

Trust in Healthcare and Trust in Science Predict Readiness to Receive the COVID-19 Vaccine in Appalachia

2,045 words

3 tables, 3 figures, 3 appendices (supplementary data tables)

Abstract

BACKGROUND: The Appalachian Region faces multiple barriers to widespread COVID-19 vaccination. The purpose of this research study was to explore the role of trust in healthcare and trust in science on Appalachian residents' readiness to receive the COVID-19 vaccine. Trust in health influencers and health information sources were also explored.

METHODS: A cross sectional survey study of Appalachian Region residents (n=1048) was completed between February 25 and March 6, 2021, with equivalent rural and non-rural sampling methods employed. Participants were >35 years of age and had not received the COVID-19 vaccine at the time of survey administration.

RESULTS: Overall, 31% of participants were *extremely likely* to receive the vaccine, while 42% were *somewhat likely/neither unlikely or likely/somewhat unlikely*, and 27% were *extremely unlikely*. Based on multiple linear regression analysis with backwards selection, trust in healthcare, trust in science, residence (rural vs. non-rural) and age were positive predictors of readiness to receive the vaccine ($F(5, 1042) = 38.9, R^2 = 0.157, p < 0.01$). Gender, education, household income, and political affiliation did not predict vaccine readiness. Trust in media for health information was modest, with ratings of none or not much for social media (64%), podcasts (61%), magazines (46%), radio (37%), newspapers (36%), and television (35%). Primary care providers emerged as the highest trusted health influencer of 15 options and a primary care provider's office was the most common preference for location for receiving the COVID-19 vaccine, particularly in participants who rated themselves as *extremely unlikely* to receive the COVID-19 vaccine.

CONCLUSIONS: These findings suggest that trust in healthcare and science are prospective foci for initiatives aimed at improving vaccine acceptance in Appalachia, particularly in younger residents of rural areas. As highly trusted health influencers, primary care providers should be leveraged and supported in COVID-19 vaccine education and distribution.

Keywords: primary care, family medicine, Appalachian region, health communication, influencer

Key Findings

1. Compared with a 15% national average, 27% of this Appalachian Region cohort reported they were *extremely unlikely* to receive the COVID-19 vaccine.
2. Trust in science and trust in healthcare were predictors of vaccine readiness and likelihood.
3. Primary care providers were rated as the most trusted health influencer. Ratings of Dr. Anthony Fauci (NIH) were polarized as he was the second most trusted and also the least trusted health influencer. Second on the least trusted list was Dr. Sanjay Gupta (CNN).
4. A primary care provider's office was the preferred choice of location to receive the COVID-19 vaccine. Of those *somewhat unlikely* or *extremely unlikely* to receive the vaccine, 51% selected a primary care provider's office as their preferred choice if they were to receive it. A primary care provider's office was the preferred choice for COVID-19 vaccination even for participants without a personal primary care provider.

Introduction

The Appalachian Region of the United States (population: 25 million) is comprised of 420 counties spanning 13 states (Alabama, Georgia, Kentucky, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, and West Virginia). Appalachia, which features unique mountain geography and a strong cultural history, also faces many health-related challenges, including greater rates of chronic disease, substance abuse, and mental health issues than other regions of the country.¹ Socioeconomic disparities and inequities in healthcare access and quality are also prevalent.¹⁻⁴

The coronavirus disease 2019 (COVID-19) pandemic has brought unprecedented hardship to the Appalachian Region and has exacerbated existing challenges and vulnerabilities.⁵⁻¹² Timely vaccination against COVID-19 is crucial to decrease its transmission, morbidity, and mortality, especially when paired with other public health strategies such as mask wearing and social distancing.¹³ However, a number of factors, including gender, age, race/ethnicity, education level, and political affiliation, influence COVID-19 vaccine hesitancy and resistance.^{14,15} Although incidence of and deaths from COVID-19 are greater among residents of rural areas, readiness to receive the vaccine is lower in these regions, despite controlling for other demographic factors.¹⁶ Rural regions also face numerous obstacles to vaccine distribution, potentially limiting access for even those who desire to receive it.^{17,18}

Trust in the health system, healthcare providers, and generalized trust are recognized as predictors of vaccine acceptance and uptake.¹⁹ Mistrust and distrust in government and science have been cited as early drivers of COVID-19 vaccine

hesitancy.^{14,20,21} In the United States, trust in the COVID-19 vaccine differs regionally and based on a variety of demographic factors.²² Minimal published data about the relationship between trust and vaccine readiness in Appalachia is available. The purpose of this study was to explore the concept of trust - in particular, trust in healthcare and trust in science - in relation to likelihood and readiness of receiving the COVID-19 vaccine in rural and non-rural residents of the Appalachian Region. A secondary aim was to describe trusted health influencers and health information sources among residents of the region.

