16%)	3 (50%)
<i>My intentions to get vaccinated against seasonal influenza have changed as a result of the COVID-19 pandemic.</i>				
Agree	–	10 (19%)	–	0 (0%)
Does Not Agree	–	42 (81%)	–	6 (100%)
<i>My beliefs about vaccination in general have changed as a result of the COVID-19 pandemic.</i>				
Agree	4 (9%)	–	2 (11%)	–
Does Not Agree	40 (91%)	–	17 (89%)	–
<i>I am knowledgeable about the symptoms and complications associated with [seasonal influenza/COVID-19] infection.</i>				
Agree	44 (100%)	49 (94%)	19 (100%)	5 (83%)
Does Not Agree	0 (0%)	3 (6%)	0 (0%)	1 (17%)
<i>I am knowledgeable about the CDC recommendations regarding seasonal influenza vaccination.</i>				
Agree	–	44 (85%)	–	4 (67%)
Does Not Agree	–	8 (15%)	–	2 (33%)

Note.
^a Percentages may not add up to 100 due to rounding.

ease the disproportionate disease burden on their communities, yet they are more hesitant to get vaccinated [21,22].

4.2. Experience-based influences on vaccine uptake

Contrary to our hypothesis, we found that participants' personal experiences with COVID-19 infection and testing – including testing positive, being symptomatic at time of testing, and having a close friend or family diagnosed with COVID-19 – were not associated with their intention to receive the COVID-19 vaccine. Despite these findings, it remains important that public health officials clearly convey to individuals who have recovered from a COVID-19 infection that they are fully eligible and recommended to be vaccinated.

4.3. Risk based influences on vaccine uptake

The most frequently cited factors positively associated with COVID-19 vaccine uptake in the qualitative analysis were the desire to protect oneself, protect others, and support public health. Participants stated that both the seasonal influenza and COVID-19 vaccines help curb community disease spread, but many participants further lauded COVID-19 vaccination as a social responsibility and civic duty. Overall, response themes about disease risk were not tied to participants' personal encounters with COVID-19 infection, but rather reflected the widespread disruption of normalcy and loss of life that has been collectively experienced by Americans throughout the COVID-19 pandemic. These collective pandemic experiences may be a powerful emotional tool for motivating future vaccine uptake.

I would like to see the world return to some degree of normalcy, and [vaccination] is the one thing that I can do to make this not necessarily a reality, but as a contribution to it ... I feel it is my civil duty to do it. (male respondent, age 60)

Not all participants focused on the benefits of COVID-19 vaccination—participants who were concerned about the safety and side effects of the COVID-19 vaccine were significantly less likely to intend to vaccinate and exhibited higher rates of vaccine hesitancy. Side effect concerns were not significantly associated with seasonal influenza vaccine intentions, indicating that safety and side effect concerns may play a greater role in decision-making for novel vaccines, regardless of robust safety and efficacy data being available.

I feel that this particular vaccine has been rushed by our government for political gain ... That would make me wary on whether or not it actually works. They are rushing it, and I have a hard time believing that is for the benefit of the people ... the rush of [the] COVID vaccine just seems nefarious somehow. (female respondent, age 40)

Most concerns about the timing, safety and efficacy, clinical trial representativeness, vaccine novelty, and government influence in COVID-19 vaccine development came from a subgroup of nine participants who intended to receive the routine seasonal influenza vaccine, but not the novel COVID-19 vaccine. All these participants were enrolled prior to or within several days of the release of the Pfizer-BioNTech clinical trial data. Although date of enrollment was not significantly associated with COVID-19 vaccine intentions in our study, we initially predicted that the increasing availability of scientific data for the COVID-19 vaccine may have helped dispel vaccine concerns among participants who were enrolled later in the study. However, current U.S. vaccination trends indicate many individuals are still foregoing vaccination, despite the abundance of data proving the vaccine safety and efficacy [9]. Vaccination campaigns are now increasingly including incentives of monetary or social value rather than detailed scientific information. Mandates have also been imposed by many companies, universities, and healthcare systems [23].