Methods

A cross-sectional survey study of individuals residing in the Appalachian Region was conducted using Qualtrics Panels, an independent web-based, crowdsourced data collection company.^{23,24} Quota sampling methods were used to ensure that the sample was comprised of respondents who were 50% rural and 50% non-rural (Rural-Urban Continuum Code of 5-9 and 1-4, respectively) to match the overall population of the region. Additional survey inclusion criteria included: age ≥ 35 years, regular social media user (Facebook, Twitter, or Instagram at least weekly), and no history of receiving the COVID-19 vaccine and no appointment to do so at the time of survey administration. This study was considered exempt from human subjects review by the Institutional Review Board of [redacted] (IRB #[redacted]).

Survey Tool and Survey Administration

The survey required approximately 20 minutes to complete and was comprised of 40 questions in the following domains: 1) Demographics; 2) COVID-19 Experiences, Attitudes, Beliefs, and Desires; and Trust/Distrust in 3) Healthcare; 4) Science; and 5) COVID-19 Health Influencers and Information Sources. Likelihood of receiving the COVID-19 vaccine was measured on a 5-point Likert scale (*extremely unlikely* to *extremely likely*) and readiness to receive the vaccine was measured via a 9-point contemplation ladder (1= *I have no thoughts or plans to receive the COVID-19 vaccine* to 9= *I am taking action to receive the COVID-19 vaccine*). The Healthcare System Distrust Scale (HSDS)²⁵ was used for #3, while #2, 4, and 5 were informed by existing published surveys.²⁶⁻²⁸ The selection of health influencers and information sources used in the survey was based on published literature, current social media trends, and feedback from three rounds of internal pilot testing.²⁹⁻³²

Between February 25 and March 6, 2021, registered Qualtrics panelists were recruited via email or social media to participate in the survey using recruitment procedures and consenting processes standard to Qualtrics Panels surveys.³³ Those who consented to participate proceeded with the survey. No personal identifiers were collected by the research team. Approximate sample size was informed by a priori power analysis, allowing 80% power to detect a small effect size or larger in multiple linear regression.

A “soft launch” was administered to approximately 5% of the target sample size on February 22, 2021 to check the survey for unexpected errors or omissions. As no changes were made to the survey after the soft launch (with the exception of the addition of one CAPTCHA question), soft launch responses (n= 56) were included in the

final sample. If participants did not complete the entire survey, failed the attention check, demonstrated straightlining behavior (i.e., response patterns indicative of inattention), provided nonsensical or irrelevant responses to the two open-ended questions, or completed the survey in an unusually slow or fast manner, their responses were excluded from the final sample using standard Qualtrics procedures.

Statistical Analysis

Data were analyzed using IBM SPSS version 26.0. Descriptive data are expressed as means \pm standard deviation. Within-variable differences were evaluated via one-way ANOVA or chi-square analysis and relationships between variables were explored using Spearman's correlation analysis. Multiple linear regression was used to evaluate the association between distrust in healthcare and distrust in science on readiness to receive the COVID-19 vaccine. Additional demographic predictors included region of primary residence (rural and non-rural), age, gender, race, ethnicity, education, annual income (household), and political affiliation. Backwards selection was used to determine which subset of predictors to include in the final model. Alpha was set at .05 for all analyses.

Results

Selected results focused on trust are presented in this brief report, with some additional findings included in the Supplemental Data. Of the 2,616 panelists who expressed interest in participating, 91 failed to provide consent, 1,149 did not meet inclusion criteria, and another 419 were excluded from data analysis, leaving a final

sample of n=1048. Demographic characteristics of the participants and their COVID-19 vaccine likelihood and readiness are shown in Table 1.

Trust

Total score on the HSDS was 26.1 ± 6.3 on a scale of 9 to 45 (higher score = greater distrust) (full results available in Supplemental Data). Participants rated their trust in science as *none* (1%), *not much* (12%), *some* (52%), and *a lot* (35%). Trust in science produced by universities was rated as *none* or *not much* by 18% of participants, compared with 43% for science produced by the government, 31% for science produced by the medical or pharmaceutical industry, and 15% for scientists themselves.

The optimal linear regression model, as identified through backwards model selection, included distrust in healthcare, distrust in science, residence (rural vs. non-rural), and age as predictors of readiness to receive the COVID-19 vaccine ($F(5, 1042) = 38.9$, $R^2 = 0.157$, $p < 0.01$). Individual predictors are provided in Table 2. Specifically, greater vaccine readiness was associated with greater distrust in science and healthcare, older age, rural residence, and more education.

Participants' trust in various news sources for health information about COVID-19 is rated highest for television, with 24% indicating *a lot* of trust (Figure 1). In contrast, trust ratings of *none* or *not much* were given for social media by 64% participants and for podcasts by 61% participants. In terms of trust in health influencers for information about COVID-19, the greatest number of participants (47%) rated *a lot* of trust in their primary care provider (Table 3). When asked which health influencer they trusted the most from a list of 15 options, 34% responded with "my primary care provider", 18%

with “Dr. Anthony Fauci, Director of the National Institute of Allergy and Infectious Disease”, and 10% with the “Centers for Disease Control (CDC)”. Remaining health influencers were rated as most trusted by less than 5% of participants. The least trusted health influencers were Dr. Fauci (24%), Dr. Sanjay Gupta, CNN Chief Medical Correspondent (15%), and Dr. Scott Atlas, Former Senior Health Advisor to President Trump (13%), and the World Health Organization (WHO) (12%), with remaining health influencers rated least trusted by less than 7% of participants.

COVID-19

Overall, 27% participants rated themselves as *extremely unlikely* to get the vaccine, while 31% were *extremely likely*, and 42% were either *somewhat unlikely*, *neither unlikely or likely*, or *somewhat likely* (Figure 2). Vaccine likelihood and readiness were positively correlated ($r= 0.828$, $p<0.001$) (Figure 2).

A total of 40% of participants rated a primary care provider’s office as their preferred location to receive the COVID-19 vaccine if they were to receive it; 21% had no preference in locations (Figure 3). Of participants *extremely unlikely* or *somewhat unlikely* to receive the COVID-19 vaccine, 51% rated primary care provider’s office as their preferred location if they were to receive it. There was no difference between preferred vaccine location in rural and non-rural residents.

Participants’ ratings of fears and concerns related to COVID-19 and the COVID-19 vaccine are shown in the Supplemental Data. Fear that that friends and family members will die from COVID-19 was rated as *some* or *a lot* by 51% of participants. Long-term safety of the vaccine and side effects of getting the vaccine were the highest

reported vaccine-related concerns (65% and 65% rating *some* or *a lot*, respectively). Thirty-seven percent of participants rated their concern about access to the vaccine as *none* and 53% rated their concern about cost of the vaccine to them as *none*. There were no differences between rural and non-rural participants in ratings of fear and concerns.

Primary care

There were 847 (81%) participants who reported having a primary care provider. *Some* or *a lot* of trust in “my primary care provider” was reported by 92% of participants. Those with a primary care provider were older (56.0 vs. 50.6 years) more likely to be female (59% vs. 54%), of higher income (25% vs. 36% earning <\$20,000 annually and 18% vs. 10% earning >\$80,000 annually), and rated greater trust in healthcare (HSDS score of 25.1 vs. 27.1) ($p < 0.05$) than those without a primary care provider. The highest ranked preferred location to receive the COVID-19 vaccine by participants without a personal primary care provider was “a primary care provider’s office”.