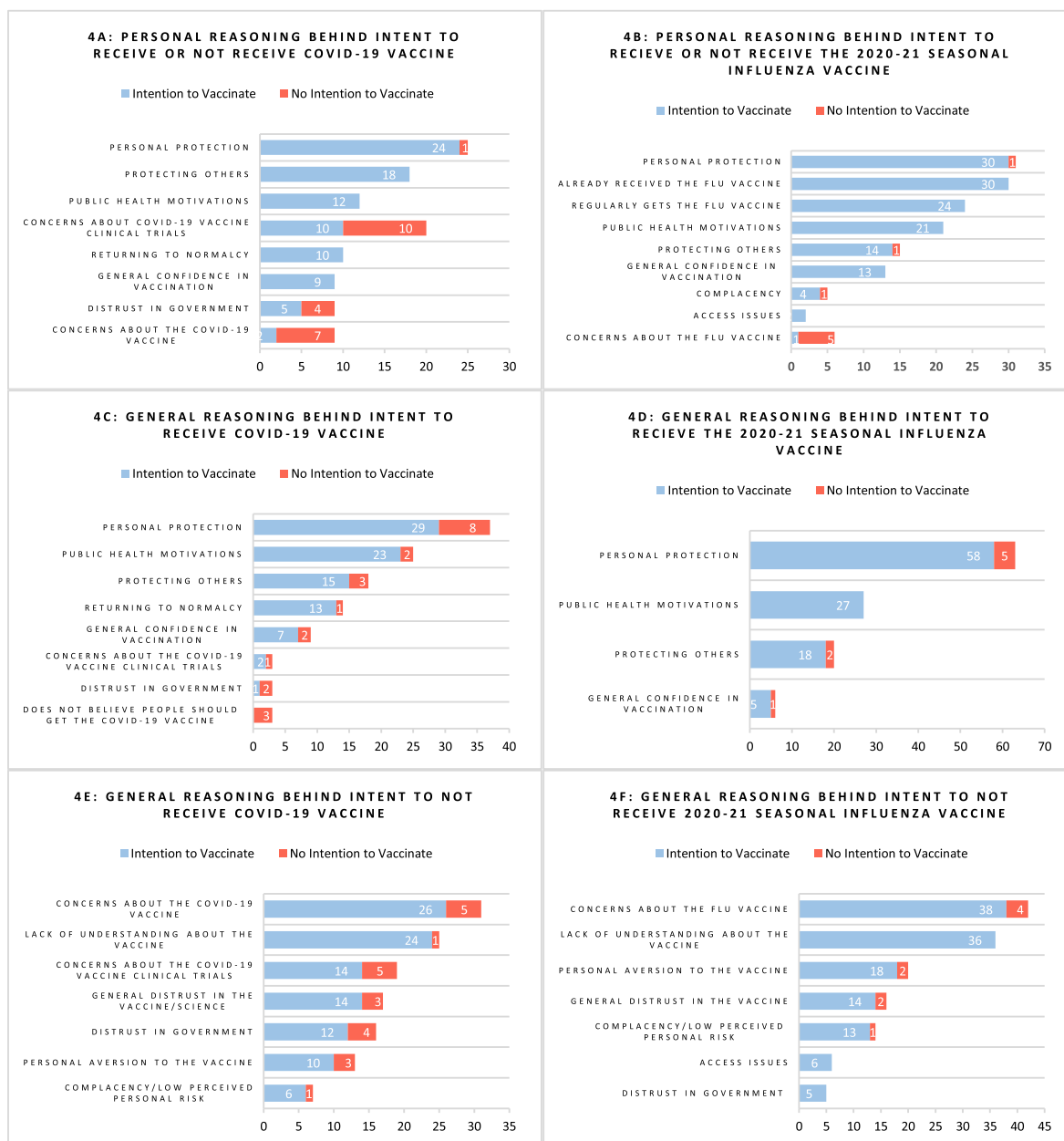


Fig. 1. Qualitative response themes.

4.4. Recommendations and Actionable Suggestions

Given our findings and review of the literature, we offer the following recommendations for developing vaccine-related communications and targeting vaccine hesitant populations.

1. **Rely on trusted community health workers, leaders, and medical professionals who share identities with their patients to disseminate vaccine-related information.** In communities with high rates of vaccine hesitancy, vaccine messaging may be most effective if doctors and community health workers who share an identity with hesitant groups are at the forefront of dissemination and are able to share why they chose to get vaccinated in spite of their shared barriers [24]. Individuals may be more likely to trust the guidance and behaviors of people who share their racial identities, religious beliefs, political affiliations, or life experiences, which should be leveraged in vaccine communications.