Discussion

The Appalachian Region has been disproportionately impacted by COVID-19 and downstream effects of COVID-19. To date, COVID-19 vaccine uptake in Appalachia has trailed other parts of the country, in spite of early success in West Virginia.³⁴ Distrust in science and healthcare were associated with lower readiness to receive the COVID-19 vaccine. Residing in a rural area was also associated with reduced vaccine readiness, which replicates recent findings.¹⁶ The White House recently announced a

substantial investment to improve vaccine access and build confidence among high-risk communities across the United States, including Appalachia.³⁵ Efforts to acknowledge the regional historical, cultural, and social foundations of existing distrust, while leveraging trusted health influencers and communication sources will be instrumental to the success of this investment throughout the region, particularly in rural Appalachia where readiness to receive the COVID-19 vaccine is the lowest.

Participants' trust in primary care providers emerged as a predominant theme of the study. Others have also highlighted the importance of primary care providers in COVID-19 vaccine education, counseling, and administration.³⁶⁻³⁸ Further research is needed to understand this trust, which could be attributed to familiarity, access, individual healthcare concerns in light of new vaccine technology, and/or the importance of established relationships in navigating complex decisions. Given the importance of strong relationships and sense of place on subjective meanings of healthcare in the region and the cultural beliefs of health as holistic in nature,³⁹ it is perhaps unsurprising that primary care providers, with whom residents might feel they could build personal relationships, were overwhelmingly preferred as a site of vaccination than large clinics, hospitals, or workplaces. Primary care, especially in rural areas, has been hit hard by the pandemic;^{40,41} enhancing resources to support primary care providers and their unique role in COVID-19 vaccine acceptance is warranted.

Conclusion

This study was a first step in improving understanding of factors that influence COVID-19 vaccine readiness in Appalachia. Trust in science and trust in healthcare

were important predictors of vaccine readiness in this region, as were age and non-rural residence. Primary care providers were identified as highly trusted vaccine influencers, while other influencers, especially those representing the government, received highly variable or poor trust ratings. Further research is needed to identify sub-regional variation in these factors, methods to enhance access and trust, and strategies to diffuse misinformation and distrust among Appalachian Region residents.

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Authors have no conflicts of interest to declare.

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Table 1. Demographic Characteristics of Participants Residing in Rural and Non-Rural Settings in the Appalachian Region

	RURAL n (%)	NON-RURAL n (%)
n	524 (50)	524 (50)
Appalachian Sub-Region	Northern: 100 (19) North Central: 89 (17) Central: 106 (20) South Central: 96 (18) Southern: 133 (25)	Northern: 94 (18) North Central: 112 (21) Central: 81 (15) South Central: 101 (19) Southern: 136 (26)
Age (years)	35-44: 126 (24) 45-54: 121 (23) 55-64: 147 (28) 65-74: 110 (21) >75: 20 (4)	35-44: 118 (23) 45-54: 127 (24) 55-64: 147 (28) 65-74: 119 (23) >75: 13 (2)
Gender	Male: 200 (38) Female: 301 (57) Other: 23 (4)	Male: 201 (38) Female: 306 (58) Other: 17 (3)
Race	White/Caucasian: 484 (92) Black/African American: 15 (3) Asian: 3 (1) Other: 22 (4)	White/Caucasian: 483 (93) Black/African American: 22 (4) Asian: 3 (1) Other: 16 (3)
Ethnicity	Hispanic/Spanish/Latinx: 22 (4) Non-Hispanic/Spanish/Latinx: 502 (96)	Hispanic/Spanish/Latinx: 34 (6) Non-Hispanic/Spanish/Latinx: 490 (94)
Education	High school or less: 219 (42) Some college or college degree: 269 (51) Graduate or professional degree: 36 (7)	High school or less: 180 (34) ** Some college or college degree: 281 (54) Graduate or professional degree: 63 (12)
Household Income (annual)	<\$20,000: 155 (30) \$20,000 to \$79,999: 295 (56) \$80,000 to \$169,999: 64 (12) ≥\$170,000: 10 (2)	<\$20,000: 123 (23) ** \$20,000 to \$79,999: 304 (58) \$80,000 to \$169,999: 85 (16) ≥\$170,000: 12 (2)
Political Affiliation	Republican: 251 (48) Democrat: 115 (22) Independent: 115 (22)	Republican: 200 (38) ** Democrat: 139 (27) Independent: 142 (27)
Political Ideology (1 to 9, with 1=extremely conservative, 5=moderate, 9=extremely liberal)	3.9 ± 1.7	4.1 ± 2.0
History of positive COVID-19 test (yes)	83 (16)	47 (9)
Friends/family members with a positive COVID-19 test	3.4 ± 4.9	2.6 ± 3.8 **
Likelihood of Getting COVID-19 Vaccine ^a	Extremely unlikely: 146 (28) Somewhat unlikely: 59 (11) Neither unlikely or likely: 75 (14) Somewhat likely: 81 (15) Extremely likely: 163 (31)	Extremely unlikely: 132 (25) Somewhat unlikely: 58 (11) Neither unlikely or likely: 75 (14) Somewhat likely: 89 (17) Extremely likely: 170 (32)
COVID-19 Vaccine Readiness ^b	4.5 ± 3.3	4.9 ± 3.3 **

^aIf a FDA-approved COVID-19 vaccine were available to you today at no cost, would you accept it?

^bEach rung on the ladder represents where people are thinking about getting the COVID-19 vaccine. Move the sliding scale on the right to the number that best represents where you are now. (1= I have no thoughts or plans to get the COVID-19 vaccine, 9= I am taking action to receive the COVID-19 vaccine).

**= p< 0.01

Table 2. Association Between Distrust in Healthcare and Distrust in Science on Readiness to Receive the COVID-19 Vaccine: Multiple Linear Regression Final Model

Predictor	Standardized Beta value	t	p value
Distrust in Science	-0.305	-10.164	0.000 **
Distrust in Healthcare	-0.139	-4.692	0.000 **
Age	0.092	3.195	0.001 **
Residence (rural vs. non-rural)	0.058	2.016	0.044 *
Education	0.056	1.936	0.053

Dependent variable = Readiness to receive the COVID-19 vaccine (contemplation ladder); Removed from model through backwards selection = gender, race, ethnicity, annual income (household), and political affiliation; To aid in interpretation of results and consistent ordering of trust measures, participants' ratings of trust in science were reverse scored, allowing quantification of *distrust* in science; * = $p < 0.05$, ** = $p < 0.01$.

Table 3. Ratings of Trust in Health Influencers Regarding COVID-19 Information

Health Influencer	Not sure	None	Not Much	Some	A lot
My primary care provider	8%	5%	10%	30%	47%
Centers for Disease Control (CDC)	7%	16%	17%	31%	30%
Physician in My Region	11%	7%	15%	40%	28%
Dr. Anthony Fauci, Director of the National Institute of Allergy and Infectious Disease	10%	32%	11%	19%	28%
Hospital or Health System in My Region	8%	11%	17%	39%	25%
Nurse in My Region	11%	9%	16%	42%	22%
My Local Health Department	7%	10%	20%	42%	20%
World Health Organization (WHO)	12%	29%	16%	24%	19%
Dr. Sanjay Gupta, CNN Chief Medical Correspondent	20%	24%	16%	23%	16%
Community Health Worker in My Region	14%	11%	22%	39%	14%
Dr. Valerie Fitzhugh, Chair of Pathology at Rutgers University, COVID-19 Vaccine Trial Participant	31%	18%	15%	23%	13%
Dr. Mehmet Oz, Professor at Columbia University, Host of the Dr. Oz Show	14%	30%	22%	22%	12%
Dr. Jane Orient, Director of the Association of American Physicians, Testified to Congress Against COVID-19 Vaccine	31%	23%	15%	21%	11%
Dr. Scott Atlas, Former Senior Health Advisor to President Trump	24%	30%	16%	20%	10%
Dr. Marc Seigel, Fox News Chief Medical Correspondent	27%	28%	16%	21%	9%

The order of information sources and health influencers was randomized in the survey with the exception of “a physician in my region”, which was programmed to always occur after “my primary care provider” in the list.

Figure 1. Ratings of Trust in New Sources for Health Information Related to COVID-19