2. **Educate on the community health benefits of vaccines with lower efficacies.** It is intuitive that vaccines with high efficacies reduce population-level disease transmission, but vaccine messaging must communicate how vaccines with lower efficacies still substantially reduce community spread. Vaccine communications should emphasize that vaccination is socially responsible at any efficacy rate, particularly as more COVID-19 vaccine candidates, with lower efficacies, receive EUAs.
3. **Promote “Vaccinating our way out of the pandemic.”** The COVID-19 pandemic has been a deeply emotional, isolating, and disruptive experience. Public health messaging should therefore emphasize that vaccination is more than just a health measure, it is a means of returning to normal life. Promoting vaccination as the way to return to loved ones, hometowns, and normalcy may be a powerful way of encouraging vaccine uptake among individuals that do not feel a strong health-based drive to get vaccinated.
4. **Continue to offer widespread town halls, Q&As, and information access for all new vaccines.** With new vaccines come new

concerns about side effects, efficacy, and novel technology. Throughout the COVID-19 pandemic, town halls and Q&A sessions have given the public an opportunity to receive accurate responses to their questions and concerns from healthcare professionals. While the COVID-19 vaccine has received a greater media spotlight than most, making healthcare professionals accessible on the news and on social media to answer questions whenever new vaccines are released may prevent individuals from seeking answers to their questions from less reliable media platforms or search engines, which could help stop the spread and consumption of misinformation.

4.5. Study limitations

This study had important limitations. Fifty-seven participants were enrolled in this research study, all of whom lived in or around Atlanta, GA and many of whom were highly educated and healthcare-affiliated professionals. Participants were recruited through convenience sampling of individuals that had previously participated in translational research or were academic faculty or staff. Thus, these results cannot be generalized to the broader United States population. One might expect this limitation to bias our sample to low vaccine hesitancy; however, the diversity of opinions registered in this study provides valid and valuable insight into the barriers to vaccine uptake among groups that are not traditionally labeled as vaccine refusers. In fact, we found that up to 23% of participants had no intention of receiving a COVID-19 vaccination, involving an array of rationale. This is concerning and would likely be amplified in a larger and broader population sample.

Participant enrollment also coincided with several political and scientific milestones: the Trump administration released their COVID-19 vaccine strategy (September 16, 2020), President Joe Biden became President-Elect (November 7, 2020), Pfizer-BioNTech released their COVID-19 vaccine trial data (November 9, 2020), Moderna released their COVID-19 vaccine trial data (November 16, 2020), and the FDA granted an EUA for both the Pfizer-BioNTech and Moderna vaccines (December 11, 2020 and December 18, 2020, respectively) [1]. While these events likely impacted participants' responses in ways that could not be controlled for in this study, the qualitative data from this study does provide a valuable snapshot of the impact that major political and scientific developments had on personal vaccine intentions between September 2020 and December 2020.

5. Conclusion

The results of this research reveal that vaccine intentions are far more than an objective health decision—they are tied to racial identity, political and scientific trust, and altruistic drives to protect loved ones and strangers. Each new vaccine and pandemic presents an opportunity to improve public health messaging, and the action items presented in this study provide a starting point for dismantling vaccine hesitancies in the populations represented by this research. As COVID-19 vaccines continue to be developed and distributed, there remains a need to address vaccine hesitancy and refine vaccine messaging in order to bring the COVID-19 pandemic to an end.

Future research should monitor differences in vaccine hesitancy towards seasonal versus pandemic viruses, in order to prepare for the potential that COVID-19 will become endemic to some areas of the world [25]. Additionally, as COVID-19 vaccines with different technologies, dose schedules, storage requirements, and efficacies against emerging COVID-19 variants continue to be developed and approved, it will be important to study the public's hesitancies across COVID-19 vaccine types.

Author statement

All study materials were reviewed and approved by the Emory University Institutional Review Board (IRB Study# 00001267). No

funding was obtained for this study. The authors report no conflicts of interest.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.puhip.2022.100276>.

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