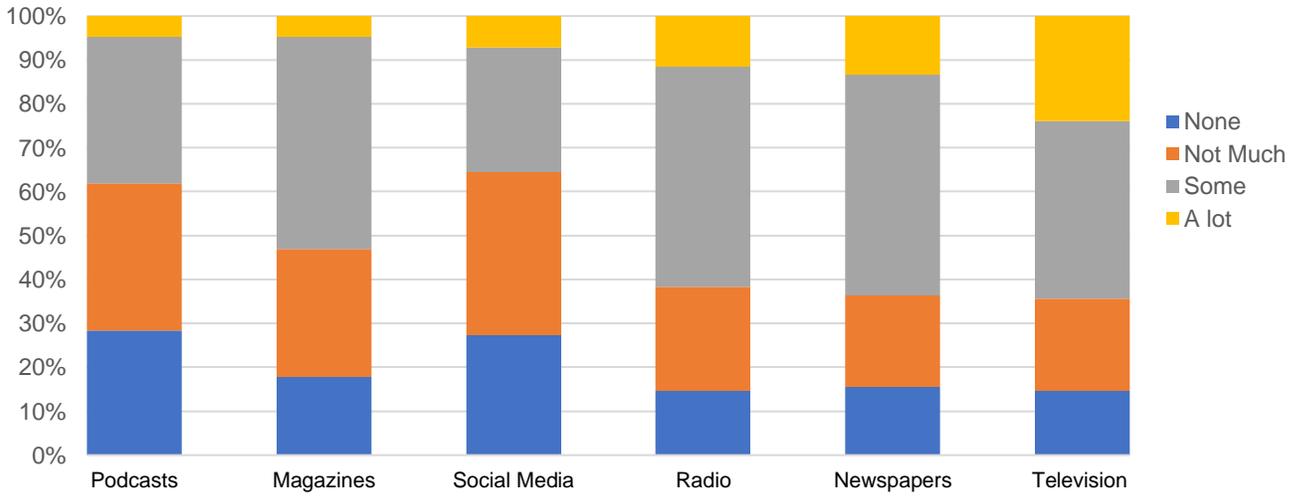
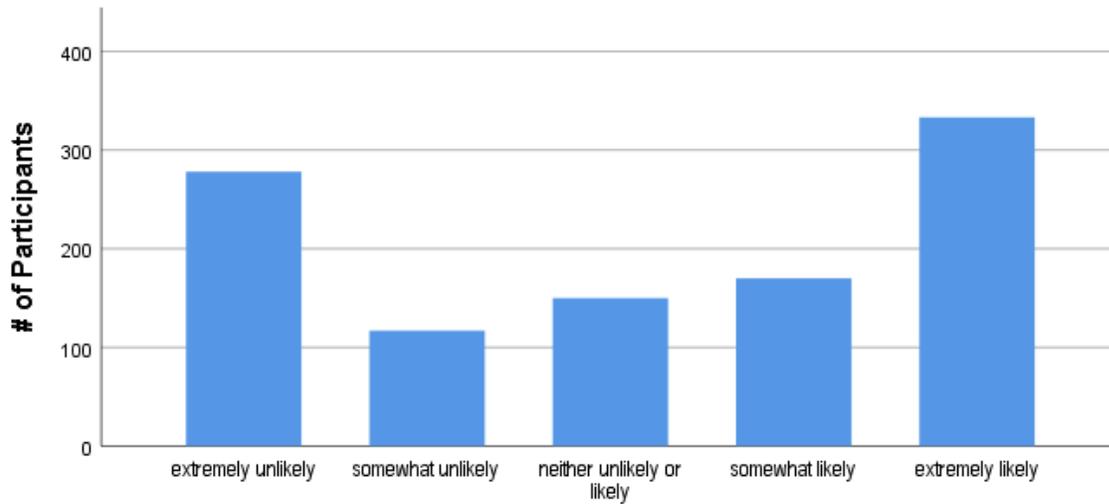
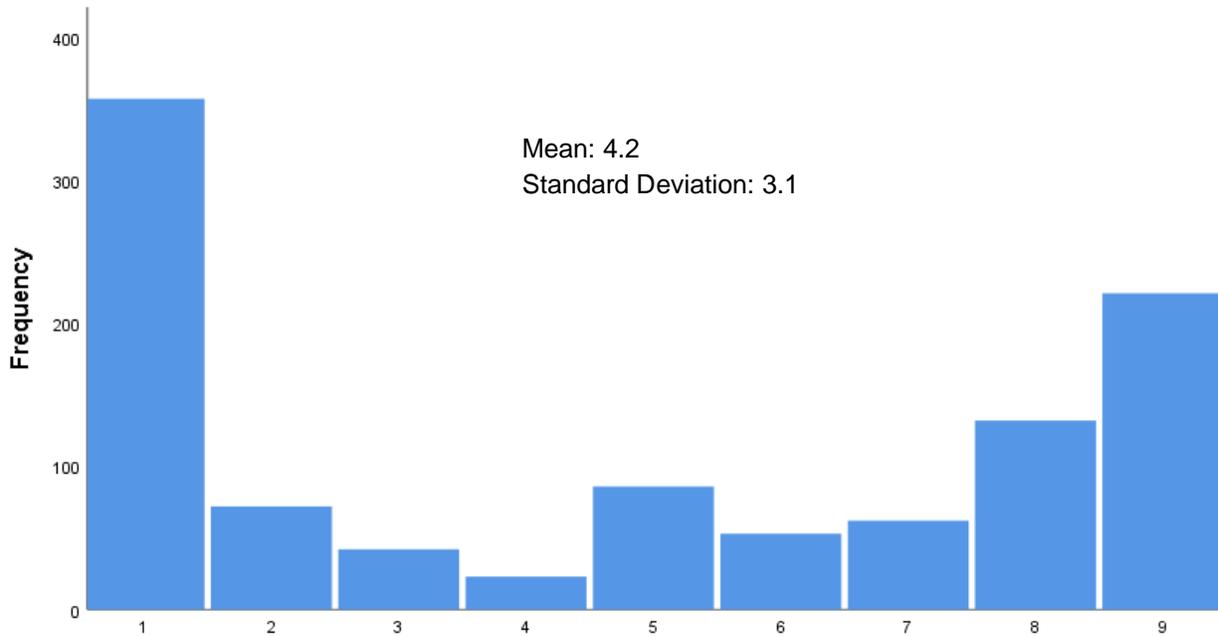


Figure 2. Likelihood of and Readiness to Receive the COVID-19 Vaccine

Vaccine Likelihood: *If an FDA-approved, no-cost COVID-19 vaccine was available to you today, how likely would you be to get vaccinated?*



Vaccine Readiness: *Each rung in this ladder represents where various people are in their thinking about getting the COVID-19 vaccine. Move the sliding scale on the right to the number that best represents where you are now.^a*

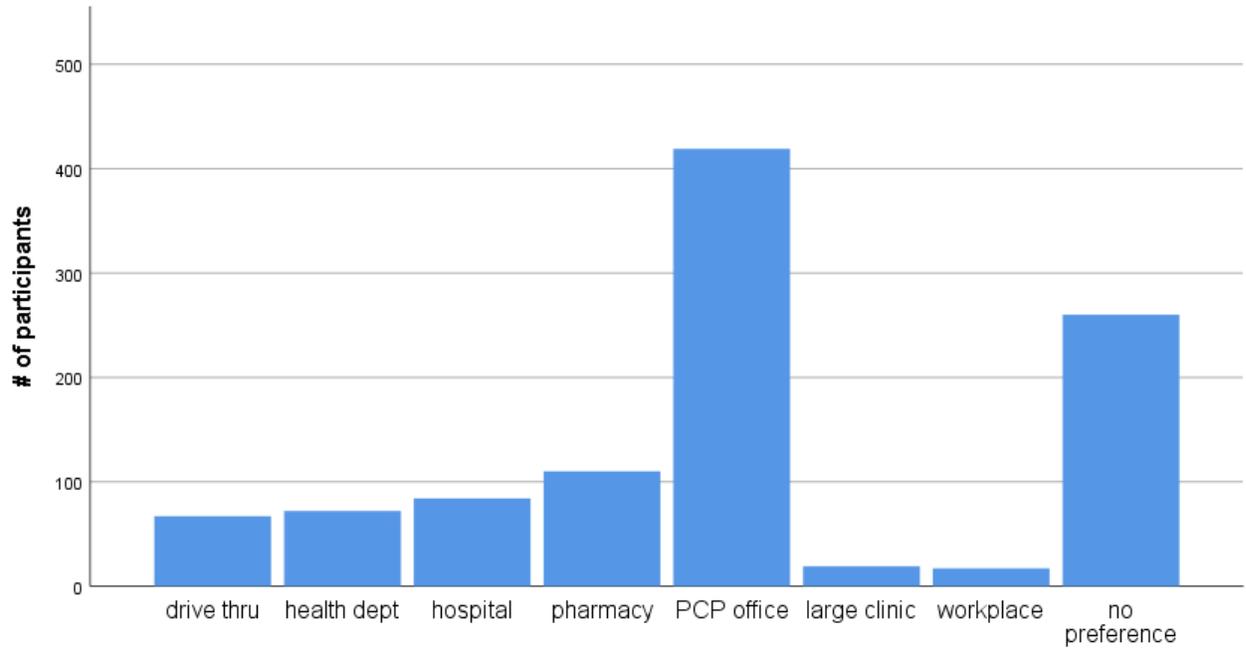


1= I have no thoughts or plans to get the COVID-19 vaccine.
5= I think I should get the COVID-19 vaccine, but I am not ready.

9= I am taking action to receive the COVID-19 vaccine.

Figure 3. Preferred Location to Receive the COVID-19 Vaccine

If you were to receive the COVID-19 vaccine, where would be your first choice to receive it?



Supplemental Data

Healthcare System Distrust Scale (HSDS)- Questions

Question	Strongly Disagree n (%)	Disagree n (%)	Not Sure n (%)	Agree n (%)	Strongly Agree n (%)
The Health Care System covers up its mistakes.	33 (3)	93 (9)	432 (41)	346 (33)	142 (13)
The Health Care System makes too many mistakes.	49 (5)	219 (21)	460 (44)	238 (23)	81 (8)
The Health Care System puts making money above patients' needs.	41 (4)	141 (14)	316 (30)	337 (32)	212 (20)
The Health Care System lies to make money.	71 (7)	194 (19)	409 (39)	261 (25)	112 (11)
The Health Care System experiments on patients without them knowing.	126 (12)	271 (26)	393 (38)	180 (17)	77 (7)
	Strongly Agree n (%)	Agree n (%)	Not Sure n (%)	Disagree n (%)	Strongly Disagree n (%)
The Health Care System does its best to make patients' health better.	160 (15)	571 (55)	202 (19)	82 (8)	32 (3)
Patients receive high quality medical care from the Health Care System.	95 (9)	493 (47)	300 (29)	124 (12)	36 (3)
The Health Care System gives excellent medical care.	79 (8)	458 (44)	337 (32)	137 (13)	35 (3)

Fears related to COVID-19

<i>To what extent have you felt fear about the following in the past week:</i>	None n (%)	A Little n (%)	Some n (%)	A Lot n (%)
Getting COVID-19	334 (32)	302 (29)	226 (22)	186 (18)
Getting sick from COVID-19	307 (29)	264 (25)	243 (23)	234 (22)
Being hospitalized due to COVID-19	348 (33)	255 (24)	236 (23)	209 (20)
Dying due to COVID-19	443 (42)	256 (24)	191 (18)	158 (15)
Friends or family members dying due to COVID-19	214 (20)	302 (29)	260 (25)	272 (26)
Doing something that will cause someone else to get COVID-19	439 (42)	305 (29)	185 (18)	119 (11)
Loss of employment or income due to COVID-19	566 (54)	192 (18)	154 (15)	136 (13)
Being judged due to precautions I take due to COVID-19	669 (67)	174 (17)	110 (11)	65 (6)

Concerns Related to the COVID-19 Vaccine

<i>How concerned are you about the following issues related to the COVID-19 vaccine?</i>	None n (%)	A Little n (%)	Some n (%)	A Lot n (%)
The speed at which the vaccine was developed.	221 (21)	239 (23)	236 (23)	352 (34)
The effectiveness of the vaccine.	200 (19)	235 (22)	302 (29)	311 (30)
The short-term safety of the vaccine.	194 (19)	237 (23)	265 (25)	352 (34)
The long-term safety of the vaccine.	153 (15)	212 (20)	250 (24)	433 (41)
Side effects of the vaccine.	147 (14)	224 (21)	246 (24)	431 (41)
Politics around the development of the vaccine.	217 (21)	199 (19)	246 (24)	386 (37)
My access to getting the vaccine.	392 (37)	232 (21)	237 (23)	187 (18)
Access of vulnerable friends and loved ones to getting the vaccine.	270 (26)	263 (25)	262 (25)	253 (24)
The cost of the vaccine to me.	559 (53)	174 (17)	146 (14)	169 (16)

